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GRISAAS-2020

International Web Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences

28-30 DECEMBER 2020

Souvenir & Conference Book (GRISAAS-2020)

Chief Editor
Dr. S.P. Singh



Organized By

Astha Foundation, Meerut (U.P.) INDIA



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A Souvenir & Conference Book Brought out on the occasion of
International Web Conference on
**GLOBAL RESEARCH INITIATIVES FOR
SUSTAINABLE AGRICULTURE & ALLIED SCIENCES
(GRISAAS-2020)**

28-30 December 2020

Organized By

Astha Foundation, Meerut (U.P.) INDIA

In Collaboration with

Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.) INDIA

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नरेन्द्र सिंह तोमर
NARENDRA SINGH TOMAR

कृषि एवं किसान कल्याण,
ग्रामीण विकास और पंचायती राज मंत्री
भारत सरकार
कृषि भवन, नई दिल्ली

MINISTER OF AGRICULTURE & FARMERS WELFARE
RURAL DEVELOPMENT & PANCHAYATI RAJ
GOVERNMENT OF INDIA
KRISHI BHAWAN, NEW DELHI



MESSAGE

It gives me immense pleasure that the **Astha Foundation**, Meerut (U.P.) India is organizing a three days International Web Conference on “**Global Research Initiatives for Sustainable Agriculture and Allied Sciences (GRISAAS-2020)**” in Collaboration with CSAUAT, Kanpur, U.P.; BAU, Sabour, Bhagalpur, Bihar; IGKV, Raipur; Chhattisgarh; UAHS, Shivamogga, Karnataka; BAU, Ranchi, Jharkhand; SKRAU, Bikaner, Rajasthan and Society for Scientific Development in Agriculture and Technology, Meerut (UP) India, during 28-30 December, 2020.

I hope the issues pertaining to various aspects of science and technology and their dissemination to the end user will be deliberated and discussed by the delegates, at length, during the conference in order to come out with certain adoptable low-cost, location specific recommendations for the benefit of the people at global level.

I convey my best wishes for great success of the conference and complement to organizers.



(Narender Singh Tomar)

कृष्ण पाल गुर्जर
Krishan Pal Gurjar



सामाजिक न्याय और अधिकारिता राज्य मंत्री
भारत सरकार
**MINISTER OF STATE FOR
SOCIAL JUSTICE & EMPOWERMENT
GOVERNMENT OF INDIA**



MESSAGE

It is a great to welcome you all to the **International Web Conference on Global Research Initiatives for Sustainable Agriculture and Allied Sciences (GRISAAS-2020)** which is being held during 28-30 December 2020 Organized by **Astha Foundation, Meerut** in collaboration with CSAUAT, Kanpur, U.P.; BAU, Sabour, Bhagalpur, Bihar; IGKV, Raipur, Chhattisgarh; UAHS, Shivamogga, Karnataka; BAU, Ranchi, Jharkhand; SKRAU, Bikaner, Rajasthan and Society for Scientific Development in Agriculture and Technology, Meerut (UP) India.

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 Web Conference to exchange the idea for the growth of Agriculture.

Krishan Pal Gurjar



M S Swaminathan Research Foundation

Center for Research on Sustainable Agriculture and Rural Development

Third Cross Street, Taramani Institutional Area, Chennai - 600 113



M S Swaminathan

Member of Parliament (Rajya Sabha)
Emeritus Chairman, M S Swaminathan
Research Foundation

MESSAGE

I am glad to know that **Astha Foundation, Meerut** in collaboration with CSAUAT, Kanpur, U.P.; BAU, Sabour, Bhagalpur, Bihar; IGKV, Raipur, Chhattisgarh, UAHS, Shivamogga, Karnataka; BAU, Ranchi, Jharkhand; SKRAU, Bikaner, Rajasthan and Society for Scientific Development in Agriculture and Technology, Meerut (UP) India are organizing a three days International Web Conference on “**Global Research Initiatives for Sustainable Agriculture and Allied Sciences (GRISAAS-2020)**” during 28-30 December 2020.

The subject chosen is very relevant and timely to address the current agricultural scenario in the country and state as well. I hope that this conference will come out with viable researches for farming community.

I wish the conference all success.

sd-

M S Swaminathan



त्रिलोचन महापात्र, पी.एच.डी
एफ एन ए, एफ एन सी, एफ एन ए ए एस
TRILOCHAND MOHAPATRA, Ph.D
FNA, FNASc, FNAAS
SECRETARY & DIRECTOR GENERAL

भारत सरकार
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MESSAGE

Fighting rural poverty has become the overriding priority in the new millennium. Our agricultural scientists and technologists have to work for doubling the productivity of the available land under cultivation. While doing so, utmost care would have to be taken for various environmental and people related aspects leading to sustainable development.

I am glad to know that the **Astha Foundation, Meerut** in collaboration with CSAUAT, Kanpur, U.P.; BAU, Sabour, Bhagalpur, Bihar; IGKV, Raipur, Chhattisgarh, UAHS, Shivamogga, Karnataka; BAU, Ranchi, Jharkhand; SKRAU, Bikaner, Rajasthan and Society for Scientific Development in Agriculture and Technology, Meerut (UP) India are organizing a three days International Web Conference on “**Global Research Initiatives for Sustainable Agriculture and Allied Sciences (GRISAAS-2020)**” during 28-30 December 2020. This is an unique event organized exclusively for systematic review of the factors responsible for decrease in availability of natural resources, degradation of land and water resources, loss of plant bio-diversity, increase in environmental pollution, climatic changes, decline in factor productivity and operational holdings and widening gap between rich and poor responsible for threatening our food security and health. The aim of International Web Conference will definitely promote the interest of Policy makers, Experts, Research scientists, Executors, Representatives from all over the country. I am sure that the outcome of the Conference will not only help in achieving the economic access to food but also give ecological access to food for future planning.

I convey my greetings and best wishes to organizers, participants and sponsors for their joint venture for the success of this three days International Web Conference.

TRILOCHAND MOHAPATRA, Ph.D

डा. अशोक कुमार सिंह

उपमहानिदेशक (कृषि प्रसार)

Dr. A.K. Singh

Deputy Director General (Agricultural Extension)



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MESSAGE

It is a matter of great pleasure to know that **Astha Foundation, Meerut** in collaboration with CSAUAT, Kanpur, U.P.; BAU, Sabour, Bhagalpur, Bihar; IGKV, Raipur, Chhattisgarh, UAHs, Shivamogga, Karnataka; BAU, Ranchi, Jharkhand; SKRAU, Bikaner, Rajasthan and Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) India are organizing a three days International Web Conference on “Global Research Initiatives for Sustainable Agriculture & Allied Sciences (**GRISAAS-2020**)” during 28-30 December 2020.

Farming is now being judged on parameters like profitability and sustainability. To excel on these parameters, farming has to be technology driven with a clear cut focus on reducing cost of cultivation and enhancing productivity and quality of produce. It requires a multi-pronged approach including management of natural resource, enhanced productivity, linking the production system to storage, processing & value addition and marketing in order to make the entire system vibrant, income generating and employment oriented.

I am sure the learned delegates will deliberate on the issues and challenges faced by 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.

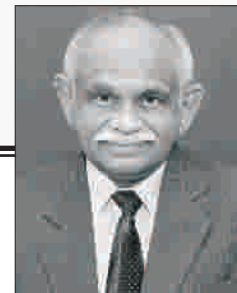
I wish the conference a grand success and congratulate the organizers for making this kind of academic interface.

Dr. A.K. Singh



National Academy of Agricultural Sciences

Prof. Anil Kumar Singh
Secretary



MESSAGE

It is a matter of great pleasure to know that **Astha Foundation, Meerut** in collaboration with CSAUAT, Kanpur, U.P.; BAU, Sabour, Bhagalpur, Bihar; IGKV, Raipur, Chhattisgarh, UAHS, Shivamogga, Karnataka; BAU, Ranchi, Jharkhand; SKRAU, Bikaner, Rajasthan and Society for Scientific Development in Agriculture and Technology, Meerut are organizing a three days International Conference on **“Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2020)”** during 28–30 December, 2020.

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)



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डॉ. एस.के. पाटील

कुलपति

Dr. S.K. Patil

Vice Chancellor



MESSAGE

Agriculture in India is highly diversified and crops are grown in diversified environments viz., water logged to rainfed uplands, hums to deep water, high humid to arid temperatures and flood prone to drylands. Soils are so extraordinarily varied that there is hardly any type or texture of soils on which cultivation cannot be done viz. acid peaty soils of Kerala (pH3), highly alkaline soils (pH 8.5 and above) of Punjab, Haryana and Uttar Pradesh. Increasing use of inputs together with improved cultures and irrigation has contributed substantially to overall growth in crop production. However, recent concerns regarding decreasing conjunctive use of organic manures, imbalanced use of fertilizers and blanket fertilizer recommendations over large domains without considering variability in soil fertility have all contributed to discouraging impacts on crop production and on soil health, particularly in intensive crop systems. Furthermore, frequent occurrence of abiotic stresses such as drought and submergence has been identified as the key to the low productivity of rainfed ecosystems.

It is a matter of great pleasure to know that **Astha Foundation, Meerut** in collaboration with CSAUAT, Kanpur, U.P.; BAU, Sabour, Bhagalpur, Bihar; IGKV, Raipur, Chhattisgarh, UAHS, Shivamogga, Karnataka; BAU, Ranchi, Jharkhand; SKRAU, Bikaner, Rajasthan and Society for Scientific Development in Agriculture and Technology, Meerut are organizing a three days International Web Conference on “**Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2020)**” during 28–30 December, 2020.

I wish the International Web Conference a grand success.



(S.K. Patil)

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ಕೃಷಿ ಮತ್ತು ತೋಟಗಾರಿಕೆ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಶಿವಮೊಗ್ಗ
UNIVERSITY OF AGRICULTURAL AND HORTICULTURAL SCIENCES, SHIVAMOGGA

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MESSAGE

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M.K. Naik
Vice Chancellor



उत्तमा वृत्तिस्तु कृषिकर्मैव

प्रो. आर. पी. सिंह

कुलपति

Prof. R. P. Singh

Vice-Chancellor

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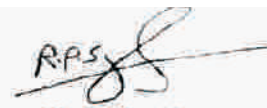
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Message

Crop yield and growth has reached a plateau and no significant increase is being realized in productivity levels. With reduced land availability and increased demand for food production, crop production is being intensified through higher fertilizer inputs and cropping. Keeping in view the annual average population growth rate of ~1.5% and estimated per capita consumption of about 450 g per day, the demand for cereal crops is expected to increase to 40% by 2025. This projected demand can be met only if there is a steady increase in productivity and production. Further, 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. Emerging challenges are plenty and new frontiers of combating these imposed challenges 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 six days International Web Conference on “**Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2020)**” during 28–30 December, 2020”. Being organized by the **Astha Foundation, Meerut (U.P.)** India will be highly pertinent. 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, delegates and sponsors for their joint venture for the success of this International Web Conference.


(R.P. Singh)



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डॉ. ओंकार नाथ सिंह
Dr. Onkar Nath Singh
कुलपति
Vice-Chancellor



Ref. No. :

Date :

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 International Web Conference on “**Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2020)**” organized by **Astha Foundation**, Meerut (U.P.) in collaboration with CSAUAT, Kanpur, U.P.; BAU, Sabour, Bhagalpur, Bihar; BAU, Ranchi, Jharkhand; IGKV, Raipur, Chhattisgarh, SKRAU, Bikaner, Rajasthan; UAHS, Shivamogga and Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) during 28–30 December, 2020.

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(O.N.Singh)

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डॉ रणधीर सिंह

सहायक महानिदेशक कृषि परिसर

Dr. Randhir Singh

Asstt. Director General (Agricultural Extension)



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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-2020 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)



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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.

International Web Conference on “**Global Research Initiatives for Sustainable Agriculture and Allied Sciences**” (**GRISAAS-2020**) during 28-30 December 2020. 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-2020

ABOUT GRISAAS

Global research initiatives for sustainable agriculture and allied sciences (GRISAAS) is 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 eleven different themes of sessions were planned for the GRISAAS and these themes itself explains the vision of GRISAAS. These themes of sessions are :

1. Innovative technology for crop improvement, biotechnology and genetic engineering
2. Biodiversity and IPRs : issues and challenges
3. Global climate change : scenario and food security
4. New frontiers in disease and pest management
5. Food processing, value addition and post harvest technology
6. Policies and economics of profitable agriculture
7. Cropping system and indigenous technical knowledge
8. Integrated approaches in physical, chemical and biological sciences
9. Soil health management and practices: key factor for crop productivity
10. Animal health, animal husbandry and dairy technology
11. Social sciences, library, information science and humanities

The **1st 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 **2nd 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 **3rd 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 **4th 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 Mahatama 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 **5th 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 reputes 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.



CONTENTS

Invited/Lead Papers		
1.	Participatory organic cotton breeding approach to achieve the sustainable development goals Amritbir Riar and Monika Messmer	1-4
1.	Global research initiatives for sustainable agriculture S.P. Singh, Barjendra, P.B. Singh, Sudhir Kumar Sarashwat, Y.K. Singh, Manoj Mishra, H.G. Prakash, Rohit Rana, Harish Pal Bhati, S.C. Gaur, Amit Kumar, B.S. Rajawat and Tanweer Ahmad	5-12
2.	Manage the negative impact of the climate change by redefining the new normal and use of advance tools and technology in agriculture science Bijendra Pal and S.P. Singh	13-15
3.	Water and nutrient management strategies for improving the crop productivity under changing climate U. Surendran	16-18
4.	Is organic farming going to stay? A.K. Choudhary, Saurabh Kumar, Rachana Dubey, Santosh Kumar and Abhay Kumar	19-22
5.	Plant-Parasitic nematode problems in vegetables Archana U. Singh	23-25
6.	Andalwood or red sander plantations to enhance on farm diversity and farm income B.M. Chittapur and Doddabasawa	26-28
7.	Millets for food and nutritional security in global climate change scenario A.S. Jeena, Rohit, Divya Chaudhary and Wanna Soe	29-32
8.	Foot and mouth disease : Current Indian scenario and control strategy Amit Kumar Verma, Desh Deepak, Amit Kumar and Arbind Singh	33-36
9.	Innovative technologies for crop improvement S.K. Chaturvedi, Artika Singh Kushwaha, Swapnil Dwivedi and S.P. Singh	37-41
10.	Sustaining farmers' income through organic farming R.S. Choudhary, N.K. Jat, Santosh Choudhary, Gajanand Jat, Roshan Choudhary, P.B. Singh and Y.K. Singh	42-50
11.	Drug resistance : What can be the way foreward Anu Rahal and Kumar A.	51-53
12.	Economic analysis of ajwain cultivation in <i>meliodubia</i> based agroforestry system under organic production system Shyamrao Kulkarni	54-56
13.	Pig farming : A tool to address the agrarian crisis in the front runners states of green revolution in India Yashwant Singh and Amit Sharma	57-61
14.	Genetic improvement of soybean cultivar for yield and its related traits by induced mutation Sandeep Kamdi, Sharad Bhure, Sudhir Kumar Gupta, Ganesh Kankal and Nitin Dadas	62-66
ABSTRACTS		1-206

Lead Papers/ Invited Papers



PARTICIPATORY ORGANIC COTTON BREEDING APPROACH TO ACHIEVE THE SUSTAINABLE DEVELOPMENT GOALS

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About 33 million ha of cotton are grown worldwide, which gives about 82 million tons of seed cotton (FAO 2021) only 0.5% is the share of organic cotton. These are on 418,935 ha in 19 countries grown by 222,134 farmers and results in 239,787 tons of organic lint (Textile Exchange 2020). Importance of cotton for rural farmers' livelihoods is evident from the number of smallholder farmers involved in cotton production e.g. 51% of the global organic cotton is produced in India by 166,767 families (Textile Exchange 2020) with an average of 2 ha only (Riar *et al.*, 2017). However, cotton is regarded as a thirsty crop; depending on the irrigation methods, it needs between 2,000 to 20,000 litres of water to produce one kilogram of cotton; equivalent to a single t-shirt and pair of jeans. Moreover, conventional cotton cultivation is responsible for the use of 5% of all pesticides, 14% of all insecticides in just 2.4% of the global arable land (UK, P.A.N 2017). This indicates that current cotton production methods are environmentally unsustainable. This paradigm of cotton needs to be changed to improve cotton farmers' livelihood and achieve the Sustainable Development Goals (SDGs) set by the United Nations General Assembly in 2015 for the year 2030. The growing awareness of the environmental impacts within the last decade and increased demand for organic textiles raised new organic cotton interest. Long-term studies comparing organic with conventional production systems exhibit several ecological and economic advantages of organic cotton, even though yields may be slightly lower. Participatory organic cotton breeding (POCB) has the potential to address 12 SDGs out of 17 SDGs. In this paper, we briefly review the approach and potential of POCB toward resilience in relation to Sustainable Development Goals.

Participatory organic cotton breeding approach : Participatory plant breeding (PPB) offers a great opportunity for developing locally adapted cultivars as well as for maintaining and increasing genetic diversity (Lancon *et al.* 2004, Ceccarelli *et al.* 2009). In the short term, the remaining non-GM cotton needs to be tested under organic and low input conditions, and a seed chain needs to be established for the most suited ones. In the mid- and long-term improved cultivars need to be bred specifically for organic and low input farming. At the moment, there is no well-established network among the different stakeholders. The organic cotton producer organizations try to find an individual solution to cover their demand for organic non-GM seed, which takes a lot of efforts and time. However, it is much more efficient if forces are joined to cover the most urgent need of non-GM seed suitable for organic cotton growers. The overall goal is to improve the availability of non-GM cotton seeds of genetically improved cotton cultivars specifically suited for organic farming systems. This is fundamental to guarantee the integrity and credibility of the organic value chain. Moreover, this will enhance the competitiveness of organic cotton as well as the income security and autonomy of smallholder cotton farmers. The goal can most efficiently be achieved in a trans- and interdisciplinary approach, where smallholders, breeders, researchers, advisors, representatives of spinning and textile industry will work closely together. The involvement of farmers at the very beginning is important to integrate their knowledge, to achieve high adoption rate and ownership of new cultivars. Facilitation is needed to build mutual understanding and trust among the different actors and stakeholders and to develop common breeding goals and visions on how to restore the organic cotton seed supply chain.

Implementation of the approach

From the first cross to create the F₁ generation up to the single plant selection, replicated yield trials, and multi-location trials until purification and seed multiplications in F₈ takes at least 8 years (Fig.-1). For the commercialization of seed according to the Indian Seed Act, the cultivars need to be tested as either truthfully labelled seed (2-3 years) or officially released cultivars on State level or across India (3-5 years) by the network of Indian Agricultural universities. Therefore, the inclusion of committed partners from public research is vital. By joining forces, not all cotton grower organizations need to get involved in long-term breeding activities, but they can develop other organizations and build on material that has already been developed in former seed projects. To avoid any conflict of interest between breeder and organic grower organizations, we streamlined the process, that breeding material and cultivars provided by a private or public breeder will remain the property of breeder and the organic growers' organization who is improving the cotton cultivars. We call the organic cotton grower organization together with their farmers in the different districts a "cluster". In our example, cluster C1 collaborates with breeder B1, cluster C3 with breeders B2 and B3 in order to obtain new breeding material and segregating populations developed by the breeders.

Both cluster C1 and C3 get engaged in participatory breeding including early generation single plant selection as well as the advanced generation replicated on-station field trials together with on-farm trials of farmers in different villages attached to the growers association (C1.1, C1.2, C1.3, C1.4, and C3.1, C3.2, C3.3, C3.4). Cluster C2, C4 and C5 are not involved in active breeding but interested in the supply of non-GM cotton seed with high agronomic performance and good fiber quality. In advanced generations (F₇-F₈) when cluster C1 and C3 have identified potential candidate cultivars and sufficient seed is available, this material is shared with all interested clusters (C1-C5) for Multi-location Trials (MLT) under the respective growing conditions. If the new cultivars perform well under the growing conditions of cluster C4, then cluster C3 in collaboration with the involved breeders B₂, and B₃ will multiply sufficient seed to cover the demand of all organic cotton farmers of this cluster. In that way, the organic farmers as a whole can participate in the progress and not only individual cotton grower associations. Therefore, it was important that the partners agreed to collaborate and to exchange information and cotton seed in order to server the spread of improved non-GM cotton seed. Although commercial F₁ hirsutum hybrids will also be tested, the focus will be put on varietal lines of *G. arboreum* and *G. hirsutum* allowing farmers to save their own seeds or establish a small seed business.

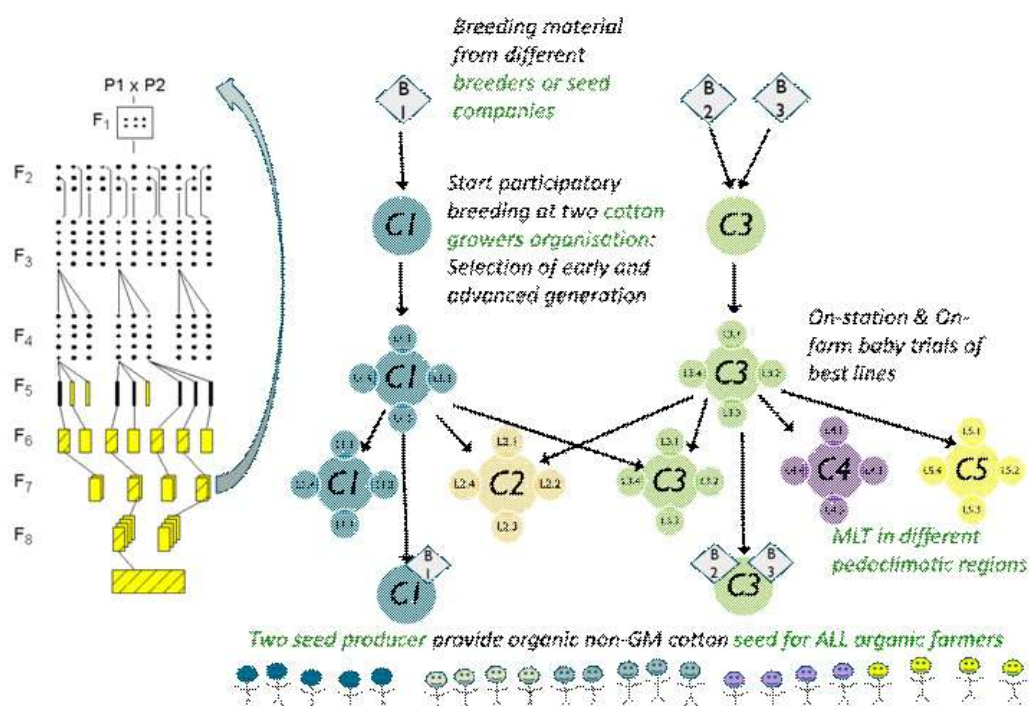


Fig. : Relationship between the different actors of decentralized participatory breeding if more than one breeder is involved.

Achieving sustainability goals through participatory plant breeding approach : Participatory organic plant breeding has the potential to contribute the following SDGs :

SDG-1: End poverty in all its forms everywhere : Decentralized POCB will improve choice and access to adapted seed, fast adoption of new cultivars, create more income in rural areas, empowerment of farmers esp. female farmers. Decentralized POCB helps to build stronger and more reliable seed systems for smallholder farmers working in diverse and harsh environments, thus contributing to income security and resilience to various risks and challenges.

SDG-2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture : POCB will contribute to agrobiodiversity, reduction of synthetic fertilizer and pesticides, and soil degradation due to more robust cultivars and a higher level of diversity. Larger number of crops and intercropping of vegetables and pulses within the organic cotton will allow more balanced nutrition. POCB will also serve as a blueprint to obtain seed sovereignty also for other crops. Access to adapted seed of large range of crops is key to combat hunger.

SDG-3: Ensure healthy lives and promote well-being for all at all ages : POCB will support the transition to more sustainable textile production by reducing the application of toxic pesticides. This is of major importance as cotton still



demands lots of labour work in the field for spraying and picking mainly done by female farmers. Risk of pesticide residues will be reduced on neighboring food crops. Furthermore, POBR will promote the growth of organic cotton textile with much stricter rules on chemicals allowed for textile dyeing and finishing. It will ensure healthy lives and promote well-being of farmer families and textile workers.

SDG-4: Ensure inclusive and quality education for all and promote lifelong learning : POBR is a knowledge-intensive process involving many stakeholders like farmers, extensionist, breeders, seed companies, ginners, spinners and textile trade, as well as socio-economists. After a trust-building process, POBR fosters mutual learning among the partners and contributes to capacity building in rural areas. A strong facilitator will ensure group learning and cooperation among partners to reach common goals resulting in social capital. Farmers will get empowered to produce their own improved seed. This will make them independent from external inputs and multinational seed companies. POBR is a long term process and needs to constantly adjust to new challenges of climate change, social and economic changes.

SDG-5: Achieve gender equality and empower all women and girls : Active involvement of female farmers in POBR and seed saving have proven to be especially rewarding, as they show different perception of breeding goals and greater endurance as male farmers. Their active engagement improves their social status and at the same time improve the breeding process (selection for easy picking traits) and seed security.

SDG-6: Ensure access to water and sanitation for all : POBR with special focus on traditional less water consuming cotton species will greatly improve water use efficiency and water-dependent nutrient use efficiency of organic cotton production. Conduction of POBR under rainfed conditions or with little irrigation allows the selection for drought-tolerant cultivars. Reduced water demand of locally adapted crops will slow down the drop of the groundwater table. Breeding for more diverse and self-regulating systems will reduce contamination of surface and groundwater with pesticides or fertilizer.

SDG-8: Promote inclusive and sustainable economic growth, employment and decent work for all : POBR for local adaptation and local value chains will increase the organic cotton area in India and helps to maintain leadership in organic cotton production in India. POBR with close links among actors from the seed to the t-shirt will improve integrity of the organic cotton sector and rebuild consumer trust. This will create jobs along the value chain (breeders, seed producers, farmers, processors, traders) and decent income in rural areas. Moreover, POBR allows to set up farmer-driven seed enterprises.

SDG-10: Reduce inequality within and among countries : Decentralized POBR improve access to seed and reduces dependency of local farmers from multinational seed companies. POBR also improves power of farmer organization. In POBR farmers, breeders, researchers, seed companies or agencies, ginners, textile industry meet at eye level. This supports mutual understanding and establishes and strengthens the partnership between the different actors along the value chain.

SDG-12: Ensure sustainable consumption and production patterns : POBR increases the productivity of cultivars with less external inputs and helps mitigating contamination. Connecting breeding with the supply chain by decentralized POBR will improve consumer awareness about value of textiles and helps to slow down the fast fashion cycle and mitigate garment waste.

SDG-13: Take urgent action to combat climate change and its impacts : Decentralized POBR for high resilience and robust cultivars as well as breeding for locally adapted more diverse farming systems and different agroecological zones will reduce the risk of crop losses due to climate change. The large number of on-farm trials in the scope of POBR allows identifying new challenges (like emerging pests and diseases) as well as selection for extreme weather conditions (e.g., delayed or interrupted monsoon rains, flooding, cool temperature). Reduced fertilizer input will also mitigate greenhouse gas emissions.

SDG-16: Promote justice, peaceful and inclusive societies : POBR can contribute to sustainable development by intensified trans- and interdisciplinary collaboration within a local society, developing a cultivar for a common goal. By engagement and empowerment of female farmers, tribal and landless farmers POBR will contribute to more inclusive societies.

SDG-17: Revitalize the global partnership for sustainable development : Participatory Organic Cotton Breeding can become a model for the closer collaboration of government, private sector and civil society. Defining breeding as a societal challenge will shift relations between the different actors of society. In order to allow biodiversity to enter the market, political and legal changes are required.



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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.

So, by conducting the conferences like GRISAAS we will be able to address these issues efficiently.



MANAGE THE NEGATIVE IMPACT OF THE CLIMATE CHANGE BY REDEFINING THE NEW NORMAL AND USE OF ADVANCE TOOLS AND TECHNOLOGY IN AGRICULTURE SCIENCE

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In India rainfed agriculture still accounts for over 92.8 million hectare or 65 per cent of cropped area. This is a challenging task for the breeding community to improve the water usage efficiency of cultivated plant species for longer sustainability. On a positive note, climate change and cultivar developments move together as every next breeding cycle and selection fall in the changed climate. The most difficult part is climate prediction and estimate are not providing the accurate data and information and hence farming community is left in ambiguity and often fail to initiate the planting at right time and select the right crop which had less risk in the current climatic conditions. Interestingly, large diversity of cropping systems exists under rainfed and dryland areas with an overriding practice of intercropping, due to greater risks involved in cultivating larger area under a single crop. For a longer sustainability out of box thinking is required, by considering socio-economic situations such as; dependency of large population on agriculture, small land-holding size, very high population pressure on land resource etc. Improving household food security has been an issue of supreme importance to millions of farmers in India, who constitute 97.15 million total operational holdings and 56.15 million marginal holding. This lead to redefine the new normal and also important to relook at the total basic work and process of development and evaluation the new cultivars which were formulated quite long and with a little change they are still in practice. Drought, shorter monsoon spread, drought and waterlogging situation in same field are very common now a days in all the tropical and sub-tropical regions. Shorter winter season and early high rising temperature after winter season is becoming very common which lead to reduction in the productivity. On this note, I will be covering a concept where climate changes and our socioeconomic condition need to consider on priority by plant breeding community and move as a concept from tolerance breeding to resilient breeding.

Key words : *Climate change, new normal climate cultivar development process and practice and climate resilient cultivar.*

Introduction

Population growth and estimated high food demand are very well-known facts, the interesting part here is to estimate the change over a period where many new and old factor influence the total demography. (Roberta V. Gerpacio, 1999-2000) says a major shift in global cereal demand is underway: By 2020, demand for maize in developing countries will surpass the demand for both wheat and rice. This shift will be reflected in a 50% increase in global maize demand from its 1995 level of 558 million tons to 837 million tons by 2020. Maize requirements in the developing world alone will increase from 282 million tons in 1995 to 504 million tons in 2020 (IFPRI 2000). However world maize production is projected at consecutive peaks from 2020-21 onwards, reaching 1,177MT by the end of the forecasted period, up by 9% from the estimate for 2018-19 which is 1076 million metric tonne (International grain conceal, March 2019). Same situation is there for almost all other crops and this indicates that we need to be careful from these predictions and estimates. Another learning here is, despite all these negative impacts of climate change, agriculture research community has helped in producing much more than what its estimated 15 year ago and required today. This is also a new school of thought where we can incorporate all these influencing factor (natural, climatic and socioeconomic) and design the agriculture research activity which can pave a path to supply healthy food at affordable price to everyone on this earth. I believe very strongly, that world will never go hungry if we continue to improve the productivity by genetic gain, reducing harvesting tools, improve plant nutritional use efficiency, continue improvement in food distribution system and crop diversification. In this article I have tried to cover all these aspects where we need to challenge ourselves and try to redefine our existing system process in order to increase the efficiency and help world to be out from the fear of food security

Climate Change and its influence on the product / cultivar developments

Crop growth conditions and crop productivity are interrelated issues. Basically, crop growth is affected by climate conditions, CO₂ concentration and technology. Concerning climate conditions, the basic variables are precipitation and air temperature that control soil moisture and water availability to plants and affect evapotranspiration. In addition, other variables such as wind velocity, the occurrence of early frosts or ice and the time occurrence of extreme phenomenon are important as they can exercise significant stress on plants and put production at risk. In Asia, where intensity, timing and duration of the rainy season



is very critical and put up a very high risk on the productivity. Climate change is a very complex issue and it can be divided in two categories one which can be taken during the process of breeding and other which are very random event and cannot be incorporated in the selection process while breeding. Increase in temperature and evapotranspiration can be taken care of very well during the breeding process as the entire breeding nursery planted in open field and generation advancement happen in natural climate. Effect of Drought and water logging condition can be taken care through screening and selection in the targeted conditions. In breeding process, it is important to develop the methodology

- I. For root trait selection enabling technology
- II. Use of plant physiology in plant breeding
- III. Screening of the early generation material under stream climatic conditions
- IV. Offseason screening.
- V. Use of weather and climate change information for design the breeding schemes
- VI. Breeding in targeted ecology
- VII. Emphasis for designing nutrients use efficient plant architecture.

New Plant type for managing the change climate and change farming system

Breeding community always review and change their selection criteria and give very high weightage to the need of farmer at present. These are a moving target and keep on changing time to time and get influenced from climate and other socioecological developments. In many crops we witness the change as an example no. of panicles or ear per unit area has reduced the significance of no. of tillers per plant in wheat, rice and millet which is a very significant yield contributing trait. In case of corn new generation breeder start saying that, the beauty of a corn ear is not in the ear length per plant but ear length per row. All these new perspectives should be considered and our old books, list of traits be reviewed and realign them as per current requirement and design the plant architecture accordingly. The breeder should develop the new list for the yield contributing traits and stress management traits and align the selection accordingly.

Traits used in past for selection	Traits may become significant in future
No. of tillers in Rice, wheat and millets	No. of panicles per unit area
Lodging tolerance – nice to have	Lodging tolerance – Must have
Low seedling mortality – nice to have	Low seedling mortality – Must have
Skipping from droughts	Drought tolerance and /or Climate resilient
High yield / unit area	Profitability (yield /unit area /unit input/per unit times)
Early, medium or late maturity	Suitable for early, medium and late planting season
Grain yield and fodder yield	Grain yield + nutrition value + fodder yield & quality
No. of bolls per plant in cotton	No. of bolls per meter square
No. of fruits/plant in tomato, okra etc.	No. of fruits per meter square

Breeding v/s demands lead breeding

Variability or recombination creation, selection and use of selected variability in developing the improved cultivars the main component of plant breeding will remain unchanged. However every requirement for tailor made and demand lead plant breeder required to revisit these components of plant breeder and see how a breeder can incorporate a commercial angle in his product design concept. It's time to think that expectation from breeding community are increasing and the science of plant breeding is evolving and hence it is necessary to widen the definition of plant breeding from breeding to product designing by using a systemic and phase gate approach, where plant breeding will consider a complete project and pass through the critical evaluation at every phase to pass the gate for next phase as listed below :

- Developing the product profiling and creating product concept note with define time line.
- Project approval, setting the bench marking and mile stones
- Translating the product profiling in to the breeding objective
- Assessing the germplasm requirements / supporting breeding tools



- Progress assessment or project monitoring on every mile stone
- Product performance validation
- Product acceptance validating
- Product scale up plan and product introduction

This approach is so critical to address the need of farmer and provide the solution to their problem which will help in increasing the productivity and profitability of farmer. Educated farmers are capable to check the label claim by product provider and this approach increase the precision in performance. Here it's very critical to see if our existing varietal release systems are still strong enough to evaluate the performance of product in the way farmers are looking for.

Excellence in Plant breeding to enhance the genetic gain/breeding cycle

Summer, rainy and winter season are getting shorter, but severities of the effects are increasing every year. Drought and waterlogging in the same field, winter and heat stress in the same field in same crop/field is normal nowadays. To handle this new climatic definition our old breeding system and approach will have some limitation and hence excellence in plant breeding is so critical which will enable to handle the current challenges and prepare ourselves for the future challenges. Here it is necessary to widen the scope of plant breeding to :

- Increase the speed in plant breeding by shorting the breeding cycle
- Increasing the pre-season in selection
- Increasing the cost effectiveness in the breeding process
- Increase the heat rate or success rate in product acceptance.

Integration of supporting sciences like genomics, gene-editing, double haploid and biotechnology in plant breeding are essential in to manage the complex traits, increase the pre-season and speed in plant breeding. Use of high throughput phonemics, use of artificial intelligence in data gathering and management and advance statistical tools are required for increasing cost effectiveness and improving the label claim.

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WATER AND NUTRIENT MANAGEMENT STRATEGIES FOR IMPROVING THE CROP PRODUCTIVITY UNDER CHANGING CLIMATE

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The agricultural scenario of the Kerala state is unique, characterized by diversity of crops and multiplicity of cropping situations. However, the low crop productivity associated with high production costs is a great concern in Kerala's agriculture. Additional stresses come from climate disruption, variability and change, resulting in impacts on water availability and temperature regimes over time and space. This paper describes about the Best Management Practices (BMPs) available. To assess climate change related impacts on crop suitability and agro-ecologically attainable yield, the study applied the Agro Ecological Zonation (AEZ) methodology, which is jointly developed by Food and Agriculture Organization (FAO) and the International Institute for Applied Systems Analysis (IIASA). Range of scenarios for crop productivity for years 2041?2070 (2050s) and 2071?2100 (2080s) using the climatic condition based on four RCPs(2.6, 4.5, 6.0, and 8.5) adopted by the Intergovernmental Panel on Climate Change (IPCC) were generated using AEZ simulation modeling. Major crops grown in Kerala are coconut, arecanut, rubber, black pepper, coffee, tea, cardamom, paddy, tapioca, cashew and vegetables. The AEZ analysis for these crops showed that for ensemble mean of RCM outputs, under rain-fed conditions, yields of banana, arecanut, rubber, coffee, and black pepper show declines between 2.89 and 86.18 %. However, coconut and rice, under rain-fed conditions, show very minor increases of 3.17 and 0.99 % respectively. Under irrigated conditions, yields of coconut, arecanut, coffee, and black pepper show a decline between 3.83 and 86.18 %. However, if we look at all the models and different RCPs, results show that with few exceptions in most of the cases yields tend to decline with climate change. In addition, the assessments for soil nutrient flow were carried out to evaluate the soil fertility status and nutrient budgeting of major crops/cropping systems at different spatial scales (plot, farm, and district level) using NUTMON-Toolbox. Results exhibited a trend of depletion of N and K from soil reserve, whereas, P was positive, indicating the need for carefully redefining N and K management strategies. These results suggest that there is an urgent need to return to water and nutrient efficient crops and assure best possible use of scarce water and precious soil nutrients resources. Drip fertigation was chosen as one of the BMPs and it was demonstrated across Kerala. Results from the project showed that the application of nutrients through drip fertigation improved the crop yield of all the demonstration plots and the increase in yield over control ranged from 13 to 317%. Drip fertigation resulted in improvement of water and nutrient use efficiency and maintenance of soil health. Benefit-Cost ratio (BC) of drip fertigation worked out under the project ranges from 2.05 to 3.50 for selected crops. Besides, strategies needs to be adopted for improving the water and nutrient use efficiency were also discussed. Investments in climate smart agriculture, micro-irrigation practices especially drip fertigation, improved water conservation practices, development and management of natural resources through watershed and afforestation activities, conservation of crop biodiversity, etc. needs to be given focus to improve the production from farms.

Continuous intensive agriculture without adequate attention on rational soil management poses serious threat to the sustainability of agro-ecosystems. One of the consequences of irrational soil management under intensive cropping is the decline in soil fertility. This nutrient mining does not get the same public attention as droughts, pest infestation *etc.*, since it is a gradual process and not associated with catastrophes and mass starvation and therefore largely invisible (Surendran and Murugappan, 2006). Also pertinent is that many soil test methods do not readily reveal nutrient mining because the available fraction extracted is buffered well by supply from other nutrient pools, as is often seen with K availability in some high CEC soils. The change in soil nutrient stocks over time has to be measured in order to quantify the extent of nutrient mining and also to provide an early caveat on adverse trends in nutrient inflows and outflows from the farm (Smaling *et al.*, 1993; Stoorgvogel *et al.*, 1993). Crop yields harvested with the present level of fertilizer recommendations and the yields harvested in many fertilizer response experiments with higher levels than the present level have unequivocally revealed that the fertilizer optima calculated in present day research are erroneous and in many cases sub-optimal.

This paper envisages a wholesome approach in different phases covering all the above aspects in order to ensure real optimum character to these fertilizer optima and sustainability to agro-production systems that are vital to break the crop yield barrier both in Kerala and Tamil Nadu. Even though the study was carried in both the states, here we are discussing about the state of Kerala only. Kerala experiences a humid tropical climate, characterized by the presence of heavy rainfall, high relative humidity, alternate wet and dry periods, abundant sunshine and high ambient temperature. It is a leading producer of



commercial agricultural commodities in the country. Major crops grown are coconut, arecanut, oil palm, rubber, coffee, tea, cardamom, paddy, tapioca, cashew etc. The agricultural scenario of Kerala state is unique, characterized by diversity of crops and multiplicity of cropping situations. However, productivity is very low when compared to other Indian states or international averages. Low fertile lateritic soils, nature of topography with undulating terrain, coupled with high intensity rainfall leads to top fertile soil loss through severe erosion and nutrient loss through leaching, which might have been one of the contributing factors for low productivity. There are also other possible reasons for this low productivity. However, at this juncture, the low yield of crops associated with high cost of production is a great concern in Kerala's agriculture. Natural resource management issues are inherently complex since they involve the ecological cycles, hydrological cycles, climate, animals, plants, geography etc. All these are dynamic and interrelated. Additional stresses come from climate variability and climate change, resulting in impacts on water availability in time and space, potentially increasing rainfall variability, resulting in more powerful monsoons and more frequent floods and droughts, and changing the water requirements, climatic suitability and yield of crops as well as the incidence of pests and diseases. Productivity of almost all the crops except rubber is lower in Kerala compared to other Indian states and a sustainable solution needs to be evolved. In this background, DST-TIFAC sponsored a project to CWRDM under India – IIASA program on "Evaluation of soil nutrient budgets at field, farm and regional level in humid tropics of Kerala and development of a model for management of soil health" to assess the soil fertility status and nutrient balance / budgeting of major crops /cropping systems at different spatial scales (plot, farm and district level) in Kerala and come out with a Decision Support System (DSS) for managing soil fertility and sustaining the crop productivity. This was done in a holistic manner through soil fertility assessment in terms of nutrient stocks / flows as an individual crop / cropping system / mixed crop and farm as a whole through field experiments and also at a district //regional level to know about the status of their soils and the strategies needed to sustain the fertility, besides exploring the possibilities for increasing the crop productivity in an environmentally sustainable way.

Field experiments results showed that 125 % of recommended dose of NPK fertilizers recorded the highest yield of 7685.9 kg ha⁻¹ and this treatment significantly improved the yield, when compared to the other treatments. The results indicated that the soil loss ranged between 0.0 and 14.44 t ha⁻¹ for different rainfall events of low to high. Results on mean quantity of soil loss in relation to the rainfall revealed that the quantity of soil loss was high under high rainfall events and was low in the case of low rainfall events. The correlation was significant with *r* value of 0.90 and *R*² value of 0.81. Data collected from the field experiment with respect to all inflows and outflows are being compared using *transfer functions* or in-built regression equations of NUTMON-model by linking nutrient input with rainfall for calibration and validation (Vlaming et al., 2001). The observed and predicted values of soil loss using NUTMON model is matching in most of the cases. But in a few cases, the model prediction is not similar to the observed values and hence, under such cases, the other environmental variables such as rainfall intensity, preceding soil moisture and crop canopy cover are being analyzed to eliminate the error percentage. Another experiment was also conducted to assess the runoff, soil loss and subsequent nutrient losses during the cropping period from the runoff plots, similar to the previous experiment. Besides, nutrient lost through leaching also has been assessed using soil water samplers. In addition, as management strategies, two treatments were included as 1. Contour trenches of 50*50*50 cm across the slope and 2. Growing pineapple as strip crop across the slope. The observed and predicted values of soil loss using NUTMON model is matching in most of the cases. Based on the two experimental data, the model was validated.

For regional level, Kozhikode district has been chosen and 20 farms have been selected covering all the agro ecological units. The result revealed that majority of the farms were low or medium in N and K. Soil available N is under low level in all the selected 20 farms. Soil available K was medium in 12 farms and low in 8 farms. In the case of P, 15 farms recorded high P values, whereas, only 5 farms recorded low P content. Nutrient budgeting was also done for individual farms and the flow diagram will help us to identify where the nutrients are flowing out from the farm. The Soil Health Cards have been distributed to these farmers with fertilizer recommendation for several crops. Collected data from all these farms were fed into the data processing module of NUTMON and the nutrient balances were computed using the NUTMON for regional level nutrient budgeting. The results showed that in majority of the farms, N and K were in negative balance whereas P was positive confirming that the existing nutrient management practices are not a sustainable one in the long run. Similar is the case for Kozhikode district as a whole. The per-hectare N and K balances was found to be -9.5 for N and -17.2 for K in kg ha⁻¹ yr⁻¹, whereas P registered a positive balance (+ 7.4 kg ha⁻¹ yr⁻¹) in Kozhikode district. In a nutshell, NUTMON-Toolbox at different spatial scales (*viz.*, micro (plot), meso (farm) and macro (district/ regional levels) exhibited a trend of depletion of N and K from soil reserve, whereas P was positive, indicating the need for carefully redefining N and K management strategies.



A decision support system (DSS) was developed as an output by combining all the data bases generated from the project, apart from using all available secondary data sources. The DSS viz., CWRDM- Integrated Crop Nutrient Management Software (CWRDM- ICNMS) will help in generating nutrient recommendation for most of the crops in Kerala by considering all the inflows and outflows from the farm. Decision Support Systems (DSS) CWRDM -ICNMS will serve as a tool to identify the depletion of nutrients and will help to suggest the management options using a systematic approach. A documentation of climate change and the increasing climatic variability with future projections for the crops of Kozhikode have also been compiled in this study. In addition, increase in temperature, uncertainty in rainfall and increase in carbon fertilization has been studied in detail and about their impacts on soil and water conditions and a focus has been given on its influence on crop productivity under humid tropical conditions in the current study. To overcome the negative impacts of climate change, apart from the developed DSS of nutrient management, several other adaptation strategies needs to be focused on to improve or at least sustain the productivity (Surendran *et al.*, 2016). Brief descriptions of the adaptation options, which potentially can reduce the vulnerability of agriculture to the effects of climate change, are also discussed. The output obtained from these works are a cost effective, eco-friendly conservation and management technology for higher input use efficiency, agricultural productivity & profitability without deteriorating natural resources for the entire farming community in Kerala and Tamil Nadu.

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IS ORGANIC FARMING GOING TO STAY?

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Introduction

The growing demand for organic products has been observed in recent years. US, Germany, France and China have emerged as big markets for organic products. Even in India, we have observed increasing demand for such products. To meet the growing demand the world over, organic farming has received further attention and impetus. This is evident from continued increase of acreages under organic farming, which is now practiced globally on more than 71 Mha of cultivable land.

Although high input agriculture (conventional farming) has provided food security the world over, it has serious effects on human and soil health and environment. Conventionally produced foods have toxic levels of insecticides and herbicides; the residual presence of such chemicals has adversely affected the micro-flora and micro-fauna population in the soil. Moreover, conventional farming exerts tremendous pressure on natural resources (Aguilera *et al.*, 2015). Contrary to this, organic farming can produce enough nutritious food to feed the world without disturbing the environment, while being more resilient to climate change and improving the livelihoods of farmers. Organic farming uses fewer pesticides, reduces soil erosion, decreases nitrate leaching into groundwater and surface water, and recycles animal wastes back into the farm (Goel *et al.*, 2020). Besides this, organic farming uses less energy and generates fewer emissions while revitalizing the soil and sequestering carbon (Niemiec *et al.*, 2020). Organic farming can outperform conventional farming under abiotic stresses like drought or flooding (Rajib *et al.*, 2013). It is, therefore, imperative to assess the potential, constraints and prospects of organic farming as the sustainable and environmentally friendly approach to crop and food production.

Organic farming vs. conventional farming

Organic farming is an agriculture system that involves cultivation of crops through natural processes, avoiding synthetic inputs to sustain soil health and ecological balance. In organic farming, use of soluble mineral inputs and synthetic herbicides and pesticides are prohibited. Soil nutrient replenishment and plant disease control in organic farming is achieved by organic fertilizers and pesticides, respectively (Goel *et al.*, 2020). Soil fertility is maintained by application of bio-fertilizers, composts and green manures (Reganold and Wachter, 2016) with increased emphasis on crop rotation. Contrary to this, conventional agriculture (high input agriculture) utilizes diverse set of technologies with major goal of providing abundant food at lowest price to the growing population. Extensive usage of chemical fertilizers, pesticides and herbicides in conventional farming provides higher crop yields, but poses severe harms to environment, soil and human health (Miksa *et al.*, 2020). The chemicals that farmers use to kill weeds pose hidden dangers to people, animals and the environment. While herbicides help to increase the food supply and boost the economy, they also contribute to pollution and illnesses ranging from skin irritation to cancer. There are multiple body of evidences that herbicides do affect micro-flora/micro-fauna, and entering into the food chain. With transgenic technology in place for the development of herbicide tolerant genotypes of field crops, the use of herbicides is likely to increase in future. In addition to these, quality of products produced through conventional farming appears to be poor in many aspects. All these have led to growing adoption of organic farming the world over.

Advantages of organic farming

Organic farming is beneficial for both consumers and environment. Products of organic farming have superior food quality as they are free from pesticides and other hazardous chemicals used in agriculture (Bialik and Walker, 2019). Being highly nutritious, organic food is healthier and fresher to consume than conventional food products. Consuming foods with high levels of pesticides can increase humans' risk for developing an autoimmune disease (Parks *et al.*, 2011). However, because of the higher levels of nutrients in organic foods, consuming them regularly helps to strengthen our immune system causing us to feel healthier overall. Organic crops have higher antioxidant activity and 18-69 percent higher concentrations of a range of individual antioxidants (Barański *et al.*, 2017). Increased intakes of polyphenolics and antioxidants have been linked to a reduced risk of certain chronic diseases such as cardiovascular and neurodegenerative diseases and certain cancers.

Organic farming is also linked to low emissions of greenhouse gases and reduced use of non-renewable energy by decreasing agrochemical use which is manufactured by burning of fossil fuels. Adoption of organic farming reduces groundwater pollution due to overuse of synthetic fertilizers and pesticides, which is a major problem associated with conventional



farming. Conversion to organic farming is recommended for severely contaminated ground water area as a restorative measure. Organic farming is useful for mitigating the global warming through its ability to sequester soil carbon. It is reported to prevent nitrogen pollution by recycling three times more reactive nitrogen than conventional farming (Aguilera *et al.*, 2015).

The adoption of organic farming has been reported to decrease soil nutrient leaching and promote diversity of plant beneficial microorganisms in agricultural soil (Goel *et al.*, 2020). Soil fauna and flora have been shown to be enriched under organic farming (Hole *et al.*, 2005). Higher activity of earthworm has been reported in organically managed field as compared to conventionally managed field (Yadav *et al.*, 2013). Additional benefit of organic crops is that they are known to be more drought-resistant than conventional crops (Rajib *et al.*, 2013). This is mainly because many chemical fertilizers are water-soluble, which means the crops need more water to grow. Organic farming also yields vital benefits in preservation of soil's organic composition. Soil organic carbon was found significantly higher under organic farming (Goel *et al.*, 2020). Besides, Goel *et al.*, (2020) have also observed significantly high density of total bacterial and nitrogen fixing bacterial communities under organic agriculture. It is thus obvious that organic farming is a sustainable way to produce high quality and safe food.

Barriers to adoption of organic farming

Production challenges : Despite the coherent advantages of organic farming, crop yield is the major factor for its limited adoption. Several attempts have been made in the past to compare the yield of crop production under organic and conventional farming. Rice grain yields were reported to increase by 20 per cent by application of spent mushroom and rice straw compost when compared with NPK fertilizer (Yadav *et al.*, 2013). However, Kirchmann (2019) reported that crop production of organic agriculture has been overestimated in meta-analyses. Comparative study of organic and conventional farming revealed 20% yield reduction under organic compared to conventional farming. However, discrepancies in yield data of both farming may be due to interactive effects of management, soil quality, crop varieties and time of harvesting (Goel *et al.*, 2020). Interestingly, organic methods can produce competitive yields in good weather, and outperform conventional farming in times of drought or flooding (Rajib *et al.*, 2013). It is also a proven fact that organic farming outperforms conventional farming in adverse weather conditions like drought by as much as 40% (Vasilikiotis, 2000). In addition, under low input agriculture especially under water limited condition, yield superiority has been recorded under organic farming.

Market uncertainty : Presently, products from organic farming are more popular and costly; this has been developing interest in farmers for adoption of organic farming. Health consciousness and ability to pay for the high-priced organic products are important driving forces behind popularization of organic farming and creation of increased market demand for organic products. However, future profitability of organic systems is not much clear to the farmers, thus reducing the rate of adoption of organic farming. Price of the organic product mainly depends on the authenticity of organic certification, supply growth and competing labels (Delbridge *et al.*, 2017). Import of organic products from international market often leads to the cost reduction of local organic products. Similarly, in the absence of a uniform clear guideline for organic products, consumers are also suspicious about the products. This calls for ensuring the quality of organic food through monitoring by an authorized reliable body.

Certification and organic transition : It is a well known fact that the products of organic farming are costly and in demand these days. Any product sold under the tag of “organic” must be certified by a third-party organic certifier. Government should make this certification process more robust, authentic and easily accessible to the small farmers. In addition to this, adoption of organic farming by conventional farmers requires changes in field managements with organic standard for a minimum period of three years (Delbridge *et al.*, 2017). This period of transition from conventional to organic is referred to as the “organic transition period”. Productivity under this period is comparatively less than under the conventional management. Moreover, products produced during this period cannot be marketed as the organic product. It is thus essential to have a uniform guidelines and strict monitoring system for organic products; this will fetch reliability for producers, and obviate suspicion from the end users.

Committed conventional farmers : Conventional farmers who believe that organic farming could not provide sufficient yield and the higher cost of organic products is only marketing tactics are less likely to adopt organic farming. Sometimes, committed conventional farmers who are not ready to accept changes are not convinced by the idea of organic farming. This is especially true for small and marginal farmers, who have less risk-bearing capacity during the “organic transition period”. The



pace of adoption gets slowed down further if large and prosperous farmers, who can afford productivity loss under “organic transition period”, are not ready to adopt organic farming. It is therefore necessary that the local Government should provide subsidy to organic farmers during “organic transition period” in order to enhance the adoption of organic farming among farmers.

Strategies for reducing barriers

The demand of organic products, private investment, technological advancements, quality aspects, and the like will be the future drivers of organic farming. Private-sector should also take lead to encourage transition through price premiums (Delbridge *et al.*, 2017). The second aspect relates to affordability. Today those who can afford buy organic products. Therefore, making them available to open market is also our responsibility. Government should ensure crop insurance options to organic producers. Addressing cultural barriers to the adoption of organic farming is more challenging. Therefore, efforts should be made to spread awareness about the possible benefits of organic agriculture. Maintaining the integrity of the organic “brand” will be critical for continued growth in demand and manufacturers’ commitment to organic products. More rigorous, accurate, and timely market data should be disseminated to analyze market of organic products and their popularity.

Literature abounds in yield penalty under organic farming when compared with high input conventional farming. Crop varieties need to be bred specifically for this system. This may include evaluation of genotypes under organic farming system. Crop husbandry and agronomy have to be worked out. As the crop removes a large amount of nutrients from the soil, it is necessary to devise strategies to fill-in the gap. An annual diary comprising information on crop calendar, crop rotation, time of green manuring as well as application of organic manures, vermi-composts, bio-fertilizers, and the like has to be prepared well in advance. For plant protection measures, availability of biopesticides and biocontrol agents need to be assured. For weed control as well, availability and procurement of efficacious bio-herbicides needs to be ascertained.

Possible outcome

Organic products are expected to be free from residues of chemical herbicides and pesticides. Moreover, these will be nutrient and antioxidant rich, and thus will promote good health in human beings. Organic farming has been shown to emit 45% less green house gases compared to that of conventional farming, thereby enhancing environmental sustainability as well.

Abiotic stress is detrimental to plant growth and development, thus decreasing crop yield worldwide (He *et al.*, 2018). Drought and flooding are known to exert substantial negative effects on crop productivity. Interestingly, organic agriculture outperforms conventional farming in times of drought or flooding (Rajib *et al.*, 2013). Therefore, adoption of organic farming will act as a sustainable way to combat yield losses due to such abiotic stresses. Moreover, in many countries including parts of India, soils have become degraded, and organic matter has been broken down to supply nitrogen. Therefore, adoption of the organic farming could be the only way to revive the soil health. However, the opponents often say that with organic farming, it will be highly difficult to feed the ever growing population which is likely to cross 10 billion mark by the year 2050 as there is significant yield penalty with organic agriculture. While arguing this, they often forget the fact that such a yield penalty can be offset if we minimize the post-harvest losses, which is over 30 percent. Moreover, they often overlook the ecosystem services that organic farming is likely to perform!

Future prospects

Organic agriculture is practiced in 186 countries by approximately 2.8 million farmers, covering a total area of nearly 71.5 Mha. The global sales of organic foods and beverages reached more than Rs 8.6 billion during 2018. The demand of organic products has been increasing day by day the world over. However, India’s share in the global organic market is almost negligible. We have already developed 51 organic package of practices for 79 cropping systems ($B:C > 1.8$), geo-referenced soil organic carbon map, identified 88 biocontrol agents including parasites, predators and microbial strains, and commercialized 22 biopesticides. These prerequisites are likely to provide our farmers the much needed inputs for adoption of organic farming. With little policy and subsidy support, India can capture new opportunities for exporting organic products including organic seeds. Despite the coherent advantages of organic farming, there has occurred only limited adoption the world over. Farmers can obtain premium prices from their certified organic products, and become prosperous. However, thinness of organic markets and expenses associated with organic certification are major factors which need to be addressed with utmost priority in the days ahead. Whether we accept or reject, organic farming is going to stay!



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PLANT-PARASITIC NEMATODE PROBLEMS IN VEGETABLES

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Plant parasitic nematodes often called as threadworms, eelworms or roundworms are microscopic invertebrate animals. They are distributed all over the world in different kinds of habitats and found in nearly every biological niche that supports life. They damage the crops not only by feeding on plants but also by interacting with various other organisms. They cause severe losses to economically important crops like vegetables, cereals, pulses, oilseeds, fruit crops, etc. Sasser and Freckman (1987) have indicated an annual crop loss due to nematodes on world wide basis to the tune of \$100 billion. Vegetables are the important component of human diet which contributes as a source of proteins, vitamins and minerals. India is the second largest vegetable producer in the world next to China which accounts for about 15% of the world's production of vegetables. The destructive plant- parasitic nematodes are one of the major limiting factor in vegetable production throughout India. Low production and productivity of vegetables are mainly because of biotic and abiotic stresses, among the biotic stresses nematodes also one of them. Large number of plant parasitic nematode is recorded from the rhizosphere of many vegetable crops like Root-knot Nematode (*Meloidogyne* spp.), Reniform nematode (*Rotylenchulus reniformis*), cyst nematode (*Heterodera* spp.), lesion (*Pratylenchus penetrans*) etc.

Crop losses due to nematode appear in different forms. It may be the loss in yield, the deterioration in the quality of the product and the increase in the cost of production, etc. Sometimes nematodes are involved in many disease complexes with fungi, bacteria and viruses, etc. It is now well established that the plant damage done by two or more pathogens is much more severe than what the pathogens cause independently. Continuous feeding of nematodes provides entry points to other pathogenic micro-organisms and breaks the physical as well as mechanical barriers of the host. In such a complex situation, nematodes may either act as wound causing agents, as resistance breaking agents or as modifiers of host tissues or as vectors.

The symptoms caused by the plant parasitic nematodes in vegetables are mainly divided into above ground and below ground symptoms.

Above ground symptoms : Above ground symptoms are non-specific and may be mistaken for the micronutrient deficiency in the soil. Typical above ground symptoms of nematode infections include stunting, yellowing, wilting, and most importantly from an economic standpoint and reduced yields. Patches of poor growth visible in the fields, Chlorosis, wilting, delay in flowering and fruit formation, reduction in plant size, yield etc. may be noted in above ground parts of infected plants.

Below ground symptoms :

Small galls/nodules seen on the roots which at a latter stage coalesce to form very large galls.

Bushy appearance of secondary roots.

Total reduction in root system.

Other symptoms include Lesions and "Dirty Roots".

Root-knot nematodes *M. incognita* and *M. javanica* are polyphagous in nature and infect vegetable crops in open field and under Polyhouses. The infective stage of the nematodes is vermiform and cannot be seen with the naked eye; because of which their presence is unnoticed by the farmer. The vermiform stage penetrates the root near the root tip, migrates to the elongation zone, anchors to the central cylinder, becomes sedentary and signals the parenchyma cells of the root cylinder to establish a feeding site called giant cell, which is metabolically very active. The establishment of the giant cell allows the nematode to withdraw nutrients from the vascular tissues of the plant. The vermiform stage develops into a globose female within a time of 25 to 30 days that lays 300 to 500 eggs in an egg-mass. These egg masses are visible on the roots as gelatinous matrix. Externally, the root-knot infection is visible as macroscopic galls which vary in size in different plant species. Under protected cultivation root-knot nematode attain huge population densities on vegetables especially on cucumber and tomato cultivar because of the favourable temperature and moisture conditions prevalent over a long period of time during the crop growth. (Singh and Kumar, 2013)

Besides, root-knot nematode on vegetable crops, semi-endoparasite *R. reniformis* is prevalent in tropical and subtropical regions and is known to infect more than 300 plant species. Among vegetables it reproduces profusely on brinjal, tomato, okra, sweet potato, squash and lettuce. It may result in dwarfing, shedding of leaves, malformed fruits and seeds and an impaired root system.



Golden cyst nematode, *Globodera rostochiensis* and *G. pallida* are serious pests of potato that have spread from southern part of the country to the north, through seed potato. Earlier it was reported as a serious pest in Kodaikanal hills, Poomparai and Gundupatti regions of Tamil Nadu, but since 2010 it has spread to potato growing regions of Himachal Pradesh and Jammu. The nematode completes its life cycle in 35 to 40 days at conducive temperatures. The cysts can survive in the soil for more than 25 years and require the presence of host root exudates for hatching. The nematode infection results in reduced size of potatoes. Another cyst forming nematode, *Heterodera cajani* infests cowpea, arhar, gram and all leguminous crops. It has a short life cycle of 18-20 days and completes several generations in a year.

These nematodes predispose the crops to fungal and bacterial pathogens, especially *Fusarium* spp., *Pythium*, *Rhizoctonia*, *Ralstonia solanacearum*, etc. and this occurs due to mechanical wounding of roots, rhizosphere modification and disruption of resistance mechanism caused by the nematodes. Such interactions aggravate the damage caused to the crop.

Thus, losses in our agriculture production due to plant parasitic nematodes justify the need for adopting different management practices i.e. Physical, Chemical, Cultural, Biological, Regulatory and IPM are undertaken to minimize the crop losses caused by nematodes (Singh and Prasad, 2016).

Crop rotation with non host crops helps in reducing the nematode pest densities significantly. The time for crop rotation however varies for root-knot species, two to three year rotation may be effective but for *Globodera* spp., at least 4 year rotation is required. (Table-1)

Table-1 : List of selected non-hosts plants useful in crop rotation.

Non-hosts or Poor hosts	Nematodes spp.
Lettuce, onion, radish	<i>Pratylenchus</i> spp.
Potato, tomato	<i>Tylenchorhynchus brassicae</i>
Cabbage, chilli, eggplant	<i>Hoplolaimus indicus</i>
Corn, greenbeans, red clover	<i>Globodera rostochiensis</i>
Castor bean	<i>M. hapla</i> , <i>M. thamesi</i>
Watermelon, tobacco	<i>Belonolaimus gracilis</i>
Corn, cowpea, potato, cotton	<i>Heterodera glycines</i>
Bean, corn, onion, potato, alfalfa	<i>H. schachtii</i>

Soil solarization of nursery beds with a thin transparent polythene mulch of 60-100 microns for 4 to 6 weeks eliminates not only nematodes, but also propagules of pathogenic fungi and weeds. Addition of deoiled cakes of mahua, mustard or neem enhances the effect of solarisation. Incorporation of finely chopped fresh biomass from cruciferous plants like mustard and cabbage in nematode infested soil followed by covering the soil with polythene mulch for at least 2 weeks releases glucosinolates that are toxic to nematodes. This phenomenon called biofumigation can be easily adopted by vegetable farmers.

Nematode management is important for high yield and quality that are required by the high cost of modern crop production. (Prasad and Singh, 2017) The several disadvantages associated with chemical control like hazards to man, effects on non target organism, phytotoxicity, hazards of pesticide residues, upsetting the ecological balance and difficulty in application. As regards the use of chemical nematicides such as Carbofuran or Carbosulphan should be avoided or minimized for nursery beds or seed treatments. Work done by several researchers have proved that some microorganisms especially fungi produced metabolites that are toxic to root-knot nematodes. Several biocontrol agents like *Trichoderma harzianum*, *Trichoderma viride*, *Paecilomyces lilacinus* are effective in controlling nematode population. Culture filtrates of *Aspergillus niger*, *Curvularia lunata*, *Trichoderma viride* and *T. lignorum* obtained from rhizosphere of tomato plants proved to be nematotoxic and inhibited hatching of *M. incognita* larvae. The combined effect of both fungal bioagents *T. viride* and *P. lilacinus* for the control of root-knot nematodes is mainly based on the toxic effect of former followed by the egg parasitic ability of the latter. (Goswami and Mittal, 2002; 2004)

Integrated nematode management approach where more than two methods are used together for controlling nematodes can enable the farmer to minimize the damage and get good crop yield. (Kogan, 1998) INM will provide solution to pest and disease problems in an eco-friendly manner. (Bridge, 1996; Singh and Prasad, 2011) The use of cultural methods and



judicious use of nematicides along with bioagents evaluated in the INM programme proved very effective in controlling nematode population and increasing crop yield.

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ANDALWOOD OR RED SANDER PLANTATIONS TO ENHANCE ON FARM DIVERSITY AND FARM INCOME

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In the contexts of climate stability and biodiversity conservation tree based land use systems need attention of both farmer and scientific community in the world. Woody perennials are to be deliberately grown along with field crops and or livestock on the same unit of land management on temporal and special arrangement to get ecological and economic benefits. The tree based land systems often called as agroforestry systems are dynamic, eco-friendly and natural resource management systems that improves the socioeconomic condition of the farmer due to diversification yet with sustained production besides improving ecological condition of the area by improving soil fertility, soil and water conservation, and creation of favourable microclimatic condition and enhanced carbon sequestration and biodiversity. And trees like sandal and red sander due to their tempting price are already making their way in the regular farming system in the tropical India and hence the present review.

The productivity of agriculture under rainfed ecosystem is lower due to inadequate and unequal distribution of rainfall, high potential evapotranspiration, lower soil organic carbon, soil erosion and fluctuation of water table. Further, in the recent past the productivity of agriculture under rainfed ecosystem has become more uncertain due to climate change and associated variability (Doddabasawa *et al* 2017). This in turn has affected the food and livelihood security of farmers. In this context resilient and sustainable tree based farming systems particularly those involving high value crops like sandal and sander need emphasis in rainfed ecosystem.

Further, in the contexts of climate stability and biodiversity conservation tree based land use systems need attention by both farmer and scientific community in the world (Chittapur *et al* 2017). In tree based land use system, woody perennials are deliberately grown along with field crops and or livestock on the same unit of land management on temporal and special arrangement to get ecological and economic benefits (Nair 1985). The tree based land systems often called as agroforestry systems are dynamic, eco-friendly and natural resource management systems that improve the socioeconomic condition of the farmer due to diversification yet with sustained production besides improving ecological condition of the area by improving soil fertility, soil and water conservation, and creation of favourable microclimatic condition and enhanced carbon sequestration and biodiversity. However, retention of trees on the farm land is an age old practice continued by the millions of farmers to get specific economical and ecological benefits. Despite these socioeconomic and ecological benefits, tree based land use systems of late are largely disappearing due to intensified agriculture dominated by monoculture. Over, the years the unscientific management of intensified monoculture systems has not only deteriorated the environment but also has threatened it through hastening climate change especially under rainfed ecosystem. This is forcing the land holder to think of reorienting his farming towards traditional based ecologically sound systems for the livelihood security under rainfed ecosystem and in this context tree based land use system hold promise. Tree based land use systems have higher importance in rainfed ecosystems as they have the ability to create microclimate conditions, improvement of soil fertility through continuous addition of litter, enhance the water availability thorough shading, mulching and improved infiltration, reducing erosion through the binding by its large and deep root biomass and also by reducing the wind velocity. That apart, tree on farm land provides various produce such as food, fodder, fuel wood and timber which are required for the livelihood of farmer. Hence, Tree based land use systems increases the farmer income by reducing the cost of cultivation and living. Further, it also improves the health and nutritional status of the farmer and acts as source of income during climatic aberrations.

The inclusion of trees in olden days was largely confined to meet the basic requirement as mentioned above. However, in recent days farmers are getting attracted for commercial tree species to get higher income from the trees such as teak, rose wood, sandal, red sander etc. Already many of the large farm holders are attracted with this idea and are venturing in sandal and red sander in many parts of the country for their significantly higher economical value. This has even made some farmers to take up entire plantation of these two species in the form of farm forestry. However, cultivation of these species is not as simple as cultivation of any other tree species and, therefore, needs understanding of their characteristics, specifically while cultivating under rainfed condition. Both these trees have different silvicultural characteristics and economics which will be discussed in this paper.

The sandalwood (*Santalum album* L.) belonging to the family of *Santalaceae*, commercially known as East Indian sandalwood, is a small to medium sized evergreen and hemiparasitic tree. The tree is indigenous to peninsular India of which 90 per cent of



the total natural population is found in Karnataka and Tamil Nadu states (Dutt and Verma 2005). The sandal wood tree grows in wide range of environmental condition varying with annual rainfall between 500 mm to 3000 mm and the best heart wood formation was reported in 600 mm to 1600 mm (Troupe 1921). Further, sandal wood grows in variety of soil conditions such as sandy, clay, red and lateritic, deep clay and rock surface soils. However, fertile red ferruginous clay loamy soils found to be most suitable. Sandal grows from sea level to a height of 1800 MSL whereas, 600 to 900msl found to be most suitable for the growth. Sandal prefers shade in early stage but it requires abundant sunlight in the later stages of the growth with the tree attaining an average height of 12-13 m with a maximum girth of 2.4 m (Setiadi and Komar 2001). However, the waterlogged soils and very cool conditions are not suitable for cultivation of the tree.

Sandal wood (heartwood) is immune to termite attack and wood borers and it is one of the finest woods for carving and ranks only next to ivory. The sapwood and sometimes the mixed woods are used for manufacturing joss sticks. Sandal is highly valued for its fragrant heartwood which yields oil preferred for perfumeries, cosmetics and medicines (Arunkumar et al., 2012). The oil is present in the heartwood and roots, and hence the tree is invariably harvested by uprooting for oil extraction (Rao et al 1999). Indian sandalwood oil has a characteristic sweet, woody odour for which it is widely employed in the fragrance industry, more particularly in the higher priced perfumes.

The resources of sandal wood in the forest dwindled drastically in the recent past due to rampant illegal felling for its high value, disease, poor regeneration and low success rates of establishment. Sandal being a hemi parasite, its silvicultural requirements are unique and there is no adequate understanding of the same. Sandal has been a component of the traditional agroforestry systems. Its regeneration and establishment, however, has been problematic because of the poor understanding of host-parasite relationships (Surendran et al., 1998).

This created a wide gap between demand and supply. Hence, the current prices of sandal wood range from Rs 3500 to 5000/kg of heart wood and an Rs100000/kg of oil and in the international market the prices are higher by 20 per cent. Further, some state governments have also liberalized the rules governed for the cultivation of sandal trees on farm land to meet the global demand as sandal has a great potential for raising as a plantation and/ or as a component of agroforestry. Sandal is a most suitable species for agroforestry especially in dry land condition because it is not an exacting species, as it is hardy species, grows well in dry and degraded land, grows in wide variety of soils and even if it is browsed by animals it can recoup by coppicing. Further, the study indicated that the heart wood formation starts from 8th year onwards and best heart can be obtained after 20 years which will give substantial income to the farmer.

On the other hand, the red sander (*Pterocarpus santalinus* L.) belonging to fabaceae family is a critically endangered and endemic species to southern parts of eastern ghat in India (Purnachandra et al., 2002). Natural distribution of red sander occurs in tropical dry deciduous forest of eastern parts of Andhra Pradesh. The tree is localized and predominantly confined to Cuddapah landscape and in elevated place of Chittur, Nellore districts of Sheshachalum hill ranges and it is also found in Tamil Nadu and Karnataka (Lahari 1986; Nair and Henri 1983).

The red sander also called as 'Pride of eastern ghat' is a medium sized, leguminous and deciduous tree species. It attains a height of 10-13 m and girth of 150-160 cm in natural forest. Interestingly, in plantation it attains a height of 15-18 m and girth of 150-250cm. The tree grows well under prevailing dry climate throughout the year with a rainfall of 100 mm to 1000 mm and it sustains minimum 11°C temperature to maximum of 46°C (Arunkumar and Geetha, 2014). Further, the tree prefers hilly terrain and also grows in shallow, poor, stony and well drained soils (Raju and Nagaraju, 1999). However, it is frost tender and susceptible to waterlogged conditions (Raju and Raju 2000).

The tree is well known for ethno medicine mainly the heart wood which contains red dye (16% santalol) used in textile, medicine and food industries. Further, the wood is also used to make furniture and handicrafts (Green, 1995, Oldfield et al 1998). The wavy and ripple heart wood is high in demand in the international market which is used to make musical instruments. Although, the demand for this wood is less in India (3 to 4 lakh/tonne) there is huge demand in China, Japan and other countries (10 to 12 lakh/tonne). It is estimated that the demand of wood is 1000 to 3000 tonnes per year. Further, lesser population, poor regeneration and rampant illicit felling have put the species under critically endangered category and as well as higher price for the wood. Further, the species is of slow growing nature and puts an average increment of girth by 0.75 cm to 1.5 cm (ICFRE, 1992). However, the red sander is a leguminous hardy species grows in dry climate and degraded soils. Further, its multiple utility and good coppicing ability made the species the most suitable one for agroforestry under rainfed conditions.



CONCLUSION

More fragile nature of rainfed ecosystem put the farmer's livelihood at risk. Hence, diversification of farming system under rainfed ecosystem is required to sustain the livelihood of farmer. Of the different options, tree based land use system which enhances the economic condition of farmer and improves ecological condition of the area is one of the viable options. In such systems, in recent days the sandal wood and red sander are much sought after by the farmers for their higher commercial value and are being raised in block plantation in farm forestry mode. These two tree species have different silvicultural characteristics and technique in cultivation, but they are quite hardy and can be successfully grown under rainfed conditions. The inclusion of these trees on farm land in the form of agroforestry will enhance the income of the farmer more on long term basis and also helps him to get ecological benefits.

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MILLETS FOR FOOD AND NUTRITIONAL SECURITY IN GLOBAL CLIMATE CHANGE SCENARIO

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Climate change is a significant shift in average weather conditions, becoming warmer, wetter, or drier over several decades or more. Climate change is one of the most defining concerns of today's world and has greatly reshaped or in process of altering earth's ecosystems. Naturally climate change has been a constant process on earth, but in recent times, approximately last 100 years, the pace of climatic shift has increased manifolds due to increased anthropogenic activities. Greenhouse gas emissions are the leading cause of the earth's rapidly changing climate. Greenhouse gas emissions cause heat to be trapped by the earth's atmosphere, and this has been the main driving force behind global warming. Human activities majorly responsible for surge in greenhouse gases are predominantly related to energy production, industrial activities and those related to forestry, land use and land-use change (Fawzy *et al.* 2020). Intergovernmental Panel on Climate Change (IPCC) reported that, till now anthropogenic activities have caused an estimated 1.0 °C of global warming above the pre-industrial level, specifying a likely range between 0.8 and 1.2 °C. Global warming is likely to reach 1.5 °C between 2030 and 2052 if the current emission rates persist (IPCC 2018).

Agriculture and Climate Change

As the earth's atmosphere heats up, it collects, retains, and drops more water, changing weather patterns and making wet areas wetter and dry areas drier. Higher temperatures worsen and increase the frequency of many types of disasters, including storms, floods, heat waves, and droughts. These events can have devastating and costly consequences. The worst effect of accelerated climate change is faced by agriculture sector. As climate change and agriculture have inextricable links, abrupt changes in climatic conditions at such a rapid pace have threatened the food security at global scale (Arora, 2019). As per Food and Agriculture Organization (FAO) data published in 2016, if the current situation of greenhouse gases emissions and climate change continue then by the year 2100 there will be decline in the production of major cereal crops (20–45% in maize yields, 5–50% in wheat and 20–30% in rice). Climate change is resulting into a very high rate of land degradation causing enhanced desertification and nutrient deficient soils. The unprecedented surge in global warming has resulted in increased events of droughts, floods, irregular patterns of precipitation, heat waves and other extreme happenings throughout the globe. Report by European Academies' Science Advisory Council (EASAC) suggests that extreme events including floods have increased by 50% in last 10 years and are now occurring at rate of four times higher than in comparison to 20 years back (EASAC, 2019). Climate change, now we know can break the backbone of agriculture at global level. This predicts drastic impacts on food distribution patterns but also on its quality and access. Not only this, it will also raise humanitarian concerns as food security is deeply linked with public health. The food security is further threatened by the increasing world population which is expected to increase by 2.0 billion over the next 30 years, from 7.7 billion today to 9.7 billion in 2050.

Food Security and Nutrition Scenario

'Food security' exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Availability of food, Access to food, Utilization and food Stability are the four pillars of Food security. The term 'food security' does not clearly spell out the nutrition dimension of food of adequate sanitation, health services and care, allowing for a healthy and active life."

The world population is growing steadily which is surely not doing any help to the Food Security and Nutrition of the World instead it is the major threat. Agricultural production in general and crop production in particular, must increase substantially in order to meet the rising food demand of a population that is projected to expand by some 40 percent over the period from 2005 to 2050. Adding on to this climate change and increasing climate variability and extremes are affecting agricultural productivity, food production and natural resources, with impacts on food systems and rural livelihoods, including a decline in the number of farmers leading to major shifts in the way in which food is produced, distributed and consumed worldwide. According to the FAO, 2019 report more than 820 million people in the world are still hungry today, underscoring the immense challenge of achieving the Zero Hunger target by 2030. Another disturbing fact is that about 2 billion people in the world experience moderate or severe food insecurity.



Climate change and Indian Agriculture

Impacts and results of climate variability for agriculture tend to be more dangerous for countries with higher initial temperature and regions with marginal or already degraded lands and low level of development with poor adaption capacity (Keane *et al.* 2009). India also faces the challenge of climate change and global warming and being a developing country it depends largely on agriculture. The agro-geological position and population of India increases the threat of climate change even more, mostly on agriculture. The report of the IPCC indicates a probability of 10-40% loss in crop production in India and other countries of South Asia with increases in temperature by 2080-2100 and decrease in irrigation water. India could lose 4-5 million tons of wheat production with every rise of 1°C temperature throughout the growing period even after considering carbon fertilization. In a study at the International Rice Research Institute, the yield of rice was observed to decrease by 10% for every 1°C increase in growing-season minimum temperature. Higher temperatures tend to reduce crop yields and favour weed and pest proliferation. Climate change can have negative effects on irrigated crop yields across agro-ecological regions both due to temperature rise and changes in water availability. Rainfed agriculture will be primarily impacted due to rainfall variability and reduction in number of rainy days. Analysis of impact of climate change under National Innovations in Climate Resilient Agriculture (NICRA) project has found that climate change is expected to affect yields, particularly in crops like rice, wheat and maize (Ministry of Agriculture & Farmers Welfare, 2019). Under NICRA, climate resilient technology demonstrations are implemented in 151 climatically vulnerable districts of the country. District Agriculture Contingency Plans have been prepared by ICAR-CRIDA, Hyderabad for 648 districts in the country to address the adverse weather conditions.

Climate smart Agriculture

The current climate change scenario calls for some urgent actions and adopt policies that can help in coping with the upcoming threats of climate change on agriculture and food security. This can be achieved by adopting climate smart agriculture system which is in line with FAO's vision of Sustainable Food and Agriculture goals. This includes developing resilient varieties of crops which can withstand abrupt stresses of temperature and precipitation, implementing biotic and sustainable agricultural methods, for example, application of bio-inoculants/bio-fertilizers using tolerant plant growth promoting rhizobacteria (PGPR) and their metabolites and other methods of organic farming in order to promote yield of crops in extreme environments in a holistic and a sustainable way (Arora, 2019). Use of bio-fertilizers and bio-pesticides will result in decreased reliance on chemical fertilizers and pesticides. Climate change and agriculture are strongly co-related. It is clear that the fast pace of climate change will have far reaching impact on agro-ecosystems and their productivity. Hence it is high time that we prepare ourselves for the up-coming challenges so as to combat the impact of climate change and ensure food security not only for humans but other living beings as well.

Approaches to tackle climate change

Climate change mitigation approaches are mainly focused on reducing CO₂ emissions, such as renewable energy, fuel switching, nuclear power, and carbon capture storage and utilization. But these solutions are subjected to the geopolitical conditions and will take a long time therefore Agriculture cannot rely on these solutions. As these actions can only mitigate the climate change which is inevitable in future.

Millets: A solution to agrarian and nutritional challenges

One of the major impacts of climate change is increase in the barren land due to increased incidents of droughts and less rainfall. Global climate change affects a variety of factors associated with drought. There is high confidence that increased temperatures will lead to more precipitation falling as rain rather than snow, earlier snow melt, and increased evaporation and transpiration. Thus the risk of hydrological and agricultural drought increases as temperatures rise. India is predicted to face more droughts as the result of climate change. Therefore there is a need to shift the agriculture gradually towards drought resilient crops that will cope with climate change and ensure food and water security as well. Millets cultivation can keep dry lands productive and ensure future food and nutritional security. These contain good amounts of vitamins, minerals, essential fatty acids, phytochemicals and antioxidants that can help to fight against global nutritional challenges. Millets are especially rich in calcium, iron and zinc where most of the major cereal crops fail. As the climate change is expected to raise the global temperature, which in turn will turn the agro-climatic conditions mostly in tropical and sub-tropical countries. This situation will demand sustainable crop substitutes and millets the best solution available. Therefore the germplasm conservation of millets holds the prime importance for now and near future.



Millets are small-seeded grasses that are hardy and grow well in dry zones as rain-fed crops under marginal conditions of soil fertility and moisture. They are possibly the first cereal grain to be used for domestic purposes; the commonly grown millets are Sorghum, Pearl Millet, Finger Millet, Barnyard Millet, Foxtail Millet, Kodo Millet, Proso Millet and Little Millet. Unlike rice and wheat that require many inputs in terms of fertilizer and water, millets grow well in dry regions as rain-fed crops. Highly nutritious, non-glutinous and rich in fibre, they are easy to digest. There are multiple benefits of millets that are recognized not only as a best substitute for changing ecological system but also health benefits. Millets are considered to impart role in lowering rate of fat absorption, slow release of sugars (low glycemic index) and thus reducing risk of heart disease, diabetes and high blood pressure. (Kumar *et. al*, 2018).

Traits Contributing Climate-Resilience to Millets

Millets possess exceptional tolerance against abiotic stresses including drought, salinity, light and heat. The short life-cycle of millets helps in escape from stress, millets take 12–14 weeks to complete seed to seed life cycle which is nearly half of that required by rice and wheat. Traits short stature, small leaf area, thickened cell walls, and the capability to form dense root system gives them natural resilience to water deficit conditions. C_4 photosynthetic pathway is highly advantageous to millets this increases carbon dioxide fixation efficiency in millets. This indirectly also increases the water use efficiency and nitrogen use efficiency making them the future crop of the world and extremely useful source of C_4 genes in grain plants (Bandyopadhyay *et al.* 2017). These attributes of millets make them next-generation crops holding the potential for research to explore the climate-resilient traits and exploit the information for the improvement of major cereals.

India and Millets

India is rich in diversity of millet germplasm. India is the largest producer of millets in the world. Millets are grown in India since antiquity. Himalayan and Peninsular India harbor the natural diversity of millets in India. Sorghum has been domesticated in Africa and widely cultivated in parts of Maharashtra, Karnataka, Andhra Pradesh and Madhya Pradesh, Indian subcontinent being the secondary centre for sorghum. Similarly for Pearl millet India is the secondary center it is cultivated in states of Rajasthan Maharashtra Gujarat Uttar Pradesh and Haryana. Finger millet is widely cultivated throughout most parts of India it was domesticated in India. Minor millets, kodo millet and little millet have been domesticated and cultivated in India. Kodo millet is Indigenous to India. It is the highest drought resistant type millet known. Indian barnyard millet cultivated in most parts of India has good variability available in cultivated forms, it is known for attaining highest growth in minimum time. Barnyard millet is grown in Uttarakhand and Karnataka. Foxtail millet and proso millet were domesticated in India and spread to other parts of world now grown majorly for animal feed and cash crop in western countries. During introduction of green revolution millets lost most of its growing areas in India but now as climate change is occurring the millets are making comeback in Indian agriculture. Year 2018 was witnessed as National Year of Millets by government of India to boost production of the nutrient-rich millets and the sunrise agri-industry involved in it. Same year India has proposed UN food and agriculture to declare 2023 as international year for millets and now it is accepted by the UN. India enjoys the large diversity and cultural connection with all the millet crops from history. India is the center of origin for most of the millets. India is the largest producer of millets in the world. Millets are grown in India since antiquity. Traditionally millets have been the intrinsic part of Indian diet and culture they are mentioned in ancient texts Yajurveda and Ayurveda. In Ayurveda millets considered special grain that have sweet, heating, dry and light effect on body and is regarded as medicinal food. In 2020, the 17 recently developed bio-fortified varieties of 8 crops to be dedicated to the nation by the Prime Minister of India this included CFMV1 and CFMV 2 of finger millet rich in calcium, iron and zinc; CLMV1 of little Millet rich in iron and zinc.

CONCLUSION

Agriculture is the highly connected to the climate conditions, thereby climate change will adversely affecting our food systems and crop productivity, especially of major cereals such as rice, wheat and maize. There is no doubt that a rapid shift in the cropping pattern and eating habits incorporating millets in today's population is vital. Projected increase in world population is bringing the challenge of food security this can be met with millets as they are naturally climate resilient crop and at the same time nutritious for health. India can play a major role in providing world ensuring the food security of its own and also of the world with gifts of millets.



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FOOT AND MOUTH DISEASE : CURRENT INDIAN SCENARIO AND CONTROL STRATEGY

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Abstract

Foot and mouth disease is highly devastating, trans-boundary, emerging and re-emerging viral disease of domestic and wild cloven hoofed animals. Domestic cloven hoofed species provides milk or meat and hide therefore serves as an important source of food security around the world. FMD is endemic in Asian and African continent of world and unfortunately economy of these continents is more dependent on livestock resources. FMD free countries of world do not import animal products from FMD prevalent Asian and African countries which causes huge monetary losses to them. Large population of livestock in Asian and African continents makes these continents as potential source for future road maps of world to ameliorate shortage of food but these trade limitations is major hurdle in this roadmap and warrants immediate eradication of FMD. Different Asian and African nations are carrying intensive FMD control program to eradicate FMD but lack of reliable diagnostic techniques, effective vaccine, specific therapy and presence of antigenic variation ability are major constraints for such programs. This article focuses on current scenario of FMD and FMD controlling programme in India with control approach for FMD.

Key words : Foot and Mouth disease, cloven hoofed, food security, FMD control programs

Introduction

Foot and mouth disease is highly contagious viral disease of wild and domestic cloven hoofed animals characterized by presence of vesicles in oral mucosa, inter digital space, coronary bands, mammary glands and other hairless part of body (Teifke et al., 2012). FMDV induced myocardial damage is main cause of death in affected neonates. FMD virus is known to affect more than 70 domestic and wildlife species including cattle, buffalo, sheep, goat, camel and pig. (Verma et al., 2012; Teifke et al., 2012). Causative virus belongs to genus Aphthovirus of family Picornaviridae and is known to exist in seven immunologically distinct serotype viz., O, A, C, Asia1, SAT1, SAT2 and SAT3. FMDV is single stranded positive sense non-enveloped RNA (~8.5 Kb) virus with icosahedral symmetry (30 nm size). Viral genome codes for structural proteins like VP1, VP2, VP3 and VP4 and approximately 10 non-structural protein. Immune response against FMDV consists of antibodies produced against both structural and non-structural FMD viral proteins. Monetary losses caused by FMD are attributable to loss of animal products and neonatal mortality (Ferrari et al., 2013). Regular vaccination, restriction of animal movement, strict dairy and zoo sanitary procedures and stamping out are effective methods of disease control.

Status of FMD in India

India is an agrarian economy with largest livestock population of world. Endemic nature of FMD poses major threat to Indian livestock sector by causing direct loss of production and loss of foreign exchange due to trade sanctions on livestock products (Verma et al., 2010). Four serotype prevalent in India are O, A, C and Asia-1 (Verma et al., 2008). Least prevalent serotype in India is C which was recorded in 1995 for last time. (Verma et al., 2012a). India suffers revenue loss of approximately Re 20,000 crores annually due to FMD in large ruminants (Verma et al., 2012a and 2012b). Keeping in consideration, the impact of FMD on national economy, India initiated their national FMD control programme (FMD-CP) in 2003-04 covering 30 million cattle and buffalo population of 54 different districts of country (Pattnaik et al., 2012). Status of these 54 districts was successfully transformed to FMD free zone therefore FMD-CP was extended to cover new 167 districts in 2010-1. At present FMD-CP is operational in 221 districts of country covering 110 million cattle and buffaloes. There is impressive decline in the incidence of outbreaks of FMD in country as a result of intensive vaccination and monitoring programme under FMD-CP.

Clinical Signs : Foot and mouth disease is initially manifested as anorexia, depression, pyrexia, drop in production, excessive salivation, vesicular stomatitis, vesicles on mammary gland, interdigital space and coronary bands of hooves (Teifke et al., 2012; Verma et al., 2012a; Yoon et al., 2012). The lesions can be evident for 7-10 days with most recovery occurring within 2-3 weeks. FMD lesions are less evident in sheep and goat and ranges from shallow erosions, agalactia and lameness signs (Yoon et al., 2012). About 20% sheep remains asymptomatic and 20% show lesion at one site. Swine also suffers less severe



oral lesions but severe foot lesions with 100% morbidity. Wildlife also suffers both acute and subclinical infections with similar vesicular lesions over oral mucosa and feet. Wildlife species like impala, blackbuck. Gazelles, warthogs and white tailed deer mostly suffers acute disease with high mortality. Chronic heat tolerance, loss of reproduction ability and myocarditis lesions are common sequelae of FMD in wildlife. Occasionally swollen tongue has also been recorded with FMD infection in wildlife (Deb *et al.*, 2012).

Diagnosis: Foot and mouth disease can be easily identified on the basis of characteristic clinical manifestations but differential diagnosis of diseases with similar oral vesicular stomatitis and feet lesions can be made on the basis of laboratory examination only. Laboratory examination is also required to identify the strain causing the FMD infection.

Laboratory diagnosis :

1. Virus isolation : Isolation of FMDV can be carried out in Primary bovine thyroid cells or primary pig, calf or lamb kidney cells, BHK-21 or IB-RS-2 cells (Sakamoto *et al.*, 2002) can be used to isolate FMD virus. Virus is confirmed on the basis of cytopathic effects or by virus neutralization assay (VNT) and typing by ELISA (OIE, 2009). If required virus can be passaged in unweaned mice.

2. Detection of viral antigens : Now a day's FMDV is detected using serological test like ELISA mainly but till 1997 complement fixation test was used to identify FMDV (Ferris *et al.* (1984).

3. Serological tests : Enzyme linked immunosorbent assay (ELISA), agar gel immunodiffusion test (AGID) and virus neutralization test (VNT) are the major serological diagnostic techniques used for diagnosis of FMD. Competitive ELISA is used to establish recovery from infection. Antibodies to structural proteins of FMDV is used to differentiate current and previous infections by ELISAs and virus neutralization tests (VNT) (Gold standard test). The Liquid phase blocking ELISA (LPBE) is most popular and commonly used ELISA for studying post vaccination immune response (Verma *et al.*, 2009).

4. Differentiation of infected and vaccinated animals (DIVA) : is used to differentiate vaccinated and unvaccinated animals. FMD vaccine induced antibody response against structural proteins of FMDV therefore traditional serological techniques which detects structural protein cannot be used to differentiate between vaccinated and unvaccinated animal. Detection of antibodies against non-structural protein is basic principle involved in differentiating vaccinated animal from non-vaccinated ones. These non-structural proteins can be identified using various techniques like non-structural protein ELISA.

5. Molecular tools : Molecular tools like of reverse transcription-polymerase chain reaction (RT-PCR) and long distance polymerase chain reaction (LD-PCR) (Shawky and Daoud, 2005) can be employed for more rapid detection of FMDV from different biological samples like vesicular epithelium (Verma, 2008; Raies *et al.*, 2009, Verma *et al.*, 2010a; Verma *et al.*, 2011), nasal swabs, serum and milk sample (Van-Rijn *et al.*, 2004). RT-PCR (Callens *et al.*, 1998), real-time PCR (Moonen *et al.*, 2003), automated RT-PCR and nested RT-PCR and nucleic acid sequence based amplification (NASBA) test (Lau *et al.*, 2008) can be used to identify the serotype of FMDV.

Treatment : There is no specific treatment for FMD but symptomatic treatment speed up the recovery and reduces the severity of disease. Symptomatic treatment includes antiseptic wash of oral mucosa, feet and other lesions. Potassium permanganate can be provided as oral mouth wash followed with application of glycerine and boric acid while 2% copper sulphate or soda ash solution followed with topical application of honey and finger millet is used to wash affected feet. Ribavirin (Kim *et al.*, 2012), 2'-C-Methylcytidine (Lefebvre *et al.*, 2013) and cytokine therapy inclusive of IFN- α are antiviral regimens that can be used to prevent occurrence of disease in susceptible animals.

Prevention and Control : Many countries like France successfully controlled FMD with vaccination and after control stopped vaccination therefore vaccination followed with sero-prevalence is proven and effective method for control of FMD. Such strategy warrants rapid diagnosis and quick response which requires well equipped laboratories, trained quick response team and veterinary staff, good governance, continuous monitoring, surveillance and compulsory vaccination (Namatovu *et al.*, 2013).

Recommendations for controlling FMD outbreaks at the farm level :

Animal should always be procured from registered source. Introduction of new animal to existing stock should be done only after quarantine. As soon as disease is suspected, movement of livestock, vehicles, equipment and workers should be restricted



so that infection didn't transmit to remote sites. Disinfection and sanitization of affected premises and equipment should be performed immediately. Sodium hydroxide (2%) and sodium carbonate (4%) (Krug *et al.*, 2011), citric acid (2.0%) (Krug *et al.*, 2012) and Virkon-S®. Hypochlorite and phenols are disinfectants effective against foot and mouth disease virus. Dispose all infected refusal, manure, animal products and carcasses by burning or burial. Virus in milk can be inactivated with heating at 100°C for more than 20 minutes while slurry warrants heating up to 67°C for 3 minutes. Rodents can act as source of transmission of virus therefore every attempt should be made to stamp them. Livestock owner of nearby uninfected farms should be directed to follow biosecurity measures strictly. Vaccination should be initiated around the infected premises. Climatic condition of tropical countries favors airborne transmission and FMD has high prevalence in non-vaccinated stock therefore strict vaccination should be followed (Kesy, 2002). FMD free countries are in continuous threat of emergence of FMDV from endemic countries. Introduction is usually via feed and infected animals therefore import of animal products from infected zone to FMD free zone should be restricted.

Vaccination

Vaccination is most effective strategy for prevention of many viral diseases including FMD (Pastoret, 2012). Since FMD affects many species therefore its vaccination should also involve all susceptible livestock species including sheep, goat and swine however policies are usually directed toward FMD control in cattle and buffaloes. There is no universally accepted FMD vaccine but conventional inactivated FMD vaccine is widely used (Uddowla *et al.*, 2012). Vaccine containing one serotype does not provide cross immunity against other serotypes therefore vaccine should be prepared for an area after thorough investigation of prevailing serotypes. Monovalent vaccine should always be used in countries where only one strain is prevailing. These inactivated FMD vaccines provide short lived immunity (4-6 months), require biannual vaccination, repeated booster every 6 months and lack cross immunity between serotypes. Since preparing inactivated vaccines requires culture of live virus there is possibility of escape of live virus from vaccine producing laboratories. To overcome these disadvantages, researchers are making attempt to develop alternative vaccines (Rodriguez and Gay, 2011). These alternative include proteins, peptides, synthetic peptide vaccine, DNA-based strategies, virus-like particle, gene replacement, empty viral capsids having desired immunogens but lacking infectious nucleic acid and DNA vaccines, epitope based vaccines, chimeric virus vaccines using reverse genetics technology and so on (Zheng *et al.*, 2013).

Commercial vaccines available in India

In India, BHK-21 cell culture based, inactivated trivalent vaccine (O, A-22 and Asia 1) are commercially available like Raksha-FMD vaccine, Bio-vet FMD vaccine, Raksha-Ovac (Indian Immunological), Bovilis FMDV- Gel, Bovilis Clovax (Intervet), etc. Recommended regimen is primary vaccination at age of 4 months followed by booster every 6 months (twice vaccination per year).

Conclusion and Future Perspectives

FMD is responsible for causing maximum monetary loss to livestock sector in FMD prevailing countries. Moreover FMD free countries are in continuous threat of emergence of this devastating disease. Countries like India who are running their FMD control program should focus on strengthening their animal health infrastructure to carry out rapid diagnosis, effective vaccination, extending intensive control strategies, constant surveillance and monitoring by antigenic and phylogenetic studies. Appropriate vaccine should be formulated based on phenotypic and genotypic characterization of virus and then vaccination should be performed in standard and recommended manner to develop herd immunity. Due attention should be given to animal breeding program focusing on developing resistant breeds. Field veterinarians should be encouraged to report the disease as soon as possible and should be regularly trained for carrying out control strategies effectively. Livestock owners should be informed about the critical control points and encouraged to adopt various preventive and control measures. In summary intensive surveillance, biannual vaccination and rapid intensive extension of control measures in case of outbreak are key to eradicate FMD.

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INNOVATIVE TECHNOLOGIES FOR CROP IMPROVEMENT

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Abstract

Development of high yielding varieties insulated against major biotic and abiotic stresses and matching integrated crop management technologies of the food grains, particularly of cereals (rice, wheat), coarse cereals (maize, sorghum, pearl millet), pulses (chickpea, pigeonpea, mungbean, urdbean, lentil, fieldpea, rajmash) and minor millets has made India as a self-reliant country in food availability. The production of foodgrains registered spectacular growth as production crossed 296 m t during 2019-20 which is ever highest in history of Indian agriculture. This production increase is mainly due to technological advances and a small portion of the increase is through area increase that too of marginal and sub-marginal land. To maintain self-sufficiency in food grain production, the multipronged strategies need to be developed and implemented for ensuring genetic improvement in present day varieties. The development of hybrids, systematic gene transfer, exploitation of molecular marker technology for enhancing selection efficiency, transgenic for bringing new genes of economic importance (genes responsible for imparting resistance against dreaded insect pests, diseases, develop nutri-dense varieties, from different genera or kingdom, gene editing to correct defects coupled with rapid generation turnover during handling of segregating material will certainly help not only in sustaining current level of production but also ensure productivity enhancement through targeted crop improvement programs.

Introduction

Indian agriculture research for development (R4D) has contributed immensely by way of not only attaining self-sufficiency in foodgrains production but also fetching precious foreign exchange through export of foodgrains including other agricultural produce. During past decades the crops varieties and management technologies have reduced losses due to major biotic and abiotic stresses thereby production has increased sustainably. The ever-growing population of the country warrants for additional production of foodgrains of about 291 m t and 377 m t by 2025 and 2050, respectively as the projected demand for total food grains is expected to reach 19.9 kg per month (Khatkar et al. 2016, Bhalla *et al.* 1999). The similar demand for food grains has been projected by others to touch 257-260 m t including for pulses (IIPR 2015). At the same time, Hon'ble Prime Minister Sri Narendra Modi in his address in 2011 has also mention that total demand for food grains will touch 280 m t by the year 2020-21 (NITI Aayog, 2020). We are fortunate enough that country could successfully produce more (285.01 m t) than the required food grains in 2017-18. It is worthwhile mention that in comparison to the total food grain production of 1950-51, India has made considerable progress sustainably (Table-1).

Table-1 : Production of major food grains.

Crop	Year (production in mt)			Times Increase during 2019-20 over 1950-51
	1950-51	2014-15	2019-20	
Wheat	6.46	95.85	107.18	16.59
Rice	20.58	106.65	117.94	5.73
Maize	1.73	24.26	28.98	16.75
Pulses	8.41	19.26	23.01	2.73
Food grains	50.82	265.05	296.65	5.83

Further, India recorded ever highest production of total food grains (296.65 m t) in 2019-20 as per 4th advance production estimates (DAC&FW, 2020). It is important to note that during last decade (from 2009-10 to 2019-20) cereals production increased by 34.43% (70.05 m t), pulses by 57.9% (8.49 m t) and total food grains by 36% (78.54 m t) that has ensured sustained food grains supply to the people of this country even during Covid19. As of now country is self reliant in total food grain production including pulses (Table-2).



Table-2 : Gaps in projected demand and actual production of food grains.

Five Year Plans (FYPs)	Commodity	Projected Demand (m t)	Actual Production (m t)	Gap in demand and supply (m t)
9Th FYP (1997-98 to 2001-02)	Cereals	193.4	199.48	-6.02
	Pulses	15.42	13.37	-4.13
	Food Grains	208.82	212.85	-10.15
10th FYP (2002-03 to 2006-07)	Cereals	200.25	202.40	-2.15
	Pulses	16.22	13.35	2.87
	Food Grains	216.47	217.28	-12.72
11th FYP (2007-08 to 2011-12)*	Cereals	212.45	221.56	-9.11
	Pulses	20.48	15.86	4.62
	Food Grains	232.93	237.42	-4.49
12th FYP (2012-13 to 2016-17)	Cereals	235.00**	241.33	-23.89
	Pulses	21.67	18.84	2.83
	Food Grains	257.00**	260.17	-3.17
13th FYP (2017-18 to 2019-20)*	Cereals	246.10	265.41	-19.13
	Pulses	23.21	23.55	-0.34
	Food Grains	280.00	288.95	8.95

*Based on three years data, **https://mofpi.nic.in/sites/default/files/vol_2.pdf

The credit for such spectacular increase goes to the development, production and supply of quality of high yielding varieties insulated against major biotic and abiotic stresses. The contribution in ever highest production of food grains of popularization of matching production technologies, policy support in terms of announcement of remunerative minimum support price (MSP) well before commencement of sowing and procurement at MSP, Pradhan Mantri Fasal Beema Yojna (PMFBY), creation of massive rain water harvesting supported irrigation network including financial support for micro-irrigation, and schemes like Bringing Green Revolution in Eastern India (BGREI) etc. cannot be underestimated.

The investment in R&D significantly contributed in development of a large numbers of high yielding varieties of cereals (rice, wheat), coarse grains (sorghum, maize), and millets (pearl millet, foxtail millets, finger millets) and pulses (chickpea, pea, lentil, pigeonpea, mungbean, urdbean, rajmash, lathyrus, moth bean, cowpea, horse gram etc.) for cultivation in different states of the country under varying agro-ecologies (<https://seednet.gov.in/SeedVarieties/CentralVariety.aspx>) and supply of their seed. In recent years hybrids of crops like rice, maize, sorghum, pearl millet, pigeonpea etc. have not only shown potential but also significantly contributed towards increase in productivity and farm profitability. Recently, development and release of biofortified varieties of food crops (cereals and pulses) are going to change the scenario of Fe, Zn and protein malnutrition among Indians in years to come. The popular scheme 'BGREI' which was initiated in 2010-11 is successfully addressing constraints limiting the productivity of "rice based cropping systems" in Eastern India covering Assam, Bihar, Chhattisgarh, Jharkhand, Odisha, Eastern Uttar Pradesh and West Bengal.

History of crop improvement

The conventional breeding started with the development of first artificial hybrid by Thomas Fairchild during 1717 when he crossed sweet william (*Dianthus barbatus*) with carnation (*Dianthus caryophyllus*). Later, many scientists used hybridization for various studies as well as in breeding programmes aiming for crop improvement. Joseph Koelreuter, made many crosses successfully in tobacco during 1760-1766. By the end of 19th century, hybridization based crop improvement programme resulted in release of a large number of high yielding varieties. The mutation breeding and polyploidy also contributed significantly during nineties. During same period, intensive research was initiated by the Indian Council of Agricultural Research (ICAR) for the development of hybrid by establishing first 'All India Coordinated Research Project on Maize in 1957 and later first hybrid of maize was released during 1960 for cultivation in India. Further, systematic research on development of varieties/hybrids was undertaken at national level by creating dedicated network projects 'All India Coordinated Research Projects (AICRPs)'. These AICRPs helped in development of high yielding varieties/hybrids and ensured free flow of germplasm and breeding material among partner institutes/universities for intensive research. Introduction of germplasm, mutagenesis and hybridization became major activities for crop improvement.



In the modern era, breeders are routinely attempting hybridization (single or multi-parent crosses) for the development of varieties/hybrids. There are several methods for handling segregating populations from F₂ and onwards for the development of varieties possessing desirable traits.

Targeted traits for crop improvement

It has been observed that many varieties released for cultivation in specific areas lack in targeted traits. For example, for bringing green revolution in eastern India (BGREI), technological issues particularly varietal aspects remained partially unaddressed. These need to be addressed by systematic incorporation of desired traits such as early maturity, high seedling vigour, heat tolerance, foliar diseases and insect pests (crop and storage grain pests) etc. Similarly, crop varieties of various food crops having desired traits for peninsular India needs to be developed. The traits related to farmers (reduced cost of cultivation, traits related to trade) and consumers (attractive and nutri-dense grains) choice and reduced cost of cultivation (machine harvestable, nutrients' acquisition and use efficient varieties) need consideration during crop improvement programs.

Innovative technologies for crop improvement

Several mating systems for self and cross pollinated crops are available for generation of breeding material and transfer targeted genes to the desirable background. Similarly many breeding methods or methods for handling breeding material after hybridization are available to the crop breeders for germplasm enhancement and crop improvement, such as the pedigree method, bulk method, bulk-pedigree, single seed descent, backcross method, and recurrent selection. These methods resulted in development and release of several hundred varieties of cereals and pulses. In recent years, many new tools and techniques have been developed for their integration in crop improvement programmes. Some of these have been mention below :

Rapid generation advancement (Off-season and speed breeding): Crop breeders always had interest in reducing duration required for isolation of a pureline variety or inbred from segregating material. Considering the huge investment requirement for generation advancement under controlled conditions (growth chambers, glasshouses/greenhouses), an alternate several suitable locations were identified for off-season generation advancement of the breeding populations and these efforts paid dividends. Breeders use to sow winter season crops during summer at comparatively cool places like in northern hills (Himachal Pradesh, Punjab, Uttarakhand) and at locations having high altitude in central (Maharashtra: Mahabaleshwar) and southern India or near to coast (Karnataka: Dharwad, Hiryur; Tamilnadu: Ooty, Kaithalgiri).

More recently, scientists could standardize photo-thermo requirements of various crops and could successfully reduced seed to seed cycle under controlled environment (growth chambers) and integrated tissues culture where they could grow immature seeds into plants successfully. With such efforts (speed breeding) Australian scientists could ensure 4-5 seed to seed cycles (generation advancement) per year. Speed breeding has opened doors for reducing duration drastically required for development of mapping populations, varieties and inbreds.

Breaking yield ceiling and broadening genetic base : Most of the varieties developed in many crops have narrow genetic base as limited number of germplasm lines could be utilized in hybridization programmes due to lack of information on vast genetic resources conserved in many genebanks. As wild and weedy relatives of the crops are rich reservoirs of the useful genes, these needs to be utilized as useful genetic resources to break genetic yield ceiling and broaden the genetic base. Sincere efforts have been made to transfer useful genes and develop newer plant types in food crops including rice, chickpea, mungbean etc.

Deployment of molecular markers : Genomic selection and molecular marker technology has facilitated identification of useful parents and systematic transfer of useful genes or QTLs into desirable backgrounds. The deployment of molecular markers linked to targeted genes/QTLs has helped in development of biotic (diseases) and abiotic stress tolerant varieties of food crops including rice and chickpea and biofortified/quality varieties.

Enhancing resource use efficiency : There is need to improve water productivity, and nutrients acquisition and use efficiency of future varieties at genetic level. Soil resources need to be developed to have large scale studies on nutrients acquisition efficiency and use efficiency. Contrasting germplasm lines can be identified and later search for genes/QTLs can be ensured. Once genes/QTLs responsible for improving water productivity (as Drought QTL from ICC4958 in chickpea) are identified, their incorporation in desirable background can lead in development of drought tolerant varieties successfully. Similarly, ample scope exists for development of nutrient use efficient varieties of food grain crops.



Tailoring climate smart varieties against multi-adversities : The temperature extremities and long drought spells are known to reduce yields of the crops. Similarly, a number of diseases, insect pests and weeds also cause huge yield losses in food crops. Crop improvement programs across globe are targeting development of multi-adversities resistant varieties so that these fit well under changing climatic conditions. Recently, scientists have made efforts to identify herbicide tolerant germplasm accessions (Gaur *et al.* 2013, Chaturvedi *et al.* 2014) for development of post emergence herbicide tolerant varieties of chickpea, fieldpea and rice.

Bringing down cost of cultivation : Efforts are being made to tailor suitable varieties of chickpea (Chaturvedi *et al.* 2014) and other crops so that these are amenable for machine harvesting. Recently developed varieties of chickpea (NBeG 47, GBM 2, Phule Vikram, RVG 204) are gaining popularity among cultivators have encouraged breeders working with other crops to developed machine harvestable varieties. The tall and erect varieties also ensure better solar light interception on crop canopy leading to reduced humidity inside crop canopy which in turn reduce incidence of foliar diseases and insect pest load. Further, these varieties promote foliar spray of plant protection agro-chemicals/botanicals more effectively as less quantity is required to cover canopy.

Bringing new genes following non-conventional approaches : Through transgenic technology, and gene editing etc. are among new tools and techniques now available for their application in crop improvement programmes. More recently, CRISPR technology has emerged as a simple yet potential tool for genome editing. It allows altering DNA sequences and subsequently modifying gene function. It can help in correcting genetic defects, thus can pave the way for improving resistance against targeted diseases of the crops.

Ensuring genetic purity of seed

The potential of any variety can be ensured firstly with the use of genetically pure seeds and secondly by adopting recommended integrated crop management technologies. The first one seems more feasible. India grown a large number of crops and their varieties in different seasons under varying agro-ecologies that makes it difficult to ensure quality seed supply through public funded systems. It warrants involvement of farmers and private players in quality seed production and supply. The quality seed helps in realizing maximum yield potential of any improved variety. The key question is how to facilitate the availability of high quality seeds to farmers ensuring genetic purity in a cost effective manner. Assurance of the genetic purity will be a major issue when huge quantity of seed is produced and procured from farmers' fields due to several reasons. The grow-out tests using the distinguishing morphological traits are normally used to assess genetic purity. However, under variable climatic conditions and growing situations use of morphological characters for distinguishing a variety from others has several difficulties. Many times two different varieties have similar attributes due to narrow genetic base and are difficult to distinguish in field. The other reason is these morphological traits are highly influenced by the growing environments and hence their expression is variable in adverse conditions. Further, grow-out test is required for testing the genetic purity of a variety on the basis of morphological attributes and takes long as variety has to be grown. As the results it is required lot of time and money for assessing genetic purity of quality seeds.

To tackle the issue of testing genetic purity, molecular markers including SSRs or microsatellites, single-nucleotide polymorphisms (SNPs), SACR and DArT developed in past 10-12 years have become useful genomic resources for determining the genetic identity of variety in several crop species because molecular markers are highly polymorphic and reproducible. Hence, their use can help in assessing genetic purity of a variety under laboratory condition in few days/weeks time. For practical purpose, it is essential to develop set of variety specific molecular markers those can help in differentiating one variety from other. Using this technique, genetic purity can be assessed rapidly and mixture (%) can be detected in a particular variety. The development and deployment of variety specific diagnostic molecular markers (SNPs, SCAR etc.) will certainly help in assessing genetic purity of seeds being produced through farmers' participation.

SUMMARY

The vast potential exists for integration of speed breeding for the development of mapping population in less time for scientific studies like mapping and tagging of gene(s) or quantitative trait loci (QTL) and/or development of pureline varieties or inbred, molecular markers in crop breeding to increase selection efficiency and reduce cost of handling large breeding populations, and transfer of targeted genes/QTLs into desirable agronomic base through marker assisted back crossing. The transgenic technology is helping in bringing genes from other species, genera or even kingdom in targeted species and these transgenic



events can be further utilized for development of new varieties carrying such useful genes e.g. transgenic maize, soybean etc. have demonstrated their potential against dreaded insect pests. The other approach is to take advantage of gene editing and that can help in correcting defects of a particular variety through gene silencing. CRISPR technology can also be used for genome editing.

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SUSTAINING FARMERS' INCOME THROUGH ORGANIC FARMING

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Introduction

Green Revolution technologies, supported by policies and fuelled by agrochemicals, machinery and irrigation are known to have enhanced agricultural production and productivity but at the same time have taken a toll on natural resources that has led to the loss of natural fertility of soils (Kaellander and Rundgren, 2008). Hence, the approach towards global food security is considered now a matter of grave concern around the world. Agricultural strategy during the post-Green Revolution-era in India has been to ensure food security and was usually farm centric and not farmer-centric. As a consequence, farming itself turned non-profitable overtime due to rising costs and uneconomical holdings. Agriculture is a predominant sector of the economy has a strong linkage with other sectors and a striking effect on poverty and unemployment. In recent years, the per capita income in the agricultural sector is just one-third of the per capita income in the country, thereby creating a huge income disparity between primary agriculture vis-à-vis other sectors of the economy. This gap has been continuously widened showing the alarming situation in terms of poverty and farmers suicide across different states.

In view of the above, it is now imperative to think beyond 'Food Security' of the country to focus on 'Income Security' of the farmers. The possible growth drivers of farmer's income are on-farm production of agricultural commodities, other allied activities, non-farm activities, remunerative prices and wage employment. Hence, in broad sense farmers' income can be improved through an increase in productivity, diversification of farm activities towards high-value crops and enterprises, reduction in the cost of production and by better price realisation to farmers through competitive markets, value chains and improved linkage between field and fork. It can also be supplemented through improved earnings from allied activities to agriculture and non-farm sector.

Among other options of increasing farmers' income, organic farming can be a viable option considering its holistic production system, growing domestic and international input and output market, consumer awareness etc. Exhibiting its potential to take care of many problems in an efficient manner (Prasad and Gill, 2009) organic farming is becoming increasingly important in the agriculture sector at a national and global level. Organic agriculture is productive and sustainable and can improve food security by diversifying on-farm crop and livestock operations and diversifies the sources of income.

Organic farming is being practised in 181 countries of the world with the global organic area of 69.8 million hectares. The world organic market is now 97 billion US\$ (FiBL & IFOAM, 2019). India is fast becoming a major base for production and supply of organically produced agricultural products to the world market. India is home to 30 per cent of the total organic producers in the world, but accounts for just 2.59 per cent (1.5 million hectares) of the total organic cultivation area of 57.8 million hectares, according to the World of Organic Agriculture-2018 report. At the same time, most organic farmers are struggling due to poor policy measures, rising input costs and limited market, as per a study by the Associated Chambers of Commerce and Industry of India (ASSOCHAM) and global consultancy firm Ernst & Young. Problems are evident even in Sikkim, which was recognised as the country's first organic state in 2018. As per survey by Centre for Science and Environment that the state's transition to organic farming is yet to become a true success. To ensure marketing of organic produce, connecting farmers with the domestic and global supply chain is extremely important.

As organic farming is a production system which relies on crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivations, mineral-bearing rocks and aspect of biological pest control. It has potential to increase farmers' income through enhanced productivity by improving soil health and balanced nutrition; can produce remunerative commodities by diversifying in the crop and allied enterprises; high price realization considering consumer awareness and premium prices; cost reduction through on-farm production and recycling of nutrient sources; and generating off-farm income and employment avenues through organic input and output marketing. It combines tradition, innovation and science to benefit the shared environment and promote fair relationships and good quality of life and revitalize rural areas through an emphasis on promoting a green economy (Giampietro and Mayumi, 2009).

This chapter highlights the prospects of organic farming to increase the productivity of crops in a sustainable way, giving due



emphasis to ancillary enterprises, agro-processing and institutional/market support with the concept of realizing maximum sale price rather than minimum support price.

Profitability of Organic Farming in India

The principle of organic cultivation is attracting farmer's world over due to its various advantages over modern agricultural practices. Essentially, it is a farming system which supports and strengthens biological processes without recourse to inorganic remedies such as chemicals or genetically modified organisms. Organic agriculture is productive and sustainable (Reganold *et al.*, 1993; Letourneau and Goldstein, 2001; Mader *et al.*, 2002). Many state-supported agencies, non-governmental organizations (NGOs) and individuals have started experimenting with organic methods of food production in the recent past. If the right market can be accessed, then organic farming in India is very profitable. There is also a very good export potential of organic produces but organic farming methods must be strictly followed and along with organic certification from authorizing agencies. Profit increases in mainly two ways :

Cost of farm input reduces by using crop and animal residue, organic waste as bio-fertilizer.

Market value and demand of organic product is high compared to traditionally grown farm produces.

Changing Food Market and Economic Trends

With liberalisation and globalisation of the world economy, the agricultural sector was also opened to world market and thus, the domestic producers were exposed to global trends in production and prices. Now our farmers have to compete with their counterparts from other countries. With time the taste and preferences of urban consumers in the domestic and international market creating a higher demand for processed, packaged and branded organic produce. As a consequence, food quality standards became stringent with time. Hence, the marketing of food is a matter of consideration at national as well as international level. The scope for marketing organic food in India is vast and still yet unexplored to its full potential. The mechanism of organic marketing is quite different from that of regular marketing. Careful selection and development of large markets and distribution channels are of utmost importance. Such marketing requires not only additional costs but also specialized skills, know-how and experience - all of which the unorganized individual farmers are usually incapable to develop (Kasturi, 2007). About 85 per cent of the total organic production in the country heads for the export market. India witnessed impressive growth in the organic food market, with exports seemingly growing between 25-30 percent and domestic markets at about 40 percent (Hill, 2016).

Trend of Organic Food Consumption in India

India produced around 1.35 million MT (2015-16) of certified organic products which include all varieties of food products namely sugarcane, oilseeds, cereals & millets, cotton, pulses, medicinal plants, tea, fruits, spices, dry fruits, vegetables, coffee, cotton, fibre etc. (Yadav, 2015). Though 50% of the organic food production in India is targeted towards exports, there are many who look towards organic food for domestic consumption as it is evident from the fact that several organic food stores are mushrooming in metro cities of India. In India, consumers prefer organic marmalade, organic strawberry, organic tea, organic honey, organic cashew butter and organic flour (Rekha and Neeraj, 2013). There is a growing demand for organic foods driven primarily by the consumer's perceptions of the quality and safety of these foods and to the positive environmental impact of organic agriculture practices. The 'organic' label is not a health claim; it is a process claim. It has been demonstrated that organically produced foods have lower levels of pesticides and veterinary drug residues and in many cases lower nitrate contents (Ramesh *et al.*, 2005).

Scope and Prospects of Organic Farming

The scope and prospects of organic farming in India are signified by the fact that the agriculture sector has profuse organic sources of nutrients like livestock dung/droppings, crop residues, aquatic weeds, forest litter, urban and rural solid wastes; and bio-products of agro-industries (Bhattacharya and Chakraborty, 2005). Moreover, inherent advantages such as its varied agro-climatic regions, local self-sustaining agri-systems, and a sizeable number of progressive farmers and ready availability of inexpensive manpower translate into the potential to cultivate organically a vast basket of products (Munda, 2006). Nearly 4.72 million ha of the area has been brought under organic certification processes, including 0.6 million ha of cultivated agricultural land and 4.12 million ha for wild harvest collection in forests (Yadav, 2015) involving around 6 lakh farmers. India ranks 10th among the top ten countries in terms of cultivable land under organic certification and the fifth largest country in having organic wild collection area and bee pastures (Willer and Kilcher, 2009).



India is endowed with various types of naturally viable organic form of nutrients across different regions of the country which will be helpful in organic cultivation of crops (Butterworth et al., 2003; Reddy, 2010b). This will help substantially in organic cultivation of crops. With the sizable acreage under naturally organic/default organic cultivation, India has tremendous potential to grow crops organically and has emerged as a major supplier of organic products in the world's organic market. The demand for organic food is increasing steadily in both the developed and developing countries at an annual average growth rate of 20-25 percent (Ramesh et al., 2005) and with the rise in health consciousness, it is fetching ground in India and establishing a good export market. Oilseeds (50%) lead among the food products exported followed by processed food products (25%), cereals and millets (17%), tea (2%), pulses (2%), spices (1%), dry fruits (1%) (Deshmukh, 2015) and various organic value-added products.

In India, organic agriculture is being increasingly adopted by farmers. They can be divided into 3 different categories: (1) For farmers living in a no-input zone, organic farming is a way of life. It has been practiced by them since ages and is a traditional way of doing agriculture; (2) In wake of the ill-effects of conventional agricultural practices and owing to the misuse of fertilizers, farmers who have recently adopted organic farming fall under this category; and (3) Those farmers who have systematically adopted organic agriculture to capture the market commercially. Most farmers fall under the first category but they are not certified farmers. Certified farmers are in the third category while both certified and non-certified farmers are included in the second category.

In view of the above facts, the prospects of organic farming can be contemplated in enhancing farmers' income. Report of Doubling Farmers Income Committee of Central Government identifies and focuses on seven major sources of growth, operating within (6) and outside (1) the agriculture sector. The priority assigned to each will vary depending on the status of agricultural development in States and Union Territories. These sources are :

Within the agriculture domain

1. Increase in crop productivity
2. Increase in livestock productivity
3. Saving in cost of production through resource use efficiency
4. Increase in cropping intensity
5. Diversification towards high-value crops.
6. Improvement in real prices received by farmers.

Outside the agriculture domain

7. Shift from farm to non-farm occupations.

Out of these envisaged seven sources of increasing farmers' income organic farming is found to address five sources. The potentials and prospects of these five sources are as hereunder.

1. Increase in agricultural (crop) productivity

Inherent low fertility of most of the soils in the country, imbalance use of NPK fertilizers and widespread secondary and micronutrient deficiencies under intensive crop cultivation areas have led to the deterioration in soil health leading to low fertilizer response and crop yields. To harness existing productivity potential on a sustainable basis degrading soil health and yield stagnation trend can be reversed through the adoption of organic farming practices. Agronomic practices like intercropping, crop rotation, line sowing, weed control, applying secondary and micronutrients are some of the strategies for bridging crop yield gaps. As the main objective of organic farming is to emphasizes the use of management practices within the system in preference to the use of off-farm inputs and thus it also relies on crop rotation, crop residues, animal manure, legumes, green manure, off-farm organic waste and aspects of biological pest control (Wani et al., 2016). Thus, the organic farming has the potential to increase farmers' income through enhanced productivity by improving soil health and balanced nutrition as evident in findings of multiple crops at multiple location research under ICAR-Network Project on Organic Farming.



2. Saving in cost of production

Organic farming has been promoted overtime to reduce chemical use in agriculture. The dual advantage of organic farming is to creating positive effects on the environment as well as to make the farmer self-sufficient as far as his requirements regarding agro-inputs is concerned (Prasad and Gill, 2009); that too at a reduced price or attractive source of rural income generation justifies it as a sustainable venture for ensuring productivity and profitability. Organic farming involves diverse crop and livestock rotations, encourages the integration of multiple farm enterprises; and encourages the use of leguminous crops for soil fertility restoration. Thus, it reduces pesticide use, reduces soil erosion, increases soil fertility, uses less energy and minimizes the gap between NPK addition and removal from the soil. All this is accomplished by using wherever possible, agronomic, biological and mechanical methods as against conventional system involving irrational use of chemical inputs and that lead to a reduction in the cost of cultivation as compared to conventional farming.

3. Agricultural diversification

Land use diversification can be attempted considering the fact that with the ever-increasing population having huge food requirements and meagre availability of organic resources with associated constraints, pure organic farming is seemed unfeasible; rather some specific area of farm can be diverted to organic farming for producing high return-high quality organic produce for domestic niche market and export.

Crop diversification towards high-value crops is required to improve income and resource use efficiency. As the country is endowed with a wide range of agro-climatic conditions, it provides ample scope for diversification of existing cropping systems through remunerative niche area crops having high market demand as organic produce. Small areas with their own micro-climatic conditions and niches provide suitable sites for growing particular crop. Shifting to high-value crops under organic cultivation is an important source to increase/double farmers' income under brand organic. Besides crop diversification, *varietal diversification* by growing of traditional varieties and landraces of certain crops like wheat, pearl millet etc. under organic cultivation may fetch higher returns under organic marketing channel due to more consumer preference because of their peculiar taste as food items.

With organic farming, *enterprise diversification* may emerge automatically as there will be more tendency of livestock rearing for the production of nutrient sources for raising organic crops. With time more and more organic input production enterprises will be established which provides off-farm employment in the whole chain of production to marketing to transportation. Besides, with full functionality of organic supply chain and premium price realization forest collections of organic commodities will also increase. All these diversifications under organic farming will offer food and nutrition security, income growth, diversification of sources of income, poverty alleviation, employment generation, judicious use of land and water resources, sustainable agricultural development, and environmental improvement.

Diversification through ancillary enterprises : Besides on-farm income, farmers' income can also be supplemented by incorporating options other than farming. In the ambit of brand 'organic' certain other ancillary enterprises of either agriculture produce like beekeeping on organic flowering crop, organic mushroom cultivation on organic straw of wheat and rice etc. or organic input enterprises like vermicompost, vermiwash, vermiculture, organic seed production etc., are other avenues of income and employment to farmers. Besides adding to income these enterprises can play a role for risk minimization in the event of unexpected crop failures.

Vermicomposting : It is a simple technology for converting organic wastes into organic composts with the help of earthworms and thereby converting wastes into the income-earning proposition. With area expansion under organic farming and crop diversification towards horticultural crops, the demand for vermicomposting is increasing. According to an estimate five vermin-compost units of 12x5x2.5 feet size with a fixed cost of Rs. 9,000-18,000 and variable cost about Rs. 22,500 will be able to generate net returns of Rs. 67,500 per annum with a monthly income of Rs. 5625 after proper functioning (Sarial, 2016).

Mushroom cultivation : Mushroom cultivation is another potential enterprise and highly remunerative among other agricultural activities. By-products/straw of paddy and wheat are the basic raw materials for the cultivation of white button mushroom and *Dhingri*. Mushroom unit of 200 bag capacity requires a total expenditure of about Rs. 45,000 and is capable of producing 6-7 q of mushroom from two crops of three months each with net income of Rs. 30,000- 50,000 depending upon the market price (Sarial, 2016).



4. Improvement in real prices received by farmers

With the rise in income, a class of consumers has emerged who are willing to pay a premium price for quality traits, freshness, particular grades and pesticide-free organic produce. Even overseas demand for traditional produce (e.g. *Panchkuta*, *NagauriMethi* etc.) and varieties is quite high. This potential couldn't be harnessed because of the missing link between producers and potential buyers and it is high time to encase this gap for increasing farmers' income in the country. Moreover, the marketing of organic food products is affected by external factors such as certification, labelling, packaging and accessibility. Stringent certification norms always discourage producer and consumer in terms of organic food marketing. But to harness this potential enabling environment has been provided by India's central government by launched two initiatives i.e. 1) by the allocation of Rs. 100 crores for organic market development in the North-East and 2) launch of government's Participatory Guarantee Systems (PGS) programme with a promise of Rs. 300 crores in 2015-16 through which a large number of organic producers have been certified, a more locally-focused alternative to traditional certification. Hence, with the increasing demand for organic processed food among urban consumers and higher price realization under liberal PGS regime will provide a favorable market for organic produce with income enhancement of producer farmers. Besides the main product, the demand and price of by-products like oil cakes, wheat/rice straw, FYM etc. have been increased due to increase in demand in organic input preparation and ancillary enterprises like vermicompost, mushroom cultivation etc.

Challenges and opportunities to harness in organic marketing : Supermarket revolution is now in vogue leading to a rise in organised retail chains and now online malls for selling agricultural products are creating a new retail culture. Small and marginal farmers, given their socio-economic profile, can hardly rise to the expectations arising out of the above and many other developments. How to organise farmers effectively to face modern markets to facilitate better incomes is an important challenge. Several Farmer Producers Organisations (FPOs) are being promoted under the aegis of NABARD's. However, the experience is still limited to ascertain the extent of income gains from organising them. But if collective action is ensured, farmers may gain economically from these marketing avenues.

Supply chain approach and contract farming : Agricultural supply chains involve both backward as well as forward linkages among all the stakeholders. Contract farming and supermarket procurement arrangements are two supply chain arrangements that are gaining momentum in India. Recent experiences indicate that contract farming and supermarket procurement approaches will have to involve small-scale farmers in the medium term. Success of such initiatives depend on factors such as ease of entry and competition among buyers, organizing farmers into formal or informal groups, enhancing farmers' capacity to adopt improved production and postharvest techniques, enabling farmers to obtain capital to make on-farm improvements, training of farmers and buyers about their rights and obligations and developing institutions to assist all stakeholders.

Promoting value chains : Agriculture in India is characterized by informal or traditional supply chains that deliver products to local middlemen and then to local small stores. Formal value chains can deliver the same product, usually in better or more uniform quality, to more commercial firms- wholesalers, supermarkets or exporters. Better integration of small organic producers into more modern value chains, both domestic and export-oriented can deliver the gains of value-addition directly to producer farmer.

Linking production to processing : Despite fast growth in demands for processed food, their production is growing very slowly in India. An important reason for this is that farmers do not get an attractive market for their produce and processors do not get assured supply of good quality produce. Thus, linking the processor with the producer farmer through contract farming make more income to organic growers.

Exclusive marketing channels for organic produce : There is still slow growth in organic outlets and due to limitations related to organic certification organic marketing channels are yet to figure substantially in our export portfolio. It is reported that the organic food sector is growing at about 20% in India, with several retail organic outlets in metro cities. Organic produce command premium price as compared to other products also warrants attracting niche customers. There is a need to have a quality check, branding and separate marketing channel for such products to flourish. Advantages of initiatives on group-based farmer-centric marketing ventures can be replicated in the case of organic produce on a pilot basis. This will ensure a steady higher segment income to the producer.

5. Shift from farm to non-farm occupations

There are certain non-farm activities related to organic farming can engage the rural educated youth for income generation.



Production of inputs for organic farming like vermicomposting, biofertilizer, bio-pesticides and their packaging marketing and retailing can be another avenue of income generation. Besides organic inputs, packaging and marketing of organic produce can also generate a source of income and employment. If market avenues can be created a boost to collection, processing and marketing of organic forest products can also be a source of income generation.

Methods or Schools of Organic Farming

Biodynamic method : Perhaps the oldest (this century) recognized method of organic agriculture is referred to as the Biodynamic Method. The Australian Philosopher Rudolph Joseph Lorenz Steiner developed the method in Germany during the 1920's and "his basic theory was that nature is a mystical, spiritual thing, and to garden it well, one must treat it as a whole entity and system, both physical and spiritual". Farming practices are related to lunar and planetary phases. Plant and mineral based preparations are often sprayed on crop plants to provide necessary nutrients.

The Rodales : J.I. Rodale searched for alternative agriculture methods in the early 1940's. He was growing more of his own food by his own resources. The recommendations of the day to treat with chemicals that he saw as potential poisons did not make sense to him. He learned about the composting methods of Sir Albert Howard in India (*An Agricultural Testament*), the work of Lady Eve Balfour (*The Living Soil*), and F. King (*Farmers of Forty Centuries*) who studied growing systems in Asia. Rodale developed an emphasis on human health and how organic gardening through reduced exposure to pesticides and production of nutrient rich vegetables was related to human health. A major emphasis was placed on the production and use of compost to enrich the soil.

Biointensive method : The Biointensive Method is mostly outlined in the book *How to Grow More Vegetables Than You Ever Thought Possible on Less Land Than You Can Imagine* (1974, 5th edition in 1995) by John Jeavons. High organic matter, growing organic matter specifically for soil building, deep cultivation or double digging, and extremely high yields per unit area of production are some key principles. However, the techniques were originally outlined by Alan Chadwick, an English horticulturist who combined French Intensive gardening methods such as double digging with Biodynamic methods. Extremely high yields have been achieved on small plots of land around the world.

Natural Farming : The Natural Farming method is based on building soil with regular surface applications of organic matter and little or no cultivation. Organic matter is allowed to slowly decompose on the surface as opposed to composting in piles. Weeds are controlled by applications of more mulch or organic matter. This method was popularized by Masanobu Fukuoka in Japan (*One Straw Revolution*, 1978). He has worked extensively to establish plants in dry or desert regions around the world using clay seedballs. He is a proponent of observing what works in nature and keeping farming simple. His approach to small-scale grain production emphasizes a meticulous balance of the local farming ecosystem, and a minimum of human interference and labor.

No Work Method : This method is very similar to the Natural Farming method. Ruth Stout published a book in 1971 called *The Ruth Stout No-Work Garden Book* (Rodale Press, Emmaus, Penna, 1971). The emphasis is on lots of organic matter for mulch to control weeds and provide nutrients. Worms and other organisms are allowed to do the work of getting nutrients to the roots.

Permaculture : Permaculture is a holistic method of farming popularized by Bill Mollison and others in 1980's. This concept has originated in Australia or New Zealand. Permaculture goes even farther to evaluate and take into account the entire landscape and physical features of a growing area for farming & getting maximum potential of crops. Plant and animal raising are considered together to make the best use of the land. Sustainability of practices and design and care for the earth are key components of Permaculture.

Veganics : Some people have chosen to use the term *veganics* as opposed to *organics*. The main difference is basing nutrient management on only plant derived nutrients and organic matter as opposed to making use of manures and other animal products. All these are not widely used term but do point out that there are different degrees of organic farming/gardening and what people consider important.

Prospects of Organic Agriculture in 21st Century

Organic 1.0 : The organic timeline can be measured in approximately 100 years: from the early days of imagining organic by those who saw the connections between how we live, eat, and farm, our health and the health of the plant (what we call



‘Organic 1.0’); to the forming of the movement and the codification of standards and enforced rules that have established organic in 82 countries with a market value of over \$72 billion per year (what is termed ‘Organic 2.0’).

Organic 2.0 : Organic 2.0 shaped the visions of the pioneers into a piratical reality. Organic has inspired producers and consumers alike and has changed unsustainable habits around the globe. There is evidence of positive impacts in a wide range of important issues including consumer health, biodiversity, animal welfare and the improved livelihood of producers. The standards maintained by state government and private organizations mainly define minimum requirements for organic production and processing. However, they often fail to entirely meet the principles of health, ecology, fairness and care, at the core of the organic philosophy.

Organic 3.0 : Organic 3.0 concept seeks to change this, by positioning organic as a modern, innovative system which puts the results and impacts of farming in the foreground. The overall goal of Organic 3.0 is to enable a widespread uptake of truly sustainable farming systems and markets based on organic principles and imbued

The concept of Organic 3.0 seeks to address the previously outlined challenges by positioning organic as a modern, innovative system which puts the results and impacts of farming in the foreground. Diverse priorities and challenges like for example climate change resilience and adaptation, access to capital and adequate income, animal welfare, availability of land, water, seed, healthy diets, and avoidance of waste in food and farming systems cannot possibly all be folded into an ever-expanding set of standards and rules. Thus, a more holistic and dynamic model is needed.

Research findings under Network Project on Organic Farming

Salient research findings under the aegis of Network Project on Organic Farming (NPOF, 2012 & NPOF, 2019) compiled over the years, location and crops are hereunder-

1. Performance of crops and cropping systems

Over different agro-climatic regions across the country crops like okra, turmeric, cotton, carrot, black pepper, cowpea, onion, ginger, dolichos bean, greengram, sunflower, garlic, maize, soybean, berseem, brinjal, chilli, capsicum, tomato, sorghum and peas have recorded more than 5-20% increase in yield under organic nutrient input system compared to inorganic system.

Rice-berseem at Jabalpur, chilli- onion and turmeric +onion at Coimbatore, groundnut-sorghum at Dharwad, cotton-wheat, maize-gram, , maize –potato- summer moong, rice-wheat- summer moong, sorghum - berseem, maize-berseem –pearl millet, maize-berseem – maize+cowpea and sorghum+ guar- oats-cowpea at Ludhiana, cauliflower-radish-tomato and cabbage-radish- capsicum at Bajaura, rice-wheat- sesbania and rice-pea (vegetable)-sesbania at Pantnagar and rice-carrot at Umiam recorded higher net returns with organic nutrient input system compared to inorganic system.

2. Productivity of maize based cropping systems

The experiment was conducted at MPUAT, Udaipur during 2015-16, 2016-17, 2017-18 and 2018-19 with the six management practices in main plots with four cropping systems in subplot in non-replicated strip plot design. Four cropping systems viz., maize + blackgram (2:2) – durum wheat – sesbania (GM), blackgram – wheat (*Triticumaestivum*), sweet corn + blackgram (2:2) – chickpea and soybean - fenugreek with six management practices viz., 100 % organic management, 75% organic + 25% innovative practices, 50 % organic + 50% inorganic, 75% organic+25% inorganic, 100% inorganic nutrient sources and state recommendation were evaluated. During 2018-19, among different cropping systems, maize + black gram-durum wheat cropping system gave maximum maize equivalent yield (10167 kg/ha) in state recommendation practices followed by 100 % inorganic management (9842 kg/ha). Results of four years’ data indicate that among the different nutrient management practices, application of 100% inorganic practices recorded maximum maize equivalent yield (7393 kg ha⁻¹) followed by state recommendation practices (7307 kg ha⁻¹) and among different cropping systems, maize + black gram-durum wheat cropping system gave maximum maize equivalent yield (9308 kg ha⁻¹) followed by black gram-bread wheat cropping system (7582 kg ha⁻¹) on pooled basis of four years. On pooled basis of four years, among four cropping systems evaluated under different management practices, maize + black gram-durum wheat cropping system recorded maximum net return (Rs. 174302ha⁻¹) under 100% inorganic practice followed by state recommendation (Rs. 162959ha⁻¹).

3. Performance of various organics sources as a nutrient source

At Meerut, application of enriched compost + vermicompost + non-edible oil cakes (@ 1/3 each) resulted in 61%



increase in yield and 156% increase in net returns in basmati rice-wheat systems as compared to fertilizer nitrogen application

At Jabalpur, FYM + neem cake (@ ½ each) in basmati rice-wheat system and FYM + neem cake + vermicompost (@ 1/3 each) to berseem registered higher grain yield and net returns as compared to the inorganic production system

At Coimbatore, application of FYM + non-edible oil cakes (@ ½ each) in rice-black gram – Sesame and maize – sunflower systems have recorded higher yield and net returns (247.4%) over the inorganic system.

At Raipur, application of non-edible oil cakes + cow dung manure + enriched compost (@ 1/3 each) in rice-chickpea and rice-wheat/mustard + lentil system recorded increase in yield and net returns (90.7%) over the inorganic system.

4. Pest and disease management

At Coimbatore, a combination of cultural, biological, botanical, physical, mechanical, and behavioural methods recorded better yield, net returns and microbial count in rice-rice system.

At Jabalpur, soil application of *Pseudomonas fluorescence* + two spray of neem extract at tillering and panicle initiation stages along with green manuring or summer ploughing is found to be better for basmati rice.

At Karjat, application of vermicompost @ 100 kg + 20 kg of *Gliricidia* leaves plant⁻¹ as basal dose to mango registered better fruit yield, net returns and B: C ratio.

At Udaipur, in black gram, mean of four years (2015, 2016, 2017 and 2018) data revealed that maximum PDI of powdery mildew (11.31%), *alternaria* leaf spot (9.0%) and *cercospora* leaf spot (22.55%) was recorded in 75% organic + innovative practices. On the other hand, minimum PDI of powdery mildew (7.50%) in 100% organic management.

At Udaipur, in sweet corn, mean of four years' data (2015, 2016, 2017 and 2018) revealed that post flowering stalk rot (PFSR) disease was observed in 75 % organic + 25 % inorganic (57.95%) and 100% inorganic nutrient management (27.49%) while no PFSR was observed in other treatments.

At Udaipur, mean of four-year data (2015-16, 2016-17, 2017-18 and 2018-19) revealed that maximum infected plants due to dry root rot of gram were observed in state recommendation practices (51.08%) and minimum infection was recorded in 100% organic management practices (39.21%). In fenugreek, maximum PDI of powdery mildew was recorded in state recommendation (61.57%) while minimum PDI was observed in 75% organic + 25 % innovative practices (23.61%).

CONSTRAINTS

Under irrigated and intensive cultivation conditions organic farming may be 5-12% less yielder but under rainfed, water stressed conditions and in marginal land areas it is 7-15% higher yielder. Realizing side effects of conventional agricultural practices, the Ministry of Commerce in India launched the National Organic Programme in April 2000 and since then the Agricultural and Processed Food Products Export Development Authority (APEDA) is implementing the National Programme for Organic Production (NPOP). Government policies to compensate the yield loss during conversion period and a premium price for produce may help the farmers to adopt organic agriculture on a large scale in India.

CONCLUSION

Presently, there is lack of government subsidies or support to make conversion to organic status easier or cheaper. The interest in organic agriculture in developing countries is growing because it requires less financial input and places more reliance on the natural and human resources available. Possibly, the greatest impact of organic agriculture is on the mindset of people. It uses traditional and indigenous farming knowledge, while introducing selected modern technologies to manage and enhance diversity, to incorporate biological principles and resources into farming systems, and to ecologically intensify agricultural production. In general, pest and disease incidence is less severe in organic farms compared to conventional farms. Organic farming systems can deliver agronomic and environmental benefits both through structural changes and tactical management of farming systems. Combination of lower input costs and favourable price premiums can offset reduced yields and make organic farms equally and often more profitable than conventional farms. Thus, it is the premium price on the organic food which decides the economic feasibility of organic farming, at least at the current rate of development in organic agriculture.

FUTURE PROSPECTS

Establishment of organic input agencies, arrangement of assured market for organic produce, formulation of policies to assure remunerative price to improve organic cultivation in the selected places is the need of the hour to promote organic farming in the country.



Potential regions suitable for organic farming have to be delineated.

Documentation of Indigenous Technological Knowledge (ITKs) on organic farming needs to be done.

Location specific and profitable organic production packages have to be prepared.

Adequate scientific information on the yield, quality, economics and post-harvest aspects of various crops has to be generated.

Need to set up quality standards for organic products.

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DRUG RESISTANCE : WHAT CAN BE THE WAY FOREWARD

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Microbial and parasitic infections cause significant disease in animals and humans. In livestock animals, these infections lower growth rates and fertility, decrease production of meat and milk, sometimes leading to mortality, and are of concern for animal welfare. In the absence of alternative prophylactic measures, antibiotics remain the principal agents for their control. Once an antibiotic is used rampantly, resistance against it is inevidently seen in the parasitic population and the hunt for a new drug grows. Development of a new drug is a time and cost expensive procedure with limited assurance of success. As a result, over the past 40 years, there have been very few new classes of antibiotics developed.

The threat posed by drug resistance to public health as well as global health security, has been reiterated in numerous World Health Assembly (WHA) resolutions. AMR is also prioritized under the Global Health Security Agenda (GHSA), and India is one of the contributing countries. The Ministry of Health & Family Welfare (MoHFW) has identified AMR as one of the top 10 priorities for the ministry's collaborative work with WHO. The National Health Policy 2017 identifies antimicrobial resistance as a problem and calls for effective action to address it.

All the drug molecules enter their site of action by passive diffusion but, being a xenobiotic, they are actively extruded by the cellular defense procedures. For therapeutic success, a minimal therapeutic level of drug needs to be maintained for certain duration of time. By hypothesis, the drug therapy can be made effective if its efflux pumps are inhibited, their expression is down regulated, or the drugs are redesigned, so that they are no longer suitable efflux substrates, and thus their clinical efficacy is restored [Kourtesi, 2013]. Out of the three rational approaches towards confronting drug resistance, reducing the efflux of clinically relevant antibiotics, probably through a potent efflux pump inhibitors or a modulator seems to carry a great prospective. Such molecules are expected to decrease the intrinsic resistance of bacteria to antibiotics, reverse acquired resistance even in highly resistant strains with multiple target mutations, and reduce the frequency of emergence of resistant mutant strains [Lomovskaya, 1999]. The over expression of efflux pumps in some clinical resistant strains has already been observed [DeMarco, 2007]. However, this over expression of efflux pumps is induced by the antibiotics itself during the course of treatment. The expression of MDR efflux pumps can be induced by host-produced compounds [Piddock, 2006a]. The problem gets even more confounded when overexpression of efflux pumps is induced by unrelated drug molecules and even antimicrobials like disinfectants and household chemicals. *Staph. aureus* exposed to increasing concentrations of ethidium bromide developed higher levels of resistance to fluoroquinolones and biocides compared to the parent strain, and this increased resistance was due to a several-fold increase in the expression of the *norA* efflux gene, which in turn was due to a 70bp deletion in the *norA* promoter region. A proton pump inhibitor agent used to treat gastroesophageal reflux disease omeprazole and newly synthesized derivative analogues of this compound were found to inhibit norfloxacin transport by NorA [Vidaillac et al., 2007]. Interestingly, paroxetine, a serotonin reuptake inhibitor, inhibits drug efflux by NorA as well as other non-MFS drug efflux pumps, such as those of the MATE family [Kuroda and Tsuchiya, 2009; Kaatz et al., 2003].

A number of known compounds are substrates and inducers or inhibitors of efflux pumps in addition to novel natural and synthetic products being reported as efflux pump inhibitors (EPI) [Wright and Sutherland, 2007]. Celecoxib alone is not bactericidal but in combination at lower concentrations helped in increasing the sensitivity of the bacteria to the antibiotics. These effects of celecoxib are probably due to the blockage of MDR transporters that are involved in pumping antibiotics out of bacterial cells (Kalle and Rizvi, 2011). Although none of these efflux pumps inhibitors are still clinically available, their use may be useful for increasing the susceptibility of different bacterial species to antibiotics [Zhou et al., 2012; Holler et al., 2012]. Several natural compounds such as the plant alkaloid reserpine, kaempferol rhamnoside, and capsaicin inhibit NorA function of *Staph aureus* [Kalia et al., 2012; Holler et al., 2012]. The mechanism of inhibition for reserpine and kaempferol rhamnoside involves direct binding and competitive inhibition of the efflux pump during drug/H⁺ antiport [Holler et al., 2012], but the mechanism for capsaicin-mediated inhibition is unclear. Another MFS multidrug efflux pump, NorA from *S. aureus*, is closely related to *bmr* [Neyfakh, 1992]. Ethidium bromide efflux from preloaded cells containing *bmr* was completely abolished by reserpine [Neyfakh et al., 1991]. Reserpine also affected the transport activities of two distinct MFS-associated chloramphenicol efflux pumps, CmlR1 and CmlR2, from the Gram-positive bacterium *Streptomyces coelicolor* [Vecchione et al., 2009]. The Gram-positive bacterial pathogen *Listeria monocytogenes* harbors the drug efflux pump, Lde, which confers resistance to the fluoroquinolones ciprofloxacin and norfloxacin and is inhibited by reserpine [Godreuil et al., 2003].



The MFS, ABC, SMR, and MATE families are widely distributed in Gram-positive and Gram-negative bacteria, while the RND super family is specific to Gram-negative microorganisms. In Gram-positive bacteria, the MFS family is the most relevant efflux pump group, the best studied members of this family being NorA from *Staph. aureus* and PmrA from *Streptococcus pneumoniae* [Lorca *et al.*, 2007; Gill *et al.*, 1999; Ubukata *et al.*, 1989]. P-glycoprotein (P-gp), one of the main members of the superfamily of the ATP-binding cassette (ABC) efflux proteins, has been shown to recognize antibiotics [Van Bambeke *et al.*, 2000, 2003], and could therefore modulate their intracellular activity. Thus, P-gp-mediated efflux was found to partially defeat the cellular accumulation and to reduce the activity of azithromycin towards *Staphylococcus aureus* phagocytized by murine J774 macrophages [Seral i2003a, b].

In humans, P-glycoprotein-mediated export of drugs causes reduced intracellular concentration, resulting in suboptimal dosing. The direct binding of drugs to P-glycoprotein has been demonstrated, although the precise mechanism of transport is still debated. The transport of several anthelmintics (including ivermectin, benzimidazoles and imidazothiazole derivatives) by human P-glycoprotein in cells expressing the transport protein has been reported [Nare, B. *et al.*, 1994; Naito *et al.*, 1998; Brayden and Griffin, 2008]. This suggests that drug efflux mechanisms might function in drug resistance in helminths that contain functionally related transport proteins. Chloroquine resistance is due to a verapamil-sensitive efflux pump (Peel, 2001), similar to ABC transporter P-glycoproteins of multidrug-resistant human cancer cells. A recent study has favoured the model for an energy-dependent efflux pump as the major basis of chloroquine resistance in *P. falciparum*; and speculated that Pgh1 might make a minor contribution and that PfCRT (for 'chloroquine resistance transporter') is either likely to be the efflux carrier or an activator of the drug carrier.

There exist different possibilities for inhibiting the activity of MDR determinants. One could be the inhibition of the energy sources required for the activity of efflux pumps: the membrane potential and the generation of ATP. However, potential inhibitors of these targets will be toxic as well for human cells and consequently are clinically useless [Olivares *et al.*, 2013]. The search for bacteria-specific elements coupling the energized state of the inner membrane to the activity of efflux pumps as TonB in *P. aeruginosa* may help in finding valuable targets [Zhao *et al.*, 1998].

One of the straight forward approaches to inhibiting efflux pumps is to prevent their energization by protons, such as in the case of drug/H⁺ antiporters. Since these efflux pumps are potentiated by protons, compounds which have proton scavenging activities can block the activity of these efflux pumps.

It has been established that RND efflux system has a role in invasion, adherence and colonization of the host cell. Therefore, the inhibition of efflux pumps may then allow to both increase the susceptibility to antibiotics and reduce the virulence of bacterial pathogens like, in brucella species, BRA1080 (a dipeptide ABC transporter protein identified in *Brucella suis*), BMEI1742 (a mitochondrial export ABC transporter identified in *Brucella mellitensis*), and BRA0749-BRA0750 (involved in oligopeptide import) [Halling *et al.*, 2005]. A major obstacle, however, may arise from the fact that MES manipulation may cause unexpected toxicities due to the variety of their physiological roles.

To conclude, It is important to understand the mechanisms of efflux pump regulation, specifically during disease pathophysiology and drug treatment. If the pathogen efflux pumps are selectively inhibited, it will lead to greater intracellular concentrations of the drug in the pathogen and better killing and will overcome the rising problem of drug resistance due to extrusion of therapeutic drugs from their site of action i.e. the pathogen. If the efflux pump of host (Mammal) can be selectively activated, it will reduce the chances of drug accumulation and toxicity in the host. This will increase the safety of the drug. It is, therefore, a key welfare issue to understand the mechanisms and genetics of drug resistance. This understanding should be helpful for monitoring the extent and spread of resistance using sensitive and specific markers, to allow for anthelmintic/antibiotic combinations or synergists to be used which will not share common mechanisms of resistance, and in some cases for overcoming the resistance or exploiting the genetic changes involved in resistance to specifically target drug resistant parasites.

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ECONOMIC ANALYSIS OF AJWAIN CULTIVATION IN *MELIADUBIA* BASED AGROFORESTRY SYSTEM UNDER ORGANIC PRODUCTION SYSTEM

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Abstract

The experiment on effect of organic manorial treatments on growth and yield of Ajwain in *Meliadubia* based agroforestry system was conducted during 2019-20 at College of Agriculture, Bheemaranagudi, UAS, Raichur. Experiment comprising eight treatments, laid out in randomized block design with replications. Ajwain was cultivated as an inter crop in one and half year old *Meliadubia* plantation. Significantly higher gross return was realized in sole ajwain crop with tree component (Rs. 113490 ha⁻¹) when compared with different treatments in agroforestry system due to higher seed yield. In agroforestry system, application of vermicompost equivalent to 75 % RDN with foliar spray of panchagavya @ 3% recorded significantly higher gross return (Rs. 95593 ha⁻¹) when compared with all other treatments except with sheep manure equivalent to 75 % RDN along with foliar spray of panchagavya @ 3% (Rs. 87575ha⁻¹) followed by application of vermicompost equivalent to 100 % RDN (Rs. 84977 ha⁻¹). As far net return was concern, sole ajwain crop without tree component recorded significantly higher net returns (Rs. 78790 ha⁻¹) when compared with all the organic manorial treatments in agroforestry system. In agroforestry system, application of vermicompost equivalent to 75 % RDN with foliar spray of panchagavya @ 3% found its superiority in net returns (Rs. 78790 ha⁻¹) over all the treatments except application of FYM equivalent to 75 % RDN with foliar spray of panchagavya @ 3% (Rs. 55167 ha⁻¹) and application of sheep manure equivalent to 75 % RDN with foliar spray of panchagavya @ 3% (Rs. 50757 ha⁻¹). Significantly lower net return was recorded with no organic manorial treatment (Rs. 33253 ha⁻¹). The benefit cost ratio (B:C) was significantly higher with no organic manorial treatment owing to lower cost of cultivation followed by sole ajwain crop without tree component due to higher seed yield.

Introduction

A large number of people in developing countries have traditionally depended on products derived from plants, especially from forests, for curing human and livestock ailments. Additionally, several aromatic plants are popular for domestic and commercial uses. Collectively they are called medicinal and aromatic plants (MAPs). About 12.5% of the 422?000 plant species documented worldwide are reported to have medicinal values; but only a few hundred are known to be in cultivation. With dwindling supplies from natural sources and increasing global demand, the MAPs will need to be cultivated to ensure their regular supply as well as conservation. Since many of the MAPs are grown under forest cover and are shade tolerant, agroforestry offers a convenient strategy for promoting their cultivation and conservation. Several approaches are feasible: integrating shade tolerant MAPs as lower strata species in multistrata systems; cultivating short cycle MAPs as intercrops in existing stands of plantation tree crops and new forest plantations; growing medicinal trees as shade providers, boundary markers, and on soil conservation structures; inter planting MAPs with food crops; involving them in social forestry programs; and so on. The growing demand for MAPs makes them remunerative alternative crops to the traditional ones for smallholders in the tropics. Being underexploited species with promising potential, the MAPs require research attention on a wide array of topics ranging from propagation methods to harvesting and processing techniques, and germplasm collection and genetic improvement to quality control and market trends. Joint forest management with farmers and contract farming with drug companies with buyback arrangement will promote cultivation of medicinal plants.

During last few decades, due to pressure of increasing population the area of forest has been shrinking. Demand for medicinal and aromatic plants (MAPs) has been increasing due to increased number of user and also due to resurgence of interest in herbal medicine and cosmetics. The variety, tonnage and values of medicinal herbs extract from forest are enormous. For Example, more than 10,000 plants are used as medicine by the people of India, 70% of which comes from forest while 90% of the medicinal plants enter into trade and industries are harvested from wild sources. India exploited about 1400 tonnes of plant products during the year 2000-2001 (Anon, 2001).

Seed spices have been known for ages as effective therapeutic food. The capacity of spices to impart biological activity is now slowly reemerging as an area of interest for human health. Ajwain (*Trachyspermum ammi* L. Sprague) is an important seed



spice that belongs to family apiaceae. Seed are 2-3 mm, long, greyish brown in colour. Its characteristic odour and taste due to presence of an essential oil (2-4%). Ajwain oil is principal source of thymol. Its characteristic aromatic smell and pungent taste is widely used as a spice in curries. It employed either alone or in mixture with other spices and condiments. More important use of ajwain is medicinal and it is a household remedy for indigestion. Its seed and oil is much valued for its antispasmodic, stimulant, tonic and aromatic carminative properties. In India, it is cultivated on commercial scale in the states of Madhya Pradesh, Andhra Pradesh, Gujarat, Maharashtra, Uttar Pradesh, Rajasthan, Bihar and West Bengal. The total area and production of ajwain in India is about 25.8 thousand hectare and 22.2 thousand MT with average productivity of 0.9 MT per hectare respectively. Looking to the importance of this crop there is an urgent need for enhancing the productivity and quality of this crop by adopting suitable agronomic practices such as organic nutrient management practices.

The long-term use of inorganic fertilizers without organic supplements damages the soil physical, chemical and biological properties and causes environmental pollution (Albiach *et al.*, 2000). Organic manures act not only as a source of nutrients and organic matter, but also increase size, biodiversity and activity of the microbial population in soil, influence structure, nutrients turnover and many other related physical, chemical and biological parameters of the soil (Albiach *et al.*, 2000). Vermicompost is the microbial composting of organic wastes through earthworm activity to form organic fertilizer, which contain higher level of organic matter, organic carbon, total and available N, P, K and micronutrients, microbial and enzyme activities.

About 95 per cent of the requirement of medicinal plants in herbal drug industry is met from natural sources, due to the dwindling resources and the need for continuous supply in bulk quantities of medicinal plants of uniform quality, the cultivation of medicinal plants in our country has become a necessity. Further, intercropping medicinal plants with other medicinal plants or with tree components is an attractive option as that would increase land use efficiency and simultaneously improve the economic status of the farmers (Kurian *et al.*, 2003). With these ideas in view, field experiment was planned to find out the effect of different doses of organic manures on growth, yield and biomass production of medicinal and aromatic plants intercropped under peach with the following objectives :

To study the growth and yield and ajwain crop as influenced by organic management practices under *Meliadubia* based agroforestry system.

To work out the economics of cultivation of ajwain crop as influenced by organic management practices under *Meliadubia* based agroforestry system.

METHODOLOGY

The experiment on effect of organic manorial treatments on growth and yield of Ajwain in *Meliadubia* based agroforestry system was conducted during 2019-20 at College of Agriculture, Bheemarayanagudi, UAS, Raichur. Experiment comprising eight treatments, laid out in randomized block design with replications. Azwain was cultivated as an inter crop in one and half year old *Meliadubia* plantation. Crop was sown at a spacing of 45 cm x 10 cm. Organic manures *Viz.*, FYM, vermicompost and sheep manure was applied as per treatments fifteen days before sowing of crop. Quantity of nutrients was calculated as per the recommended dose of nitrogen i.e., 100:50:50 kg N, P₂O₅ and K₂O. Panchagavya at the rate of 3 per cent was sprayed at initiation of flowers. Observations on growth parameters was recorded at physiological maturity stage. The crop was harvested and separated grains and stalk, yield was calculated.

Outcome

Seed yield of ajwain was significantly influenced by different treatments in agroforestry system. Significantly higher seed yield of ajwain was recorded in sole ajwain crop without tree association (8.73 q ha⁻¹) when compared with different treatments in *Meliadubia* based agroforestry system (3.67 to 7.35 q ha⁻¹). Among the different treatments in agroforestry system, application of vermicompost equivalent to 75 % RDN with foliar spray of panchagavya @ 3% recorded significantly higher seed yield (7.35 q ha⁻¹) when compared with all other treatments except application of sheep manure equivalent to 75% RDN along with foliar spray of panchagavya @ 3% (6.60 q ha⁻¹) and application of vermicompost equivalent to 100 % RDN (6.54 q ha⁻¹). No organic manurial treatment recorded significantly lower seed yield (3.67 q ha⁻¹) when compared with all the treatments. Similar trend was followed in stalk yield also. Biological yield was significantly influenced by the different treatments. Sole ajwain crop without tree component recorded significantly higher total biological yield (28.90 q ha⁻¹) when compared with all other treatments. In agroforestry system, application of vermicompost equivalent to 75 % RDN with foliar spray of panchagavya @ 3% produced significantly higher total biological yield (25.99 q ha⁻¹) when compared with all the



treatments except application of sheep manure equivalent to 75 % RDN along with foliar spray of panchagavya @ 3% (24.03 q ha⁻¹). There was no significant difference in harvest index due to different treatments, however higher harvest index was observed in sole ajwain crop without tree association followed by of vermicompost equivalent to 75 % RDN with foliar spray of panchagavya @ 3%.

Economic Analysis

The data pertaining to economic analysis of *Carumcopticum* cultivation under organic nutrient management practices in *Meliadubia* based agroforestry system was presented in Table 4.

Significantly higher gross return was realized in sole azwain crop with tree component (Rs. 113490 ha⁻¹) when compared with different treatments in agroforestry system due to higher seed yield. In agroforestry system, application of vermicompost equivalent to 75 % RDN with foliar spray of panchagavya @ 3% recorded significantly higher gross return (Rs. 95593 ha⁻¹) when compared with all other treatments except with sheep manure equivalent to 75 % RDN along with foliar spray of panchagavya @ 3% (Rs. 87575ha⁻¹) followed by application of vermicompost equivalent to 100 % RDN (Rs. 84977 ha⁻¹). As far net return was concern, sole ajwain crop without tree component recorded significantly higher net returns (Rs. 78790 ha⁻¹) when compared with all the organic manurial treatments in agroforestry system. In agroforestry system, application of vermicompost equivalent to 75 % RDN with foliar spray of panchagavya @ 3% found its superiority in net returns (Rs. 78790 ha⁻¹) over all the treatments except application of FYM equivalent to 75 % RDN with foliar spray of panchagavya @ 3% (Rs. 55167 ha⁻¹) and application of sheep manure equivalent to 75 % RDN with foliar spray of panchagavya @ 3% (Rs. 50757 ha⁻¹). Significantly lower net return was recorded with no organic manurialtreatment (Rs. 33253 ha⁻¹). The benefit cost ratio (B:C) was significantly higher with no organic manurial treatment owing to lower cost of cultivation followed by sole ajwain crop without tree component due to higher seed yield.

At the end of the day what counts to farmers is the monetary gains and therefore, it is most important that new farming interventions should to be economically sound so that peasants can opt the same and replace with the existing practices. Many medicinal plants have been evaluated and compared with the other crops or existing farming systems for economic feasibility. Monetary gains from various MAPs have been arrived by various researchers based on the available market prices and analysis tools . The economic analysis of MAPs integrated under agroforestry systems reveal that many of the medicinal plants can be grown at different ages of tree species and the economic benefits are invariably higher than the sole crop and tree species.

CONCLUSION

The findings of present study suggested that cultivation of ajwain in combination with *Meliadubia* recommended for better economic return from the agroforestry systems. Application of organic manures had significantly increased yield and growth performance of ajwain intercropped under *Meliadubia*.



PIG FARMING : A TOOL TO ADDRESS THE AGRARIAN CRISIS IN THE FRONT RUNNERS STATES OF GREEN REVOLUTION IN INDIA

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Punjab and Haryana are the two important agrarian states who played predominant role in green revolution in India. Green revolution, in mid- 1960, significantly contributed to make India self-sufficient in food grain production, with quantum increase in production and productivity of wheat and rice. The success of green revolution revolved around introduction of following measures :

- Introduction of high yielding hybrid varieties.
- Multiple cropping pattern.
- Development of surface and ground water irrigation facilities.
- Mechanization of farm operations.
- Use of chemical fertilizers, pesticides and insecticides.
- Assured minimum support price and market for wheat and rice.

Green revolution led a paradigm shift in traditional cropping pattern of this agroclimatic zone from wheat/maize/pulses/pearl millet to wheat-paddy. The economic and social benefits of above measures reached plateau in mid 1990s and subsequently the fall out of above measures even raised doubt on sustainability of agriculture and gave rise to new sets of problems like :

- Loss of plant genetic biodiversity due to introduction of high yielding varieties.
- Exhaustion of soil nutrients resulting in poor soil health due to indiscriminate use chemical fertilizers, insecticide and pesticides.
- Depleting and polluted ground water due to excessive harvesting of ground water for irrigation of water guzzling paddy crop

These problems are culminating in burning social, economical and environmental issues like polluted and scarcity of ground water, indebtedness of farmers due to decreasing margin of profit in agriculture associated with increasing cost of inputs against saturated level of crop productivity and decreasing land holding over the years and environmental pollution associated with paddy stubble burning and green house gas emission in paddy cultivation.

Agriculture profile of transgangetic plains (Punjab and Haryana) in relation to cropping pattern, irrigation facilities and chemical fertilizers over 1970-71 to 2018-19.

Parameter	Punjab		Haryana		Transgangetic plains (Punjab and Haryana)	
	1970-71	2018-19	1970-71	2018-19	1970-71	2018-19
Total geographical area (thousand square Km)	50.36	50.36	42	42	92.36	92.36
Total cultivable area (Th ha)	3974	4158	3448	3676	7422	7834
Total area under wheat (Th ha)	2336	3510	1129	2558	3465	6068
Total area under paddy (Th ha)	390	3065	271	1386	661	4451
Cropping intensity (%)	140	190	139	184	139.5	187
Total area under maize (Th ha)	548	114	113	6.2	661	120.2
Chemical fertilizers (Thousnd MT)	213	1481	70	1358	283	2839
Fertilizer application (Kg/ha)	54	356	20	369	37	363
Total number of tube wells (lakhs)	1.92	14.76	1.04	8.48	2.96	23.24
Tube well density (No./square Km)	4	29	2	20	5	25
Total farm holdings (lakhs)	13.75	10.93	9.13	16.28	22.88	27.21
Average size of farm holding (ha)	2.9	3.77	3.8	2.2	3	3



Crop diversification

Undisputedly crop diversification, aiming to reduce the area under paddy cultivation in this non traditional belt of transgangetic plains is immediately required to address the environmental and human health issues arises of depleting water table, soil health and paddy stubble burning, but lack of robust marketing facilities for alternate agriculture produce is major deterrent for farmers for adoption alternate crops. Further, in changing climate scenario, alternative diversification plan should be comparatively climate tolerant, so that farmers, particularly small and marginal get protection in the event of frequent natural calamities like drought, rain, hailstorms, insect and pest attack etc. Therefore current situation favors, that livestock farming should be in the core of any crop diversification plan.

Factors favorable for livestock faming in crop diversification plan.

Factor	Agriculture farming	Livestock farming
Land Holding	Continuously decreasing and fragmented land holding and increasing input cost.	Lower land requirement
Climate vulnerability	More vulnerable to sudden Climate change and losses	Less vulnerable to sudden climate change and losses
Price stability	Wide fluctuation in price	Not much fluctuation
Employment	Generate seasonal employment	Generate employment round the year
Risk	High risk	Low risk

Pig Farming : An Emerging Opportunity For Crop Diversification: India with a huge 1380 million human population provides a vast market for animal protein sources, milk, eggs and meat. Traditionally, dairy remained an integral part of crop farming in Indian agriculture system and during the post green revolution period, significant growth of Indian dairy sector resulted in white revolution proved instrumental to provide the employment and income generation to farmers. Now India has emerged world leader in milk production and surpassing the Indian Council of Medical Research (ICMR) recommendations of availability of 300 g milk per person per day with availability 394 g milk per day per person. However, in meat production, there is still a gap of 44 % to achieve recommended availability of 10.95 Kg meat per annum per person (30 g/day) to ensure nutritional security of Indian population. This huge gap in demand and availability in domestic market provides great opportunity for ushering to Pink revolution in Indian agriculture and livestock sector. Therefore in current situation meat animal production has potential for crop diversification and to deal with agrarian economic crises.

Animal protein source	Per capita ICAR recommendation	Per capita Availability in year 2018-19	Per capita gap	% gap
17 Milk (g/day)	300	394	Surplus	Surplus
Egg (per annum)	180	79	101	56
Meat (Kg/ annum)	10.95	6.14	4.81	44

Source : ICMR report and BAHS 2019

Role of Pig in pink revolution and crop diversification : Due to high growth rate and prolificacy, pig is a natural meat producing animals. Further, due to low initial capital investment and labor requirement, adaptability of pigs to wider feed resources, no losses associated with involuntary culling, disease resistant, high feed efficiency and flexibility in marketing makes pig farming more relevant in current socio-economic scenarios of shirking input resources. Breaking all the social taboos and misconception pig farming on scientific line is getting popular among farmers. It is evident from the fact that over the years cross bred and exotic pig population have increased while indigenous low producing pig decreased. However, higher slaughter rate than birth rate is another indicators of increasing requirement of pork in domestic market.

Parameter	Punjab	Haryana	Both Haryana and Punjab	India
Total pig population (000)	53	108	161	9055
Pig slaughtered (000)	19.33	153.77	173.1	10734.89



Annual Growth rate %	13	-3	5	-2.5
Pork production (000 tons)	1.09	7.02	8.11	404.46
Total meat production (000 tons)	231	512	743	8110
Pork (% of total meat)	0.5	1.4	0.9	5.0
% Annual slaughter rate	36	142	108	119
Average carcass yield(kg)	56	46	47	38

Source : BAHS, 2019

Scope of pig faming : The growth and prospectus of market oriented intensive livestock production system predominantly determined by demand of livestock product. So far prospects of pig farming in India is concerned, two types of pork market exist, one traditional pork eaters, which are mainly schedule caste, schedule tribe and some christian population mainly inhabited in eastern, northeastern and southern states of India and another continental market where high quality pork is used in hotels. But in India pork market is still not fully exploited. According to highly conservative approach the projection for scope of pig farming can be determined on the following facts and figures.

Current human population in 2018-19	1320 million
Traditional pork consuming population around 20% (people from north eastern states, tribal, Christians and other special classes)	264 million
Daily pork consumption by traditional pork eating population	10 g/day
Annual pork requirement of a traditional pork consumer	365 X 10= 3650 g/ 3.56 Kg
Total annual pork requirement	264 X 3.56=963.6 million Kg/ thousand tons
Current pork production	404.6 thousand ton
Pork Deficiency	559 thousand ton
Annual production of fattener pigs (No.) if average dressing percentage 70% and marketing weight is 100 Kg)	559000000 Kg pork /70 Kg pork per pig= approx. 80 lakhs additional fatteners pigs to be produced per annum.
Additional number of breeding sows required (average weaning litter size 9, farrowing index 2, and post weaning mortality 1) so 16 marketing pigs will be produced by one breeding sow per year)	5 lakhs
Additional number of breeding boars required, if sow : boar ratio (10 : 1)	50 thousands
Total additional pig population required	85.5 lakhs
Current pig population	90.55 lakhs
Optimum pig population	Approx. 179 lakhs
Optimum pig population density (pig/10000 humans)	Approx. 14 pigs /1000 human heads

Scope of pig farming for diversification of paddy : In order to achieve optimum pig population density of 14 pigs per 1000 human heads in Punjab and Haryana, corresponding to total human population, projected scope of pig production can be determined as per following facts.

Total human population of transgangetic states of Punjab and Haryana	59.06 million
Additional pig production to achieve the optimum pig population density of 14 pigs per 1000 human heads	Fatteners of 100 kg body weight = 826840 Breeding Boars = 5100 Breeding sows =51000
Feed requirement	



Type of animal	Feeding days	Feed/day (Kg)	Number of animals	Total feed required (Kg)
Boar	365	3	5,100	55,84,500
Pregnant and Lactating sow	240	5	51,000	61,200,000
Dry sow	125	3	51,000	19,125,000
Total feed required by one fattener to achieve marketing weight of 100 Kg		300	8,26,840	28,40,52,000
Total feed required (Kg)				36,99,61,500
Maize required @ 50% of total feed (Kg)				18,49,80,750 (185 million tons)
Land required (hectare) (average maize productivity, 3400 Kg/ha)				Approx. 54400

Minimum around 21580 hectare land in the Punjab and Haryana under paddy cultivation can be shifted to cultivate maize for pig production. This strategy will minimize the cost of pig production, solve the problem of marketing of maize, value addition of production chain, employment generation along with helping in water conservation, energy saving, mitigating green house gas emission, paddy burning.

Impact assessment for substituting paddy with maize for pig production :

Water saving :

Parameter	Paddy	Maize
Crop yield per hectare	6167	3400
Comparative water requirement for cultivation of per kg crop (liter)	1704	283
Total water requirement per hectare (cubic meter)	10505	962
Water saving per hectare (cubic meter)		955
Total water saving for substitution of 54400 hectare land under paddy with maize (thousand cubic meter)		51552

An average Indian daily requires around 135 liters of water. Above saved water can meet out the annual requirement of around 10.60 lakhs persons.

Energy saving : There are around 25 tubewells per square kilometer area in transgangetic states of Punjab and Haryana for harvesting of ground water for irrigation of water guzzling paddy crop.

Parameters	Paddy	Maize
Total tubewell operation time for irrigation of one hectare land for cultivation of crop (hours)	252	35
Electricity consumption by 10 HP tubewell	1879.92	261.10
Electricity cost @ Rs. 8 per unit	15039.36	2088.8
Total saving after for irrigation of one hectare land (Rs)		12950

A total of Rs. 7045 lakhs can be saved with substitution of 54400 hectare land under paddy in these two states with maize.

Green house gas emission: Green house gas emission is associated with paddy cultivation and paddy straw burning. The submerged conditions in paddy fields are actively involved in methane production. The submerged rice fields, characterized by oxygen depletion due to high moisture and relatively high organic substrate levels, offer an ideal environment for the activity of methanogenic bacteria. Application of organic materials also increases methane emission from rice fields. Yagi and Minami (1990) observed that application of rice straw to rice fields increased methane emission rates. On an average 8447.59 Kg green house gases are produced for cultivation of one hectare paddy. Therefore for reduction of paddy cultivation in 21580 hectare area in Punjab and Haryana alone can directly annually reduce the atmospheric load of approximately 1.82 lakh tons of green house gases. According to a report of committee on crop residue management, ministry of agriculture, Govt. of India, around 28.10 million tones of paddy straw was produced in Punjab and Haryana during the year 2018-19. It is estimated that burning of one ton of paddy straw accounts for loss of 5.5 kg Nitrogen, 2.3 kg phosphorus, 25 kg potassium and 1.2 kg sulphur besides, organic carbon. Generally crop residues of different crops contain 80% of Nitrogen (N), 25% of Phosphorus (P), 50% of Sulphur (S) and 20% of Potassium (K). If the crop residue is incorporated or retained in the soil itself, it gets enriched,



particularly with organic C and N. Heat from burning residues elevates soil temperature causing death of beneficial soil organisms. Frequent residue burning leads to loss of microbial population and reduces level of N and C in the top 0-15 cm soil profile, which is important for crop root development. Crop residues burning is a potential source of green house gases (GHGs) and other chemically and radioactive important trace gases and aerosols such as CH₄, CO, N₂O, NOX and other hydrocarbons. It is estimated that upon burning, Carbon (C) present in rice straw is emitted as CO₂ (70% of Carbon present), CO (7%) and CH₄ (0.66%) while 2.09% of Nitrogen (N) in straw is emitted as N₂O. Besides, burning of crop residue also emits large amount of particulates that are composed of wide variety of organic and inorganic species. Many of the pollutants found in large quantities in biomass smoke are known or suspected carcinogens and could lead to various air borne/lung diseases. Further substitution of area under paddy with maize will help to some extent to reduce the problems associated with paddy burning in the region.

Therefore paddy for maize and pig for meat and manure is quite relevant to deal with current social, economical and environmental issue of predominant agriculture based economy of Punjab and Haryana and need policy, institutional and financial support for effective implementation of above suggested measures.



GENETIC IMPROVEMENT OF SOYBEAN CULTIVAR FOR YIELD AND ITS RELATED TRAITS BY INDUCED MUTATION

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ABSTRACT

Mutation breeding is an effective approach in improvement of the crop having a narrow genetic base such as soybean by creating variability. Therefore, the present study was conducted with an objective to create genetical variable population for yield and its contributing characters. Genetically pure seeds of TAMS-38 were irradiated with three doses of gamma rays i. e. 200, 250 and 300 Gy. The treated seeds along with the control were sown immediately after treatment to raise the M₁ generation at Shankar Nagar farm, Botany section, College of Agriculture, Nagpur in summer 2018. Similarly, M₂ generation in *kharif* 2019, and M₃ generation in *Summer* 2020 were sown along with control. Different qualitative and quantitative observations were taken at different growth stages and subjected to statistical analysis. Reduced germination per cent in all the treatments was observed as compared to control in M₁ and M₂. In M₂ generation, the treatment T₁ induced the highest mutant frequency followed by T₂ and the lowest in T₃. It is inferred from the study that the gamma rays had the potential to induce variability in yield contributing characters of soybean. The treatment T₂ exhibited the highest mutagenic efficiency, while T₃ showed the lowest. Among the treatments the highest mutagenic effectiveness was observed in T₂ followed by T₁, while the lowest was noticed in T₃. High mean for yield and its contributing characters were observed in some treatments as compared to control in M₂ and M₃ generations. Significant differences were observed between the progenies for all the five characters studied in M₂ and M₃ generations. The estimates of genotypic coefficient of variation were lesser than the estimates of phenotypic coefficient of variation in M₃ generation indicating the environmental influence over the characters studied. The medium to high GCV and PCV were observed for seed yield plant⁻¹ and their contributing trait which indicates there is substantial variation is present. High heritability was recorded for all the characters under study. High estimate of heritability suggested less influence of environmental factor in the expression for yield and its related traits. Similarly, genetic advance as a percentage of mean were medium to high for all the characters in M₃ generation under the study. In the present study only four characters viz., seed yield plant⁻¹, number of pods plant⁻¹, number of branches plant⁻¹ and plant height which showed medium to high GCV, high heritability and medium to high genetic advance as percentage of mean were considered for selection in M₃ generation. This revealed that the above mentioned four characters were influenced by additive gene action and selection would be effective in improving these traits, hence were considered as criteria for selection in this study.

Key words : Soybean, gamma rays, variability, heritability, genetic advance as percentage of mean and mutants.

Introduction

The soybean [*Glycine max* (L.) Merrill] is a world crop, cultivated widely in the United States, Brazil, Argentina, China and India. It occupies coveted place with top rank among the oilseed crops of world as well as India. In Vidarbha region of Maharashtra state, single crop cannot position itself as a sustainable crop in rain fed condition. Soybean has given best consistent yield performance and there by good return to the cultivators. Soybean has profoundly given the backbone support to soybean growing farmers as this crop can grow in minimum cost and yielded high in short duration of time. Since their introduction in India, farmers were getting better economic return from this crop. Last few years were not found good for this crop, since this crop was extremely and drastically suffered due to erratic environment and biotic havack. The yield was drastically reduced. Since this crop can play important role in diversification of Agriculture by incorporating in intercropping and sequential cropping, it's a need to survive this crop in this area for betterment of farmers of this area. Therefore, there is a prime need to genetically improve and make this crop more sustainable by applying suitable breeding technique. In this area this will be achieved by generating genetic improvement by mutation breeding. Therefore, present research is proposed to create genetically variable populations for yield and its contributing traits.



METHODOLOGY

Genetically pure seeds of soybean cultivar TAMS-38 were divided into 4 lots (each lot contain 500 gm seed) and three lots were irradiated with three doses of gamma rays i. e. 200, 250 and 300 Gy at BARC, Trombay, Mumbai and fourth lot of 500 gm was kept for sowing as control. The treated seeds along with the control were sown immediately after treatment to raise the M_1 generation at Shankar Nagar farm, Botany section, College of Agriculture, Nagpur. The M_1 population was studied by recording observations at different growth stages. Seeds of each treatment in M_1 generation harvested separately and stored. In *Kharif* 2019, M_1 seeds were sown as M_2 generation as single plant progenies along with control at Shankar Nagar farm, Botany section, College of Agriculture, Nagpur. M_2 population was screened for yield contributing characters and other morphological characters. In second year (Summer 2020), M_2 seeds were sown as M_3 generation as single plant progenies along with control and were screened for yield traits and other traits. Selected M_3 plants were harvested separately. Observations were recorded at different growth stages in M_1 to M_3 for plant height (cm), number of branches plant⁻¹, number of pods plant⁻¹, 100 seed weight (g) and seed yield plant⁻¹(g). The data recorded during M_3 generation were subjected to the statistical analysis i.e., mean, range, genotypic variance, phenotypic variance, heritability (broad sense) (Hanson *et al.* 1956), genotypic coefficient of variation (%), phenotypic coefficient of variation (%) (Burton and Devane, 1953), genetic advance (GA) (Robinson *et al.*, 1949), genetic advance as percentage of mean (Johnson *et al.*, 1955).

RESULTS AND DISCUSSION

The data of germination and mortality per cent in M_1 generations (Summer 2019) is given in table 1. Reduced germination per cent in all the treatments was observed as compared to control (65.91%). Treatment T_3 recorded the highest reduction in germination per cent (28.73%), while it observed 40.67 % in treatment T_1 and 32.13 % in treatment T_2 . Germination per cent reduced with the increase of doses of gamma rays. The highest mortality was recorded in T_3 (43.07%) while the lowest was observed in T_1 (37.17%) as compared to their respective control (3.09%). Mortality per cent was found to increase with increase in doses of gamma rays.

The data of germination and mortality per cent in M_2 generations (*Kharif* 2019) is given in table 2. Reduced germination per cent in all the treatments was observed as compared to control (70.55%). Germination per cent reduced with the increase of doses of gamma rays. Similarly, the highest mortality was recorded in T_3 while the lowest was observed in T_2 as compared to their respective control.

From different treatments of gamma rays on soybean the economical and morphological mutants were isolated from the variety of TAMS-38 (Table 3). Visible macromutants like early flowering, late flowering, early maturing, late maturing, dwarf, tall, increased 100 seed weight, sterile, high yielding, more pods, more branched and chlorophyll deficient mutants were identified and isolated in M_2 generation. The treatment T_1 induced the highest mutant frequency followed by T_2 and the lowest in T_3 . It is inferred from the study that the gamma rays had the potential to induce variability in yield contributing characters of soybean. It was observed that gamma rays had significant effect on days to flowering, days to maturity, plant height (cm), number of branches plant⁻¹, number of pods plant⁻¹, 100 seed weight (g) and seed yield plant⁻¹(cm). The economical mutants identified needs to be observed for their breeding behavior in further generations and their utilization in improvement of soybean.

From table 4, it is observed that T_2 exhibited the highest mutagenic efficiency (0.45), while T_3 (0.12) showed the lowest. Among the treatments the highest mutagenic effectiveness was observed in T_2 (0.0108) followed by T_1 (0.0102), while the lowest was noticed in T_3 (0.0062).

The data for effect of gamma rays on different quantitative traits of soybean are presented in table 5. Data regarding seed yield plant⁻¹ revealed that mean value of seed yield plant⁻¹ increased in gamma rays treatment as compared to control. Gopinath and Pavadai (2015) also reported that the yield parameters like number of seeds plant⁻¹, grain yield plant⁻¹, recorded the moderate and high mean value in the 50 kR of gamma rays, 0.5% of EMS and 0.4% of DES treated population when compared to control plants in soybean. Data regarding 100 seed weight revealed that the 100 seed weight decreased in all treatments as compared to control. It was found in this study that mean of 100 seed weight reduced in gamma rays treatment. Waghmare and Mehara (2000) also observed the significant reduction of 100 grain weight in grass pea irradiated with gamma rays. Data on number of pods plant⁻¹ revealed that the mean value ranged from T_3 300 Gy treatment (53.40) to T_2 250 Gy treatment (58.74). Lande *et al.* (2018) also reported that the mean number of pods plant⁻¹ increased in gamma rays treatment as compared to



control. Number of branches decreased in all the treatments as compared to their control treatment. It is revealed that gamma rays treatment resulted in decrease in number of branches plant⁻¹ as compared to control. EI-Demerdash (2007) reported that the number of branches plant⁻¹ was decreased by gamma irradiation. Plant height (cm) reduced significantly in all the treatments as compared to control. The maximum mean for plant height was noticed in T₃ (300 Gy) (31.60 cm) and minimum in T₁ 200 Gy treatment (28.66). Lande *et al.* (2018) reported that the plant height reduced in all the treatment as compared to control. EI-Demerdash (2007) studied the effect of gamma irradiation doses of 100, 150 and 200 Gy on soybean plants and found decrease in plant height by gamma irradiation.

Data regarding estimates of genetic parameters in M₃ generation for five characters are presented in table 6. High mean for yield and its contributing characters except plant height were observed in T₂ (250 Gy) as compared to control. Significant differences were observed between the progenies for all the five characters studied. The coefficient of variation (CV) ranged from 2.95 to 33.40 % for various characters (Table 6). The lowest coefficient of variation (< 20) was observed for the characters 100 seed weight (2.95%) and plant height (11.58%) which showed the best genetic potential and its genetic influence. The high coefficient of variation was observed for seed yield plant⁻¹ and no. of branches plant⁻¹ and no. of pods plant⁻¹ which indicates more influence of environmental fluctuation. Pavadai *et al.* (2010), Malek *et al.* (2014) and Nagarajan *et al.* (2017) also observed high CV and the influence of environment on yield and yield component in soybean.

The estimates of genotypic and phenotypic coefficient of variation are necessary to understand the role of environmental influence on different traits. The estimates of genotypic coefficient of variation were lesser than the estimates of phenotypic coefficient of variation indicating the environmental influence over the characters studied. Genotypic coefficient of variation exhibited medium to high category for all the characters except 100 seed weight studied. The medium to high GCV and PCV were observed for seed yield plant⁻¹ and their contributing traits except 100 seed weight which indicates there is substantial variation is present. High genotypic coefficient of variation and phenotypic coefficient of variation were reported by Malek *et al.* (2014) and Nagarajan *et al.* (2017) in soybean for plant height, number of pods plant⁻¹ and seed yield plant⁻¹.

The coefficient of variation indicates only the extent of variability existing for various characters but does not give any information regarding the heritable proportion of it. Hence, the amount of heritability permits greater effectiveness of selection by separating out the environmental influence from the total variability and indicates the accuracy with which a genotype can be identified phenotypically. High heritability was recorded for all the characters under study. High estimate of heritability for the above traits suggested less influence of environmental factor in the expression for these traits. Pavadai *et al.* (2010), Nagarajan *et al.* (2017) and Kumar *et al.* (2017) were reported high to moderate heritability for yield and yield components in soybean.

Genetic advance as a percentage of mean were moderate to high for all the characters under the present study. High genetic advance as a percentage of mean were reported in soybean by Malek *et al.* (2014), Nagarajan *et al.* (2017) and Kumar *et al.* (2017) for number of pods plant⁻¹ and seed yield plant⁻¹, Malek *et al.* (2014) for plant height and by Malek *et al.* (2014), Nagarajan *et al.* (2017) and Kumar *et al.* (2017) for 100 seed weight.

In the present study only four characters viz., seed yield plant⁻¹, number of pods plant⁻¹, number of branches plant⁻¹ and plant height which showed medium to high GCV, high heritability and medium to high genetic advance as percentage of mean were considered for selection in M₃ generation. This revealed that the above mentioned four characters were influenced by additive gene action and selection would be effective in improving these traits, hence were considered as criteria for selection in this study.

Table-1 : Germination and mortality per cent in M₁ generations (summer 2019).

S.N.	Treatment	Germination (%)	Mortality (%)
1.	T ₁ (200 Gy)	40.67	37.17
2.	T ₂ (250 Gy)	32.13	40.13
3.	T ₃ (300 Gy)	28.73	43.07
4.	T ₄ (Control)	65.91	3.09



Table-2 : Germination and mortality per cent of M_2 generations (Kharif 2019).

S.N.	Treatment	Germination (%)	Mortality (%)
1.	T ₁ (200 Gy)	47.34	8.84
2.	T ₂ (250 Gy)	46.59	6.02
3.	T ₃ (300 Gy)	37.83	15.47
4.	T ₄ (Control)	70.55	3.05

Table-3 : Frequency of induced mutants in different gamma rays treatments in M_2 generation.

S. N.	Type of mutation	T ₁	T ₂	T ₃	Total
1.	Chlorophyll Deficient	0.04	0.07	-	0.11
2.	Early flowered	0.04	0.07	0.06	0.17
3.	Late flowered	0.08	0.05	0.13	0.26
4.	Early matured	0.08	0.07	0.06	0.21
5.	Late matured	0.24	0.26	0.20	0.70
6.	Dwarf	0.22	0.15	0.13	0.50
7.	Tall	-	-	-	-
8.	100 seed weight above 13 g	0.12	0.10	0.06	0.28
9.	Sterile	0.06	-	-	0.06
10.	High yielder	0.24	0.21	0.20	0.65
11.	More pods	0.29	0.32	0.26	0.87
12.	More branched	0.22	0.24	0.20	0.66
Total		1.63	1.54	1.30	4.47

Table-4 : Mutagenic efficiency and effectiveness of gamma rays treatments in M_2 generation.

S.N.	Treatments	Per cent Lethality	Per cent mutant 100 M_2 plant ⁻¹	Mutagenic efficiency	Mutagenic effectiveness
1.	T ₁ (200 gy)	8.84	2.04	0.23	0.0102
2.	T ₂ (250 gy)	6.02	2.71	0.45	0.0108
3.	T ₃ (300 gy)	15.47	1.87	0.12	0.0062
4.	Control	3.05	-	-	-

Table-5 : Effect of gamma rays on mean yield and its contributing traits in M_2 generation.

S.N.	Doses of mutagen	Seed yield plant ⁻¹ (g)	100 seed weight (g)	No. of pod plant ⁻¹	No. of branches plant ⁻¹	Plant height (cm)
1.	200 Gy	9.43	11.88	55.65	3.31	28.66
2.	250 Gy	9.86	11.49	58.74	3.91	29.35
3.	300 Gy	9.55	11.28	53.40	3.86	31.60
4.	Control	8.90	12.23	37.33	4.87	40.75

Table-6 : Genetic parameter estimates for yield and contributing traits in M_3 generation (Summer 2019).

S. N.	Genetic parameters	Seed yield plant ⁻¹ (g)	100 seed weight (g)	No. of pod plant ⁻¹	No. of branches plant-1	Plant height (cm)
1.	T ₁ 200 Gy (mean)	16.12	12.04	83.76	3.23	30.99
2.	T ₂ 250 Gy (mean)	23.43	12.98	117.7	3.98	36.00
3.	T ₃ 300 Gy (mean)	22.70	12.30	80.80	3.20	30.00
4.	Range	3.6-41.3 (37.7)	10-15.2 (5.2)	32-219 (187)	2-7 (5)	18-52 (34)
5.	Overall Mean	19.76	12.52	99.24	3.54	33.17



6.	Control	17.96	12.40	59.60	3.20	39.60
7.	GCV (%)	34.76	9.56	34.70	22.26	12.38
8.	PCV (%)	41.66	10.00	40.57	32.71	16.95
9.	Heritability (%)	69.61	91.32	73.13	46.30	53.31
10.	G A (per cent of mean)	49.84	17.98	52.26	21.22	13.60
11.	CV	22.96	2.95	33.40	23.97	11.58

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Abstracts



MORPHOPHYSIOLOGICAL STUDIES IN MUNGBEAN [*VIGNA RADIATA* (L.) WILCZEK]

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Abstract

Morphophysiological studies on seed and seedling characteristics were carried out with 25 genotypes of mungbean during Kharif-2018. The analysis of variance revealed significance differences among genotypes for all 21 characters studied. This study indicated the existence of ample amount of genetic diversity in the material and therefore, signifying the scope of selection for genetic improvement of mungbean. The high degree of genetic variability along with high heritability and high genetic advance as per cent of mean were recorded for seedling dry weight, seedling fresh weight, seed yield per plant, biological yield per plant, seedling vigour index, water absorption index, water absorption capacity, seedling length, harvest index, true density, bulk density, 100-seed weight, seed volume, number of branches per plant and plant height, which indicates that these characters were under the control of additive gene action and therefore, form the basis of selection for mungbean improvement programme. Days to maturity, plant height, number of branches per plant, number of seeds per pod, biological yield per plant, harvest index, true density, bulk density, porosity, water absorption capacity, water absorption index and seedling dry weight had significant positive correlation with seed yield and also directly contributed towards seed yield. In addition to these traits, biological yield per plant and harvest index also had direct effect on seed yield. Therefore, selection based on these traits would results improvement in seed yield of mungbean. Genotypes/ varieties exhibited higher seed yield along with other desirable traits Keshwanand Mung-1, SML-832, ML-683, RMG-268, MH-421, GM-4, RMG-344, SML-668, Sweta, RMG-492, therefore, all above mentioned genotypes could directly be used for cultivation under irrigated normal soil and water situation of arid zone as well as in future breeding programme to develop superior varieties.

SELF HELP GROUPS (SHGS) : VEHICLE OF RURAL WOMEN EMPOWERMENT

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Abstract

Empowerment of women is the need for the hour. Efficient transfer of innovations in livestock farming and their practical application to field situation is a key to development of livestock sector. Self Help Groups (SHGs) play a key role towards women empowerment by providing basic education, training for self-employment and self-awareness programs. The present study was carried out in Ludhiana district of Punjab to assess the empowerment status of rural women of livestock based Self Help Groups. A total 120 SHG beneficiaries were subjected to structured interview schedule for the study. The study revealed that regarding overall adoption about Scientific Livestock Farming Practices (SLFPs), majority of the beneficiaries (38.33%) were in medium category followed by 37.50 per cent and 24.17 per cent in high and low category, respectively. Majority of the beneficiaries (53.33%) had medium level of adoption regarding breeding practices. In case of feeding practices, most of the members (65.00%) were found under medium level of adoption. As far as health care practices were concerned, about 50.83 per cent of the beneficiaries possessed medium level of adoption. Regarding management practices, 40.83 per cent of the beneficiaries were observed in high category of adoption. Information empowerment of SHG beneficiaries through group activities like trainings, meetings, and contacts with change agents of SHGs helped them in adopting scientific livestock farming practices (SLFPs) and improving their socioeconomic status.

ENHANCEMENT OF RESISTANT STARCH AND IRON CONTENT WITH REDUCTION IN PHYTIC ACID CONTENT IN GROUNDNUT–A STUDY WITH TECHNOLOGICAL SOLUTION

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Abstract

Groundnut is a rich and affordable source of edible oil, dietary protein, carbohydrates and minerals. Its components are highly



digestible with 94% digestibility and 0.70 score of protein digestibility-corrected amino acid score (PDCAAS) value. Starch, being the major carbohydrate (11.5%) in groundnut, is found in digestible and non-digestible form (resistant starch). Like dietary fibers, resistant starch (RS) is not digested in the small intestine and thus, is fermented by habitat microflora of the colon to produce short chain fatty acids. Benefits of RS include reduction of the glycemic index, hypocholesterolemic and protective against colorectal cancer. Moreover, groundnut also possesses a chelating mineral inhibitor, phytic acid, which remains as a concern for the mineral bioavailability. So, in the present study, the effect of various processing methods like roasting, soaking (8 h and 16 h) and microwave irradiation on resistant starch, Iron and phytic acid content in popular groundnut varieties was assessed to enhance groundnut quality and consumption. Results showed that all the processing methods except for 16 h water soaking significantly increased the RS content. Further, results of phytic acid content demonstrated that seed soaking for 8 h caused a significant reduction in phytic acid (23-68%) content followed by MW irradiation and roasting as compared to raw samples. The estimated bioavailability of iron (Phy:Fe) was low due to the molar ratios being higher than the critical values and thus, is mainly affected by the phytate content. Soaking for 8 h improved the estimated bioavailability of iron which may be due to decrease in phytic acid content in the samples. During the soaking (8 h) process, the endogenous dietary enzyme, phytase, may have been activated, resulting in lower phytate content; thereby improving the Phy:Fe ratio. Hence, water soaking has enhanced resistant starch and iron content with concomitant reduction in phytic acid content and would significantly improve estimated iron bioavailability in groundnut.

VL BHAT 202: AN IMPROVED NUTRITIONALLY SUPERIOR BLACK SOYBEAN (BHAT) VARIETY FOR UTTARAKHAND HIMALAYAS

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Abstract

Black soybean (*Bhat*) variety, VL Bhat 202 was developed by ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS), Almora, Uttarakhand for cultivation during *Kharif* season under rainfed organic conditions of Uttarakhand hills. This variety was notified and released in 2020 by the Central Sub-Committee on Crop Standards Notification and Release of Variety for Agricultural Crops. VL *Bhat* is derived from the cross VL Soya 1/ EC 361362. VL Bhat 202 has excellent phenotypic acceptability, white flower, pointed ovate leaves and determinate plant type with good standing ability which protect the crop from lodging during rains as well as enable this variety to be grown as a sole crop in contrary to the traditional black soybean varieties. This variety has exhibited an average yield of 1,596 kg/ha and shown significant yield advantage of 35.95% over black seeded soybean check VL Soya 65 (1,174 kg/ha) in three years of testing under organic with 115-120 days maturity duration. This variety is nutritionally rich as it has 39.19% protein and 16.55% oil content with appreciable amount of polyphenols (3.06mg/100g) in its seed which impart strong antioxidant activity. VL Bhat 202 showed highly resistant reaction against frog eye leaf spot and moderately resistant against pod blight, the important diseases of black soybean in the hills as well as found resistant to aphids, soybean beetles and moderate resistance to white flies and defoliators. This variety has potential to revive the interest of farmers for the profitable cultivation of black soybean in the hills.

EFFECT OF VARIOUS STRATEGIES TO MITIGATE SOIL CRUST FORMATION IN COTTON IN NORTH INDIA

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Abstract

Crop-stand establishment is adversely affected by poor emergence of seedlings due to soil crusts. The problem of soil crusting or capping is worldwide; it occurs under a wide range of climatic conditions. Rainfall occurrence within a few days after sowing, but before seedling emergence is one of the several factors that cause compacted or crusted surfaces. The magnitude



of compaction varies with various factors like soil type, raindrop size and amount and intensity of rainfall etc. In many arid and semi-arid regions soil crusting is quite common, especially on sandy and loamy soils. In these regions, the rapid drying of soil enhances the development of soil crust. Sometimes the crust restricts the emergence of cotton (*Gossypium hirsutum* L.) and other crop seedlings completely and makes replanting necessary. Soil crust formation before seedling emergence has put tremendous pressure on researchers to devise various strategies to tackle with this burning issue. A field experiment was therefore conducted at the research farm of ICAR-CICR, Regional Station, Sirsa, Haryana, India on a Gangatic alluvial soil during *kharif* season of 2019-20 to determine the effect of various strategies to mitigate soil crust formation in cotton in North India. The field experiment was conducted in randomized block design, keeping fourteen treatments viz. (T₁) Absolute control (without soil crust); (T₂) Control (with soil crust); (T₃) Super Absorbent Polymer @ 100 kg ha⁻¹; (T₄) Gypsum @ 2.5 t ha⁻¹ in seed rows; (T₅) Farm yard manure @ 3 t ha⁻¹ in seed rows; (T₆) Chopped crop residue/wheat bhusa 3 t ha⁻¹; (T₇) Spraying of phosphoric acid @ 100 l ha⁻¹ in seed rows (before making soil crust); (T₈) Spraying of polyvinyl alcohol @ 0.5% (before making soil crust); (T₉) Spraying of phosphoric acid @ 100 l ha⁻¹ in seed rows (after making soil crust); (T₁₀) Spraying of polyvinyl alcohol @ 0.5 % (after making soil crust); (T₁₁) Running of manually operated peg/spike tooth weeder/harrow (two days after crust); (T₁₂) Water spraying 2-4 days; (T₁₃) Goond Katira @ 12.5 kg ha⁻¹ and (T₁₄) Goond Katira @ 25 kg ha⁻¹ and was replicated thrice. Water sprinkling was done manually with hand held water sprinklers to create ~ 10-15 mm rain fall 3-4 DAS. Sowing of hybrid Bt cotton was done manually by dibbling keeping one seed per hill. The treatment number (T₃), (T₄), (T₅), (T₆), (T₇), (T₈), (T₁₃) and (T₁₄) were imposed after sowing before making soil crust and the treatment number (T₉), (T₁₀), (T₁₁) and (T₁₂) were imposed after formation of soil crust. Highest values of plant height, yield attributes as well as seed cotton yield were obtained under T₅ which were followed by T₆ and T₁ as compared to all other treatments. The germination (%) and seedling emergence was highest under T₁. Significantly poor values of germination (%), seedling emergence, plant height, yield attributes as well as seed cotton yield were obtained with all the treatments with soil crust formation (except T₅, T₆, T₁₁ and T₁₂).

GENETIC VARIABILITY AND CORRELATION STUDIES FOR YIELD AND YIELD CONTRIBUTING CHARACTERS IN ADVANCE LINES OF INDIAN MUSTARD (*BRASSICA JUNCEA*)

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Abstract

The present research was carried out to determine the best selection criteria for yield improvement in rapeseed (*Brassica juncea* L.). Fifty-four genotypes of *Brassica juncea* were sown at AICRP on Mustard at Nagpur (M.S) during the years 2018-2019 to evaluate the components of variability (genotypic and phenotypic), heritability, correlation (genotypic and phenotypic) for yield and its related components. High to moderate values of GCV and PCV were recorded for yield per plot, number of siliqua per plant and 1000 seed weight indicates that there is substantial variation present but it also suggests that there is scope to enrich variation for these characters. High heritability coupled with high genetic advance as percent mean was observed for yield per plot, number of siliqua per plant and 1000 seed weight. This indicates the lesser influence of environment in expression of these characters and prevalence of additive gene action in their inheritance. Naturally, selection based on phenotypic observations for these characters would be effective. At phenotypic and genotypic level, yield per plot had significant positive correlation with number of primary branches, plant height and number siliqua per plant. These characters are playing an important role in indirect selection for yield.

SIRE EVALUATION CONSIDERING FIRST LACTATION AND MILK CONSTITUENT TRAITS IN CROSSBRED CATTLE

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Abstract

The performance records of 579 crossbred daughters of 36 sires maintained at Directorate of Livestock Farms of GADVASU, Ludhiana were used to evaluate the sires for first lactation and milk constituent traits. The first lactation traits viz. age at first calving (AFC), weight at first calving (WFC), first dry period (FDP), first service period (FSP), first lactation 305 days milk



yield (FL305MY), first calving interval (FCI), peak yield (PY), days to attain peak yield (DPY) and milk constituent traits viz. fat percent, SNF percent, fat yield (FY), SNF yield (SNFY), were considered for the study. The Least squares and Best linear unbiased prediction (BLUP) procedure were used to obtain the estimates of breeding values. By LSM the estimated breeding values for AFC, WFC, FDP, FSP, FL305MY, FCI, PY, DPY, FP, SNF, fat yield, and SNF yield were ranged from 807.46 to 1161.75 days; 307.28 to 433.21 kg; 54.91 to 113.5 days; 103.56 to 273.63 days; 2076.61 to 4606.26 kg; 371.84 to 569.17 days; 11.85 to 21.76 kg; 34.29 to 74.85 days; 3.511 to 4.150 %; SNF percent 7.605 to 8.754 %; 77.46 to 187.84 kg and 178.85 to 283.20 kg respectively. By BLUP method the estimated breeding values for AFC, WFC, FDP, FSP, FL305MY, FCI, PY, DPY, FP, SNF, fat yield, and SNF yield were ranged from 827.01 to 1116.29 days; 356.11 to 400.29 kg; 68.35 to 101.52 days; 124.24 to 241.76 days; 2709.97 to 3635.22 kg; 393.22 to 520.84 days; 14.74 to 19.24 kg; 46.95 to 65.81 days; 3.767 to 4.090 %; 7.932 to 8.311 %; 115.23 to 135.30 kg and 210.50 to 243.59 kg respectively. The estimated breeding values (EBV's) by both methods showed large genetic variation between sires for first lactation and milk constituent traits. While, product moment correlations among EBVs of sires for milk constituent traits were medium to very high. Rank correlation estimates indicated that top 4 to 5% sires had similar rank for first lactation performance traits and milk constituent traits. The results suggested that to improve milk productivity and quality selection of bulls should be done on the basis of daughter's FL305MY performance along with WFC and milk constituent traits.

RETURN OF THE FORGOTTEN CROP – BROWN TOP MILLET

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Abstract

Millets often referred as positive crops, are major food sources of people of arid and semi-arid regions of the world. They are also considered as the positive crops for the dry and rainfed situations. Millets can be used for food, feed and fodder, and they can be used as raw material for industries. Millets are staple food of Asia and African countries. The major millets are Sorghum and Bajra and other crops referred as minor millets like finger millet, little millet, proso millet, brown top millet, barnyard millet, kodo millet and foxtail millet. These millets referred as “coarse grains” or “poor man's crops”. They are not usually traded in the international markets or even in local markets in many countries. The millets are the hardest grains and can sustain and flourish even in the most adverse agro-climates with poorest quality soil, minimum water, most in drought conditions and lastly, the minimum care and management practices compared to wheat and paddy crops. Browntop millet is a warm season crop and it can produce heavy seeds compared to other millets. This crop grown in a variety of soils and climates. It can be used as a wild life food crop, livestock grazing crop, for erosion control, hay production and also as a food grain crop. Millets are a major food source in arid and semi-arid arid parts of the world. Although India is the top most producers of millets, observed a steady decline in its production and utilization. Brown top millets provide nearly all essential nutrients. Brown top millet referred as miracle or positive crop for the dry and rainfed situations. The Browntop millet is known for its rapid forage production. It is grown for several other purposes like cover crop in plantation crop for soil erosion control and for high straw production. It suppresses root-knot nematode in the soil. The nutrient content of browntop millet is on par with other millets and cultivation of this crop is also easier there is an urgent need to popularize this millet.

MILLETS- FOODS OF TWENTY FIRST CENTURY

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Abstract

Climate change, global warming” are the most chanting words nowadays, among the environmentalists and scientific community. Climate change, is the change in the weather parameters viz. temperature, rainfall-amount and distribution, wind



velocity, etc., in a manner that is not favourable to both plant and animals on earth. Climate change has deleterious effect on both human welfare and agriculture production. Humans however can escape those effects through their intelligence, while crops suffer a lot by climate change, resulting in lower yields and reduced quality of the produce. This results in increased malnutrition and insufficiency of food for the increasing population. Researchers are looking for novel ways to combat the adverse climatic effect on agriculture sector, which has to feed the whole world. Major cereals viz., rice, maize, wheat, etc., have dominated the agriculture sector with their capability of meeting rising food demands due to their high potential yields. Millets are one of the oldest foods known to humans & possibly the first cereal grain to be used for domestic purposes. Millets are the small-seeded grasses that belongs to the family, Poaceae/Graminae. There are two major millets (sorghum and bajra) and six minor millets (finger millet, foxtail millet, little millet, proso millet, kodo millet and barnyard millet). Recently few more minor millets have been added to this group viz., tef, fonio, quinoa and browntop millet. Since centuries, millets have been a prized crop in India and are staple diet for nearly 1/3rd of the world's population. Millets have potentiality of contributing to increase food production, both in developing and developed countries. Millets are most commonly available in the form of pearled and dehulled rain. Millets are tasty grains that have a mildly sweet, nut-like flavour. Millets are amazing in their nutrient content and are commonly known as “nutri-cereals or nutri-millets”.

LOW INPUT MICROPROPAGATION STRATEGIES FOR PRODUCTION OF DISEASE FREE PLANTING MATERIALS AND ENTREPRENEURSHIP DEVELOPMENT THEREIN

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Abstract

The technique of disease free planting materials production through micropropagation has proved to be a boon for the commercial production of vegetatively growing plants whose seeds either are not viable viz. banana, bamboo, pointed guard, seed potato, strawberry, pineapple etc. or appears after a very long period like bamboo. Business men, commercial plant growers and entrepreneurs find tremendous utility of this technique. For establishment of a tissue culture laboratory the input cost involves equipments, manpower, electricity apart from the land and construction. The total cost on the inputs may range from twenty five lakhs to seven crores, depending on the number of plants produced annually and the same may be minimised at various level of the operation. The low cost equipments are available in the market which can be purchased initially and later on can be moved on the expensive one. The knowledge of the works performed at different stages of this operation viz. the sub-culturing work in laminar hood or nutrient media preparation or hardening of plants at polyhouse and nethouse may further lead to reduction of cost by managing different low cost means. After undergoing some basic training, entrepreneurs are able to establish their own laboratories, wherein they can produce large number of plants for commercial purpose. Trained manpower is the primary requisite, so there is a great scope for the entrepreneurs. Entrepreneurs may primarily be involved in marketing of tissue cultured raised plants. Government at the central and state level have been continuously supporting the entrepreneurs by training or by providing subsidies in different form i.e. on tissue culture raised plants or for setting up of new laboratories or polyhouses or nethouses. Conclusively, tissue culture operation has tremendous scope and opportunity for the youth and entrepreneurs for good earning and livelihood.

BIOFORTIFIED VALUE ADDED FOOD PRODUCTS FROM MORINGA LEAF POWDER

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Abstract

The present study entitled was carried out in Pt. Kishori Lal Shukla College of Horticulture and Research Station, Rajnandgaon (C.G.), Faculty of Horticulture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) and Bhabha Atomic Research Centre Mumbai, Maharashtra and during 2019-2020. Phytochemicals analysis of MLE extract showed positive result for total phenolic content, flavonoids and tannin. Irradiation improved the bioactive properties of *Moringa* leaves. 1 kGy irradiated dose of *Moringa* leaf powder had higher antioxidant property as compare to 0 kGy and 2.5 kGy. *Moringa* leaves showed good anti-diabetic activity due to α -amylase and -glucosidase inhibitory activity. It showed



antimicrobial activity against most common gram-positive food pathogenic bacteria (*Staphylococcus aureus*, *Bacillus cereus*). The *Moringa* blend of fortified Herbal Tea standardised in 1 kGy with T7 *Moringa* Herbal Tea with lemon grass (per 2 g) (Tea -750mg (37.5%), *Moringa* powder-400mg (20%), Stevia -100mg (5%), Lemon grass -750mg (37.5%) and the other one is T12 *Moringa* Herbal Tea with cardamom (per 2 g) (Tea -750 mg (51.5%), *Moringa* powder -500mg (34.5%), Stevia -100mg (7%), Cardamom -100mg (7%). Blend of *Moringa* Soup with tomato base was standardized in 1kGy gamma radiation dose with 1.66% *Moringa* leaf powder. Garam Masala mixture was standardized with 3% and 5% *Moringa* leaf powder in both ways unirradiated or irradiated method (1 kGy). For the sensory attributes 13 combinations of *Moringa* Herbal Tea are prepared and selected the 2 best combinations (i.e. lemon grass and cardamom). For the sensory attributes 4 combinations of *Moringa* Soup are prepared and selected the 2 best combinations (i.e. control and radiated). For the sensory attributes 8 combinations of *Garam Masala* are prepared and selected the 4 best combinations (i.e. 3% and 5%, with Non irradiated and irradiated with 1kGy MLP).

BIO-EFFICACY OF CERTAIN ECO-FRIENDLY INSECTICIDES AGAINST MAJOR INSECT PESTS OF SUNFLOWER AND THEIR IMPACT ON SEED YIELD AND YIELD PARAMETERS

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Abstract

A field experiment was conducted to investigate the efficacy of certain eco-friendly insecticides against the defoliator *Spilarctia obliqua* Fab. and capitulum borer *Helicoverpa armigera* Hub. in sunflower at AICRP(Sunflower), ZARS, GKVK, Bengaluru during the consecutive *Kharif* seasons of 2016-17 and 2017-18. The results revealed significant differences between treatments at 1, 4 and 7 days after imposition of the sprays. Significantly lowest larval number was recorded in case of BIPM module w.r.t. *S. obliqua* (0.33 larvae/plant) one day after spray and further no larval population was noticed at 4 and 7 DAS, followed by NSKE 1.33 (4DAS) & 0.33 (7DAS), spinosad 2.00 (4DAS) & 1.33 (7DAS), neem oil 2.00 (4DAS) & 1.00 (7DAS), mahua oil 2.33 (4DAS) & 1.67 (7DAS) and pongamia oil 2.67 (4DAS) & 2.00 (7DAS). Highest larval population was observed in untreated check (7.00 & 7.67 larvae/plant at 4 & 7 DAS). Significant lowest number of egg and larval population was also observed in BIPM module (2.67 eggs/plant & 0.33 larvae/plant), followed by spinosad with 3.00 egg/plant & 1.33 larvae/plant at one DAS and no larval population was recorded at 4 and 7 DAS in case of BIPM module. Highest egg and larval population was observed in untreated control with 0.33 egg/plant and 2.00 larvae/plant at seven DAS. The highest seed yield other yield attributing parameters were recorded in case of BIPM module (2787.96 kg/ha), followed by spinosad treatment (2754.44 kg/ha) and significantly lowest seed yield was observed in untreated control (2549.63 kg/ha). All other treatments recorded intermediate seed yields i.e., NSKE (2734.63 kg/ha) > neem oil (2678.33 kg/ha) > PSKE (2675.37 kg/ha) > pongamia oil (2660.19 kg/ha) > mahua oil (2652.22 kg/ha) in that decreasing order. Therefore, this two year study substantiated the fact that the BIPM module comprising of Seed treatment with imidacloprid 70WS (5g/kg) + metalaxyl 35 SD (5g/kg) + handpicking and destruction of gregarious early instar larvae of defoliators (*Spodoptera litura* and *Spilarctia obliqua*) + two sprays with spinosad 45 SC @0.0045%, first spray during star bud stage and second spray during full bloom stage of the crop) was most superior in the suppression of the defoliator and capitulum borer in sunflower, besides registering highest seed yield.

EVALUATION OF ACID LIME GERMPLASM FOR GROWTH, FRUIT YIELD AND QUALITY

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Abstract

Acid lime (*Citrus aurantifolia* Swingle) is a third most important tropical and sub-tropical citrus fruit crops of India next to mandarins and sweet orange among all citrus species. It is native to north eastern India and areas having dry climate and low rainfall are best suited for growing limes. Gujarat is one of the leading acid lime producing states of country, however, known variety is lacking from the state. Therefore, acid growing areas of Gujarat were surveyed for collection and evaluation elite



types during 2016-17. On the basis of *in-situ* observations elite clones were collected as air-layers and planted in the experimental farm CHES, Godhra during 2016-17. A total number of 25 germplasm including commercial varieties were evaluated during the 2019 & 2020. The maximum plant height was recorded in Pramalini (3.60 m) followed by Sai Sarbati (3.50 m) and CHESL-30 (3.35 m) while Ganganagar-1 was found most dwarfing (1.65 m) followed by CHESL-17 (2.33 m). Canopy spread in both the direction was found maximum in CHESL-12 (3.48 & 3.40 m) followed by Pramalini (3.42 & 3.39 m) while the minimum canopy spread was observed in Ganganagar-1 (1.88 & 1.93 m). The maximum stem girth was recorded in Pramalini (7.72 cm) followed by CHESL-10 (6.90 cm) and Sai Sarbati (6.85 cm). Acid lime accession CHESL-32 recorded the highest average fruit weight (38.57 g), peel thickness (1.55 mm), acidity (8.15 %) and ascorbic acid (43.55 mg/100 ml) with 48.55 % juice. However, = 33 g fruit weight, length and width = 35 mm were noted in CHESL-3, CHESL-6, CHESL-10, CHESL-13, CHESL-15, CHESL-31, Vikram and Sai Sarbati. A minimum peel thickness of 0.95 mm was observed in CHESL-13 which was followed by 1.08 mm in Ganganagar-1. In most of the genotypes, number of seeds was found to be 10 or lesser than that except Ganganagar-1 (13.88) and CHESL-17 (14.35). However, the highest juice percentage was recorded in CHESL-3 (56.72 %) followed by CHESL-13 (56.43 %), CHESL-10 (50.33 %) and CHESL-9 (48.81 %). Fruit juice TSS was recorded maximum in Pramalini (9.65 °Brix) followed by CHESL-12 (9.53 °Brix) while CHESL-3 recorded the minimum TSS (6.75 °Brix). Ganganagar-1 recorded the minimum acidity (5.17 %). The highest number of fruits/tree was recorded with CHESL-32 (1240) followed by CHESL-27 (962). Similarly, the highest average yield/tree was observed in CHESL-32 (42.39 kg) closely followed by CHESL-27 (34.52 kg). No severe infestation of leaf miner and citrus canker was observed in these genotypes.

ETHNO-VETERINARY MEDICINE (EVM) USED BY THE RAIKAPASTORALIST OF MARWAR REGION OF RAJASTHAN TO CURE COMMON DISEASES OF SMALL RUMINANTS

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Abstract

The *Raika* also known as Rebari. *Raikas* is a most important pastoralist community of Rajasthan which is mostly 70 per cent of their population living in marwar region of Rajasthan. *Raika* pastoralists of marwar region of Rajasthan have a large network of traditional healer and having great knowledge of traditional practices to treatment of their animal disease, make use of a large variety of indigenous plants, minerals and animal products to cure their diseased animals. Therefore, the present study was designed to document and appraise Ethno-Veterinary Medicine (EVM) used by the *Raika* pastoralists to treatment of common health disease of small ruminants (sheep and goat) like diarrhea, bloat, jaundice and fever. The study was carried out at purposively selected Marwar region of Rajasthan and a total 120 *Raika* pastoralists were interviewed from the six villages of Pali and Jodhpur district on an open-ended interview schedule to document the ethno-veterinary practices. For participatory assessment of identified ethno-veterinary practices, Quantification of Indigenous Knowledge (QuIK) was applied. The *Raikas* were using total 15 ethno-veterinary medicine to cure these four common diseases. Use of alum and jaggery was found most effective to treat diarrhea, whereas, they used only alum to treat fever. They also used mixture of turmeric, acidic butter, tea and black salt to manage bloat in their animal most effectively. To cure Jaundice of animal, they perceived use of mixture of lemon, baking soda and pepper was more effective ethno veterinary practice. Hence, pharmacodynamics of these ethno-veterinary practices may be studied before further replication and use.

VARIETAL INTERACTION TO *CARYEDON SERRATUS* IN STORED PEANUT DURING DIFFERENT STORAGE BAGS AND INTERVAL

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Abstract

Caryedon Serratus is one of the most important pests of stored peanut. Adult beetle lays eggs on pods of peanut upon hatching larvae bores into the pods and feeds on peanut kernels. After completion of larval stage it comes out of pods by making a circular hole popularly known as exit windows and pupates in the silken cocoons. In India, Gujarat is the major producer and



exporter of peanut. In Gujarat *C. serratus* is the major pest of stored peanut and it is locally called as cocoon disease of peanut due to characteristic appearance of cocoons which are glued to peanutpods and to storage bags. A study was conducted to know the varietal interaction of peanuts stored and *C. serratus* in two different bags for an interval of six months. GJG 22 was the most preferred variety by *C. serratus* as it recorded more than 1000 eggs with in four months of storage. Similarly, highest pod damage was recorded in GJG 22 with more than 90 per cent damage within four months of storage. Among the storage bags, plastic bags (HDPE 160 Micron) was found effective in managing bruchid, even with prior infestation KDG 128 did not cross 50 per cent damage after six months storage period. When we analyzed biochemical parameters of peanut varieties, results revealed that high total sugar content was the reason for *C. serratus* to prefer GJG 22 stored in both the bags.

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.

UPCOMING ELITE RICE VARIETY ‘VL DHAN 159’ FOR CULTIVATION UNDER ORGANIC CONDITION OF UTTARAKHAND HILLS

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Abstract

Rice is the major kharif crop of Uttarakhand cultivated in about 260 lakh ha area with production 664 lakh tones and productivity 2,552 kg/ha. A huge difference in production and productivity of rice between hill and plain region is observed mainly due to availability of irrigation facilities and improved varieties. Rice grown in plains are almost entirely under irrigated condition whereas about 67% area in hill rice is under rainfed condition, therefore, development of improved varieties of rice for rainfed upland ecosystem is essential for yield stabilization for hill farmers and fulfill the requirement of rainfed upland rice growers. Keeping this point in view concerted effort is being made for the development of high yielding varieties of rice for the hilly regions. VL Dhan 159 is an early duration rice variety suitable for cultivation under rainfed upland organic condition of Uttarakhand hills. This was developed by ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS), Almora, Uttarakhand for kharif season and released by State Varietal Release Committee of Uttarakhand in the meeting held on 19 May, 2020. It has been recently submitted for notification to the Central Sub-Committee on Crop Standards Notification and Release of Variety for Agricultural Crops. VL Dhan 159 is derived from the cross VL 66/HPR 2143 with maturity duration of 110-115 days. Under organic conditions, this variety has recorded an average yield of 2,054 kg/ha and out yielded the check varieties *Vivek Dhan 154* by 42.34 per cent, *VL Dhan 221* by 27.34 per cent and *VL Dhan 156* by 33.64 per cent. It was found resistant against leaf and neck blast (score 0-3), brown leaf spot (score 3-4), sheath rot (score 1), leaf scald (score 1-3) and false smut (score 0), stem borer and leaf folder (score 0-1) under natural condition. It has more number of panicles/m² (229) compare to the checks *Vivek Dhan 154* (200) and *VL Dhan 156* (172). This variety has intermediate plant height, semi-erect, panicle mostly exerted and plants are non lodging. It has exhibited better quality characteristics like high hulling (82.8%) and milling (72.1%), intermediate Alkali Spreading Value (4.0), Gel consistency (50) and amylose content of 25.93%, Grain Chalkiness is very occasionally present. It has short bold grain kernel length (5.27mm), kernel breadth (2.63mm), L/B ratio (2.00), semi-erect and intermediate plant type, compact and well exerted panicle, awnless grain and straw apiculus colour, green coloured leaf blade and leaf sheath and erect flag leaf. VL Dhan 159



has full potential to increase production and productivity of rainfed upland rice crop under organic cultivation in hills of Uttarakhand.

BACTERIOLOGICAL ANALYSIS OF FRESH VEGETABLES OF LOCAL MARKET AND EFFECT OF VINEGAR ON THEIR QUALITY

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Abstract

Fruits and vegetables are vital for health and well-being of humans as they are good dietary source of micronutrients, vitamins and fiber. A wide range of microbial contamination is seen in fruits and vegetables because of their contact with soil, dust, water and by handling at harvest and during post-harvest processing. As most of the fruits and some of the vegetables are consumed as raw, they lead to many food borne diseases. Therefore the present research was undertaken to assess the surface microbiological load of fresh vegetables are collected from Pulivendula local market and effectiveness of vinegar as an anti-microbial agent in reducing the surface microbial load of the samples was assessed. In this analysis two different concentrations of vinegar i.e., 1.5% and 3% with residence times 5 minutes and 10 minutes were used. Vegetable samples of lady's finger and radish were collected and examined for their surface microbial load. The highest *Bacillus* count of 5.2×10^4 cfu/g was found in lady's finger followed by *E.coli* count of 5.6×10^4 cfu/g. After treating with 3% of vinegar for 10 minutes in lady's finger the *Bacillus* count reduced to 148 cfu/g, *E.coli* to 48 cfu/g and *Staphylococcus* and fungi were absent. For Radish the microbial load reduced to 48 cfu/g for *Bacillus*, 44 cfu/g for *E.coli* and *Staphylococci* and fungal growth was absent. The least microbial loads for the samples lady's finger and radish were obtained when treated with 3% vinegar solution for 10 minutes. Introducing the effective decontamination/processing/cleaning methods at household levels is a main aim of our research

FIELD RESISTANCE OF CHILLI GERMPLASMS AGAINST ANTHRACNOSE DISEASE CAUSED BY COLLETOTRICHUM CAPSICI

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Abstract

Anthracnose of chilli caused by *colletotrichum capsici* is a wide spread problem limiting the profitable cultivation and seed production throughout the major chilli growing regions of India. Thirty genotypes open pollinated genotypes obtained from AVRDC, NBPGR Regional Station, few local varieties collected from Warangal district of Telangana state and Dharwad district of Karnataka state. Were screened against anthracnose disease under natural and artificial field condition at college of horticulture, Rajendranagar, during in the year 2016. The observation on disease severity was recorded at 145 days after transplanting. All the genotypes reacted differentially and significantly to anthracnose. All the 30 genotypes scored grades of 3 to 4 and were found to be under natural condition was found to be 3 lines are resistance AVPP0514 (PDI- 4.4), AVPP9813 (PDI-4.2) and PBC-81 (PDI-4.3), one line in moderately resistance line was EC-334182 (PDI- 22.8), twenty four lines scored the highest grade 3 thereby found to be susceptible lines and reaming 2 lines scored the highest grade 4 are highly susceptible. All the 30 genotypes scored grades of 3 to 4 and were found to be under artificial condition three lines are in moderately resistance AVPP0514 (PDI- 22.7), AVPP9813 (PDI-22.9 and PBC-81 (PDI-23.5). Six lines scored the highest grade 3 lines are susceptible and reaming 21 lines scored the highest grade 4 are highly susceptible. None of the test genotype was immune and highly susceptible to anthracnose. The results of the present investigation will be helpful in breeding program.



QUALITY CHARACTERISTICS OF FISH PROTEIN ISOLATE INCORPORATED PASTA PRODUCT

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Abstract

Fish protein isolate was prepared from Nile Tilapia fish meat by pH shifting process. Fish protein isolate had moisture content of 75.95% and a pH of 6.2. Protein Isolate from Tilapia fish meat was used for preparation of pasta product. Wheat flour and refined wheat flour was used as base material. Fish pasta was prepared by incorporating isolate at 5%, 10% and 15% concentration. Pasta products prepared without incorporation of fish protein isolate was kept as control. Biochemical and microbiological quality of fish pasta were evaluated up to 5 months. Pasta product had 8.2% - 9.8% moisture, 11.55% - 14.58% protein, 0.59%-0.62% fat and 2.1% -2.2% ash content. TVB-N, TBA values showed increased trend and were within the acceptable limit during storage. PV value reached 20.8% during third month in 15%FPI incorporated sample. Other sample PV values were within the limit up to four month. TPC in all sample reached acceptable level (5log cfu/g) during four month. Sensory analysis revealed that incorporation of fish protein isolate up to 10% was comparable with control.

WHEAT GENETIC RESOURCES DIVERSITY FOR UTILIZATION IN MANAGEMENT OF ABIOTIC STRESSES

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Abstract

Abiotic stresses severely affect wheat production and productivity, globally. Among various stresses, major factor affecting wheat production is the drought and terminal heat stress, which is likely to increase further due to anticipated climate changes. The above challenges can be effectively addressed by development of drought and heat tolerant varieties which is the most economical and environment friendly approach to mitigate the effect of these stresses. The germplasm resources are the reservoirs of important genes/gene complexes for crop improvement. However, the worth and potential of the conserved resources can be realized only if their economic traits are known. Therefore, to promote the utilization of genetic resources in breeding programs, a comprehensive evaluation of wheat accessions conserved in the Indian National Genebank was conducted at various locations to identify sources of abiotic stress tolerance. A composite core-set of wheat (2226 accessions) was developed based on 34 agro-morphological descriptors and evaluated for drought tolerance in multi-location evaluation trials. Preliminary screening based on DSI resulted into identification of 49 promising accessions which are being further validated. Also, a reference set for terminal heat stress comprising 316 wheat accessions were developed based on multi-year evaluation from ~19000 accessions. The tolerant germplasm, identified can be excellent donors to be deployed into the background of high yielding wheat cultivars through conventional or molecular breeding approaches, and are expected to contribute toward food security at national and global levels.

BIOREMEDIATION OF QUIZALOFOP ETHYL BY BACTERIAL CONSORTIA FROM POLLUTED SOILS OF ASSAM

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Abstract

Herbicides, as a tool for weed management are gaining immense popularity as it provides economic, efficient and timely control of weeds. The continuous use of herbicide quizalofop-ethyl belong to Aryloxyphenoxy-propionate group used as post emergence herbicide against grasses and broad leaves weeds has called the special attention due to the multifaceted toxicity, persistence of the herbicide molecule in soil and enters finally the entire food chain. The build up of herbicide residues in soil



affecting the soil microbial community that are primarily involved in the nutrient cycling and crop residue decomposition resulting in the poor soil health. Laboratory pot study was conducted to work out the consequences of bacterial consortia on quizalofop-p-ethyl treated soil with treatments comprised of T1 –Quizalofop Ethyl @ 50g/ha, T2 – Quizalofop Ethyl @ 50g/ha +Vermicompost @ 2 ton/ha, T3 – Quizalofop Ethyl @ 50g/ha + Bacterial consortia @ 10 ml /6 kg soil and T4 – Quizalofop Ethyl @ 50 g/ha + Vermicompost @ 2 ton/ha + Bacterial consortia @ 10 ml /6 kg soil with repetition of four CRD as the statistical design. Bacterial consortia of $(52.32 - 782.4) \times 10^6$ CFU g⁻¹ soil were inoculated to the pots @ 10ml per 6kg soil with 30 % soil moisture content. All together 26 bacterial cultures were isolated, out of which 4 from coal, 8 from petroleum oil, 3 from brick, 5 from cement and 6 from paper polluted soil using specific media. Identification of the bacterial isolates was done by sequencing of 16SrRNA and phylogenetic tree of which most of the bacteria belongs to the strains Bacillus, Pseudomonas, Fictibacillus, Acinetobacter. The treatments (T3 and T4) with bacterial consortia resulted faster degradation with shorter half lives of quizalofop ethyl over the treatments (T1 and T2) without bacterial consortia.

INFLUENCE OF PGR'S AND NUTRIENTS FOR ENHANCING THE PRODUCTIVITY IN BT. COTTON

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Abstract

The role of different osmo protectants in plant tolerance to drought stress is significant because they regulate multitude of metabolic processes. The present study was conducted at Agricultural Research Station, Dharwad farm during the year 2019-20 therefore to investigate the influence of foliar application of different PGR's and Nutrients on morpho-physiological parameters for enhancing the productivity in Cotton under rainfed condition. The experiment consisted of eight treatments applied which are 2% urea, 2% KNO₃, 1% Thiourea, Salicylic acid @ 50ppm, Glycine Betaine @ 100ppm, Salicylic acid @100ppm and PPFM 1%. Among all the treatments foliar application of KNO₃ at weekly interval of four sprays after 50% flowering recorded significantly highest plant height, monopodial, sympodial, no. of bolls per plant, total dry matter production and boll weight per plant under rainfed condition. Also 2% KNO₃ application recorded highest Photosynthetic rate ($27.5 \mu \text{mol CO}_2 \text{m}^{-2} \text{S}^{-1}$), compared to control ($25.1 \mu \text{mol CO}_2 \text{m}^{-2} \text{S}^{-1}$) and seed cotton yield (1910.5kg/ha) as compared to other treatments and control (1670.1 Kg/ha) and it was on par with Glycine Betaine @ 100 ppm single spray at 50% flowering (1808.7 Kg/ha).

ASSESMENT OF WATER STABLE AGGREGATES IN RELATION TO PHYSICO CHEMICAL PROPERTIES OF SOIL OF BABINA WATERSHED IN JHANSI DISTRICT OF BUNDELKHAND REGION

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Abstract

The studies of water stable soil aggregates (>0.25mm) was carried out in Babina watershed representing typical red (Amarpur and Imilia series) and black soils (Chamraua and Badaura series) of district Jhansi in Bundelkhand region of Uttar Pradesh (India) under Operational Research Project for Resource conservation on sustained basis. Analysis of water stable soil aggregates (>0.25mm) in different soil series of Babina watershed representing typical red (Amarpur and Imilia series) and black soils (Chamraua and Badaura series) of Jhansi district of Bundelkhand region of U.P. revealed that black soils (Vertic Ustochrepts) were rich in water stable aggregates as compared to red soils (Typic and Udic Ustochrepts, Typic Ustifluvents). Water stable aggregates among various soil series ranked in order of Badaura > Chamraua > Imilia > Amarpur. The result represented that erodibility among the project area varies according to soil conservation measures adopted. Revinces lands with conventional up and down cultivated soils are more erodible in comparison to land treated by various soil conservation practices On the basis of erosion ratio, erosion index and water stable aggregate as principle indices of erodibility, soil under various soil conservation practices may be arranged in the order of : *Conventional method > sowing across the slope > Sunken structure > submerged bund with vegetative > check dam > contour bunding*



> land leveling and field bunding > vegetative barriers. A significant and positive correlation was recorded of water stable aggregates with clay ($r=0.979^{**}$), silt ($r=0.529^{**}$), silt+clay ($r=0.912^{**}$), moisture equivalent ($r=0.986^{**}$), water holding capacity ($r=0.987^{**}$), organic carbon ($r=0.937^{**}$), total N ($r=0.963^{**}$), available P_2O_5 ($r=0.933^{**}$), available K_2O ($r=0.920^{**}$), Exch. Ca^{++} ($r=0.746^{**}$), Exch. Mg^{++} ($r=0.881^{**}$) and clay/ moisture equivalent ($r=0.822^{**}$) negatively correlated with sand ($r=-0.912$), easily dispersible silt+clay ($r=-0.0259$), bulk density ($r=-0.986^{**}$), particle density ($r=-0.876^{**}$), hydraulic conductivity ($r=-0.936^{**}$), pH ($r=-0.839^{**}$), EC ($r=-0.976^{**}$), dispersion ratio ($r=-0.983^{**}$), erosion ratio ($r=-0.962^{**}$), erosion index ($r=0.962^{**}$), clay ratio ($r=-0.501^{*}$) and silt/clay ratio ($r=-0.499^{**}$). Among adopted eight soil conservation practices, soil erodibility decreased with increasing clay content. Soils of Babina watershed are erosive in nature and require warrant and prompt attention for implementing intensive soil conservation measures in the entire watershed in order to subside the havoc of soil erosion with in safe limits because adopted soil conservation measures are variably effective to controlling the erosion.

MOLECULAR IDENTIFICATION OF MAJOR BLAST RESISTANCE GENES IN RICE LANDRACES FROM INDIA

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Abstract

Rice blast disease caused by the fungus *Magnaporthe oryzae* is one of the important devastating diseases causing huge losses worldwide. In the present study, major blast resistance genes were investigated in landraces and improved lines originating from India. Based on phenotypic evaluation, 149 landraces were classified into three distinct groups: resistant (55), moderately resistant (63) and susceptible (31). The genetic frequencies of the 18 major blast resistance genes were between 19% and 90%. The cluster and population structure analysis grouped the landraces into two groups. Through principal coordinate analysis, the scatter plots partitioned the resistant and moderately resistant landraces into different groups. Analysis of molecular variance showed maximum (88%) diversity within populations and least (12%) diversity between populations. Association analysis identified seven markers 40n23r, RM5811, ta5, yl 153/154, z56591, z56592 and k3957 that are significantly associated with blast disease and explained a phenotypic variance of 4.0–36%. The associated genes could be used in marker-assisted rice breeding programmes for gene pyramiding to develop rice varietal resistance against blast disease. The present study represents a valuable blast resistance genetic resource that could be used for identification of new R genes, donors for blast resistance, and genomic studies.

STUDY OF SOIL P-FRACTIONS IN DIFFERENT GROUNDNUT GROWN SOILS UNDER VARYING P-DOSAGES, INCUBATION TIMES AND TEMPERATURES

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Abstract

Phosphorus (P) is the essential nutrient element for groundnut overall growth, nitrogen fixation and yield. Bio-availability of P in soil is governed by various factors like concentration of organic matter, Iron, Aluminium, Calcium, Zinc, type of clay, moisture percent, humic acid content, rate of fertilizer application, native P availability, soil temperature, nature of crop root system and other competitive nutrient limiting factors. Fertilizer P added to soils undergo a series of fixation reactions like adsorption and precipitation on clay surface, lime, iron and aluminium oxides, thus the water-soluble labile fertilizer P transform into moderately labile (P on clay surfaces, adsorbed onto Fe and Al oxides and di-calcium phosphates) and non-labile forms (Octa-calcium phosphate and Hydroxyapatite) (Javid and Rowell, 2003). In order to understand the fate of applied P, we studied the rate of P-fixation and transformation into different P-fractions under different fertilizer doses, incubation temperatures and times in calcareous soils of Junagadh and Sandy soils of Bikaner. Soils were collected after groundnut harvest of kharif 2016 and method developed by Hedley (1982) was used for soil P-fractionation *in-vitro*. Initial pH



and EC of the soils are 8.2, 0.15 dS/m and 8.3, 0.18 dS/m for Junagadh and Bikaner soils respectively. Initial Olsen P was found to be high in Sandy soils (20.2 kg/ha) than in *vertisols* (15.26 kg/ha). Initial total P was found to be more in *vertisols* (420 ppm) followed by sandy soils (285 ppm). CaCO_3 (%) was 19.60% in Typic Haplustepts (Black soils) and 2.20% in Typic Haplocambids (Sandy soil). The experiment consisted of control (no P applied), 10 kg P/ha, 20 kg P/ha, 40 kg P/ha, 80 kg P/ha with four incubation periods like 5 DAI, 15 DAI, 30 DAI, 45 DAI. KH_2PO_4 served as P-source. Recoverable P ranged from 0.8 to 5.5 kg/ha, fixed P 9.2 to 74.5 kg/ha, P fixation capacity (%) ranged from 92% to 93.12% in *vertisols* at 5DAI. P fixation capacity (%) increased linearly from 5 DAI to 45 DAI. In Sandy soils, P fixation capacity (%) ranged from 75% to 89% at 5 DAI. The maximum fixation is observed at 30 DAI. Surprisingly, P fixation decreased at 45DAI. In *vertisols*, among the various forms of P analyzed, Ca-P was found to be abundant (165 kg/ha) followed by Fe-P (35 kg/ha), Al-P (10 kg/ha) and Saloid-P (26.4 kg/ha), where as in sandy soils Ca-P was found to be dominant (102 kg/ha) followed by Fe-P (48.2 kg/ha), Saloid-P (26.4 kg/ha) and Al-P (2.2 kg/ha). So, the order of P-fixation in *vertisols* is Ca-P>Fe-P>Al-P>Saloid-P and in sandy soils it is Ca-P> Fe-P>Saloid-P>Al-P. In black soils P-fixation (%) ranged from 82.5% to 96.3% and in sandy soils the range is from 71% to 92% at 5 DAI. Al-P and Fe-P was markedly higher in *vertisols* at 45°C than at 15°C, which is *vice-versa* with respect to Ca-P. Similar trend was observed in sandy soils, but with lower values than black soils. In essence, P-fixation increased with increase in incubation temperatures, irrespective of incubation time and dosage. Soils with more clay and CaCO_3 has more P-fixation which reduced the equilibrium-P in soil solution

SOCIO ECONOMIC IMPACT OF COVID-19 PANDEMIC ON SHEEP FARMING : A CASE STUDY

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Abstract

A study was conducted at Malpura tehsil (Tonk district) of Rajasthan to assessment of impact of COVID -19 on socio-economic conditions of sheep farmers. Data for the period of 06 months (January to June 2020) were collected from the sheep farmers, sheep traders/ butcher and mutton consumers. A total of 60 samples, 20 from each category were purposively selected under the study. Study revealed that all the consumers, sheep traders/ butchers were respond that after the COVID -19 (March-May) the demand of sheep and sheep products is changed drastically and supply of the sheep were also affected due to restriction of transportation and lock down. Data shows that 90 percent farmers say that no changes were in mortality /morbidity and lamb losses pattern during lockdown period. About 100 percent sheep farmers were accepted that average price of animals was decreased (06.88%) as compared to before COVID -19 infections. Majority of butchers/traders stated 22.60 percent additional cost on rearing of sheep is increases due to lower consumption of meat by the consumers during lockdown period.

CLIMATE-SMART PERFORMANCE OF MAIZE (*ZEA MAYS*) AND ORANGE (*CITRUS SINENSIS*): A STUDY FROM ARUNACHAL PRADESH

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Abstract

Climate is changing, and it is unavoidable. There are various factors responsible for climate change through the emission of Green House Gases (GHGs). The Agriculture sector is responsible for the emission of GHGs, which is the reason for climate change and global warming as well as the agriculture sector is extremely vulnerable to climate change. The most challenging task to technocrats, policymakers and different stakeholders of agriculture and allied sector is how to produce maximum from per unit area of land without or less emission of GHGs. Climate-smart agriculture (CSA) is a relatively new approach to adjust the trade-off between maximum productivity with less or zero-emission of GHGs. It is crucial to identify and develop a database about the climate-smart performance of different crops to implement CSA in large scale. This study is an attempt to examine the climate-smart performance of two important crops, namely, maize and orange in Arunachal Pradesh. An interview schedule with 20 parameters was developed for data collection from the respondents. In this study, 50 respondents for each crop were included. The mean of each parameter, as well as the overall mean of all parameters were calculated to



determine the climate smartness of each crop. The study revealed that both the crops, i.e., maize and orange are climate-smart with an overall mean value of 2.7 and 2.58, respectively. Further, in the case of maize, the individual mean values of 12 parameters exceeded the mid-value (i.e., 2.5) of the maximum achievable score. In contrast, in the case of orange, the individual mean value of 10 parameters exceeded the mid-value of the score.

EFFECT OF DOLOMITE ON GROUNDNUT IN ALFISOLS

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Abstract

Groundnut is most widely grown oilseed crop in peninsular India and some areas under coastal ecosystem with acidic soils particularly, in coastal Tamil Nadu, Kerala, Karnataka and Goa. Calcium deficiency is predominant under acidic soil conditions which leads to higher percentage of aborted seeds (empty pods) and unfilled or partially filled pods called pops. Dolomite (CaCO_3 , MgCO_3) is a double carbonate salt, having an alternate structural arrangement of calcium and magnesium ions which improves the physical, chemical and biological conditions of the soil, neutralizes the soil acidity and cuts fertilizer cost through improved fertilizer use efficiency. Dolomitic lime addition is needed not only to increase the availability of calcium and magnesium but also to increase the concentration of basic cations like potassium especially in acidic soils. In the view of above points, the present study was carried out to know the effect of dolomite on groundnut in alfisols. A field experiment was conducted at Main Agricultural Research Station, UAS, Dharwad during *kharif* 2019 and laid out in randomized complete block design consisting eight treatments replicated thrice. Results of the study showed that application of cured dolomite with FYM @ 750 kg ha^{-1} recorded significantly lower pops percent (7.8 %), higher number of pods plant⁻¹ (14.4), pod weight ($14.5 \text{ g plant}^{-1}$), 100 kernel weight (39.9 g), kernel yield (19.8 q ha^{-1}), oil yield (888 kg ha^{-1}) and higher net returns ($66,240 \text{ ha}^{-1}$). The results also showed that numerically higher pH (6.41) and EC (0.237) were recorded with application of dolomite @ 750 kg ha^{-1} , whereas higher organic carbon in the soil was recorded with application of cured dolomite with FYM @ 750 kg ha^{-1} . Significantly higher soil exchangeable calcium and magnesium (1.61 and $1.17 \text{ cmol (p}^+) \text{ kg}^{-1}$) respectively was recorded with application of cured dolomite with FYM @ 750 kg ha^{-1} . Progressive increase in yield observed between application of dolomite @ 500 to 750 kg ha^{-1} was tiny as compared to similar increase from 250 to 500 kg ha^{-1} . It clearly indicated that in the present study groundnut responded up-to 500 kg ha^{-1} dolomite application either with or without curing thereafter law of diminishing marginal returns has been observed i.e., adding additional factor of production (dolomite) would actually result in smaller increases in output (yield) and similar difference existed between cured and uncured treatments. Hence, application of dolomite @ 500 kg ha^{-1} was found better.

EFFECT OF MODIFIED FLY ASH ON SOIL PROPERTIES AND BIOAVAILABILITY OF CADMIUM, LEAD AND CHROMIUM IN A CONTAMINATED VERTISOL

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Abstract

Environmental pollution is the biggest menace the world faces today. Recently fly ash was used as a potential soil amendment for remediation of contaminated soil. An incubation studies and pot culture experiment was conducted to study the effect various amendments (fly ash, acid (HCl) modified fly ash, Alkali (NaOH) modified fly ash and humic acid modified fly ash) and their application rates (1, 2.5 and 5% dry w/w basis) on heavy metal (Cd, Pb and Cr) stabilization in a Cd, Pb and Cr contaminated soil. Plant bioavailable (DTPA extractable) content of Cd, Pb and Cr was significantly reduced as a result of fly ash and/or acid, alkali and humic acid modified/treated fly ash as soil amendment in cadmium, lead and chromium contaminated soil. Among these amendments, the performance of NaOH modified fly ash was significantly higher in stabilizing the Cd in a cadmium contaminated soil to an extent of 37.43% and Pb in a lead contaminated soil to an extent of 16.43% at highest rate (5%) of application. Likewise, acid modified fly ash application in a chromium contaminated soil proved to a better option in stabilizing the Cr to an extent of 22.79% at highest rate (5%) of application. The results from the



pot culture experiment also revealed that highest per cent reduction of 44.9% and 55.6% in spinach leaf Cd and Pb content as compared to control was observed in a Cd and Pb contaminated soil amended with alkali modified fly ash, respectively. Similarly, the highest per cent reduction of 64.6% in spinach leaf Cr content as compared to control was observed in a Cr contaminated soil amended with acid modified fly ash. Further, the lowest transfer coefficient value (0.33 and 0.02) was observed in the alkali modified fly ash amended Cd and Pb contaminated soil and the acid modified fly ash amended Cr contaminated soil indicates greater reduction in mobility of heavy metal (Cd, Pb and Cr) from soil to plant system. From the study, it was clearly evident that alkali modified fly ash addition as soil amendment has greater potential in reducing the mobility of heavy metal in soil and its subsequent transfer to edible plant parts (spinach leaf) as evidenced by reduction in DTPA extractable Cd & Pb in soil and lower transfer coefficient value in a Cd and Pb Contaminated soil (artificially spiked soil). However, both acid and alkali (NaOH) treated fly ash was proved as a better option for spinach yield and also reducing the translocation of potentially toxic heavy metal (Cr) to spinach leaf in a Cr contaminated soil.

EVALUATION OF NEWER INSECTICIDES AGAINST BIHAR HAIRY CATERPILLAR, *SPILOSOMA OBLIQUA* (WALKER) ON SOYBEAN

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Abstract

An experiment on bio-efficacy of different insecticides viz: Indoxacarb, flubendiamide, chlorantraniliprole, chlorfenapyr, novaluron, emamectin benzoate, beta-cyfluthrin and quinalphos evaluated against *Spilosoma obliqua* infesting soybean was conducted at Agricultural Research Station, College of Agriculture, Anand Agricultural University, Jabugam. The result indicated that the plots treated with of chlorantraniliprole and flubendiamide (3 ml/ 10 litre of water) found effective against hairy caterpillar. Indoxacarb (5 ml/ 10 litre of water) also found promising in controlling the population of *S. obliqua*.

TO STUDY THE NUTRITIONAL AND BIOCHEMICAL CHARACTERISTICS OF PIGEON PEA(*CAJANUS CAJAN*) EVALUATED BY NIRS-2500.

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Abstract

This crop is commonly known as Angola pea, Gungo Pea, Congo pea and pigeon pea. It belongs to the leguminosae family. The most popular variety of this crop are tall varieties, dwarf varieties and smaller bushes. This crop is the very much important legume crop which is normally cultivated in either tropical and subtropical climatic conditions. Pigeon pea is a drought tolerant and warm weather cultivated crop. The health problem of protein mal nutrition is widely spread among the poor people and under developed countries. In Indian people protein source generally comes from either animal or plant. This protein rich crop is an important legume which provide sufficient protein content and can be grown in rainfed condition with minimum requirement of management. Pigeon pea is rich in starch, protein, calcium, manganese, crude fiber, fat, trace elements, and minerals. Besides its high nutritional value, pigeon pea is also used as traditional folk medicine in India, China, Philippines and some other nations. Literature on this aspect show that pigeon pea is capable to prevent and cure a number of human ailments such as bronchitis, coughs, pneumonia, respiratory infections, dysentery, menstrual disorders, sores, wounds, abdominal tumors, tooth ache, and diabetes. About 90% of the world production of mung bean (*Vigna radiata*) is produced in Indo-Burma region. Pigeon pea (*Cajanus cajan*) accounts for about 5% of the world's legume production. Mung bean and pigeon pea provide rich sources of protein for animals and humans in many parts of the world. They also supply a significant amount of minerals and vitamins. Pigeon pea and mung bean can be consumed as dehulled splits, whole, canned, boiled, roasted or ground into flour to make a variety of desserts, noodles, snacks and main dishes. Pigeon pea and mung bean are



normally dehulled to improve cooking and nutritional qualities and to reduce cooking time. Dehulling mung beans and pigeon peas helps to remove antinutritional compounds such as polyphenols located in the seed coat. Cooking and soaking can eliminate or reduce the phytic acid content present in these legumes. These legumes are classified as hard-to-dehull because of the presence of mucilage and gum forming a strong bond between the hulls and the cotyledons. To dehull these legumes, the hulls must be loosened from the cotyledons before they can be abrasively separated from the cotyledons.

STORAGE TECHNIQUES IN THE PRODUCTION OF EGG PARASITOID, *TRICHOGRAMMA CHILONIS* FOR PROMOTION OF BIOLOGICAL CONTROL IN SUSTAINABLE AGRICULTURE

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Abstract

Effective storage method for host insect and parasitoid is required to produce quality biocontrol agent for successful bio-control programs. Quiescence is an adaptation to resist unforeseen environmental changes, and it is a popular approach to use this naturally occurring phenomenon to improve storage of *Trichogramma*. Host insect, *Corcyra cephalonica* eggs were stored at 6°C with RH 70% for a period from 7-70 days and the effect of host eggs storage on parasitization by *Trichogramma chilonis* was assessed by recording their percent parasitization and adults' emergence. Storage of UV treated host eggs for 42 days at 6°C was effective with high parasitization (70.94%), adult emergence (62.99%) and 3 days of longevity compared to storage of fresh host eggs (68.99% parasitization and 60.35% adult emergence). Cold storage of parasitoids, *T. chilonis* as Trichocard in sealed polythene cover in refrigerator at 6°C for a period from 7-70 days was observed for the adult emergence. *T. chilonis* showed highest cold storage capability at 6°C was 3 weeks with good adult emergence (76.56%). Storing *T. chilonis* at 6°C temperature provide a minimum of 60% emergence rate and 3 days of longevity after 423 days of storage. Increasing the shelf life of host eggs and storage period of parasitoid, *T. chilonis* as Trichocard facilitates large scale production and adoption by farmers in turn enhance the sustainability *Trichogramma chilonis* at field level for the effective management of borer pests.

OATS FOR HUMAN CONSUMPTION; BOOST THE ECONOMY AND LIVELIHOOD OF TRIBAL, SMALL AND LARGE FARMERS IN HARSH, TEMPERATE CLIMATIC CONDITIONS OF LADAKH AND KASHMIR-INDIA

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Abstract

Oats (*Avena sativa* L.) have received considerable attention for their high content of dietary fibers, phytochemicals and nutritional value. It is believed that consumption of oats possesses various health benefits such as hypocholesterolaemic and anticancerous properties. Oats have also recently been considered suitable in the diet of celiac patients. Owing to their high nutritional value, oat-based food products like breads, biscuits, cookies, probiotic drinks, breakfast cereals, flakes and infant food are gaining increasing consideration. Research and development on oat and its products may be helpful in combating various diseases known to mankind. This paper provides an overview of the nutritional and health benefits provided by oats as whole grains and its value added products. It is designed to provide an insight on the processing of oats and its effect on their functional properties. The protein of rolled (flakes) oats is generally greater than that found in other cereal grains. Oats is the only cereal containing globulin or legume-like protein, avenin, as the major (80%) storage protein. Many of the vitamins and minerals found in oats are combined in the bran and germ. Most oat food products use the entire groat, making it a nutritious cereal grain. In fact the health effects of oat rely mainly on the total dietary fiber and beta-glucan content, which reduce postprandial blood glucose; insulin responses and lowers blood lipids, especially serum total and LDL-cholesterol. Medicinally, oats are used for patients suffering from diabetes, hypertension and high cholesterol. Besides, conventional breeding methods, molecular breeding (MB) approaches have made possible to identify and dissect β -glucan content rich regions across oat genome, such approaches have enabled to accelerating improvement in oat grain quality and increasing the nutritional value of the crop for human consumption. Till date, the investigations undertaken by SKUAST-K the premier



research institutes of Kashmir valley have focused on development of agro ecologically specific cultivars having high green forage yield with better nutritional quality for cattle but there has been very little investigations regarding screening of available germplasm resources for nutritional quality suited for human consumption. Keeping in view health benefits of oat grain, therefore, there is an urgent need of exploiting new research technologies to boost grain yield with desirable quality parameters and increasing the nutritional value of the crop for human consumption under cold conditions of Ladakh (Kargil, Leh, Zaskar in India. Here we review the health benefits of Oats (*Avena sativa* L.), and highlight the potential for future expansion in this field through various processing and breeding methods and to develop an economically viable and sustainable crop production option. The manuscript also reviews various uses of oats and its fractions for clinical and industrial purposes and in development of value added food products.

STUDY ON DEVELOPMENT IN WO₃ NANOMATERIALS FOR TREATMENT OF WASTEWATER

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Abstract

Water is most precious gift by nature for human being. Water sources are contaminated by direct discharge of wastewater by different mean. Organic materials (dyes, waste medicines etc.) are one of the largest groups of organic pollutants. So, the removal and degradation of organic pollutants have been a matter of considerable interest. Semiconductor photocatalysis is of significant interest for applications related to environment and energy, such as pollutant degradation, water splitting and hydrogen production. Tungsten trioxide (WO₃), an n-type semiconductor, is a potential candidate for visible light active photocatalyst for organic pollutant degradation. It has low conduction band level, so the conduction band electrons are not able to reduce oxygen (O₂) into superoxide radical anion ([•]O₂⁻). Hence fast recombination of charge carriers take place which responsible for lesser photocatalytic activity of pure WO₃. So, to develop highly efficient WO₃ photocatalyst modifications are necessary. The present study is an attempt to demonstrate the effect of doping and coupling on WO₃ for improving photocatalytic activity (PCA) of WO₃ material under light irradiation to degrade the organic pollutant from wastewater.

IDENTIFICATION OF BIOFORTIFIED RESTORERS ON VARIED CMS SOURCES IN PEARL MILLET [*Pennisetum GLAUCUM* (L.) R. BR.]

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Abstract

Pearl millet [*Pennisetum glaucum* (L.) R. Br.], hybrids grown widely in India are all based on A1 CMS source. Fertility restoration behaviour was studied in hybrids developed using biofortified restorers on two diverse cytoplasm in Pearl millet. CMS sources used in the study included A1 CMS which was developed from male sterile line Tift- 23A, A4 CMS which was identified in a wild grassy *Pennisetum glaucum* (L.) R. Br. sub sp. *Monodii* (Maire) Brunken. Fertility restoration of seven biofortified restorers viz., Fe & Zn-1, Fe & Zn-5, Fe & Zn-8, Fe & Zn-9, Fe & Zn-12, Fe & Zn-13, Fe & Zn-14, on eight CMS lines viz., ICMA-98222, ICMA-04999, ICMA-06444, ICMA-96666 and ICMA-97111 are of A1 based cytoplasm and ICMA-15666, ICMA-03999 and ICMA-05222 are of A4 based cytoplasm, have been studied during kharif 2019-20. Out of seven biofortified restorers used in the present investigation, four restorers viz Fe & Zn-1, Fe & Zn-5, Fe & Zn-9, Fe & Zn-12 could restore fertility completely (90 - 100 %). Whereas Fe & Zn-08 exhibited complete fertility restoration on six CMS lines except on ICMA-06444A1 and ICMA-03999A4 on which the extent of fertility restoration was partial (60-70%). Fe & Zn-13 and Fe & Zn-14 revealed complete restoration on seven CMS lines and partial fertility restoration on ICMA-97111A1 and ICMA-15666A4, 50-60% and 70-80% of partial fertility restoration was observed respectively. This investigation has helped in identification of biofortified restorers for varied CMS sources for further development of diversified new hybrids in Pearl millet.



CASE STUDY ON COST ECONOMICS OF FARMYARD MANURE SPREADERS

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Abstract

Timely application of manure in accordance with the nutrient requirements of the crops will result in improved crop production. Farmyard manure (FYM) is the oldest organic manure used by man ever since involved in farming. In organic farming, manure applicator is promising solution for uniform spreading of farm yard manure over the field. In order to provide and review the information found in the literature about cost economics of farmyard manure spreader, the first point is to be noted that animal drawn FYM applicator was economically feasible, eco-friendly and easily operated in field. Animal drawn FYM applicator is useful to marginal and small scale farmers. Further next information by the review was that tractor operated manure spreader saved the 94% time of FYM spreading as compare to traditional method. Average actual field capacity of the tractor operated manure spreader was 1.473 h/ha at forward speed of 2.438 km/h with effective swath width 7.4 m. The cost of spreading with the tractor operated manure spreader was Rs. 247 per ha. The saving in cost was 72 per cent as compared to conventional method of manual broadcasting. Another machines of tractor trailer cum farmyard manure spreader saved the FYM spreading time 50-60% when compared to the conventional method. The operational cost was Rs. 124 per hectare and reduction of cost of operation by Rs. 156 per hour as compared to conventional tractor-trailer system. Special attention has been paid to the relevance of capacity of FYM hopper for reducing number of passes of machine and increase in field capacity for saving cost of operation and time of manure spreading.

RELATIVE TOXICITY OF INSECTICIDES TO LADYBIRD BEETLE, *CHEILOMENES SEXMACULATA* (FABRICIUS)

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Abstract

An investigation was carried out to evaluate the relative toxicity of different stages of ladybird beetle, *Cheilomenes sexmaculata* (Fabricius) at Department of Agricultural Entomology, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) during the year 2019-20. A total of nine insecticides, viz.; acetamiprid (0.006%), buprofezin (0.05%), fipronil (0.01%), flonicamid (0.015%), imidacloprid (0.089%), spinosad (0.0135%), spiromesifen (0.0229%), thiacloprid (0.013%) and thiamethoxam (0.01%) were evaluated. The analysis of relative toxicity of insecticides against eggs, grubs and adults of *C. sexmaculata* showed that acetamiprid, thiacloprid and spinosad showed more than 50 % mortality. Imidacloprid, spiromesifen and fipronil were relatively less toxic to the predator than spinosad. While flonicamid, buprofezin and thiamethoxam proved safer insecticides to the adults of *C. sexmaculata*. On the basis of toxic potential of insecticides to *C. sexmaculata*, the insecticides evaluated can be arranged in descending order as: acetamiprid > thiacloprid > spinosad > imidacloprid > spiromesifen > fipronil > thiamethoxam > buprofezin > flonicamid.

RECENT ADVANCES IN THE DETECTION OF PLANT DISEASES

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Abstract

Morphological, cultural and microscopic methods of detection of plant disease require substantial time, expertise and classical taxonomic comprehension. These limitations created a need for investigations that rely on molecular aspects. Thus, came into light the versatile novel molecular methods in fungal diagnostic field that are gaining immense value in recent times. The



phenotypic characters based immunological techniques and genetic load dependent technology based on nucleic acid probe and polymerase chain reaction technique are comparatively advantageous over the conventional methods as they do not require culturing of organisms and also provide purely specific and precise results. The pathogens present in latent phase with no visible sign of infection can be determined using nucleic acid-based methods along with the phylogenetic details with closely related species. The molecular methods viz., DNA/RNA probe technology encompasses macro array, in situ hybridisation, fluorescence in situ hybridisation and southern hybridisation. PCR technology is varied into multiplex PCR, nested PCR, real-time PCR and reverse transcriptase (RT)-PCR. Another extensively used recent outbreak in the field of diagnostics is DNA barcoding. Nucleic acid sequence-based amplification (NASBA), loop-mediated isothermal amplification (LAMP) and rolling circle amplification (RCA) are employed under Isothermal amplification technology.

MORPHOLOGICAL CHARACTERIZATION OF SOUTH INDIAN AVOCADO (*PERSIA AMERICANAMILL.*)

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Abstract

Avocado (*Persea americana* Mill.) is one of the emerging high value fruit crop in India belongs to the family of Lauraceae. It was originated in Mexico and Central America possibly from more than one wild species. In India, avocado is not a commercial fruit crop and the production is very limited. Avocado was introduced by an American missionary, residing in Bangalore between the years 1906 and 1914 from Royal Botanical Gardens, Ceylon. Later on, it was spread to different parts of the country. Wide variability was created in avocado for fruit shape, size, colour and quality traits due to its high heterozygous nature. As a result, large number of accessions have been evolved naturally due to seed propagation. Hence to know the diversity exists in avocado the present study was formulated. In the present study, the survey was carried in hot spots of South India mainly Karnataka, Tamil Nadu and Kerala. Total eighty-three accessions were collected from parts of South India, among which forty-three accessions from Karnataka, twenty-nine from Tamil Nadu and eleven from Kerala. All the collected accessions were characterized by using Bioversity International avocado descriptors for different morphological, fruit and seed traits. The results showed the wide variation for fruit shape, fruit size uniformity, fruit base shape, fruit apex shape, pedicel position on fruit, apex position, ridges on fruit, pedicel shape, fruit peel surface, peel colour, fibre in flesh, flesh texture, seed shape, seed position and cotyledon surface among different accessions. The presence of avocado population ranged from the elevation of 680 MSL to 1600 MSL. Eight different forms of fruit shapes were existing in collected accessions among which narrowly obovate (24.10 %) and obovate (21.69 %) shapes were more common than pyriform (7.23 %) and high spheroid (6.02 %). With respect to fruit colour, light green colour (38.55%) accessions were more dominant compare to other colours and two yellow colour accessions were also found in identified population. This studies not only helps to know the status of diversity exists in avocado for different traits and also useful for the development of a conservation strategy for future breeding programme.

CLIMATE-SMART PERFORMANCE OF BAMBOO (*BAMBUSA* SP): EVIDENCE FROM EASTERN HIMALAYAN REGION

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Abstract

Climate change is a global challenge. Eastern Himalayan Region (EHR), India is extremely vulnerable to climate change. EHR is an internationally recognized biodiversity hotspot. The EHR is home, livelihood and survival for millions of people. Agriculture is the mainstay for about 75% of the population and plays a crucial role in the economy of the region. But, agriculture is entirely dependent on climatic factors and most vulnerable to climate change. Climate change is influencing the production, productivity and regional food security. Climate-smart agriculture (CSA) is the approach to achieve food security



without or less emission of Green House Gases (GHGs). This paper is an attempt to examine the climate smartness of bamboo (*Bambusa* sp), a commonly grown non-timber plant. Globally recognized three major dimensions; namely, productivity, resilience and mitigation were emphasized to assess the climate smartness. Altogether, 26 parameters/aspects had been taken into consideration to determine the climate smartness of bamboo. A questionnaire with 5 points continuum was developed to collect the information from the respondents. The mean of individual parameter/aspect, as well as overall mean of all parameters/aspects, were calculated to assess the climate smartness in respect of particular aspect and overall. In this study, 35 technocrats and scientists from Agriculture and allied departments, research station, and KVKs of Nagaland, India were included as respondents. The overall mean score was 3.15, and the mean score was 3.0 and above in respect of 24 parameters/aspects. Based on the findings of the study, it is concluded that bamboo is a highly climate-smart crop. Therefore, policy and extension mechanism should take the initiative for better and faster expansion of area under bamboo to mitigate the emission of GHGs and reduce the negative impact of climate change on EHR.

DISPARITY IN FOODGRAINS PRODUCTION IN NORTH EASTERN REGION OF INDIA

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Abstract

Agriculture growth and instability have remained subject of intense debate in the agricultural economics literature in India. This paper investigates the temporal variations in area, production and yield of foodgrains across the states of north eastern India. The study period was from 1966-67 to 2014-15 and it has been divided into five periods: 1966-67 to 1974-75, 1975-76 to 1984-85, 1985-86 to 1994-95, 1995-96 to 2004-05 and 2005-06 to 2014-15 to have an understanding of decadal performance among the states. Variance analysis depicts that yield varies slowly over each study period with a large variability among the states suggesting the identifiable state specific factors that causes the variation in a large scale with a significant p-value less than 0.001 in all the periods. The probable state specific factors may be government policies, agriculture input technologies, topography, soil fertility, natural resources, agriculture functionaries, etc. Study shows in 2005-06 to 2014-15 the average yield of an individual state over the years ranges between 284.6 (Mizoram in 2008) to 2782.9 (Tripura in 2015) and varies by 1303.4 across the states (between variation), but varies by 287.2 for each individual state over time (within variation). Similar pattern has been observed in rest of the periods as well as in the entire period. Overall, between and within variation of yield of foodgrains exhibit gradual increase over the period 1966-67 to 2014-15 where the quantity and rate of increment is highest for between variation and least for within variation during these five consecutive periods. This means that state specific factors are becoming more specific resulting the variability larger among the states in the course of time. Among the states Mizoram followed by Nagaland registered comparatively highly instable in area, production and yield in all the periods while Sikkim, Meghalaya and Assam were found comparatively more stable. Arunachal Pradesh, Manipur and Tripura were lying somewhere in between the two situations.

VARIABILITY, INTERRELATION ANALYSIS AND GENETIC DIVERGENCE IN COWPEA [*VIGNA UNGUICULATA* (L.) WALP.] GENOTYPES

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Abstract

The current experimental trial was conducted to draw out the informations on different variability parameters, correlation and path coefficient and genetic divergence for 12 attributes in thirty cowpea genotypes. Analysis of variance showed appreciable and significant genetic variability among the genotypes for all the traits under present study. Phenotypic and genotypic coefficient of variation along with heritability and genetic advance as per cent of mean (genetic gain) were reported high for traits like number of pods per plant, harvest index, seed yield per plant and plant height. Plant height, number of pods per plant, harvest index and number of seeds per pod were significantly and positively associated with seed yield and also



contributed directly towards seed yield. These 30 genotypes were clustered into 8 distinct groups using Mahalanobis D^2 statistic and Tocher's method. Cluster I and cluster II were the largest comprised of 12 genotypes each. Cluster III, IV, V, VI, VII and VIII were monogenotypic indicating wide diversity from the rest and also from each other. The maximum intra cluster D^2 value was observed within cluster II followed by cluster I suggesting that genotypes present in these clusters might have different genetical constitution. The highest inter cluster distance was registered between cluster II and cluster III followed by cluster II and cluster V and cluster II and cluster IV indicating wide divergence among these clusters. The crossing among the genotypes of these divergent clusters could be used in hybrid development programme of cowpea.

ROBUST GENOMIC PREDICTION USING INTEGRATED FRAMEWORK UNDER ADDITIVE AND NON ADDITIVE GENETIC ARCHITECTURE

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Abstract

Genomic selection procedures have proven to be useful in estimating breeding values and predicting phenotype using genome-wide molecular marker information. Number of parametric methods has been proposed to predict individual breeding values by modeling the relationship between individual genotype and phenotype. However it has been observed that parametric methods only performs satisfactory when system under study have additive genetic architecture. However, some nonparametric methods have also been developed to capture non additive (dominance & epistasis) variances, but these generally fail to capture additive variances. The idea behind this study is to identify best suitable model from each of the parametric and nonparametric category and to develop an integrated model which can capture merits of both the models. It was observed from the results of comparative study between parametric and nonparametric methods that under additive architecture, GBLUP performed quite well while, performance of SVM was found to be encouraging in the case of non-additive architecture. Keeping these results in the mind, a robust model has been developed for genomic prediction which can handle additive and epistatic effects simultaneously by minimizing their error variance. Developed integrated model has been evaluated using the measures of prediction accuracy and error variance. Moreover, it has also been observed that our proposed model is robust to the diverse genetic architectures.

AN ANALYSIS ON THE MEDIA COMMUNICATION BARRIER AND SUITABLE INTERVENTIONS FOR EFFECTIVE ADOPTION OF ADVANCED BANANA CULTIVATION TECHNOLOGIES IN TAMIL NADU, INDIA

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Abstract

The knowledge levels of farmers on science and technology are very less or negligible and are the major obstacle in achieving the potential growth and development in the agricultural production in the country. Though the growth of Information and Communication Technology (ICT) in the developing countries offers new avenues in transferring the technology/knowledge from lab (source) to land (receiver ends), the access to the farmers in accessing of information is rated as poor. Also without a strong willingness of the media in disseminating the advanced technologies to the farmers, it is impossible to assimilate, adopt, and generate new farm technologies. Under the circumstances, the present research was attempted to examine the media communication barriers and constrains and also to assess the satisfaction level of media communication intervention in dissemination of cultivation technology among the banana farmers. The study was conducted in five selected major banana growing blocks of Tiruchirappalli district in Tamil Nadu. In this study, adoption of the quantitative survey method for the collection of opinion data from 750 respondents revealed that there is communication barriers and constrains in effective transfer of technologies on banana cultivation and delivery of seasonal based related information. The major barriers and constraints associated with institutions and extension centers are financial crisis, lack of man power, lack of in-service



training. It is imperative that the mass media such as print, electronic and new media is involved in dissemination of the emerging science and technology information meaningfully for the better understanding of the target groups and to avoid communication barriers and constraints. It is also learnt that in the digital era it is the responsibility all TV and Radio channels' to dedicate more sufficient timeslots and regular broadcast timings for agricultural programmes in local language which will motivate the people to involve in the agricultural occupation. Further, this will bring the sustainability, relevance and responsiveness among farmers and significant changes in their behavior to adopt new innovations in agriculture.

MOLECULAR VARIABILITY STUDY AMONG THE ISOLATES OF *SCLEROTIUM ROLFSII* SACC., INFECTING GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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Abstract

Groundnut (*Arachis hypogaea* L.) oilseed crop is largely grown throughout the world. Ten isolates of *S. rolfsii* collected from groundnut grown areas were investigated for their genetic variability study. ITS primers (ITS1 and ITS4) produced amplicon size of 650-700bp by PCR amplification of rDNA, which confirmed that all isolates cluster were belonged to genus *Sclerotium*. RAPD primers detected genetic variation among the isolates and divide into similarity groups. The highest numbers of amplicons (13) was observed in OPA-9 primer. Total 105 polymorphic and monomorphic bands were produced by RAPD primers. Highest (D) power was generated by OPA-9 primer. Isolates SrA-SrH (0.575), SrBKN-SrA (0.384) and SrBKN-SrBKL (0.330) exhibited highest similarity coefficient. UPGMA based dendrogram, generated for distinct isolates revealed that, SrBKN, SrA, SrH, SrJPF, SrJPP and SrT isolates included in Groups I. SrBKL shows highest (51%) diversity in Group II whereas Group III, Churu (SrC) isolate shows 49% diversity. From the dendrogram and cluster analysis it has been cleared that Group I was more genetically diversified among the isolates. Hence, present investigation will helpful to understand the epidemiological aspect of different strains and their management.

DEVELOPMENT, EVALUATION AND GENOTYPING OF DOUBLE LOW WHITE RUST RESISTANT LINES IN INDIAN MUSTARD (*BRASSICA JUNCEAL*.)

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Abstract

Present study aims to develop 44 genotypes having both quality as well as white rust resistance in *B. juncea*. The double low trait and white rust resistance trait were further confirmed at genotypic level using trait specific molecular markers. The lines under study were also undergone through cluster analysis to study genetic relatedness among them. The forty-four advanced double low lines were developed through pedigree selection method from different crosses involving high yielding lines (NRCHB101, NRCDR02, Varuna, PCR7) and double low quality donors (EC564648, EC552573, NUDHYJ-3, NUDHYJ-5) as parents, have been evaluated in field during *rabi* 2017-18 for 12 yield and attributing traits. These lines were also evaluated biochemically for 9 quality traits, that include, saturated fatty acid (%); oleic acid (%); linoleic acid (%); linolenic acid (%); erucic acid (%); glucosinolate (microgram/ gram defatted seed-meal); antioxidant (AAE mg/g); flavonoid (QE mg/g) and beta-carotene (ppm) for 3 consecutive years (2017-19). The lines were inoculated artificially and reactions to white rust have been observed for 2 consecutive years (2018-20). Subsequently, double low trait in these lines was further confirmed by genotyping of these lines using CAPS markers for FAE 1.1 gene namely E1 and E2 for low erucic acid and low glucosinolate specific markers i.e. GER-1 (Q1) and GER-5 (Q5). Resistance for white rust was further confirmed genotypically using intron polymorphic markers namely, At5g41560 and At2g36360 linked to white rust loci AcB1-A4.1 and AcB1-A5.1, respectively. The analysis of variance of these lines revealed significant difference among the genotypes for all the traits studied, indicating sufficient amount of genetic variability in the material. Study of genetic parameters showed highest phenotypic and genotypic



coefficient of variation for flavonoid, number of secondary branches and beta carotene, high heritability from 72.16% for plant height to 99.72% for antioxidant, while higher genetic gain for seed yield per hectare, oil yield per hectare, linolenic acid, antioxidant, flavonoid and beta carotene. The principal component analysis (PCA) indicated first seven principal components (PCs) showing Eigen values more than one and cumulatively explaining 75 % of total variability. The first component (PC1) explained 25.78% of variation through seed yield, oil yield, fruiting zone length, oil content, 1000 seed weight, primary branches and secondary branches, while PC2 accounted 13.12% of variation loaded on main shoot length, siliquae on main shoot, seed yield, oil yield and fruiting zone length. The lines were further analyzed for dissimilarity index generated through binary matrix using thirty SSR polymorphic markers with an objective to observe the genetic distance among them. Allelic differentiation measured in terms of PIC value ranged from 0.129 to 0.678 with an average of 0.456. The dendrogram was constructed and grouped into three clusters with seven sub-clusters (IIa, IIb, IIIa, IIIb, IIIc, IIId, IIIE). The developed white rust resistant double low lines can be utilised in improving breeding programme of *B. juncea*.

DISEASE PREVALENCE IN CROSS-BREED CATTLE OF BIHAR IN MIDDLE INDO-GANGETIC PLAINS

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Abstract

Bihar is geographically located on both sides of the river Ganga having good potential for livestock husbandry and is the fifth largest livestock (36.5 million) populated State in the country. The cross-breed female cattle population in the state has increased from 1.1 million in 2003 to 3.9 million in 2019. The Bihar state reached 10 million tons in milk production in 2018-19, growing from 2.7 million tons in 2001-02. In the present study, disease observed, diagnosed and reported in cross-bred cattle during animal health camps organized in different districts of middle Indo-Gangetic plains of Bihar for disease diagnosis, prophylaxis and treatment from 2016-2019 has been recorded and analyzed. It was observed that cross-breed cattle health suffered from infertility, mastitis, indigestion, FMD, 3-day sickness, udder edema, acidosis, lameness, tick infestation, theileriosis, udder pox, etc. Diagnosis was based on disease history, clinical observations and laboratory investigations. Zone wise variation in disease and health problems varied. Information about the animal management techniques from the owner was collected in pre-tested questionnaire for follow up study with the help of KVKs. Most of these conditions were provided with suitable line of treatment using long or single use parenteral medicines or multiple dose oral medicines with variable recovery rate. The recovery was recorded based on improvement in clinical symptoms and improvement in production. Follow up animal health camps and farmer's response for meso-level health intervention was positive and economically beneficial for the intervened farmers related to increase in production and body weight and decrease in losses due to health problems.

DECIPHERING THE MOLECULAR BASIS OF INTERACTION BETWEEN THE PLANT GROWTH PROMOTING BACILLI RHIZOBACTERIA AND *ORYZA SATIVA*

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Abstract

The use of *Bacillus amyloliquefaciens* as a biocontrol agent exploits copious mechanisms against the plant pathogens, which includes; potential to produce various antibiotics, direct inhibition of pathogens, plant growth promotion and induction of defense enzymes. But the interaction between rice plants and *B. amyloliquefaciens* is yet to be clearly defined which can be studied by way of molecular techniques. Among the various molecular techniques available, proteomics approach has been widely used to study the molecular mechanisms behind the interactions between the host-pathogen-PGPR strains. Sampling of leaf and root tissues from control and treated plants were collected at 72 h after bio-agent treatment, the experiment was repeated twice (biological replications) with adequate replications. The protein was extracted using lysis buffer and protein quantification was done using the Bradford method. The differentially expressed proteins were sent to Sandor Lifesciences



Pvt Ltd, Hyderabad, India for MALDI-TOF MS/ MS analysis. MASCOT search demonstrated homology for the following important proteins viz., Thioredoxin, Hexokinase-6, Signal peptide peptidase-like 3, Protein phosphatase 2C, Ribulose biphosphate carboxylase, Copper transporter. The functions of the proteins were identified and these proteins might play a major role in the bio-protection mechanism of the strain *B. amyloliquefaciens* in rice plants.

SAFETY OF INDIAN PLANT GERMPLASM AND ASSOCIATED INTELLECTUAL PROPERTY RIGHTS

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Abstract

India is the richest centre of plant genetic diversity in the world. 10.9 % of global plant germplasm numbering to 45,400 families originated in India. More than 70% of the germplasm collected in the International Gene Bank of IRRI Philippines were resourced from India. So is the case with many crops of food, fibre and other useful plants. Question is raised on the safety of this germplasm. Enough regulations and institutions have been put in place to protect the germplasm. Intellectual Property India in 1970, NBPGR in 1976, Plant Varieties and Farmers Right Act (PPV & FRA) in 2001, Plant Breeders Right in 2001, Geographical Indication (GI) in 2003 and Rajiv Gandhi National Institute of Intellectual Property Management in 2006. Are these working effectively ? Cases of Basmati, Turmeric and Neem are historic. But recent case to examine is Kalanamak rice. Kalanamak is heritage rice of eastern Uttar Pradesh and valued for its high aroma, superb taste and high nutritive quality. It has rare high level of iron and zinc. 250 germplasm of Kalanamak rice were collected from farmers and research institutions, described for 42 morph-agronomic characters, catalogued and conserved at National Gene Bank, at National Bureau of Plant Genetic Resources, New Delhi. Kalanamak was registered under Protection of PPV & FRA. It received Geographical Indication (GI) tag for 11 districts in eastern U.P. and effective until March 2030. Four improved varieties namely Kalanamak KN3, Bauna Kalanamak 101, Bauna Kalanamak 102 and Kalanamak Kiran were released and notified in 2010, 2016, 2017 and 2019 respectively. Price of the Kalanamak paddy ranges between Rs. 3,500/- to Rs. 4,000/- per quintal contrary to Rs. 1,800 MSP announced by the governments. Cost of cultivation being the same as HYV, Kalanamak farmers get three times more net profit. Organic Kalanamak fetches 20% premium over normal Kalanamak. Summarily compared to Rs. 28,000 / ha net profit from common HYV rice, Kalanamak 3 will give Rs. 47,500, Kalanamak Rs. 78,500 and Organic Kalanamak Rs. 99,000 per hectare net profit. Farmers are assured of local and export market defying the proverb “Paddy and Poverty go together”. But all will be a day dream if Japan grows Kalanamak and catch our export markets, as announced by someone 2020. Is there any one to protect Kalanamak under PPV & FRA, Plant Breeders Right and GI ? The answer appears “No”. We will discuss it.

SURGICAL MANAGEMENT OF ACQUIRED EVISCERATION OF RUMEN IN A BUFFALO

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Abstract

Evisceration is the protrusion of the viscera through a defect in the body wall. It may be congenital or acquired. In spite of the inciting cause exposure of the abdominal viscera warrants immediate surgical intervention. A clinical case of traumatic ruminal evisceration was managed surgically. The lacerate wound and exposed rumen was cleaned with normal saline and examined thoroughly for any perforation and contamination. Buffalo sedated with with butorphanol at dose rate of 0.2 mg per kg body weight and midazolam at the dose rate of 0.2 mg per kg body weight. Rumen was carefully reduced into abdominal cavity. The tear peritoneum and muscle was close with non-absorbable suture material polyimide No.2 in overlapping pattern, followed by a subcutaneous suture with vicryl no. 2 in continuous pattern. Skin was sutured as per the standard technique. Animal post operatively prescribed with broad spectrum antibiotic amoxicillin sodium and Sulbactam sodium at the dose rate of 10 mg/ kg body weight intramuscularly for 7 days. Inj. Fuxin meglumine was given at the dose rate of 2 mg/ kg body weight



I/M for three day as analgesic agent. Animal start feeding from next day and fully recovered after 15 day. Suture removed on 12th days.

ROLE OF AGRICULTURAL BIOTECHNOLOGY TO ENHANCE CROP PRODUCTIVITY IN POST COVID ERA

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Abstract

The ongoing coronavirus pandemic is a public health emergency with grave implications for the population of the world. India, as part of the global community, has been adversely impacted by ongoing health crisis— especially the poor and marginalized. However, there is a relatively low understanding of socio-economic science. This pandemic is a global health crisis and can also lead to the food security crisis in India if correct measures are not taken. In India, it is imperative to minimize the adverse effect and disruption of livelihood of the poor and marginalized. Although supplies of staples, fruits, vegetables, and meats have been adequate during the COVID-19 outbreak so far, still there are threats to food security, in the long term. Restrictions on transportation and movement of people have already led to some food logistic challenges. India needs to create more synergies in food technology, agriculture, biotechnology. Prioritizing and adaption of innovation should act as main drivers of productivity growth and improved sustainability. The application of biotechnology to agriculturally important crop species has traditionally involved the use of selective breeding to bring about an exchange of genetic material between two parent plants to produce offspring having desired traits such as increased yields, disease resistance, and enhanced product quality. The exchange of genetic material through conventional breeding requires that the two plants being crossed (bred) are of the same, or closely related, species. Such active plant breeding has led to the development of superior plant varieties far more rapidly than would have occurred in the wild due to random mating. However, traditional methods of gene exchange are limited to crosses between the same or very closely related species; it can take considerable time to achieve desired results; and frequently, characteristics of interest do not exist in any related species. Modern biotechnology vastly increases the precision and reduces the time with which these changes in plant characteristics can be made and greatly increases the potential sources from which desirable traits can be obtained. Fostering Genetically Modified Organisms (GMOs), using genetic engineering is another way of contributing to food and nutrition benefits while boosting agricultural production besides reducing a post-harvest loss. The application of biotechnology in agriculture has resulted in benefits to farmers, producers, and consumers. Biotechnology has helped to make both insect pest control and weed management safer and easier while safeguarding crops against disease. Biotech crops can make farming more profitable by increasing crop quality and may in some cases increase yields. The use of some of these crops can simplify work and improve safety for farmers in the coming years. This may allows farmers to spend less of their time managing their crops and more time on other profitable activities.

INVITRO EVALUATION OF PSEUDOMONASFLUORESCENSISOLATESFOR THE INHIBITION OFASPERGILLUSFLAVUS AND AFLATOXIN CONTAMINATION IN GROUNDNUT

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Abstract

Aflatoxin contamination caused by *Aspergillusflavus* is a qualitative problem in groundnut (*Arachis hypogaea* L.) occurring at both pre-and post-harvest stages. Use of plantgrowth-promoting rhizobacteria (PGPR) is a viable and sustainable option in managingaflatoxin problem in groundnut. Of different PGPR, *Pseudomonas* spp. is one of the widely used bacteria againstmajor plant pathogens in groundnut. Ten native *Pseudomonas fluorescens* isolates fromgroundnut rhizosphere were isolated and screened against *A. flavus* by dual culture andin vitro seed colonization (IVSC) assays. In general, allthe isolates



under study inhibited *A. flavus* in dual culture studies. Of different treatments, highest inhibition of *A. flavus* was obtained with Pf7 (54.8%) followed by Pf2 (48.7%) and Pf6 (48.2%). The isolates of *P. fluorescens* (Pf) evaluated by IVSC indicated that the colonization severity of *A. flavus* was significantly reduced over control when seeds were treated with bioagents, Pf2, Pf6, Pf7 and Pf9. Of these, seed treatment with Pf7 has resulted in least colonization severity of *A. flavus*. This is followed by Pf2 and Pf9 and Pf6. The seeds in control have recorded maximum colonization severity by *A. flavus*. The difference in colonization severity over control was highest with Pf7 (25.8), followed by Pf2 and Pf9 (22.7) and Pf6 (18.5). Overall, the Pf isolates, Pf7, Pf2, Pf9 and Pf6 were effective in reducing *A. flavus* infection on groundnut seeds. Of different treatments, the aflatoxin content was least in seeds treated with Pf7 (27.8 $\mu\text{g kg}^{-1}$). The efficacy of Pf7 was significantly superior over other Pf isolates. This was followed by seeds treated with Pf1 (754.7 $\mu\text{g kg}^{-1}$), Pf8 (1051.6 $\mu\text{g kg}^{-1}$) and Pf2 (1151.9 $\mu\text{g kg}^{-1}$) with no significant differences among them. Seeds in control have recorded highest aflatoxin content of 1521.1 $\mu\text{g kg}^{-1}$. Overall, the PGPR isolate, Pf7 was highly effective in reducing kernel aflatoxin contamination in groundnut through IVSC assays. In our present study, the Pf7 isolate exhibited superior activity in inhibiting mycelial growth of *A. flavus*, its colonization on groundnut seeds and aflatoxin production.

MOLECULAR CHARACTERIZATION OF *FUSARIUM OXYSPORUM* SP. *LENTIS* AND ANALYZING DEFENSE RESPONSES OF LENTIL AGAINST IT

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Abstract

Lentil (*Lens culinaris* Medikus Sub sp. *Culinaris*) is one of the most nutritious pulse crops riched in protein, carbohydrate and minerals. In the global lentil scenario, India ranked first in the area and second in the production with 39% and 22% of world area and production respectively. Bihar is one the major lentil growing state which is being grown on an area of about 1.51 million hectare area with a production of about 1.0 million tones. The majority of the lentil crop grown in Tal area of the state. As it is cultivated as a rainfed crop, it gets severely affected by several biotic and abiotic stresses. Among the biotic stresses, Fusarium wilt, caused by *Fusarium oxysporum* f. sp. *lentis*, is one of the major fungal diseases and remarkably causes severe crop damage from vegetative to reproductive stage, thus causing severe yield loss. The present study was designed to analyze the degree of aggressiveness of *fusarium* isolates of the state, to determine the genetic variability among them and to study the biochemical and molecular basis lentil defense response upon pathogen infection. For the research work, total 12 *Fol* isolates were collected from major lentil growing areas in Bihar (Tal area of Mokama, Lakhisarai, Barh and Bhagalpur, Banka districts) The isolates were collected from different lentil growing region of the state and the pure culture were maintained. To study the aggressiveness of the isolates, two differential lentil genotypes (resistant PL-6 & susceptible JL-3) of wilt were grown in soil infected with fusarium under green house condition. In resistant (PL-6) cultivar, the pre-germination mortality among all the treatment ranged between 5 to 62.7%. while in JL-3 i.e. susceptible cultivar, the pre-germination mortality among all the treatment ranged between 37.7 to 90.6%. Among all the isolates, AGLF-11 isolate exhibited higher aggressiveness and significantly caused pre and post germination mortality in both the genotypes, while FOL+ isolate was found least aggressive. Further, molecular characterization of the isolates was also carried out on the basis of amplification and sequencing of ITS regions of isolate and the results revealed that there was significant diversity between the isolates. In molecular characterization, a wide range of genetic diversity (~62% to 99%) was observed among all isolates. AGLF-9 isolate was most dissimilar among all the isolate and the percentage identity was about 62% as compare to others. On the basis of the results of first experiment, we considered AGLF-11 and FOL + as highly aggressive (HA) and least aggressive (LA) isolate respectively and the comparative expression analysis was further carried out. In comparative biochemical analysis, the expression of all the PR proteins (glucanase, chitinase, POX and SOD) was significantly increased in both the cultivars (PL-6 and JL-3) upon infection with least aggressive FOL-(+) isolate at 24 hai and 48 hai and thereafter decreased in subsequent hours. Cultivars (PL-6 and JL-3) infected with highly aggressive AGLF-11 isolate, the expression of PR-proteins was increased at 24hai only and significantly decreased afterthat. When the expression analysis was compared between the cultivars, resistant (PL-6) genotype retained higher enzymatic activity in both isolates i.e H.A & L.A as compare to the susceptible (JL-3) cultivar. In gene expression analysis, the PR genes were significantly expressed in PL-6 as compare to the



JL-3 upto 48 hai upon least aggressive FOL-(+) isolate infection. The results suggest that PR-gene products may have a function in plant development and therefore, highly expressed in tolerant genotype of lentil, ready to detect any attack and provide durable defense system to plants. The detailed characterization of PR genes would be potentially used as molecular markers for screening resistance/susceptible lentil genotypes as well as could be used for developing transgenic and/or improved lentil varieties resistant to *Fol* infection suitable under changing climatic scenario.

EFFECT OF STOCKING DENSITY ON THE CARCASS TRAITS OF SOVIET CHINCHILLA AND NEW ZEALAND WHITE BREEDS OF BROILER RABBIT

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Abstract

The experiment was conducted to determine the effect of stocking densities on the productive performances of broiler rabbits under the climatic condition of Assam. 24 number each from Soviet Chinchilla and New Zealand White breeds of rabbits were taken for the study. The 24 rabbits of both the genetic groups were grouped as 4, 8, 12 individuals and placed in identical cubicles of Length-1.16 m and breadth-1.30 m size. The groups were nomenclature as GI, GII and GIII for the convenience of the study. Space allocation in the cubicle housing 4 rabbits was 0.38m²/ animal, cubicles housing 8 and 12 rabbits had space allocation of 0.19m²/animal and 0.12m²/animal respectively. At 13th week preslaughter weight, hot carcass weight, inedible offal weight, dressing percentage, edible offal weight, different wholesale cuts and major proximate composition of meat was estimated.

Results reveals that stocking density had no effect ($P > 0.05$) on carcass characteristics, hot carcass weight, dressing percentage, edible and inedible offal weight, different wholesale cuts and major proximate composition of meat.

ASSESSING IMPACT OF COLD TEMPERATURE AT GROWTH AND PRE-FLOWERING IN WINTER MAIZE

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Abstract

Maize is the third most important cereal crop after rice and wheat in India contributing to around 10 percent food grain production in the country. Multiple uses of maize like food, feed, fodder and industrial raw material are the driven forces for increasing its demand globally. Maize is traditionally a *kharif* season crop, but its cultivation is increasing in the rabi and spring season due to higher productivity than the *kharif* crop. Abiotic stresses like cold, waterlogging, drought and heat cause significant yield losses in maize. Low temperature or cold stress during the growth and pre-flowering stage is one of the major causes of yield reduction in winter maize. In rabi 2017-18 rabi maize crop production suffered from very poor grain setting due to cold stress at pre-flowering and prolong winter. Looking into the above facts the present study was conducted in RBD with two replications using 25 commercial and advanced stage experimental hybrids in 2018-19 and 35 hybrids in 2019-20. The experiment was laid on five sowing dates 25th October, 5th, 15th, 25th November and 25th December in both the year. Observations were recorded on 15 morphological and yield component traits. Based on pooled mean yield performance, the experiment laid on the 5th of November reported the highest mean yield (104. q/h) whereas, the experiment laid on 25th November showed the lowest mean yield (70.7 q/h). The crop laid on 25th November indicating the effect of cold stress at growth stages whereas sowing of the test entries on 25th October showed lower yield (89.6 q/ha) than the crop shown on 5th November indicating the mild effect of cold stress at growth and reproductive stage. The crop sown on 25th December managed to recover well after winter and resulted in an almost comparable yield of crop sown on 25th October. The planting of 5th November taken the maximum number of days to anthesis and maturity leading to the highest yield. The planting of 25th October coincides with the lowest temperature (8.5 °C) during anthesis affecting yield (fig 4). The planting of 15th November and 25th November was affected by cold temperature during growth and developmental stages up to the knee-high stage,



although temperature during anthesis was at par for both 5th and 25th November sowings. The study indicated that planting of maize on 5th November resulted in the highest yield and most suitable for the rabi maize planting in Bihar.

OPPORTUNITIES & CHALLENGES IN FOOD PROCESSING AND VALUE ADDITION

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Abstract

Despite the remarkable progress made in increasing food production at the global level, the FAO estimates that approximately half of the population in the World doesn't have access to adequate food supplies. In Rwanda, Ghana, Benin and India, recent studies have generated similar findings with losses ranging from 30% to 80%. There are many reasons for this, one of which is food losses occurring in the post-harvest management. This describes the major relevance and needs to ensure proper post-harvest handling and protection of the agricultural produce. Physical and quality losses are mainly due to poor temperature management, use of poor quality packages, rough handling, and a general lack of education regarding the needs for maintaining quality and safety of perishables at the producer, wholesaler, and retailer levels. Beyond promoting access to food, maintaining the taste of each product is fundamental to the market. Before the produce reached the market, there are multiple factors that can cause them harm or damage. According to many studies, farmers have been losing between 30% and 40% of the value of their fruits and vegetables before they reach the final consumer. These losses are observed at harvesting, during packing, transportation, in wholesale and retail markets and during delays at different stages of handling.

GREEN HERITAGE RIGHTS- AN ANALYSIS OF BIODIVERSITY POLICIES AND ITS IMPLICATIONS ON MANAGEMENT OF INDIAN PLANT GENETIC RESOURCES

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Abstract

Germplasm resource management has been an integral component of every advancement made in the history of crop breeding and it remained undistinguished from its more apparent counterpart (plant breeding) till three decades ago. However, as trait based plant breeding gained prominence, the concept of germplasm management emerged as an area in itself and as of now, it dictates the norms of breeding programmes. Three global international agreements that directly impact the access, exchange, conservation and utilization of PGR today are the Convention on Biological Diversity (CBD), 1993; the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), 2004 and the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits arising from their Utilization (NP), 2014. The ITPGRFA is the legal instrument for ABS with regard to PGRFA belonging to 64 crops mentioned in Annex I of the Treaty. Recently there were efforts to expand the list of Annex I crops, by including all of PGRFA, but it was not agreed by the General Body of the ITPGRFA due to significant differences in opinion amongst the participating nations. In the global scenario, there have been several reports on *prima facie* restrictions for access to Indian germplasm (Westengen *et al*, 2013; Lopez- Noriega *et al*, 2013) owing to our national legislative mechanism. Hence, in order to assess the extent of availability of Indian germplasm, we analysed the global conservation status of Indian-origin PGR accessions using Genesys Global Portal on Plant Genetic Resources. According to Genesys, there are 2,802,770 accessions in the global germplasm pool, conserved by over 450 organizations. Amongst these, 122,174 (4.36%) are Indian-origin accessions, of rice (19,230), Chick pea (12,922), pigeon pea (11,148), sorghum (9,983), wheat (7,242), pearl millet (8,088), ground nut (4,295), lentil (3,635), finger millet (3,041) etc. For majority of these crops, India is either the vavilovian centre of origin or a primary or secondary centre of diversity, thereby indicating availability of unique and diverse germplasm, along with landraces. Amongst these, 80,059 accessions are available for access as part of multilateral system of ITPGRFA and another 9000 accessions are available for distribution through bilateral system. The major holders of Indian-origin germplasm are the genebanks in USA, the Philippines, Australia, Russia, Taiwan, Lebanon, Nigeria Germany and UK. The 11 CG genebanks together holds 73,541 accns of Indian origin which accounts for 8.6 % of their total collection (largest individual contribution by any nation). Thus, it can be concluded that India is a major contributor to the global germplasm pool. Further, India has the second largest genebank in the world,



conserving more than 4.4 lakh accessions. We need to put cautious steps forward and critically oversee every development in the Treaty scenario. The new challenge being posed by Digital Sequence Information is one fine example.

“PHULE SONALI” COWPEA VARIETY FOR WESTERN MAHARASHTRA

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Abstract

A cowpea genotype, *Phule Sonali* is a white seeded cowpea genotype derived through the pedigree selection method from a cross of RC 101 x Phule Vithai made during 2011. The selections were made in F₂ population during 2013-14 and evaluated for yield and disease resistance for subsequent generations during 2012-13 to 2017-18. It was evaluated in station trial for yield evaluation repeatedly during 2016-17 and 2017-18 and tested in University multilocation varietal (13) trial during *Kharif* 2017-18 and 2018-19, were conducted at Agricultural Research Station Pandharpur, Solapur, Mohol, Karad, Rahuri, Badnapur and Akola. The genotype Phule Sonali consistently out yielded On the basis of overall mean performance of 13 locations the genotype Phule Sonali recorded (1392 kg ha⁻¹) seed yield as against the checks Phule vithai (1210 kg ha⁻¹), Phule Rukhumai (1001 kg ha⁻¹) and RC 101 (1068 kg ha⁻¹). It was increased seed yield over the checks Phule vithai, (13.07 %) Phule Rukhumai (28.08%) and RC 101 (23.27%). Simultaneously it was evaluated in All India Coordinated Initial Varietal Trial during 2017-18 at 10 locations for South zone. A genotype Phule Sonali consistently recorded higher seed yield than the checks PCP 306-1 (6.5 per cent), GC 3 (5.9) per cent and TPTC (4.03) percent. The performance in station and University multilocation varietal trial, it gave higher yield than the check Phule Vithai (12.45%) and PCP -0306-1 (19.49%) A genotype early (71-75 DAS) to maturing, Dwarf bushy, Determinate erect growth habit with synchronous maturity, complete non-viny, dark green leaves and bold (13.50 g) size and kidney shape seeds, moderately resistant YMV and CYMV and free from dry root rot, Minor incidence of Pests. Good bold grains of quality in respect of milling, cooking, rich in protein and amino acids having good yield potential. The overall mean performance of the genotype Phule Sonali consistently recorded the higher yield than all the checks included in respective trials. It was recommended and released as a Phule Sonali for seed purpose during 48th Joint Agresco at PDV, Akola during 29-31st November, 2020 for seed purpose cultivation in Western Maharashtra

STUDY OF GENOTYPE X ENVIRONMENT INTERACTION FOR RICE GENOTYPES USING WRICKESECOVALENCE METHOD

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Abstract

Rice is the major staple food for majority of the people in the world. Due to continuous and concerted efforts of many scientists made it possible, the development of variance varieties suitable for each and every agro-ecological condition throughout the world. But genotype expression over environments is referred to as genotype by environment interaction and is main challenge faced by the plant breeders as they reduce the stability of genotypic values under diverse environments. Further the impact of environment on phenology and growth varies depends on the crop, variety and growth duration and stage etc. In view of this the present study was conducted with 23 rice genotypes developed at Agricultural research Station, Nellore, ANGRAU, AP, India during 2017, 2018 and 2019 kharif seasons in randomized block design with here replications having a spacing of 20x15cm² in each season. All the recommended practices were followed to get a good and healthy crop. The genotype and environment interaction was studied for these 23 genotypes using Wricke's method of stability analysis (Wricke, 1962). The term ecovalence is used for the relative contribution of genotype 'I' to the overall genotype-environment interaction. This method considered the GxE interaction mean square on the criteria for stability. The minimum Wi² value indicates the stable performance of the genotypes. The results indicated that the genotypes NLR 3587, NLR 3580, NLR 3580 and NLR 3573 had the lowest ecovalence values and therefore would be considered to be the most stable genotypes. The ranks for these genotypes for yield were 1,15,4 and 17 respectively. Ecovalence values for NLR 3581 was low and the mean grain yield was also lower than the mean grain yield. For the genotypes, NLR 33892, NLR 3539, NLR 3592, NLR 3585, NLR 3548,



NLR 3586 and NLR 3545, even though the average grain yield was higher than the mean grain yield but the ecovalence values were high. Hence, the genotypes fall under these two categories may not be stable. The genotypes, NLR 3587 and NLR 3580 recorded both high grain yield as well as less ecovalence values, hence considered as stable genotypes with respect to yield.

COMPATIBILITY OF NEONICOTINOIDS, PYRETHRINS, SPINOSYNS AND ORGANOPHOSPHATES GROUPS OF INSECTICIDES WITH ENTOMOPATHOGENIC FUNGI VIRULENT AGAINST WHITEFLY *BEMISIA TABACI*

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Abstract

The use of entomopathogenic fungi (EPFs) is an important alternative to chemical insecticides for managing whitefly-*Bemisia tabaci*. EPFs alone may not always provide adequate management of sucking pests, but the concept of using ETFs in conjunction with pesticides in an integrated pest management programme is successful when both the pest management strategies implemented together are compatible. We evaluated 10 virulent EPFs against nymphs of *B. tabaci* and for their compatibility with insecticides belonging to neonicotinoids, pyrethrins, spinosyns and organophosphates groups under *in vitro* conditions. The highest nymphal mortality was recorded with *Beauveria bassiana* strain Bb-4511, Bb-4565 and *Metarhizium anisopliae*-Ma-1299 at 1×10^6 conidia /ml compared to other EPFs. The lowest LC_{50} values 0.2×10^4 and 0.5×10^4 conidia ml^{-1} were observed with *Cordyceps javanica* Cj-089 and Bb-4511, respectively. The toxicity index values were ranged from 19.5 to 106.9 irrespective to all EPFs and chemicals. Comparatively, the neonicotinoids, spinosyns were found to be compatible to moderately toxic to all the 10 EPFs, except Bb-4543, Bb-4565. Organophosphates (ethion) and pyrethrins (bifenthrin) were toxic to very toxic to all the EPFs except Bb-4511, Fv-083 and Ma-1299. However, the EPF strains Cj-102, Cj-089 were compatible with the half doses of bifenthrin, ethion and full doses of neonicotinoids and spinosyns. The results indicated that the most virulent EPFs can be used in conjunction/pairing with the compatible insecticides in IPM program for *B. tabaci* and CLCuD.

ENHANCEMENT OF SEED QUALITY OF LENTIL USING CHITOSAN AND ITS NANOPARTICLES

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Abstract

Lentil is considered as the future legume crop due to its high vegetarian protein and enriched micronutrient content. India ranked first in the area (18.00 lakh ha) and second in the production (11.00 lakh tonnes). Even after, ranking first in total area, production is not at par due to less productivity (611 kg/ha) as compared to Canada (1633 kg/ha). The major reason behind declining its productivity is mainly due to lack of quality seed. Non-availability of quality seeds remains one of the greatest impediments in bridging the wide gap between potential and harvested yields. Strategies for improving the growth and development of crop species have been investigated for many years. Seed priming using nanoparticles is emerging as promising technique for quality enhancement as it is positively associated with uptake of nutrient in order to increase seed vigour and initiating early germination. Our present study was focused to assess the efficacy of chitosan and its nanoparticles on seed quality enhancement in lentil based on their physiological and biochemical changes. Seeds primed with 0.5% chitosan showed significantly high germination i.e. 92% while 82% germination was recorded in control while the highest germination percentage (93 %) was recorded at 200 ppm chitosan nanoparticles concentration. The increase in mean germination percent, root, shoot, seedling length and vigor index I & II in all CNPs priming concentrations was observed as compared to control in lentil seed. All physiological parameters were found significantly higher in the seeds primed with 50, 100, 150, 200 and 300 ppm CNPs priming over control. However, in comparison to the enhanced values obtained at 200 ppm CNPs priming, the decrease in root length, shoot length, seedling length and vigor index I were observed at 300 ppm CNPs priming. Chitosan and its nanoparticles priming enhanced the capacity of seeds to scavenge free radicals by elevating



antioxidants i.e. SOD, CAT and POD as a defence response. These changes in biochemicals in primed seeds showed beneficial effects of chitosan priming on germination and seedling growth. Since Chitosan is a derivative of natural elicitors, chitin, and its nanoparticles could be a best agent for seed quality enhancement for several reasons. The positive effect have encouraged to further extend the application of this technology for seed quality enhancement in pulse crops in the changing climatic scenario.

WILT DISEASE MANAGEMENT BY INTEGRATING VERMICOMPOST, BIOAGENT AND SALICYLIC ACID IN CHICKPEA

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Abstract

Chickpea is a valued crop and provides nutritious food for an expanding world population and will become increasingly important with climate change. Chickpea (*Cicer arietinum* L.) is the second most important food legume crop with a total cultivated area of 17.81 million hectares worldwide. However, the productivity of Chickpea is severely affected by wilt disease caused by *Fusarium oxysporum* f. sp. *ciceris* (Foc). Apart from chemical control, eco-friendly approaches for wilt disease management in chickpea is painstaking. The biocontrol efficiency against wilt pathogen could be enhanced by proper employing synergy between vermicompost amendment and foliar application of SA, as they administer different modes of action. The combined treatment of 15 %vermicompost along with seed bacterization and pre-inoculation foliar spray of SA showed complete protection against *F. oxysporum* f. sp. *ciceri*. The beneficial effect of vermicompost and PGPR isolate on root and shoot length, and fresh and dry weight of chickpea plants were also observed. Taken together, our findings revealed the high potential of integrating vermicompost, bioagent and foliar application of SA to surrogate chemical fungicides for eco-friendly and sustainable management of wilt disease in chickpea.

CONSUMER BUYING BEHAVIOUR TOWARDS PURCHASE OF FOOD ITEMS FROM ORGANIZED RETAIL OUTLETS OF SURAT CITY

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Abstract

The Indian market is highly complex in terms of a wide geographic spread and distinct consumer preferences varying by each region. In India there is growth of organized retailing. Retail sector is one of the main contributors to the Gross Domestic Product (GDP) of different countries and also one of the biggest employers In India. At present India is witnessing new changes in evolving food shopping which is constructed by retailers to attract the consumers. In this regard, this paper intends to find parameters considered by consumers' in selecting an organized retail outlets and to study the consumers buying behaviour for purchase of food commodities from organized retailers. For the study, 150 respondents were selected as sample size and data were collected through structured questionnaire. The major findings of the study were that consumers consider quality of products, reasonable price, discount and schemes, friendly employees, several brands etc. as the major parameters in selecting an organized retail store. And the major factors which were mostly considered by consumers to purchase different food commodities from organized retail store were like for groceries were quality of product available, affordable price, and availability of the products; for Fruits & Vegetables quality of product (not rotten, not broken, free of worms), affordable price, freshness of the produce and availability of products and for quality of product (not rotten, not broken, free of worms), affordable price, expire period, packaging of the products and discounts. The Indian retail sector is witnessing a tremendous growth but need of the hour is to focus on the parameters considered by consumers which leads to consumers satisfaction and retail prosperity.



SUSTAINABILITY OF ORGANIC FARMING : A THREE DIMENSIONAL PERSPECTIVE

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Abstract

Organic farming has gained a good momentum and farmers are being motivated to adopt organic farming through different extension strategies. Scientific school of thought claims organic farming as sustainable. In this background, in order to assess the opinion of farmers about organic farming, a study was conducted in Bengaluru rural and Chikballapur district of southern Karnataka to assess the sustainability of organic farming. Data were collected from 120 organic farmers. Ex post facto research design as employed for the study. The results revealed that 47.50 per cent of the respondents opined that organic farming is highly sustainable followed by less sustainable (29.16%) and sustainable (23.33%). With respect to ecological sustainability of organic farming is concerned, 47.50 per cent of respondents responded that organic farming is highly sustainable followed by less sustainable (28.33%) and sustainable (24.16%). While economical sustainability of organic farming is concerned, it can be noticed that 52.50 per cent of respondents felt that organic farming is sustainable followed by highly sustainable (30.00%) and less sustainable (17.50%). In case of social sustainability of organic farming, 47.50 per cent of organic farmers considered organic farming as highly sustainable, 28.33 per cent of organic farmers considered organic farming as sustainable and 24.16 per cent perceived organic farming as less sustainable.

ANALYSIS OF KNOWLEDGE LEVEL OF DAIRY FARMERS ABOUT GOOD DAIRY FARMING PRACTICES

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Abstract

The present study was conducted in Central plain zone (CPZ) of Punjab to study knowledge of dairy farmers about good dairy farming practices (GDFPs). The data were collected by using well-structured interview schedule from 150 dairy farmers of CPZ. The study revealed that majority of the dairy farmers (37.33%) had high overall knowledge level followed by medium (36.00%) and low (26.67%) level of overall knowledge about good dairy farming practices. The Knowledge Index (KI) of breeding, feeding, health care and management practises were found to be 81.50, 78.00, 63.44 and 64.53 and were ranked as 1st, 2nd, 3rd and 4th, respectively. Knowledge of dairy farmers about good dairy farming practises can be enhanced by given special emphasis on livestock extension approaches and by proper efforts of policy makers, research institutes and extension system and providing regular technical guidance related to good dairy farming practices through telephone helpline, radio, TV and various other social media tools.

EFFECT OF CONSERVATION AGRICULTURE ON HYDRAULIC CHARACTERISTICS OF SOIL

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Abstract

A study was undertaken to evaluate the long term effect of different conservation agriculture (CA) practices in maize-wheat cropping system on soil hydraulic characteristics and different infiltration models were used to predict infiltration rates. Six treatments were selected viz; conventional tillage (CT), permanent narrow bed (PNB), permanent narrow bed with residue (PNB+R), permanent broad bed (PBB), permanent broad bed with residue (PBB+R) and zero tillage (ZT). BD values of 0-5 cm of soil layer at the time of sowing showed that ZT had highest BD (1.55 Mgm⁻³) and significantly different from CT and PBB+R. BD was lowest in PBB+R (1.39 Mgm⁻³), followed by PNB+R (1.43 Mgm⁻³). In PBB+R, BD was 8 and 15% lower than CT and ZT. In 0-15 cm of soil depth, highest saturated hydraulic conductivity (Ks) of 69.85 cm/day was obtained in PBB+R and lowest value of 55.30 cm/day was observed in ZT at the time of sowing. The initial infiltration rate was highest



(22.93 cmhr⁻¹) in PBB+R and was lowest (7.64 cmhr⁻¹) in CT. At 15-30 cm soil depth, though lowest Ks of 53.84 cm/day was obtained in ZT but it was not significantly different from CT which had a value of 55.60 cm/day at the time of sowing. PBB+R had significantly 20.8 and 24.7% higher Ks than CT and ZT. The initial infiltration rates of PNB, PNB+R, PBB and ZT were 15.29 cmhr⁻¹, 20.37 cmhr⁻¹, 17.20 cmhr⁻¹ and 11.46 cmhr⁻¹, respectively. The steady state infiltration rate was highest (7.49 cmhr⁻¹) in PBB+R and the time taken to reach was 2.58 hrs. The lowest steady state infiltration rate of 2.11 cmhr⁻¹ was observed in CT plot and time taken to reach was 1.62 hrs. Cumulative infiltration of all the treatments followed the order: PBB+R>PNB+R>PBB>PNB>ZT>CT. The result suggested that in all the residue applied plots long term adoption of CA practices could soil hydraulic properties and distribution of soil water in the profile.

INHIBITION OF POTATO LEAFROLL VIRUS MULTIPLICATION AND SYSTEMIC TRANSLOCATION BY SIRNA CONSTRUCTS AGAINST PUTATIVE ATPASE FOLD OF MOVEMENT PROTEIN

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Abstract

Viruses cause many severe plant diseases, resulting in immense losses of crop yield worldwide. Therefore, developing novel approaches to control plant viruses is crucial to meet the demands of a growing world population. Recently, RNA interference (RNAi) has been widely used to develop virus-resistant plants. Once genome replication and assembly of virion particles is completed inside the host plant, mature virions or sometimes naked viral genomes spread cell-to-cell through plasmodesmata by interacting with the virus-encoded movement protein (MP). We used the RNAi approach to suppress MP gene expression, which in turn prevented potato leafroll virus (PLRV) systemic infection in *Solanum tuberosum* cv. Khufri Ashoka. Potato plants agroinfiltrated with MP siRNA constructs exhibited no rolling symptoms upon PLRV infection, indicating that the silencing of MP gene expression is an efficient method for generating PLRV-resistant potato plants. Further, we identified novel ATPase motifs in MP that may be involved in DNA binding and translocation through plasmodesmata. We also showed that the ATPase activity of MP was stimulated in the presence of DNA/RNA. Overall, our findings provide a robust technology to generate PLRV-resistant potato plants, which can be extended to other species. Moreover, this approach also contributes to the study of genome translocation mechanisms of plant viruses.

MOLECULAR CHARACTERIZATION OF *FUSARIUM OXYSPORUM* F. SP. *LENTIS* AND ANALYZING DEFENSE RESPONSES OF LENTIL AGAINST IT

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Abstract

Lentil (*Lens culinaris* Medikus Sub sp. *Culinaris*) is one of the most nutritious pulse crops riched in protein, carbohydrate and minerals. In the global lentil scenario, India ranked first in the area and second in the production with 39% and 22% of world area and production respectively. Bihar is one the major lentil growing state which is being grown on an area of about 1.51 million hectare area with a production of about 1.0 million tones. The majority of the lentil crop grown in Tal area of the state. As it is cultivated as a rainfed crop, it gets severely affected by several biotic and abiotic stresses. Among the biotic stresses, Fusarium wilt, caused by *Fusarium oxysporum* f. sp. *lentis*, is one of the major fungal diseases and remarkably causes severe crop damage from vegetative to reproductive stage, thus causing severe yield loss. The present study was designed to analyze the degree of aggressiveness of *fusarium* isolates of the state, to determine the genetic variability among them and to study the biochemical and molecular basis lentil defense response upon pathogen infection. For the research work, total 12 *Fol* isolates



were collected from major lentil growing areas in Bihar (Tal area of Mokama, Lakhisarai, Barh and Bhagalpur, Banka districts) The isolates were collected from different lentil growing region of the state and the pure culture were maintained. To study the aggressiveness of the isolates, two differential lentil genotypes (resistant PL-6 & susceptible JL-3) of wilt were grown in soil infected with fusarium under green house condition. In resistant (PL-6) cultivar, the pre-germination mortality among all the treatment ranged between 5 to 62.7%. while in JL-3 i.e. susceptible cultivar, the pre-germination mortality among all the treatment ranged between 37.7 to 90.6%. Among all the isolates, AGLF-11 isolate exhibited higher aggressiveness and significantly caused pre and post germination mortality in both the genotypes, while FOL+ isolate was found least aggressive. Further, molecular characterization of the isolates was also carried out on the basis of amplification and sequencing of ITS regions of isolate and the results revealed that there was significant diversity between the isolates. In molecular characterization, a wide range of genetic diversity (~62% to 99%) was observed among all isolates. AGLF-9 isolate was most dissimilar among all the isolate and the percentage identity was about 62% as compare to others. On the basis of the results of first experiment, we considered AGLF-11 and FOL + as highly aggressive (HA) and least aggressive (LA) isolate respectively and the comparative expression analysis was further carried out. In comparative biochemical analysis, the expression of all the PR proteins (glucanase, chitinase, POX and SOD) was significantly increased in both the cultivars (PL-6 and JL-3) upon infection with least aggressive FOL-(+) isolate at 24 hai and 48 hai and thereafter decreased in subsequent hours. Cultivars (PL-6 and JL-3) infected with highly aggressive AGLF-11 isolate, the expression of PR-proteins was increased at 24hai only and significantly decreased afterthat. When the expression analysis was compared between the cultivars, resistant (PL-6) genotype retained higher enzymatic activity in both isolates i.e H.A & L.A as compare to the susceptible (JL-3) cultivar. In gene expression analysis, the PR genes were significantly expressed in PL-6 as compare to the JL-3 upto 48 hai upon least aggressive FOL-(+) isolate infection. The results suggest that PR-gene products may have a function in plant development and therefore, highly expressed in tolerant genotype of lentil, ready to detect any attack and provide durable defense system to plants. The detailed characterization of PR genes would be potentially used as molecular markers for screening resistance/susceptible lentil genotypes as well as could be used for developing transgenic and/or improved lentil varieties resistant to *Fol* infection suitable under changing climatic scenario.

ROLE OF AGRICULTURAL BIOTECHNOLOGY TO ENHANCE CROP PRODUCTIVITY IN POST COVID ERA

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Abstract

The ongoing coronavirus pandemic is a public health emergency with grave implications for the population of the world. India, as part of the global community, has been adversely impacted by ongoing health crisis— especially the poor and marginalized. However, there is a relatively low understanding of socio-economic science. This pandemic is a global health crisis and can also lead to the food security crisis in India if correct measures are not taken. In India, it is imperative to minimize the adverse effect and disruption of livelihood of the poor and marginalized. Although supplies of staples, fruits, vegetables, and meats have been adequate during the COVID-19 outbreak so far, still there are threats to food security, in the long term. Restrictions on transportation and movement of people have already led to some food logistic challenges. India needs to create more synergies in food technology, agriculture, biotechnology. Prioritizing and adaption of innovation should act as main drivers of productivity growth and improved sustainability. The application of biotechnology to agriculturally important crop species has traditionally involved the use of selective breeding to bring about an exchange of genetic material between two parent plants to produce offspring having desired traits such as increased yields, disease resistance, and enhanced product quality. The exchange of genetic material through conventional breeding requires that the two plants being crossed (bred) are of the same, or closely related, species. Such active plant breeding has led to the development of superior plant varieties far more rapidly than would have occurred in the wild due to random mating. However, traditional methods of gene exchange are limited to crosses between the same or very closely related species; it can take considerable time to achieve desired results; and frequently, characteristics of interest do not exist in any related species. Modern biotechnology vastly increases the precision and reduces the time with which these changes in plant characteristics can be made and greatly increases the potential sources from which desirable traits can be obtained. Fostering Genetically Modified Organisms



(GMOs), using genetic engineering is another way of contributing to food and nutrition benefits while boosting agricultural production besides reducing a post-harvest loss. The application of biotechnology in agriculture has resulted in benefits to farmers, producers, and consumers. Biotechnology has helped to make both insect pest control and weed management safer and easier while safeguarding crops against disease. Biotech crops can make farming more profitable by increasing crop quality and may in some cases increase yields. The use of some of these crops can simplify work and improve safety for farmers in the coming years. This may allow farmers to spend less of their time managing their crops and more time on other profitable activities.

PRADHAN MANTRI FASAL BIMA YOJNA(PMFBY) FOR MINIMISATION OF FARMERS' RISK IN AGRICULTURE; STATUS AND PROGRESS

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Abstract

Agriculture is one of the most important sectors of the Indian economy. Thus, the development of agricultural sector is essential for overall economic progress of nation. Agricultural production is an outcome of biological activity which is highly sensitive to changes in weather. The erratic and uneven distribution of monsoon rains perpetuated yield/price volatility and hence increased farmer's exposure to risk and uncertainty. In this scenario of high risk and uncertainty of rain fed agriculture, allocating risk is an important aspect of decision making to farmers. The risk burden of the farmers can be reduced through crop insurance, which is primarily a way of protecting farmers against the element of chance in crop production. Crop insurance spreads the crop losses over space and time, provides social security to the farmers, helps in maintaining their dignity, offers self-help, encourages large investments in agriculture for improving crop yield and increasing agricultural production. In this direction, Pradhan Mantri Fasal Bima Yojana (PMFBY), was started on 18th February 2016 and implemented from Kharif 2016. Its main purpose was to provide insurance cover to farmers suffering crop loss due to any natural calamities and other risks for sustainable income. Since implementation in the Kharif 2016, the scheme has entered in the tenth season that is Rabi 2020-21. This ambitious scheme is open for all types of farmers and tenants in all states and UTs of India. Under PMFBY, since starting from Kharif 2016 and by the end of Kharif 2020, a total of 1866.44 lakhs farmers have registered for the scheme, total area insured 2235.82 lakh hectares, total sum insured Rs 879345.18 crores and total premium paid by the farmers Rs 17004.21 crores. Up to 2018-19, about 32.67 percent of insured farmers have received the claims for the losses they incurred up to 2018-19.

TOXICITY ASSAY AND HUMORAL IMMUNE RESPONSE OF CALCIUM PHOSPHATE NANOPARTICLES ADJUVANTED VACCINE FORMULATION OF *SALMONELLA* TYPHI

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Abstract

Typhoid fever is one of the major foodborne illness in humans caused by *Salmonella enterica* serovar Typhi, which is an intracellular anaerobic gram-negative bacteria. The enteric fever has become a public health burden affecting many developing as well as developed countries. The limitations of presently available vaccines have stirred an urgent need to develop an effective typhoid vaccine. Adjuvants are non-toxic and have ability to enhance the immune responses against pathogenic infections. The frequently used adjuvants like alum, Freund's complete adjuvant etc have potential to provoke humoral immune response but with a limited cellular immune response. Hence there is an emergent need for novel and effective vaccine adjuvants to provoke the desired immune response. In present scenario, calcium phosphate nanoparticles have proven to be a major alternative, as they minimize the immune-regulatory reactions and are readily absorbed in humans. These nanoparticles have potential to function as vaccine adjuvants and provoke more balanced T helper type (Th1 and Th2) immune responses for enhanced cell mediated and humoral immunity. In the present study, efforts were made to assess the efficacy of calcium phosphate adjuvanted nanoparticles of outer membrane proteins of *Salmonella* Typhi. The calcium



phosphate adjuvanted-Omps nanoparticles were prepared and characterized. Further, these nanoparticles were tested for the toxicity in rats and for immune-potential to provoke humoral immune response and protective immunity in mice model in comparison with Montanide. Organ specific biomarkers and blood chemistry were considered as indicators of toxicity. The levels of organ specific biomarker (like ALT, AST, Urea, Creatinine and total protein) were found to be almost similar in treated and control group on 72 hrs and 14 days after the injection. Similarly no significant changes could be observed in the blood chemistry of treated rats. Calcium phosphate adjuvanted-Omps nanoparticles provoked a stable and long term humoral immune response and better protective immune response in comparison to Montanide-Omp complex. Therefore, on the basis of our findings we could deduce that calcium phosphate nanoparticles can be used as an effective and safe nano adjuvant system to augment the immune response as compared to other conventional adjuvants and may also accelerate the development of an efficacious, safe and cost effective vaccine for typhoid fever.

ROLE OF AZOLLA AS A BIO-FERTILIZER ON GROWTH AND YIELD OF PADDY CROPS

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Abstract

The modern-day intensive crop cultivation requires the use of chemical fertilizers, but fertilizers are not only short supply but also expensive in developing countries. Therefore, the current trend is to explore the possibility of supplementing chemical fertilizers with organic ones, more particularly biofertilizers of microbial origin. Paddy is the major crop in the south and south-east Asia and covers an area of about 36 million hectares in India. This work is focused on the use of biofertilizer on growth and yield of paddy (*Oryza sativa* L. var. Saket) crops. In this work, the application of Azolla as organic manure up to 200g Azolla/kg soil till 120 days. The results indicated that during the interval (30, 60 and 120days) of analysis of plant parts showed that the dry matter yield of paddy plants increased with an increasing amount of Azolla. Along with this, there were biochemical changes like chlorophyll, ascorbic acid, catalase, peroxidase and uptake of the mineral nutrient element (Ca, K, P, Mg, S, Fe, Mn, N) and crude protein value also increased.

BIOFORTILIZATION : TO RESTORE AND MAINTAIN SOIL HEALTH STATUS FOR SUSTAINABLE AGRICULTURE

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Abstract

Chemical fertilizer is used to give the plant nutrient requirements within a short period to get faster results. Newly improved varieties of crops need high proportions of fertilizer. But chemical fertilizer has certain limitations and entails a lot of disadvantages. When chemical fertilizer is applied, the entire contents would not be absorbed by the plants and the remaining parts would react in the soil. Part of it would be washed away and would contaminate water and some part of it would evaporate to the atmosphere; thereby the environment is polluted. Microorganisms are useful for bio-mineralization of bound soil and make nutrients available to their host and/or its surroundings. Bio-inoculants are individual strains or consortia of known microbes that have potential plant growth-promoting benefits added directly to the soil, or as a seed coating when re-seeding. Bio-inoculants are the potential agents to fight the major challenges of soil degradation, nutritional security, food security, climate change and sustainability. These can complement chemical fertilizers for increasing crop productivity in a sustainable basis. Bio-inoculants contain beneficial microbes that enhance plant growth, when applied to the field, by the asset of its nutrient solubilization, nitrogen fixation, phyto-hormone production and induction of defense mechanism resulting in also improved soil health and productivity. Biofertilizers mainly help in nitrogen fixation, phosphate solubilization, potassium solubilization and organic matter decomposition thereby making inherent soil nutrient available for plant growth to meet crop demand. Use of biofertilizer is environment friendly, so application of biofertilizer alone or in combination with inorganic fertilizer is desirable for sustaining crop production in long run without having adverse effect on environment.



INNOVATIVE APPROACHES FOR CROP IMPROVEMENT AND CLIMATE RESILIENT IN CEREALS

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Abstract

Agriculture discovered by human about 10,000 years ago. The first domesticated plants were cereals, legumes and other species. Food is the necessity for sustainability of human life on this planet. In the 21st century agriculture faces, multiple challenges to produce more food and fiber to feed a growing world population and expected to grow to almost 10 billion by 2050. The global food production must be increase by 70% to fulfill the need of expanding population and growing consumption of food (Godfray *et. al.*, 2010). Yet, almost 800 million people are hungry and 2 billion suffer micronutrient deficiencies (FAO, 2017). Satisfying increased demands on agriculture with existing farming practices is likely to lead to more intense competition for natural resources. However, it was not possible to cope with the demand of food by using conventional methods of cultivation. The innovative approaches for crop improvement have been introduced for rapid crop improvement, higher production, improved quality of produce and multiple disease resistant crops. In this context, biotechnology and molecular breeding have opened up new avenue in the field of crop improvement and improved genotypes that can survive under changing climate. Therefore, Intensive biotechnology and molecular biological application like, Genetic engineering (GE), Gene editing, Gene pyramiding, RNAi, Marker assisted backcross (MABC), nanotechnology and biochemical profiling is also very much required to shift from traditional crop improvement technique. Marker-assisted selection has been initiated in India in several major crops for target traits that include resistance to biotic and abiotic stresses and some quality traits. In rice, bacterial blight resistant gene in Samba Mahsuri, three bacterial blight resistant gene (Xa21, Xa13 and Xa5) in Pusa Basmati-1 (improved PB-1), sub emergence tolerance (Swarna-sub-1) have been improved. In maize, a hybrid (Vivek QPM9) improved for lysine and threonine content and in pear millet hybrid resistant to downy mildew (HHB-67-2) have already been released. All these above methods, definitely help in development of high yielding cultivar and desired quality traits in cereals.

ENHANCEMENT OF ANTIOXIDANT ACTIVITY OF YOGHURT BY SUPPLEMENTED WITH ENCAPSULATED BIOACTIVE ANTHOCYANIN POWDER

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Abstract

Anthocyanin present in *Garciniamango stana peel* acts as natural colourant and antioxidant. This compound is less stable at high pH and degrades when exposed to various environmental conditions include pH, light, heat, oxygen etc. Encapsulation of anthocyanin extracts by spray drying protects the bioactive compounds from degradation and helps in retaining their stability. Hence it can be used as a functional ingredient to increase the antioxidant potential of yoghurt. To increase the functionality of yoghurt by supplementing with encapsulated anthocyanin powder from *Garciniamangostana* peel and to study the stability of encapsulated anthocyanin powder in yoghurt during storage. Anthocyanin was extracted using ethanol acidified with 1% citric acid and concentrated by rotary vacuum evaporator at 50°C. The concentrated extract was added with 20% of maltodextrin for encapsulation to increase the TS (Total solids) of the extract. Spray drying (SD) was done at inlet temperature of 160°C and outlet temperature of 65°C. The encapsulated powder were incorporated in yoghurt at different composition viz., 0.25%, 0.5 % and 0.75% and analysed for total anthocyanin content and antioxidant activity during storage. Encapsulated anthocyanin powder (EAP) of mangosteen peel increased the anthocyanin and antioxidants content of yoghurt. No significant changes in physicochemical characteristics of yoghurt (TSS, Titratable acidity and pH) were observed. Viable Lactobacillus (LAB) counts of functional yoghurt during storage period (one week) varied from 10.00±0.008 to 10.32±0.16 log₁₀cfu/g. Anthocyanin and antioxidant content were increased in yoghurt incorporated with encapsulated anthocyanin powder. The inclusion of 0.5% EP in yoghurt showed better consumer acceptability. Hence SDEAP from mangosteen peel can be used as functional ingredient in yoghurt perhaps it can be used as possible natural colourants.



ASSOCIATION STUDY AMONG THE YIELD AND LODGING SRELATED TRAITS OF DIFFERENT RICE GENOTYPES GROWN UNDER THE IRRIGATED TRANSPLANTED CONDITION.

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Abstract

Lodging resistance is the complex trait, dependent on many component characters and it responds poorly to the direct selection. For the improvement of lodging resistance with high grain yield, the knowledge of the association between lodging resistance and its related traits will be helpful. It is determined by plant height, root thickness, culm diameter, strength and elasticity, and the weight of the upper part of the plant. Plant height, particularly the length of basal internodes, is an important component of plant architecture affecting lodging resistance and relating to crop yield. The proportionality between the physical strength in basal internodes and the weight of the upper part determines the vulnerability of a given cultivar to lodging. Accordingly, lodging is occurred in the basal internodes owing to loss of balance between the weight of upper part and the sturdiness of the basal internodes. In present investigation, 225 accessions of rice (*Oryza sativa* L.) were evaluated to establish the characters inter-relationship among for various 24 agronomical and lodging related parameters. Lodging related traits were determined at 30 days after 50 per cent flowering. Character association analysis revealed significant positive association of grain yield per plant with number of spikelets per plant ($r=0.203$), number of filled spikelets per plant ($r=0.244$), spikelet fertility % ($r=0.224$), thousand grain weight ($r=0.285$), biological yield per plant ($r=0.455$), harvest index ($r=0.620$), upper biological yield (dry weight of the plant above 40 cm) ($r=0.462$), lower biological yield (dry weight of the plant below 40 cm) ($r=0.279$), grain yield / upper biological yield ratio ($r=0.524$) and upper biological yield / lower biological yield ratio ($r=0.195$). It indicated that grain yield can be increased whenever there is an increase in these characters. Hence, these characters can be considered as criteria for selection for higher yield. Likewise significant positive correlation of lodging incidence was found with flag leaf length ($r=0.181$), flag leaf width ($r=0.176$), plant height ($r=0.468$), panicle length ($r=0.264$), upper biological yield (dry weight of the plant above 40 cm) ($r=0.210$), upper biological yield / lower biological yield ratio ($r=0.243$), culm length ($r=0.448$), internode numbers ($r=0.300$) and basal internode length II ($r=0.249$). Diameter of basal internode I and II had the positive correlation with lodging incidence. It indicated that reduction in internode numbers and basal internode length II (from ground) will determine the stem strength and increase the lodging resistance in rice.

ROLE OF FARM WOMEN IN POST-HARVEST ACTIVITIES OF DRY CHILLI

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Abstract

Demographically, agriculture is the largest economic field and plays a major role in the entire socio-economic structure. Today, through addressing gender issues in agriculture through regional, national and global initiatives and collaborations, the global community is becoming increasingly conscious and committed to achieving more sustainable and broad-based agricultural development. The agricultural research agenda needs to be reoriented to address existing challenges for sustainable development and the subsistence of small and marginal resource holders, especially woman farmers in order to resolve existing gaps. Agricultural and post-harvest activities are not just an enterprise for women farmers, but a way of life in which all family members, including children participate in one or another. Farm women play a vital role in post-harvest activities that varies from the different crops and regions in most of the developing nations including India. History says that during the 15th century, tropical America introduced chilli crops to India, as the South Asian climate ideal for growing this crop. In India Chilli (*Capsicum annum*) is the universal spice cultivated almost all over the world. Women are more concentrated on certain phases or activities of the supply chain. In post-harvesting operations of dry chilli they play numerous intensive jobs especially in manual harvesting, traditional sun drying, storage, manual grading, weighting and bagging of dry chilli, filling dry chilli into gunny bags for trampling process, processing, and marketing. Majority 80 per cent of the women farmers rely, directly or indirectly on post-harvest agricultural activities for their livelihood. While performing certain



post-harvest operations of dry chilli women faces many health related problems and constraints, which will further reduces their participation. By formulating farm women-focused policies and strategies will encourage women's participation.

EFFECT NITROGEN LEVELS UNDER DIFFERENT SPACING ON SEED YIELD, QUALITY PARAMETERS AND ECONOMICS OF CORIANDER

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Abstract

The current investigation was carried out at Research farm of Department of Vegetable Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar during *rabi* season of the year 2019-20. The field experiment was conducted in randomized block design with three replications. Experiment contains four nitrogen levels (0, 25, 50 and 75 kg ha⁻¹) and three different row to row spacing (20 x 15 cm, 30 x 15 cm and 40 x 15 cm) were taken into consideration. The nitrogen was applied in two split doses *i.e.* 50 per cent at sowing and remaining dose at 40 days after sowing (DAS). Result of the experiment revealed that the highest seed (21.19 q/ha) yield was recorded at 75 kg N ha⁻¹ with spacing 40 x 15 cm and lowest in control. The quality parameters *i.e.* test weight, electrical conductivity, standard germination and vigour indices were recorded highest with 75 kg N ha⁻¹ and spacing 40 x 15 cm and the highest cost of cultivation (Rs. 48445/ha) was occurred in coriander sown at higher nitrogen levels under different spacing. Highest net returns (Rs. 110480/ha) and B:C 2.28 were obtained at 75 kg N ha⁻¹ with 40 x 15 cm and followed by 50 kg N ha⁻¹ with 30 x 15 cm with net returns of (Rs. 110480/ha) and B:C of 2.29. Based on the results one year experimentation, it may be concluded that nitrogen dose at 75 kg ha⁻¹ and row to row spacing 40 x 15 cm was distinctly superior over the other treatments and found more profitable by realizing the net returns (Rs. 110480/ha) and benefit cost ratio of 2.28 on sandy loam soils of Hisar.

IMPACT ANALYSIS OF TRAININGS AND ON FARM TESTING IN CHICKPEA (*CICER ARIETINUM*) CULTIVATION UNDER NIMAR VALLEY

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Abstract

The impact assessment with reference to increase in knowledge levels of farmers regarding scientific package of practices, extent of adoption of selected technology and percent adoption of production technology was carried out in ten selected farmers. The data about knowledge level of scientific package of practices of chickpea indicated that low, medium, and high level of knowledge after intervention of Krishi Vigyan Kendra was found to be 8, 56 and 36 per cent, respectively. Highest knowledge regarding selected scientific innovations was found for irrigation management (61 %), weed management (55 %), integrated nutrient management (45 %) integrated pest management (31 %) and pest, disease control (28 %), respectively. The technology index indicated there was feasibility of evolving technologies at the farmer's field.

MINIMIZING THE CLIMATIC RISK IN AGRICULTURE THROUGH WEATHER BASED AGROMET ADVISORIES

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Abstract

Weather factor is major role of increasing and decreasing agricultural production. Weather manifests its influence on agricultural operation and farm production. Forecast can help to minimize the farm losses through proper management of agricultural operations. The complete avoidance of all farm losses due to weather factor is not possible but it can be minimized to some extent by making adjustments through timely and accurate information of weather forecast. Weather forecast and weather based agromet advisories can help in increasing the economic benefit to the farmers by suggesting them the suitable



management practices according to the coming weather conditions. A study was therefore, undertaken on adaptation of agromet advisory bulletin and economic impact of agromet advisory services (AAS) for different crops over non users of agromet advisory services (Non AAS) from different selected villages of Barwani district of Madhya Pradesh. Results showed that the farmers, who followed the agromet advisories, are able to reduce the input cost and increase in the net benefit by 12 to 15 percent as compared to non AAS farmers. This input was due to the crop management done by the farmers according to agromet advisory bulletins based on the weather forecast. Thus the application of agromet advisory bulletin is a useful tool for enhancing the productions and income by minimizing the adverse affect of weather.

PHYLLOSPHERE MICROFLORA AS BIOCONTROL AGENTS IN PLANT DISEASE MANAGEMENT

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Abstract

The phyllosphere is a term used to refer the total above-ground portions of plants as habitat for microorganisms. The phyllosphere can be further subdivided into the caulosphere (stems), phylloplane (leaves), anthosphere (flowers), and carposphere (fruits). With the development of ecological agriculture, the impact of over use of chemical fungicides on environment and food safety has become a serious concern. Alternative to chemical fungicides Phyllosphere microflora plays an important role as biocontrol agents. The internal and external foliar microbiota has many functions, including indirect protection against pathogens, through the interaction of non-pathogenic bacteria with the foliar plant pathogens. Volatile organic compounds produced by a strain of *Bacillus subtilis* was identified to have antifungal activity to *Rhizoctonia solani* and *Pythium ultimum*. They may also play a key role in carbon and nitrogen cycling and help in important environmental processes such as methanol degradation and nitrification. Further microbial interactions in the phyllosphere gives protection against pathogens and release of phytohormones to stimulate plant growth and colonization and suppress infection of tissues by plant pathogens. Increase disease resistance and productivity of agricultural crops to an average of 30-37% in yield. There are an increasing number of biocontrol agents (BCAs), such as *Bacillus* spp., *Pseudomonas* spp., *Trichoderma* spp. etc., being commercialized for various crops BCAs were selected from non-pathogenic or antagonistic microorganisms, and applied as foliar spray on plants to enrich the beneficial population of microflora and act as primary defence. Phylloplane-associating microorganisms may be regarded as one of the desirable strategy, ecologically viable alternative, biological control for controlling plant diseases.

ETHNO-VETERINARY MEDICINE (EVM) USED BY THE *RAIKA* PASTORALIST OF MARWAR REGION OF RAJASTHAN TO CURE COMMON DISEASES OF SMALL RUMINANTS

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Abstract

The *Raika* also known as Rebari. *Raika* is a most important pastoralist community of Rajasthan which is mostly 70 per cent of their population living in marwar region of Rajasthan. *Raika* pastoralists of marwar region of Rajasthan have a large network of traditional healer and having great knowledge of traditional practices to treatment of their animal disease, make use a large variety of indigenous plants, minerals and animal products to cure their diseased animals. Therefore, the present study was designed to document and appraise Ethno-Veterinary Medicine (EVM) used by the *Raika* pastoralists to treatment of common health disease of small ruminants (sheep and goat) like diarrhea, bloat, jaundice and fever. The study was carried out at purposively selected Marwar region of Rajasthan and a total 120 *Raika* pastoralists were interviewed from the six villages of Pali and Jodhpur district on an open-ended interview schedule to document the ethno-veterinary practices. For participatory assessment of identified ethno-veterinary practices, Quantification of Indigenous Knowledge (QuIK) was applied. The *Raikas* were using total 15 ethno-veterinary medicine to cure these four common diseases. Use of alum and jaggary was found most effective to treat diarrhea, whereas, they used only alum to treat fever. They also used mixture of turmeric, acidic butter, tea and black salt to manage bloat in their animal most effectively. To cure Jaundice of animal, they perceived use of mixture of



lemon, baking soda and pepper was more effective ethno veterinary practice. Hence, pharmacodynamics of these ethno-veterinary practices may be studied before further replication and use.

SOIL HEALTH MANAGEMENT PRACTICES AND CROP PRODUCTIVITY

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Abstract

Management techniques that focus on soil health are promising solutions to mitigate some environmental impacts and may increase economic returns. The growing interest in low input agricultural practices coupled with challenges in the agro-ecosystems which are accelerated by population pressure, poor soil management practices and climate change calls for a holistic approach to soil management and agricultural production as a whole. Globally, food systems face multiple challenges including that adapting to a changing climate, increasing yields and maintaining and increasing crop nutritional quality. The following soil management practices improves soil health especially through their influence on soil: conservation tillage practices or conservation agriculture, crop rotations, intercropping with legumes, cover cropping, agro-forestry, use of organic manures and crop residues, soil liming and inoculation with effective microorganism. These practices have a positive influence on soil microbial and faunal activities and increase soil microbial populations, diversity and functions. Soil health management contributes to sustainable crop production in a number of ways including nutrient cycling, soil aggregation, soil aeration and bio-control or suppression of plant pathogens.

EFFECT OF POMEGRANATE JUICE ON PHYSICO-CHEMICAL PROPERTIES OF ICE-CREAM

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Abstract

The objective of this study was to investigate the effects of adding pomegranate juice to ice creams. In this study, the effects of 10, 20, 30, 40, and 50% pomegranate juice on the physicochemical properties of ice cream such as overrun, hardness, melting rate, total soluble solids (TSS), fat, fiber, ash, titratable acidity, pH, and sensory analysis were investigated. The findings indicated that the hardness, TSS, ash, and titratable acidity increased significantly, while the fat content, pH, melting rate, and overrun decreased significantly, with an increase in the level of pomegranate juice. The sensory properties of ice cream were appraised using principal component analysis. Based on the sensory analysis scores, 50 % pomegranate juice was found to be the best treatment. The nutritional analysis of most acceptable ice creams found good amount of nutrient in comparison to standard milk ice-cream.

SOIL QUALITY INDICATORS FOR SUSTAINABLE CROP PRODUCTIVITY

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Abstract

Soil is the most precious renewable natural resource and an important component of Earth's biosphere. The increase in population is putting a continuous pressure on soils leading to degradation and making them gradually unfit for cultivation of crops. In India the usage of chemical fertilizers has increased drastically impacts on soil fertility, nutrient imbalances and quality of environment. Thus without prior knowledge on status of soil fertility might have been resulted adverse effects on soils as well as crops both in terms of nutrient deficiency and crops and toxicity either by adequate or over usage of fertilizers.



Sustainability of agricultural systems has become an important issue in developing countries, including India. Since many of the issues of sustainability are related to soil quality, assessment of soil quality and the direction of change with time is a primary indicator of whether agriculture is sustainable. The response of soils to management and inputs also depends on soil quality. It is therefore important to identify the soil characteristics responsible for changes in soil quality, which may eventually be considered as soil quality indicators for assessing agricultural sustainability. Traditionally, soil quality research focused primarily on chemical and physical properties because simple methods of analysis were available; however, more recently, it has been suggested that soil biological properties can serve as early and sensitive indicators of agro ecosystems in response to soil management practices.

PERFORMANCE OF GUAVA VARIETIES INFLUENCED BY CSR-BIO MICROBIAL CULTURE ON YIELD, QUALITY AND SOIL PROPERTIES IN SODIC SOIL

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Abstract

A field experiment of guava was established in the year 2015 in sodic soil at farmer's field village Vinovanagar district Kanpur dehat in the jurisdiction of C. S. Azad University of Agriculture and Technology, Kanpur using high yielding varieties Sweta and Lalita of guava. The studies confined to the Impact of CSR-Bio microbial culture on yield, quality and soil properties of guava under sodic soil conditions. The highest fruit size 57.1 cm², fruit weight 141.5 g, seed weight 5.71 g and specific gravity 1.17 g/cm³ were recorded in Sweta variety and fruit size 59.9 cm², fruit weight 147.5 g, seed weight 5.74 g and specific gravity 1.22 g/cm³ were recorded in Lalita variety of guava with the application of CSR-Bio microbial culture (soil application + foliar spray). The maximum yield/plant 65.5 Kg, yield/ha 18.7 mt, sugar content 8.35% and ascorbic acid 272.5 mg/100g with the mean values of yield/plant 53.1 Kg, yield/ha 15.0 mt, sugar content 7.34% and ascorbic acid 246.5 mg/100g were recorded in Sweta variety and yield/plant 70.2 Kg, yield/ha 19.5 mt, sugar content 8.44% and ascorbic acid 278.6 mg/100g with the mean values of yield/plant 58.0 Kg, yield/ha 15.6 mt, sugar content 7.54% and ascorbic acid 252.9 mg/100g were recorded in Lalita variety of guava with the application of CSR-Bio microbial culture (soil application + foliar spray). The performance of Lalita is better in comparison to Sweta variety of guava. The maximum changes in soil pH from 8.9 to 8.5, EC from 0.76 to 0.68 dSm⁻¹, ESP from 37.2 to 30.2 %, organic carbon from 2.9 to 3.9 g kg⁻¹, available N from 165.2 to 179.3 kg ha⁻¹, available P from 17.3 to 25.4 kg ha⁻¹ and available K from 214.3 to 231.2 kg ha⁻¹ with the application of CSR-Bio microbial culture (soil application + foliar spray) than other treatments. The use of CSR- Bio microbial culture as soil application is better in comparison to foliar spray in case of changes in physico-chemical properties of soil.

INFLUENCE OF FUNGICIDE AND DIFFERENT *RHIZOBIUM* INOCULANTS ON GROWTH AND YIELD OF SOYBEAN (*GLYCINE MAX* (L.) MERRILL)

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Abstract

An experiment was carried out at in *Kharif* season at student research field, College of Agriculture, Indore (M.P.) to study the influence of fungicide and different *Rhizobium* inoculants on growth and yield of soybean (*Glycine max* (L.) Merrill). The soil of the experimental field was medium black in texture, neutral in reaction (pH 7.70) with normal EC (0.23 dS/m) and medium organic carbon contents (0.56 %) and analysing low in available N (225 kg/ha), medium in available P (9.60 kg/ha) and high in available K (508 kg/ha) contents. A field experiment was consisted of 15 treatments replicated four times in randomized block design (RBD). As per treatment, the seed of soybean cv. JS 335 treated or not treated with fungicides and inoculated with *Rhizobium* culture before 15, 10, 05, 01 days of planting and on the day of sowing. Among the treatments, seed treatment with Thiram + Carbendazim 50 WP – inoculation with Premax+ Rizo-liq (ODS)] (T10) recorded the maximum plant height (66.75 cm) at harvest, branches per plant (4.02), fresh weight (35.83 g) per plant at 75 DAS, dry matter per plant (23.14g) at 75 DAS, leaf area index (12.87) at 60 DAS, number of pods (39.18) per plant, number of seeds (2.84) per pod while minimum



was recorded in T15 absolute control (No fungicide, No culture). The maximum yield (2.15 t/ha) was recorded under [Thiram + Carbendazim 50 WP - Premax+ Rizo-liq (ODS)] (T10) treatment and the minimum (1.51 t/ha) was recorded in absolute control (T15) treatment. The application of Rhizobium with or without fungicides showed a synergic effect in increasing the seed yield of soybean per hectare.

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH PARAMETERS AND YIELD OF HYBRID MAIZE (*ZEAMAYS* L.) UNDER CENTRAL PLAIN ZONE OF UTTAR PRADESH

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Abstract

An field experiment was carried out to evaluate the integrated nutrient use on growth and yield of hybrid Maize (*Zea mays* L.) during *Kharif* 2017-18 at Soil Conservation and Water Management Farm, CSA University of Agriculture and Technology, Kanpur on hybrid Maize with three level of inorganic fertilizers (kg/ha) i.e. 100% R.D.F. (100 N + 60 P + 40 K + 20 Z), 75% RDF (75+45+30+15), & 50% RDF (50+30+20+10) along with three Levels of organic manure viz; 15, 20 & 25 ton FYM/ha. The result obtained that the fertility level i.e. 75% RDF + 25 t FYM/ha was found better in all respect as compared to other combinations of fertility management. The growth parameters viz, plant height, number of functional leaves, days to silking, tasselling, number of cobs per plant, length of cob (cm), number of grains per cob, grain weight (g) per cob, 1000 grain weight were recorded highest under the fertility level of 75% RDF + 25 t FYM/ha followed by 100% RDF + 20 t FYM/ha and 50% RDF + 15 t FYM/ha. Grain, biomass and stover yield were significantly increased with increasing levels of fertility. The 75% RDF treatment of fertility was recorded higher water use efficiency as compared to other treatments. Both the fertility management practices registered higher net return over other treatments. The highest net return of Rs. 17849.03 ha⁻¹ was obtained from the treatment 75% RDF and 25 t FYM/ha with B:C ratio 1.67 as compared to rest fertility management practices.

IMPACT OF CLIMATE CHANGE ON AGRICULTURE

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Abstract

Changes beyond the average atmospheric condition that are caused both by natural factors such as the orbit of earth's revolution, volcanic activities and crustal movements and by artificial factors such as the increase in the concentration of greenhouse gases and aerosol are referred to as Climate changes. The average increase in global temperature by global warming, has become a notable trend that will lead to significant global changes in the future. The impacts of climate change can be classified into two groups i.e. positive and negative based on the results observed in related fields. The positive impacts of global warming include the increase in crop productivity due to fertilization effect caused by the increase in carbon dioxide concentration in the atmosphere, expansion of the areas available for production of tropical and/or subtropical crops, expansion of two-crop farming due to the increased cultivation period, reduction of damages of winter crops by low temperature, and reduction of heating value for agricultural crops grown in the protected cultivation facilities. The temperate fruits like apple, peach, plum and cherry gave higher yield due to extreme chilling. Negative impacts of global warming include reduced crop quantity and quality due to the reduced growth period following high levels of temperature rise; reduced sugar content, bad coloration, and reduced storage stability in fruits; increase of weeds, blights, and harmful insects in agricultural crops; reduced land fertility due to the accelerated decomposition of organic substances; and increased soil erosion due to the increased rainfall. The year 2003 was denoted as the year of heat and cold waves across the world. Food grain production in India has taken a tremendous growth due to the Green Revolution. There have been similar revolutions in the production of milk, fish, eggs, sugar, and a few other crops. India is now the largest producer of milk, fruits, cashew nuts, coconuts and tea in the world, the second largest producer of wheat, vegetables, sugar and fish, and the third largest producer



of rice. The increasing demand of food due to ever growing population have resulted in intensive agricultural practices i.e. use of agro-chemicals, livestock generation for meat and other source of income, exploitation of water resources etc. This has led the undesired situation by release of greenhouse gases due to agricultural activities and resulting in pollution of natural resources. As the forests act as a sink to the increasing amount of CO₂; the higher rate of deforestation mainly for development and agriculture, have imbalanced the natural process of carbon cycle.

DEVELOPMENT OF VALUE ADDED PRODUCTS PASTA FORTIFIED WITH VEGETABLES

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Abstract

Pasta is prepared by using different material such as semolina, durum, farina flour, corn, rice and wheat or these combinations with water. In recent year pasta is popular as breakfast cereal and has good nutritional value. In India, most of the vegetables are available seasonally with higher nutritional value but are not fully utilized. To see the prevalence of high level of micronutrient, to overcome malnutrition in different vulnerable sections and nutritional disorders. Vegetables are rich sources of micronutrients such as iron, calcium, vitamin, etc. Vegetables are a good source of protein, fiber, antioxidant, and minerals, making it a suitable ingredient to be used in the formulation of foods such as pasta with high nutritional or biological values. Different varieties and colors, flavor pasta have available in the market. Our study focused on pasta production, consumption, nutritive value. Different flours fortified with vegetables are used for making pasta and their effects on their nutritive value.

VARIETAL INTERACTION TO *CARYEDON SERRATUS* IN STORED PEANUT DURING DIFFERENT STORAGE BAGS AND INTERVAL

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Abstract

Caryedon Serratus is one of the most important pests of stored peanut. Adult beetle lays eggs on pods of peanut upon hatching larvae bores into the pods and feeds on peanut kernels. After completion of larval stage it comes out of pods by making a circular hole popularly known as exit windows and pupates in the silken cocoons. In India, Gujarat is the major producer and exporter of peanut. In Gujarat *C. serratus* is the major pest of stored peanut and it is locally called as cocoon disease of peanut due to characteristic appearance of cocoons which are glued to peanut pods and to storage bags. A study was conducted to know the varietal interaction of peanuts stored and *C. serratus* in two different bags for an interval of six months. GJG 22 was the most preferred variety by *C. serratus* as it recorded more than 1000 eggs with in four months of storage. Similarly, highest pod damage was recorded in GJG 22 with more than 90 per cent damage within four months of storage. Among the storage bags, plastic bags (HDPE 160 Micron) was found effective in managing bruchid, even with prior infestation KDG 128 did not cross 50 per cent damage after six months storage period. When we analyzed biochemical parameters of peanut varieties, results revealed that high total sugar content was the reason for *C. serratus* to prefer GJG 22 stored in both the bags.

RECENT STUDIES ON BIOFERTILIZERS FOR SUSTAINABLE VEGETABLE PRODUCTION

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Abstract

A recent study was undertaken to evaluate the reported findings on biofertilizers for sustainable vegetable production. Biofertilizers are one of the most important component of integrated nutrient management (INM) for sustainable vegetable production. Although vegetable production consuming high amount of chemical fertilizers for intensive cultivation and high



yield, But, heavy use of fertilizers causing soil sickness and plant health problems accompanied by hazardous residual effect. Therefore, it has been essential to evolve and adopt a suitable strategy for integrated nutrient supply by using a judicious combination of chemical fertilizers, organic manures and biofertilizers. It will be useful in curtailing the dependence on fertilizers for nutrient supply to plants. INM ensures maximum yield of crops without deleterious effects on physical, chemical and biological properties of soil and plant health. Biofertilizers not only accelerates the easily availability of soil nutrients to plants, but also produce hormones, vitamins and other growth factors required for the growth and development of plants. Nitrogen fixing bacteria and phosphate solubilizers are the main biofertilizers for the horticultural crops. Seed treatment, set treatment, seedling treatment and soil treatment are utilized biofertilizers application. Azotobacter and phosphorus solubilizing bacteria has been found 15.8% and 10% increase in brinjal production respectively. It has been also reported Rhizobacter increases pea production by 13.38 %, Whereas, *Azospirillum* increases cabbage production by 11.87%.

BIOCHAR – A SOLUTION TO CROP BURNING

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Abstract

It is no secret that farmers in India are adversely affected every year by many troubles related to the monsoon, crop quality, disappearing yields, and soil fertility. Since they have no viable way to dispose of residual crop waste each season, they often resort to crop burning in North India and this causes a spike in air pollution every year. Biochar, a form of burned organic matter, could be the potential solution to several of these problems and has gained significant scientific importance in recent times. It is essentially organic matter that is burned without oxygen to produce a black residue that can enhance soil fertility when mixed into it. Ancient cultures like settlers along Amazon River and Native American tribes have successfully used it to improve soil fertility by burning organic matter inside covered pits. Further evidence suggests that the process also helps store or sequester carbon, thus helping reduce pollution. Organic waste (called ‘feedstock’ when it’s in the form of raw material) is transformed through heating without oxygen (to prevent combustion), into charcoal-like material producing heat and energy, as well as byproducts like bio oil and fuel gases, which are sources of clean energy. This process of heating is known as pyrolysis.. Biochar also lasts in the soil for a very long time and thus is an effective form of carbon storage.

RESPONSE OF TEFF TO VARIED METHODS OF PLANTING AND FERTILIZER RATES

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Abstract

A field experiment entitled “Response of teff to varied methods of planting and fertilizer rates” was conducted at ICAR-KVK, Haveri during *Kharif*-2019. The experiment was laid out in Randomized Complete Block Design with Factorial concept, consisting two factors viz., planting methods (M₁: line sowing and M₂: transplanting) and nutrient management [N₁: control, N₂: 100 % organics (6 t FYM ha⁻¹), N₃: 20:10:10 kg N:P₂O₅:K₂O ha⁻¹, N₄: 30:15:15kg N:P₂O₅:K₂O ha⁻¹ and N₅: 40:20:20 kg N:P₂O₅:K₂O ha⁻¹ (6 t FYM ha⁻¹ commonly applied to all the three fertilizer treatments)] and replicated thrice. Transplanting of teff recorded significantly higher number of effective tillers (449.0 m⁻²), grain weight (0.31 g ear⁻¹), grain yield (239.95 kg ha⁻¹), straw yield (406.84 kg ha⁻¹), gross returns (84,999 ha⁻¹), net returns (53,106 ha⁻¹) and B-C ratio (2.66) over line sowing. Among different nutrient management practices, application of 20:10:10 kg N:P₂O₅:K₂O ha⁻¹ along with 6 t FYM ha⁻¹ recorded significantly higher grain weight (0.33 g ear⁻¹), grain yield (269.27 kg ha⁻¹), gross returns (95,220 ha⁻¹), net returns (63,136 ha⁻¹) and B-C ratio (2.96), which was on par with application of 30:15:15 kg N:P₂O₅:K₂O ha⁻¹ along with 6 t FYM ha⁻¹. Significantly higher moisture, protein, fat and ash content in teff grains were also observed under application of 20:10:10 kg N:P₂O₅:K₂O ha⁻¹ (10.70, 11.77, 2.58 and 2.91 %, respectively). However, application of 30:15:15 kg N:P₂O₅:K₂O ha⁻¹ and 40:20:20 kg N:P₂O₅:K₂O ha⁻¹ recorded on par values with respect to quality parameters. The interaction effect didn’t show any significant influence on the performance of teff crop.



OPTICAL PROPERTIES OF $\text{Co}_x\text{Sn}_{1-x}\text{O}_2$ NANOPARTICLES SYNTHESIZED BY COPRECIPITATION METHOD

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Abstract

Semiconductor metal oxide nanoparticles are used in optoelectronics and photonics devices such as solar cells, photodiodes, gas sensing devices, phototransistors. Among various metal oxides, tin dioxide (SnO_2), an n-type semiconductor with wide band gap (3.6 eV at 300 K), has been widely used in various applications such as liquid crystal displays, transparent conducting electrodes, optoelectronic devices, solar cells, electrochemical sensors, Li-ion batteries and catalysts. In this work, $\text{Co}_x\text{Sn}_{1-x}\text{O}_2$, (where, $0 = X = 0.09$) nanoparticles is synthesized by chemical Coprecipitation method. Fourier Transform Infrared (FTIR) Spectra show the stretching and vibrational mode of metal-oxygen bond at 650 cm^{-1} , confirm the presence of O-Sn-O bonding. The optical properties of pristine SnO_2 nanoparticles is compared with cobalt doped tin oxide nanoparticles ($\text{Co}_x\text{Sn}_{1-x}\text{O}_2$) having different concentrations ($X= 3, 6$ and 9%). The optical band gap of pristine and Co doped SnO_2 nanoparticles is decreases 3.6 eV to 3.04 eV. As the concentration of Co is increases (3-9%) optical band gap is decreases from 3.6 eV to 3.04 eV. Hence, as the concentration of Cobalt (Co) is increased the optical band gap is decreased, which is useful for optoelectronic devices.

MILLETS—THE CLIMATE SMART CROPS

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Abstract

Changing climate has deleterious effect on both human life and agriculture production. Human however can escape those effects through his intelligence, while crops suffer a lot by climate change, resulting in lower yields and reduced quality of the produce. This results in increased malnutrition and insufficiency of food for the increasing population. Researchers are looking for novel ways to combat the adverse climatic effect on agriculture sector, which is feeding the whole world. Major cereals viz., rice, maize, wheat, etc., have dominated the agriculture sector with their capability of meeting raising food demands due to their high potentiality, yet fail to yield sustainably under changing climate. India ranks second in the incidences of malnutrition among children and more than one third of the world's malnourished children live in India. The major cereals are deficient in many of the nutritional factors, hence cannot check the nutritional balance that are essential components of one's daily diet for being healthy. Scientists have concluded that, there is an urgent need for alternate crops that can potentially meet nutritional security and can yield sustainably even under varied climate is the only best option to overcome the dominance of the major cereals. Millets are one of the oldest foods known to humans & possibly the first cereal grain to be used for domestic purposes. Since centuries, millets have been a prized crop in India and are staple diet for nearly $1/3^{\text{rd}}$ of the world's population. Millets have potentiality of contributing to increase food production, both in developing and developed countries. Millets are most commonly available in the form of pearled and hulled kind. Millets are tasty grains that have a mildly sweet, nut-like flavour. Millets are amazing in their nutrient content and are commonly known as "Nutri-cereals or Nutri-millets".

EFFICACY OF NEWER INSECTICIDE CHLORFENAPYR 10SC AGAINST DEFOLIATOR AND POD BORER ON SOYBEAN AND ITS SAFETY TO NATURAL ENEMIES

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Abstract

Field studies were carried at Instructional Farm , RVSKVV Krishi Vigyan Kendra, Dewas (M.P.) to study the comparative



bio-efficacy of Chlorfenapyr 10 SC , at four doses viz., 144 ml a.i./ha, 192 ml a.i./ha, 240 ml a.i./ha and 288 ml a.i./ha along with Chlorantraniliprole 18.5% SC @ 30 ml a.i./ha and Profenofos 50% EC 500 ml a.i./ha against Defoliator, *Spodoptera litura* (Fabricius) and pod borer , *Helicoverpa armigera* (Hubner) of soybean its safety to natural enemies at during Kharif season of 2016. The Chlorfenapyr 10SC @ 288 ml a.i./ha provided optimum control against the *S. litura* and *H. armigera* of soybean along with significant increased yield and was at par with commercial product (Std. check Chlorantraniliprole 18.5% SC @ 30 ml a.i./ha) against above pests. At a lower dose @ 144 ml a.i./ha was also effective against *Spodoptera* and *Helicoverpa* . Chlorfenapyr 10SC in any dose is quit safe to the important natural enemies such as different spider species, coccinellids and chrysopa associated in soybean. Beside this, Chlorfenapyr 10SC did not cause any phytotoxicity to soybean in any concentration and hence safe for the crop. Hence Chlorfenapyr 10SC @ 288 ml a.i./ha may be recommend for controlling tobacco caterpillar and *Helicoverpa* of soybean.

IDENTIFICATION OF BIOFORTIFIED RESTORERS ON VARIED CMS SOURCES IN PEARL MILLET [*Pennisetum glaucum* (L.) R. BR.]

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Abstract

Pearl millet [*Pennisetum glaucum* (L.) R. Br.], hybrids grown widely in India are all based on A1 CMS source. Fertility restoration behaviour was studied in hybrids developed using biofortified restorers on two diverse cytoplasm in Pearl millet. CMS sources used in the study included A1 CMS which was developed from male sterile line Tift- 23A, A4 CMS which was identified in a wild grassy *Pennisetum glaucum* (L.) R. Br. sub sp. *Monodii* (Maire) Brunken. Fertility restoration of seven biofortified restorers viz., Fe & Zn-1, Fe & Zn-5, Fe & Zn-8, Fe & Zn-9, Fe & Zn-12, Fe & Zn-13, Fe & Zn-14, on eight CMS lines viz., ICMA-98222, ICMA-04999, ICMA-06444, ICMA-96666 and ICMA-97111 are of A1 based cytoplasm and ICMA-15666, ICMA-03999 and ICMA-05222 are of A4 based cytoplasm, have been studied during kharif 2019-20. Out of seven biofortified restorers used in the present investigation, four restorers viz Fe & Zn-1, Fe & Zn-5, Fe & Zn-9, Fe & Zn-12 could restore fertility completely (90 - 100 %). Whereas Fe & Zn-08 exhibited complete fertility restoration on six CMS lines except on ICMA-06444A1 and ICMA-03999A4 on which the extent of fertility restoration was partial (60-70%). Fe & Zn-13 and Fe & Zn-14 revealed complete restoration on seven CMS lines and partial fertility restoration on ICMA-97111A1 and ICMA-15666A4, 50-60% and 70-80% of partial fertility restoration was observed respectively. This investigation has helped in identification of biofortified restorers for varied CMS sources for further development of diversified new hybrids in Pearl millet.

IN-SILICO BASED NETWORK PERTURBATION STUDY IN BLADDER CANCER PATHWAY

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Abstract

Receptor Tyrosine Kinases (RTKs), are one of the most prominent members of cellular pathways and play a major role in biological processes. Protein kinases are usually found to be at elevated levels in cancer. Biological network perturbation helps in understanding the effect of perturbing a single gene or a group of genes in a disease network. As per the KEGG pathway data, there is a total of 41 genes involved in bladder cancer pathway. Due to numerous therapeutic and treatment approaches an individual genes or group of loss their activity. In the present work, we have considered removed an individual gene or a group from the network and we have studied the network perturbation effect using STRING and NEXCADE server. The outcomes revealed the loss of network connection and identify the key gene regulators within the bladder cancer pathway. Out of 19 perturbed conditions, switching off the HRAS, KRAS and NRAS from the pathway resulted in total 46 network connections,



whereas perturbation with RTKs such as EGFR and ERBB2 showed a similar outcomes. Identifying the important genes that cause these diseases and the effect of perturbation of these genes on the rest of the network gives crucial insight into the workings of the network. This can facilitate in developing target-specific therapeutic agents that target important genes involved in the network for the treatment of bladder cancer.

HETROSIS STUDIES FOR YIELD AND YIELD COMPONENTS IN PEARLMILLET (*PENNISETUM GLAUCUM* (L.) R. BR.)

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Abstract

The line $\times$ tester analysis involving fifty hybrids, fifteen parents (five lines and ten testers) and three checks including national check GHB 558, local check VPMH 7 and commercial check Kaveri super boss were used to assess the magnitude of heterosis for grain yield and its components in pearl millet under rainfed conditions at RARS, Vijayapur, Karnataka. Thirty five hybrids showed significant positive heterosis over mid parent and thirty three hybrids showed significantly positive heterobeltiosis for grain yield per hectare. Twenty four hybrids exhibited significant positive standard heterosis over check GHB 558, three hybrids over check VPMH 7 and three hybrids over best check Kaveri super boss for grain yield per hectare. Whereas, thirty four hybrids exhibited significant positive heterosis over mid parent and thirty one hybrids exhibited significant positive heterobeltiosis for dry fodder yield per hectare. Twenty two hybrids over GHB558, one hybrid over VPMH 7 exhibited significant positive standard heterosis for dry fodder yield per hectare. Three hybrids viz., ICMA 01666 $\times$ PMBSN-73 (3561.852 kg/ha), ICMA 01666 $\times$ PMBSN-81 (3538.845 kg/ha) and ICMA 01666 $\times$ PMBSN-66 (3494.023 kg/ha) were superior for grain yield per hectare. Hybrids ICMA 01666 $\times$ PMBSN-73 (11225.535 kg/ha), ICMA 05444 $\times$ PMBSN-81 (11049.501 kg/ha) and ICMA 01666 $\times$ PMBSN-66 (10980.262 kg/ha) were superior for dry fodder yield per hectare. The hybrid ICMA 01666 $\times$ PMBSN-73 exhibited highest grain yield and dry fodder yield per hectare and this hybrid will be evaluated across locations and years for further release in state.

MOLECULAR CHARACTERIZATION OF PLANT GROWTH PROMOTING ZINC TOLERANT BACTERIA

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Abstract

In the present study, thirty zinc tolerant bacteria (ZTB) were screened for MIC against Zn and tolerated high concentration of the zinc ranging from 2.5mM to 62.5mM. All 30 ZTB showed zinc solubilization upto 0.25% ZnO in the medium, whereas at 2% ZnO in MSM medium only 12 isolates showed solubilization. The heavy metal removal studies revealed that ZTB were able to remove Zn from the nutrient broth medium efficiently and the highest biosorption of zinc was recorded in the bacterial strain Z-15. Biochemically, out of 30 ZTB isolates, 18 isolates were found positive for starch hydrolysis, 27 isolates were found positive for citrate utilization, 6 isolates were found positive for nitrate reduction, one isolate were found positive for gelatin hydrolysis, 19 isolates were found positive for catalase activity and 4 isolates were found positive for oxidase activity. All the 30 ZTB isolates were subjected to various plant growth promoting activities. All ZTB strains were positive for IAA production, GA₃ production and ammonia production, whereas 24 ZTB isolates were positive for ACC Deaminase activity, 8 ZTB strains showed siderophore production and 9 ZTB isolates were positive for HCN production. Out of 30 ZTB isolates, 24 isolates showed phosphorus solubilization activity, 30 isolates showed potash solubilization, 15 isolates showed silica solubilization and 27 isolated showed phytase production. The molecular diversity studied through BOX PCR, ERIC PCR and REP PCR showed significant genetic diversity among different zinc tolerant bacteria. The plant growth promoting activity of ZTB isolates under zinc stress conditions in maize were studied in *in vitro* conditions resulted in significant increase of shoot length, root length and total chlorophyll content compared with the uninoculated control (pot containing 1% Zn). After 14 days



of growth under *in vitro* conditions, the expression of stress related enzymes were significantly higher in maize plantlet treated with selected ZTB strains compared to the uninoculated control under Zn stress conditions.

ROLE OF ALOE VERA AN ANCIENT HERB FOR EVALUATION OF NUTRITIONAL, BIOLOGICAL AND ITS CLINICAL APPLICATIONS

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Abstract

Aloe vera has a great importance in therapeutic areas. The plant of aloe vera is a biggest role of health for human beings as it contains richest natural source of nutrients. Because it has various medicinal properties like-anti-inflammatory, antibacterial, antiviral, antitumor, antiarthritic, antirheumatoid, anticancer, immunomodulatory, hypoglycemic or antidiabetic properties so it is well known an ancient herb for modern prosthodontist. In addition, aloe vera has further role to cure constipation, gastrointestinal disorders, and for immune system deficiencies. The plant presence of more than 200 different biologically active substances. This plant has so many biological activities that is antibacterial and antimicrobial activities of the nonvolatile constituents of the leaf gel which contained polysaccharides. In present time, aloe vera has a broad scope due to its composition, rheology, processing and pharmaceutical application in foods and cosmetics. In African as well as eastern European countries, aloe species are spread throughout the world. The genus Aloe has 400 species but only two of them are commercially important such as *Aloe barbadensis* Miller and *Aloe arborescens*. Due to its various phytocomponents and biological attributes that promoted to boost up immunity and help disease condition.

ASSESSMENT OF HERITABILITY AND GENETIC ADVANCE FOR EARLY SEEDLING VIGOUR AND GRAIN YIELD IN EARLY DURATION GENOTYPES OF RICE UNDER DIRECT SEEDING CONDITION

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Abstract

Rice is widely cultivated under irrigated and rainfed conditions, with improved varieties and landraces that specifically adapt to these situations. In India, more than 50% of rice areas under rainfed conditions are cultivated as direct seeded rice (DSR). Due to unpredictable rainfall patterns, labour scarcity and unavailability of timely irrigation water, direct seeded rice has become regular practice under rainfed situation. Strong early seedling vigour is desirable trait in dry direct-seeded rice for enhancing crop establishment and the ability to compete against weeds. A survey of genetic variability is essentially the first step of plant breeding for crop improvement. In addition it, estimates of heritability along with the genetic advance is important factors behind the entire success of selection. The present investigation deals with the estimation of heritability with genetic advance as per cent of mean of eighty rice genotypes for different 26 early seedling vigour traits, yield and its component traits under direct seeded condition in order to decide the selection criteria for improvement of Early seedling vigour and grain yield. High estimates of heritability (>60%) were found for seedling length on 20 days after sowing (DAS) (67.21), seedling dry weight on 20 DAS (68.90), seedling length on 30 DAS (74.05), seedling dry weight on 30 DAS (77.00), germination % (81.76), vigor index I (75.09), vigor index II (76.34), days to 50% flowering (95.15), panicle length (83.44), plant height (74.01), panicle per meter square (69.07), 1000 grain weight (93.42), filled spikelet (96.21), unfilled spikelet (97.19), spikelet fertility % (97.29), paddy length (97.84), paddy breadth (95.53), paddy L/B ratio (97.10) and grain yield (87.25). However, moderate heritability for seedling length on 10 DAS (39.08), seedling dry weight on 10 DAS (49.88), number of leaf on 30 DAS (51.53), flag leaf length (55.95) and flag leaf width (42.21). The magnitude of genetic advance as percent of mean was recorded high for maximum traits, except some trait. Moderate genetic advance showed by seedling length on 10 DAS (10.19), germination % (12.11), days to 50% flowering (17.85), panicle length (17.23) and flag leaf width (12.11), and also such trait showed low genetic advance viz number of leaf on 10 DAS (2.71), number of leaf on 20 DAS (0.10) and number of leaf on 30 DAS (7.69). The knowledge of heritability coupled with expected genetic advance for a trait



helps in deciding the scope of improvement of that particular trait through selection. All the traits possessing high values of genetic advance indicated that the characters are governed by additive genes and selection will be rewarding for the improvement of such trait. It clearly indicates that most likely the heritability is due to additive gene effects and selection may be effective.

DETERIMENTAL EFFECTS OF ACRYLAMIDE INDUCED TOXICITY ON BRAIN AND ITS AMELIORATION IN WISTAR RATS

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Abstract

The present study was designed to investigate and understand the ameliorative potential of α -tocopherol and reduced glutathione (GSH) against the toxicity and oxidative stress caused by acrylamide (ACR) in liver and kidneys in male Wistar rats. Adult male Wistar rats (32) were divided into eight groups (G₁-G₈) such as, control G₁ (basal diet only), G₂ (basal diet + α -tocopherol), G₃ (basal diet + GSH), G₄ (vehicle control, basal diet + corn oil), G₅ (basal diet + ACR), G₆ (ACR + α -tocopherol), G₇ (ACR + GSH) and G₈ (ACR + α -tocopherol + GSH). ACR, α -tocopherol and GSH were orally administered to rats @ 30 mg/KgBW, 5 IU/ KgBW and 2mg/ KgBW, respectively for 45 days. Rats of all groups were sacrificed after 45th day of the study, and liver and kidney tissues were collected for the assessment of histopathological parameters. In Post mortem of the rat's absolute weights of both the organs revealed significant reduction in weight in G₅, while in control groups (G₁-G₄), the weight was normal and constant. Histopathologically liver in G₅ showed hepatic degeneration, congestion in central vein, sinusoids, portal triad and infiltrations of inflammatory cells; while in kidney glomeruli fragmentation, degeneration, tubular dilatations, congestion and infiltrations were evident in the ACR fed group (G₅) but substantially it was regained and marked improved was visible with the co-feeding of the ameliorating agents in specific the α -tocopherol. With the end of this study, it was apparent that, α -tocopherol and GSH played substantial role in maintaining the balance between oxidant and antioxidant mechanism and conferred better amelioration from ACR induced hepatotoxicity and nephrotoxicity.

PROTECTED CULTIVATION OF VEGETABLES : OPPORTUNITIES AND CHALLENGES

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Abstract

Protected cultivation techniques are a set of agricultural applies designed for artificializing the crop environment through the use of soil covers and/or plant covers to control pests and also climatic atmosphere. While protected cultivation method may enhance the productivity of vegetable crops along with growth and yield. In spite of its great importance, it challenging a lot of bio-factors like photo stress, moisture stress, temperature stress, weed growth, insufficiencies in soil nutrients, extreme wind velocities and atmospheric carbon-dioxide. The different advantages of protected cultivation of vegetables are quality, profitability and favourable marketing rate to the growers. Protected cultivation is an emerging technology for raising vegetables, flowers and other high rated as well as consumable crops. In advance agriculture, protected structures held an excessive potential for more production with greater productivity. This study was assumed to examine the position, challenges and opportunities in protected cultivation and related governmental schemes facilities for horticultural crops in India and particularly Uttar Pradesh. It was identified that the cumulative area achieved under protected cultivation by NHM in India. Financial support or subsidy is also provided by the Govt. agency to spread this methodology all over India. Recourse is resourcefully used in these structures because modern methods/techniques were applied.



ENHANCING FOREST PRODUCTIVITY THROUGH AFFORESTATION TECHNIQUES ON ARID SALT AFFECTED SANDY SOILS IN RAJASTHAN

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Abstract

Rehabilitation of naturally occurring salt affected areas is very much needed to fulfill the requirement for fodder and fuel wood for rural livelihood but they require some management approaches to their reclamation. In India, 6.73 m ha area has been reported to be salt affected covering about 50 % (2.98 m ha) occurs in Rajasthan, Gujarat, Haryana and Punjab. Experimental trials were conducted on lithic, calcid, coarse sandy to loamy sand salt affected soil in Jodhpur, Rajasthan to find out suitable exotic and indigenous plant species and afforestation techniques to increase the land productivity. In first experiment *Salvadora persica* (L) a preferential halophyte, evergreen multipurpose indigenous tree with various level of gypsum and nitrogen showed 85.2 to 66.7 % survival in different treatments at 72 months of age. Effect of treatments was considerable and T6 (gypsum + 9g N) was the best treatment attaining 207cm of height and 212 cm of crown diameter, which was 38 % and 24 % respectively more than the untreated plants. It produced 12.0 kg/tree of above ground biomass followed by 10.7kg and 8.8kg in T8 (gyp + 27g N) and T2 (9 g N) respectively which was 71%, 53% & 27% more than the control (untreated plants). Survival is sustained even after 18 years and its natural germination is observed under *Prosopis juliflora* suppressing it to grow as tree. In another experimental set up for halophyte species like *Suaeda nudiflora*, *Atriplex lentiformis*, *Atriplex stocksii* and *Aloe vera* performed well on different types of mound techniques i.e. Double ridge mound (DRM) and Circular dished mound (CDM). Results revealed that *S. nudiflora* maintained the best survival after 36 months on soil structures (DRM 87.5% & CDM 100%) as well as in control (95.8%). While CDM was the best structure for *A. lentiformis* (95.8%) and DRM for *A. stocksii* (87.5%), their performance was poor in control (21%). *S. nudiflora* attained significantly higher height (123-168.cm) on all the three structures as compared to *Atriplex* species. Height of *A. Lentiformis* did not differ with *A. stocksii* as well as control. For crown diameter, *S. nudiflora* attained maximum values on all the three structures; on soil structures its difference was significant with *A. stocksii* only (57.4% & 72.5% more on DRM and CDM, respectively). The difference was 28.1% and 38.2% on DRM and CDM with *A. lentiformis*. *S. nudiflora* recorded maximum mean green and dry (4916.1 & 1649.7 g) biomass compared to 2462.2 & 824.8 g for *A. lentiformis* and 1548.3 & 631.3g for *A. stocksii*. Soil structures significantly enhanced the total biomass than control in all the three species. Based on survival and growth, *S. nudiflora* was the best species followed by *A. lentiformis* and *A. stocksii*. Overall DRM was the best planting practice producing maximum dry biomass. Thus, it can be concluded that slight managements with these species are best to enhancing land productivity in salt affected sandy soils in arid Rajasthan.

PHARMACOKINETIC - PHARMACODYNAMIC MODELLING OF CIPROFLOXACIN IN POULTRY

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Abstract

Ciprofloxacin is a second generation fluoro quinolone antimicrobial drug, an inexpensive and readily available drug, used both in human and veterinary medicine. Ciprofloxacin is a broad-spectrum drug effective against both Gram-negative and Gram-positive bacteria. It is used to treat many bacterial infections including *E. coli* infections in poultry. Planned blood sampling in poultry (n=8) after single dose intravenous and oral administration of ciprofloxacin at the dose rate of 10 mg/kg body weight was done to obtain pharmacokinetic parameters with non-compartment modelling. Plasma drug concentrations at various time-points were measured by ultra high performance liquid chromatography (UHPLC) method using UV detector. For pharma codynamic study, field isolates of *E. coli* recovered from natural outbreaks in poultry were used and minimum inhibitory concentration (MIC) data were worked out for ciprofloxacin against same isolates using Hi Comb™ method. A MIC breakpoint equal to 0.1 µg/ml was estimated for susceptible *E. coli* bacteria. The calculated average value of pharmacokinetic - pharma codynamic (PK-PD) indices like AUC/MIC and C_{max}/MIC were favourable (> 90 and > 15, respectively) for ciprofloxacin in poultry to treat susceptible *E. coli* infection. The calculated loading oral dose of



ciprofloxacin in poultry was 9.2 mg/Kg body weight followed by maintenance dose of 7.5 mg/Kg body weight to be repeated every 24 hours.

FLORAL AND POLLINATION BIOLOGY OF SEWAN GRASS (*LASIURUS SINDICUS* HENR.)

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Abstract

A total of sixty plants of sewan were raised in isolation in the field by growing single seed. Covering of inflorescence with parchment paper and whole plant with plastic clear sheet, malasiya cloth and white khadi cloth bag at the initiation of flowering was done to observe the mode of pollination in the plants. Studies related to anthesis are being undertaken where around 400 spikes were tagged to study the anthesis related traits. Some of these spikes were harvested at 1-2 upper seed maturity stage and rest at 21st day of spike emergence for recording the observations. More than 500 spikes were covered with parchment paper for observation of mode of pollination which were later harvested at 25th day, 30th day, 35th day and 40th day of spike emergence for observations related to seed setting and seed formation. Some quantitative and qualitative floral characteristics of sewan were recorded including spike emergence, duration of anthesis, number of anthers/ spike, anther colour, spike length, peduncle length, etc. Practical utility of this study is that there will be knowledge about flower structures, flower development pattern, seed setting and mode of pollination which would be useful in various genetic studies and improvement programs of sewan grass.

BREEDING APPROACHES FOR ADAPTATION CLIMATE VARIABILITY

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Abstract

Climate change is predicted to increase variability among existing individual. Developing variety types with high degrees of heterozygosity and genetic heterogeneity for adaptation traits helps achieving better individual and population buffering capacity. Traits that potentially enhance adaptive phenotypic plasticity or yield stability in variable climates include photoperiod-sensitive flowering, plastic tillering, flooding tolerance, seedling heat tolerance, and phosphorus efficiency. For sustainable productivity increase, improved cultivars should respond to farmer-adoptable soil fertility management and water harvesting techniques. Larger-scale, on-farm participatory testing will enable assessments of varietal performance under evolving climatic variability, provide perspective on needs and opportunities, and enhance adoption. Strengthening seed systems will be required to achieve sustainable impacts. In the long run, the climatic change could affect agriculture in several ways such as quantity and quality of crops in terms of productivity, growth rates, photosynthesis and transpiration rates, moisture availability etc. Drivers of climate change through alterations in atmospheric composition can also influence food production directly by its impacts on plant physiology. Biotechnology provides breeders with a number of new tools that may help to develop more drought tolerant varieties such as marker assisted selection (MAS), molecular breeding (MB), and transgenic plants.

STUDIES ON PREPARATION OF WET TURMERIC PICKLE

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Abstract

Natural plant products have been used throughout human history for various purpose. Turmeric is a plant that has a very long



history of medical use dating back nearly 4000 year because of its brilliant yellow colour turmeric is also known as INDIAN SAFFRON in North India turmeric is commonly called “haldi” belongs to the family Zingiberaceae and it’s botanical name curcuma longa. Turmeric overcomes various health problems related to our body and brain. It increases the antioxidant capacity of the body it reduce risk of heart disease and hence it overcome various health problems we must eat wet turmeric in our daily diet, because wet turmeric contains more amount of ‘curcumin’ than powdered variety. Various turmeric products such as pickle, powder etc. The turmeric pickle is prepared by using wet turmeric, mustard seed, fenugreek, asafetida, red chilli powder, salt, mustard oil, lemon juice. The recipe of wet turmeric pickle were standardized with different samples and sensory evaluation done by 9 point hedonic scale.

IN VITRO EFFICACY OF PLANT EXTRACTS AGAINST EARLY BLIGHT OF TOMATO (*ALTERNARIA SOLANI*)

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Abstract

Early blight caused by *Alternaria solani* tomato is a destructive disease of tomato resulting into heavy yield losses. Various fungicides are frequently used to control the disease. However, chemicals are causing serious problem and more alarming amongst them are the pollution of air, water and soil, residual toxicity, development of resistance in fungal pathogens and harmful effects on non target organism. Plant extracts are an ideal source for disease management as they are low cost, eco-friendly, safe to human beings and micro-organisms and hence constitute suitable plant protection component for disease management. Aqueous plant extract of ten medicinal plants were tested against *Alternaria solani* for their antifungal activity under *in vitro* condition. At 5 per cent concentration maximum inhibition (47.67%) was in *Ginger officinale* extract with least colony diameter of 45.00 mm and this treatment was significantly superior over rest of the treatments. Similarly, at 10 per cent concentration the treatment of *Ginger officinale* extract recorded minimum colony diameter (24.67 mm) which gave 71.31 per cent mycelial growth inhibition. It was followed by treatment of *Azadirachata indica* and *Allium sativum* extract which recorded 25.39 and 26.18 mm colony diameter, respectively. At 15 per cent concentration similar trend of results was obtained. Minimum colony diameter (17.00 mm) with maximum growth inhibition (80.15%) was recorded in treatment of *Ginger officinale* extract and it was at par with treatment of extract *Azadirachata indica* which recorded 17.78 mm colony diameter with 79.24 per cent inhibition of mycelial growth. Moreover, all plant extracts were significantly superior over control in inhibiting the mycelial growth of *A. solani* at 5, 10 and 15 per cent concentration.

ANTIBIOTIC SUSCEPTIBILITY PATTERNS IN BACTERIA ISOLATED FROM DIFFERENT NATURAL THERMAL ZONES OF SIKKIM HIMALAYA

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Abstract

Prokaryotic life has dominated most of the evolutionary history of our planet, evolving to occupy virtually all available environmental niches. Sikkim Himalayas are unique as in a short distance three different kind of natural thermal conditions exists i.e., psychrophilic, mesophilic and thermophilic due to the presence of hot spring in snow covered mountain in Sikkim Himalayas. The microorganisms surviving in the psychrophilic condition are called as psychrophiles (the microorganisms which optimally grows below 20°C) whereas the thermophiles are which grow at temperature above 40°C. Microbes which can grow at very high temperature (above 100 °C) or nearly at freezing point of water challenges our understanding of the physical and chemical constraints on life. Understanding how living communities survive and are structured under various environmental conditions is not only important but is also very fascinating. These extreme or exhilarating environments and the microorganisms living in them has open the doors for search of life exterior to earth and also the leeway to transfer life from one planet to another. The culturable bacterial diversity was performed of three natural thermal conditions and presence or absence of three different kind of bacteria, i.e., thermophilic, mesophilic and psychrophilic bacteria along with bacterial



diversity we had performed antibiotic resistance Testing (AST) of the isolates. The culture dependent bacterial diversity showed the dominance of phyla Firmicutes and genus *Geobacillus*. Most of the collected isolates from psychrophilic and thermophilic zones showed susceptible to at least 10 different antibiotics which were further supported by the absence of antibiotic resistance.

EFFECT OF ENDOPHYTES, BIOAGENTS AND *PSEUDOMONAS FLUORESCENS* (PF) BASED ZINC NANO PARTICLE ON PLANT GROWTH PROMOTION OF SORGHUM SEEDS

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Abstract

Selective pomegranate fungal (*Trichoderma harzianum*, *T. asperellum*) and bacterial (*Bacillus vallismortis*) endophytic suspension, bioagents (*T. viridae* and *B. amyloliquifaciens*) and green nanoparticles (*Pseudomonas fluorescens* based Zinc Nanoparticles (Pf-ZnNPs) @ 0.15 %) were prepared and evaluated for their Plant growth promoting activity on sorghum seeds by the standard roll towel method (ISTA, 1993). Among all treatment tested for their growth promotion activities, the higher per cent seed germination was recorded in Pf-ZnNPs @ 0.15 % (86.67 %) which was on par with *B. amyloliquifaciens* (84.33 %), *T. harzianum* (83.33 %) and *B. vallismortis* (83.33 %) and were significantly superior to the untreated control (75.33 %). The maximum shoot length and root length was recorded in *B. vallismortis* (12.18 and 20.11 cm), which was on par with shoot length of *T. harzianum* (11.50 cm). The minimum shoot length and root length was recorded in untreated control (9.59 and 15.60 cm). The higher seedling vigor index was observed in *B. vallismortis* (2127.86) which was on par with Pf- ZnNPs @ 0.15 % (1990.52) and *T. harzianum* (1984.62). The lower seedling vigor index was recorded in untreated control (1516.57). This study proves that endophytic microorganisms and nanoparticles can also influence the plant growth either directly or indirectly.

EFFECT OF ENVIRONMENTAL CONDITIONS ON TOMATO MOSAIC DISEASE DEVELOPMENT UNDER NATURAL CONDITION

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Abstract

Tomato (*Solanum lycopersicum* L.) crop is confronted with a number of biotic and environment stresses due to which crop yield remained far lower than the potential. Tomato mosaic disease is most devastating, as it completely destroys the crop. To combat this problem twenty germplasm of tomato viz. Pusa Ruby, EC-620406, Arka Vikas, EC-771607, EC-676791, Hisar Anmol, EC- 514109, EC- 514109, EC-677191, EC-677049, EC- 677123, Avinash 2, Arka Sourabh, Kashi Vishes, Local, Kajal, Hiasr Arun, Money Maker, EC-620417, Arka Ananya, EC-617048 were screened against disease. EC-771607, Hisar Anmol were found resistant while Kashi Vishes, Hisar Arun, Arka Ananya were found moderately resistant. However, EC-677049, Avinash 2, Money Maker, EC-620417 and EC-617048 showed susceptible reaction and Pusa Ruby was found susceptible against the disease. The germplasm viz. EC-620406, Arka Vikas, EC-676791, EC- 514109, EC- 514109, EC-677191, EC- 677123, Local, Kajal and Arka Sourabh showed moderately susceptible reaction against the disease. The disease incidence of these germplasm were correlated with the data of environmental factors (temperature, relative humidity and rainfall). Temperature (maximum and minimum) relative humidity (maximum and minimum) and rainfall during the course of disease development contributed about 99.9, 99.7, 99.8, , 99.7, 98.8 and 99.7 per cent in Pusa Ruby, EC-677049, Avinash-2, Money Maker , EC-620417 and EC-617048 respectively. The correlation of disease development with weather parametres revealed that maximum and minimum temperature exhibited significant and positive correlations with disease development whereas, maximum and minimum relative humidity exhibited negative correlation and rainfall had no significant correlation with disease development. Multiple correlation coefficients indicated that temperature (maximum and minimum) and relative humidity (maximum and minimum) had strong relationship with disease development.



STUDY ON EFFECT OF MICROWAVE DRYING ON DRYING AND QUALITY CHARACTERISTICS OF BANANA CHIPS

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Abstract

Control and pre-treated Banana chips were dehydrated using microwave energy at different power levels (20W, 40W, 60W and 80W). Dried samples were evaluated for drying parameters and quality attributes, viz. rehydration ratio, color, and microbial load. It was found that the increase in power level, decreases the drying time to reach minimum drying time of 19 min at 80W, whereas maximum drying time 45min was at 40W. Maximum Rehydration ratio was observed at 40W, lower Rehydration ratio was observed for both control and pretreated sample at 20W and 80W. The packaged (LDPE) banana chips were microbiologically safe upto 90 days in FSSAI norm. Page, Henderson and Pabis, Lewis, Wang, Singh, Peleg model more validated. Lowest RMSE value was observed in Peleg model followed by Lewis model. Pretreated sample shared lower L value (34.19, 30.07, 37.82, 45.82) than control sample (39.06, 28.88, 48.51, 47.17) whereas fresh banana (70.86) at 20W, 40W, 60W, 80W. Pretreated sample shared A value (7.39, 5.65, 5.91, 9.34) than control sample 7.28, 2.52, 10.33, 8.87) whereas fresh banana (4.56) at 20W, 40W, 60W, 80W. Pretreated sample shared lower B value (24.1, 21.66, 26.55, 30.14) than control sample (28.85, 15.08, 37.94, 36.99) whereas fresh banana (32.24) at 20W, 40W, 60W, 80W respectively.

A NUTRITIOUS LIQUID : HONEY

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Abstract

The consumption of honey has a very long history; it has been used in innumerable foods and beverages as sweetening and flavoring agent. Since ancient times, honey has been known for its nutritive and therapeutic values. Honey is produced all over the world, global production of honey is approximately 1.20 Metric tons per annum. Honey forms part of traditional medicine in many cultures, it has been traditionally used by Egyptians, Greeks, Romans, and Chinese to heal wounds and diseases of the gut, including gastric ulcers. It has also been used as a remedy for cough, sore throat, and earaches. Honey is composed of at least 181 components and is basically a solution supersaturated in sugars, fructose (38%) and glucose (31%) are the most important; the moisture content is about 17.7%, total acidity 0.08% and ashes constitute 0.18%. Honey has a wide number of substances, including ascorbic acid, small peptides, flavonoids, tocopherol, and enzymes such as glucose oxidase, catalase, and peroxidase. Therefore, honey is a natural alternative to sulfites for controlling enzymatic browning during fruit and vegetable processing and for obtaining juices and preserves. Due to the large number of beneficial effects that honey presented on the body, could be considered as potential ingredients for different foods. It is an inexpensive moist dressing with an antibacterial, anti-inflammatory, antioxidant and tissue healing properties. Daily consumption of 2g can provide number of health benefits.

INFORMATION TECHNOLOGY IN AGRICULTURE : BOON IN DOUBLING FARMERS' INCOME

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Abstract

Agriculture is the largest livelihood provider in rural India. In the agricultural sector, constant application of latest innovative ideas and better technologies is essential to enhance the economic well being of the farmer. The problem of Indian agriculture is not lack of technology, R&D efforts but inadequacy and inefficiencies in the dissemination of information to the farmers.



Therefore, Information Technology in agriculture can act as a driving force in the development process. Information technology is playing a vital role in agricultural production and marketing. Information technology allows farmers to save time on orders and delivery and getting feedback. Farmers' crop database must be managed. The data base includes the kinds of crops, the size of cultivated area, time of harvest and yield. Farmers of the extension personnel transmit those data via the internet to data base server. Crops information service system should be created. This system analyzes the crop data to create some statistical tables. Farmers can access these statistical data by browsing the home page and make their production plan. Production technology and information inquiry system should be created. Production equipment inquiry service system should be created. This system gathers information from the company of seeds and crop production equipment to build the production equipments inquiry service system. Mobile based app may be helpful in providing the weather based data, market rate of produce and other agronomy based information to the farmers. Agmarknet, State Agricultural Marketing Boards (SAMB), Kisan Call Centre, Community Radio stations, Call centre at KVKs, Call centre at ATIC are the important Agencies, Models, Initiatives, Projects of the Agricultural Marketing Information Network.

BIODRAINAGE : BOON FOR WATERLOGGED AND SALINITY SOILS

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Abstract

Irrigated agriculture covering about 17% of the total cropped area of the world contributes 40% of the total food production. In India, about one-third area under irrigation produces two-third of the food grains. Recognizing the fact that irrigation is an essential input for increasing and sustaining the agricultural production, particularly in arid and semi-arid regions, large investments have been made world over during the last 50 years for its expansion. In this period, the net irrigation potential has increased from 95 million hectare to 260 million hectare in the world and from 22.5 million hectare to 69.38million hectare in India. Expansion of irrigation in the past provided large dividends in terms of increased food production and nutritional security. However, introduction of canal irrigation in arid and semi-arid regions without provision of adequate drainage causes rise in ground water table leading to waterlogging and secondary salinisation. Presently, about one-third of the world's irrigated area faces the threat of water logging, about 60 million hectare is already water logged and 20million hectare is salt affected. As per estimate of Ministry of Water Resources, in canal command areas of the country 14million hectare is waterlogged and 6.72million hectare salt affected. In the predominantly agricultural state of Haryana, Punjab, Delhi, UP, West Bengal, Andhra Pradesh and Rajasthan nearly 50% area faces rising ground water table and salinity problems and about 10% area has already become waterlogged resulting in reduced crop yields, low profits and abandonment of agriculture lands. The problem is very serious in arid and semi-arid regions where underground water is of poor quality. The problems of water logging and salinity can be effectively tackled by conventional subsurface drainage systems provided these are properly designed, installed, maintained and operated. But these are more expensive and sometimes cause environmental problems. The limitations and shortcomings of the conventional engineering based drainage systems call for alternative approaches to keep the agriculture sustainable over the long term. The alternative approaches must be effective, affordable, socially acceptable, environment friendly, sustainable and upgrade natural resources of land and water. Biodrainage comprising of deep rooted vegetation with high rate of transpiration seems the promising option. Biodrainage may be defined as "pumping of excess soil water using bio-energy through deep rooted vegetation with high rate of transpiration." The biodrainage system consists of fast growing tree species, which absorb water from the capillary fringe located above the ground water table. The absorbed water is translocated to different parts of plants and finally more than 98% of the absorbed water is transpired into the atmosphere mainly through the stomata. This combined process of absorption, translocation and transpiration of excess ground water into the atmosphere by the deep rooted vegetation conceptualizes bio-drainage. Fast growing Eucalyptus species known for luxurious water consumption under excess soil moisture condition are suitable for biodrainage. These species can be planted in blocks in the form of farm forestry or along the field boundary in the form of agroforestry. Other suitable species for block plantations are *Casuarinaglauca*, *Terminaliaarjuna*, *Pongamiapinnata* and *Syzygiumcumini* etc. The evaporation from the soil takes place up to a depth of 4 m. Therefore, we must plan to keep this 4 m soil depth free from waterlogging to minimize the process of secondary salinisation of soils and to sustain the crop productivity in canal command areas located in arid and semi-arid regions. For this, we need fast growing trees like Eucalyptus having their root system penetrating at least up to this depth. The bio-drainage technique could be applied in two contexts viz. curative (for water waterlogged areas) and



preventive (for potentially waterlogged areas). Biodrainage system helps in dryland/rainfed systems to recharge control, groundwater flow interception, discharge enhancement and in Irrigated systems, water table control, channel seepage interception.

A 16S RRNA BASED METAGENOMIC INVESTIGATION OF THE UTERINE BACTERIAL MICROBIOTA, THEIR PREVALENCE AND ANTIMICROBIAL RESISTANCE PATTERN OF ISOLATES FROM THE CLINICAL CASES OF CATTLE METRITIS

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Abstract

Metritis severely affects the economy of by reducing productivity and hampering reproductive cycle of the animals. This acts like two-sided sword to damage dairy economy. For prevention and control of metritis, it is essential to understand the dynamics of the uterine microbiota at parturition. Keeping these aspects in mind the present study was planned to establish cattle uterine microbiota at and immediate after parturition; to identify the major bacterial pathogens involved in the cattle metritis and also to suggest the prevention and control strategies to avoid post parturient metritis in cattle. The present study included 24 cattle including 11 showing the clinical signs of metritis whereas 13 with regular estrous cycle. Out of them 7 and 3 regular isolates of *E. coli* were recovered from metritic and apparently healthy cattle. All the presumptive isolates of *E. coli* were confirmed by the amplification species specific of 556 base pair *uidA* genes. Four animals also revealed presence of *Staphylococcus spp.* in metritis cases with the prevalence of 36.6 %. All the bacterial isolates were subjected to antibiotic sensitivity test against 14 antibacterial drugs like Ciprofloxacin, Levofloxacin, Enrofloxacin, Gentamicin, Amikacin, Streptomycin, Cloxacillin, Penicillin G, Cefoperazone, Cephalexin and Ceftriaxone, Metronidazole, Amoxicillin Clavulanic Acid and Oxytetracycline. *E. coli* isolates revealed 100% resistance against Cloxacillin, Penicillin G, Metronidazole, Levofloxacin and Oxytetracycline, 90% against Enrofloxacin and Streptomycin, 70% against Amikacin and 60% against Amoxycyclav. *Staphylococcus* isolates revealed 100% resistance against Cefoperazone, Cloxacillin, Penicillin G, Streptomycin, Metronidazole, Levofloxacin and Oxytetracycline and 75% against Gentamicin and Ciprofloxacin. When all the isolates were classified for antibiotyping, study revealed eight biotypes of *E. coli* and four biotypes in *Staphylococcus spp.* The uterine discharges of both healthy cyclic and metritic cows were subjected for metagenomic analysis to compare the changes in uterine microbiota. The pooled samples of five healthy and five metritic cows of Sahiwal breeds were subjected for metagenomic analysis using MG-RAST server. The analysis revealed the presence of 4 domain of microbes in metritic animals as compared to two domains in healthy animals. The healthy animals have almost 100% population of archaea with only 29 domains of bacteria. While in contrast to it, metritic animals revealed 87 % bacteria and 12 % archaea. Similarly, studies of Phylum revealed 6 and 19 phyla in healthy and metritic samples. The results of classes revealed 8 and 32 classes in healthy and metritic samples. The samples from metritic cows revealed 108 families in comparison to 17 families in samples of healthy animals. Similarly, samples from metritic cows revealed 235 genera in comparison to 22 genera in samples of healthy animals.

STUDIES ON PREPARATION OF WET TURMERIC, LEMON BALLS

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Abstract

The product wet turmeric, lemon balls prepared by using wet (Fresh) turmeric, cinnamon, lemon juice and black salt. Wet turmeric is a good source of 'curcumin' and lemon is a good source of vitamin 'C'. 'Curcumin' is found more amount in wet



turmeric than the powdered variety, that's why the present study was undertaken to develop a product by using wet turmeric rather than Powdered variety. 'Selam' variety of wet turmeric was selected to prepare the product because it contains 5.1% of 'Curcumin'. Due to the addition of cinnamon, lemon juice, black Salt it gives spicy, bit sour and salty taste and flavour to the product. All added ingredients are rich in nutrients and having good antioxidant property. The nutrients in wet turmeric are more easily absorbed and used by the body as compared to dried. Like turmeric 'cinnamon' is a powerful antioxidant known as polyphenols. Cinnamon is an excellent antimicrobial agent. It has been known to stop the growth of bacteria and fungi. The recipe of wet turmeric, lemon balls were standardized with different samples and sensory evaluation done by 9 point hedonic scale.

INTELLECTUAL PROPERTY RIGHTS AND THEIR IMPORTANCE

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Abstract

Intellectual property rights (IPR) have been described as concepts, ideas, and creative expressions on the basis of which the willingness of the public to grant property status is based. IPR grants inventors or creators of that property certain exclusive rights in order to enable them to reap commercial benefits from their creative efforts or reputation. IPR is the subject of global trading activities and livelihoods around the world in the new scenario of globalization. These rights improve the creative environment by giving the creator or inventor recognition and economic benefits, while the lack of knowledge of IPR and its ineffective implementation can impede the nation's economic, technological and societal developments. There are many ways of protection of intellectual property, such as patents, copyrights, trademarks, geographical indications, industrial designs, trade secrets, layout designs, protection of new plant varieties, etc. The biggest hitch with developing countries such as India is the lack of awareness about IPR. Lacking IPR awareness, outsiders are stealing our money and ideas and offering biopiracy provision. Having IPR in the basic educational framework and supporting IPR registration by encouraging innovators and developers is important for policy makers. In terms of available raw materials, cheap labor, innovative and innovative committed labor, India has all the tools. In addition, the status of the involvement of India in IPR-related activities.

RURAL ENTREPRENEURSHIP IN INDIA : OPPORTUNITIES AND CHALLENGES AHEAD

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Abstract

In India, about 75% of the households live in villages. Rural entrepreneur is a key figure in economic progress of India. In recent times, more and more entrepreneurs are realizing the potential of rural market and have started focusing on it. Therefore, promotion of rural entrepreneurship is extremely important in the context of producing gainful employment and reducing the widening disparities between the rural and urban population. Rural Entrepreneurship can be defined as entrepreneurship emerging at village level which can take place in a variety of fields of endeavor such as business, industry, agriculture and acts as a potent factor for economic development. Rural entrepreneurship recognizes opportunity in the rural areas and accelerates a unique blend of resources either inside or outside of agriculture and brings an economic value to the rural sector by creating new methods of production, new markets, and new products and generates employment opportunities. Rural entrepreneurs play a vital role for the economic development of a country in the form of capital formation, balanced regional development, employment generation, improvement in standard of living, increase in per capita income, check on migration of rural population, equitable distribution of economic power. In spite of such vital role, most of the rural entrepreneurs face peculiar problems like illiteracy, fear of risk, lack of training and experience, limited purchasing power and competition from urban entrepreneurs. Some of the major problems faced by rural entrepreneurs are paucity of funds, competition, middlemen involvement, legal formalities, lack of technical knowledge and infrastructural facilities, risk, adverse social, cultural and industrial environment, non-availability of skilled labours, lack of market information, etc. Finally



in order to make the rural entrepreneurship worthwhile and successful, the following measures may be adopted such as creation of finance cells, training and awareness programmes, setting up of marketing co-operatives, proper supply of raw materials etc. Therefore, there should be more stress on rural entrepreneurship since it's a way of converting developing country into developed nation.

TO STUDY POLYMORPHIC VARIATION IN DRUPE AND SEED OF *BUCHANANIA LANZAN* SPRENG

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Abstract

Buchanania lanzan is a member of family Anacardiaceae, commonly known as Achar or Chironjee. It is found throughout the greater part of India in dry deciduous forest upto an altitude of 1200 msl and sub Himalayan tract upto 900 msl. It is a medium sized tree known for its high medicinal value. Polymorphic studies include morphological parameter of drupe seed, their weight analysis and emptiness of seed. Drupe was collected from seven different seed sources. The experiment was conducted at Forest Research Institute, U.P. This studies include the length, breadth and thickness of both drupe and seed. Seed source Malva (S6) found to be the best i.e. 1.044 cm, 0.918 cm, 0.688 cm for drupe and 0.683 cm, 0.510 cm and 0.338 cm in case of seed. In the same way seed source sirsi (S2) shows maximum value in different parameters seed weight analysis i.e. weight of fresh kernel (59.00), number of drupes in 10 grams (29.25) and weight of 100 drupes in gram (23.75) whereas weight of 100 fresh kernel found to be 3.625 for Sukrut (S5). The maximum percentage of emptiness of seed was found to be 21.75 for Ghoraval (S1) and Muirpur (S6) seed sources.

IMPORTANCE OF DIFFERENT TYPES OF MILLETS

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Abstract

Millets are a group of highly variable small-seeded grasses, widely grown around the world as cereal crops or grains for human food and as fodder. There is evidence of the cultivation of millet in the Korean Peninsula dating to the Middle Jeulmun Pottery Period (around 3,500–2,000BC). In India, millets have been mentioned in some of the oldest Yajurveda texts, identifying foxtail millet (*priyangava*), Barnyard millet (*aanava*) and black finger millet (*shyaamaka*), thus indicating that millet consumption was very common, pre-dating to the Indian Bronze Age (4,500BC). Even until 50 years ago millets was the major grain grown in India. From a staple food and integral part of local food cultures, just like many other things, millets have come to be looked down upon by modern urban consumers as “coarse grains” – something that their village ancestors may have lived on, but that they had left behind and exchanged for a more “refined” diet. Unfortunately, this said refined diet lacks the nutrients critically important for us (food should be as local and wholesome as possible).

Small millets are especially rich in iron, zinc and calcium, and have other dietary qualities that can help stave off anaemia, celiac disease, and diabetes. It is the most important small millet in the tropics and is cultivated in more than 25 countries in Africa and Asia, predominantly as a staple food grain. According to Rohit Jain, Co-founder of Banyan Roots, an organic store selling products at reasonable and sustainable price points, “There are two broad categories of millets, namely major and minor millets. While pearl millet, sorghum, finger millet and foxtail millets come in the category of being the major millets, others such as *sama*, *kodo*, *chinna* etc., are considered minor millets. Many of the minor millets are endangered, as they are getting depleted, and some of them have even totally been eliminated.” Each millet has an importance of its own. While some millet, such as finger millet, are full of calcium, some like jowar have potassium and phosphorus, and foxtail is fibrous while kodo is rich in iron. Therefore, it is advisable to keep rotating the kind of millets we are eating. We should also remember that we should not mix millets and should only eat one grain in a meal as each grain has its own requirement as the medium for digestion and mixing them can create imbalances in body. Due to its high resistance against harsh conditions, millets are sustainable to the environment, to the farmer growing it, and provide cheap and high nutrient options for all. Nearly 40 percent of the food produced in India is wasted every year. Millets do not get destroyed easily, and some of the millets are good for



consumption even after 10-12 years of growing, thus providing food security, and playing an important role in keeping a check on food wastage. Millet is fibrous in content, has magnesium, Niacin (Vitamin B3), is gluten-free and has a high protein content.

EFFECT OF ORGANIC MANURES AND INORGANIC FERTILIZER ON PLANT GROWTH, YIELD AND PHYSIOLOGICAL PARAMETERS OF PEA (*PISUM SATIVUM* L.)

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Abstract

The effect of organic manures and inorganic fertilizer on plant growth, yield and physiological parameters of Pea (*Pisum sativum* L.) was induced during kharif 2016. The application of organic and inorganic fertilizer T0 Control T1 (Farm Yard Manure 100%), T2 (Vermicompost 100%), T3 (NPK 100%), T4 (Vermicompost 75% + NPK 25%), T5 (Vermicompost 75% + Farm Yard Manure 25%) T6 (Vermicompost 50% + Farm Yard Manure 50%) T7 (Vermicompost 50% + NPK 50%) which was found significant on parameters. The highest plant height was measured in were found in T₇ (VC50% + NPK50%), (50.44). The maximum number of branches 60 days T₇ (5.77). The maximum number of pods per plant was noted in T₇ (VC50% + NPK50%) (12.2) which was found significant. The maximum number of seeds per pods was noted in T₇ (VC50% + NPK50%) (6.96), the maximum seeds yield per plot (g) was noted in T₇ (VC50% + NPK50%) (61.25), The T₃ (NPK 100%) which was found significant maximum leaf area was noted in (2.096). maximum 100 seeds weight 20.28(g) maximum Chlorophyll b content (0.783) mg./g FW. was noted. total Chlorophyll content (12.472) mg./g FW. maximum Protein content 19.25 (mg/g) was noted. And The maximum Chlorophyll a content (1.816) mg./g FW was noted in T₆ (VC 50% + FYM50%) Over all treatment (T₇ vc 50% + NPK 50%), T₃ (NPK 100%), T₆ (VC 50% + FYM 50%) was found to be very much effective in improving of growth, yield, and Physiological parameters on Pea (*Pisum sativum* L.)

UTILIZATION OF DRONES AS AN INNOVATIVE TECHNOLOGY FOR CROP IMPROVEMENT

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Abstract

The impact of a growing global population is affecting the very natural resources on which human life is based. There is extreme need to fulfil the food demand of each and every person. Agriculture sector is the most promising sector, dealing with the lot of problems now a day's one of the main problems is labour unavailability for farming. Other problems or difficulties are extreme weather events, inadequate amount and inefficient application of fertilizer, infection, diseases, allergies and other health problems due to chemical application (fungicide, pesticide, insecticide etc.) or insect/animal bite. The Use of advanced technologies such as drone in agriculture offer potential for facing several major or minor challenges. The major applications of drone in agriculture are irrigation, crop monitoring, soil and field analysis and Health assessment.

MORPHOLOGICAL CHARACTERIZATION OF MUNGBEAN GENOTYPES FOR QUANTITATIVE TRAITS

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Abstract

Mungbean [*Vigna radiata* (L.) Wilczek] is one of the important pulse crop and it is the third most important pulse crop after chickpea and pigeon pea. Due to short growth duration allows adaptation to many cropping systems and rotations. It is a



self-pollinated, herbaceous, annual crop having $2n = 2x = 22$ chromosomes with a genome size of 579 Mb/1C. Its capacity to restore soil fertility through nitrogen fixation makes it a valuable crop in various cropping systems. It is an excellent source of easily digestible protein (22-25%) and other nutrients. It is rich in essential amino acids especially lysine, which is deficient in most of the cereal crops and contribute to the balanced diet. According to International Union for Protection of New Plant Varieties (UPOV), any new characteristics used in genotype characterization should be clearly defined, accepted and should have standard method of observation, least or not affected by environment, available to breeders, associated with reasonable costs and efforts. To identify mungbean genotypes, international and national bodies like UPOV, IPGRI and IIPR have published relevant descriptors. The present investigation was carried out with 80 diverse genotypes along with checks of mungbean during Kharif and summer season. Data were recorded on various morphological characters including hypocotyl pigmentation, days to 50 percent flowering, plant height, number of branches, number of pods per plant, pod length, 100-seed weight and seed yield. Analysis of variance shown significant differences among all the genotypes for all the characters studied.

BIOFORTIFIED CROPS : A SUSTAINABLE WAY TO RELIEVE MALNUTRITION

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Abstract

By any mean, the magnitude of micronutrient under nutrition is unacceptable. It is estimated that nearly 2 billion people suffer from iron deficiency, a quarter of the world's population is suffering from poor zinc intakes, and the magnitudes for vitamin A deficiency are also very high as well. Mineral deficiency is one of the main global challenges to human health for people who live especially in developing and under developed countries. Food provides energy, carbohydrates, proteins, essential fats, vitamins, antioxidants and minerals to meet our daily metabolic requirement. Nutritious diet is essential for proper growth and development in humans as it helps in preventing diseases, besides maintaining the body metabolism. 'Bio-fortification' of crops is a practicable and most economical approach for overcoming 'hidden hunger'. Increasing the concentration of minerals in edible portions of cereal crops involves better uptake from soil and improved translocation to grains from leaves and at the same time enhance their bioavailability by reducing their anti-nutritional compounds and/or enhancing concentration of mineral absorption promoters. Biofortification is also varying cost effective method. After an initial large research investment, seeds can be distributed and the "implementation costs of growing biofortified foods are nil or negligible", as opposed to supplementation which is comparatively expensive and requires continued financing over time.

STUDY OF HETEROSIS EFFECT IN WHEAT (*TRITICUM AESTIVUM* L.) UNDER LATE SOWN IRRIGATED CONDITION

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Abstract

The present investigation entitled "Genetic studies on terminal heat tolerance in wheat (*Triticum aestivum* L.)" was carried out during Rabi 2017-18 and 2018-19 at the All India Co-ordinated Wheat & Barley improvement project, B.T.C. College of Agriculture and Research Station, Bilaspur and Research cum Instructional farm, IGKV, Raipur (CG), India. The experiment was conducted in RBD involving six lines, three testers and 18 F₁s hybrids of wheat with two replications for study of character associated with the magnitude of heterosis in wheat under late sown irrigated condition. The most of the crosses like viz., CG 1015 X HALNA showed highly significant heterosis for the character of number of spikelet per spike, canopy temperature depreciation and days to maturity, followed by crosses MP 3336 X PHSL 10 showed highly positive significant heterosis for the character of spike weight, seed yield per plant and harvest index. Crosses RAJ 4238 X PHSL 10 showed highly positive significant heterosis for the character of number of tillers per plant. Crosses HD2932 X HALNA showed highly positive significant heterosis for the character of 1000 seed weight and crosses HD 2285 X HUW 661 showed highly positive significant heterosis for the character of biological yield per plant under late sown and heat stress condition.



GENETIC VARIABILITY AND ASSOCIATION ANALYSIS IN RICE GERMPLASM

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Abstract

Rice (*Oryza sativa* L.) is the important cereal crop that belongs to the Poaceae family and the Oryzoidea sub family, known as “Global Grain” due to its use as the primary staple food in around 100 countries in the world. The basic objective of the plant breeders would always be towards yield improvement as well as quality improvement in staple food crops. The present investigation is carried out to study the genetic parameters and association analysis for grain yield and quality characters in forty five rice germplasm accessions. Analysis of variance intended that the mean sum of square because of treatment showed high significant for all the quantitative and quality attributes. Grain yield per plant was estimated highly significant as well as positive correlation including biological yield per plant, harvest index, filled spikelet per panicle, total number of grains per panicle, effective panicles per plant and total tillers per plant. These characteristics were indicated strong relationship with grain yield per plant and in improving grain yield selection for these characters will be useful. Out of forty five rice genotypes studied, the entry Bora excelled others by expressing superior performance for quantitative traits with biological per yield plant and grain yield per plant, harvesting index followed by Parwatkala, Bhejari, and Saraiphool. Consequently, for grain appearance quality the entry Saraiphool expressed best performance for paddy length, brown rice length and kernel length. Similarly for milling quality best genotypes are Korma followed by MTU1010 and Parwatkala. According to eating and cooking quality best lines are Soth followed by Hunder, Parwatkala and Sathaka.

ERGONOMICAL CONSIDERATION IN FARM MACHINERY TO REDUCE OPERATIONAL DRUDGERY OF FEMALE WORKERS

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Abstract

Large production on agriculture which is derived from the labour and workout comes of highly dedicated farm workers. In the changing scenario, the participation of women workforce in agricultural is going to increase to 45% by 2020 i.e. out of total estimated agricultural workforce of 230 million in 2020, about 103 million will be women workers. In Chhattisgarh state, total population is 25,545,198 as per 2011 census of which male and female are 12,832,895 and 12,712,303 respectively. In which the percentage female agriculture labour are 54.40 % and male agriculture labour are 32.90%. As large as 54.40% of the total workforces engaged in agriculture females, contributing a major proportion to the farm production. Thus in future women workers will play a greater role in Indian agriculture. Now mechanization level continuously improving and more hand tools, implements are being developed, manufactured and used for various agricultural operations. Anthropometric data, muscular strength, maximum aerobic capacity and heartbeat of female workers are taken under consideration to develop woman friendly machinery. Ergonomical design is necessary to reduce the energy expenditure of female workers also reduce their physical cost and provide better comfort during operating the machinery for various operations.

IMPACT OF VARIOUS GUM ENHANCER ON PHYSICOCHEMICAL PROPERTIES OF EXUDATED GUM DHAWARA (*ANOGEISSUS LATIFOLIA*)

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Abstract

Dhawara (*Anogeissus latifolia*) belonging to combretaceae family available in Chhattisgarh (Sarguja, Bijapur, Raipur, Mungeli, Bilaspur District). This is a tree of tropical and subtropical climatic regions. This gum mainly consists of calcium salts of high molecular weight polysaccharides which on hydrolysis yields arabinose, galactose, mannose, xylose and



glucuronic acid. Therefore the investigation was entitled as “Effect of different gum enhancers on gum exudation in Dhawara (*Anogeissus latifolia*)”. For chemical methods of tapping various gum enhancer *i.e.* T₁ (distilled water), T₂ (ethephon), T₃ (H₂SO₄), T₄ (ethephon + H₂SO₄), T₅ (HCl) was injected by drill method (at 4 cm deep and 4 cm diameter slant hole) and gum inducer was injected by injector and covered the hole with clay. The maximum rate of gum exudation was obtained in between February to March in ethephon @ 3.9% + H₂SO₄ @ 1%. The tree diameter ranged from 1.50 to 1.58 m and the exudation was observed only in ethephon @ 3.9%, 4ml and have taken minimum time one week for exudation and in ethephon @ 3.9% + H₂SO₄ @ 1%, 4ml the exudation started within 2 week. The pH value of all gum samples indicated the slightly acidity because of its higher acid content and its plays significantly role in dispersion stability. The range of pH was obtained 4.49 to 5.65 in chemically tapped gum in Dhawara. However, the significantly lowest value of pH was observed in gum sample obtained by HCl 1%, while maximum pH value was observed in ethephon 3.9% + H₂SO₄ 1%. The solubility was maximum in hot water and only in ethanol and it was insoluble in acetone. The value of viscosity was greater at low rpm/min and decreased gradually with increase in rpm 10, 20, 30 rpm/min, the value was obtained at 10 rpm/min is 1240 cP.

EVALUATION OF FUNGICIDES AGAINST COLLAR ROT (*SCLEROTIUM ROLFII* SACC.) OF LENTIL

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Abstract

The efficacy of fungicides (7 systemic, 4 non-systemic and 6 combo) was tested at different concentrations of 20, 50, 100, 200 and 500 ppm against *S. rolfsii* on PDA by poisoned food technique in vitro condition and seed treatment with fungicide under pot experiment. It was concluded that systemic fungicides like, Hexaconazole 5% EC, Propiconazole 25% EC and combo products Tubaconazole 50% + Trifloxystrobin 25% WG, Captan 70% + Hexaconazole 5% WP, Propiconazole 13% + Difenconazole and Carboxin 37.5% + Thiram 37.5% showed complete inhibition of the pathogen at all the concentrations tested. Whereas, the non-systemic fungicide Mancozeb 75%WP, Thiram 75% WS and Propineb 70% WP was found inhibitive only at higher concentrations (100 ppm) against *S. rolfsii* under in vitro condition. Similar results were found in case of seed treatment with fungicide under pot experiment.

ORGANIC FARMING AND SUSTAINABLE AGRICULTURE

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Abstract

Throughout the history of organic agriculture, practitioners have emphasized healthy, living soil as the foundation of sustainable and successful farming (Howard, 1947; Pfeiffer, 1938), and have often assessed soil health in terms of soil organic matter (SOM) content. As the organic movement grew during the mid-late 20th century, its leaders urged farmers and gardeners to “build soil organic matter,” or humus, and to “feed the soil.” Recommended practices included: Return manure and crop residues to the soil. Compost materials to stabilize nutrients and develop humus before applying to the soil. Use organic mulches. Grow and plough-down green manure crops. Diversify the crop rotation. Integrate crop and livestock production. Popular writings on organic agriculture promoted SOM and humus as the remedy for all that ails the garden or field, from difficult-to-work soil and low crop yields or quality to pests, weeds, and diseases. This led new or transitioning organic growers to round up as much organic material as they could—manure, leaves, straw, kitchen scraps, and more—and add them directly to the soil or after composting. Sometimes this approach worked well. However, pitfalls were often encountered, such as nitrogen (N) tie-up after plowing down a lot of straw or other high-carbon residues, slugs and other pests attracted by organic mulch, and plant-growth-inhibiting (allelopathic) substances or plant pathogens in crop residues or immature compost. Initially, Extension and other mainstream agricultural professionals cautioned farmers that, because of these issues, the organic approach would not make sufficient economic returns. However, as concerns about soil degradation and erosion mounted, farmers, Extension agents, and conservationists began to recognize the importance of SOM and soil life,



and scientists began to unpack the “black box” of SOM in order to better understand how to manage it for optimum production and long-term sustainability. Growing recognition of the importance of healthy living soil has led to substantial research endeavors to define and measure soil health, and to develop practical guidelines for improving and maintaining soil health 2 building organic MATTER FOR HEALTHY SOILS: AN OVERVIEW in farming and ranching.

PREDICTING YIELD FOR WHEAT CROP IN EASTERN REGION OF UTTAR PRADESH USING DSSAT MODEL

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Abstract

The crop simulation models can predict crop yield as a function of soil, climate and genetic coefficients. Forecasting yield of crops is important for planners in taking tactical decisions for ensuring food availability. The aim of this study was the calibration and validation of CERES –wheat model (v4.7) for High yielding variety of wheat in Prayagraj and Varanasi district of Uttar Pradesh. Crop simulation models are useful tool to forecast the crop yield. The study indicated that DSSAT v 4.7 is a strong tool for prediction of yield in advance, with the introduction of the correction factor to transform the point based results to regional/districts scales. There is a need to create databases for relational layers of bio-physical and socio-economic aspects for the growing regions to be subsequently integrated with the crop simulation results for regional estimates. Based on the areas under different dates of sowing and crop cultivars, a correction factor was applied on simulated yield to predict the district wise and regional wheat yield. The simulated yield was higher than the actual yield in the both district, while the forecasted yields were very close to actual. The Relative deviation of the forecasted yield from the actual was $\pm 4\%$ and $\pm 9\%$. Thus the model can be used in predicting the district wise as well as regional yield of wheat in different districts of Uttar Pradesh. The results clearly revealed the capability of the simulation model to forecast the wheat yield by incorporating the variability in other unaddressed factors with the simulation results. Thus the result show the performance of the methodology of yield forecast over different district, and the averaged results over seasons and the results clearly revealed satisfactory performance of the approach in yield estimates on district as well as regional scales. The simulated wheat yield predication along with observed yield in 2009-19 for the both district, validation results indicate that the hind cast wheat yields for most of the districts are within the acceptable error limit ($\pm 10\%$) in all the years of validation; however, prediction was marginally higher in the Varanasi district as compare to Prayagraj district. The results clearly indicated that the CERES-Wheat model can be used to regional production estimates of wheat in Uttar Pradesh.

IMPACT OF BIO STIMULANTS ON POST HARVEST QUALITY OF GLADIOLUS (*GLADIOLUS GRANDIFLORUS* L.)

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Abstract

There is much scope to increase Gladiolus (*Gladiolus grandiflorus* L.) cultivation in chhattisgarh and the use of physiological tool may be helpful to enhance the quality and vase life because early senescence is the main limiting factor during the marketing of cut flowers. The present investigation was entitled “Impact of bio stimulants on post harvest quality of gladiolus (*Gladiolus grandiflorus* L.)” in five different experimental cultivars i.e., Saffron, Summer shine yellow, American beauty, Candyman and White prosperity in the department of plant physiology, IGKV, Raipur. The vase life studies was conducted in laboratory at room temperature (27-28°C) via using cut spikes at ten pre storage pulsing mediums for vase life studies i.e., Sucrose, FeSO₄, Salicylic acid, GA₃, KNO₃, CaCl₂, Citric acid, ZnSO₄, MgSO₄ and each treatment was replicated thrice. The studies indicated that the pre storage pulsing treatment i.e., 2% sucrose was found significantly superior over other treatments. It is so because the senescence process of cut flowers was delayed by the application of sucrose. The translocated sugars by accumulation in the flower tissue increase their somatic concentration and improve their ability to absorb water and maintain turgidity. ZnSO₄ @ 0.2% was found to be significantly poor performer for vase life of all the cultivars of gladiolus and also degrade the flower pigments and deteriorated the flower quality of cut flower spikes.



ASSOCIATION ANALYSIS STUDIES FOR YIELD AND QUALITY PARAMETERS IN AROMATIC BREEDING LINES OF RICE (*ORYZA SATIVA* L.)

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Abstract

The present experiment entitled “Genetic analysis for yield and quality parameters in aromatic breeding lines of rice (*Oryza sativa* L.)” was conducted at “Research and Instructional Farm, Department of Genetics and Plant Breeding, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh), during Kharif (wet season) 2019.” In this programme sixty seven aromatic rice breeding lines (including 5 checks viz; Badshahbhog, Dubraj, Indira Sugandhit Dhan-1, Chhatisgarh Devbhog and Chhatisgarh Sugandhit Bhog) were used. The research was conducted in complete randomized block design with two replications. The major objective of the research programme was 1. To estimate genetic variability parameters for yield and quality traits. 2. To estimate association of yield and quality traits and 3. To estimate genetic diversity among the aromatic breeding lines. The analysis of observation on 27 qualitative and quantitative traits, reported the presence of ample amounts of variability in the experimental material for all the characters. “Higher magnitude of coefficient of variations were observed for cooking width, consistency of gel, grain yield per plant, amylose content, alkali spreading value (ASV), filled spikelet per panicle and total number of spikelet per plant”. “High heritability estimate coupled with high genetic advance as % of mean” was reported for gel consistency followed by amylose content, filled spikelet per panicle, test weight, flag leaf length, plant height, grain yield per plant, length of kernel, length of grain and spikelet fertility %. These characters are assumed to be regulated by additive gene action and selection for these traits can be rewarding. Analysis of correlation coefficient, positive and significant correlation of grain yield per plant with test weight, harvest index, volume expansion, cooking length, cooking width and head rice recovery (%). Hence, these characters are helpful to determine the higher grain yield and can be used as selection criteria. Path analysis also gives an insight about the direct and indirect contribution of traits towards yield. The traits like kernel length, filled spikelet per panicle, day to maturity, test weight, plant height, total tillers per plant, head rice recovery (%), flag leaf length and alkali spreading value, volume expansion, grain width, and harvest index showed positive significant direct effect on grain yield per plant. Thus, these characters can be used for improvement of grain yield per plant in rice.

EFFECT OF ENVIRONMENTAL FACTORS ON BACTERIAL BLIGHT DISEASE DEVELOPMENT IN POMEGRANATE

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Abstract

Bacterial blight caused by *Xanthomons axonopodis* pv. *punicae* is very serious disease on pomegranate lead to heavy losses in terms of yield and quality. The study was carried out to understand the correlation of environmental factors on disease development during kharif 2019-20. During the crop season, highly significant and positive correlation of disease severity with evening relative humidity was observed at 1 per cent level of significance. While, highly significant and negative correlation of disease severity with Maximum temperature, minimum temperature and evaporation was observed at 1 per cent level of significance. Significant and positive correlation of disease severity with morning relative humidity was observed at 0.5 per cent level of significance. While, significant and negative correlation of disease severity with wind velocity was observed at 0.5 per cent level of significance. Positive correlation of disease severity with rainfall and rainy days was observed but they are non-significance and negative correlation of disease severity with sunshine hours was observed however, they are non-significance. Ideal conditions for bacterial blight development on pomegranate was observed as average temperature range between 32.2-23.1 °C, humidity range between 73.6 -55.8 per cent with 5.5 sunshine hours, 4.5 km/hr wind velocity, 5.9 mm evaporation and total rainfall 463.4 mm with 27 rainy days. The data was subjected to multiple regression analysis among the ten, nine multiple regression coefficients -0.50, -7.15, -0.41, 0.89, -1.23, -0.36, 0.02, 0.38 and 3.22 were obtained for independent weather variables viz., maximum temperature (°C), minimum temperature (°C), morning humidity (%), evening humidity (%), wind velocity (km/hr), sunshine (hrs), rainfall (mm), number of rainy days and evaporation (mm) with R square value 0.75 for oily spot of pomegranate.



HEALTHY FOOD THROUGH ORGANIC FARMING

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Abstract

In today's time, the losses due to the frequent use of chemical fertilizers are a matter of great concern for us. Its harm effect is not only on our soil, it's also harmful for our health. Excess use of chemical fertilizers in the soil, it contributes to the accumulation of nutrients. When these nutrients reach high concentration levels and the ground is no longer able to assimilate them, they leach away into groundwater and polluted the water. Acidity of chemical fertilizers also adversely affect the soil pH, thereby changing the kinds of microorganism that can live in the soil. Excess use of chemical fertilizers can contribute to the release of greenhouse gases such as CO₂ and nitrous oxide into the atmosphere. Continuous use of chemical fertilizers on soil depletes the essential nutrients of soil. As a result, the food produced in these soils has less vitamins and minerals content. Presently, it is impossible to completely stop the use of chemicals fertilizers, but with the use of bio-fertilizers, its use can be reduced somewhat.

Bio-fertilizer is a substance which contain living microorganism, which applied with the seeds, plant surface or soil. Bio-fertilizer promotes growth by increasing the supply for availability of nutrients to the plant. Bio-Fertilizers increase the availability of essential plant nutrients through the natural process of nitrogen fixation, solubilizing phosphorus and stimulation plant growth through the synthesis of growth promoting substances. Bio-fertilizer is technically livings, it can symbiotically associate with plant root. Involved microorganism readily and safely convert complex organic material in simple compounds, So that plant is easily taken up. It's does not matter how's the condition of the soil, uptake of nutrients through chemical fertilizers is not more than 40% by the plant. But with the use of bio-fertilizers, it increases and the fertilizer is fully utilized. Bio- fertilizers contribute to increased yield of crops by improving root development, increase the rate of water and mineral uptake from the soil. It is an environmental friendly source of plant nutrients and are an important compound of integrated nutrient management and integrated plant nutrition system.

CEREBRAL TRYPANOSOMOSIS IN BUFFALO—A CASE STUDY

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Abstract

Animal trypanosomosis is one of the major economic yet neglected disease in tropical and subtropical regions of the world. *Trypanosoma evansi* affects a wide host range like cattle, buffalo, dog, horse and camel including man. Trypanosomosis in buffaloes is highly prevalent in Indian subcontinent. *Trypanosoma evansi* is a flagellated hemoprotozoan parasite and is transmitted mechanically mainly by blood sucking fly of genus *Tabanus*. This communication deals clinical management of cerebral trypanosomosis. An adult buffalo aged between 4-5 years from Chirkhatta forest region of Lalkuan, District Nainital, Uttarakhand was presented with the history of dull and depressed appearance with generalised weakness, intermittent fever (39.5-40°), nervous signs like circling movements, hyperaesthesia, twitching of muscles, pressing of head against the manger, staggering gait and stamping of feet indicative of acute trypanosomosis. Blood sample was collected and brought to Department of Veterinary Parasitology, Pantnagar, Uttarakhand. Tentative clinical diagnosis was made on the basis of history and clinical signs. Confirmatory diagnosis was made using microscopic examination of thin blood smear stained with Giemsa stain. Blood smear examination revealed the presence of intercellular flagellated hemoprotozoan, *Trypanosoma evansi*. Following diagnosis, animal was treated with Triquin @ 6 mg/kg body weight via subcutaneous route with supportive drugs. A gradual reduction was observed in nervous signs like circling movements, hyperaesthesia, head pressing and staggering gait and clinical signs completely disappeared after a week. Peripheral blood smear was again examined 7 days post treatment to determine the presence/ absence of the organism and found negative for *Trypanosoma evansi*. Acute cerebral trypanosomosis is a fatal disease and may cause death of the affected animal. Hence, taking in view the severity of the disease, it is necessary to take efficient control measures on time. The findings of the present study prove that acute cerebral trypanosomosis can be managed effectively and also save the life of infected animal, if diagnosed properly in due course of time and treated accordingly.



IMPACT OF CLIMATE CHANGE IN AGRICULTURE

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Abstract

Climate change and agriculture are interrelated processes, both of which take place on a global scale, with the adverse effects of climate change affecting agriculture both directly and indirectly. This can take place through changes in average temperatures, rainfall, and climate extremes (e.g., heat waves); changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods; and changes in sea level. Climate change is already affecting agriculture, with effects unevenly distributed across the world. Future climate changes will most likely affect crop production in low latitude countries negatively, while effects in northern latitudes may be positive or negative. Animal husbandry also contributes towards climate change through emissions. Agriculture contributes towards climate change through anthropogenic greenhouse gas emissions and by the conversion of non-agricultural land such as forests into agricultural land. In 2010, agriculture, forestry and land-use change were estimated to contribute 20–25% of global annual emissions. In 2020, the European Union's Scientific Advice Mechanism estimated that the food system as a whole contributed 37% of total greenhouse gas emissions, and that this figure was on course to increase by 30–40% by 2050 due to population growth and dietary change.

ASSESSMENT OF GENETIC DIVERSITY IN LENTIL (*LENS CULINARIS* MEDIK.) GENOTYPES UNDER NORMAL AND LATE SOWN CONDITIONS IN BIHAR.

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Abstract

Present investigation is conducted to study the genetic variability, direct and indirect inter-relationship, and to assess genetic diversity in the lentil accessions for yield and its attributes under normal and late sown condition. Significant treatment differences were expressed for all the characters under study except number of primary branches per plant, number of pods per cluster under both normal and late sown condition and number of seeds per pod in late sown condition. High heritability (%) along with high genetic advance as % of mean was documented for number of secondary branches per plant, number of pods per plant, number of filled pods per plant, 100 seed weight, grain yield per plant and biological yield per plant, indicating that these characters are advocated by additive gene and directional selection for these traits would be more rewarding. The correlation analysis revealed that grain yield per plant showed highly significant and positive association with number of pods per plant, number of filled pods per plant, 100 seed weight, grain yield per plant, biological yield per plant and harvest index had positive and highly significant association with grain yield per plant under both normal and late sown condition. Path analysis in both normal and late sown condition displayed that biological yield per plant had maximum and positive direct effect on grain yield per plant followed by harvest index and number of filled pods per plant. On the basis of Mahalanobis D² statistics, seven clusters were designed. Among the seven clusters, cluster I constituted maximum number of genotypes (10) followed by cluster II (8), cluster III (7) accounting for 19.44 per cent towards total genetic diversity, cluster IV (6), cluster V (3) diversity and cluster VI and VII was monogenotypic under timely sown condition whereas in late sown condition, five clusters were formed displaying cluster II with maximum number of genotypes (18) followed by cluster I (11), cluster III (5) and lastly, cluster IV and V was monogenotypic. Owing to the results of inter-cluster distance and mean performance of clusters for different traits, the genotypes viz, FLIP 2010-86L and X2011S-172-1 under normal sown and likewise, Pusa Vaibhav and IPL-406 under late sown environment are expected to trigger the desirable segregants for yield and its determinants. 100 seed weight contributed maximum towards genetic divergence followed by grain yield per plant and number of pods per plant in timely sown and 100 seed weight chased by number of pods per plant and number of secondary branches per plant under late sown environment. Molecular genetic diversity through 20 SSR markers also exhibited maximum diversity between them. The result revealed diversified lentil genotypes which can be utilized in further crossing programme for exploring choke-full yield potential in lentil.



STUDIES ON FORMULATIONS OF NPK BIOFERTILIZER CONSORTIA AND THEIR EFFECT ON MAIZE (*ZEAMAYS*) GROWTH

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Abstract

Plants need nutrients for their growth and development. To meet plants nutrient requirement chemical fertilizers are applied but their adverse and harmful effects on environment invites scope for the use of bioinoculants in the form of biofertilizers. Individual application of each of the bioinoculants would be expensive and laborious. Hence, development of consortia with consistent efficiency under field conditions and longer shelf life will pave way for successful commercialization of this technology. Therefore, bioinoculants consisting of biofertilizer strains capable of providing N, P and K nutrients as single inoculants with enhanced shelf-life will be useful technology in present agriculture. So, an attempt was made to develop two NPK biofertilizer consortia each consisting of local efficient strains of a nitrogen fixer (*Gluconacetobacter* G1 or *Azospirillum* ACD-15), *Psuedomonas striata* as phosphate solubilizing bacterium (PSB) and a potassium solubilizing bacterium (KSB) in five different formulations namely, lignite, kaolinite, liquid, Na-alginate and bentonite at the Department of Agricultural Microbiology, University of Agricultural Sciences, Dharwad based on their compatibility and populations. And a green house experiment was carried to test the effect of developed formulations on growth of maize (*Zea mays* L.). The results of maize growth parameters such as shoot length at 45 (60.14 cm) and 90 DAS (111.60 cm) in Na-alginate formulation, root length at 45 (8.65 cm) in Na-alginate formulation and 90 DAS (12.70 cm) in liquid formulation and number of leaves per plant 45 (8.40) and 90 DAS (12.30 cm) in liquid formulation were recorded significantly higher over dual inoculation (lignite based *Azospirillum* ACD-15 and PSB) and uninoculated control. However, there was no drastic difference in the effect of two microbial consortia. The present study has revealed that the different formulations consisting of biofertilizer strains influenced the growth of maize irrespective of microbial consortium.

COMBINING ABILITY ANALYSIS FOR YIELD AND YIELD ATTRIBUTES IN DUAL PURPOSE SORGHUM [SORGHUM BICOLOR (L.) MOENCH]

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Abstract

Combining ability analysis (GCA) enables plant breeders to select parental lines for crossing and provides the opportunity to understand the nature of gene actions involved in the inheritance of desired traits. In this study, we used a line x tester mating design to generate 30 hybrid crosses using three restorer (R) and ten cytoplasmic male sterile (CMS; A) lines. Field performance of the hybrids, parents and standard checks were evaluated for grain yield and important phenological, fodder and quality traits. There were a significant effect of GCA and SCA for most of the traits evaluated, indicating the participation of additive or dominant genes in inheritance. The restorer line SPV 1822 and five male sterile lines ICSA 29003, ICSA 29004, ICSA 29011, ICSA 29014 and ICSA 29016 show potential for use as parents in sorghum breeding programs. Crosses ICSA 29004 × SPV 1822 and ICSA 29012 × SPV 1822 were identified for multilocation testing.

EFFECT OF EXTRACTION METHODS ON THE PHYSICO-CHEMICAL PARAMETERS AND ACCEPTABILITY OF APPLE JUICE

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Abstract

The apple juices of four common categories like natural, crushed, centrifuged and filtered are obtained. Apple juice contains an appreciable amounts of the soluble solids/ constituents of the original apple sugar, acids, carbohydrates and minerals. The unclarified apple juice is generally sold in the fresh satate or preserved by chemical preservation for prompt consumption. The



crushed apple juice is an extreme type of unclarified apple juice containing larger quantities of fine cellular material. A large portion of apple juice is sold as filtered or the clear juice. Extraction methods of fruit juice affect both the analytical and sensory characteristics of the final product. However, extraction of juice has always been a mechanical process and is most laborious as well as unattractive of all. In the present investigation, two extraction methods including, screw type extractor and hydraulic press were tested for the apple juice extraction. The physico-chemical and sensory evaluation of the extracted apple juice showed promising results. Higher yield of juice (50.19%) was obtained when hydraulically pressed with significant effect on acidity, sugars, pectin and pH. Ascorbic acid was higher in hydraulically pressed apple juice. Similarly higher overall acceptability scores (6.80) were obtained for hydraulically pressed juice as compared to juice extracted using screw type juicer (6.33) on the scale of 9.0.

COMBINING ABILITY STUDIES USING BLAST RESISTANT RESTORERS IN PEARLMILLET (*Pennisetum glaucum* (L.) R. BR.)

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Abstract

The experiment consists of fifty experimental hybrids generated from five A1 cytoplasm based male sterile lines and ten blast resistant restorers evolved from crossing in L × T fashion during summer 2019-20. These fifty experimental hybrids along with parents (fifteen) and three checks were evaluated during Kharif 2019-20 at Regional Agricultural Research Station, Vijayapur, Karnataka. The results revealed that, in general combining ability analysis PMBSN-118, PMBSN-22 and PMBSN-81 were found to be having maximum gca effects. PMBSN-118 had better general combining ability for plant height, panicle weight per plot, grain yield per hectare and dry fodder yield per hectare. PMBSN-22 had better general combining ability for panicle girth, grain yield per hectare, dry fodder yield per hectare and thousand seed weight. Whereas PMBSN-81 showed good combining ability for plant height, panicle length, panicle weight per plot and dry fodder yield per hectare. In specific combining ability analysis four crosses viz., ICMA 05444 × PMBSN-72, ICMA 01888 × PMBSN-22, ICMA 97555 × PMBSN-118 and ICMA 01666 × PMBSN-66 were identified as the best specific combiners for grain yield per hectare and major yield components. Combining ability studies revealed that both general and specific combining ability variances were important but the estimates of sca variance were higher in magnitude for all the characters. This is further supported by ratio of gca and sca variance. The estimates of gca/sca ratio (variance ratio) indicate that a relatively higher proportion of sca was responsible for the expression of all the characters and the magnitude of the ratio varied among the different characters. Thus, indicating the predominance of non-additive gene action.

DISTINCTNESS, UNIFORMITY AND STABILITY CHARACTERIZATION OF OAT (*Avena sativa* L.) GENOTYPES

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Abstract

Multipurpose oat crop cultivated for grain, pasture, forage or as a rotation crop belongs to cereal family Poaceae, ranks 6th in world cereal production following wheat, maize, rice, barley and sorghum. Oat is largely used for livestock as fodder crop and has occurred in human diet for a long time, mainly as oatmeal and rolled oats, but the constructive physiological effects of oat products were recognized recently. The germplasm available in oat crop is backbone of the plant breeding programs, selected for crop improvement helps the breeder to maintain the genetic diversity collected from diverse regions prerequisite in the development of new varieties. The purpose to protect the new crop variety under Protection of Plant Variety and Farmers' Rights Act by conducting the DUS test is a statutory requirement. One hundred twelve genotypes of oat characterised for twenty nine morphometric characters. The genotypes were categorised into different groups based on visual and measurable observations. The morphologically observed characters include early plant vigour, early plant growth habit, lowest leaves hairiness of sheaths, panicle orientation of branches, leaf blade hairiness of margins of leaf below flag leaf, panicle attitude of



branches, leaf colour, primary grain hairiness on lemma surface, main culm hairiness on uppermost node, panicle awnness, grain colour of lemma, main culm pithiness primary grain hairiness of base, primary grain length of rachilla and primary grain length of basal hairs while plant height, days to 50% flowering, days to maturity, no. of panicle bearing tillers, peduncle length, panicle length, primary grain length of lemma, flag leaf blade length, flag leaf blade width, main culm diameter, number of nodes on main culm, main culm internode length, 1000-seed weight and outer glume length were metric traits.

EFFICIENCY OF VARIOUS SOURCES AND LEVELS OF HUMIC ACID ON SOIL PROPERTIES, GROWTH AND YIELD OF CAPSICUM

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Abstract

A field experiment was conducted at farmer's field of Devanahalli taluk to evaluate the efficiency of Humic acid (HA) extracted from different sources on growth, yield and soil properties. Humic acid extracted from three different sources viz., poultry manure, pressmud and coffee pulp at two levels 60 and 90 kg ha⁻¹ along with RDF was carried out with capsicum as the test crop. Increase in yield (55.41 t ha⁻¹) and growth parameters fruit length (10.13 cm), breadth (8.90 cm) and pericarp thickness (0.69 cm) was observed with application of RDF + HA 90 kg ha⁻¹ extracted from poultry manure followed by application of RDF + HA 90 kg extracted from pressmud and coffee pulp @90 kg ha⁻¹. There was significant increase in soil physical and chemical properties of soil after harvest of the crop. Decrease in bulk density (1.32 Mg m⁻³) and increase of MWHC (40.71 %) and higher CEC value of 15.24 cmol (p+) kg⁻¹ was observed with application of in HA @ 90 kg ha⁻¹ compared to control (RDF alone). Similar was the trend in buildup of nutrient status of soil with highest available nitrogen (334.22 kg ha⁻¹), phosphorus (125.23 kg ha⁻¹) and potassium (319.19 kg ha⁻¹) content. Thus among different sources and levels of application HA extracted from poultry manure applied @90 kg ha⁻¹ along with RDF was found sufficient in improving the soil health followed by pressmud and coffee pulp extracted humic acids.

SUSTAINABLE EMPOWERMENT OF WOMEN THROUGH VALUE ADDITION IN FINGER MILLET (*ELEUSINE CORACANA*)

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Abstract

Rural Indian women are extensively involved in agricultural activities, but the nature and extent of their involvement differs with variations in agro-production systems. In addition to their role in agricultural production, women are gainfully employed in agri-based allied activities like dairying, animal husbandry, poultry, goatery, rabbit rearing, beekeeping, floriculture, horticulture, fruit preservation, value added food products etc. This would also help in generating self-employment and women entrepreneurship. Entrepreneurship skills can help in building confidence and self-awareness through income generation. Various activities can be taken up by rural women for income generation while being at home and by organizing themselves in Self Help Groups (SHGs). Usually, women's representation is greater in allied agriculture than in grain production, and poor households require the greater involvement of women in income-generating activities than financially stable ones. Different extension methods like on campus training programs and group discussions were developed on the value addition of tamarind to create awareness among the public. In this perspective Seethe Byraveshwara Self Help Group of 15 farm women was identified to be trained in KVK for the development of value added products and an on campus training programme for a week was provided to disseminate technology on production of finger millet value added products like Ragi laddu, ragi mixture, ragi chocolate, ragi malt and ragi kurkure and to estimate cost benefit ratio. Raw materials, branding, labelling and packaging materials were distributed to the SHG to encourage them for the product development and selling of the products. Advertising and marketing of the products initially was carried on in the free stalls of exhibitions in krishi melas and in district melas where



the products created huge demand. Results showed that processing of quintals of ragi for five products like ragi laddu (70Kg), ragi mixture (51.25 Kg), ragi chocolate (80.50Kg), ragi malt (130Kg) and ragi kurkure (48.5 Kg) respectively. Ragi laddu, ragi mixture, ragi chocolate, ragi malt and ragi kurkure production procured was 18,560, 27,850.50 and 29,250.75, 27,640.75 and 28,648.50 respectively. The total processing cost of Ragi laddu, ragi mixture, ragi chocolate, ragi malt and ragi kurkure was 13,470, 14,500.00 and 15,250.00, 17,560 and 15,550 respectively. The ragi laddu of marketing efficiency ratio were 1.37, ragi mixture was 1.92, ragi chocolate was 1.91, ragi malt 1.57 and ragi kurkure was 1.84 respectively. The value addition of finger millet has helped to improve their family income per month from 20,000/- to 25,000. These trained individuals of SHGs now serve as the resource persons in training the budding up SHGs.

BIOFORTIFIED VALUE ADDED FOOD PRODUCTS FROM *MORINGA* LEAF POWDER

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Abstract

The present study entitled was carried out in Pt. Kishori Lal Shukla College of Horticulture and Research Station, Rajnandgaon (C.G.), Faculty of Horticulture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) and Bhabha Atomic Research Centre Mumbai, Maharashtra and during 2019-2020. Phytochemicals analysis of MLE extract showed positive result for total phenolic content, flavonoids and tannin. Irradiation improved the bioactive properties of *Moringa* leaves. 1 kGy irradiated dose of *Moringa* leaf powder had higher antioxidant property as compare to 0 kGy and 2.5 kGy. *Moringa* leaves showed good anti-diabetic activity due to α -amylase and α -glucosidase inhibitory activity. It showed antimicrobial activity against most common gram-positive food pathogenic bacteria (*Staphylococcus aureus*, *Bacillus cereus*). The *Moringa* blend of fortified Herbal Tea standardised in 1 kGy with T7 *Moringa* Herbal Tea with lemon grass (per 2 g) (Tea -750mg (37.5%), *Moringa* powder-400mg (20%), Stevia -100mg (5%), Lemon grass -750mg (37.5%) and the other one is T12 *Moringa* Herbal Tea with cardamom (per 2 g) (Tea -750 mg (51.5%), *Moringa* powder -500mg (34.5%), Stevia -100mg (7%), Cardamom -100mg (7%). Blend of *Moringa* Soup with tomato base was standardized in 1kGy gamma radiation dose with 1.66% *Moringa* leaf powder. *Garam Masala* mixture was standardized with 3% and 5% *Moringa* leaf powder in both ways unirradiated or irradiated method (1 kGy). For the sensory attributes 13 combinations of *Moringa* Herbal Tea are prepared and selected the 2 best combinations (*i.e.* lemon grass and cardamom). For the sensory attributes 4 combinations of *Moringa* Soup are prepared and selected the 2 best combinations (*i.e.* control and radiated). For the sensory attributes 8 combinations of *Garam Masala* are prepared and selected the 4 best combinations (*i.e.* 3% and 5%, with Non irradiated and irradiated with 1kGy MLP).

NEW BIOTECHNOLOGICAL APPROACHES TO INSECT PEST MANAGEMENT

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Abstract

Genome editing technologies are helpful for understanding the functions of target genes in diverse organisms. Zinc finger nucleases (ZFNs) and transcription activator-like effector nucleases (TALENs) technologies were used for genome modification which require the use of a variety of nucleases and the off-target effects of nucleases can lead to cellular toxicity which are complex and labor-intensive. When compared with RNA interference (RNAi) technology, CRISPR generates changes at the genomic level that are stable and heritable and the mutant gene can be transmitted to the next generation, while gene silencing by RNAi is usually an instantaneous process, unless the dsRNA is supplied continuously. CRISPR/Cas9 system is far more convenient and effective than ZFNs and TALENs. CRISPR loci are typically composed of a clustered set of CRISPR associated (Cas) genes and a signature CRISPR array, which includes a series of repeat and spacer sequences. Cas9 system cleaves a specific sequence using the Cas9 nuclease coupled with a single guide RNA (sgRNA) inducing ds DNA cleavage. The cleavage sites are repaired by non-homologous end joining or by homologous recombination. It has been used to precisely edit genomes of numerous eukaryotic organisms, including insect orders of Coleoptera, Diptera, Lepidoptera and Hemiptera which facilitates functional genomic studies of model and non-model species and the development of novel genetics-based pest control approaches.



COMBINING ABILITY ANALYSIS FOR YIELD AND YIELD ATTRIBUTES IN DUAL PURPOSE SORGHUM [SORGHUM BICOLOR (L.) MOENCH]

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Abstract

Combining ability analysis (GCA) enables plant breeders to select parental lines for crossing and provides the opportunity to understand the nature of gene actions involved in the inheritance of desired traits. In this study, we used a line x tester mating design to generate 30 hybrid crosses using three restorer (R) and ten cytoplasmic male sterile (CMS; A) lines. Field performance of the hybrids, parents and standard checks were evaluated for grain yield and important phenological, fodder and quality traits. There was a significant effect of GCA and SCA for most of the traits evaluated, indicating the participation of additive or dominant genes in inheritance. The restorer line SPV 1822 and five male sterile lines ICSA 29003, ICSA 29004, ICSA 29011, ICSA 29014 and ICSA 29016 show potential for use as parents in sorghum breeding programs. Crosses ICSA 29004 × SPV 1822 and ICSA 29012 × SPV 1822 were identified for multilocation testing.

BIODIVERSITY AND SUSTAINABLE DEVELOPMENT

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Abstract

Biodiversity—the diversity of life on Earth—is defined as the variability among living organisms from all sources, including diversity within species, between species, and of ecosystems. Biodiversity is essential for sustainable development and human well-being. It underpins the provision of food, fibre and water; it mitigates and provides resilience to climate change; it supports human health, and provides jobs in agriculture, fisheries, forestry and many other sectors. Given the need for biodiversity and healthy ecosystems to achieve the 2030 Agenda, it is not surprising that many Sustainable Development Goals (SDGs) include targets that reflect their important role. It is clear that the survival of our own species is vitally dependent on the services of other species and ecosystems. It is important to realize, however, that the benefits that biodiversity supplies to humanity are delivered through populations of species residing in living communities within specific physical settings, through complex ecological systems, or ecosystems. The role of biodiversity and healthy ecosystems is thus reflected not only in SDG 14 (life below water), and SDG 15 (life on land), but also in many other goals and targets. For example, there are critical biodiversity dependencies for SDG 2 on zero hunger; the 2030 Agenda for Sustainable Development will not be achievable. Therefore, consideration of biodiversity and ecosystems will be essential as countries embark on the implementation of the 2030 Agenda and its SDGs, and in the implementation of key national priorities for sustainable development. In order to ensure sustainable development, it is necessary to conserve biodiversity and use it sustainably.

NOVEL APPROACH : PLANT METABOLIC ENGINEERING THROUGH TRANSCRIPTION FACTORS

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Abstract

Plants produce a large numbers of metabolites through various metabolic pathways. They are divided into primary metabolites comprising of carbohydrates, proteins, lipids, nucleic acids and secondary metabolites like terpenes, phenolics and alkaloids. They are utilized as food, pharmaceutical compounds and raw materials for industry. Therefore, plant biosynthetic pathways have been intensively studied and genetic engineering to control the biosynthetic pathways has been applied for the effective production of useful metabolites. There are three basic goals of metabolic engineering in plants. To increase the production of desired compound. To decrease the production of unwanted compound. Production of a novel compound. Strategies for achieving goals (Capell and Christou, 2004) Engineering of single step in a pathway. To increase or decrease metabolic flux.



To target compounds, to block competitive pathways. To introduce short cuts that diverts metabolic flux in a particular way. Engineering of multi steps in a pathway. Up regulating more than consecutive enzymes in a pathway. Up regulating enzymes in one pathway while suppressing those in another competing pathway (polycistronic antisense RNA). Using regulatory genes to establish multipoint control over one or more pathways in the cell i.e. transcription factors. Transcription factors (TFs) are master regulators controlling gene clusters. TFs are proteinous in nature and are composed of at least two discrete domains: a DNA binding domain (DBD) and an activation/repression domain (RD). TFs regulate the expression of genes positively (activator) or negatively (repressor) for different metabolic pathways. Methods used for identification of transcription factors in plant. That is DNA-Protein interactions, Gene fusions for the identification of protein domains, In vivo protein-protein interaction studies, Electrophoretic Mobility Shift assay, Transient assay, In vitro transcription assay, DNA Footprinting Techniques and Microarray. Main conclusion for modulation of transcription factors (metabolic regulator) appears to be an emergent techniques and more effective for the control of metabolic pathways than modulation of single enzyme genes in plants. Knowledge of metabolic pathways and its regulation through endogenous transcription factors could be helpful to design artificial transcription factors through which, the regulation of metabolic pathways are more effective.

ROLE OF ELICITORS IN INDUCING DISEASE RESISTANCE IN PLANTS

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Abstract

Plants are challenged by a variety of biotic stresses like fungal, bacterial, or viral infections. This lead to a great loss to plant yield. There are various ways available for the farmers to protect their crops from the disease. Some ways include the development of resistant cultivars, biological control, crop rotation, tillage, and chemical pesticides. Nearly all chemical pesticides or fungicides have a direct antibiotic principle. But their use at commercial level is uneconomical, the application is cumbersome, and some are proved to be carcinogenic. Therefore, considerable efforts have been accomplished to devise environmentally-friendly strategies for the check of plant diseases and thus to save mankind from health hazards. Induced resistance is one of the natural phenomena to protect plants from diseases. Elicitors are the chemicals (or) bio-factors from various sources that can trigger physiological and morphological responses and also increase in production of secondary metabolites, Phytoalexin biosynthesis, increase in the activity of defense enzymes (PAL, POD, polyphenol oxidase, cinnamyl alcohol dehydrogenase, and catalase, etc), induces Systemic acquired resistance and Local Acquired Resistance by the accumulation of pathogenesis-related proteins and differential gene. Plants can activate separate defense pathways depending on the type of pathogen encountered. Commonly tested chemical elicitors are salicylic acid, methyl salicylate, benzothiadiazole, benzoic acid, chitosan, and so forth which affect the production of phenolic compounds and activation of various defense-related enzymes in plants. Jasmonic acid (JA) and ethylene dependent responses seem to be initiated by necrotrophs, whereas salicylic acid (SA) dependent response is activated by biotrophic pathogens. Elicitors cause no adverse effects on human health and leave no residues. Hence, the use of elicitors in disease management is an eco-friendly strategy and reduces environmental and health hazards.

PATTERN OF VARIATION AMONG LENTIL (*LENS CULINARIS*) GERMPLASM COLLECTED FROM UTTARAKHAND HILLS

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Abstract

A collection of 46 accessions of Lentil collected from Uttarakhand were evaluated for qualitative characters viz., Plant growth habit, Seed testacolor, Cotyledon colour and Seed testa mottling and quantitative traits such as plant height, hundred seed weight and grain yield. Out of 46 accessions, orange cotyledon colour and absence of seed testa mottling was observed in 44 accessions. Similarly, erect growth habit(26) and pink seed testacolor(29) was recorded for most of the accessions. Highly significant differences among the accessions were observed for Plant height (m), Hundred seed weight and Grain yield owing to their varied geographical locations. All the quantitative characters showed a varied range of variation among the accessions.



Widest range was observed for grain yield (3.99 - 84.02 g/plot) with a mean of 33.87 g/plot. In general coefficient of variation was observed higher at phenotypic level than genotypic level. High variability along with high heritability and genetic advance offers greater scope of selection for improvement of grain yield and seed weight. Two lines namely PCPGR7803 and PCPGR7998 were found to be superior over the best of the checks VL 514 for grain yield, which could be given to farmers for cultivation. Though the observations taken on germplasm but the collection had a great potential to throw unique lines with sustainable yield.

PATTERN OF VARIATION AMONG BARNYARD MILLET (*ECHINOCHLOA FRUMENTACEA*) GERMPLASM FOR QUALITATIVE AND QUANTITATIVE CHARACTERS

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Abstract

A collection of 61 germplasm accessions of barnyard millet were evaluated for qualitative character viz., Plant growth habit, Inflorescence Shape and color, Panicle compactness, Lodging, Lower raceme shape and branching, Grain shape and color and quantitative traits such as Plant Height(m), Basal tiller number, Flag leaf length (cm), Flag leaf Width (cm), Peduncle length (cm), Panicle length (cm), Lower Raceme Thickness (cm), Lower Raceme length(cm), Biological yield (g/plant) and Grain Yield (g/plant) and pattern of variation was elucidated. Almost all of the accession showed erect growth habit bearing cylindrical (25) and pyramidal (33) inflorescence of dark purple (52) colour. Intermediate type of panicle compactness was observed for most of the accession (40) with curved (43) and branched lower raceme(54). Most of the accessions (43) were non-lodging type, all having concave grain shape with mostly grey (21) and light grey (29) seed colour. The results of analysis of quantitative traits revealed highly significant differences among the accessions for all ten yield and yield attributing characters owing to their varied geographical locations. Most of the characters showed a varied range of variation among the accessions. Widest range was observed for grain yield (2.50 to 54.50 g per plant) with a mean of 20.99 g per plant. The dry fodder yield was also found around a mean of 190 g per plant with a range of variation from 60 to 340 g per plant. In general coefficient of variation was observed higher at phenotypic level than genotypic level. High variability along with high heritability and genetic advance offers greater scope of selection for improvement of grain and fodder yield. Though the observation taken on germplasm, but the collection had a great potential to throw unique lines with sustainable yield and fodder yield.

VARIATION FOR QUALITATIVE AND QUANTITATIVE CHARACTERS AMONG FINGER MILLET (*ELEUSINE CORACANA* (L.) GAERTN) GERMPLASM

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Abstract

Pattern of variation was analyzed among the 41 germplasm accessions of Finger millet for qualitative traits viz., plant growth habit, internodes and leaf sheath pigmentation, leaf sheath pubescence, stem culm branching, ear shape, finger branching, finger position of branching, finger multiple whorl, seed color, seed shape, seed surface and quantitative traits such as flag leaf length (cm), flag leaf width (cm), peduncle length (cm), spike length (cm), finger length (cm), finger breadth (cm), finger number, productive tiller number, plant height(m), biological yield (kg/plot) and grain yield (g/plot). Most of the finger millet accessions (22) showed decumbent type of growth habit, while 19 of the accessions found to be erect for growth habit. Pigmentation at leaf juncture was found only in 16 germplasm accessions. Leaf sheath pubescence was found to be present only in 11 finger millet accessions and absent in remaining 30 accessions. Out of total only 17 entries have exhibited stem culm branching. In the terms of ear shape, compact, fist type, open, semi compact and droopy ear heads were recorded in 3, 6, 12, 7 and 13 accessions respectively. Finger branching was also absent in most (24) of the accessions. A total of 17 accessions were observed to have in thumb position of finger branching. Finger multiple whorl was present only in 12 germplasm accessions. Majority of accessions produced dark brown (17) seeds followed by copper brown (8), light brown (13) and white (4) seed producing entries. Most of the entries have smooth surfaced (32) seeds with round (26), reniform (12) and ovoid



shape. A varied range of variation was observed for all the yield and yield attributing characters, which indicates a huge amount of variability among these germplasm accessions. Widest range was observed for grain yield (27.48 to 299.03g per plot) with a mean of 205.19 g per plot. The dry fodder yield was also found around a mean of 2.38kg per plot with a range of variation from 1.09 to 4.49 kg per plot. In general, phenotypic coefficient of variation was observed higher than genotypic coefficient of variation. For both grain yield and dry fodder yield high variability along with high heritability and genetic advance was observed which offers greater scope of selection for improvement for these traits. Though the observation taken on germplasm, but the collection had a great potential to throw unique lines with sustainable yield and fodder yield.

PERCEPTION AND KNOWLEDGE OF AGRICULTURAL STUDENTS ON SOCIAL MEDIA- AN ANALYSIS

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Abstract

Usage of advanced ICT tools is growing day by day in the 21st century and among all the usage of social media tools are increasing very rapidly. The use of social media platforms is also gained its place in the field of agriculture and students of agriculture are also using these platforms for their academic work and to share agricultural information. The study was conducted to analyze the social media user behaviour of agriculture students, and their knowledge, perception levels towards the use of social media in connection with the usage of social media platforms in agriculture. The study was conducted among undergraduate of agriculture and research scholars in various departments of agriculture belonged to PJTSAU with a sample size of 60. Google forms were used to collect the data and simple statistics *i.e.* frequency and percentage were used to analyze the data. The sample contains the 59.10 per cent of female students, rest 40.90 per cent were male students and 61.80 per cent were studying under graduation and 38.20 per cent are research scholars. Majority of the respondents (50.00 %) were using more than five social media platforms followed by two and three social media platforms with 18.33 per cent each and four social media platforms (13.34%). Among different social media platforms, WhatsApp (95.00%) was the most used social media platforms among students followed by YouTube (76.66%), Facebook (63.33%), Instagram (53.33 %), Twitter (46.66 %), Telegram (41.66%), LinkedIn (33.33%) and Pinterest (26.66%). Majority of students using the social media platforms for entertainment (90.00%) followed by, to communicate with peers (73.33%), Update knowledge (71.66%), Academic purpose (63.33%) and contact with professionals (46.66%). Smartphones (100.00%) is the most used gadget to access social media platforms, followed by laptop (55.00 %) and tablet (5.00%). Regarding the login to social media platforms majority (51.60%) of the students were several times a day followed by constant login (35.00%), occasionally (10.00%) and one time a day (3.40%). Regarding the duration of usage, the majority (80.00 %) were using the more than two hours, followed by one to two hours (13.33 %) and less than an hour (6.67%). Regarding information evaluation, the majority of the students (35.00%) were evaluated sometimes, followed by most of the time (31.66%), all-time (18.33%) and never (15.01%). The students have a strong network with students with the mean score (2.93) followed by Professors (2.10), agricultural scientist (1.95) and Subject expert (1.80). The majority have perceived that the use of social media in agriculture as medium (63.33%) followed by high (31.66%) and low (5.01%). Regarding the knowledge level of using the social medium tools for as the source of information, the majority were having medium level (51.66%) followed by high (38.33%) and low (10.01%).

MOLECULAR APPROACHES FOR POTENTIAL CROP IMPROVEMENT

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Abstract

As the global world, population is rapidly and alarmingly increasing, new methods have been introduced for better production, improved nutrient content and disease resistant crops. Since start, man has been trying to manipulate different ideas and techniques to save the crops from different diseases by using conventional methods. Unfortunately, conventional methods are no more serviceable towards the current needs. Although, from past five decades global food grain production is growing as with increasing population but still 1 billion persons of the world are malnourished because of food insecurity (Hazell and



Wood, 2008). It has been estimated that worldwide food production must be increased by 70 % by the year 2050 to fulfill the need of expanding population and growing consumption of food (Godfray *et al.*, 2010). In this age of technology, biotechnology has opened up new horizons in the field of science. Besides the growing population rate, extreme weather, reduced agricultural land availability, increasing biotic and abiotic stresses are significant constraints for farming and food production. Development of molecular approaches like gene pyramiding, genetic engineering (GE) or recombinant DNA technology, Molecular Breeding (MB), Marker assisted backcross breeding (MABB) and Marker assisted recurrent selection (MARS), genome editing that can contribute to crop improvement can increase production to some extent. Marker-assisted selection and gene pyramiding are very important breeding strategies for conferring broad spectrum and durable resistance against diseases causing yield loss in rice. Marker-assisted gene pyramiding has the potential to accelerate the breeding programmes and guarantee the durability of resistance conferred in the host plant (Chukwue *et al.*, 2019). Genetic engineering is an exceptional way of breeding as compared to conventional breeding. It is a way of extending genetic base. Secondly, as it avoids the problem of linkage drag associated with the conventional breeding it is more effective and it is less time consuming. Till now, many genetic engineered crops have been developed and commercialized that result in improved production efficiency, increased market focus, and enhanced environmental conservation. Such crops include longer post-harvest storage tomatoes, insect resistant cotton and maize, virus resistant potato, herbicide resistant soybean and canola. RNA interference is an emerging tool in biotechnology for crop improvement. It has been widely used for increasing crop yield, resistance against biotic and Abiotic stresses and enriched nutrient fruits. RNAi includes the sequence specific gene silencing at post transcription level. Genome editing tools are becoming popular molecular tools of choice for functional genomics as well as crop improvement. Because of their several attractive features such as simplicity, efficiency, high specificity, and amenability to multiplexing, genome editing technologies are revolutionizing the way crop breeding is done and paving the way for the next generation breeding.

EFFICIENCY OF VARIOUS SOURCES AND LEVELS OF HUMIC ACID ON SOIL PROPERTIES, GROWTH AND YIELD OF CAPSICUM

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Abstract

A field experiment was conducted at farmer's field of Devanahalli taluk to evaluate the efficiency of Humic acid (HA) extracted from different sources on growth, yield and soil properties. Humic acid extracted from three different sources viz., poultry manure, pressmud and coffee pulp at two levels 60 and 90 kg ha⁻¹ along with RDF was carried out with capsicum as the test crop. Increase in yield (55.41 t ha⁻¹) and growth parameters fruit length (10.13 cm), breadth (8.90 cm) and pericarp thickness (0.69 cm) was observed with application of RDF + HA 90 kg ha⁻¹ extracted from poultry manure followed by application of RDF + HA 90 kg extracted from pressmud and coffee pulp @ 90 kg ha⁻¹. There was significant increase in soil physical and chemical properties of soil after harvest of the crop. Decrease in bulk density (1.32 Mg m⁻³) and increase of MWHC (40.71 %) and higher CEC value of 15.24 cmol (p+) kg⁻¹ was observed with application of in HA @ 90 kg ha⁻¹ compared to control (RDF alone). Similar was the trend in buildup of nutrient status of soil with highest available nitrogen (334.22 kg ha⁻¹), phosphorus (125.23 kg ha⁻¹) and potassium (319.19 kg ha⁻¹) content. Thus among different sources and levels of application HA extracted from poultry manure applied @ 90 kg ha⁻¹ along with RDF was found sufficient in improving the soil health followed by pressmud and coffee pulp extracted humic acids.

AWARENESS AND PERCEPTION OF FARMERS ABOUT FASAL BIMA YOJANA

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Abstract

Agriculture is associated with negative outcomes that arise from floods, drought, pests, diseases and a plethora of other natural disasters. Under such a situation, crop insurance is a risk management tool that farmer can use. The Pradhan Mantri Fasal Bima Yojana (PMFBY) launched in 2016 as an insurance service for farmers. Crop insurance is a means to protect oneself



against a small probability of large unexpected, unforeseen losses. These uncertainties may include crop losses/failures arising from named/unnamed perils beyond control. In order to avail insurance cover for crops, one needs to pay a premium. With this background the present study was carried out in Dharwad district of Karnataka during the year 2018-19. Sixty farmers (30 from each village) from two villages were selected randomly. The pre-tested and well structured interview schedule was used to collect the data. The data was analyzed with suitable statistics such as frequency and percentages. The results revealed that majority (83.33%) of farmers from Kavalageri village had medium level of awareness and only 16.66 per cent had high level of awareness about crop insurance scheme. In Chandanmatti village majority (76.66%) of the farmers had medium awareness followed by high (16.66%) and low (06.66%). Bank officials and Raita Samparka Kendra's play a major role in making awareness among farmers but they are not suits to explain the real terms and condition of crop insurance among farmers. So the service providers have to look on the product innovations and appropriate distribution channel to make crop insurance reach more effectively. Further the results shows cent percent of the farmers perceived that premium amount is calculated on the basis of number of risk factors such as drought, flood and pest etc. They were also perceived that all the crops they sow should be insured, crop insurance policies should be formulated on the basis of losses, insured area is prevented from sowing/planting due to deficit rainfall or adverse seasonal conditions and the coverage of post harvest losses. Overall farmers perceived that Pradhan Mantri Fasal Bima Yojana is a good initiative from the government in order to cope with changing climate and risks associated with natural calamities.

ENHANCE THE PRODUCTIVITY OF CUMIN IN BARMER DISTRICT OF RAJASTHAN, INDIA

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Abstract

Krishi Vigyan Kendra conducted front line demonstration on Cumin variety GC-04 at farmer's fields in district Barmer during years 2012-13 to 2018- 19. The productivity and economic returns of Moong in demonstrated plots were calculated and compared with the corresponding local check. The data obtained was pooled for seven years. It was observed that on an average 27.14 percent higher grain yield was recorded in demonstration plots than the local check. The extension gap, technology gap and technology index were 1.37 q/ha, 5.09 q/ha and 42.47 percent, respectively. An additional investment of Rs.2520/ha coupled with scientific monitoring of demonstration and non monetary factors resulted in additional return of Rs. 22696/ha over the farmers practices. Fluctuating minimum selling price of Cumin during different years influenced the economic returns per unit area.

ROLE OF BIOCOMPOST IN IMPROVING SOIL HEALTH IN FINGER MILLET

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Abstract

Finger millet (*Eleusine coracana* L.) is an important principal staple food crop mainly grown in the states of Karnataka, Andhra Pradesh, Odisha and Tamil Nadu in India. It is commonly known as "Nutritious millet". In India, Finger millet is cultivated in an area of about 1.13 million hectares with an annual production of 1.82 million tones with a productivity of 1601 kg ha⁻¹. In Andhra Pradesh, it is grown in an area of 32000 hectares with a production of 43000 tonnes and a productivity of 1344 kg ha⁻¹. This crop has much significance in Chittoor district, being grown in an area of 5000 hectares with a production of 9000 tones and a productivity of 1580 kg ha⁻¹. Biocompost is a combination of pressmud and distillery spent wash along with consortium of efficient microbial cultures and also enriched with FeSO₄, ZnSO₄ and bio fertilizers. It is a dark brown to black coloured by-product of sugarcane industry which provides beneficial quantity of organic matter, nutrients and favourable condition for soil micro-organisms. Biocompost plays an important role in improving soil physical (WHC, porosity and bulk density etc.), chemical (pH, CEC etc.) and biological properties (soil enzymes and microbial population) which leads to increase in nutrient supplying capacity of soil and reduces the dependency on inorganic fertilizers. Addition of bio-compost either alone or in combination with inorganic fertilizers significantly improved the organic carbon and availability of nutrients (N, P, K and S) with reduction in bulk density of soil. It has best potential to improve soil organic carbon, WHC and decreased



bulk density. Application of bio compost reduced the recommended dose of fertilizers and improved organic matter and physical properties of soil like WHC, porosity and decreased the bulk density during the crop production. The increase in OC content may be attributed to recycling of roots, above ground residues and stubbles due to higher biomass production with application of bio compost. Bio compost is organic in nature and contains high organic compounds and addition of these organics to soil, the soil organic carbon content increases due to decomposition by microorganisms. Balanced and integrated use of organic and inorganic fertilizers enhance the accumulation of soil organic matter and improve soil chemical properties. The cation exchange capacity (CEC) of soils was also higher with bio compost due to higher basic cationic content of bio compost and also smaller sized particle which increases the surface area. The use of bio compost have made soil more porous, allowing better root growth and development, thereby resulting in higher CEC, leads to more nutrient uptake and higher yield.

VARIABILITY AND GENETIC DIVERSITY STUDY IN A DIVERSE SET OF INDIAN MUSTARD (*BRASSICA JUNCEA* L.) GERMPLASM

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Abstract

Rapeseed-mustard accounts for nearly one-third of the oil produced in India, making it the country's key edible oilseed crop. The present investigation was designed to evaluate 150 diverse germplasm of Indian mustard for seed yield and attributing traits. A total of 150 genotypes of Indian mustard were evaluated in Augmented Block Design along with 5 checks (NPJ112, Maya, RGN 73, Pusa Bold, Krani) in five blocks. Single row of 3m length was planted for each genotype. Data were collected on five randomly selected plants for 16 different quantitative traits for each genotype. ANOVA revealed significant differences between genotypes for all trait studied. Seed yield/plant (g) varied from 4.14 to 45.15 with a general mean of 25.19g. 1000-seed weight/plant (g) ranged from 2.05 to 7.14, with a mean of 4.92g. Oil content (%) varied from 36.79 to 42.57. A good range of variation was noticed for all the traits studied. High estimates of PCV was noticed for first basal branching (51.26%), followed by dry plant weight (45.43%) and seed yield/plant (34.15%), seeds/siliquae (28.11%). Seed yield/plant had significant and positive correlation with fruiting zone length, main shoot length, plant height, no. of primary branches/plant, no. of secondary branches/plant, silique length, no. of silique on main shoot, 1000-seed weight. In Principal component analysis cumulatively first five components explained 97.27% of the total variation in the data. The NJ phenogram grouped 155 accessions of Indian mustard into five clusters. Clustering of genotypes was irrespective of their origin. The present study was found useful for identification of diverse genotypes of Indian mustard for different yield attributing traits. The promising lines will be utilized in Indian mustard breeding programme.

GENOTYPIC VARIATION AND GENETIC GAIN FOR TURCICUM LEAF BLIGHT IN MAIZE (*ZEA MAYS* L.)

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Abstract

A set of 50 newly derived inbred lines of maize at ICAR-IARI Regional Research Centre, Dharwad, Karnataka, were screened against turcicum leaf blight (TLB) and grain yield along with the yield attributes during two consecutive rainy season of 2017 and 2018. The investigation was laid out in randomized complete block design and the genotypes were screened against TLB under artificial epiphytotic. TLB pathogen was mass cultured on sorghum grains and inoculations were done twice using whorl method at 35 and 45 days after sowing. The inbred lines, PDM-4641, D-1013, DDM-2207 and DDM-2313 were highly resistant to TLB disease score of 3.0/10. However, no genotype recorded immune reaction against TLB indicating oligogenic/polygenic nature of inheritance of TLB resistance. This implied that population improvement schemes would be beneficial in accumulating favourable alleles to develop resistant inbred lines. The mean sum of squares due to genotypes was



highly significant for TLB reaction and grain yield attributes indicating the substantial genetic variation for the traits studied. The traits, TLB reaction, grain yield and test weight exhibited high heritability, GCV, PCV and genetic gain (GAM). High heritability coupled with high genetic gain implied that phenotypic selection will be effective in genetic improvement of these traits. High heritability with moderate GCV and high PCV coupled high GAM for ear height and number of kernels per row suggested that selection will also be effective for these traits. High heritability with moderate GCV, PCV and high GAM revealed by plant height, cob length, cob girth and number of kernel rows per cob indicating the suitability of selection in the population developed by these inbred lines. Days to 50 per cent tasseling, days to 50 per cent silking and shelling percentage displayed high heritability estimates coupled with Low GCV, PCV and GAM suggesting that selection will be less effective for these traits, hence improving these traits through population improvement methods has been suggested.

EFFECT OF VARIOUS SOURCES OF NUTRIENT ON GROWTH AND YIELD OF INDIAN MUSTARD

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Abstract

A field experiment was conducted during 2018-19 at Directorate of Rapeseed – Mustard Research, Bharatpur, Rajasthan to evaluate the various sources of nutrients on growth and yield of Indian mustard. Experiment was conducted in split plot design including five treatments in main plot viz. RDF (T_1), RDF+FYM (T_2), RDF+FYM+Biofertilizers (T_3), RDF + FYM + Biofertilizers + mustard straw (T_4), T_4 +jivamrat (T_5) and three treatments for sub plots viz. RDN 100% (N_1), RDN 125% (N_2) and RDN 150% (N_3). So, there were 15 treatments in the field with three replications. The sources of N and P were urea (46% N) and single super phosphate (16% P_2O_5 & 12% S), respectively. Other package of practices, including insect, pests including weed control were followed according to local agronomic practices unless otherwise indicated. Result showed that the treatment T_4 and T_5 performed at par and if we are using RDF+ FYM+ Biofertilizer + Mustard Straw, It gives around 20 % more yield compare to RDF. Further results revealed that, increased N level increased crop yield, if we are applying 150 % RDN it gives 7.7% more yield compare to RDN.

COMPONENT WISE RANKING OF DIFFERENT LIVELIHOOD SECURITIES OF AGRICULTURAL LABOURERS

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Abstract

The present study was conducted in three districts of Andhra Pradesh viz., Kurnool, Guntur and Srikakulam during 2018-20 to identify the profile characteristics of agricultural labourers. An Ex-post facto research design was used for the study. A total of 240 respondents were selected for the study. Different livelihood security of agricultural labourers was ranked according to rank order importance of their index scores. of transport security (84.71%)-I, clothing security (82.83%)-II, asset security (71.59%)-III, habitat security (55.47%)-IV, food and nutritional security (48.37%)-V, health security (47.80%)-VI, information security (45.41%)-VII, social security (41.55%)-VIII, educational security (13.91%)-IX.

COMPOSITE INLAND FISH FARMING IN FARM POND AS ADDITIONAL SUBSIDIARY INCOME

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Abstract

ICAR-KrishiVigyan Kendra, Saidapur Farm, UAS, Dharwad effectively experimented to promote the inland fisheries in underutilized farm pond in the last six years (2015 to 2020) through front line demonstration (FLD) in Dharwad district of Karnataka state. The State Government, Department of Agriculture had implemented scheme on farm pond (Krishi Honda) in different villages mainly in rainwater dependent area during the year 2014-15 with aiming to recharge and rejuvenate ground



water table, mitigate drought situations, provide water to farming, people and animals during drought situations etc. Farmers were utilizing these farm ponds mainly for crops, drinking purpose etc. Scientist of KVK Dharwad implemented composite inland fisheries by rearing Catla (40%), Rohu (30%) and Common carp (30%) of total 6000 no. stocks in underutilized farm pond of farmers field itself for 8-12 months and the input cost per demo is 2800/-. Total of 30 demonstrations were conducted to 30 small holder farmers from Navalugund, Hubli and Dharwad taluk. Upon consideration of six year data, there was significant increase in weight gain (800-950 gram) and length (20-25 centimeter). About 3.16 t per ha fish production was obtained and makes extra profit (Rs.50/kg, 2000*50) of Rs. 150,000/- by this technology in consideration with mortality and other factors. Such production technology improves farmers' economic conditions by better utilization of farm pond besides protective irrigation to field crops.

QUALITY CHARACTERISTICS OF FISH PROTEIN ISOLATE INCORPORATED PASTA PRODUCT

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Abstract

Fish protein isolate was prepared from Nile Tilapia fish meat by pH shifting process. Fish protein isolate had moisture content of 75.95% and a pH of 6.2. Protein Isolate from Tilapia fish meat was used for preparation of pasta product. Wheat flour and refined wheat flour was used as base material. Fish pasta was prepared by incorporating isolate at 5%, 10% and 15% concentration. Pasta products prepared without incorporation of fish protein isolate was kept as control. Biochemical and microbiological quality of fish pasta were evaluated up to 5 months. Pasta product had 8.2% - 9.8% moisture, 11.55% - 14.58% protein, 0.59%-0.62% fat and 2.1% - 2.2% ash content. TVB-N, TBA values showed increased trend and were within the acceptable limit during storage. PV value reached 20.8% during third month in 15%FPI incorporated sample. Other sample PV values were within the limit up to four month. TPC in all sample reached acceptable level (5log cfu/g) during four month. Sensory analysis revealed that incorporation of fish protein isolate up to 10% was comparable with control.

PERCEPTION OF RURAL YOUTH TOWARDS AGRICULTURE AS AN OCCUPATION IN SRIKAKULAM DISTRICT

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Abstract

In the present study the Perception of Rural Youth towards Agriculture as an Occupation is conducted in the year 2017-18 in Srikakulam district of Andhra Pradesh. The place of rural youth class is more important for the future of country. Young people are very important resource required for the development of every nation especially for sustainability of agricultural production. The socio economic development and prosperity of rural areas depends to a considerable extent on the type of youth living in rural areas, because the rural youth have abilities to orient themselves to go along with the main stream of the development areas. They reflect the national potentiality and represent the life blood of nation. Active involvement of youth in agriculture is necessary for sustainable agricultural systems but is currently a challenge in many areas. The wide spread illiteracy in rural areas, unemployment among the educated youth, lack of proper guidance, are some of major problems. It is disturbing to note that youth are losing interest and confidence in agriculture and allied activities, hence they are not willingly involved in agricultural operations. Considering all the above things, the objectives were framed according to it. An ex-post facto research design was followed. One of the objective is to find the Perception of rural youth towards agriculture. Perception is operationalized as interpretation of rural youth about agriculture based on their past experience. A sample of 120 respondents were selected for the study from three mandals namely Etcherla, Kaviti, and Mandasa. The respondents were interviewed personally with the help of interview schedule developed. Data was collected and interpreted. The results revealed that majority (63.33%) of rural youth had medium level of perception followed by the rest with high (20.00%) and low (16.67%) level of perception.



MOLECULAR IDENTIFICATION OF MAJOR BLAST RESISTANCE GENES IN RICE LANDRACES FROM INDIA

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Abstract

Rice blast disease caused by the fungus *Magnaporthe oryzae* is one of the important devastating diseases causing huge losses worldwide. In the present study, major blast resistance genes were investigated in landraces and improved lines originating from India. Based on phenotypic evaluation, 149 landraces were classified into three distinct groups: resistant (55), moderately resistant (63) and susceptible (31). The genetic frequencies of the 18 major blast resistance genes were between 19% and 90%. The cluster and population structure analysis grouped the landraces into two groups. Through principal coordinate analysis, the scatter plots partitioned the resistant and moderately resistant landraces into different groups. Analysis of molecular variance showed maximum (88%) diversity within populations and least (12%) diversity between populations. Association analysis identified seven markers 40n23r, RM5811, ta5, yl 153/154, z56591, z56592 and k3957 that are significantly associated with blast disease and explained a phenotypic variance of 4.0–36%. The associated genes could be used in marker-assisted rice breeding programmes for gene pyramiding to develop rice varietal resistance against blast disease. The present study represents a valuable blast resistance genetic resource that could be used for identification of new R genes, donors for blast resistance, and genomic studies.

FARMERS ATTITUDE TOWARDS SKILL ORIENTED TRAINING PROGRAMMES ORGANIZED BY KVK

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Abstract

In changing world, with emerging trends and advances in agricultural sector, skill oriented training programmes becomes necessity of the hours. Skill oriented training programmes for rural youth, farmers and farm women is being organized by KVK, Sirohi with the aim to impart skills pertaining to agriculture based vocations & allied areas to promote employment. Apart from this, for creation of skilled manpower to perform farm and non-farm operations efficiently. The present study was conducted in four villages of Reodar and Sirohi tehsils of Sirohi district. Objectives of study were to know the attitude of farmers towards skill oriented training programmes and their socio-economic profile. The data were collected personally from respondents by using pre-tested and well structured interview schedules and data were analyzed by using appropriate statistical tools i.e. frequency, percentage and mean score. Results showed that 64.16 % respondents had a favourable attitude towards skill oriented training programmes. The findings also reveals that majority of respondents (55.83 %) prevails in the middle age group, 29.16 % of the respondents were educated up to high school level, 42.50 % were belonged to Other Backward Caste(OBC) and having small size of family (46.67%).

PROCESS PARAMETERS OPTIMIZATION FOR OHMIC HEATING OF SOYMILK ON THE PROPERTIES OF SOY PROTEIN LIPID FILM

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Abstract

Soymilk of Total soluble solids (7.5°Brix) of pH 6.5 was ohmically heated at three different electric field strengths (viz. 10, 11.5 and 13 V/cm) at three different target temperatures (80, 85 and 90°) for three different formation times (5, 10 and 15 min) for the formation of soy protein lipid films. Designed experiments were conducted based on a three level factorial design to determine the optimum processing condition for the ohmic heating process. The processing parameters were optimized with



the help of response surface methodology to obtain product with maximum yield, thickness and film formation rate. The optimum processing conditions were electric field strength (10V/cm); target temperature (90?) and formation time (6.42 min). The corresponding properties of soy protein lipid films like yield, thickness and film formation rate were 2.2 g/100ml, 0.9 mm and 1g/ 10 min respectively.

EFFICACY OF NEWER INSECTICIDE CHLORFENAPYR 10SC AGAINST DEFOLIATOR AND POD BORER ON SOYBEAN AND ITS SAFETY TO NATURAL ENEMIES

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Abstract

Field studies were carried at Instructional Farm , RVSKVV Krishi Vigyan Kendra, Dewas (M.P.) to study the comparative bio-efficacy of Chlorfenapyr 10 SC , at four doses viz.,144 ml a.i./ha, 192 ml a.i./ha, 240 ml a.i./ha and 288 ml a.i./ha alongwith Chlorantraniliprole 18.5% SC @ 30 ml a.i./ha and Profenofos 50% EC 500 ml a.i./ha against Defoliator, *Spodoptera litura* (Fabricius) and pod borer , *Helicoverpa armigera* (Hubner) of soybean its safety to natural enemies at during Kharif season of 2016. The Chlorfenapyr 10SC @ 288 ml a.i./ha provided optimum control against the *S. litura* and *H. armigera* of soybean alongwith significant increased yield and was at par with commercial product (Std. check Chlorantraniliprole 18.5% SC @ 30 ml a.i./ha) against above pests. At a lower dose @ 144 ml a.i./ha was also effective against Spodoptera and Helicoverpa . Chlorfenapyr 10SC in any dose is quit safe to the important natural enemies such as different spider species, coccinellids and chrysopa associated in soybean. Beside this, Chlorfenapyr 10SC did not cause any phytotoxicity to soybean in any concentration and hence safe for the crop. Hence Chlorfenapyr 10SC @ 288 ml a.i./ha may be recommend for controlling tobacco caterpillar and Helicoverpa of soybean.

EVALUATION OF PRE-RELEASED CULTURES OF RICE AGAINST BACTERIAL LEAF BLIGHT CAUSED BY *XANTHOMONAS ORYZAE PV. ORYZAE* (XOO)

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Abstract

Rice is an important crop globally, serving as the staple food for half of humanity and moreover being used in industry and for animal feed. Bacterial leaf blight is caused by *Xanthomonas oryzae pv. oryzae* (Xoo) is one of the most important diseases of the crop. In India, it causes yield losses from 6-60% in different states depending upon stage and severity of infection and type of cultivars. In present study, during 2019-20, thirty pre-released cultures which were developed at Agricultural Research Station, Bapatla screened against bacterial leaf blight disease at Agricultural Research Station Nellore. Under field conditions all the entries were artificially inoculated at maximum tillering stage through leaf clip inoculation and scored by following 0-9 Scale, Standard Evaluation system (SES), International Rice Research Institute (IRRI). Among them no entry was found resistant, but 7 entries (BPT2953, BPT2938, BPT2954, BPT2850, BPT2776, BPT2766, BPT3137) were identified as moderately resistant (Score 3) 14 entries (BPT2848, BPT2858, BPT2863, BPT2910, BPT2824, BPT2950, BPT3145, BPT3143, BPT3032, BPT3141, BPT2795, BPT2932, BPT3164, BPT3072) were moderately susceptible, remaining nine entries were susceptible.

CASE STUDY ON COST ECONOMICS OF FARMYARD MANURE SPREADERS

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Abstract

Timely application of manure in accordance with the nutrient requirements of the crops will result in improved crop



production. Farmyard manure (FYM) is the oldest organic manure used by man ever since involved in farming. In organic farming, manure applicator is promising solution for uniform spreading of farm yard manure over the field. In order to provide and review the information found in the literature about cost economics of farmyard manure spreader, the first point is to be noted that animal drawn FYM applicator was economically feasible, eco-friendly and easily operated in field. Animal drawn FYM applicator is useful to marginal and small scale farmers. Further next information by the review was that tractor operated manure spreader saved the 94% time of FYM spreading as compare to traditional method. Average actual field capacity of the tractor operated manure spreader was 1.473 h/ha at forward speed of 2.438 km/h with effective swath width 7.4 m. The cost of spreading with the tractor operated manure spreader was Rs. 247 per ha. The saving in cost was 72 per cent as compared to conventional method of manual broadcasting. Another machines of tractor trailer cum farmyard manure spreader saved the FYM spreading time 50-60% when compared to the conventional method. The operational cost was Rs. 124 per hectare and reduction of cost of operation by Rs. 156 per hour as compared to conventional tractor-trailer system. Special attention has been paid to the relevance of capacity of FYM hopper for reducing number of passes of machine and increase in field capacity for saving cost of operation and time of manure spreading.

RELATIVE TOXICITY OF INSECTICIDES TO LADYBIRD BEETLE, *CHEILOMENES SEXMACULATA* FABRICIUS

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Abstract

An investigation was carried out to evaluate the relative toxicity of different stages of ladybird beetle, *Cheilomenes sexmaculata* (Fabricius) at Department of Agricultural Entomology, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) during the year 2019-20. A total of nine insecticides, viz.; acetamiprid (0.006%), buprofezin (0.05%), fipronil (0.01%), flonicamid (0.015%), imidacloprid (0.089%), spinosad (0.0135%), spiromesifen (0.0229%), thiacloprid (0.013%) and thiamethoxam (0.01%) were evaluated. The analysis of relative toxicity of insecticides against eggs, grubs and adults of *C. sexmaculata* showed that acetamiprid, thiacloprid and spinosad showed more than 50 % mortality. Imidacloprid, spiromesifen and fipronil were relatively less toxic to the predator than spinosad. While flonicamid, buprofezin and thiamethoxam proved safer insecticides to the adults of *C. sexmaculata*. On the basis of toxic potential of insecticides to *C. sexmaculata*, the insecticides evaluated can be arranged in descending order as: acetamiprid > thiacloprid > spinosad > imidacloprid > spiromesifen > fipronil > thiamethoxam > buprofezin > flonicamid.

STUDY OF GENOTYPE X ENVIRONMENT INTERACTION FOR RICE GENOTYPES USING WRICKESECOVALENCE METHOD

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Abstract

Rice is the major staple food for majority of the people in the world. Due to continuous and concerted efforts of many scientists made it possible, the development of variance varieties suitable for each and every agro-ecological condition throughout the world. But genotype expression over environments is referred to as genotype by environment interaction and is main challenge faced by the plant breeders as they reduce the stability of genotypic values under diverse environments. Further the impact of environment on phenology and growth varies depends on the crop, variety and growth duration and stage etc. In view of this the present study was conducted with 23 rice genotypes developed at Agricultural research Station, Nellore, ANGRAU, AP, India during 2017, 2018 and 2019 kharif seasons in randomized block design with here replications having a spacing of 20x15cm² in each season. All the recommended practices were followed to get a good and healthy crop. The genotype and environment interaction was studied for these 23 genotypes using Wricke's method of stability analysis (Wricke, 1962). The term ecovalence is used for the relative contribution of genotype 'I' to the overall genotype-environment interaction. This method considered the GxE interaction mean square on the criteria for stability. The minimum Wi² value



indicates the stable performance of the genotypes. The results indicated that the genotypes NLR 3587, NLR 3580, NLR 3580 and NLR 3573 had the lowest ecovalence values and therefore would be considered to be the most stable genotypes. The ranks for these genotypes for yield were 1,15,4 and 17 respectively. Ecovalence values for NLR 3581 was low and the mean grain yield was also lower than the mean grain yield. For the genotypes, NLR 33892, NLR 3539, NLR 3592, NLR 3585, NLR 3548, NLR 3586 and NLR 3545, even though the average grain yield was higher than the mean grain yield but the ecovalence values were high. Hence, the genotypes fall under these two categories may not be stable. The genotypes, NLR 3587 and NLR 3580 recorded both high grain yield as well as less ecovalence values, hence considered as stable genotypes with respect to yield.

IMPROVEMENT IN SOIL FERTILITY AND YIELD OF MUSTARD BY USING NUTRIENTS FORTIFICATION IN CALCAREOUS SOILS

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Abstract

Experiment conducted to enhance the micro and secondary nutrient availability to Indian mustard in arid and semi-arid regions where it is often found deficient in soils. The problem is aggravated in these areas when saline/ sodic ground waters are used as a chief source of irrigation owing to shortage of good quality water. Though, the irrigation water in such areas is poor in quality but it is inescapable as there is no alternative source of irrigation in such areas. However, it can be used for growing salt tolerant crops such as mustard by using suitable management practices. The application of micronutrient enriched FYM may improve availability and their uptake to mustard results in higher productivity and quality of crop in calcareous soils. An experiment comprising 15 treatment combination replicated thrice, was laid out in split plot design with three treatments of FYM level (Control, @5 t ha⁻¹ and @10 t ha⁻¹) and five treatment of sources of nutrient (control, 2.5 kg Zn + 1 kg B+ 5 Kg Fe + 10 kg S ha⁻¹, 5 kg Zn + 2 kg B+ 10kg Fe +20 S kg ha⁻¹, 2.5 kg Zn + 1 kg B+ 5 Kg Fe +10 kg S Enriched FYM @ 500 kg ha⁻¹ and 5 kg Zn + 2 kg B+ 10kg Fe+20 kg S Enriched FYM @ 500 kg ha⁻¹). Result showed that significantly highest seed yield (2964 kg ha⁻¹) was observed under the treatment in which micro and secondary nutrient applied at the rate of 5.0 kg Zn + 2 kg B+ 10 Kg Fe +20g S Enriched FYM @ 500 kg ha⁻¹ (Zn₂B₂Fe₂S₂ En) but at par effect was observed under the treatment in which micro and secondary nutrient applied at the rate of 2.5 kg Zn + 1 kg B+ 5 Kg Fe +10g S Enriched FYM @ 500 kg ha⁻¹ (Zn₁B₁Fe₁S₁En). Interactive effect of different level of FYM and sources of nutrient on seed yield of mustard revealed that half dose (@5 t ha⁻¹) of Farm Yard Manures is sufficient to obtained significantly highest seed yield of mustard when micro and secondary nutrient are applied by enriching with FYM. The treatment in which nutrient applied at the rate of 5.0 kg Zn + 2 kg B+ 10 Kg Fe +20g S Enriched FYM @ 500 kg ha⁻¹ (Zn₂B₂Fe₂S₂ En) increased the seed yield by 27.48 and 3.96 percent over control and Zn₁B₁Fe₁S₁En, respectively.

IMPACT OF RAINFALL ON YIELD GAP AND ECONOMIC ANALYSIS PARAMETERS TO EVALUATE THE PERFORMANCE OF OATS FODDER IN BARAMULLA DISTRICT OF JAMMU & KASHMIR

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Abstract

A field experiment (On farm trail) was conducted for two successive years during Rabi (winter) seasons of 2016-17 and 2017-18 at farm, ICAR-CITH, KVK Baramulla, for assessing performance of different improved varieties of fodder oat under rainfed farming condition. Details of technologies selected for assessment of different oat varieties namely: Locally available seed (Farmers Practice), SKO-96 and SKO-108 from SKUAST-K. The problem diagnosed/defined was lower productivity of locally available fodder oat as sown by farmers. The experiment was based on Cereal based system (Rice-Oat) production system, and the results showed that SKO-108 recorded higher green fodder yield (580 Q/ha) and 77 Q/ha dry yield under late sowing rainfed condition during 2016-17 and SKO-108 recorded higher green fodder yield (590 Q/ha) and 78 Q/ha Seed dry yield under rainfed condition during 2017-18. The final recommendation for micro level situation was also suggested that SKO-108 may be grown by farmers, if there is no rain during the month of October- November. No rainfall during the month



of October-November was reported during the whole crop season. Discussion with farmers followed by field visit and advisory services from specialist of the crop was also undertaken meanwhile the two years crop duration.

FODDER PRODUCTIVITY OF SORGHUM [*SORGHUM BICOLOR* L.] MOENCH UNDER VARYING SOWING DATES AND LEVELS OF NITROGEN UNDER TEMPERATE CONDITIONS OF KASHMIR

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Abstract

A field experiment entitled “Fodder productivity of sorghum [*Sorghum bicolor* (L.) Moench] under varying sowing dates and levels of nitrogen under temperate conditions of Kashmir”. was conducted at Faculty of Agriculture, Wadura (SKUAST-K) in split plot design with three dates of sowing (11th June, 26th June and 10th July) in main plots and four levels of nitrogen application (90,120,150 and 180 kg N ha⁻¹) in sub plots with three replications and 12 treatment combinations. The soil of the experimental field was clay loam in texture, neutral in reaction, medium in organic matter, potassium (224 kg/ha), phosphorus (19.6 kg/ha) and low in nitrogen (240 kg/ha). The crop sown on 11th June and 26th June recorded significantly higher plant height, dry matter accumulation and leaf area index as compared to 10th July sowing. Sowing of 11th June and 26th June also recorded significantly higher green fodder yield, dry matter yield and nitrogen uptake as compared to 11th July sowing. Crude protein content was also found higher in first two sowings however the crude fibre content was found higher in 3rd sowing. Net returns (Rs 60602 ha⁻¹ and Rs 57214 ha⁻¹) as well as benefit cost ratio (1.70 and 1.62) were higher with 11th June and 26th June sowing (treatments D₁N₄ and D₂N₄) than third date of sowing. Application of 180 kg N ha⁻¹ significantly increased plant height, dry matter accumulation and leaf area index than other treatments of nitrogen application. Total green fodder as well as dry fodder yield and crude protein content (%) significantly improved by application of nitrogen up to 180 kg ha⁻¹. However crude fibre content (%) decreased with increased levels of nitrogen. Highest net returns (Rs 60602 ha⁻¹) and B: C (1.70) was recorded with the application of 180 kg N ha⁻¹.

MORPHOLOGICAL CHARACTERIZATION OF SOUTH INDIAN AVOCADO (*PERSIA AMERICANA* MILL.)

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Abstract

Avocado (*Persea americana* Mill.) is one of the emerging high value fruit crop in India belongs to the family of Lauraceae. It was originated in Mexico and Central America possibly from more than one wild species. In India, avocado is not a commercial fruit crop and the production is very limited. Avocado was introduced by an American missionary, residing in Bangalore between the years 1906 and 1914 from Royal Botanical Gardens, Ceylon. Later on, it was spread to different parts of the country. Wide variability was created in avocado for fruit shape, size, colour and quality traits due to its high heterozygous nature. As a result, large number of accessions have been evolved naturally due to seed propagation. Hence to know the diversity exists in avocado the present study was formulated. In the present study, the survey was carried in hot spots of South India mainly Karnataka, Tamil Nadu and Kerala. Total eighty-three accessions were collected from parts of South India, among which forty-three accessions from Karnataka, twenty-nine from Tamil Nadu and eleven from Kerala. All the collected accessions were characterized by using Bioversity International avocado descriptors for different morphological, fruit and seed traits. The results showed the wide variation for fruit shape, fruit size uniformity, fruit base shape, fruit apex shape, pedicel position on fruit, apex position, ridges on fruit, pedicel shape, fruit peel surface, peel colour, fibre in flesh, flesh texture, seed shape, seed position and cotyledon surface among different accessions. The presence of avocado population ranged from the elevation of 680 MSL to 1600 MSL. Eight different forms of fruit shapes were existing in collected accessions among which narrowly obovate (24.10 %) and obovate (21.69 %) shapes were more common than pyriform (7.23 %) and high



spheroid (6.02 %). With respect to fruit colour, light green colour (38.55%) accessions were more dominant compare to other colours and two yellow colour accessions were also found in identified population. This studies not only helps to know the status of diversity exists in avocado for different traits and also useful for the development of a conservation strategy for future breeding programme.

COMBINING ABILITY ANALYSIS OF F₁ GENERATION IN BREAD WHEAT (*TRITICUM AESTIVUM* L.)

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Abstract

Wheat is an edible grain, one of the oldest and most important of the cereal crops in the world. Eight diverse genotypes were crossed in diallel mating design excluding reciprocals for studying of combining ability analysis in F₁ generation of wheat at Crop Research Farm, Nawabganj of C.S.A. University of Agriculture and Technology, Kanpur-208002 UP India. The genotypes under study were planted in a randomized complete block design (RCBD). Highly significant variances for both general and specific combining abilities for all the characters studied were found which indicated the importance of both additive and non-additive gene effects. On the basis of GCA effect the good parents were namely, K7903 for seven characters, K307 for six characters, HD 3171 for six characters, PBW502 for six characters, WH147 for five characters, K1006 for five characters, DBW14 for five characters and K906 for two characters. On the basis of SCA effects top five superior combinations in order to merit were observed for viz, WH147 X PBW502 in respects to days to 75% heading, number of spikelets per spike, number of grains per spike, biological yield per plant and grain yield per plant. In order to merit were K7903 X DBW14 for days to 75% heading, plant height, number of grains per spike, biological yield per plant and grain yield per plant. In order to merit were HD3171 X WH147 for days of maturity, number of spikelets per spike, spike length and weight of grains per spike. In order to merit were HD3171 X K906 for days to maturity, number of spikelet per spike and harvest index. In order to merit were HD3171 X K906 for days of maturity, number of spikelets per spike, harvest index.

EVALUATION OF LEAF NUTRIENT STATUS OF TAMARIND AND ITS RELATION WITH QUALITY, YIELD ATTRIBUTES, SOIL PHYSICO-CHEMICAL PROPERTIES OF SOIL IN MARATHWADA REGION OF MAHARASHTRA

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Abstract

Knowledge concerning the behavior and accumulation of nutrients in tamarind leaves is the significant information for the management of fertilization. Therefore, this study was conducted to evaluate the concentration and accumulation of essential nutrients in leaves of tamarind and their correlation with soil physico-chemical properties, available nutrient status; quality and yield attributes under different soil types in tamarind growing areas of Marathwada region in Maharashtra. Fourteen tamarind orchards under different soil type were surveyed and selected from different district of Marathwada region. The results revealed that highest concentration of total N, P, K, S and Mn in leaves of tamarind were found in soils of Vertisols and lowest in Entisols whereas highest concentration of total Fe, Zn and Cu were found in soils of Inceptisols and lowest in Vertisols but lowest concentration of total Cu in Entisols. The nutrients content of tamarind leaves shown different positive and negative correlation with soil properties, available nutrients; quality and yield attributes of tamarind. Amongst those, total N, P, K, S, Mn and Zn in leaves showed positive correlation with physic-chemical properties but total N, P and Mn showed significant relation with OC and clay content whereas total K showed significantly positive relation with clay and negatively with CaCO₃ as like total Zn. Total Fe and Cu showed negative relation with soil physico-chemical properties except with OC for total Cu. Total N showed significant positive correlation with available N, P and K, total P exhibited significant positive



relation with available N and P and Total Mn showed significant positive relation with only available N. Total Zn and P showed significant negative correlation with available Mn. TSS showed positive correlation with all total nutrients except total Fe and Cu but significantly positive correlation were observed with total N and Mn. The yield and yield attributes of tamarind were showed significant and positive correlation with total N, P and Mn. The study revealed that a total nutrient in leaves considerably affects the quality and yield attributes of tamarind.

EFFECT OF PHOSPHORUS AND BIO-ORGANICS ON GROWTH, YIELD ATTRIBUTES AND YIELD OF SUMMER GREENGRAM

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Abstract

Field experiment was conducted during two consecutive summer seasons of 2018 and 2019 at Agronomy Research Area, JNKVV, College of Agriculture, Tikamgarh (Madhya Pradesh) to study the effect of phosphorus levels and different bio-organics on growth, yield attributes yield of summer greengram. The results indicated that increasing levels of phosphorus enhanced the growth parameters, yield attributes and yield of summer greengram. Significantly greater plant height at harvest (55.7 cm), number of branches (5.10), total plant dry weight (11.3 g plant⁻¹), number of nodules plant⁻¹ at 45 DAS (11.9), total nodules dry weight (36.9 mg plant⁻¹), number of pods plant⁻¹ (41.7), number of seeds pod⁻¹ (9.52), 1000-seed weight (39.9 g), Seed yield (1140 kg ha⁻¹) and straw yield (2005 kg ha⁻¹) were recorded with the application of 60 kg P₂O₅ ha⁻¹ over rest of the treatments. Application of phosphorous @ 60 kg P₂O₅ ha⁻¹ resulted into an increase of seed yield over control, 20 and 40 kg P₂O₅ ha⁻¹ by 144.1, 91.3 and 47.3 per cent, respectively. Application of vermicompost @ 2 t ha⁻¹ + VAM significantly increased the plant height (49.4 cm), number of branches (4.56), total plant dry weight (10.0 g plant⁻¹), number of nodules plant⁻¹ at 45 DAS (10.6), total nodules dry weight (33.0 mg plant⁻¹), number of pods plant⁻¹ (37.9), number of seeds pod⁻¹ (8.52), 1000-seed weight (36.3 g), Seed yield (852 kg ha⁻¹) and straw yield (1613 kg ha⁻¹) over control and increased the seed yield by 40.6, 19.0, 11.4 and 17.7 per cent over B₀, B₁, B₂ and B₃, respectively.

PLANT DIVERSITY AND SOIL-PHYSIOCHEMICAL PROPERTIESIN DIFFERENT FORAGE PRODUCTION SYSTEMS

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Abstract

The higher plant and insect diversity can foster the health and productivity of natural ecosystems, as well as arable and non-arable ecosystems. Plant and insect diversity can be influenced by different production systems. Therefore, a field experiment was conducted from July to May in the year 2019 to 2020 at ICAR-Indian Grassland and Fodder Research Institute, Jhansi to study the impact of different forage production systems (i.e. GRA, grassland, ANU, sorghum-oats, and PER, Bajra Napier Hybrid + no intercropping (rainy season) + intercropping berseem (winter)). Preliminary data from the study revealed that the majority of the soil physical and chemical properties are similar among the systems except soil water holding capacity (14-28% greater in ANU) and organic carbon content (32-39% greater in GRA). Carbon cycling enzymes such as O-diphenol oxidase (34-53% greater) and dehydrogenase (48-61%) were higher in the ANU and PER systems compared to GRA system, because of the higher moisture content. However, acid phosphatase (8.66-8.87 µg g⁻¹ of soil greater) and carbon mineralization (1.32-1.33 µg CO₂-C g⁻¹ of soil) were greater in the GRA system compared to ANU and PER systems. Species richness (36 and 36) and Shannon-Wiener index (2.92 and 2.86) were greater in both GRA and PER system, respectively than that in ANU (30 and 2.49, respectively) system. The lack of soil disturbance, higher moisture, and organic carbon contents, and enhanced biochemical activities might be the reason for the higher plant diversity in GRA and PER system. Overall, the adaptation of the perennial systems could improve plant diversity and ecosystem services in the semi-arid region.



EVALUATION OF NEWER INSECTICIDES AGAINST BIHAR HAIRY CATERPILLAR, *SPILOSOMA OBLIQUA* (WALKER) ON SOYBEAN

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Abstract

An experiment on bio-efficacy of different insecticides viz; Indoxacarb, flubendiamide, chlorantraniliprole, chlorfenapyr, novaluron, emamectin benzoate, beta-cyfluthrin and quinalphos evaluated against *Spilosoma obliqua* infesting soybean was conducted at Agricultural Research Station, College of Agriculture, Anand Agricultural University, Jabugam. The result indicated that the plots treated with of chlorantraniliprole and flubendiamide (3 ml/ 10 litre of water) found effective against hairy caterpillar. Indoxacarb (5 ml/ 10 litre of water) also found promising in controlling the population of *S. obliqua*.

DEVELOPMENT OF VALUE ADDED PASTA PRODUCTS FORTIFIED WITH VEGETABLES

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Abstract

Pasta is prepared by using different material such as semolina, durum, farina flour, corn, rice and wheat or these combinations with water. In recent year pasta is popular as breakfast cereal and has good nutritional value. In India, most of the vegetables are available seasonally with higher nutritional value but are not fully utilized. To see the prevalence of high level of micronutrient, to overcome malnutrition in different vulnerable sections and nutritional disorders. Vegetables are rich sources of micronutrients such as iron, calcium, vitamin, etc. Vegetables are a good source of protein, fiber, antioxidant, and minerals, making it a suitable ingredient to be used in the formulation of foods such as pasta with high nutritional or biological values. Different varieties and colors, flavor pasta have available in the market. Our study focused on pasta production, consumption, nutritive value. Different flours fortified with vegetables are used for making pasta and their effects on their nutritive value.

AVAILABLE NUTRIENTS BALANCE UNDER LONG-TERM FERTILIZERS EXPERIMENT ON SOYBEAN - SAFFLOWER CROPPING SEQUENCE IN VERTISOLS

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Abstract

Long term fertilizer experiment was started from 2006-07 at Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani to study the effect of manures and fertilizers on yield and soil properties under Soybean-Safflower cropping sequence during 2006-07 to 2018-19 on Vertisols (*Typic Haplusterts*). The results of pooled mean indicated that the 100% NPK + FYM recorded highest grain yield of soybean (23.00 q ha⁻¹), safflower (16.75 q ha⁻¹) and was statistically at par with 150% NPK, 100% NPK + 25 kg ZnSO₄ ha⁻¹ in both the crops. The minimum grain yield of soybean and safflower was recorded in control (8.82 q ha⁻¹ and 8.49 respectively) followed by 100 % N alone (10.35 q ha⁻¹ and 9.10 q ha⁻¹ respectively). During last five year 2014-15 to 2019-20 the minimum grain yield of soybean was recorded in application of 100 % N alone i.e. 5.12 q ha⁻¹ whereas in control 5.44 q ha⁻¹ and maximum yield was recorded in 100% NPK + FYM (18.58 q ha⁻¹). The available nutrients balance since 2006 to 2019 indicated that the maximum negative balance of NPK was noticed in control -25.85, -0.45 and -139.36 kg ha⁻¹ respectively followed by FYM @10 t ha⁻¹ and 100%N alone. The maximum negative balance of S and Zn (-5.76 and -0.147 respectively) was recorded in 100% N alone followed by control. This indicates that the imbalance application of nutrients decreased the yield and soil quality.



CHARACTERIZATION AND CLASSIFICATION OF TAMARIND GROWING REGION OF MARATHWADA OF MAHARASHTRA

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Abstract

Information of the kinds and properties of soils is significant for making decisions with respect to crop production and also other land use types. Fourteen typical pedons of tamarind orchards from different district of Marathwada region of Maharashtra were surveyed, characterized and classified on the basis of morphological, physical and chemical properties of the soil. The results revealed that variation in morphological, physical, and chemical properties of the soils. Tamarind growing soils were very shallow to very deep (19 to 150 cm), black (10YR 2.5/1) to very dark grayish brown (10YR 7/2) in colour. Landform was moderately sloping to level plain with imperfect to well in drainage condition. Granular to angular blocky in structure with no sticky no plastic to very sticky very plastic in consistency. The bulk density of soils ranged from 1.27 to 1.62 Mg m⁻³ increases with depth while saturated hydraulic conductivity varied from 2.12 to 29.75 cm hr⁻¹ and sand, silt and clay content ranged between 2.77 to 45.91, 20.74 to 53.54 and 21.36 to 75.81 percent, respectively and categorized as silty clay loam to clayey in texture. The soils were slightly to strongly alkaline (pH 7.06 to 8.66), non saline, very low to very high in organic carbon content (0.20 to 1.29 per cent). CaCO₃ increased with depth and slightly to highly calcareous in nature (2.80 to 29.40 per cent). The cation exchange capacity of soils was varied from 29.98 to 75.13 cmol (p+) kg⁻¹ in different horizons of the pedons. Calcium was the dominant cation followed by magnesium, sodium and potassium and percent base saturation varied from 83.00 to 102.60 percent. The soils were classified as Typic Ustorthents, Typic Haplustepts, Calcic Haplustepts, Typic Haplusterts and Calcic Haplusterts.

QUALITY OF VERMICOMPOST AND COMPOST OF MUNICIPAL SOLID WASTE (MSW) AND THEIR EFFECT ON SOIL CHARACTERISTICS, NUTRIENTS CONTENT, UPTAKE AND YIELD OF CHICKPEA.

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Abstract

Aim of work is to prepare vermicompost and compost from municipal solid waste (MSW) collected from Latur city (Maharashtra) and to study its application effect on soil quality, nutrients content and its uptake of chickpea under Inseptsos. The study of MSW vermicompost and compost was found that the MSW vermicompost having more amount of organic carbon (20.17%) than the MSW compost (17.16 %). The availability of essential nutrients was more (5 to 44%) in MSW vermicompost comparatively than the MSW compost. The lesser values of heavy metals concentration was found in MSW vermicompost compared to MSW compost (5 to 17%). The concentration of heavy metals in im vermicompost and compost of MSW was found within permissible limits. The application vermicompost and compost of MSW in soil results revealed that the soil fertility, nutrients content and its uptake and yield of chickpea were significantly increased with increasing levels of MSW vermicompost and compost. The maximum nutrient status in soil recorded in treatment RDF + vermicompost of MSW @ 7.5 t ha⁻¹ followed by T₇ - RDF + compost of MSW @ 7.5 t ha⁻¹ which was significantly superior over control (RDF). Similar trend was observed in case of nutrient contents, uptake and yield of chickpea. The content of DTPA extractable heavy metals increased with increasing levels of MSW compost and vermicompost in soil. The maximum content of heavy metals was found in treatment T₇ - RDF + compost of MSW @ 7.5 t ha⁻¹ indicating compost of MSW having high amount of heavy metals as compared to vermicompost but it was found below permissible limits. From above result however concluded that the application of MSW vermicompost and compost was found beneficial for improvement of soil quality, nutrients uptake and yield of chickpea. The vermicomposting and composting of MSW becomes is solution for management of MSW in metropolitan cities.



EFFECT OF TANK SILT APPLICATION ON SOIL QUALITY, GROWTH, UPTAKE AND YIELD OF SOYBEAN UNDER INCEPTISOLS

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Abstract

The field experiments were conducted on impact of tank silt application on soil quality, growth, yield and uptake of chickpea and soybean under Inceptisols (Typic Haplustepts). at Department of Soil Science and Agricultural Chemistry farm, College of Agriculture, Latur data indicated that the application of tank silt @ 5 t ha⁻¹ + FYM @ 2.5 t ha⁻¹ + RDF (T7) to soybean recorded the significantly higher plant height, number of branches, number of pods at all growth stages followed by treatment tank silt @ 10 t ha⁻¹ + RDF (T6) and FYM @ 5 t ha⁻¹ + RDF (T9) which was significantly superior over Control (T1) and RDF (T2) alone. The BD, pH, EC and CaCO₃ was found non significant where as maximum soil organic carbon content was recorded at application of tank silt @ 5 t ha⁻¹ + FYM @ 2.5 t ha⁻¹ + RDF (T7) followed by FYM @ 5 t ha⁻¹ + RDF (T9). The maximum available NPK and micronutrients viz, Fe, Zn, Mn and Cu was noticed at application of tank silt @ 5 t ha⁻¹ + FYM @ 2.5 t ha⁻¹ + RDF (T7) followed by FYM @ 5 t ha⁻¹ + RDF (T9) was significantly superior over Control (T1) and RDF (T2) alone. The maximum content and uptake of NPK was found in treatment T7 application of tank silt @ 5 t ha⁻¹ + FYM @ 2.5 t ha⁻¹ + RDF (T7) followed by FYM @ 5 t ha⁻¹ + RDF (T9) and T4 application of tank silt @ 10 t ha⁻¹ + RDF was significantly superior over Control (T1) and RDF (T2) alone. The maximum grain and straw yield was recorded in treatment T7 application of tank silt @ 5 t ha⁻¹ + FYM @ 2.5 t ha⁻¹ + RDF (T7) followed by FYM @ 5 t ha⁻¹ + RDF (T9) and T4 application of tank silt @ 10 t ha⁻¹ + RDF was significantly superior over Control (T1) and RDF (T2) alone. **This** indicated that application of RDF (30:60:30) along with tank silt @ 5 t ha⁻¹ + FYM @ 2.5 t ha⁻¹ Or tank silt @ 10 t ha⁻¹ improve the soil quality and productivity of soybean.

ASSESSMENT OF HERITABILITY AND GENETIC ADVANCE FOR EARLY SEEDLING VIGOUR AND GRAIN YIELD IN EARLY DURATION GENOTYPES OF RICE UNDER DIRECT SEEDING CONDITION

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Abstract

Rice is widely cultivated under irrigated and rainfed conditions, with improved varieties and landraces that specifically adapt to these situations. In India, more than 50% of rice areas under rainfed conditions are cultivated as direct seeded rice (DSR). Due to unpredictable rainfall patterns, labour scarcity and unavailability of timely irrigation water, direct seeded rice has become regular practice under rainfed situation. Strong early seedling vigour is desirable trait in dry direct-seeded rice for enhancing crop establishment and the ability to compete against weeds. A survey of genetic variability is essentially the first step of plant breeding for crop improvement. In addition it, estimates of heritability along with the genetic advance is important factors behind the entire success of selection. The present investigation deals with the estimation of heritability with genetic advance as per cent of mean of eighty rice genotypes for different 26 early seedling vigour traits, yield and its component traits under direct seeded condition in order to decide the selection criteria for improvement of Early seedling vigour and grain yield. High estimates of heritability (>60%) were found for seedling length on 20 days after sowing (DAS) (67.21), seedling dry weight on 20 DAS (68.90), seedling length on 30 DAS (74.05), seedling dry weight on 30 DAS (77.00), germination % (81.76), vigor index I (75.09), vigor index II (76.34), days to 50% flowering (95.15), panicle length (83.44), plant height (74.01), panicle per meter square (69.07), 1000 grain weight (93.42), filled spikelet (96.21), unfilled spikelet (97.19), spikelet fertility % (97.29), paddy length (97.84), paddy breadth (95.53), paddy L/B ratio (97.10) and grain yield (87.25). However, moderate heritability for seedling length on 10 DAS (39.08), seedling dry weight on 10 DAS (49.88), number of leaf on 30 DAS (51.53), flag leaf length (55.95) and flag leaf width (42.21). The magnitude of genetic advance as percent of mean was recorded high for maximum traits, except some trait. Moderate genetic advance showed by seedling length on 10 DAS (10.19), germination % (12.11), days to 50% flowering (17.85), panicle length (17.23) and flag leaf width



(12.11), and also such trait showed low genetic advance *viz* number of leaf on 10 DAS (2.71), number of leaf on 20 DAS (0.10) and number of leaf on 30 DAS (7.69). The knowledge of heritability coupled with expected genetic advance for a trait helps in deciding the scope of improvement of that particular trait through selection. All the traits possessing high values of genetic advance indicated that the characters are governed by additive genes and selection will be rewarding for the improvement of such trait. It clearly indicates that most likely the heritability is due to additive gene effects and selection may be effective.

EFFECT OF FOLIAR APPLICATION OF COMPOST TEA ON NUTRIENT UPTAKE AND APPARENT NUTRIENT BALANCE IN SOIL UNDER SOYBEAN [*GLYCINE MAX* (L)]

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Abstract

The field experiment was conducted on Vertic Heplustepts (Inseptisols) soil of farm, Department of Soil Science and Agriculture Chemistry, College of Agriculture, Latur. The experimental plot was laid out in a randomize block design (RBD) with three replication and eight treatments *viz.*, T₁ - Control (RDF 100%), T₂-100% RDF + Water spray, T₃- RDF + Compost tea @ 10 % foliar spray, T₄ - RDF + Compost tea @ 15% foliar spray, T₅-RDF + Compost tea @ 20 % foliar spray, T₆- RDF + Compost tea @ 25 % foliar spray, T₇ - RDF + Compost tea @ 50 % foliar spray, T₈ - RDF + Compost tea @ 75 % foliar spray. The results indicated that the plant nutrient content, uptake and yield of soybean were significantly increased with foliar application of compost tea. The maximum plant nutrient content, uptake and yield of soybean were recorded in treatment T₇ - RDF + Compost tea @ 50 % foliar spray followed by T₈ - RDF + compost tea @ 75 % foliar spray which was significantly superior over control (RDF). The available N P K and Zn in soil were found significantly decreased over control. Increasing the dose of foliar application of compost tea on soybean a decrease in available NPK status of soil after harvest of the soybean crop. From the above result however concluded that the foliar application of compost tea along with RDF increased nutrient content, uptake and yield of soybean crop and mining of nutrients from soil.

SURGICAL MANAGEMENT OF VENTRAL HERNIA IN BUFFALO

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Abstract

Hernia is a protrusion of the contents of a body cavity through the body wall. In bovine most common site of a hernia is the abdominal. In animals ventral hernia occurs due to trauma like kick, blow, horn thrust or falling on blunt objects and rupture of pre pubic tendon. There are lots of treatment options for ventral abdominal hernia that depend on the size of the hernial opening. Application of bandage, clamps or ligatures may be helpful in a few cases where the hernia ring is small, but surgical intervention is required in most clinical cases of hernia. A clinical case of buffalo with swelling in ventral region reported at referral veterinary polyclinics, IVRI Izatnagar with history one month earlier falling on picket. History, clinical examination and ultrasonography confirmed the clinical case of ventral hernia. Ultrasonography examination revealed content of hernia is part of rumen and intestine and decided surgical repair of hernia. Buffalo sedated with with butorphanol at dose rate of 0.2 mg per kg body weight and midazolam at the dose rate of 0.2 mg per kg body weight. An elapical incision was given at hernia site to expose hernia ring and rumen and part of intestine carefully reduced into abdominal cavity. The hernia ring was freshed and close with non-absorbable suture material polyimide No.2 in overlapping pattern, followed by a subcutaneous suture with vicryl no. 2 in continuous pattern. Skin was sutured as per the standard technique. Animal post operatively prescribed with broad spectrum antibiotic amoxicillin sodium and Sulbactam sodium at the dose rate of 10 mg/kg body weight intramuscularly for 7 days. Inj. Fuxin meglumine was given at the dose rate of 2 mg/ kg body weight I/M for three day as analgesic agent. Animal start feeding from next day and fully recovered after 15 day. Suture removed on 12th days.



ORGANIC AGRICULTURE FOR SUSTAINABILITY

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Abstract

Green revolution in India boosted the productivity by adopting nutrient responsive, high yielding varieties of crops. However, the success of green revolution in recent years has often masked by the factors affecting natural resources and human health as well as agriculture. Indian agriculture is the major source of livelihood for more than 60% of the population though its contribution to the national GDP was 15.2 per cent. Indian farmers' produce a wide variety of food crops (cereals, pulses, oilseeds), fruits and vegetables. With the impact of agrochemicals on the environment and people's health a major shift in consumer preference with regard to food quality particularly developing countries. Organic agriculture has a potential to fulfill the food requirement of the world with sustainable resource utilization. Organic farming was practiced in India since decades. Organic agriculture plays a crucial role towards sustainable utilization of natural resources in food production by minimizing the pollution and contribution of green house gases and ultimately climate change. Compared to conventional farming, organic farming practices provide safe food but also have huge potential to mitigate climate change by increasing soil carbon sequestration. Organic agriculture can be considered as a way forward for sustainability.

EFFECT OF ZINC AND IRON FERTILIZATION ON GROWTH AND YIELD OF DIRECT SOWN RICE

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Abstract

A field experiment entitled "Response of Direct Sown Rice to Zinc and Iron Nutrition" was conducted at Agriculture College Farm, Bapatla, during *khari*, 2017. The experiment was laid out in randomized block design (RBD) with seven treatments replicated thrice. The treatments consisted of T₁- RDF (180 :60 :40 N-P₂O₅-K₂O (kg ha⁻¹); T₂- RDF + ZnSO₄ @ 50kg ha⁻¹ through soil application; T₃- RDF + FeSO₄ @ 25kg ha⁻¹ through soil application; T₄ - RDF + ZnSO₄ @ 50 kg ha⁻¹ + FeSO₄ @ 25 kg ha⁻¹ through soil application; T₅- RDF + foliar spray of ZnSO₄ @ 0.2% at 20 and 45 DAS; T₆- RDF + foliar spray of FeSO₄ @0.5% at 20 and 45 DAS; T₇- RDF + foliar spray of ZnSO₄ @ 0.2% and FeSO₄ @ 0.5% at 20 and 45 DAS. Recommended dose of nitrogen, phosphorus and potassium were applied to all the plots in the form of urea, single super phosphate and muriate of potash, respectively. The results revealed that, plant height, number of tillers m⁻², dry matter production, number of grains per panicle, grain and straw yield of direct sown rice were significantly higher with RDF + ZnSO₄ @ 50 kg ha⁻¹ + FeSO₄ @ 25 kg ha⁻¹ through soil application (T₄) which was comparable with T₇ treatment (RDF + foliar spray of ZnSO₄ @ 0.2% and FeSO₄ @ 0.5% at 20 and 45 DAS) RDF applied without Zn and Fe, recorded the lowest growth parameters.

EVALUATION OF GENETIC DIVERSITY IN RICE (ORYZA SATIVA L.) FOR DIRECT SEEDING TRAITS USING SSR MARKERS

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Abstract

Assessing the diversity of rice genotypes involves phenotyping, analyzing biochemical substances, and genetic assessment through DNA diversity. The evaluation methods involving the identification of phenotypes and biochemical traits are may not be reliable always, as they are environmentally influenced; labour and cost intensive. Evaluating genetic diversity based on DNA is the most extensively used evaluation method in terms of repeatability, stability, and reliability. Molecular markers, such as RFLP (restriction enzyme based), RAPD, AFLP, SSR, and SNP (PCR based) are useful tools for evaluating genetic diversity and determining cultivar identity. SSR markers, also called DNA microsatellites, are regions of DNA where



sequences of one to five nucleotides are repeated, and they are uniformly distributed in the genomes of most eukaryotes. The purpose of the present study was conducted at Regional Agricultural Research Station, Maruteru, A.P., to evaluate the genetic diversity within a diverse collection of rice accessions, and to determine differences in the patterns of diversity. Forty eight rice genotypes of particular interest *i.e* to direct seeding were evaluated for genetic diversity using SSR markers linked to ten traits of direct seeding. The results indicated that among SSR markers used, 10 SSR loci were polymorphic and produced 36 alleles. The number of alleles per locus generated by each marker varied from 2 to 5 alleles with an average of 3.6 alleles per locus. The polymorphic information content (PIC) values ranged from 0.305 to 0.797 with an average of 0.628. Out of the 10 polymorphic SSR markers used, 8 markers were highly informative ($PIC > 0.50$), 2 markers were informative ($0.25 < PIC < 0.50$). Highly significant correlation coefficient was found between PIC values and the number of alleles detected per locus ($r=0.925^{**}$). The SSR markers RM201, RM263 and RM5509 were the highest polymorphic markers in current study. The Jaccard's similarity coefficients among the studied genotypes ranged from 0.1 to 1. The 48 rice genotypes were grouped into six major clusters at 35 % similarity level. Cluster II was the largest with 11 genotypes followed by clusters III and I with seven and six genotypes respectively.

INFORMATION TECHNOLOGY IN AGRICULTURE : BOON IN DOUBLING FARMERS' INCOME

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Abstract

Agriculture is the largest livelihood provider in rural India. In the agricultural sector, constant application of latest innovative ideas and better technologies is essential to enhance the economic well being of the farmer. The problem of Indian agriculture is not lack of technology, R&D efforts but inadequacy and inefficiencies in the dissemination of information to the farmers. Therefore, Information Technology in agriculture can act as a driving force in the development process. Information technology is playing a vital role in agricultural production and marketing. Information technology allows farmers to save time on orders and delivery and getting feedback. Farmers' crop database must be managed. The data base includes the kinds of crops, the size of cultivated area, time of harvest and yield. Farmers of the extension personnel transmit those data via the internet to data base server. Crops information service system should be created. This system analyzes the crop data to create some statistical tables. Farmers can access these statistical data by browsing the home page and make their production plan. Production technology and information inquiry system should be created. Production equipment inquiry service system should be created. This system gathers information from the company of seeds and crop production equipment to build the production equipments inquiry service system. Mobile based app may be helpful in providing the weather based data, market rate of produce and other agronomy based information to the farmers. Agmarknet, State Agricultural Marketing Boards (SAMB), Kisan Call Centre, Community Radio stations, Call centre at KVKs, Call centre at ATIC are the important Agencies, Models, Initiatives, Projects of the Agricultural Marketing Information Network.

EVALUATION OF PERENNIAL GRASSES FOR THEIR SUITABILITY UNDER IRRIGATED CONDITION OF NORTHERN DRY ZONE OF KARNATAKA

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Abstract

Hybrid Napier grass is most adopted forage crops in Northern Karnataka due to its quick growth, high yield potential, better palatability, digestibility and rooting ability. It is advantages in various ways such as saving in cost of production, and high yield in short period. Rationing also offers an opportunity of continuous supply of green forage. Several Hybrid Napier crosses have been developed by the TNAU, IGFRI, UAS, Dharwad *etc.* It is very much need of the hours to study the performance of these hybrids under varying climatic conditions to know its suitability and yield potentiality. Keeping this in view a field experiment was conducted at Krishi Vigyana Kendra, Vijaypura, Karnataka for two subsequent years of 2018-19 and 2019-20 under irrigated conditions in medium black soils having 0.58 per cent organic carbon, 211 kg/ha



available Nitrogen, 56 kg/ha available Phosphorus and 135 kg/ha available Potassium with 8.2 pH. to explore the performance of Hybrid Napier grasses under irrigated condition. The treatments comprised eight Hybrid Napier cultivar, viz., NB-21, DHN-6, APBN-1, IGFRI-7, Phule Jaywanth, CO-3, CO-5 and DHN-15. A total of eight treatments were laid out in randomized block design with three replications. The pooled results of two years revealed that, Hybrid Napier cv. DHN-15 recorded significantly higher green fodder yield (759 q/ha). However which was on par with the hybrid napier cultivar DHN-6, CO-3, CO-5, Phule Jaywanth and APBN-1. Significantly lower green fodder yield was recorded by NB-21 cultivar (445 q/ha). Among different perennial grasses, the highest net returns (Rs. 59401 ha⁻¹) and BC ratio (2.68) was obtained with Hybrid Napier cultivar DHN-15 and closely followed by DHN-6, CO-3, CO-5, Phule Jaywanth and APBN-1. The lowest was with NB-21 cultivar (Rs. 22174 ha⁻¹ & 1.66, respectively).

EFFECT OF VARYING ROW SPACING AND NUTRIENT MANAGEMENT PRACTICES ON NUTRIENT UPTAKE BY CROP, AVAILABLE NUTRIENT IN SOIL AND ECONOMICS OF LINSEED (*LINUM USITATISSIMUM* L.) UNDER RAINFED CONDITION

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Abstract

A field experiment was conducted to study “Effect of varying row spacings and nutrient management practices on nutrient uptake by crop, available nutrient in soil and economics of linseed (*Linum usitatissimum* L.) under rainfed condition” during rabi, 2017 at College of Agriculture farm, Raichur, on medium black soil. Fourteen treatment combinations consisting of two row spacings i.e., S₁ (30 cm) and S₂ (45 cm) and seven nutrient management practices i.e., N₁ (Recommended FYM (3 t ha⁻¹)), N₂ (Recommended NPK), N₃ (Recommended NPK + FYM (3 t ha⁻¹)), N₄ (125% Recommended NPK), N₅ (125% Recommended NPK + FYM (3 t ha⁻¹)), N₆ (Recommended NPK + FYM (2 t ha⁻¹) + Vermicompost (1 t ha⁻¹)), N₇ (125% Recommended NPK + FYM (2 t ha⁻¹) + Vermicompost (1 t ha⁻¹)) were tried in split plot design with three replications. The present study revealed that available nutrient in soil after harvest of crop; N, P₂O₅ and K₂O content were non-significantly influenced due to row spacing treatments. Whereas, the row spacing of 30 cm (S₁) recorded significantly higher N, P and K uptake (16.96, 8.23 and 9.86 kg ha⁻¹, respectively) compare to row spacing of 45 cm. Application of 125% Recommended NPK + FYM (2 t ha⁻¹) + Vermicompost (1 t ha⁻¹) recorded significantly higher available soil nitrogen, phosphorus and potassium (209.76, 47.16 and 213.83 kg ha⁻¹, respectively) and also higher uptake of nitrogen, phosphorus and potassium at harvest (20.05, 10.48 and 11.18 kg ha⁻¹, respectively). Crop sown with row spacing of 30 cm recorded significantly higher net returns (? 19,687 ha⁻¹) and BC ratio (2.22) while application of 125% Recommended NPK + FYM (2 t ha⁻¹) + Vermicompost (1 t ha⁻¹) recorded significantly higher net returns (? 28,510 ha⁻¹) and BC ratio (2.43).

GGE BIPLLOT ANALYSIS OF GENOTYPE X ENVIRONMENT INTERACTION IN *GOSSYPIMUM ARBOREUM* COTTON

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Abstract

In plant breeding, multi environment trials conducted to evaluate the performance of genotypes across the range of environments. The GGE Biplot is a useful visualization tool for accessing the performance of genotypes in different environments. In GGE biplot if first two Principal components (PCs) explains more than 60% of the total variation then the data were adequately summarized in the biplot. In the present study, the 9 genotypes viz CISA 6-165, CISA 6-350, CISA 6-123, CISA 6-187, CISA 6-214, CISA 6-295, CISA 614-1, CISA 6-209, CISA 6-256 were sown under seven different environmental conditions. the genotypes will be referred as G1 to G9. The seven different environmental conditions were cotton growing season 2010-11 to 2016-17 henceforth referred as E-1 to E-7. The aim of our study was to determine the stability of the genotypes in terms of seed cotton yield (SCY in Kg/ha), Ginning Out Turn (GOT) and Boll Weight (g) under different environmental situations through GGE Biplot stability analysis technique. In case of SCY the first PCs explained



91.08% of total variation. All the environments formed only one mega environment (ME) for seed cotton yield. Only G1, G7, G8, G9 were under the mega-environment performed better as compared to other genotypes but was not stable across the environments. Performance of a particular genotype was accessed by average environment coordination method and result showed G7 was the highest performer followed by G8, G9 and G1. In case of GOT, the first two PCs explained 73.12% of total variation and two mega environments were formed. The genotypes G1, G5, G7 and G9 were better performers under E2, E4, E5, E6 and E7 (ME1). Other genotypes viz. G2, G3 and G6 were the best performer under ME2 (i.e. under E1 and E3) in term of GOT. The genotype G9 was best performer with higher average GOT and stability followed by G5 and G7. Genotypes G7 and G9 could be ranked similarly in terms of stability for GOT. In case of Boll wt. 71.77% of total variation was explained by first two PCs. The environments formed three mega environments in which G2, G3, G4 and G6 were best performer under ME1 (E3, E4, E6 and E7), G7 and G8 performed better under E1 and E2 (ME2) and G1, and G9 were better performer under E5 (ME3). The genotype G6 when placed on GGE biplot according to AEC method showed its higher average yield with better stability in terms of boll weight followed by G8 and G7. In conclusion, Genotype G7 (CISA 614-1) for seed cotton yield, genotype G9 (CISA 6-256) for GOT and genotype G6 (CISA 6-295) for Boll weight may be used for further breeding program for specific trait improvement.

EFFECT OF JAMUN POMACE POWDER ON NUTRITIONAL AND ORGANOLEPTIC PROPERTIES OF COOKIES

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Abstract

The present study was carried out to study the effect of jamun pomace powder having very high fiber content, on nutritional and sensory characteristics of cookies. The wheat flour was replaced by five substitution levels of jamun pomace powder (0, 5, 7, 9 and 11 percent (w/w)). The procedure for cookies preparation was standardized and evaluated for the nutritional, textural and organoleptic parameters. The findings indicated that the moisture content, ash, crude protein and crude fiber content of cookies were increased whereas crude fat content decreased with increment in pomace powder. The treatment T₃ obtained higher scores for color (7.85), taste (8.2), texture (8.0), flavor (8.11) and overall acceptability (8.0) as compared to other treatments. The texture properties were measured using 3-point break test and the increasing trend observed for breaking force with the increase in the content of jamun pomace powder. However, among all the treatments, T₃ (7 % jamun pomace powder) was found acceptable than other treatments. Thus (T₃) 7% jamun pomace powder can be incorporated in formulation of cookies without any undesirable changes in chemical and organoleptic attributes of cookies. The analysis reveals that the good quality fortified cookies with improved functional and nutritional properties could be produced from incorporating the jamun pomace powder without affecting the sensory attributes.

HETEROSIS STUDY IN BREAD WHEAT (*TRITICUM AESTIVUM* L.)

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Abstract

Wheat is the most important cereal for majority of world's population. It is the important staple food of about two billion peoples (36% of the world population). Eight genotypes of bread wheat (*Triticum aestivum* L.) were crossed in diallel fashion and F₁ studies were made. The experimental material consisted of eight parents and their 28 F₁s were grown in Randomized Block Design with three replications at Crop Research Farm, Nawabganj of C.S. Azad University of Agriculture and Technology, Kanpur (U.P.) during Rabi 2019-20. The heterosis over economic parent (DBW 187) was studied through a 8×8 parent diallel cross excluding reciprocals for nine various characters, viz., days to 75% heading, days to maturity, plant height (cm), number of tillers/plant, number of spikelets/ear, ear length, number of grains/ear, 1000-grain weight (g) and grain



yield/plant (g). The heterosis was varied from -41.97% to 14.98% for grain yield/plant. Cross combinations, namely, DBW 187×DBW 107(14.98%) and HD 2733×DBW 187(14.70%) exhibited maximum heterotic response for grain yield/plant and its related attributes. These crosses may be utilized in further breeding programmes for improvement in grain yield/plant.

STUDIES ON *HERICIUM ERINACEUS* AND *H. CORALLOIDES*, TWO RARE NEARLY EXTINCT WILD EDIBLE FUNGI FROM DODA DISTRICT IN J&K

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Abstract

During collection forays in the temperate forests of district Doda, two species of *Hericium* genus *H. erinaceus* and *H. coralloides* were collected. Both were found growing on Oak (*Quercus leucotricophora*) trees and logs. Both species have earlier been reported from European, North American and some East Asian countries. In India they have been reported from Himachal Pradesh. They are extremely rare and are included in red data list of threatened European species. The mushrooms in this genus are known to contain compounds called erinacines which have medicinal properties and have been used in traditional medicines throughout the world for centuries. Scientific studies on these nearly extinct fungi are extremely useful and may help greatly in their conservation.

MASS DEATH DUE TO CAECAL COCCIDIOSIS IN CHICKS

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Abstract

Mass mortality was being observed in a chicken farm at the age of 20 to 30 days. The birds were showing depression and bloody diarrhoea. These birds were subjected to systemic post mortem for ascertaining the cause the death. External examination of the body showed emaciated and dehydrated body. The peri anal region was soiled with bloody discharges. On opening the carcass the visceral organs appeared pale. Most apparent change was visible in the caeca was appeared ballooned and filled with clotted blood. On opening the caeca flacks of clotted blood can be seen. Rest of the organs did not show any appreciable changes. Faecal material along with smear from intestinal scrapping was taken in to the glass slide. Caecal tissue sample was also collected for histopathological examination. Smear collected from the intestine were observed under low and high power of microscope were numerous coccidian oocysts were visualized. The oocytes were thick layered and some of them showed sporulation inside. Intestinal histopathology was done by paraffin embedding technique and seen under microscope were the mucosa and submucosa were highly burdened with eimerianoocyst. Thus, the case was diagnosed as Caecal coccidiosis. Caecal coocidia is a common cause of mass mortality in young birds and is caused by *Eimeriatenella* species. It is found in caeca of birds and mode of infection is by ingesting oocyst. It harbors the mucosa epithelial cells and leads to its damage and hemorrhage and thereby, death of birds.

POST MORTEM DIAGNOSIS OF AFLATOXICOSIS IN A CHICKEN FARM

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Abstract

Necropsy request was submitted in the Department of Veterinary Pathology, Bihar Veterinary College, Patna with the case where the owner reported that he was growing chickens for last few years with profitable business, but for the first time he experienced such mass mortality in his farm. He was having a flock size of 5000 chickens. At the age of about 25 days, within 8 days, 2000 chickens succumbed showing the symptoms of greenish diarrhoea, incoordination, ataxia, convulsions before death. They were being treated with local veterinarians with antibiotics and Vitamin B complex but after treatment the



mortality rate increases. He also reported that they were being fed with new bag of purchased corn. The blood report showed TLC 10.5 th./mm^3 , TEC 2.60 m/mm^3 , Hb. 9.5 g/dl , lymphocytes 36%, heterophils 55%, monocytes 07%, basophils 01% and eosinophils 01%. The PM examination was systematically conducted which revealed profuse haemorrhages over the muscles, particularly neck and thigh region. Massive blood clots were also found in the internal cavities. Almost all the visceral organs were oedematous and haemorrhagic with marked congestion. The liver was enlarged, haemorrhagic and yellow, while kidneys showed nephrotic changes. Tissue samples and gastric contents were collected for further laboratory diagnosis. Microscopically, the liver showed severe fatty change with haemorrhages while kidneys tubular epithelial cells were swollen. It was suspected for Aflatoxins which was further confirmed by gastric contents analysis in laboratory. Very good and immediate results were obtained on recommendation of Vitamin E and Selenium preparation. Immediate change of feed was also advised.

YOGA AND AYURVEDA IN TODAY'S PANDEMIC

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Abstract

World community is facing an unprecedented pandemic of novel corona virus disease (COVID-19) caused by Severe Acute Respiratory Syndrome Corona virus 2 (SARS-CoV- 2). The disease has spread globally with more than 1.43 million confirmed cases and 82,100 deaths as of April 8, 2020. Despite worldwide efforts to contain it, the pandemic is continuing to spread for want of a clinically-proven prophylaxis and therapeutic strategy. The dimensions of pandemic require an urgent harnessing of all knowledge systems available globally. Utilization of Traditional Chinese Medicine in Wuhan to treat COVID-19 cases sets the example demonstrating that traditional health care can contribute to treatment of these patients successfully. Drawing on the Ayurveda classics, contemporary scientific studies, and experiential knowledge on similar clinical settings, here we propose a pragmatic plan for intervention in India. We provide a plan for graded response, depending on the stage of infection among individuals, in a population. Notwithstanding the fact that no system of medicine has any evidence-based treatment for COVID-19 as yet, clinical interventions are required to be put in place. Therefore, pragmatic strategy proposed here for Ayurveda system of medicine requires immediate implementation. It will facilitate learning, generate evidence and shall be a way forward.

CLIMATE CHANGE : SCENARIO AND FOOD SECURITY

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Abstract

In India, 700 million people living in rural areas directly depend on climate-sensitive sectors like agriculture, forests and fisheries and natural resources. Since last few years, Earth's mean global temperature increased by 1.1°C to 6.4°C . Climate variability receive significant impact on plant physiology in many ways. Addressing climate change impacts on agriculture is special challenge. Small changes in temperature and rainfall have significant effects on the quality of fruits, vegetables, tea, coffee, aromatic and medicinal plants, and basmati rice. Every 1°C rise in temperature reduces wheat production by 4-5 million tonnes. Global reports indicate a loss of 10-40 per cent in crop production. Climate change will affect all four dimensions of food security: food availability, food accessibility, food utilization and food systems stability. It will have an impact on human health, livelihood assets, food production and distribution channels, as well as changing purchasing power and market flows. Its impact will be both short term, resulting from more frequent and more intense extreme weather events, and long term, caused by changing temperatures and precipitation patterns, Agriculture, forestry and fisheries will not only be affected by climate change, but also contribute to it through emitting greenhouse gases. They also hold part of the remedy. However, they can contribute to climate change mitigation through reducing greenhouse gas emissions by changing agricultural practices. Food security is the outcome of food system processes all along the food chain. At the same time, it is necessary to strengthen the resilience of rural people and to help them cope with this additional threat to food security. Particularly in the agriculture sector, climate change adaptation can go hand-in-hand with mitigation. Climate change adaptation and mitigation measures need to be integrated into the overall development approaches and agenda.



PHYTO-MELATONIN ALLEVIATES THE IMPACT OF OSMOTIC STRESS IN WHEAT

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Abstract

Phyto-melatonin is a tryptophan derived indole amine compound. It has been considered as novel master regulator in living organisms because of its ubiquitous presence, conserved structure and diverse action. In plant systems, melatonin has established itself as new signalling molecule and plant growth regulator. It controls diverse function and physiological processes such as circadian rhythm, seed germination, tropic responses, growth promotion, rooting induction, cellular and cytoskeleton development, reproduction, abiotic and biotic stress protection and senescence regulation in the plants. We studied the effect of melatonin on seed germination and seedling growth rate of wheat under osmotic stress. The results showed that the treatment of melatonin at the time of seeds germination had positive effect on germination rate and on seedling growth. The melatonin treatment produced relatively greater influence in osmotic stress condition than that in osmotic stress-free plants. Many recent studies also confirmed the potential role of melatonin in regulation of important physiological processes under abiotic stress.

MINIMIZING THE CLIMATIC RISK IN AGRICULTURE THROUGH WEATHER BASED AGROMET ADVISORIES

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Abstract

Weather factor is major role of increasing and decreasing agricultural production. Weather manifests its influence on agricultural operation and farm production. Forecast can help to minimize the farm losses through proper management of agricultural operations. The complete avoidance of all farm losses due to weather factor is not possible but it can be minimized to some extent by making adjustments through timely and accurate information of weather forecast. Weather forecast and weather based agromet advisories can help in increasing the economic benefit to the farmers by suggesting them the suitable management practices according to the coming weather conditions. A study was therefore, undertaken on adaptation of agromet advisory bulletin and economic impact of agromet advisory services (AAS) for different crops over non users of agromet advisory services (Non AAS) from different selected villages of Barwani district of Madhya Pradesh. Results showed that the farmers, who followed the agromet advisories, are able to reduce the input cost and increase in the net benefit by 12 to 15 percent as compared to non AAS farmers. This input was due to the crop management done by the farmers according to agromet advisory bulletins based on the weather forecast. Thus the application of agromet advisory bulletin is a useful tool for enhancing the productions and income by minimizing the adverse affect of weather.

MORPHOLOGICAL AND PATHOLOGICAL CHARACTERIZATION OF FIELD PEAS CULTIVARS

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Abstract

Field pea is an important crop for vegetarian population of India. It is widely cultivated throughout the country in *rabi* season. In an attempt to characterize various germplasm of field pea collected not only from different areas of M.P. but also from various parts of India. These cultivars were screened for morphological, physiological and pathological characterization. Data on seed colour, seed per pod, 100 seed weight, germination percentage, plant height and seed weight were recorded. They were also screened against plant diseases like wilt and root rot and powdery mildew under field conditions. A high degree of diversity was observed amongst different germplasms for morphological and physiological traits. Correlation studies revealed positive and significant correlations among yield, 100 seed weight, seeds per pod etc.



PRICE FORECASTING OF RAGI IN TELANGANA STATE

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Abstract

It is the most important small millet in the tropics covering 12% of global millet area. It is cultivated in more than 25 countries in Africa (Eastern and Southern) and Asia (from Near East to Far East), predominantly as a staple food grain. The major producers are Uganda, India, Nepal, and China. The specialty of these tiny deep red pearls is the abundance of nutrients present in them. Finger millet is a rich source of calcium, iron, protein, fiber and other minerals and is a gluten-free food. The cereal has low fat content and contains mainly unsaturated fat. It is easy to digest and does not contain gluten; people who are sensitive to gluten can easily consume finger millet. It is considered as one of the most nutritious cereals. The price forecasts are made by analyzing the prices of Agricultural Commodities concerned over 10 years using advanced statistical tools like ARIMA, ARCH and GARCH models. Model parameters were estimated using the R- software. The performance of fitted model was examined by computing various measures of goodness of fit viz., low AIC, BIC and MAPE values. Comparing the same with prices of futures markets and national and international reports of trade surveys besides conducting state level trade surveys. The ARIMA (110) model was the best model for the price forecast of ragi. Ragi price per quintal will be around Rs. 2200 – 2600 at the time of January to April 2021.

DESIGNING AND STORAGE PERFORMANCE OF FORCED VENTILATED ONION STORAGE STRUCTURE

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Abstract

Onion (*Allium Cepa* L.) is undoubtedly one of the most significant and most famous bulb groupings, known to people and devoured far and generally. It is refreshing for its particular impactful taste, and onion is an essential constituent of our daily diet so that a large number of onion are stored to meet domestic and export demands during the sleepy season, i.e., May to September. A comparative study of the naturally ventilated onion storage structure and forced ventilated onion storage structure was conducted in Nashik, Malegaon, India, to determine their performances. Onion bulbs were stored for 110 days in naturally ventilated storage structure and in forced ventilated onion storage structure. The study was conducted from the end of May to September. Hourly temperature and relative humidity of naturally and forced storage environment were monitored, and the physiological weight loss, sprouting percentage, rotting percentage, and percentage of marketable bulbs on stored bulb were recorded every twenty days interval. The total percentage of onion bulb loss increases with the storage period in both storage methods. Lower values were observed in forced ventilated onion storage structure than naturally ventilated onion storage structure. On the 110 days after storage, the overall bulb losses in forced ventilated onion storage structure and naturally ventilated structure were found to be 17.50% and 45.69%, respectively.

IMPACT OF KISAN MOBILE ADVISORY SERVICES ON FARMING COMMUNITY IN RAISEN DISTRICT OF MADHYA PRADESH

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Abstract

Kisan mobile advisory services (KMAs) is one such initiative of ICT which provide location specific and crop specific farm advisory services and facilities to the farming community in a given area. The KMA services have been provided to the respondent with consultation of expert of different field by the center. The study was carried out in Raisen district of Madhya



Pradesh. Four villages form Sanchi block of the district were selected. From the selected four villages, thirty respondents from each village were selected, thus total sample size for the present investigation consist of 120 respondents.

Result of study shows that messages was partially understandable, needful and timely, partially applicable and majority of respondents agree with the help of this service save time and money, increase in social contact, increase in knowledge, increase in productivity and the content was fully adoptable. The study indicate that KMA is one of the most useful tool for dissemination of agriculture information to farmer and also can play a greater role in enhancing efficiency of extension service by reaching large number of peoples.

STUDY OF GENOTYPE X ENVIRONMENT INTERACTION FOR RICE GENOTYPES USING WRICKES ECOVALENCE METHOD

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Abstract

Rice is the major staple food for majority of the people in the world. Due to continuous and concerted efforts of many scientists made it possible, the development of variance varieties suitable for each and every agro-ecological condition throughout the world. But genotype expression over environments is referred to as genotype by environment interaction and is main challenge faced by the plant breeders as they reduce the stability of genotypic values under diverse environments. Further the impact of environment on phenology and growth varies depends on the crop, variety and growth duration and stage etc. In view of this the present study was conducted with 23 rice genotypes developed at Agricultural research Station, Nellore, ANGRAU, AP, India during 2017, 2018 and 2019 kharif seasons in randomized block design with here replications having a spacing of $20 \times 15 \text{ cm}^2$ in each season. All the recommended practices were followed to get a good and healthy crop. The genotype and environment interaction was studied for these 23 genotypes using Wricke's method of stability analysis (Wricke, 1962). The term ecovalence is used for the relative contribution of genotype 'I' to the overall genotype-environment interaction. This method considered the GxE interaction mean square on the criteria for stability. The minimum Wi^2 value indicates the stable performance of the genotypes. The results indicated that the genotypes NLR 3587, NLR 3580, NLR 3580 and NLR 3573 had the lowest ecovalence values and therefore would be considered to be the most stable genotypes. The ranks for these genotypes for yield were 1,15,4 and 17 respectively. Ecovalence values for NLR 3581 was low and the mean grain yield was also lower than the mean grain yield. For the genotypes, NLR 33892, NLR 3539, NLR 3592, NLR 3585, NLR 3548, NLR 3586 and NLR 3545, even though the average grain yield was higher than the mean grain yield but the ecovalence values were high. Hence, the genotypes fall under these two categories may not be stable. The genotypes, NLR 3587 and NLR 3580 recorded both high grain yield as well as less ecovalence values, hence considered as stable genotypes with respect to yield.

STUDY ON KNOWLEDGE AND ADOPTION OF SOIL HEALTH CARD BASED FERTILIZER APPLICATION IN RAISEN DISTRICT OF MADHYA PRADESH

Swapnil Dubey, Ranjeet Singh Raghav, Mukul Kumar, P. K. Dwivedi, Alok Suryawanshi and Pankaj Bhargava

Krishi Vigyan Kendra, Raisen (M.P.)

Abstract

In India since inception of soil health card programme during 2015-16 in order to increase agricultural production and sustain soil health, a large number of soil health cards have been distributed to the farmers. In order to assess the knowledge and adoption of soil health card, the present study was carried out by Krishi Vigyan Kendra, Raisen (M.P.). The farmers who were issued soil health card were comparatively more aware about various soil health card aspects like major nutrients (N, P & K), soil pH, soil EC and micronutrients as compared to farmers without soil health card. Data shows that maximum number of respondents had medium knowledge score that is 62 per cent followed by respondents with low knowledge score (24%) and only 14 per cent respondents had high knowledge score about soil health card. Major constraints faced by the farmers in adoption according to soil health card were difficulty in having knowledge about the importance of micronutrients, the prices of fertilizers being too high and non-availability of organic manure.



DEVELOPMENT OF HERBICIDE TOLERANCE IN WHEAT USING NON-TRANSGENIC METHODS

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Abstract

Wheat is the highly consumed crop worldwide after corn (FAO/2019-20). Weed infestation is one of the major impediment and threat to the production of wheat across the globe. A variety of herbicides viz., atrazine, imidazolinone, glyphosate etc are applied to the crops. Herbicide tolerance enables the crops to survive and propagate in the presence of lethal doses of herbicides. Mutation Breeding is an effective approach in weed management. It was found that EMS treated wheat lines showed variable degree of herbicide resistance in SST 56 and SST 875 wheat genotypes and other crops also like soybean and canola. The method of physical mutagenesis like gamma irradiation is not so effective when compared to EMS because of non-development of any commercial trait. Development of various crops resistant to imidazolinone has been reported using non-transgenic method like mutagenesis followed by *in vitro* selection where the average amount of regeneration efficiency was found to be decreased on increasing the concentration of imidazolinone in MS media. Recently, transgene free wheat germplasms have been developed using Base editing method conferring tolerance to herbicides like sulfonylurea, imidazolinone, aryloxyphenoxy propionate. Also, development of non-transgenic glyphosate tolerance has been done in wheat by using a reverse genetics approach called, TILLING (Targeting Induced Local Lesions in Genome).

FORMATION CONSTANTS AND CHEMICAL EQUILIBRIA OF TERNARY METAL COMPLEXES OF BIOMOLECULES AND AMINO ACIDS WITH TRANSITION METAL IONS BY POTENTIOMETRIC METHOD

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Abstract

The biologically active metal ions like cobalt, nickel, copper zinc have significant role in complexation with amino acids and peptides in living system which acts as model for many complexes metal amino acid equilibrium occurring in enzymatic process. The formation of binary and ternary complexes of metal ions such Co, Ni, Cu, Zn with nucleic acid base uracil and amino acid asparagine were investigated. The relevant stability constant and complexation equilibria of ternary complexes in solution at 30 °C and at constant ionic strength ($I = 0.1M NaNO_3$) have been studied potentiometrically. Species distribution curves are obtained by plotting percent (%) concentration of the species obtained through SCOGS computer technique against pH. The distribution curves are finally sketched by running the computer program ORIGIN 4.0. The stability of binary and ternary complexes follows Irving, William order. The solution structure of metal complexes has been discussed.

MICRORNA FOR CROP IMPROVEMENT

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Abstract

One of the most familiar challenges for both conventional and modern crop improvement is that the appearance of one desirable trait in a new crop variety is always counter balanced by the impairment of one or more other beneficial characteristics. The best way to overcome this obstacle is the flexible utilization of regulatory genes that provide more efficient and explicit regulation in a targeted manner. MicroRNAs (miRNAs), a type of short non-coding RNA, controls the activity of the genes by the biological process called RNA interference (RNAi). The verified targets of these miRNAs encode a varied range of regulatory proteins, majorly transcription factors (66%) which clearly indicate that miRNAs play a role at the



core of gene regulatory networks and their target genes can be exploited for crop improvement. The discovery of miRNAs as the natural pivotal regulators of gene expression has led to the development and application of several miRNA-derived approaches for crop improvement. One simple and straightforward approach is to modulate agronomic traits by constitutively over expressing a specific miRNA. However, the direct use of few miRNAs in crop breeding may be tricky as manipulation of such miRNAs may enhance one trait while also impairing the other desired traits. In cases in which miRNAs function as negative regulators of the traits of interest, overexpressing a miRNA-resistant form of the target that escapes cleavage by its miRNA or using an artificial miRNA–target mimic that inhibits the activity of a given miRNA might be effective strategies for improving crop traits. According to records registered in miRBase (<http://www.mirbase.org>), 2,560 mature miRNAs encoded by 2,063 precursors have been identified through experimental or computational approaches from nine major crops, including rice, maize, wheat, barley, soybean, potato, tobacco, tomato and cotton, which are of preeminent importance to entertain world food, livestock and poultry feed, fibre and other economic requirements.

EVALUATION OF RICE FALLOW PULSES AND OIL SEEDS

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Abstract

Rabi rice crop is being harvested in the month of March & April in Nellore district of Andhra Pradesh in India. Farmers are keeping land vacant immediately after harvest of the rice crop. Sowing of rice fallow pulses will not only utilise the residual soil moisture but also improves system productivity and net returns besides improving the soil fertility. After the pulses were harvested, these plants decompose and increase the nitrogen content in soil. When the farmers raise paddy, the nutrient-rich soil will enhance the paddy yield during the next season. The Hindu, 2015 Hence present trial has been taken up to evaluate the rice fallow pulses and oil seeds to increase the system productivity of rice instead of keeping the land vacant during summer. Field experiment was conducted at Agricultural Research Station, Nellore during *summer*, 2019 to evaluate the pulses and oil seeds in rice fallows. Four crops namely Green gram (IPM 2-14), Blackgram (TBG 104), Cowpea (TPTC 29) and Gingelly (YLM 66) were sown in rice fallows with four replications in RBD. Highest seed yield of 560 kg/ha was recorded with green gram which is on par with sesamum (505 kg/ha) followed by blackgram (437 kg/ha) and the lowest yield was recorded with cowpea (256 kg/ha). Highest net returns of Rs20,400/- was obtained with sesamum with a B:C ratio of 2.02 followed by Greengram with net returns of Rs 18,080/- and a B:C ration of 1.90

NON-TIMBER FOREST PRODUCTS (NTFPs) SUPPORTING THE PRIMARY HEALTH CARE IN GUREZ VALLEY OF NORTH-WESTERN KASHMIR HIMALAYA

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Abstract

Non-timber forest products (NTFPs) not only acts as an important source of herbal medicines for forest dwellers but also for pharmaceutical industries and on the other hand, it supports the living of the traditional communities dwelling in and around the forests by providing income to them. Keeping the above facts in view this study seeks to document the diversity, distribution, pattern of utilization of NTFPs among the households in Gurez Valley of Kashmir. Multi-stage random sampling technique was employed to select the villages (10) and the households (103). Primary data collected were based on the personal interviews taken from the household heads by using the well-structured pre-tested interview schedules and quasi-participant observations. The results from the study revealed that the sample populace derives medicinal purpose from 56 NTFPs belonging to 40 genera and 31 families. The family Asteraceae had the highest representation (09) medicinal



NTFPs. Of the total edible NTFPs roots represent the highest (20) while as, basidiocarp, bulb, resin represent lowest (01). Out of the 56 medicinal NTFPs collected by the rural people, maximum (82.14%), were derivatives of herbs followed by shrubs (7.14%), tree (5.35%), climber (3.57%), and fungi (1.78%). So far as therapeutic properties of different ailments are concerned maximum (9) of the medicinal NTFPs were used as antitussive, astringent, febrifuge. Hence, NTFPs are being used traditionally to improve healthcare, a local regulatory system should be launched to check over-exploitation and premature harvesting so that it can be extracted on sustainable basis.

ADAPTATION AND MANAGEMENT TO CLIMATE CHANGE WITH CLIMATE SMART SYSTEM FOR SUSTAINED FARM INCOME

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Abstract

The agriculture sectors need to overcome three intertwined challenges of the 21st century were sustainably increase agricultural productivity by sustainable use of critical resources such as water, energy and land to meet global demand; adapt to the impacts of climate change; and contribute to reducing the accumulation of greenhouse gases in the atmosphere. However, the impacts of climate change, which include increasing temperatures, shifting precipitation patterns, more severe and frequent extreme weather events and the loss of ecosystem services and biodiversity will threaten the agricultural production and food systems, especially in developing countries. Adaptation to climate change refers to the process of adjustment to actual or expected climate and its effects. To overcome the above issues we need to modify agricultural practices in a more sustainable way. Developing climate smart agriculture is thus crucial to achieve future food security and the implementation of the 17 Sustainable Development Goals agreed in 2015. Mitigation options reduce the contribution of agriculture sector to greenhouse gas emission, and management strategies provide agriculture production under changing scenarios. Water harvesting by *ex-situ*, *in-situ* methods, soil and water conservation measures, micro irrigation and crop residue management became to increase the cropping intensity. Multiple options of Happy seeder, zero tillage and other biomass management practices prevent farmers from burning crop residues. Green manure crops, soil test based fertiliser application and soil health cards across all sited help to improve soil fertility and resource conservation. Agro advisories based on Information and Communication Technologies (ICTs) and insurance on crops and livestock can also help farmers to reduce the impact of climate change and variability.

NON-ENZYMATIC BROWNING AND THEIR IMPACT ON PROCESSED FRUITS

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Abstract

Browning is a complex biochemical process that is broadly classified into enzymatic and non-enzymatic pathways. The presence of enzymes such as Polyphenol oxidase and peroxidase at favorable conditions have found to cause browning which is due to oxidation of phenols to melanin (colored) compounds or intermediate compounds such as O-quinone (Colourless) which further acts as a precursor for Non-enzymatic browning. Non-enzymatic browning is mainly an oxidative process that occurs at specific pH and water activity levels. Caramelization and Maillard reaction are the two forms of non-enzymatic browning occurring in foods. Caramelization *i.e.*, charring of sugars occurs during the process of product development whereas, the Maillard reaction is caused due to interaction of reducing sugars and free amino acids. As fruits being a rich source of high sugar content that too fructose being a major fruit sugar fruit-based processed products are more prone to browning. These reducing sugars such as glucose, galactose, glyceraldehyde, ribose, and xylose are characterized by a free aldehyde group or a free ketone group which is readily available for the reactions with amino acids to form Maillard reaction products. The major free amino acids contributing to the process are cysteine and lysine. The intensity of browning depends



and various factors such as moisture, water activity, pH, nature of sugar, Vitamin-C, total phenols, and antioxidants. Browning not only affect the sensory attributes but also drastically degrade nutritional content. Delaying browning and maintaining the quality of processed fruits are still remained a major challenge to food processors.

STUDIES ON ENHANCING SEED QUALITY BY PRIMING TECHNIQUES IN SOYBEAN [*GLYCINE MAX* (L.) MERRILL.]

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Abstract

Quality seeds are those which germinate evenly, imbibe water rapidly and produce stand in the shortest possible time under wide range of field conditions (Dighe *et al.*, 1982). Seed priming provides physical and microbial protection to seeds. Similarly it also gives protection against stress and acts as an efficient carrier for nutrients and pesticides. The seed priming can thus be helpful to obtain good crop stand through improved germination and seed vigour. The present investigation was carried out during kharif season of 2019 at experimental farm of Department of Agricultural Botany, Dr. P. D. K. V., Akola (MS), India. Different priming treatments were done with nine treatments with three replications viz. (T1) untreated seeds as control, (T2) hydro priming for 2 hr, (T3) hydro priming with CaCl_2 (1.5%) 2 hr, (T4) hydro priming with 60 ppm GA_3 for 2 hr, (T5) hydration with 1.5% KNO_3 for 2 hr, (T6) hydro priming with *Tricoderma viride* (0.5 %), (T7) hydro priming with Rhizobium culture 2.5%, (T8) hydro priming with Carbendazim @ 0.2%, (T9) seed priming with IAA @ 80 ppm for 2hr. From the experimental observations, it may be concluded that soybean seeds positively responded to treatments of priming. Nevertheless, priming generally improves the seed quality parameters of soybean through improving germination percentage, seedling length, seedling dry weight, vigour index, field emergence, initial plant stand, days to 50 per cent flowering, plant height, and yield per hectare. The highest benefit of priming can be obtained from seeds primed with CaCl_2 (1.5% for two hours) treatment.

LATHYRUS SATIVUS L. – ITS EFFECTS AND BENEFITS

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Abstract

Lathyrus sativus is a valuable plant of culture, both using it and as a precursor and is cultivated on about 500 thousand ha the globe. The species *Sativus* is widely cultivated *Lathyrus sativus* and this crop occupies large area in India, Spain, Portugal, Near East, North Africa. The *Lathyrus sativus* L. is part of the Fabaceae family. The people knew it under various names: dinner, dental peas, cicericula, dentisor. It is a precious annual plant, which has a long history of culture. The areas large occupy it crop. It is used in human nutrition and animal feeding. The berries are used up to mature, green and mature in the form of garner. It is used in animal feed as a green fodder, a fan, alone or mixed with cereals, and the grains are given as concentrated fodder. The *Lathyrus sativus* are also used to obtain high-quality glues used in aviation, textile, veneering, etc. The stem is in the muscle, branched, but non-resistant to fall. The leaves par pinnate with two narrow, lance late leaves, end with branched circle. The flowers are of violet color, rarely pink, blue, placed in racemic 2-3. Flour from the *Lathyrus sativus* is used (10%) for tasty bread. The fruit are a pod patty with two wings, containing 2-6 seeds, angular or flat, white, yellowish-yellow, variegated. Plant height is from 80-90 cm up to 150 cm. The plant has a pivotal, deep (120-125 cm) root with branches. The roots have no dosities that represent colonies which are filled with nitrogen fixation bacteria. After the protein content exceeds peas, beans and other legumes for beans and from pod of *Lathyrus sativus*, can obtain casein, its quality being close to casein of animal origin. The green parts of the plant contain up to 800 mg of the vitamin C, carotene up to 22 mg percent. The plant also contains saponins, bitter substances, a small amount of alkaloids, flavonoids, trace elements: manganese, iron, copper, chromium, etc. The pod of chichling can only be used in the diet after boiling. It also serves as a good liver for bee. The bitter *Lathyrus sativus* contain on average 24.5% protein; 53.5% non-added extractive substances; 2.1% fat; 4.3% cellulose, etc. Straw and chaff have a 7 to 10% protein content, representing a fairly valuable feed. The *Lathyrus sativus* is recommended for use of the healing of chronic bronchitis and against pneumonia. Alcohol-ready with *Lathyrus sativus* can be used in



homeopathy. At the same time, in popular medicine, the *Lathyrus sativus* is used to fight diarrhea. It is also used the infusion of roots from *Lathyrus sativus* in the case of insomnia and for heart pain. The secondary effects were not observed. As a herb are use the field *Lathyrus sativus*, the spring lathyrus. The *Lathyrus sativus* has been studied in pharmacologically and clinically by the Tomsk Institute of Medicine, Russian Federation.

EFFECT OF FOLIAR SPRAYS OF CHITOSAN AND IBA ON CHEMICAL, BIOCHEMICAL AND YIELD CONTRIBUTING PARAMETERS OF PIGEONPEA

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Abstract

The effect of foliar sprays of chitosan (25, 50, 75, 100 and 125 ppm) and IBA (25, 50, 75, 100 and 125 ppm) on the chemical, biochemical and yield contributing parameters of pigeon pea cv. PKV-Tara was studied during *kharif* 2017-2018 at farm of Botany section, College of Agriculture, Nagpur. Experiment was laid out in RBD design with three replications and eleven treatments. Spraying of chitosan and IBA was done two times i.e. on 45 and 65 DAS. Observations about chemical and biochemical parameters like leaf chlorophyll, N, P, K content in leaves, protein content in seed were also estimated. Observations on yield contributing parameters like 100 seed weight, number of pods plant⁻¹, number of seeds pod⁻¹, seed yield plant⁻¹, plot⁻¹ were recorded. Foliar sprays of 25 ppm IBA followed by 50 ppm chitosan significantly enhanced chemical and biochemical parameters and yield contributing parameters when compared with control and rest of the treatments under study.

RESPONSE OF SULPHUR APPLICATION ON QUALITY ASPECTS, YIELD AND YIELD CONTRIBUTING PARAMETERS OF SOYBEAN [*GLYCINE MAX* (L.) MERRILL.]

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Abstract

A field experiment entitled "Response of soil application of various doses of sulphur on morpho-physiological parameters, quality aspects, yield and yield contributing parameters of soybean" was undertaken at Regional Research Centre, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Amravati during *kharif* season 2013-2014 in the Randomized block design with four replications having six treatments including viz., 0, 30, 40, 50, 60 and 70 kg sulphur/ha. The recommended dose of 30 kg N, 75 kg P₂O₅ per hectare was given, sulphur was given through the Bensulf 90% (Mahadhan). The present investigation was carried out in the *kharif* 2013-2014 to determine the morpho-physiological and bio-chemical, quality and yield of soybean. Highest growth contributing parameters like plant height, number of leaves, number of branches and dry matter per plant and quality parameter like nitrogen, protein and oil content was recorded highest with the treatment 40kg/ha Sulphur application. Similarly highest number of pods, no. of root nodules/plant, Seed yield/plant and seed yield kg per hectare along with net monetary returns and benefit cost ratio was recorded with 40 kg/ hectare sulphur application. However, it will be helpful to carry out similar studies over years for drawing a strong conclusion.

POTENTIALITY OF *LATHYRUSSATIVUS* L. GRAIN AS ANIMAL FEED

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Abstract

Lathyrus (*Lathyrus sativus* L.) is known as excellent feed and fodder crop for centuries as a main concentrate for horses (Anonymous, 1894). Although, *Lathyrus* is an important legume crop with low cost and easy cultivation grown in India, Bangladesh, China, Ethiopia, Nepal, and Pakistan for human food and animal feed. Inherently *Lathyrus* possesses resistance drought, excess moisture, salinity, diseases, and insect pests. As *Lathyrus* has an ambivalent reputation due to ODAP content in its plant parts, efforts are on to develop low or ODAP free *Lathyrus* varieties with high biomass for dual purpose for human



food and animal feed. Older published animal feeding studies are of limited use, since the presence and role of ODAP was unknown until the 1960s. More recent feeding studies indicate that low ODAP lines of *L. sativus* can be safely incorporated at inclusion rates up to 40, 30 and 70% of the diet of poultry, pigs and sheep, respectively, without growth reductions (Hanbury, et.al, 2000). Livestock is a key component of farming systems in South Asia and in Africa, and most particularly with small and marginal farmers, estimated about 678 million, and indicates importance of livestock to their livelihoods (ILRI, 2000). Lathyrus is increasingly recognized as an important feed and fodder crop by their source poor farmers of semi-arid and dry areas. Acceptability of low ODAP varieties by the farmers of non-traditional Lathyrus growing areas and high nutritional composition makes the Lathyrus a perfect dual purpose for crop securing food, feed and fodder security in the region. (Sarkar, et.al., 2010). As world demand for legume feed protein is likely to increase due to increasing demand for animal food products. *L. sativus* are crops that should be considered in regions with suitable environments. (Hanbury, et. al., 2016).

ENHANCING SEED GERMINATION BY SEED PRIMING TECHNIQUES IN SOYBEAN [*GLYCINE MAX* (L.) MERRILL.]

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Abstract

An Experiment was carried out during *kharif* season of 2019 at experimental farm of Department of Agricultural Botany, Dr. P. D. K. V., Akola (MS). Different priming treatments such as (T1) (untreated seeds) as control, (T2) hydro priming for 2 hr, (T3) hydro priming with CaCl_2 (1.5%) 2 hr, (T4) hydro priming with 60 ppm GA_3 for 2 hr, (T5) hydration with 1.5% KNO_3 for 2 hr, (T6) hydro priming with *Tricoderma viride* (0.5 %), (T7) hydro priming with Rhizobium culture 2.5%, (T8) hydro priming with Carbendazim @ 0.2%, (T9) seed priming with IAA @ 80 ppm for 2hr were given with nine treatments and three replication. From the data it is revealed that the seed treatment had significant effect on soybean seed germination. The seed priming with @ 1% CaCl_2 (T3) had significantly higher germination percentage (85.23 %) followed by seed treatment with 60 ppm GA_3 (T4) as 83.92 %. The lowest germination (75.30%) was observed in untreated control. Significant variation in seedling length, seedling dry weight, vigour index I and vigour index II was observed due to different seed invigoration treatments. Highest seedling length of 27.25 cm was recorded in seeds primed with 60 ppm GA_3 (T4) followed by seed primed with @ 1% CaCl_2 (27.20 cm). Lowest seedling length of 23.90 cm (T1) was recorded in control. Seedling dry weight is one of major component of seed quality in soybean. Most of the invigoration treatment recorded more seedling dry weight than control. The seeds primed with @ 1% CaCl_2 (T3) recorded significantly highest dry matter content (0.973g) followed by dry matter content of 0.951 g was recorded in seeds treated with 60 ppm GA_3 (T4) and priming with KNO_3 - 0.951g (T5). The lowest dry matter of 23.90 g (T1) was recorded in control (T1).

A STUDY ON LIVELIHOOD A PATTERNS OF AGRICULTURAL LABOURERS

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Abstract

The present study was conducted in three districts of Andhra Pradesh viz., Kurnool, Guntur and Srikakulam during 2018-20 to identify the profile characteristics of agricultural labourers. An Ex-post facto research design was used for the study. The problems perceived by the agricultural labourers in percentage rank order of their importance were: lack of fixed wages for fixed work (88.75%), nature of agricultural labour is painful physical activity (82.50%), lack of fixed wages for fixed work (80.83%), mechanization led to decreased demand for labourer (80.41%), lack of hygienic living conditions at home and worksite (80.00%), poor social relationship existing with other sections of society (77.08%), inadequate opportunities for health care (77.08%), inadequate alternate sources of employment during lean crop season or period (75.83%), inadequate awareness about various Government schemes (75.41%), lack of training for skilled activities about livelihood systems (75.00%), inadequate basic facilities or amenities at work site (72.91%), lack of small scale labour intensive enterprises to save from un employment during lean crop period (72.50%), lack of good housing facilities (67.50%), gender discrimination in wages more for men than women (65.00%) and delayed payments of wages by the owners (61.66%).



COMPONENT WISE RANKING OF DIFFERENT LIVELIHOOD SECURITIES OF AGRICULTURAL LABOURERS

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Abstract

The present study was conducted in three districts of Andhra Pradesh viz., Kurnool, Guntur and Srikakulam during 2018-20 to identify the profile characteristics of agricultural labourers. An Ex-post facto research design was used for the study. A total of 240 respondents were selected for the study. Different livelihood security of agricultural labourers was ranked according to rank order importance of their index scores. of transport security (84.71%)-I, clothing security (82.83%)-II, asset security (71.59%)-III, habitat security (55.47%)-IV, food and nutritional security (48.37%)-V, health security (47.80%)-VI, information security (45.41%)-VII, social security (41.55%)-VIII, educational security (13.91%)-IX.

TRICHODERMA A WONDERFUL BIOCONTROL AGENT FOR PLANT HEALTH MANAGEMENT: PRESENT STATUS AND FUTURE NEEDS

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Abstract

Plant disease management through fungicides is not an eco-friendly approach due to high health hazards and the longer residual effect of these complex chemicals in the food chain. These fungicides are being utilized at an increasing rate by the growers which lead to the development of resistance in plant pathogens. In addition to high health risks, these chemicals also increase the cost of production significantly which forces us to look for an eco-friendly and cost-effective approach. The biological control of plant disease is one of "Integrated Disease Management" approaches and various biocontrol agents such as *Gliocladium*, *Aspergillus*, *Candida*, *Ampelomyces*, *Trichoderma*, *Pseudomonas*, etc. were reported to control various plant disease by plant pathologist in last decade but the *Trichoderma* spp. as BCA widely accepted because of their biological habitats, antagonistic nature. *Trichoderma* spp. are asexual fungi that are present in the rhizosphere of all types of cultivated soils. *Trichoderma* spp. are preferred for its rapid growth, easy application which stimulates plant defense mechanism and promotes plant growth with a wide range of mode of actions such as direct parasitism, competition, antibiosis, and indirect toxic effect. This chapter highlights information on *Trichoderma* spp., the antagonistic mechanisms, and its commercial production and applications.

STORAGE TECHNIQUES IN THE PRODUCTION OF EGG PARASITOID, *TRICHOGRAMMA CHILONIS* FOR PROMOTION OF BIOLOGICAL CONTROL IN SUSTAINABLE AGRICULTURE

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Abstract

Effective storage method for host insect and parasitoid is required to produce quality biocontrol agent for successful bio-control programs. Quiescence is an adaptation to resist unforeseen environmental changes, and it is a popular approach to use this naturally occurring phenomenon to improve storage of *Trichogramma*. Host insect, *Corcyra cephalonica* eggs were stored at 6°C with RH 70% for a period from 7-70 days and the effect of host eggs storage on parasitization by *Trichogramma chilonis* was assessed by recording their percent parasitization and adults' emergence. Storage of UV treated host eggs for 42 days at 6°C was effective with high parasitization (70.94%), adult emergence (62.99%) and 3 days of longevity compared to storage of fresh host eggs (68.99% parasitization and 60.35% adult emergence). Cold storage of parasitoids, *T. chilonis* as Trichocard in sealed polythene cover in refrigerator at 6°C for a period from 7-70 days was observed for the adult emergence. *T. chilonis* showed highest cold storage capability at 6°C was 3 weeks with good adult emergence (76.56%). Storing *T. chilonis* at 6°C temperature provide a minimum of 60% emergence rate and 3 days of longevity after 423 days of storage.



Increasing the shelf life of host eggs and storage period of parasitoid, *T.chilonis* as Trichocard facilitates large scale production and adoption by farmers inturn enhance the sustainability *Trichogramma chilonis* at field level for the effective management of borer pests.

CLUSTER FRONT LINE DEMONSTRATION- AN INTEGRATED APPROACH TOWARDS DOUBLING INCOME OF THE FARMERS AND SUSTAINABILITY

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Abstract

The field experiment was carried out as a cluster front line demonstration among 30 ha area of pigeonpea variety TJT 501 and 30 ha area of Linseed variety JLS 27. The productivity of pulse crops especially pigeonpea and Linseed continues to be quite low due to irregular and late onset of monsoon, low fertility of soil, imbalance use of fertilizer in Mandla district last one decade. The yield of pigeonpea and Linseed crops can be increased by the demonstrating high yielding varieties and scientific management practices at the farmers' field under the supervision of Krishi Vigyan Kendra scientists working in operational area. The importance of varieties and scientific management practices delivered through cluster front line demonstration to popularize new high yielding pigeonpea and Linseed varieties, a demonstration with scientific management practices were conducted at the farmers field during the year 2016-17 and 2017-18 and achieved the expected yield and sustainability. Average percentage increase in the yield over the local check was recorded 84.57 *per cent*. The demonstrated plot yield is 6.46 q/ha as compare to check plot ie. 3.5 q/ha. In case of pigeonpea the percentage of increase in yield is 63.15 *per cent* over local check and demonstrated plot yield is 12.4 q/ha as compare to check plot ie. 7.6 q/ha.

STUDIES ON GENETIC EVALUATION OF RICE RESTORER LINES THROUGH VARIABILITY, HERITABILITY AND GENETIC ADVANCE ANALYSIS

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Abstract

In India, rice is the staple food for 90% of Asiatic population. India secures first position in acreage with total cultivated area of 44.80 million hectare and second in production with 109.7 million tonnes. As per 2nd advance estimates, released by Department of Agriculture, Cooperation and Farmers Welfare, India's rice production has increased at 1.2 percent from last five year while area under rice cultivation remained same substantially during this period. Although, holding great rank, the average productivity of rice is low compare to other countries. With much of the potential hidden, varied ecosystem and season is one of the reasons behind the low productivity of rice. Therefore, hybrids cater to fulfil need of developing high yielding rice varieties for varied climatic condition. Restorer would contribute in such task by maintaining the fertility in hybrids. Restorer lines of rice are utilized in hybrid breeding programme to meet the demand of growing population by enhancing the productivity through assessment of variability. With the aim of determining the genetic parameters of variability, the present investigation was carried out among 90 genotypes of rice plotted in randomized block design under rice improvement project at seed breeding farm, JNKVV, Jabalpur during Kharif season 2018. The 21 quantitative and 8 quality traits were observed and revealed significant difference among them through analysis of variance. Superior genotype ANP 526 based on mean yield, CBSN 168 based on quality parameters and PRR 828 based on fertile and total spikelet per panicle. The narrow magnitude of difference between GCV and PCV indicated efficient selection as less influenced by environment. The high estimate of GCV and PCV showed scope of improvement through direct selection and high heritability with high genetic advance expressed simple inherited trait along with preponderance of additive gene action. Thus, total spikelet per panicle, fertile spikelet per panicle, and spikelet density percentage were found to be high in almost all genetic parameters of variability such as mean, range, genetic advance, GCV and PCV, which could be considered in future rice breeding programme for obtaining better restorer. While, lowest GCV and PCV was exhibited for traits hulling percentage, milling percentage and head rice recovery percentage indicates need of creation of variability. None of the traits exhibited low heritability. High heritability coupled with high genetic advance was high for trait total spikelet per panicle, fertile spikelet per



panicle and spikelet fertility percentage indicates that these characters are largely controlled by additive gene action, and improvement is possible through mass selection and progeny selection.

STUDIES ON PRINCIPAL COMPONENT ANALYSIS OF JNPT LINES OF RICE FOR THE IMPORTANT TRAITS RESPONSIBLE FOR YIELD AND QUALITY

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Abstract

Rice (*Oryza sativa* L.) is one of the most important crops, feeding more than half the world's population. Asia, Sub-Saharan Africa, and South America are the largest consuming regions. Globally, India stands first in rice cultivation area and second in rice production, after China. It contributes 26.9 per cent of worldwide rice production. Within the nation, rice occupies one quarter of the total cropped area, contributes around 40 to 43 per cent of total food grain production and continues to play an important role in the national food and livelihood security framework. Ninety per cent of all rice are being grown and consumed in Asia. World production of paddy has risen steadily from about 220 million tonnes in 1960 to over 759.6 million tonnes in 2017 and rice production is 503.9 million tonnes in 2017. At that level, global production would exceed the 2016 record by a modest 0.6 per cent, or 4.5 million tonnes. In present study, sixty-seven JNPT (Jawahar New Plant Type) lines were evaluated for twenty-eight morphological and quality traits planted in RCBD with three replications. The experiment was conducted during *kharif* seasons of 2018 at Seed Breeding Farm, Department of Plant Breeding and Genetics, JNKVV, Jabalpur (M.P.), India. PCA revealed that out of twenty-eight, only eight principal components (PCs) exhibited more than 1.0 eigen value and showed about 81.84% total variability. The PC1 showed 20.82% while, PC2, PC3, PC4, PC5, PC6, PC7 and PC8 exhibited 13.31%, 11.99%, 10.88%, 9.50%, 6.72%, 4.56% and 4.04% variability, respectively. It was observed that for selecting the high yielding lines in the rice the characters viz., spikelet density, spikelet fertility, number of tillers plant⁻¹ and panicle weight plant⁻¹ might be considered. On the basis of high PC score in PCA ten most prominent lines namely JNPT-1059-9, JNPT-1059-10, JNPT-1062-1, JNPT-1062-2, JNPT-1064-9, JNPT-1065-1, JNPT-1065-2, JNPT-1065-3, JNPT-1066-52 and JNPT-1068-65 were identified for yield and quality traits.

GENE SILENCING TECHNOLOGY : POTENTIAL AND APPLICATIONS

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Abstract

Gene silencing is defined as an epigenetic change of gene expression leading to inactivation of genes, these changes do not alter the DNA sequence. Gene silencing can also be defined as means of down regulating or turning off a particular genes without change in its DNA sequence. Gene silencing is a technique used to reduce or eliminate the production of a protein from its corresponding gene. It can be described as switching-off or switching-on of a gene without any change in its sequence. In 1990 Jorgensen aimed to increase the pigmentation in petunia introduced transgene homologs to endogenous genes often resulted in plants with both genes suppressed called co-suppression. Later in 1995, Guo and Kempthues worked on antisense RNA in the germ cells of *C. elegans* which were equally effective in gene silencing at homologous target genes. In 1998 Mello and Fire extended the experiment of Guo and Kempthues and found that combination of sense and antisense RNA was ten times more than the single stranded RNA. This discovery of mechanism of RNA interference by ds RNA by Andrew Fire and Craig Mello gave them the noble price in 2006. Gene silencing is the regulation of gene expression in a cell to prevent the expression of a certain gene. Gene silencing can occur during either transcription or translation and is often used in research. In particular, methods used to silence genes are being increasingly used to produce therapeutics to combat cancer and diseases, such as infectious diseases and neurodegenerative disorders. Currently, there are several routes of Gene Silencing identified in plants, and all these pathways play an important role at the cellular level, affecting differentiation, gene regulation and protection against viruses and transposons. GS techniques represent great opportunities for plant breeding. Several practical applications in economically important crops are possible as well as research on gene function and expression.



EFFECT OF WEED MANAGEMENT ON YIELD AND YIELD CONTRIBUTING TRAITS ONION (*ALLIUM CEPA* L.) CV. N-53

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Abstract

An experiment was conducted to assess the effect of herbicide application on yield and yield contributing traits of onion at Hitech Unit, RCA, MPUAT, Udaipur (Rajasthan). There were seven different herbicidal treatments including hand weeding and absolute control. The experiment was laid out in randomized block design with three replications. The results showed that maximum bulb weight (146.58 g) was recorded by Quizalofop- p-ethyl 5 % EC 4000 ml followed by weed free treatment. Bulb yield per ha was significantly higher with treatment Quizalofop- p-ethyl 5 % EC 4000 ml (271.79 q/ha) followed by weed free treatment (225.45 q/ha), Quizalofop- p-ethyl 5 % EC 2000 ml (225.35 q/ha) and standard check (217.77 q/ha). It is concluded that application of Quizalofop- p-ethyl (Quizalofop- p-ethyl 5 % EC) 5 % EC @ 4000 ml per ha gives higher yield per unit area.

INTEGRATED FARMING SYSTEM : AN MOVE TOWARD TO IMPROVE FAMILY FARMING

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Abstract

All over the world, farmers work hard to earn a living. However, not all farmers make money, especially small family farmers. There is very little leftover after they pay for all their inputs (seeds, livestock breeds, fertilizers, pesticides, energy, feed, labor, etc.). The emergence of integrated farming systems (IFS) has enabled farmers to develop a framework for an alternative development model to improve the feasibility of small sized farming operations. In the last few decades, “modern” technologies have been widely used to enhance the productivity per acre of land to ensure that there is enough food for the increased global population. Due to the indiscriminate and erratic use of chemical pesticides and fertilizers, our food and ecosystems have been poisoned. In the last few decades, “modern” technologies have been widely used to enhance the productivity per acre of land to ensure that there is enough food for the increased global population. Due to the indiscriminate and erratic use of chemical pesticides and fertilizers, our food and ecosystems have been poisoned. The integrated farming system is a commonly used term to explain a more integrated approach to farming compared to monoculture approaches. It refers to agricultural systems that integrate livestock and crop production or integrate fish and livestock and may sometimes be known as integrated bio-systems. In this system, an inter-related set of enterprises is used so that the “waste” from one component becomes an input for another part of the system. This reduces costs and improves production and/or income. Since it utilizes waste as a resource, farmers not only eliminate waste but they also ensure an overall increase in productivity for the whole farming system. Integrated farming tries to imitate nature’s principle, where not only crops but also varied types of plants, animals, birds, fish, and other aquatic flora and fauna are utilized for production.

By choosing the suitable cropping methodology with mixed cropping, crop rotation, crop combination and inter-cropping, so that there is less competition for water, nutrition and space and by adopting eco-friendly practices. By utilizing a multi-story arrangement so that the total available area is used effectively and there is a high level of interaction between biotic and abiotic components.

By integrating subsystems by which the various components interact positively, so that the overall farm productivity is increased. The integrated farming system is also a sustainable system which focuses on increasing farm productivity by increasing diversification, resource integration and creating market linkages. Thousands of small and marginal family farmers in resource-poor regions in Asia and Africa have converted their farming to this sustainable farming system to diversify farm production, increase cash income, and improve the quality and quantity of food produced and the exploitation of unutilized resources. It usually takes three to four years to establish a well-integrated farm with market linkages to ensure nutrition and the livelihood of a family.



The integrated farming system approach introduces a change in farming techniques for maximum production in the cropping patterns and ensures the optimal utilization of resources. The farm waste is recycled for productive purposes in the integrated system. A judicious mix of agricultural enterprises like dairy, poultry, piggery, fishery, sericulture etc. suited to the given agro-climatic conditions and socio-economic status of the farmers can bring prosperity to the farming operations. Many farmers and even entire countries throughout the world are adopting the integrated farming system which use practices that consider the present and future climatic conditions, soil characteristics, the food habits of the population and estimates the future food requirements of the ever increasing human and animal population. The new integrated practices include improved farming technologies like integrated nutrient management, site-specific nutrient management, conservation technology, use of bio-fertilizers, crop rotation, zero tillage, and the use of farm management systems like Agriculture which helps farmers track their activities on fields, as well as the whole farm productivity and profitability. Agriculture we also supports farmers with integrated farming by providing them with a knowledge base of the best practice processes in the form of required tasks that allow them to plan the season in advance. Through the conversion to an integrated farming system and the adoption of modern farming practices, the problems of food security and global warming mitigation should definitely be solved.

EFFECT OF FERMENTED MILK FOODS ON NON-SPECIFIC IMMUNOMODULATION : AN OVERVIEW

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Abstract

Fermented milk products containing live starter culture bacteria are reported to possess a beneficial health effect on human including enhanced immune performance, reducing the lactose intolerance, increased resistance to diseases causing microbes, alleviation of food allergies and inhibition of cancer growth. An optimally working system is important for defense against infectious diseases and cancers. Deficit in any component of the system can expose human being to a greater risk of infection or may increase the severity of disease. There is sufficient reports to suggest that lactic cultures apply their immunomodulatory effects by augmenting both non-specific (e.g. phagocyte function, NK-cell activity) and specific (e.g. antibody production, increase in production of cytokine, lymphocyte proliferation, delayed-type hypersensitivity) host immune responses but still uncertainty exist on specific mechanisms. The action of LAB is species and strain specific and depends on dose also. It is noteworthy that most of the reports supporting these immunomodulatory effects are derived from in vitro and/or animal trials and there is a dearth of carefully designed and suitably controlled clinical trials indicative of immunity development in humans. This review discusses the effect of Fermented products and LAB on non-specific immune reaction and highlights gaps in our knowledge that require further research.

THE PUSH-PULL STRATEGY- AN INNOVATIVE APPROACH FOR INSECT-PEST MANAGEMENT

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Abstract

The Push-pull technology is a strategy for controlling agricultural pests by using repellent “push” plants and trap “pull” plants. Push-pull technology involves the use of behavior-modifying stimuli to manipulate the distribution and abundance of pest and/or beneficial insects for pest management. This technique deals with intercropping the main crop with a repellent intercrop (push), with an attractive trap plant (pull) planted as a border crop around this intercrop. The insect pest is thus repelled from the main crop and is simultaneously attracted to the trap crop. Plants such as *Desmodium* and molasses grass (*Melinis minutiflora*) act as good repellents whereas good trap crops include well-known grasses such as Napier grass (*Pennisetum purpureum*) and Sudan grass (*Sorghum vulgare sudanense*). In Kenya, Tanzania, and Uganda alone, push-pull technology has been adopted by 68,800 smallholder farmers. In eastern and southern Africa various stem borers cause 10-50% yield loss which is significantly controlled by using push-pull technology. Various studies show that this technology can be employed to control *Helicoverpa* in cotton, *Sitona lineatus*, the pea leaf weevil in beans, the Colorado potato beetle in



potatoes, the pollen beetle in oilseed rape, onion maggot on onions, thrips on chrysanthemums, bark beetles on conifers etc. The fall armyworm, which has recently invaded India and has been causing serious damage, can also be controlled by this strategy using *Desmodium uncinatum* or *D. intortum* as repellents and *Pennisetum purpureum* Schum or *Brachiaria* as attractants. The principles of the push-pull strategy are to maximize control efficacy, efficiency, sustainability, and outputs, while minimizing negative environmental effects. The push-pull technology has the potential to improve the livelihoods of small-holder farmers and rural families, increase agricultural productivity and improve environmental sustainability. It opens up significant opportunities for income generation by small-holder farmers and, represents a platform technology around which new income generation and human nutritional components, such as livestock keeping, can be added. Hence, this technology can serve as a useful tool for integrated pest management and sustainable agriculture.

CHARACTER ASSOCIATION 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 2018-19 were 48.537 lakh hectares, 69.696 lakh tones and 1436.00 kg/ha, respectively. While in Rajasthan, the area, production and productivity of groundnut during 2018-19 were 6.689 lakh hectares, 16.381 lakh tones and 2449 kg/ha, 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 at Instructional Farm, CTAE (MPUAT), Udaipur, ARSS, Pratapgarh, ARS, Banswara, KVK, Chittorgarh and ATC, Chittorgarh during *Kharif* 2018 and 2019. Among the tested entries viz., PBS 12196 (3224 kg/ha), followed by TG 37 A (2634 kg/ha) were found highest mean dry pod yielder and recorded significantly superior mean dry pod yield over the checks viz. TG 37 A (2634 kg/ha), SG 99 (2501 kg/ha), JL 501 (2444 kg/ha), GG 7 (2359 kg/ha) and GJG 9 (2362 kg/ha). Kernel yield were ranged from 1838-3360 kg/ha. The shelling out-turns of different entries ranged from 68-70%. Sound mature kernels were ranged from 89-92 percent. 100-kernel weight ranged between 42-46g. The days to maturity ranged from 102-105 days.

RESPONSE OF SULPHUR APPLICATION ON QUALITY ASPECTS, YIELD AND YIELD CONTRIBUTING PARAMETERS OF SOYBEAN [*GLYCINE MAX* (L.) MERRILL.]

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Abstract

A field experiment entitled “Response of soil application of various doses of sulphur on morpho-physiological parameters, quality aspects, yield and yield contributing parameters of soybean” was undertaken at Regional Research Centre, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Amravati during *kharif* season 2013-2014 in the Randomized block design with four replications having six treatments including viz., 0, 30, 40, 50, 60 and 70 kg sulphur/ha. The recommended dose of 30 kg N, 75 kg P₂O₅ per hectare was given, sulphur was given through the Bensulf 90% (Mahadhan). The present investigation was carried out in the *kharif* 2013-2014 to determine the morpho-physiological and bio-chemical, quality and yield of soybean. Highest growth contributing parameters like plant height, number of leaves, number of branches and dry matter per plant and quality parameter like nitrogen, protein and oil content was recorded highest with the treatment 40kg/ha Sulphur application. Similarly highest number of pods, no. of root nodules/plant, Seed yield/plant and seed yield kg per hectare along with net monetary returns and benefit cost ratio was recorded with 40 kg/ hectare sulphur application. However, it will be helpful to carry out similar studies over years for drawing a strong conclusion.



STUDY OF SOIL P-FRACTIONS IN DIFFERENT GROUNDNUT GROWN SOILS UNDER VARYING P-DOSAGES, INCUBATION TIMES AND TEMPERATURES

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Abstract

Phosphorus (P) is the essential nutrient element for groundnut overall growth, nitrogen fixation and yield. Bio-availability of P in soil is governed by various factors like concentration of organic matter, Iron, Aluminium, Calcium, Zinc, type of clay, moisture percent, humic acid content, rate of fertilizer application, native P availability, soil temperature, nature of crop root system and other competitive nutrient limiting factors. Fertilizer P added to soils undergo a series of fixation reactions like adsorption and precipitation on clay surface, lime, iron and aluminium oxides, thus the water-soluble labile fertilizer P transform into moderately labile (P on clay surfaces, adsorbed onto Fe and Al oxides and di-calcium phosphates) and non-labile forms (Octa-calcium phosphate and Hydroxyapatite) (Javid and Rowell, 2003). In order to understand the fate of applied P, we studied the rate of P-fixation and transformation into different P-fractions under different fertilizer doses, incubation temperatures and times in calcareous soils of Junagadh and Sandy soils of Bikaner. Soils were collected after groundnut harvest of kharif 2016 and method developed by Hedley (1982) was used for soil P-fractionation *in-vitro*. Initial pH and EC of the soils are 8.2, 0.15 dS/m and 8.3, 0.18 dS/m for Junagadh and Bikaner soils respectively. Initial Olsen P was found to be high in Sandy soils (20.2 kg/ha) than in *vertisols* (15.26 kg/ha). Initial total P was found to be more in *vertisols* (420 ppm) followed by sandy soils (285 ppm). CaCO₃ (%) was 19.60% in Typic Haplustepts (Black soils) and 2.20% in Typic Haplocambids (Sandy soil). The experiment consisted of control (no P applied), 10 kg P/ha, 20 kg P/ha, 40 kg P/ha, 80 kg P/ha with four incubation periods like 5 DAI, 15 DAI, 30 DAI, 45 DAI. KH₂PO₄ served as P-source. Recoverable P ranged from 0.8 to 5.5 kg/ha, fixed P 9.2 to 74.5 kg/ha, P fixation capacity (%) ranged from 92% to 93.12% in *vertisols* at 5DAI. P fixation capacity (%) increased linearly from 5 DAI to 45 DAI. In Sandy soils, P fixation capacity (%) ranged from 75% to 89% at 5 DAI. The maximum fixation is observed at 30 DAI. Surprisingly, P fixation decreased at 45DAI. In *vertisols*, among the various forms of P analyzed, Ca-P was found to be abundant (165 kg/ha) followed by Fe-P (35 kg/ha), Al-P (10 kg/ha) and Saloid-P (26.4 kg/ha), where as in sandy soils Ca-P was found to be dominant (102 kg/ha) followed by Fe-P (48.2 kg/ha), Saloid-P (26.4 kg/ha) and Al-P (2.2 kg/ha). So, the order of P-fixation in *vertisols* is Ca-P>Fe-P>Al-P>Saloid-P and in sandy soils it is Ca-P>Fe-P>Saloid-P>Al-P. In black soils P-fixation (%) ranged from 82.5% to 96.3% and in sandy soils the range is from 71% to 92% at 5 DAI. Al-P and Fe-P was markedly higher in *vertisols* at 45°C than at 15°C, which is *vice-versa* with respect to Ca-P. Similar trend was observed in sandy soils, but with lower values than black soils. In essence, P-fixation increased with increase in incubation temperatures, irrespective of incubation time and dosage. Soils with more clay and CaCO₃ has more P-fixation which reduced the equilibrium-P in soil solution.

EVALUATION OF AYURVEDIC DRUGS FOR ANTIBACTERIAL ACTIVITY AGAINST *XANTHOMONAS AXONOPODIS PV PUNICAE*

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ABSTRACT

The bacterial blight of pomegranate caused by *Xanthomonas axonopodis* pv *punicae* is serious disease leads to heavy toll in terms of yield and quality. Evaluation of different ayurvedic drugs against *Xanthomonas axonopodis* pv. *punicae* was done to find out environmental friendly way to manage the disease. Ayurvedic drugs viz, Mahamanjisthadi kwath, Vidangasav, Bhumimbadi Khada, Amla Juice, Chandansav, Somasav, were found effective against bacterium at 10 and 15 per cent concentration under *in vitro* conditions. Among these, Mahamanjisthadi kwath exhibited maximum zone of inhibition and per cent inhibition over untreated control. Testing of selected ayurvedic drugs at field conditions revealed that only Mahamanjisthadi kwath reduced development the bacterial blight disease intensity up to 21 days.



EFFECT OF BIOCHAR AND INM PRACTICES ON PRODUCTIVITY AND PROFITABILITY OF MAIZE (*ZEAMAYS* L.) IN NORTH EAST INDIA

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Abstract

A field experiment was conducted during *pre-kharif* season of 2018-19 at Research Farm of ICAR RC for NEH Region, Umiam, Meghalaya to study the effect of biochar and integrated nutrient management (INM) practices on performance of maize. The experiment was comprising of twelve treatment combinations and laid out in a Factorial Randomized Block Design (FRBD) with three replications. The results revealed that among the biochar levels, significantly highest value of kernel yield was found under biochar @ 15 t ha⁻¹ as compared to remaining treatments whereas, higher stover yield was registered under biochar @ 15 t ha⁻¹ which was statistically at par with biochar @ 10 t ha⁻¹ and significantly higher than other treatments. Among the INM practices, highest kernel yield was recorded under 75% RDN+25% FYM but it remained statistically at par with 100% RDN and 50% RDN+50% FYM and significantly higher than other treatments. Whenever, application of 75% RDN+25% FYM was recorded highest stover yield as compared to other treatments, respectively. Among the different biochar levels, significant higher value of gross return was noticed under biochar @ 15 t/ha as compared to all remaining treatments while, maximum net return was recorded with the application of biochar @ 5 t/ha which was statistically at par with biochar @ 10 t/ha and significantly higher than other treatments. The significantly higher B:C ratio was noticed under control plot as compared to all remaining treatments, respectively. In case of INM practices, significantly maximum gross returns was recorded under 75% RDN+25% FYM compared to 100% RDN and 50% RDN+50% FYM. However, maximum net return was recorded under 75% RDN+25% FYM which was performed statistically superior over rest of the treatments but given statistically similar results with 100% RDN and 50% RDN+50%. The maximum B: C ratio was registered under 100% RDN but it was remained statistically at par with 75% RDN+25% FYM and significantly higher than other treatments. Combination of biochar @15 t/ha along with the application of 75% RDN+25% FYM is a suitable practices for profitable production of maize in the NE of India and other similar ecoregions.

CONSERVATION AGRICULTURE AND PHOSPHORUS MANAGEMENT IN CORN : IMPACT ON PRODUCTIVITY, QUALITY, ECONOMIC RETURNS AND ENERGY DYNAMICS

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Abstract

Globally increasing food and industrial demand of corn (*Zea mays* L.) has exerted heavy pressure on natural resources over the years which lead to create several challenges for sustainable crop production without deteriorating the soil health. Conservation agriculture (CA) and integrated phosphorus management is an innovative resource conserving approach to



make agriculture more sustainable by protecting the soils and environment. Hence, address to these challenges an experiment was conducted at Research Farm of ICAR-Indian Agricultural Research Institute, New Delhi for two consecutive years from 2016-17 and 2017-18 to assess the effect of tillage and P management on corn productivity, quality, economic outcome and energy dynamics. Three tillage practices viz., CT-R (Conventional tillage with no residue), ZT-R (Zero tillage with no residue), ZT+R (Zero tillage with residue @ 2.5 t/ha for both corn and wheat) were assigned in main plots and five phosphorus management practices viz., P₁ (Control-NK as per recommendation, but no P), P₂ (17.2 kg P/ha), P₃ (17.2 kg P/ha + PSB), P₄ (17.2 kg P/ha + Compost inoculants) and P₅ (34.4 kg P/ha) were allocated in subplots. All the treatment replicated thrice in split plot design. The results revealed that the maximum corn yield, amino acid and protein content and yield, net returns, gross returns of energy was recorded under ZT+R while, higher B: C ratio and energy efficiency was noticed under ZT-R. Among the P management practices, application of 34.4 kg P/ha recorded maximum corn productivity, amino acid and protein content and yield, B: C ratio, and energy efficiency during both the years of experimentation. Combination of ZT+R along with the application of 34.4 kg P/ha is a suitable and energy saving practices for profitable production of quality corn in the Western Ghat Plains Zone of India and other similar ecoregions.

SITE SPECIFIC N MANAGEMENT IN RICE-WHEAT CROPPING SYSTEM FOR SUSTAINABLE HIGHER PRODUCTIVITY AND PROFITABILITY IN IGP REGION OF INDIA

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Abstract

The rice-wheat cropping system (RWCS) is a major production system in the Indo-Gangetic Plains of India covering nearly 10.5 mha including 4.11 mha of the north western (NW) states comprising Punjab, Haryana, Uttarakhand and western Uttar Pradesh. In India, RW systems account for >80% of the total cereal production and about 50% of the total calorie intake. More than 90% area of the RW area is irrigated and is facing yield stagnation, soil degradation, declining ground water table and air pollution (Singh et al., 2011). Among the crop production factors, poor nutrient management is the major limiting factor for crop production. The human population continues to grow steadily with the shrinking resources being used for agricultural production situates great challenge against Indian agricultural system to attain food and environmental security. To counter these twin challenges in the country there is urgent need of application of modern Hi-tech technologies for enhancing the productivity and sustainability of the rice-wheat system for long term on scientific basis. SSNM looks a win technology towards improving the capability of agricultural land to produce crops on sustainable basis. The SSNM is the component of precision farming which determine spatial and temporal variability in the crop production which in turn aimed for increasing crop productivity and reducing environmental menaces. It is innovative technology which comprises the application of several Hi-tech tools like Geographical Information System (GIS), Global Positioning System (GPS), Remote Sensing (RS), Variable Rate Technology (VRT) and Decision Support System (DSS). Precision land levelling, precision planting, precision nutrient management by using Green Seeker, leaf colour chart (LCC), site specific nutrient management (SSNM) has a lot of potential for enhancing crop yield and input use efficiency under field conditions while reducing the cost of production and deleterious impacts on environmental. Among different precision nutrient management practices STCR produced significantly higher grain yield by 13.8 and 33.8% over SPAD and control, respectively, but it remained at par with Green seeker and 100% RDF. N, P, K content and uptake in grain, straw and total as well as protein content were significantly higher with SSNM. However, Amongst N precision management practices, STCR resulted significantly higher N, P and K harvest index and agronomic efficiency, apparent recovery and physiological efficiency except nitrogen physiological efficiency in green seeker. In India, there are wide possibilities to practice a part of PF technologies in rice-wheat system accomplished through the use of simple and inexpensive gadgets like LCCs and expensive gadgets like chlorophyll meter and optical sensors.



ANTIBIOTIC SUSCEPTIBILITY PATTERNS IN BACTERIA ISOLATED FROM DIFFERENT NATURAL THERMAL ZONES OF SIKKIM HIMALAYA

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Abstract

Prokaryotic life has dominated most of the evolutionary history of our planet, evolving to occupy virtually all available environmental niches. Sikkim Himalayas are unique as in a short distance three different kind of natural thermal conditions exists i.e., psychrophilic, mesophilic and thermophilic due to the presence of hot spring in snow covered mountain in Sikkim Himalayas. The microorganisms surviving in the psychrophilic condition are called as psychrophiles (the microorganisms which optimally grows below 20°C) whereas the thermophiles are which grow at temperature above 40°C. Microbes which can grow at very high temperature (above 100°C) or nearly at freezing point of water challenges our understanding of the physical and chemical constraints on life. Understanding how living communities survive and are structured under various environmental conditions is not only important but is also very fascinating. These extreme or exhilarating environments and the microorganisms living in them has open the doors for search of life exterior to earth and also the leeway to transfer life from one planet to another. The culturable bacterial diversity was performed of three natural thermal conditions and presence or absence of three different kind of bacteria, i.e., thermophilic, mesophilic and psychrophilic bacteria along with bacterial diversity we had performed antibiotic resistance Testing (AST) of the isolates. The culture dependent bacterial diversity showed the dominance of phyla Firmicutes and genus *Geobacillus*. Most of the collected isolates from psychrophilic and thermophilic zones showed susceptible to at least 10 different antibiotics which were further supported by the absence of antibiotic resistance.

DEVELOPMENT OF USLE / MUSLE MODELS FOR SOIL EROSION STUDIES IN VIDISHA DISTRICT OF M.P.

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Abstract

Land degradation such as soil erosion has been continuing in many regions of India due to ongoing deforestation and slow paced adoption of conservation agriculture (CA), faulty cultivation practices and intensive agricultural activities with aims to expand farm land in view of obtain more production. A study has been conducted in the Central Vindhyan plateau of Madhya Pradesh in the Betwa river basin at Vidisha district which are at moderate to high risk of land degradation. Approximately 93.68 M ha is severely eroded out of total nearly 147.75 M ha area subjected to various types and degree of erosion an estimated area of approximately 2.06 M ha is in the form of ravines in the country. These land forms are almost totally devoid of fertility and can hardly sustain any vegetation. Out of estimated 20.06 lakh hectare area under ravine in the country about 6.83 lakh hectare is occupied in the Madhya Pradesh. Out of that nearly 1.88 lakh hectare ravine area is estimated to belongs to Betwa river basin. Bhopal division of the state indicating that the Betwa basin suffers most severely from the problem of land degradation due to ravine formation. The phenomenon of gully erosion expended in the lateral direction all along river courses. Gullies and ravine flank for about two km along the bank. The Vidisha and adjoining districts suffers badly due to its erosion prone soil characteristics viz. (Sandy clay loam with increase in sand with depth, poor organic carbon content, low binding capacity, high infiltration rate, poor aggregation and high dispersion ratio). And further ravine broaden & got deepen due to subsurface flow also. To make effective use of the region's soil & water resources at a watershed scale, soil & water conservation techniques have been proposed and evaluated, maximized the use of resources by classifying arable lands into vegetation zones, *insitu* runoff water harvesting techniques, conservation agricultural areas depending on specific land and topographic features of the watershed. Evaluation of effects of introducing the above mentioned techniques using the soil & water assessment tools (SWAT) and predictive USLE / MUSLE models have been examined with using recent advanced RS & GIS powerful tools for facilitating proper erosion estimation of soil loss for ravines on watershed basis in view of sustain crop productivity, profitability of agricultural household using predictive models based on a survey of farmer's existing conditions.



STEPS FOR REJUVENATION AND CONSERVATION OF WETLANDS IN BIHAR

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Abstract

A wetland is a distinct ecosystem that is flooded by water, either permanently or seasonally, where oxygen-free processes prevail. The convention, signed in 1971 in the Iranian city of Ramsar, is one of the oldest inter-governmental accord for conserving the ecological characters of wetlands. Several varieties of fish are found in wetlands with varying harvesting period. During post-monsoon (October-November) small fishes e.g. *Puntius* spp. (Pothia), *Channa* spp. and from December and onwards big fishes e.g. Indian Major Carps, catfishes and large exotic carps are found in wetlands of Bihar. In wetlands, no supplementary feed is provided by the fishers. Wetlands are vital and serve an array of functions like flood mitigation, erosion control, ground water recharge, micro climate regulation etc. Good health of wetland is important for our overall economy, agriculture and well being. The contribution that wetland make to human well being have often been unnoticed or underappreciated. Therefore, policy interventions are required in order to rejuvenate, restore and conserve the ecosystem of wetlands in Bihar. The already existing farmed laws to protect the wetland ecosystem need to be strictly enforced e.g. Bihar Water Bodies Management Act 2006 (amended in 2007) for fishing in open water bodies is prohibited for the period between June 15 to August 15 every year for the protection of juveniles, mesh size regulation, prohibition of use of explosive material or poison for fishing, control of flow of excessive agro-chemicals and fertilizer from peripheral agriculture field need to be enforced.

RUMINANTS VICTIM OF LEADPOISONING

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Abstract

Lead poisoning, also known as lead toxicity can be chronic or acute characterized by absorption of lead into the body. Frequent causes include flaking high lead paint, ash from fires in which lead materials burnt, used oil and battery disposal from machinery handled improperly. It lodges in the reticulum of cattle and other ruminants, where acids gradually change into poisonous salts. Lead also combines with red blood cells and bone marrow causes anaemia, damages small blood vessels causing bleeding, and deprives the nerves, brain, and other organs of oxygen. It also severely harms the kidney and liver and causes sterility, fetal death and abortion. Symptoms exhibited are depression, loss of appetite, apparent blindness, frothing at the mouth, muscle tremors, staggers, excitable and convulsions. Injections of thiamine hydrochloride (vitamin B1) can reduce the effects on the central nervous system. Drenching with small amounts of magnesium sulphate (Epsom salts) may also help to reduce the absorption of lead from particles held in the reticulum of cattle, sheep, and other ruminants. Several measures should be taken to protect cattle, and the human food chain from lead contamination and toxicity which includes checking fields and barns for vehicle batteries, building materials, flaking lead paint, putty, lead flashing; remove or fence off fly-tipped material; prevent access to burnt-out cars and old machinery that may contain lead; avoid access to bonfire ash; keep animal's soil consumption as least as possible; avoid waterlogged land and poached land for grazing; keep away from overgrazing and maintain adequate sward height; fence off bare areas of soil; calibrate cutters when making silage to minimize soil uptake; flatten any molehills prior to cutting grass for silage; provide salt licks and mineral supplements; use mains water or tested borehole water rather than natural run-off water from high lead soils.

RANIKHET DISEASE : A FATAL AND CONTAGIOUS VIRAL INFECTION TO POULTRY BIRDS

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Abstract

Ranikhet disease, also popularly known as "Avian Pneumo-Encephalitis" and "New castle Disease" is highly contagious and



fatal to poultry birds. It is caused by a group of viruses, which form avian paramyxovirus type 1 (PMV -1) serotype and have single-stranded RNA as genetic material. Newcastle disease virus (NDVs) placed them in five pathotypes which include viscerotropic velogenic, neurotropic velogenic, mesogenic, lentogenic and, asymptomatic. Viscerotrophic velogenic pathotype causes highly virulent form of the disease. Hemorrhagic lesions are characteristically present in the intestinal tract and remarkably observed only in this pathotype. Respiratory signs with depression, watery greenish diarrhoea, and swelling of the tissues of the head and neck are observed, although nervous signs are often observed, especially in vaccinated poultry. Neurotropic velogenic causes high mortality (can be high as 100%) following respiratory and nervous signs. Mesogenic causes low mortality following respiratory and sometimes nervous signs. Lentogenic pathotype causes mild or inapparent respiratory infection while asymptomatic causes inapparent enteric infection. Onset is very rapid but signs appear throughout the flock within 2–12 days (average 5) after aerosol exposure. Spread is slower if the fecal-oral route is the primary means of transmission, especially for caged birds. Young birds are often the most susceptible ones. Observed signs depend on whether the infecting virus and its predilection for respiratory, digestive, or nervous systems. Respiratory signs are gasping, coughing, sneezing, and rales. Nervous signs include tremors, paralyzed wings and legs, twisted necks, circling, clonic spasms, and complete paralysis. Eggs may become unusual in color, shape, or surface and have watery albumen. Well-vaccinated birds don't show any symptoms of infection except a decrease in egg production, but these birds will shed the virus through their saliva and feces. Poorly vaccinated birds can develop torticollis, ataxia, or body and head tremors within 10–14 days after infection and may recover with supportive care. Vaccines are available which can be used to induce an antibody response.

MINIMAL PROCESSING AND PACKAGING OF FRUITS AND VEGETABLES

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Abstract

Shelf-life extension of fresh fruits and vegetables is a major technological need to overcome the post-harvest losses owing to their perishable nature. In recent years, there has been a considerable increase in the demand for high-quality fruits and vegetables, coupled with convenience and safety. High quality usually implies fresh-like quality characteristics of flavour, texture, colour, aroma, and overall appearance, and consumers are indicating a strong preference to these fruits and vegetables over their counterparts. Minimal processing is a growing processing trend that offers the consumer, convenience, “freshness” of quality, nutrition, and safety. Consumers have also become more critical of the use of synthetic additives to preserve food or enhance characteristics such as colour and flavour. Minimally processed foods can be kept safe with partial or minimal preservation treatment. In addition, it results fewer possible alterations to the food quality. As it involves removing or reducing the natural barriers to deterioration, it offers scientists an enormous challenge in trying to extend the shelf life of minimally processed fresh produce. However, the consumer demand for minimally processed products, changes in perception of the consumers for “freshness” of quality of fresh produce, and the convenience of such products warrant further research and developments in this area.

ION SELECTIVITY ACROSS BARIUM MOLYBDATE SYNTHETIC MEMBRANE IN CONTACT WITH BI-UNIVALENT ELECTROLYTES

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Abstract

The Barium molybdate synthetic membrane is prepared by the ion interaction method. Electrical conductivity has been measured for using bi-univalent electrolytes (Chlorides of magnesium, calcium and zinc). The effect of concentration of the electrolyte, kind of ion, and the size of the ion on the permeation rate have been studied. The permeation rate decreases with increasing the concentration of the electrolyte and the size of the ion. Membrane was characterized by using Scanning



Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Thermogravimetric Analysis (TGA)/ Differential Thermal Analysis (DTA), and X-Ray Diffraction (XRD) analysis. The synthetic membrane was tested for its biological activity against gram-negative and gram-positive microorganism.

POTENTIOMETRIC DETERMINATION OF EFFECTIVE FIXED CHARGE DENSITY FOR PARCHMENT SUPPORTED IRON TUNGSTATE MODEL MEMBRANE

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Abstract

Membrane Potential and Bi-ionic Potential across the parchment supported iron tungstate. Membrane bathed in different concentration of 1:1 electrolyte (KNO₃, NaNO₃, NH₄NO₃) have been measured. The methods used for the estimation of effective fixed charge density were: The Teorell-Meyer-Sievers method (TMS) and Kobatake *et al*, The value derived from different theories were almost the same, confirming there by the validity of the recently developed theories of membrane potential for the evaluation of effective fixed charge density of the system under investigation. The prepared membrane has been characterized on the basis of SEM, TEM, TGA, DSC, FTIR, XRD and Elemental Analysis. The membrane was also tested for its antimicrobial activity against different microorganism.

REMOVAL OF TOXIC METALS FROM WASTEWATER BY MEMBRANE TECHNOLOGY

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Abstract

Wastewater containing toxic metals can be produced by many industries. The application of membrane technologies for the treatment of wastewater containing toxic ions to reduce fresh water consumption and environmental degradation was investigated. Membrane technologies like microfiltration, ultrafiltration, nanofiltration and reverse osmosis could be used to treatment of the industrial wastewater. The low level of the toxic metals concentration in the permeate implies that water with good quality could be reclaimed for further reuse. Several applications are well assessed and are expanding very quickly. Membrane fouling, Membrane cleaning, and Membrane modules have been discussed.

ASSESSMENT OF ANTIFUNGAL ACTIVITY OF SOME MEDICINAL PLANTS

Archana Mishra and Archana Tiwari

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Abstract

This study reports for the first time the antifungal activities of acetone, hexane, dichloromethane and methanol leaf extracts of four plant species (*Acacia pennata*, *Ana phalis w ightiana*, *Cap parispepiaria* and *Catunare gum spinosea*) from Belgaum district of Karnataka state, India. The antifungal activities were determined against pathogens (*Candida albicans*, *Kluyeromyces polysporous*, *Aspergillus niger*, *Aspergillus fumigatus*) representing yeasts, moulds and non-thermal dimorphic fungi. MIC values were determined by checking the growth after 24 and 48 h to determine the antifungal activity against the tested pathogens. Highest antifungal activity was observed with methanolic extracts of *A napña/is w ightiana* against all the tested pathogens with the MIC values ranging from 0.02 to 0.06. Methanolic extracts of *Acacia pennata*, *Ana phalis w ightiana*, *Ca pparispepiaria* have very strong antifungal activity against tested pathogens particularly *C. albicans* and *K.*



polysporus. The overall results provide promising baseline information for the potential use of the crude extract of leaf in the treatment of fungal infections. An attempt has been made to highlight the promising plant species for further investigation as leads for new drug development.

DETERMINATION OF PHYSIOLOGICAL MATURITY AND SEED QUALITY IN SEWAN GRASS (*LASIURUS SINDICUS* L.)

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Abstract

Sewan grass has the greatest resistance to hydric deficit among grasses cultivated in dry regions due to its efficiency in using rain water, as a result of morphological adaptations that allow for fast growth in the beginning of the rainy season, after suffering a harsh and prolonged hydric deficit. Availability of quality seed is major problem in sewan grass production because of several physiological factor viz. unevenness in inflorescence emergence, high natural shelling, and seed dormancy, that hinders the uniform establishment of populations and favors the appearance of invasive plants in the pasture. Thus, studies related to the maturation process of this seed species are of paramount importance to establish the point at which seeds reach maximum physiological quality and to determine their ideal harvesting time. The objective of this research was to study the maturation process of sewan grass seeds in order to determine their best harvesting time. The seeds were collected from unopen inflorescences in five days of interval totaling six harvest, to observe maximum germination percent and other seed quality parameters. The maximum germination percentage was observed in seed lots harvested from 20 days after inflorescences (70%) opening. The seed lot harvested from the day of opening of inflorescence and after 25 days of opening of inflorescence was least, indicating narrow window of seed maturation process in sewan grass seed. Dry matter accumulation and speed of emergence from the seed lot harvest after 20 days of inflorescences opening. The harvesting of sewan grass seed should be done between 20 to 25 days of inflorescence opening for quality seed.

HYBRID EMBRYO RESCUE : A NON CONVENTIONAL BREEDING APPROACH IN PULSES

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Abstract

Pulses are the nutritionally dense edible seed of legumes. They also have the ability of fixing nitrogen into the soil with increase in demand in pulse crop consumption. Production should also be increased and need to develop different varieties. Conventional breeding method are time consuming with many incompatible reason. Thus inter-specific crosses allow for the interrogation of important alleles of agriculture interest from wild species. Embryo rescue is one of the earliest and most successful method of in vitro culture. The main factor for inherently weak embryo are genotype, time of hybridization and age of embryo rescue is very important for growing successfully in culture and obtaining biotic and abiotic resist hybrid in pulses. This technique is the boon of tissue culture for develop new varieties. The gene-pool can be increased by raising inter specific hybrid. This will play an important role in economy in our country.

PLANT-PARASITIC NEMATODE PROBLEMS IN VEGETABLES

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Abstract

Plant-Parasitic Nematode often called as threadworms, eelworms or roundworms are microscopic invertebrate animals. They are distributed all over the world in different kinds of habitats and found in nearly every biological niche that supports life. They cause severe losses to economically important crops like vegetables, cereals, pulses, oilseeds, fruit crops, etc. Sasser and



Freckman (1987) have indicated an annual crop loss due to nematodes on world wide basis to the tune of \$100 billion. The destructive plant- parasitic nematodes are one of the major limiting factor in vegetable production throughout India. Low production and productivity of vegetables are mainly because of biotic and abiotic stresses, among the biotic stresses nematodes also one of them. Vegetables are the important component of human diet which contributes as a source of proteins, vitamins and minerals. India is the second largest vegetable producer in the world next to China which accounts for about 15% of the world's production of vegetables. Large number of plant parasitic nematode is recorded from the rhizosphere of many vegetable crops like Root-knot Nematode (*Meloidogyne spp.*), Reniform nematode (*Rotylenchulus reniformis*), cyst nematode (*Heterodera spp.*), lesion (*Pratylenchus penetrans*) etc. They damage the crops not only by feeding on plants but also by interacting with various other organisms. These nematodes predispose the crops to fungal and bacterial pathogens, especially *Fusarium spp.*, *Pythium*, *Rhizoctonia*, *Ralstonia solanacearum*, etc. However, predisposition occurs due to mechanical wounding of the roots, rhizosphere modification and disruption of resistance mechanism caused by the nematodes. Such interactions aggravate the damage caused to the crop. Majority of the farmers remain unaware of nematodes as pests as no conspicuous aboveground symptoms are observed on the plants. Various options of nematode management are available, such as crop rotation, soil solarisation, use of bio-nematicides, botanicals and Integrated nematode management approach can reduce nematode pest densities in the soil and increase crop yield.

EMPOWERMENT OF WOMEN THROUGH INFORMATION COMMUNICATION TECHNOLOGIES

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Abstract

Information is a source of power. In modern India, women play an important role in the decision making. In India 50 per cent of women are illiterate. This illiteracy is a big barrier. Proper education is necessary for the development of country. There are Information Communication Technologies which provides information, education and knowledge among the women. In India women are suffering from different types of problems due to lack of knowledge, information and education. Thus, ICTs can be a good tool for empowerment. Emails, chat and Voice over Internet Protocol (VoIP) are boons to the rural areas. ICTs enable interactive communication unimpeded by distance, volume, medium, or time. ICT makes the role of time and distance less significant in organizing business and production related activities. Women, therefore can work from anywhere and at anytime and raise that extra income to become more financially independent and empowered. Present paper aim is to discuss the role of ICTs in empowering rural women.

EVALUATION OF PRE RELEASED PROMISING SUGARCANE CLONES FOR SALINITY TOLERANCE

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Abstract

Problematic soils are a major limiting production factor for every crop. Soil salinity is one of the most devastating problem which causes major reduction in cultivated land area, crop productivity and quality. Sugarcane (*Sacharun officinarum* L.) is a typical glycophyte and moderately sensitive to soil salinity. Using the salt tolerant clones is one of the most important strategies to solve the problem of salinity. In this view an experiment was carried out to evaluate salinity tolerance of promising sugarcane clones with microplot techniques at Agricultural Research Station, Perumallapalle, ANGRAU, Andhra Pradesh during 2019-20. Thirteen sugarcane clones were studied for salinity tolerance with two treatments viz., control and salt treatment. Soil EC of 6 dS m⁻¹ was developed in salt treatment with external addition of salt water. Results revealed that the mean germination, single cane weight, sucrose and commercial cane sugar (CCS) were significantly differed by clones, treatments as well as with their interaction. Significantly the highest mean germination (74%) and single cane weight (1.760 kg) were recorded in control treatments than salt treatments (57% of germination and 1.330 kg of single cane weight). The clone 2013 T 39 showed less percent (3.12%) reduction in single cane weight in salt treatment. 2013 T 39 and 2013 T 132 showed less percent reduction in sucrose (1.06 and 1.91%, respectively). The genotypes 2013 T 16, 2013 T 132 and 2013 T



106 showed maximum K/Na ratio than other genotypes under salt treatments.. from this data it is concluded that the sugarcane clones 2013 T 16, 2013 T 39, 2013 T 132 and 2013 T 106 were suitable for saline soils in Andhra Pradesh.

INFLUENCE OF CHEMICAL FERTILIZERS AND MANURES ON NUTRIENT UPTAKE, YIELD AND SOIL FERTILITY OF FINGERMILLET

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Abstract

Boosting yield, reducing production cost and improving soil health are three interlinked components of sustainable triangle. Therefore there is need to improve soil fertility and quality of economic product by increasing use of organic manures and biofertilizers. Hence a field experiment was conducted during 2019-20 to study the effect of chemical fertilizers and organic manures on nutrient uptake and yield of finger millet at Agricultural Research Station, Perumallapalle, ANGRAU, Andhra Pradesh during *Kharif*, 2019. The experiment was laid out with two treatments viz., organic and inorganic treatments. FYM @ 4 t ha⁻¹ and vermi compost @ 1 t ha⁻¹ were applied to organic plot. Recommended dose of fertilizers (60-30-20 kg N-P₂O₅-K₂O ha⁻¹) were applied to inorganic plot. Plant samples were collected at tillering, flowering and at harvest for estimation of nutrient content and soil samples were collected at initial and after harvest for estimation of available nutrient status. Results revealed that the grain yield was significantly affected by organic and inorganic treatments. Highest grain yield was recorded with application of inorganic fertilizers (30.99 q ha⁻¹) than organic manures (29.52 q ha⁻¹). The N and K uptake by plant at tillering stage was significantly affected by inorganic fertilizers and organic manures. The highest N and K uptake was observed with inorganic fertilizers application. Available nitrogen and phosphorus were not significantly affected by chemical fertilizers and organic manures except available potassium.

CROP RESIDUE BURNING-IMPACT AND MANAGEMENT

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Abstract

Crop Residue Burning (CRB) has been identified as a major health hazard causes remarkable pollution problems in the atmosphere and deteriorating health of the soil, one of the major sources of air quality deterioration in Delhi in the months of October and November is due to CRB in the neighbouring states of NCR. Presently, around 381 million tonnes of dry matter is being burnt globally, of which around half (49.3%), i.e. around 188 million tonnes is contributed by maize followed by wheat and rice with an almost equal share of around 23%. In India, around 49.14 million tonnes of crop residues is being burnt annually with a larger share from rice (48%), and the share of wheat, maize, and sugarcane is 24%, 21%, and 7%, respectively. India stands first in the world in terms of paddy straw burning, accounting for around 26.89% of the total rice residue burnt. Total 61261 burning events were detected in the three States between 01-Oct-2019 and 29-Nov-2019, which are distributed as 50705, 6360 and 4196 in Punjab, Haryana and UP, respectively. The burning of crop residue leads to significant changes in the physicochemical, biological and biochemical properties of soil. About 90% of N and S and 15-20% of P and K contained in rice residue are lost during burning. Burning of 23 million tonnes of rice residues in NW India leads to a loss of about 9.2 million tonnes of C equivalent (CO₂-equivalent of about 34 million tonnes) per year and a loss of about 1.4×10⁵ t of N (equivalent to Rs 200 crores) annually. In addition, in-field burning of crop residues also destroys the beneficial micro-flora and fauna of soil causing adverse impact on soil health. The burning of crop residues generates numerous environmental problems. The main adverse effects of crop residue burning include the emission of greenhouse gases (GHGs) that contributes to the global warming, increased levels of particulate matter (PM) and smog that cause health hazards. Particulate matter (PM) concentration in October-November is possibly due to the effect of post-monsoon crop residue burning (CRB) the contribution of the biomass burning in winter is quite high at 17% (for PM₁₀) and 26% (for PM_{2.5}) leading to one of the most debated and highlighted issues “Delhi Air Pollution”. Residue retention as mulch and residue incorporation of paddy straw can increase yield, water use efficiency, soil health and profitability, while decreasing weed pressure in rice-wheat cropping



system over rice straw burning. Concurrent use of super straw management system (SMS)-fitted combines and Turbo Happy Seeder in rice-wheat cropping systems is recognized as a significant technological innovation for in-situ residue management and has a great prospect for reducing rice residue/stubble burning. Ex-situ methods like composting, mechanical collection of straw by use of balers, High-Density straw compacting, pyrolysis (biochar), briquetting, pelletisation, Rice-Straw Mushroom Production, Rice bio-parks *etc.*, utilizes crop residue as material for their process and technology. Thus, above strategies is considered to be addressing the issue of crop residue burning as well as maintaining soil health and long-term sustainability of RWCS.

SOIL EROSION IS THE BIG PROBLEM IN INDIA

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Abstract

Soil erosion represents the process of detachment and transportation of soil particles by geomorphic agents. Indian soil quality suffers from soil erosion, fertility loss, water logging, salinity and alkalinity and man-made issues like urbanization and transport development issues. Excessive soil erosion in India combined with consequent high rate of sedimentation in reservoirs and decreased soil fertility has led to grave environmental problems. Soil erosion mostly affects practically all kinds of lands such as the forest lands, agricultural lands, arid and semi-arid lands, surface mines, roads, construction sites, coastal areas etc. India predominantly witnesses water erosion. The rate of soil erosion by moving water is directly proportional to the intensity and duration of the downpour. In coastal areas the intensity of the erosion is decided by the velocity of the waves, volume of water, extension of vegetation cover, nature of rocks, etc. The estimated amount of soil erosion that occurred in India was 147 million hectares. In including various type of erosion such as 94 million hectares were claimed by water erosion, 16 million hectares by acidification, 14 Million hectares by flooding, 6 Million hectares salinity and 9 million hectares from wind erosion. 29 percent of the soil that is eroded is lost in the sea while 61 percent is just relocated. The southern coasts of India, like the coasts of Kerala are most prone to such kind of aggressive form of Soil erosion.

REAL TIME NITROGEN MANAGEMENT TOOLS TO MANAGE NITROGEN NEEDS IN RICE

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Abstract

Rice (*Oryza sativa* L.) is the world's most important staple food crop for more than half of the global population. South East Asia is the centre of origin of cultivated rice and is considered as the prime location for rice cultivation. Total global rice production was 472.96 Million metric tons from the area 159.44 M ha with the productivity of 4.4 M t ha⁻¹. Asia accounts for 60% of the global population, about 92% of the world's rice production and 90% of global rice consumption. In India, rice is grown on 43.44 Million hectares, with annual production of about 112.40 M t and productivity of about 2700 kg ha⁻¹. India is the second largest country for rice production and rice continues to hold the key to sustain food production by contributing 20-25 per cent of agriculture and assures food security for more than half of the total population. In Andhra Pradesh, rice is the major staple food crop, which is predominately irrigated, is grown in both *kharif* and *rabi* seasons in all districts of the state. It accounted for 28.38% of the total cropped area and grown in an area of 21.05 lakh hectares with annual production of 120.03 lakh tonnes at a mean productivity level of 5702 kg ha⁻¹. Nitrogen (N) fertilizer is the key input in most rice soils to accomplish high yield. The current recommendations of split application of N fertilizer with fixed rates at specific growth stages for large rice growing area assume the requirement of rice for fertilizer is constant across large areas and years. The requirement of rice for N fertilizer can, however, vary greatly from location to location, season to season and year to year because of high variability among fields, seasons and years in N supplying capacity of soil. These 'blanket' recommendations have served their purpose in producing higher yields, but they are limited in their capacity to increase nutrient use efficiency.



Many times, to ensure high yields, farmers apply fertilizer N rates even higher than the blanket recommendation. Over application of N in rice crop leads to further lowering of N fertilizer recovery efficiency. The blanket recommendations are also not tuned to temporal variations in crop N demand. One of the important problems among them is lack of suitable nutrient management technology to combat the various losses of nutrients such as runoff, leaching, volatilization, de-nitrification, fixation, removal by weeds etc. and to provide steady supply of nutrients in available form throughout the cropping season for sustainable production. The optimum use of nitrogen can be achieved by matching N supply with crop demand. Improving the synchrony between crop N demand and the N supply from soil and or the applied N fertilizer is likely to be the most practical strategy to increase N use efficiency. Hence, the split application of fertilizer N in rice is going to remain as an key component of fertilizer N management strategy. Plant N requirements can be assessed through plant tissue analysis which takes 10-14 days period to receive a fertilizer recommendation and does not seem to be a practical proposition. Farmers generally prefer to keep leaves of the crop dark green which leads to over application of fertilizer N resulting its low use efficiency. Hence, need based N applications that include the usage of spectral properties of leaves should be used in a more rational manner to guide the precise nitrogen requirement in rice. Among various N management strategies, site-specific N management is one of the most advanced ones. This can be prescriptive, corrective management (real time N management) or a combination of both. Prescriptive are based on supplying capacity of soil, expected crop demand, targeted yield, efficiency of fertilizer and risk from weather and pest infestation. Real time nitrogen management is a method of rapid assessment of leaf nitrogen content that is closely related to the photosynthetic rate and biomass production and is a sensitive indicator of changes in crop nitrogen demand within the growing season. This approach revolves around quick and reliable diagnostic tools which are based on measurement of spectral characteristics of the radiation reflected, transmitted or absorbed by the leaves to estimate the chlorophyll content. Since most of the plant N is found in chloroplasts and chlorophyll protein, the N status of the plant could be assessed. Real time N management techniques need to be established and followed to improve N use efficiency leading to higher grain yield and minimal fertilizer N loss to the environment. Some non invasive optical tools viz., leaf colour charts, chlorophyll meters, digital, aerial and satellite imageries based on spectral reflectance by the intact leaf has been evolved. Thus, appropriate preventive N fertilizer management scenarios need to be worked out that can be used before using the SPAD meter, LCC or Green seeker to guide corrective N fertilizer application at a given crop growth stage.

EFFECT OF PROCESSING ON NUTRIENT AND PHYTONUTRIENT CONTENT OF DIFFERENT COLOURED TURMERIC (*CURCUMA SPECIES*)

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Abstract

The principal spice of Southeast Asia, Turmeric (*Curcuma species*), is known as the “THE GOLDEN SPICE” as well as “THE SPICE OF LIFE”. Curcumin, the principal curcuminoid present in *Curcuma* has a very long history of medicinal use for a wide variety of diseases and conditions, including skin, pulmonary, gastrointestinal systems and many more, since the time of Ayurveda. The particular study were made to determine curcuminoid content using HPLC (High Performance Liquid Chromatography) technique, the proximate composition, dietary fibre content and total polyphenols as well as individual polyphenols in raw and cured different coloured turmeric samples. Another purpose was to measure the antioxidant capacities using the DPPH, FRAP & ABTS assays. Seven Different coloured (white, pale-yellow, yellow, orange, deep orange, purple and black) fresh turmeric (*curcuma*) rhizomes belong to four species were collected from different states of India, which were divided into two groups – raw samples and cured/ processed samples. The curing of the rhizomes were done by the traditional method with pre-treatments i.e. boiling time (15 minutes), 0.1% alkaline solution and drying temperature and time (50°C and 10 hours). The proximate values (Calories-335.17 Kcal, Carbohydrate- 60.22 %, Protein- 13.04%, Fat- 10.21%, and Ash- 9.53%), curcuminoids (6.53 g/100g), polyphenols and dietary fibres (39.61%) was found to be higher in cured turmeric samples. Antioxidant activity measured using DPPH assay showed higher scavenging activities of cured samples (100.64-332.81 mg/ml). ABTS and FRAP assay showed the scavenging activities of raw samples (146.38mg/ml and 33.2 FeSO₄/100g respectively) found to be higher. The cured turmeric sample was found to be rich sources of curcuminoids, polyphenols, proximate and dietary fibres. The change in the bioactive compounds during the curing process may be due to the condensation occurred during the processing. Even the antioxidant activity by DPPH assay showed higher scavenging activities of cured samples, but ABTS and FRAP assay showed the higher scavenging activities of raw samples and methanolic extract found to show more activities than water extract, this may be due to presence of more lipid soluble bioactive components present in the both raw and processed turmeric samples.



MULTIVARIATE ANALYSIS AND CHARACTER ASSOCIATION FOR AGRO-MORPHOLOGICAL TRAITS IN AICRIP RICE GENOTYPES

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Abstract

Fifty AICRIP rice genotypes were evaluated to study genetic variability, correlation, path, principal component analysis (PCA) and cluster analysis. Variability studies revealed significant differences among the genotypes for the traits studied. High values of heritability and genetic advance were observed for plant height, number of tillers per plant, number of productive tillers per plant, panicle weight, number of filled grains per panicle and number of unfilled grains per panicle. Character association of the yield attributing traits at both genotypic and phenotypic level revealed significantly positive association of grain yield per plant with test weight. Path coefficient analysis revealed that number of productive tillers had highest direct positive effect on grain yield per plant followed by plant height, panicle length and number of unfilled grains per panicle. PCA showed that a cumulative variance of 45% from number of tillers per plant, number of productive tillers per plant and days to fifty percent flowering would be beneficial in contributing to the total morphological diversity. Therefore, selection of genotypes with more number of productive tillers per plant would be most suitable for yield improvement programme. Hence, selection for this character could bring improvement in yield and yield components.

MICROSATELLITE POLYMORPHISM STUDY IN IRON- AND ZINC-RICH RICE VARIETIES (SWARNA AND TYPE 3)

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Abstract

A microsatellite is a specific sequence of DNA which contains repeats. In present study, rice microsatellite (RM) markers were used to study the parental polymorphism between two parents (Swarna and Type 3). The experiment was conducted at Indian Institute of Rice Research, Rajendranagar, Hyderabad (India). 'Swarna' and 'Type 3' rice varieties dense in grain iron and zinc were used to study the parental polymorphism. Out of 171 SSR markers used for parental polymorphism, 52 markers showed polymorphism and 119 were monomorphic with expected base pair ranging from 84 to 383 bp. Therefore, these polymorphic rice microsatellite markers can be used in fine mapping of iron- and zinc-rich micronutrient genes to study the mapping populations of crosses obtained from these parents.

CO-INOCULATION EFFECT OF ACETOBACTER DIAZOTROPHICS AND PHOSPHATE SOLUBILIZING FUNGUS ON GROWTH, YIELD AND NUTRIENT UPTAKE IN SORGHUM (SORGHUM BICOLOR)

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Abstract

Sorghum is a grass species cultivated for its grain, which is used for food for humans, animal feed and ethanol production. It is also known as great millet, durra, shalu, jawar. Inoculation of biofertilizers leads to reduction of chemical fertilizer requirement by fixation & solubilization of plant nutrients and thus, may able to maximize plant growth, yields and quality of output. The study was conducted to evaluate Co-inoculation of *Acetobacter diazotrophics* and phosphate solubilizing fungus on growth, yield and nutrient uptake in sorghum. The dual inoculation of *Acetobacter diazotrophics* @ 25g Kg⁻¹ seed and



phosphate solubilizing fungus 10 g Kg^{-1} along with application of 75% of recommended dose of nitrogen, phosphorus and 100% recommended dose of potash had profound effect on growth parameters (Height at 60 days 74.23 cm at harvest 215.90 cm), yield (28.14 q/ha) and nutrient uptake (nitrogen uptake 134.10 kg/ha and phosphorus uptake 29.13 kg/ha) in sorghum. However, this treatment was at par with the treatments of *Acetobacter diazotrophics* and phosphate solubilizing fungus along with application of 100% of recommended dose of nitrogen, phosphorus and potash on growth parameters (Height at 60 days 70.73 cm at harvest 214.47 cm), yield (26.65 q/ha) and nutrient uptake (nitrogen uptake 137.40 kg/ha and phosphorus uptake 31.07 kg/ha). Thus, the present investigation explicitly substantiate that co-inoculation of *Acetobacter diazotrophics* and phosphate solubilizing fungus in conjunction with application of 75% of recommended dose of nitrogen, phosphorus and 100% of potash fertilizer is most suitable for getting higher yield..

EFFECT OF INDUSTRIALIZATION AND URBANIZATION ON AGRICULTURE

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Abstract

Industrialization and urbanization becomes a bane for the agriculture now days. With increase in industrialization and urbanization, the growth of agriculture sector decline continuously. Large area of land is covered under industry and infrastructure, which results in shortage of agriculture productive lands. The waste products of industry and urban areas are flowed in water bodies such as river, lakes and ponds which pollute them and make them unsuitable for any kind of use. The harmful effluents released from industry contaminate the air with harmful gases and suspended material. These gases and suspended particles affect the growth and development of plants and animals. The suspended particles are inhaled during breathing and cause blockage in veins and arteries of animals and humans. To feed the ever increasing population of our country, the farmer put high pressure on shrinking land to get higher output. For this, farmer use modern technology and chemicals which reduce the productivity and fertility of soil. The polluted water of lakes and ponds become poisonous for the water living entities and results in death of plants and animal species. The waste effluents of urban areas and industry have high concentration of heavy metals which are very poisonous for animals and plants which survive under water and on land. The growth of plants and microbes in soil is reduced due to increase in concentration of heavy metal in soil. The effects of industries and urbanization need to be decreased to get a healthy environment for plants and animals. Special management practice needs to be developed to suppress this increasing problem to survive on earth.

EFFECT OF SALICYLIC ACID AND NUTRIENT SOURCES ON GROWTH AND YIELD OF INDIAN MUSTARD (*BRASSICA JUNCEAL.*)

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Abstract

A field experiment entitled “Effect of Salicylic acid on growth, yield, biomass partitioning and quality of Indian mustard under different nutrient sources” was conducted on loamy sand soil at CCS Haryana Agricultural University, Hisar over a period of two consecutive years during Rabi season (2018-19 and 2019-20). The treatments in mustard during Rabi seasons comprising 20 combinations having 4 levels of foliar spray of salicylic acid and 5 different nutrient sources was laid out in a split plot design with four replications. Mustard variety RH-725 was sown at 30 cm row spacing using seed rate of 4 kg ha^{-1} .

Results showed that salicylic acid applied as 200 ppm foliar spray at flower initiation and full bloom stage recorded the maximum values of growth parameters (plant height, dry matter accumulation, dry matter partitioning, number of branches LAI, CGR, RGR NAR and LAD), yield parameters (number of siliqua on main shoot, number of siliquae plant⁻¹, length of main shoot length of siliqua, number of seeds siliqua⁻¹ and 1000 seed weight), yield (seed, stover and biological yield), physiological traits (Relative water content and chlorophyll content), soil nutrients availability, nutrients content and uptake, net returns ($\text{₹ } 44431 \text{ ha}^{-1}$) and B:C ratio (1.72) proved significantly superior over all other treatments. However, the treatment application of 200 ppm salicylic acid at flower initiation remained equally effective with regard to above parameters.



Further, Results showed that application of treatment 1/3 each through FYM, vermicompost and biogas slurry proved significantly superior over all other treatments with respect to all growth parameters (Plant height, dry matter accumulation, dry matter partitioning, number of branches, LAI, LAD, CGR, RGR and NAR). The yield attributes (number of siliqua on main shoot, number of siliquae plant⁻¹, length of main shoot length of siliqua, number of seeds siliqua⁻¹ and 1000-seed weight) and seed, stover and biological yields, physiological parameters (Relative water content and chlorophyll), quality parameters (protein, oil content and yield), soil nutrients availability, nutrients content and uptake, net returns (? 35747ha⁻¹) and B:C ratio (1.63) were significantly higher with application of 50% RDN through chemical fertilizers + 50% through FYM.

RESPONSE OF FYM AND GYPSUM ON SEED YIELD AND QUALITY OF RADISH UNDER HIGH RSC WATER

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Abstract

The study was conducted to assess the effect of FYM and gypsum on seed quality of radish under high RSC water. The three levels of farmyard manure (0, 10 and 20 t/ha) and three levels of gypsum (0, 5 and 10 t/ha) were laid out in randomized block design (factorial) with four replications. The application of farmyard manure and gypsum individually and in combination significantly influenced the seed yield, seed quality and economics of radish crop. Application of farmyard manure @ 20 t/ha in combination with 100% neutralization of RSC through gypsum (10 t/ha) were recorded significantly maximum seed yield (6.62 q/ha), test weight (10.96 g), standard germination percentage (76.57%), seedling length (36.97 cm), seedling dry weight (11.56 mg), vigour index-I (2832.5), vigour index-II (885.39), net returns (Rs.92451/-) and benefit to cost ratio (1.87) as compared to control where no FYM and gypsum was applied during both the years of study. Hence, combined application of FYM and gypsum minimize the harmful effect of sodic water and maximize the yield and quality of seed in radish.

IDENTIFICATION OF WATER LOGGING STRESS RESPONSIVE MICRORNAS IN PIGEONPEA (*CAJANUS CAJAN* (L.) MILLSP.)

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Abstract

Waterlogging stress is major abiotic stress having detrimental effects on pigeonpea productivity worldwide. Tolerance to water logging stress is complex phenomenon and controlled by multiple genes imparting a number of physiological and biochemical changes. Recent studies have shown that microRNAs (miRNAs) play key role in regulation of plant abiotic stress responses by regulating number of transcription factors and metabolic genes. This work was done to identify water logging stress responsive miRNAs of pigeonpea. Waterlogging treatment was given to tolerant (ICPL 20092) and susceptible pigeonpea genotypes (ICPL 87) at early vegetative stage (30 days after sowing) for 24hr by placing pots in cemented tank filled with water 5 cm above the soil. Small RNA library of control and treated leaf and root sample was prepared and next generation sequencing was done on Illumina platform. Bioinformatics analysis of small RNA reads was done and 140 known and 137 novel miRNA were identified. Among them 286 microRNAs expressed differentially between control and treated root and leaf samples of susceptible and tolerant genotype which could be considered as water logging responsive microRNAs. Among differentially expressed microRNAs; miR171c-3p, gma-miR398c, gma-miR408a-5p and gma-miR408a-5p and vvi-miR319e showed maximum upregulation whereas novel_148, gma-miR166u, gma-miR156d and novel_143 showed maximum downregulation. Gene targets of differentially expressing known and novel miRNAs were also predicted. Gene targets of differentially expressing miRNAs like Copper chaperone for superoxide dismutase, chloroplastic/cytosolic, Sugar transporter ERD6-like 16, ARATH probable glucan endo-1,3-beta-glucosidase had been reported to play important role in water logging stress tolerance thus the water logging stress responsive microRNAs identified in this study could be utilized as targets for developing water logging stress responsive pigeonpea genotypes.



INFLUENCE OF FYM AND GYPSUM ON GROWTH, YIELD TRAITS AND SEED YIELD OF RADISH APPLIED WITH HIGH RSC WATER

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Abstract

In this study, the response of treatments comprising of three levels of farmyard manure (0, 10 and 20 t/ha) and three levels of gypsum (0, 50 and 100% neutralization of RSC) were laid out in factorial RBD with three replication having a net plot size of 3.0x3.0 m and Punjab Safed cultivar was used for this study at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, India during period of 2017-18 and 2018-19. The application of farmyard manure and gypsum individually and in combination significantly influenced the growth, yield traits and seed yield. Among the interaction combinations, the plant height at harvest (cm), number of pods per plant, pod weight (g), pod length (cm), number of seeds per pod, seed recovery (%), seed yield (g/plot), seed yield (kg/ha), biological yield (q/ha) and harvest index (%) were recorded significantly maximum in F₂G₂ treatment where farmyard manure was applied at the rate of 20 t/ha in combination with 100% neutralization of RSC by gypsum both the years of study.

ADOPTION GAP AND CONSTRAINTS OF IMPROVED ARID LEGUME PRODUCTION TECHNOLOGY AMONG FARMERS OF FRONT LINE DEMONSTRATION

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Abstract

Legumes, broadly defined by their unusual flower structure, podded fruit, and the ability of 88% of the species examined to date to form nodules with rhizobia are second only to the Graminae in their importance to humans. Arid legumes comprising moth bean, Mungbean, cowpea, cluster bean and chickpea occupy more than 4.0 million hectare area in the agroeco sub region of arid zone. Mothbean, even though decreased in area to about 0.85 million hectare but increased in production to 0.18 million tons. Similarly, the productivity jumped to 210 kg ha⁻¹. Even though the coefficient of variation decreased with area but increased with production. There it signifies that the crop is relegated to more marginal areas. The increase in yield was only due to adoption of improved technology like varieties and cultural practices. Most of the fertile area under moth bean was replaced by mungbean. Thus the coefficient of variation of production decreased consequently with increase in area. The present production is 266 kg per hectare. Cowpea, even though, was a neglected crop with less area; it recorded an area increase but fall in productivity. Production could be increased with expansion in area. However, this was not followed with varietal replacement. Chickpea, an irrigated crop, recorded a significant increase in area of production and productivity but the point of concern is increasing coefficient of variability. This requires the attention of the scientists and policy makers. Cluster bean commercial crop with a large coefficient of variation associated with area and production earning worth Rs. 1126 crores by exporting 1.89 lac tons of guar gum. Increase in area but decrease in production and productivity could be attributed to mismatch between available length for growing period and selection of varieties. Thus the scenario of legumes production represents area of less stability and high variability. Not much information is available on horse gram in this tract. With these crops a response to micro-nutrients like zinc was also noticed in the farmer's field. The higher adoption level of improved moongbean production technology among the beneficiary in comparison of non-beneficiary respondents, might be due to the reason that the trainings were given to the beneficiary farmers by the RRS Jaisalmer they have also been provided necessary guidance, literature by scientists and SMS of KVK Jaisalmer. Selection of the state Rajasthan is done because CAZRI is located in this state while Jaisalmer is selected because CAZRI –RRS-Jaisalmer is located in the Jaisalmer Qamar, Village Basanpeer Deda and Narshmokidhani is selected because SCSP could be implemented in Scheduled Cast dominated village farmers only. Here 100 farmers of the village both male and female has been selected, all belong to Scheduled Cast category. The majority of households were aware (94.7 %) and 87.9 % adopted forage/browse legume technologies. Results showed that most of the farmers were full-adopters based on the type of species used (66.7 %) and area under forage (47.8 %) criteria. The most commonly adopted species were *Mucuna pruriens* (60.6 %) and *Leucaena leucocephala* (53.5 %). The size of household, land size and number of dairy cattle significantly affected adoption of forage/browse legume technologies. Lack



of inputs, low yields and lack of persistence of legumes and lack of fencing material were identified as core factors limiting adoption of forage/browse legume technologies. Study area is located in western Rajasthan. CAZRI RRS Jaisalmer is mentioned to provide and disseminate the improved technology. For this purpose SCSP is being implemented in the selected villages no Jaisalmer Rajasthan .thus basanpeer village was selected because SCSP could be implemented. A total of 120 farmers including male and female were selected all belonging to SC category. Village *Basanpeernarshimokidhani* and *Deda* is selected because SCSP could be implemented in Scheduled Cast farmers only. Here 40 farmers (20 Beneficiary and 20 Beneficiary) of the each village both male and female has been selected, all belong to Scheduled Cast category.

SCREENING FOR TEMPERATURE TOLERANT GENOTYPES AND GENETIC PARAMETER STUDIES IN CHILLI (*CAPSICUM ANNUUM* L.)

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Abstract

Fifteen chilli genotypes were screened for temperature resilience during summer season in of 2017-18. The genotypes were subjected to two temperature levels, i.e. optimum temperature (inside the growth chamber) and summer temperature (in open field condition). The characters like plant height, fruit length, fruit weight, pedicel length, number of seeds per fruit, rate of photosynthesis, chlorophyll, pollen fertility, pollen viability and fruit set per cent were decreased and leaf proline, leaf phenol and ascorbic acid were increased under high temperature stress. However, variable response was observed for the traits oleoresin and capsaicin content depending upon the genotypes under temperature stress condition. Genotypes LCA-960, UARChH-42 and 9608U were found more temperature resilient in chilli. The genotype PBC-80 registered highly sensitive to temperature stress condition. Phenotypic coefficient of variation was more than genotypic coefficient of variation for all the characters studied. High heritability coupled with high genetic advance in per cent of mean was observed for characters like plant height, fruit length, fruit weight, pedicel length, number of seeds per fruit, rate of photosynthesis, chlorophyll, leaf proline, leaf phenol, ascorbic acid, oleoresin, capsaicin, pollen fertility, pollen viability and fruit set per cent.

STUDIES ON EFFECTS OF CROP GEOMETRY AND VARIETIES ON YIELD AND YIELD ATTRIBUTES OF MUSTARD UNDER POPLAR IN TERAJ OF UP

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Abstract

A field experiment was conducted at farmer's field in Distt. Pilibhit of Western Terai and Bhabar region of U.P., India, during rabi season of 2018-2019 and 2019-2020, to find out suitable variety and optimum spacing for different Mustard varieties, as pure and under Poplar trees. Three varieties of Mustard, viz; Goldi (V1), Ullahas (V2) and Pant pili sarson-1 (V3) were taken as treatments in the main plot, whereas, four spacings, 40cm x 30cm (S1), 45cm x 20cm (S2), 30cm x 15cm (S3) and 20cm x 10cm (S4), were imposed as subplot treatment, in pure field as well as under trees. The experiment was conducted in split plot design with 3-replications and repeated in rabi seasons for two consecutive years (2018-2019 and 2019-2020). The results of the experiment revealed that the maximum seed yield was recorded in Pant pili Sarson-1 (1648.0kg/ha and 2052.0kg/ha, respectively in 1st and 2nd year) followed by Goldi and Ullahas. And, seed yield of Pant pili sarson-1 under Poplar trees was also recorded highest in both the years under 2 and 3 years plantation (1542.0kg/ha and 1422.0kg/ha, respectively). The same pattern was also seen for stover yield (kg/ha) in pure as well as in intercropped fields. Regarding, plant geometry significantly higher yield was seen in 40cm x 30cm (2241.0kg/ha and 2836.0kg/ha, respectively in 1st and 2nd year) in Pant pili Sarson-1. The same pattern was observed in Goldi, followed by Ullahas. Similar results were also noticed in Mustard, grown with trees. Crop geometry (40cm x 30cm), observed the best in respect of number of primary branches/plant and seeds/siliqua, and it was also reflected on seed yield and Stover yield (kg/ha). The Pant pili Sarson-1, of Mustard is highly suitable and recommended in Terai region of U.P., due to its higher yield. So, wider spacing is suitable for Pant pili sarson-1, because of their bigger canopy.



EFFECT OF SALINITY STRESS ON OSMOREGULATION OF JUVENILE FENUGREEK

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Abstract

The environmental ordeal, such as salinity (soil or water) and drought are becoming acute obstacles for irrigation of vegetal crops in arid and semiarid regions. Fenugreek (*Trigonella foenum-graecum L.*) leaves and seeds are used extensively as condiments in India. Also it has multifarious medicinal chattels. The present research set sights on the effect of induced salinity during germination and early seedling growth on Fenugreek. The studies involved four treatments of salinity including 0 mM (control), 50 mM, 100 mM and 200 mM NaCl. The results showed that different treatments of salinity had considerable effect on the germination percentage, Plumule to Radicle Length Ratio, Seedling Vigour Index, Germination Velocity, Seedling, Plumule, Radicle, Shoot and Root length, Shoot and Root fresh weight, Seedling, Plumule, Radicle, Shoot and Root dry weight, Total Chlorophyll content, Glycine Betaine, Proline, Trehalose, Antioxidant scavenging activity and Total Protein of variety 1 and variety 2. The highest total chlorophyll content was found in variety 1. Germination percentage in both the varieties showed considerable decrease with increasing salinity up to 200 mM NaCl. This reduction was more in variety 2 as compared to variety 1. The seedling vigour index of both varieties was significantly inhibited by all salinity levels, particularly at 200 mM NaCl. Seed vigour is the sum total of all those properties that determine the activity and performance of seed lots having acceptable germination in a wide range of environments. Glycine Betaine in variety 1 revealed decrease with salinity increase but in case of variety 2 its values increases at 50 mM and lowest at 0 mM NaCl. The concentration of Proline was found to be high in variety 2 as compared to variety 1 under salinity stress. The result showed that antioxidant is responsive in salt stress. Variety 1 had higher level of antioxidant and had greater resistance to different types of stress.

GENETIC EVALUTION OF BREEDING EFFICIENCY DETERMINED BY TWO METHOD IN JAMUNAPARI GOATS

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Abstract

The present study was undertaken on performance records of 107 jamunapari goats spread over a period of 8 years which were the progeny of 17 sires, maintained at Jamunapari farm, Central Institute for Research on Goats, Makhdoom, Farah-Mathura (U.P) India. Only those goats which had completed minimum three lactations were considered for study on breeding efficiency. The influence of year, season of kidding and other genetic and non-genetic factors on the economic traits were studied by least squares analysis. After necessary correction for significant effects, genetic and phenotypic parameters were obtained using paternal half-sib correlation method. Breeding efficiency were generated from reproduction traits. The breeding efficiency was determined by using the methods of Wilcox *et al.* (1957) and Tomar (1965). The records on reproductive traits viz., age at first kidding and kidding interval were collected and also generated wherever was required. Least squares means for reproduction traits were for age at first kidding 954.28+_{44.69} days and for kidding interval 377.61+_{30.84} days respectively. The result of analysis of variances of herd life reproduction traits showed that the sire, year of kidding and regression of weight of dam at twelve month (Linear) affected age at first kidding significantly. Whereas, kidding interval was significantly influenced by year and season of kidding. The least squares means for breeding efficiency as per the methods of Wilcox *et al.* (1957) and Tomar (1965) were 95.39+_{04.25} percent and 88.29+_{04.94} percent, respectively. The year of kidding and regression of dam's weight at twelve months significantly affected breeding efficiency estimated as per the methods of Wilcox *et al.* (1957) and Tomar (1965). The heritability estimates were computed by paternal half sib method after correcting the data for significant effects. Heritability estimates for kidding interval was 0.207+_{0.322}. The phenotypic correlation was of lower magnitude than the genetic correlation in general. The genetic and phenotypic correlation among the reproduction traits were in positive. The breeding efficiency values obtained using method of Wilcox *et al.*, (1957) were higher than that of method of tomor (1965). The estimates in the present study by both the methods were high enough to indicate that the reproductive performance of goats was optimum. However, the difference in average estimates by two



methods indicated that there is greater variability in the age at first kidding. Optimum genetic potential for reproduction traits may be achieved by proper management and feeding through the years and seasons. The breeding efficiency computed as per method of Wilcox *et al.* (1957) were higher and indicated that the goats with lower kidding intervals be retained in the herd to improve economic efficiency. The Jamunapari goats should be managed in such way that their service period may not extend 90 days and kidding interval may range between of 300 and 365 days. The optimum level of breeding efficiency may be considered important criterion for selection to bring about improvement in the herd.

BIO-EFFICACY OF INSECTICIDES FOR MANAGEMENT OF FALL ARMYWORM, *SPODOPTERA FRUGIPERDA* (J. E. SMITH) ON MAIZE (*ZEA MAYS* L.)

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Abstract

Bio-efficacy of insecticides viz., spinosad 45 SC, emamectin benzoate 5 SG, thiodicarb 75 WP, chlorantraniliprole 18.5 SC, azadirachtin 10000 ppm, *Metarhizium anisopliae* and *Beauveria bassiana* was evaluated against fall armyworm, *Spodoptera frugiperda* on maize at Agronomy farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan during Kharif 2019 and 2020. The result revealed that three sprays of chlorantraniliprole 18.5 SC was found most effective against *S. frugiperda* with maximum reduction of larval population, lowest plant damage (%), lowest leaf damage (%), lowest cob damage (%) and highest grain yield. However, the maximum incremental benefit cost ratio was obtained from three sprays of emamectin benzoate 5 SG.

ASSESSMENT OF GENETIC VARIABILITY PARAMETER IN BLACKGRAM [*VIGNA MUNGO* (L.) HEPPER] GERMPLASM

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Abstract

The present investigation was carried out on 28 blackgram genotypes during Kharif-2018 at field experimentation site of Genetics and Plant Breeding, Naini Agricultural Institute, SHUATS, Prayagraj to study about genetic variability, heritability and genetic advance. ANOVA showed highly significant genetic variability for all 28 blackgram genotypes for 12 characters studied indicating that significant amount of genetic variability present in the material. High GCV and PCV was observed in harvest index (%) (10.1, 12.68) followed by seed yield per plant (9.79, 12.17). High heritability coupled moderate genetic advance as percent of mean were observed in number of pods per plant, pod length, number of primary branches per plant, harvest index, biological yield and seed yield per plant. Mean performance for seed yield per plant and other characters taken in to consideration genotype VALLAB URD may be considered as best genotype followed by Shuats Urd (ABL)-95 and KU-96-7.

PHYSIOLOGICAL CHARACTERS AND YIELD OF QUINOA (*CHENOPODIUM QUINOA* WILLD.) AS INFLUENCED BY DATES OF SOWING AND VARIED CROP GEOMERTY

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Abstract

Quinoa (*Chenopodium quinoa* willd.) is an annual herbaceous climate resilient crop belongs to Amaranthaceae family, but formerly placed in Chenopodiaceae family that originated in the Pacific slopes of the Andes in South America. The popularity of quinoa is dramatically increased in recent years in India because it is gluten-free (helpful for diabetic patients) and high in



protein. Quinoa can play a major role in future diversification of agriculture system in India and can be introduced in India to check malnutrition as well as to increase foreign exchange. It can replace rice to certain extent owing to its low glycemic index and reduce GHG emissions with environment sustainability. A field experiment was conducted during *rabi* 2015-16 to evaluate quinoa at different dates of sowing (15 October, 1 November and 16 November) and varied crop geometry (15×10 cm, 30×10 cm, 45×10 cm, 60×10 cm) in semi-arid regions of Telangana in split plot design with three replications. The weekly mean maximum and mean minimum temperature during crop growth period was 31°C and 16.1°C, respectively with an average temperature of 23.5°C. The higher plant height was obtained in 16th November sowing and higher number of branches plant⁻¹, leaf area was recorded in 1st November sowing. Leaf, stem, panicle and total dry matter was higher with 15 October sowing. Higher crop growth rate, relative growth rate, growing degree days (GDD) and photothermal units (PTU) was obtained on 15 October sowing. Days to maturity recorded higher in 15 October sowing (107) followed by 1 November (101) and 16 November (97) sowings respectively. Plant height, number of branches plant⁻¹ were higher at 60 × 10 cm compared to other crop geometries. The higher leaf, stem, panicle, total dry matter production and CGR was recorded with 15th October sowing with narrow (15 × 10 cm) spacing, whereas higher RGR and NAR were obtained under 60 × 10 cm spacing. The panicle length, number of spikelets panicle⁻¹, number of grains panicle⁻¹ and internode higher seed, stalk yield was obtained with 15 October sowing. Among the yield attributes, number of branches plant⁻¹, panicle length, number of spikelets panicle⁻¹ were higher under wider spacing 45 × 10 cm and 60 × 10 cm compared to narrow (15 × 10 cm) spacing. The highest seed and stalk yield were obtained with narrow (15 × 10 cm) spacing and was followed by 30 × 10 cm. The interaction effect showed higher seed yield with 15th October date of sowing along with 15 × 10 cm and 30 × 10 cm. Number of panicles plant⁻¹ ($R^2 = 0.653$) and panicle weight ($R^2 = 0.692$) significantly influenced the seed yield of quinoa. Minimum temperature expressed positive influence ($R^2 = 0.415$) on seed yield of quinoa than average temperature ($R^2 = 0.343$). Growing degree days ($R^2 = 0.431$) and photothermal units ($R^2 = 0.419$) showed positive influence on seed yield of quinoa.

INTRODUCTION OF PRE *KHARIF* CROPS FOR IMPROVING THE PRODUCTIVITY IN RICE (*ORYZA SATIVA* L.) BASED CROPPING SYSTEM

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Abstract

A field investigation was conducted for three years during 2014-15 to 2016-17 on sandy clay loam soils of Regional Agricultural Research Station, Anakapalli to find out the effect of pre-kharif crop on performance of succeeding rice and rice fallow maize. The experiment was laid out in randomized block design with three replications and eight treatments. Significant differences were noticed with pre-kharif crops on yield attributes and yield of rice and yield of rice fallow maize. Significantly superior performance of rice was observed for all these parameters with Sesbania (T_7), while cowpea (T_2) was the next best treatment. The seed yield of rice fallow maize was significantly superior with Sunnhemp (T_2), while the lowest with fallow (T_1). Highest net returns ha⁻¹ (Rs.1,69,596/-) and system productivity (11676 kg ha⁻¹) was recorded with Sesbania-rice-rice fallow maize (T_7) followed by sunnhemp-rice-rice fallow maize (T_6) and cowpea-rice-rice fallow maize (T_2) and the lowest with fallow-rice-rice fallow maize (T_1). Based on the above findings, it was concluded that for sustainability of rice based cropping system, Sesbania-rice-rice fallow maize and Sunnhemp-rice-rice fallow maize were suggested for North Coastal Zone of Andhra Pradesh.

EFFECT OF WEED MANAGEMENT PRACTICES ON BARLEY GROWTH AND YIELD IN DEHRADUN

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Abstract

The experiment was laid out in a Randomized Block Design replicated thrice with seven treatments consisted of T_1 : Weedy check; T_2 : Hand weeding 30 & 60 DAS; T_3 : Metribuzin 250 g ha⁻¹; T_4 : Sulfosulfuron 25 g ha⁻¹; T_5 : Metsulfuron-methyl 6 g



ha⁻¹; T₆: Clodinafop 60 g ha⁻¹; T₇: 2-4 D@500 g ha⁻¹. The results indicated that all the weed management practices were found significantly superior to weedy check in reducing weed growth and increasing crop growth parameters. During the critical period of crop-weed competition significantly reduced the weed density, drymatter and recorded higher weed control efficiency in T₂ lowest weed index. Similar effect was also observed with the integration application of herbicides significant increase in plant height, drymatter accumulation, yield attributes and grain yield was noticed in T₂. T₅, Metsulfuron-methyl 6 g ha⁻¹ and T₆, Clodinafop 60 g ha⁻¹ recorded significantly higher grain yield of barley over weedy check. Highest equivalent yield, net return and benefit cost ratio were obtained in barley. From the present investigation, it can be concluded that T₅, Metsulfuron-methyl 6 g ha⁻¹ followed by T₆, Clodinafop 60 g ha⁻¹ reduced the weed density, drymatter and recorded higher weed control efficiency. Adoption of herbicidal application is beneficial in realizing the highest barley equivalent yield, net return and B :C ratio.

IN VITRO ASSAY OF BIOAGENTS, ANTIBIOTICS, CHEMICALS AND LEAF EXTRACTS AGAINST *X. ORYZAE* PV. *ORYZAE* (XOO) ISOLATES.

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Abstract

Bacterial leaf blight (BLB) of rice caused by *Xanthomonas oryzae* pv. *oryzae*, is one of the most destructive diseases in rice cultivation throughout the worldwide due to its growing concern as this disease is wide spread, devastating and its control measures. The antibacterial potential of *Pseudomonas fluorescence* (Liquid base) and *PfGr* (isolate), different broad spectrum antibiotics such as streptomycin, tetracycline, chloramphenicol and ampicillin chemicals such as copper oxychloride (COC) and leaf extracts such as *Adhatoda vasica* (Adulsa) and *Occimum sanctum* (Tulas) were used to observe the sensitivity of five different bacterial isolates (KXoo1, PMXoo2, KAXoo3, IGXoo4 and GAXoo5) *in vitro* by paper disc method (Disk diffusion). Out of two bioagents, four antibiotics, one chemical and two phyto extracts, chloramphenicol (0.1%) and tetracycline (0.1%) were found highly effective in inhibiting the growth of all *Xoo* isolates. The average inhibition in growth was 33.89 and 31.00 per cent respectively irrespective of isolates. Maximum growth inhibition was recorded in tetracycline while minimum inhibition was observed in copper oxychloride. Leaf extract of *Occimum sanctum* (10%) and copper oxychloride (0.25%) showed less inhibition against all five *Xoo* isolates.

EFFECT OF FEEDING BUTYRIC ACID ON BLOOD BIOCHEMICAL PARAMETERS IN BROILER

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Abstract

The aim of the study was to see the effect of supplementing different levels of butyric acid on blood biochemical parameters of commercial broiler birds. This experiment was conducted at Poultry Research and Training Center, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut. One hundred and eighty day-old broiler chicks (Cobb 400) were procured. The chicks were randomly distributed into 4 treatments with 3 replicates in each treatment on the basis of body weight. The first treatment (T1) served as control in which basal diet was offered without butyric acid supplementation while in T2, T3 and T4 groups, the basal diet was supplemented with butyric acid at the rate of 0.5%, 1.0% and 1.5%, respectively. The blood biochemical parameters were analysed at the end of 6th week of age. The effect of supplementing basal diet with different levels of Butyric acid on certain blood biochemical parameters viz., cholesterol (mg/dl), total protein (g/dl), uric acid (mg/dl), AST (IU/L), ALT (IU/L) and ALP (IU/L) were measured at 6th week of age in experimental Cobb 400 birds. The results obtained as the Total protein (g/dl), Uric acid (mg/dl) and ALT (IU/L) were found similar to control but the Cholesterol (IU/L) was recorded as higher in T4 supplemented group than control. AST (IU/L) level was found higher in T4 group than control whereas ALT (IU/L) and ALP (IU/L) was found to be higher in T1 control group than other supplemented groups. The cholesterol (mg/dl) and AST (IU/L) were represented to highest in T4 supplemented group than other groups. The cholesterol



(mg/dl) and AST (IU/L) were represented to highest in T4 supplemented group than control but ALT (IU/L) and ALP (IU/L) were recorded to highest in T1 control group than supplemented groups. The total protein (g/dl) and uric acid (mg/dl) was found to be highest in T3 supplemented group than control. Though blood biochemical parameters and liver enzyme activity varied from control, all the values in control and supplemented groups were in normal physiological range.

RESOURCE USE EFFICIENCY IN OKRA IN MEERUT DISTRICT OF WESTERN UTTAR PRADESH

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Abstract

Fruits and vegetables account for nearly 90% of total horticulture production in the country. India is the largest producer of okra in the world next to China with area, production and productivity of 509 thousand hectare, 6095 million tonnes and 120 mt/ha. On the basis of primary data to know resource use efficiency of okra cultivation. The purposive sampling was used to select districts and villages on the basis of highest area under these crops random sampling technique was used to select the 100 farmers and categorized under marginal small and medium farmers. Cobb-Douglas production function, elasticity of production and return to scale were analysed in this study and coefficient of multiple determinations (R^2) on marginal, small and medium size group of farms accounted for 0.93254, 0.88651 and 0.81054, respectively, returns to scale on marginal, small and medium farms were analysed and observed to be 0.89247, 0.91587 and 0.87624, respectively, marginal value productivities are positive and more than unity in case of human labour, seed and plant protection.

EVALUATION OF CHERRY TOMATO PRODUCTION UNDER CONTROL ENVIRONMENTS

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Abstract

India has a wide range of diverse agro-climatic conditions but cultivation practices of vegetables in India have been generally restricted to regional and seasonal needs. Protected cultivation or controlled environment agriculture is a total concept of modifying the natural environment for optimum plant growth. It incorporates the manipulation of air velocity, atmospheric concentration of carbon dioxide, root zone oxygen concentration and nutrient and moisture supply to control crop growth. The aim of protected cultivation is to achieve independence of climate and weather and to allow crop production in areas where the natural environment limits or prohibits plant growth. Keeping this in view, A study was undertaken during the winter season in the greenhouse at CCS Haryana Agricultural University, Hisar to evaluate the performance of two tomato hybrids (Olay & Mini Red) and two spacing (100 x 45 cm & 100 x 60 cm) along with pinching + stacking or without pinching + no stacking for growth and yield parameters. Seedlings were raised in pro trays using soilless media i.e. cocopeat, vermiculite & perlite in the ratio of 3:1:1. Before transplanting the greenhouse soil were sterilized with formalin solution. The results revealed that cherry tomato variety Olay transplanting at a spacing of 100 x 45 cm with pinching + stacking treatment gave maximum yield 385.4 q/ha with B: C ratio 3.81 under polyhouse condition.

TO STUDY THE EFFECTS OF LOW TUNNEL PRODUCTION TECHNOLOGY FOR EARLY HARVEST OF CUCURBITS

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Abstract

Plastic low tunnels are flexible transparent coverings that are installed over single or multiple rows of vegetables to enhance the plant growth by warming the air around the plants in the open field during winter season normally when the temperature is below 10°C. Plastic low tunnels are often used to promote the growth of plants during the period of winter season. All kind of protected technologies may not be economical and useful to the farmers in India, because of their very high initial, running



and maintenance cost, but some protected technologies are simple, suitable and highly profitable under Indian conditions, which can be adopted by Indian farmers for production of different vegetable crops. The demand of off-season vegetables is increasing day by day in several big and medium sized cities of the country, which provide a wide scope for protected vegetable cultivation through off-season cultivation of vegetables mainly the cucurbits in peri-urban areas of the country. Plastic low tunnel technology is a simple, suitable and profitable technology for off-season cultivation of cucurbits during the winter season in northern plains of the country. Keeping this in view, A study was undertaken during the winter season in the low tunnels at CCS Haryana Agricultural University, Hisar to evaluate the performance of two cucurbits i.e. bottle gourd cv. Pusa Naveen and bitter gourd cv. Pusa Do-mousami and four dates of sowing (15 Nov., 15 Dec., 15 Jan. and 30 Jan.) under low tunnels for growth and yield parameters. The results revealed that maximum marketable fruit yield (316.6 q/ha) in bottle gourd cv. Pusa Naveen with B: C ratio (3.80) and in bitter gourd cv. Pusa Do-mousami the maximum marketable yield (90.9 q/ha) with B:C ratio (1.30) was obtained when crop was sown on 15th December under low tunnel.

GROWTH PHYSIOLOGY AND YIELD OF ONION AS INFLUENCED BY FOLIAR SPRAY OF MEPIQUAT CHLORIDE (MC) 5% AS AT FLOWERING STAGE

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Abstract

Onion is one of the most important bulb crops extensively grown in India in particular North Eastern region of Karnataka. It is widely used both as raw green leaves and matured bulb and is also used to add flavour to various delicious curries. As a food item, it is usually served cooked, as a vegetable or part of a prepared savory dish, but can also be eaten raw or used to make pickles or chutneys. Mepiquat chloride is a water soluble organic molecule, which is absorbed by the green parts and redistributed throughout the plant. Mepiquat chloride inhibits gibberellic acid biosynthesis in green part of the crop plant and consequently reducing cell enlargement and cell division rate. Therefore, an experiment was conducted to know the growth physiology and yield of onion as influenced by foliar spray of mepiquat chloride (MC) 5 % AS at flowering stage . The study was conducted during Kharif 2015 & 2016 at ARS, Dadesugur of UAS, Raichur by using randomized block design. The one month old seedling was manually transplanted in field in a plot size (6.0 m x 3.0 m) and the spacing is 15 cm x 7.5 cm (rows x plants). The onion variety selected for the trial was Bellary red. It is a high yielding variety. The effectiveness of MC 5% AS was studied with different levels as T₁ MC 5 % AS @ 2.0 ml/l, T₂ MC 5 % AS @ 2.5 ml/l, T₃ MC 5 % AS @ 5.0 ml/l are sprayed at 30-35 DAT while T₄ MC 5 % AS @ 2.0 ml/l, T₅ MC 5 % AS @ 2.5 ml/l and T₆ MC 5 % AS @ 5.0 ml/l are sprayed at 45-50 DAT and T₇ MC 5 % AS @ 2.0 ml/l @ 30 DAT then 15 days after first spray with T₈ –Control. Based on the pooled data for both the years of this study, the onion crop plant height has been significantly reduced (8.50 %) over control due to application of MC @ 5 % AS @ 2.5 ml / l. While number of leaves/plant, length and diameter of bulb, bulb weight and bulb yield have been improved due to application of MC @ 5 % AS @ 2.5 ml /L by 7.2 % and 5.2 % & 4.8 %, 6.9 % and 12.9 %, respectively followed by T₅ for all the parameters of onion crop . The bulb yield had significant positive association with reduction in plant height, number of leaves, bulb length and chlorophyll content indicating the importance of these parameters in improving the bulb yield potential of onion.

ALLELOPATHIC EFFECTS OF PLANT TREE SPECIES ON SEED GERMINATION & SEEDLING GROWTH OF WHEAT VARIETIES

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Abstract

Allelopathic effect of three medicinal plants species viz *Dalbergia sissoo*, *Populus deltoides*, & *Cassia siamea* was examined on seed germination and seedling growth of four (HD2687, PBW 343, UP2338, HW1085) popular wheat (*Triticum aestivum* L.) Varieties. The aqueous leaf extracts reduced the seed germination and seedling growth of wheat. The value of per cent reduction in seed germination and germination relative index (GRI), inhibitory effect of different leaf extracts was maximum in susceptible varieties (UP2338 & HW1085) followed by tolerant varieties (HD2687 & PBW 343). The root and shoot length,



root and shoot dry weight declined with the increase in the concentration of the leaf extracts of all the three plant tree species. Leaf extracts of all three plant tree species showed prohibitory effect on sugar and protein and a exciting effect on total amino acid contents of the wheat seedling. The results indicated that the alleopathic effect of leaf extracts of *Cassia siamea* was maximum in terms of all physiological and biochemical parameters.

INVITRO EVALUATION OF *PSEUDOMONAS FLUORESCENS* ISOLATES FOR THE INHIBITION OF *ASPERGILLUS FLAVUS* AND AFLATOXIN CONTAMINATION IN GROUNDNUT

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Abstract

Aflatoxin contamination caused by *Aspergillus flavus* is a qualitative problem in groundnut (*Arachis hypogaea* L.) occurring at both pre-and post-harvest stages. Use of plant growth-promoting rhizobacteria (PGPR) is a viable and sustainable option in managing aflatoxin problem in groundnut. Of different PGPR, *Pseudomonas* spp. is one of the widely used bacteria against major plant pathogens in groundnut. Ten native *Pseudomonas fluorescens* isolates from groundnut rhizosphere were isolated and screened against *A. flavus* by dual culture and *in vitro* seed colonization (IVSC) assays. In general, all the isolates under study inhibited *A. flavus* in dual culture studies. Of different treatments, highest inhibition of *A. flavus* was obtained with Pf7 (54.8%) followed by Pf2 (48.7%) and Pf6 (48.2%). The isolates of *P. fluorescens* (Pf) evaluated by IVSC indicated that the colonization severity of *A. flavus* was significantly reduced over control when seeds were treated with bioagents, Pf2, Pf6, Pf7 and Pf9. Of these, seed treatment with Pf7 has resulted in least colonization severity of *A. flavus*. This is followed by Pf2 and Pf9 and Pf6. The seeds in control have recorded maximum colonization severity by *A. flavus*. The difference in colonization severity over control was highest with Pf7 (25.8), followed by Pf2 and Pf9 (22.7) and Pf6 (18.5). Overall, the Pf isolates, Pf7, Pf2, Pf9 and Pf6 were effective in reducing *A. flavus* infection on groundnut seeds. Of different treatments, the aflatoxin content was least in seeds treated with Pf7 (27.8 $\mu\text{g kg}^{-1}$). The efficacy of Pf7 was significantly superior over other Pf isolates. This was followed by seeds treated with Pf1 (754.7 $\mu\text{g kg}^{-1}$), Pf8 (1051.6 $\mu\text{g kg}^{-1}$) and Pf2 (1151.9 $\mu\text{g kg}^{-1}$) with no significant differences among them. Seeds in control have recorded highest aflatoxin content of 1521.1 $\mu\text{g kg}^{-1}$. Overall, the PGPR isolate, Pf7 was highly effective in reducing kernel aflatoxin contamination in groundnut through IVSC assays. In our present study, the Pf7 isolate exhibited superior activity in inhibiting mycelial growth of *A. flavus*, its colonization on groundnut seeds and aflatoxin production.

FUNCTION AND TOXICITY STUDY OF FRUIT PRESERVATIVE

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Abstract

The processed fruits have higher susceptibility to microbial spoilage than their complete counterparts. In addition, they also pose a food safety risk if consumed raw. In the last few decades, food scientists have attempted to ensure microbiological safety and quality of fresh-cut fruits. This is achieved by use of food preservatives but it is also been demonstrated that higher usage of these preservatives can be harmful to human beings. Therefore, the present study was conducted to investigate the effect of citric acid and acetic acid on microbial contaminants of fresh-cut fruits such as apple, banana, pineapple, papaya, watermelon. Some highly infectious bacterial genera like *Salmonella enterica*, *Enterobacter tabaci* were found to be present on fresh-cut fruits. The MIC of citric acid on these isolates was found out to be 1%, >15% whereas the MIC of acetic acid was found out to be 0.6%, 0.8% respectively. Cumulative effect of both the additives showed the MIC of 0.6%. The cytotoxicity of chemical preservatives was also guesstimated employing two human cell lines i.e. INT 407 (Human epithelial cells), Blood lymphocyte. The IC 50 value were calculated employing Graphpad Prism software. The good of fit and Anova analysis revealed a significant co-relation between the concentration of preservative under study and cellular response. No significant changes in morphological pattern, cell growth pattern and other cellular properties were observed. However, few cellular abnormalities at higher concentration of acetic acid was recorded on INT 407. The present study endeavors to lay a preliminary



platform for understanding the spectrum of application of citric acid and acetic acid on different natural fruit species and their interaction with the gut cell in-vitro.

EVALUATION OF DIFFERENT MODULES AGAINST SERPENTINE LEAF MINER, *LIRIOMYZA TRIFOLII* IN CUCUMBER UNDER MIDDLE GUJARAT CONDITION

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Abstract

Field experiment was conducted during *kharif* season of 2017 and 2018 with three modules and replicated six in the Large Plot Sampling CRD with plot size 15.00 m x 5.00 m². There was significantly lower number of leaf mines based on pooled data was recorded in Module 2, chemical insecticides (1.21/leaf) however, the next best effective treatment was Module 1, IPM (3.06/leaf) which recorded significantly lower number of mines as compared to Module 3, farmers practices (4.75/leaf). The data on pooled over years on per cent leaf damage indicated that Module 2 (6.67%) was found most effective in controlling leaf miner damage to cucumber leaf which as compared to rest of the modules. The next effective treatment was Module 1 (21.14%) while, Module 3 (the farmers practice module) was recorded higher leaf damage (21.14%) as compared to other modules. There was significantly higher fruit yield recorded from plots treated with Module 2 (127.07 q/ha). Module 1 (94.88 q/ha) remained next best effective module for the production of fruit yield.

CORRELATION AND PATH COEFFICIENT ANALYSIS BETWEEN GRAIN YIELD AND KERNEL CHARACTERS IN RICE (*ORYZA SATIVA* L.)

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Abstract

An investigation was carried out at rice research centre, PJTSAU, Hyderabad using 16 rice genotypes including 11 maintainer lines and 5 varieties for kernel characters and grain yield to understand the association among yield components and their direct and indirect influence on the grain yield. Analysis of variance revealed considerable variability among the genotypes for 13 the characters among 15 characters. The correlation analysis indicated that grain yield was significantly associated with plant height, number of productive tillers per plant, panicle length, leaf area index and number of grains per panicle. Path-coefficient analysis showed that kernel length had the highest positive direct effect on grain yield followed by number of grains per panicle, number of productive tillers per plant and test weight. Hence, selection based on these traits could help to bring simultaneous improvement of yield, yield attributes and kernel characters.

EFFECT OF DIFFERENT LEVELS OF PRUNING ON GROWTH, YIELD AND QUALITY OF GUAVA (*PSIDIUM GUAJABA* L.) VAR. HISAR SAFEDA

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Abstract

The field experiment was conducted in the horticulture research farm, CCS HAU College of Agriculture Kaul, Kaithal during the Kharif season 2020-21 "Effect of different levels of pruning on growth, yield and quality of guava (*Psidium guajava* L.) var. Hisar Safeda was undertaken on 7 year old guava plants. The experiment was laid out in Randomised Block Design with seven treatments replicated thrice. The treatments comprises retention of main trunk upto 1 m along with primary



branches 1 m and secondary branches 0.50 m. (T1), retention of main trunk upto 1 m along with primary branches 1 m and secondary branches 1 m. (T2), heading back of tertiary branches at 25% (T3), heading back of tertiary branches at 33% (T4), heading back of tertiary branches at 50% (T5), heading back of tertiary branches at 75% (T6) and control (T7). The results of the present study indicated significant differences with respect to quality parameters like maximum fruit weight, diameter of fruit, volume of fruit, TSS, ascorbic acid content were recorded in the treatment of (T1) retention of main trunk upto 1m along with primary branches 1 m and secondary branches 0.50m. and the treatment (T2) retention of main trunk upto 1 m along with primary branches 1m and secondary branches 1 m. While maximum no. of shoots per plant, minimum days required for flowering, minimum days required from pruning to fruit set, days from fruit set to harvesting, maximum no. of fruits per tree and maximum yield were recorded in 50%, 33%, and 25% heading back of tertiary branches. Pruning practice in guava with heading back of tertiary branches at 50%, 33% and 25% are beneficial for obtaining maximum yield and quality fruits.

IN-VITRO CORM MULTIPLICATION IN SAFFRON (*CROCUS SATIVUS* L.)

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Abstract

Saffron (*Crocus sativus* L.) is an important spice, known for its aroma, colour and medicinal properties and is regarded as the most costly spice in the world. Despite its wide popularity which has enabled all saffron producing countries to increase production during the last 3-4 decades, there has been a decrease in saffron production in almost all the countries. Production of quality planting material (corms) is a major limiting factor in saffron propagation as the rate of generation of daughter corms under natural conditions is low which results in limited availability of propagating material for field cultivation. Therefore, an *in-vitro* multiplication technique like micro-propagation is a good alternative method of propagation for saffron. In the present investigation, corm explants were cultured on different nutrient media supplemented with various concentrations of plant growth regulators. Micro-corm formation was observed on all the media combinations. Maximum number (9) and weight (1.03 to 1.98 g) of micro-corms developed were observed on MS media supplemented with 6-benzyl amino purine (BAP) (3.5 mg/L) + naphthalene acetic acid (NAA) (1.0 mg/L). Shoot and root regeneration was observed in the micro-corms developed under *in-vitro* conditions. Maximum number of shoot (17.3) and length of shoots (8.9 cm) was also observed on MS media supplemented with NAA (23.5 μ M) + BAP (25.5 μ M). Maximum number of roots (10) and length of roots (9.7 cm) were obtained on MS media containing NAA (21.5 μ M) + BAP (22.5 μ M). The *in-vitro* micro-propagation seems to be a very promising technology for production of quality planting material in saffron.

STUDIES ON COMBINING ABILITY AND GENE ACTION FOR SEED YIELD AND YIELD CONTRIBUTING TRAITS IN SESAME (*SESAMUM INDICUM* L.)

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Abstract

Combining ability analysis of ten crosses made in L x T fashion involving two lines and five testers indicated that the mean sum of squares were significantly different among parents, crosses, parents x crosses indicating that the parental lines used in crossing possess sufficient genetic diversity for all the characters studied except parents x crosses interaction and testers for plant height. The contribution of lines was more compared to testers for days to flowering, days to maturity, plant height, number of capsules/plant, test weight and seed yield but testers contributed much for the seed yield. The magnitude of variance due to sca was predominant compared to gca for all the characters revealing that non additive gene action is important for days to 50% flowering, maturity, plant height, number of capsules per plant, test weight and seed yield per plant. The line YLM 66 was found to be the best general combiner for days to flowering, days to maturity, plant height, number of capsules/plant, test weight and seed yield. Among testers NIC 17274 followed by AT 324 and NIC16220 were found to be the best general combiners for seed yield, capsules per plant, test weight and early maturity while DS 18-46 recorded higher *per se* performance for seed yield and yield components but was found late in maturity. Of the 10 single cross combinations, five crosses viz: YLM 66XNIC 17274, YLM 66X NIC16220, YLM66X AT 324, YLM 146 XNIC 17274, YLM 146X AT 324 and YLM 146 X DS 18-46 were found most promising for seed yield and majority of the yield



components. The crosses viz; YLM66 x NIC 17274, YLM 66 X NIC16220, YLM 146XNIC 17274 with high mean for seed yield and yield components and significant sca effects involved parents of high general combining ability for seed yield. Selections in these crosses may be postponed to later generations so as to get desirable transgressive segregants. The other three crosses viz., YLM 66X AT 324, YLM 146 x DS 18-46 and YLM 146 X ATG 324 with high *per se* performance for seed yield and non significant sca effects involved H x H general combining ability parents which can be handled through pedigree method of breeding so as to isolate superior genotypes.

MAPPING OF RESISTANCE (R) GENES IN PLANTS

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Abstract

Gene mapping represents map of genes present inside chromosome of an organism. In eukaryotic system, nucleus is contained inside the cell that possesses chromosomes with large number of genes present on them as DNA segment. It is easy to visualize the phenotype of an organism simply by looking at it but genotype can only be determined through gene mapping that involves the procedure to identify locus of a particular gene in order to depict presence and position of target gene of interest. Gene mapping is required to find gene-locus in a vast region of interest where one cannot go for looking the position of each and every gene. It is also used to measure distance between various genes, identify markers and to place a collection of molecular markers on to their respective positions on the genome. The pre-requisites for gene mapping include development of molecular markers with high heritability in addition to tight linkage with target gene of interest in order to locate one or few genes in total genome of organisms as well as mapping population that may be F2 progenies, backcross progenies, double haploids, recombinant inbred lines and near isogenic lines. Gene mapping may be classified into genetic mapping and physical mapping. Genetic mapping is used to determine the linkage/distance between two R-genes based on their recombination frequencies and, thus, determines the chances of their simultaneous inheritance but does not reveal about exact position of gene. On the other hand, physical mapping shows physical location of R-genes whereas comparative maps are used to compare genetic as well as linkage maps based on shared markers. Gene mapping is a potential tool in plant pathology to find out diseased genotype and genes responsible for it by comparing genome maps of healthy and faulty individuals, to use gene therapy to cure abnormalities. It may also have applications in plant breeding including development of disease resistant genotypes and can be used in development of anti GMO's.

SITUATION AND PROBLEMS OF CHILD BEGGING : A SOCIAL WORK STUDY (WITH SPECIAL REFERENCE TO GAFUR BASTI OF HALDWANI MUNICIPAL CORPORATION, NANITAL)

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Abstract

Now the question arises how to stop this begging; In India, this task seems very difficult because people here are serious, they are not ready to curse anyone, to end this, we all have to be determined not to give alms to the beggars. It can also be stopped by making proper arrangements of clothes and housing, when these real incapacities are arranged then they will be removed from beggary as well as others Minister will not have the opportunity to ask for alms in his hiding place and they automatically will all be forced to find their livelihood could not be effective until these other measures now. Begging is a serious problem in India. Which has been in practice for several decades? In the Indian constitution, begging is called a crime. Still thousands of people are seen begging on the streets of the country. In whose background the following reasons are seen in direct/indirect form: Born beggars -who are born in the house of a beggar. They consider beggary as their occupation. Physically weak people who adopt begging. Despite being physically healthy, people go begging, pretending to have a physical disability. With the help of religion, some families beg their children. The Uttarakhand government has also banned begging in the entire state. Prior to this, begging was banned in Haridwar district of Uttarakhand. Although the order of prohibition was issued under the Juvenile Justice Act earlier on the begging of children below 18 years, but now the government in a notification issued by the



Governor, Section of Uttar Pradesh Beggars Resistance Act 1975. The government said that after banning beggary, arrangements for rehabilitation of beggars will also be made. According to which the Directorate of Social Welfare is preparing to construct beggary houses in all the districts soon so that through them, the beggars will be rehabilitated by encouraging them for self employment

TO STUDY THE ACADEMIC ACHIEVEMENT AND PARENT CHILD RELATIONSHIP OF ADOLESCENT

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Abstract

Present study was conducted to find out relationship between academic achievement & parent child relationship of adolescent Girls in the age group of 15-17yrs. Academic achievement test of Dr. A.K. Singh & A. Sen Gupta & family relationship Inventory of J.P. Sherry & J.C. Sinha was used for study data was systematically tabulated & inference were drawn, through the statistically analysis. The result reveal that the Girls who are accepted by their parents, their 'r' value is +0.74 & boys value is +0.72 which shown high degree positive correlation and their academic achievement is also higher. The Girls who are concentrated by their parents has also high academic achievement & their 'r' value is +0.65 & boys value is +0.60 which shown positive correlation. The Girls who are avoided by their parents has low level of academic achievement & their 'r' value is +0.46 & boys value is +0.40 which shows moderate degree positive correlation.

BIOMASS DENSIFICATION- A NOVEL TECHNOLOGY FOR CONVERTING WASTE TO ENERGY

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Abstract

Presently India depends largely on import of fossil fuels to meet energy demands. Approximately 80% of India's electricity production comes from fossil fuels. Not only electricity but all other household chores depend on its availability. For the continuous growth of country as well as to meet the requirement we need a constant supply of energy source. Fossil fuels being non renewable in nature would totally exploit one day, so we have to look for other alternatives. Utilization of biomass energy is gaining eye of everyone for future needs, for it would be cheap and environment friendly. Biomass is any organic matter that is available on a renewable or recurring basis, including dedicated energy crops and trees, agricultural food and feed crops, agricultural crop wastes, wood wastes, aquatic plants, animal wastes, municipal wastes and other waste materials, and is recognized as one of the major potential sources for energy production.

HETEROSIS STUDIES FOR YIELD AND YIELD COMPONENTS IN PEARLMILLET (*Pennisetum glaucum* (L.) R. BR.)

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Abstract

The line × tester analysis involving fifty hybrids, fifteen parents (five lines and ten testers) and three checks including national check GHB 558, local check VPMH 7 and commercial check Kaveri super boss were used to assess the magnitude of heterosis for grain yield and its components in pearl millet under rainfed conditions at RARS, Vijayapur, Karnataka. Thirty five hybrids showed significant positive heterosis over mid parent and thirty three hybrids showed significantly positive heterobeltiosis for grain yield per hectare. Twenty four hybrids exhibited significant positive standard heterosis over check GHB 558, three hybrids over check VPMH 7 and three hybrids over best check Kaveri super boss for grain yield per hectare. Whereas, thirty four hybrids exhibited significant positive heterosis over mid parent and thirty one hybrids exhibited significant positive



heterobeltiosis for dry fodder yield per hectare. Twenty two hybrids over GHB558, one hybrid over VPMH 7 exhibited significant positive standard heterosis for dry fodder yield per hectare. Three hybrids viz., ICMA 01666 × PMBSN-73 (3561.852 kg/ha), ICMA 01666 × PMBSN-81 (3538.845 kg/ha) and ICMA 01666 × PMBSN-66 (3494.023 kg/ha) were superior for grain yield per hectare. Hybrids ICMA 01666 × PMBSN-73 (11225.535 kg/ha), ICMA 05444 × PMBSN-81 (11049.501 kg/ha) and ICMA 01666 × PMBSN-66 (10980.262 kg/ha) were superior for dry fodder yield per hectare. The hybrid ICMA 01666 × PMBSN-73 exhibited highest grain yield and dry fodder yield per hectare and this hybrid will be evaluated across locations and years for further release in state.

NESTED PCR ASSAY FOR DETECTION OF RICE ORANGE LEAF PHYTOPLASMA IN THE ZIGZAG LEAFHOPPER VECTOR, *RECILIA DORSALIS* (MOTSCHULSKY)

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Abstract

Rice Orange Leaf was widely distributed in South and South-east Asia including Thailand, Malaysia, Indonesia, China, Sri Lanka and the Philippines. ROL is transmitted by the leafhopper *Recilia dorsalis* Motschulsky, which also transmits rice dwarf virus and rice tungro virus. These diseases differentiate from ROL on symptoms and geographic distribution. In the Philippines, the ROL phytoplasma is transmitted by *R. dorsalis* in a persistent manner, with an incubation period of 15-33 days. 'Candidatus Phytoplasma asteris' group phytoplasmas have been reported in many crops in India, Rice Orange Leaf phytoplasma is the first report of 16Srl aster yellows group phytoplasma infection of rice (*Oryza sativa* L.) in India. Phytoplasmas are known to be transmitted by plant hoppers, leafhoppers and psyllids in a persistent, propagative manner. In our present study, Nested PCR assay using primer pairs (p1/p7 and R16F2n/R16R2) amplified at ~ 1.2 kb of 16S rRNA gene of phytoplasma from the vector collected from infected plant. It was found that the nested PCR assay had proven to be a reliable molecular tool for detection of the Rice Orange Leaf (ROL) phytoplasma in leafhopper vector. These results suggested that rice orange leaf phytoplasma was detected in Zigzag leaf hopper and reported for the first time in India.

ASSESSMENT OF IRRIGATION WATER FOR CROP PRODUCTION IN NORTH WESTERN RAJASTHAN

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Abstract

In Rajasthan, arid and semi-arid tract occupy about three fourth of the geographical area of the state and underground water is the main source of irrigation in this belt. Due to limited availability of irrigation water in these areas, quality of irrigation waters to be assumed of great importance. Underground waters of arid and semi arid tracts have generally high salt content and high proportion of sodium. Poor quality of irrigation water is an important factor in the development of salinity and alkalinity in the soils. Water containing high amount of dissolved soluble salts affects the soil properties. These salts affect the plant growth either due to their presence in higher quantities or changes in the exchange complex of the soil colloids or by indirect effect on soil microbes and plant root activities, or a combination of all these factors. The salt content of soil was closely related to salt content of irrigation waters. Therefore, quality of irrigation waters in relation to its impact on soil properties is of particular interest in arid and semi arid areas. Detailed systematic information are not yet available about salt concentration, salinity levels and available nutrient for plant growth in soil and quality of underground irrigation waters of this area, which is essential for sustainable resource management. Therefore, an urgent need was felt for extensive and well planned investigation of irrigation water for suggesting guidelines towards better utilization. The comprehensive in sequence is missing as regard of assessment of underground irrigation water of around Jorbeer, Gangasahar & Binasar, Hussensar, Napasar, Badrasar and Raisar villages of Bikaner district. Hence, it is very indispensable to classify the underground waters utilize for irrigation of field with respect to their fittingness for growing of crops. The study was carried out in these areas during 2018-2019. All the water samples collected were during July to November 2018, December 2018 to April 2019, July to November 2019 and December 2019 to April 2020 and subjected to chemical analysis in the laboratory for pH, EC, soluble cations (K^+ , Ca^{++} , Mg^{++}



and Na^+ , soluble anions (CO_3^{2-} , HCO_3^- , Cl^- and SO_4^{2-}), RSC and SAR by adopting standard methods and procedures. Representative ground water samples were collected from Jorbeer, Gangasahar & Binasar, Hussensar, Napasar, Badrasar and Raisar villages of Bikaner district and analyzed for cationic and anionic composition according to standard methods. Ground waters were grouped on the basis of availability of SAR, and RSC values. Sodium adsorption ratio of water samples were estimated as per U.S.D.A. Hand book 60. Result revealed that pH of irrigation water was varied and per cent of irrigation water samples between 8.6-9.5 pH were 8.33, 14.58, 32.50, 21.43, 31.25 & 26.79% at Jorbeer, Gangasahar & Binasar, Hussensar, Napasar, Badrasar and Raisar location, respectively and remaining 15 and 16.67% irrigation water samples were >9.5 at Hussensar and Badrasar location, respectively. Remaining all irrigation samples were < 8.5 pH. Per cent irrigation water samples under medium salinity waters (EC 3.0 - 5.0 dS/m) were 4.17, 14.58, 27.50, 17.86, 27.08, and 26.79 at Jorbeer, Gangasahar and Binasar, Hussensar, Napasar, Badrasar and Raisar, respectively. Per cent irrigation water samples were 22.50, 1.79, 29.17, 3.57% under high salinity waters (EC 5.0-10.0 dS/m) at Hussensar, Napasar, Badrasar and Raisar, respectively except 2.50% which was under very high salinity waters (EC > 10.0 dS/m) at Hussensar location. Remaining irrigation samples were under low salinity waters (EC < 3.0 dS/m). Percent irrigation water samples under medium sodic waters (SAR 20-30) were 29.17, 14.58, 12.50, 16.07, 14.58 & 28.57%; 2.08, 8.33, 12.50, 8.93, 18.75 & 14.29% under high sodic waters (SAR 30 - 40) and 6.25, 22.92, 57.50, 25.00, 60.42 & 33.93% under very high sodic waters (SAR > 40) at location of Jorbeer, Gangasahar & Binasar, Hussensar, Napasar, Badrasar and Raisar, respectively. Remaining samples were < 20 SAR at all the location and none of irrigation water samples were found under < 5 SAR. 52.08, 37.50, 30.00, 25.00, 14.58 and 51.79% irrigation water samples were under medium alkali waters (RSC 2.5 - 5.0 me/l) and 8.33, 18.75, 30.00, 30.36, 27.08 and 19.64% under high alkali waters (RSC 5-10 me/l) at location of Jorbeer, Gangasahar & Binasar, Hussensar, Napasar, Badrasar and Raisar, respectively. Remaining irrigation water samples were 2.08, 4.17, 20.00, 31.25, and 5.36% high alkali waters (RSC > 10.0 me/l) at Jorbeer, Gangasahar & Binasar, Hussensar, Badrasar and Raisar, respectively. Remaining all the samples at respective locations were less than RSC 2.5 me/l. In the places/villages/locations, where Indira Gandhi Nahar Project (IGNP) water is available for irrigating the field, but in sufficient quantities of irrigation water is not available to meet out the evapotranspirational demand of crops. Underneath these circumstances, the strategies for obtaining higher crop productivity could include mixing of poor quality irrigation water with good quality water to get irrigation water of average quality of water for use throughout the year for different crops. On the other hand, good quality of irrigation water may be used at the most critical stages of growth and therefore the saline water at the stages where the crop has comparatively more tolerance. Further research is desired to identify the best options considering the tolerance of crops at various growth stages. Problematic soil in semi arid region is formed because of indiscriminate application of irrigation with poor quality under-ground water. Low irrigation water quality i.e. saline, it is unfit for irrigation in alkali and highly alkali soils and in haphazard use created secondary salinization and sodication to the extent that growth of the crop may be stopped/ceased.

ESSENTIAL PLANT IONS AVAILABILITY IN SOIL OF NORTH WESTERN RAJASTHAN

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Abstract

The north western region of Rajasthan is characterized by stormy southwest winds along with frequent dust storms. Soils of the zone are sandy in texture, very low in fertility with regard to all most all nutrients. Soils are aeolian in nature with extremely high permeability at surface and low in nutrient and water retention capability. In arid region, blanket use of fertilizers over a period of time has resulted into nutrient disproportion in soil. Moreover, heavy dose of straight fertilizers containing only macro-nutrient has led to scarcity of macro and micronutrients at various locations. Applications of fertilizers by the farmers in the fields without prior information of soil fertility status results in unfavorable effects on soil as well as on crop in terms of nutrient deficiency/ toxicity either by the insufficient or overdose of fertilizers. Therefore, the present study was undertaken to judge essential plant ions availability in the soils of arid crops region of Bikaner district to evaluate their magnitude of sufficiency/deficiencies and imbalances to refine fertilizer recommendations and promote site specific nutrient management. Under this study, farmer's fields were selected randomly by keeping in view the identified major area of Bikaner districts of Rajasthan. Composite surface soil samples (0-15 cm) were collected from Jorbeer, Gangasahar & Binasar, Hussensar, Napasar, Badrasar and Raisar villages of Bikaner district before sowing *rabi* and *kharif* crops and soil samples were air dried followed by sieving by 2 mm sieve to remove gravels, stones and organic and crop residues by using standard procedure. The processed soil samples were analyzed for their available macro and micronutrients for plant growth employing



conventional methods. Result revealed that pH of soil ranged between 9.89-7.20, 7.15-9.95, 7.88- 9.73 and 7.62-9.86 with the mean values of 8.51, 8.81, 8.71 and 8.8; EC (ds/m) of soil ranged between 0.14-0.89, 0.08-0.75, 0.14-0.87 and 0.12-0.57 with the mean values of 0.89, 0.75, 0.87 and 0.26, respectively, during July to November 2018, December 2018 to April 2019, July to November 2019 and December 2019 to April 2020. The pH of study area was varied from normal to alkaline. Accumulation of bases especially Na^+ under low rainfall conditions seen to be the primary reason for alkaline soil reaction. The higher values of EC of surface soils might be due to high evaporation demand of the arid-ecosystem due to prevailing high temperature and low rainfall and irrigating soils with poor quality underground waters. Organic carbon content of surface soils were varied from 0.03-0.06, 0.06-0.50, 0.07-0.56 and 0.03-0.08% with mean value 0.18, 0.18, 0.19 and 0.19% ; nitrogen content of surface soils were ranged between 44.96-349.87, 67.12-450.91, 74.25-311.45 and 38.07-360.56 N kg/ha with mean value 156.73, 161.00, 163.83 and 147.23 during July to November 2018, December 2018 to April 2019, July to November 2019 and December 2019 to April 2020, respectively. The low organic carbon content of these soils could be ascribed to occasional addition of organic materials, scanty natural vegetations and poor decomposition due to low rainfall and rapid oxidation due to high summer temperature and wind erosion. Soils of the studied area were found to be low in available nitrogen content. Available phosphorus content of surface soils were ranged from 6.11-20.24, 3.11-29.45, 6.19-20.09 and 5.95-18.78 P kg /ha with mean value 12.41, 12.79, 12.01 and 11.83; available potassium content of surface soils were varied from 118.38- 330.23, 117.70-347.29, 119.17-382.17 and 103.88-355.81 K kg/ha with mean value 242.25, 221.52, 230.01 and 218.02, respectively, during July to November 2018, December 2018 to April 2019, July to November 2019 and December 2019 to April 2020. Thus, the soils of the study area were found to be low to medium in available phosphorus content and found medium in K. The available iron content of surface soils varied from 1.54-6.44, 2.35-7.90, 0.27-7.10 and 2.66-6.89 mg/kg with mean value 4.17, 4.61, 4.48 and 4.60; available manganese content of surface soils varied from 1.45- 3.85, 1.29-6.34, 1.34-8.73 and 1.57-7.29 mg/kg with mean value 2.30, 2.14, 2.64 and 2.55 mg/kg; available Zn content of surface soils at different sites varied from 0.17-1.39, 0.24-1.20, 0.11-1.30 and 0.22-1.11 mg/kg with mean value 0.53, 0.54, 1.11 and 0.51 mg/kg and available copper content of surface soils were ranged between 0.13-1.03, 0.12-0.98, 0.09-2.75 and 0.12-1.33 mg/kg with mean value 0.28, 0.22, 0.26 and 0.25 mg/kg during July to November 2018, December 2018 to April 2019, July to November 2019 and December 2019 to April 2020, respectively. Available iron, zinc and copper content were lower in soils of Bikaner, whereas, available Mn content was slightly higher in surface soils of Bikaner district. Availability of these nutrients was mainly influenced by organic carbon content followed by silt plus clay content and pH. The variations in available iron, manganese, zinc and copper status of surface soils, respectively could be explained by soil properties like silt plus clay content, organic carbon content, EC and pH.

SOCIETAL APPLICATIONS OF ISRO IN AGRICULTURE

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Abstract

A satellite is an artificial object which has been intentionally placed into orbit to keep an eye on earth. There are wide range of satellite applications like meteorology, television broadcasting, mobile telephony, navigation, remote sensing, etc.,. Space systems are increasingly being used in multiple fields, such as financial management, education, tele-medicine, scientific research and disaster management, to gather real time information and increase efficiency and connectivity. In agriculture it is used in various fields like agro-climatic mapping, soil mapping, watershed development, agricultural drought assessment, pest assessment and control, land use/land cover mapping, crop production forecasting, cropping system analysis, fisheries development, wasteland management, water resource management, desert resource management, coastal resource management, natural resource management, crisis management and precision farming (PA) or satellite farming or site specific crop management (SSCM) are the major satellite based technologies used in agriculture. Development of India can only be achieved by developing rural areas. Even then many rural people were deprived from accessing information related to their development. Hence satellite technologies generated lots of hopes in reaching the unreached through technological breakthrough. Apart from the cultural societal application can further explore in the form of Precision farming, Site specific crop management, watershed development, real time forecasting etc., have promising results towards meeting information needs on a continual basis. Hence, there is a great scope and prospect for space technology to move the country on the path of development and ensure agricultural development and holistic development of India.



CONSTRAINTS FACED BY THE TRIBAL WOMEN

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Abstract

The study was carried in Heggadadevanakotetaluk of Mysuru district during 2018-19 to assess the constraints faced by tribal women. Ex post facto research design was employed for the study. The major extension constraint faced by the tribal women was 'Inadequate technical support from scientists and developmental departments' (82.50 %), 'less subsidies available in the development departments' (48.33 %) was the major economic constraint, Alcoholism (72.50 %) of husbands was the major social constraint and Poor hygiene facility (64.16 %) was the major infrastructural constraint. Based on the results, it can be concluded that there is a need of addressing the constraints faced by tribal women to make them more empowered socially, economically and culturally by providing them with proper extension, economic, social and infrastructural facilities in order to uplift the weaker section of these tribal communities.

MSMES : FACILITATOR OF EMPLOYMENT

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Abstract

The Micro, Small and Medium Enterprises (MSME) sector has emerged as a highly vibrant and dynamic sector of the Indian economy over the last five decades. It contributes significantly in the economic and social development of the country by fostering entrepreneurship and generating large employment opportunities at comparatively lower capital cost, next only to agriculture. MSMEs are complementary to large industries as ancillary units and this sector contributes significantly in the inclusive industrial development of the country. Micro sector with 630.52 lakh estimated enterprises accounts for more than 99% of total estimated number of MSMEs. Small sector with 3.31 lakh and Medium sector with 0.05 lakh estimated MSMEs accounted for 0.52% and 0.01% of total estimated MSMEs, respectively. Out of 633.88 estimated number of MSMEs, 324.88 lakh MSMEs (51.25%) are in rural area and 309 lakh MSMEs (48.75%) are in the urban areas. Some major problems with MSMEs are lack of adequate capital and timely finance. Non-availability of suitable technology, Competition from MNCs, Low production capacity, Ineffective marketing strategy, Constraints on modernization & expansions. Inferior quality impact export competitiveness. Cumbersome government procedures and rules for establishing new units. Based on the above data it can be concluded that MSME's are boon for reducing regional imbalances and a means to utilize the natural and abundant human resources available in India. It helps in generating employment opportunities in the rural areas with low capital, raising the real income of the people and the government should continue to put concerted efforts for holistic development of MSMEs in key areas like human capacity development, knowledge services, access to finance, technology, infrastructure, market access, and ease of doing business.

STUDIES ON READY-TO-SERVE BEVERAGE FROM AMLAFRUIT WITH DIFFERENT HERBS

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Abstract

Now a day's people are suffering from number of diseases like diabetic, Blood Pressure, cancer, obesity etc., Due to their life style and food habits. Ready to serve beverages has made a place in the diet of people especially in today's world of fast pace living. Ready to serve juices provides instant and quick serving beverages, which is hassle free, easy and quick to serve, as it overcome to strenuous method of preparing fresh juice. Understanding the benefits of Amla, Ginger, and Mint which is having antibacterial, anticarcinogenic, antiemetic, antiviral, antitumor, anti-cardiotoxic properties which officious for treatment of diabetes, cancer arthrosclerosis, liver etc. Herbs have medicinal, aromatic, phototherapeutic properties. It is rich source of micro nutrient and phenolic compounds. During this study, the process for the preparation of Amla, Ginger and Mint



RTS are formulate and standardize the recipe. The various analysis are done like different major and minor compounds of raw material and RTS, microbial study and sensory evaluation. So as result The Natural beverages are those prepared from fresh aonla fruits and herbs gives the more benefits so as to protect the body. This RTS beverage can serve to be the richest sources of vitamin C, antioxidants and various phenolic compounds which are responsible for removing trace elements present in the intestine. This product serve as the immunity food during various pandemic to increase the immunity power of the body. Beverages based on aonla, ginger and mint contain RTS daily serve a considerable amount of attention reflecting growing awareness of the natural beverages in the market place.

NGOS AND KVKs ARE BASE OF RURAL DEVELOPMENT : AN APPRAISAL

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Abstract

In Indian condition, rural development is a complex process as it involves continuous reorientation and adaptation of traditional values, practices and institutions in order to incorporate increasing corpus of scientific knowledge and technologies to enhance quality of life and welfare of the people. It is essentially a problem of change in modernization which can be handled effectively only with the active participation of the people in every stage of decision making. It is now widely believed that rural development as a people-centered programme may be viewed as a process of change to brought about and sustained by the people or the target group themselves. For this to happen people have to be organized and enable to be active participants of the development process. The KVKs are equally involved for agriculture and rural development. Given the manner government machinery operates, this job cannot be performed by the government servants only. This role is appropriately suited to the NGOs which have emerged as viable forces for the articulation of people's needs and grievances. Recognizing this government policy has also been to encourage NGOs and KVKs to participate in the task of rural development wherever and whatever way it is feasible. The task of development is so huge and complicated that just implementing government plans is not sufficient to fix the problem. To achieve this, a holistic vision and collaborative efforts involving various departments, agencies and even NGOs is required. Owing to such a great need, the number of NGOs and KVKs in India is increasing rapidly and, at present, there are about 30,000 active NGOs and 750 KVKs in India.

ANIMAL HEALTH PERCEPTIONS AND CHALLENGES AMONG SMALLHOLDER FARMERS

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Abstract

Improvements to smallholder farming are essential to improvements in rural prosperity. More than 80% of the world's poor people live in rural regions, and the majority of them are smallholder farmers. Smallholder farmers have an important role in improving rural prosperity in the state of Bihar. Small farmers in the Koshi region of Bihar operate mixed farming enterprises in a resource limited environment, which is subject to seasonal flooding. Participatory techniques, were used to elucidate the animal health challenges experienced in this landscape in order to inform and guide future animal health education and interventions. Access to veterinary services and medicines is limited by both financial and geographic constraints. Interviewees discussed nutritional and management issues such as poor availability of fodder and grazing land, while meeting attendees preferred to concentrate discussions on animal health issues. Livestock keepers were adept and consistent at describing disease syndromes. The key challenges identified by farmers were: foot-and-mouth disease; Newcastle disease; haemorrhagic septicaemia; chronic fasciolosis; diarrhoea; bloating diseases; goat pox; and sarcoptic mange. Improvements in the efficiency of farming in this region is a prerequisite for the local achievement of United Nations Sustainable development goals. There exist clear opportunities to increase productivity and prosperity among farmers in this region through a combination of vaccination programmes and planned animal management schemes, driven by a programme of participatory farmer education. Planned programmes of vaccination for foot and mouth disease, haemorrhagic septicaemia, goat pox and



Newcastle disease would have the potential to yield great benefits, while biosecurity education could help to limit the introduction and spread of these diseases.

IMPACT OF CARBON SEQUESTRATION ON CLIMATE CHANGE

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Abstract

Carbon sequestration is a phenomenon and secures the atmospheric CO₂ in the form of carbon in to the soil, that would otherwise remain in atmosphere and results in negative impact on climate. Earth's atmosphere comprises of several GHG's such as CO₂, CH₄, N₂O, water vapour and other gases consequently results in to natural greenhouse effect. Since C as CO₂ is the key player in global warming, hence most of the options aimed at addressing the global warming are directed towards trapping of atmospheric C. Current level of GHG's are 406 ppmv, 1893ppbv, 326 ppbv respectively. SOC represents a stock of around 1,500–2,400 Gt C (5500–8800 Gt CO₂) in top layers of soil globally. Global estimates of soil C sequestration potential vary considerably by 2–5 Gt CO₂/year. Soil have lost around 140–150 Gt C (510–550 Gt CO₂) through intensive cultivation practices. Ground covers is an efficient sink for atmospheric carbon sequestration and improve soil fertility and to protect the soil from erosion. Grassland management to enhance production and rehabilitate degraded lands leads to carbon sequestration. Improved grazing management leads to an increase of soil carbon stocks by an average of 0.35 Mg C ha⁻¹ yr⁻¹. Selection of crop species with greater biomass in the shoot and root systems usually enhances the C input and SOC. Soil carbon sequestration could be a significant GHG removal strategy at the same time improve the soil fertility.

ASSESSMENT OF GENE EFFECTS IN MAIZE GENERATIONS FOR QUALITY TRAITS

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Abstract

Maize (*Zea mays* L.) is the world leading, economically and nutritionally important cereal crop and is locally known as 'makka'. It is being cultivated in different agricultural zones under diverse situations of rainfall and altitude around the world. Due to great diversity of morphological, physiological and biochemical traits of maize, together with a very broad adaptability and genetic variability provide the development of types with various purposes in the process of selection. Different maize types with specific traits are also grown like, high-lysine maize, high oil maize, white-seeded maize, sweet maize and popping maize. It has been preferred by the evolutionists, geneticist and plant breeders to develop concepts, quantitative genetic models and improved populations/hybrids for practical use over last many decades. The dramatic increase in production and yield levels of maize during the last four decades is mostly due to genetic improvement of hybrids and better production technology. It is well known fact that greater is the variability among the parents, the tremendous are the chances of further improvement. The genetic improvement of maize or any other crop largely depends on the type and relative amount of genetic components and presence of non-allelic interaction for different characters in the plant materials under investigation. Estimation of the types of gene action involved in the expression of traits, the level of additive effects and the degree of dominance are very important in designing a breeding method for improving the trait of interest. Generation mean analysis, a biometrical method developed by Mather and Jinks (1982), is a useful technique for determining gene effects for polygenic traits. It is a useful technique that provides the estimation of main genetic effects (additive, dominance and their digenic interactions) involved in the expression of quantitative trait such as yield and its components traits and besides yield, the method was successfully applied for research on mode of inheritance of numerous other traits including quality traits. Therefore, the present study was conducted to evaluate genetic and epistatic effects governing the inheritance of quality traits of maize. The present study was carried out with six crosses viz. HKI 209 x HKI 1128, HKI 209 x HKI 163, HKI 1332 x HKI 1128, HKI 1332 x HKI 163, HKI 325-17AN x HKI 1128 and HKI 325-17AN x HKI 163 with their six generations viz. P₁, P₂, F₁, F₂, BC₁ and BC₂. The results obtained for genetic components (genetic effects) have been explained for quality characters of maize viz., protein content, tryptophan content, oil content and starch content (expressed in percentage) according to the



analysis procedure for three parameter and six parameter models. Both individual scaling test (A, B, C and D) and joint scaling tests were used in all the six crosses to determine whether at all, the additive-dominance model was adequate for different traits. Further, the three parameters m , (d) and (h) were estimated through joint scaling test to depict whether the additive-dominance model was adequate or not or to detect epistasis. In the presence of epistasis or inadequacy of three parameter model, the additive (d) and the dominance (h) effects and non-allelic interaction components (additive $\times$ additive (i) , additive $\times$ dominance (j) and dominance $\times$ dominance (l)) of generation means were estimated according to Hayman (1958). The chi square (χ^2) value was significant according to joint scaling test for all the characters in all the six crosses studied, except for oil content in cross HKI 325-17AN $\times$ HKI 1128 which were not significant, showing the adequacy of three parameter model where the additive dominance model was found to be fitted. Also the significant values of scale A, B C, D in all the crosses for all the characters indicated the presence of epistasis (non-allelic interaction), which was also inferred from the generation means. As the three parameter models did not satisfactorily explain the genetic variability for all these traits, therefore, a six parameter model was applied to accommodate epistatic interactions. Results revealed that duplicate type of interaction was apparent for protein, tryptophan, oil and starch content in cross HKI 325-17AN $\times$ HKI 163; oil, tryptophan and starch for cross HKI 1332 $\times$ HKI 1128; however, complementary type of interaction was reported for protein content in cross HKI 325-17AN $\times$ HKI 1128 and oil content in cross HKI 209 $\times$ HKI 163. For protein content additive effects were significant for HKI 209 $\times$ HKI 1128, HKI 1332 $\times$ HKI 1128, HKI 1332 $\times$ HKI 163 as well as epistatic interactions played a significant role in inheritance of this trait and it was also revealed that significant magnitude of l and non significant magnitude of h indicated the dispersal of alleles in the parents. The involvement of duplicate type of non-allelic gene interactions was prominent to explain the inheritance of tryptophan content. For oil content additive, dominance and interactions played a significant role in inheritance of this character in these crosses however the magnitude of dominance effect was more pronounced. For starch content the significant magnitudes of both d (additive) and h (dominance) and all non allelic interaction (i , j and l) in HKI 1332 $\times$ HKI 163, HKI 325-17AN $\times$ HKI 1128 and HKI 325-17AN $\times$ HKI 163 revealed that additive, dominance and interactions played a significant role in inheritance of this character in these crosses. It was concluded that both additive $[d]$ and dominance $[h]$ gene effects were significant for all of the traits studied, indicated that both additive and dominance effects were important in the inheritance of quality traits. Significant epistatic gene interaction (i , j and l) were also observed for all the quality characters under study suggesting the existence of epistasis gene action in the maize crosses.

ROLE OF AGRICULTURAL BIOTECHNOLOGY TO ENHANCE CROP PRODUCTIVITY IN POST COVID ERA

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Abstract

The ongoing coronavirus pandemic is a public health emergency with grave implications for the population of the world. India, as part of the global community, has been adversely impacted by ongoing health crisis— especially the poor and marginalized. However, there is a relatively low understanding of socio-economic science. This pandemic is a global health crisis and can also lead to the food security crisis in India if correct measures are not taken. In India, it is imperative to minimize the adverse effect and disruption of livelihood of the poor and marginalized. Although supplies of staples, fruits, vegetables, and meats have been adequate during the COVID-19 outbreak so far, still there are threats to food security, in the long term. Restrictions on transportation and movement of people have already led to some food logistic challenges. India needs to create more synergies in food technology, agriculture, biotechnology. Prioritizing and adaption of innovation should act as main drivers of productivity growth and improved sustainability. The application of biotechnology to agriculturally important crop species has traditionally involved the use of selective breeding to bring about an exchange of genetic material between two parent plants to produce offspring having desired traits such as increased yields, disease resistance, and enhanced product quality. The exchange of genetic material through conventional breeding requires that the two plants being crossed (bred) are of the same, or closely related, species. Such active plant breeding has led to the development of superior plant varieties far more rapidly than would have occurred in the wild due to random mating. However, traditional methods of gene exchange are limited to crosses between the same or very closely related species; it can take considerable time to achieve desired results; and frequently, characteristics of interest do not exist in any related species. Modern biotechnology vastly increases the precision and reduces the time with which these changes in plant characteristics can be made and greatly increases the potential sources from which desirable traits can be obtained. Fostering Genetically Modified Organisms



(GMOs), using genetic engineering is another way of contributing to food and nutrition benefits while boosting agricultural production besides reducing a post-harvest loss. The application of biotechnology in agriculture has resulted in benefits to farmers, producers, and consumers. Biotechnology has helped to make both insect pest control and weed management safer and easier while safeguarding crops against disease. Biotech crops can make farming more profitable by increasing crop quality and may in some cases increase yields. The use of some of these crops can simplify work and improve safety for farmers in the coming years. This may allow farmers to spend less of their time managing their crops and more time on other profitable activities.

GROUP VARIABLES OF SELF-HELP GROUPS UNDER NATIONAL RURAL LIVELIHOOD MISSION

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Abstract

The government of India since independence has the aim to uplift the poor and to alleviate poverty. To overcome this government started many poverty alleviation programmes to provide self-employment to the poor section of the society. All these schemes were target oriented but the issue of poverty alleviation was so grave and complicated that the desired results remained an unachieved or distant dream. After lots of introspection and feedback of previous schemes, a new philosophy and approach saw the light of the day and Swarn Jayanti Grameen Swarojgar Yojna (SGSY) was restructured as National Rural Livelihood Mission (NRLM). The strategy was to include a women member from the rural households to be part of a self-help group. The National Rural Livelihoods Mission (NRLM) became the world's largest poverty alleviation programme and evolved as a national movement in 2011. Universal social mobilization, financial inclusion and livelihood enhancement are the three pillars of the NRLM. A study was undertaken to study the various group variables that affect the performance of the Self-Help Groups (SHGs) in the light of NRLM-Aajeevika in the Uttarakhand state. The data was collected using the appropriate interview schedule in the Dehradun and Udham Singh Nagar district of Uttarakhand state. The group variables under study include group process, participation, task function, maintenance function, group atmosphere and interpersonal trust respectively.

PRESENCE OF *CUSCUTAREFLEXA* ROXB ON VARIOUS HOST PLANTS IN MANDSAUR DISTRICT OF MADHYA PRADESH

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Abstract

Cuscutareflexa (Dodder) is important flowering plant parasite known as amarbel, parasitic on a number of variety of plants of agricultural and horticultural crops and other plants. When this parasitic plant attaches itself to a plant, it wraps itself around it, insert themselves into the vascular system of the host, produces haustoria and absorb the food material from host. As far as the medicinal value is concerned, it is used internally for the treatment of protracted fevers and externally in body pains and itchy skin. In the form of Ayurvedic medicine, used to treat difficulty in urinating, jaundice, muscle pain and coughs. Surveys based study was conducted to find out the host plants of *Cuscutareflexa* Roxb. from different localities of Mandsaur District of Madhya Pradesh, India. During survey six host plants viz *Azadirachta indica* A. Juss., *Bougainvillea spectabilis* Willd., *Ficus religiosa* L., *Hibiscus rosa-sinensis* L., *Acacia nilotica* (L) Willd. Ex Del and *Thevetia peruviana* Pers.) K. Schum were identified. *Cuscutareflexa* belong to family Convolvulaceae showing character with extensive leaflessness having parasitic climber nature. The herb exhibit large covering of host plant with yellowish green colour and thread like twinning. Due to lack of chlorophyll it cannot make its own food by photosynthesis. The plant expands its canopy to various trees, shrubs, herbs and affects important various crops. The dependence of plant is on their host plant for food and nutrition. *C. reflexa* having various flower colours produced from white to pink with large quantity Seeds which can survive in the soil for many years in the search of the appropriate host. This study aims to observe the severity of this host plant in the region so that the probability of beneficial use may be searched out and negative effect on agricultural and horticultural crops might be managed.



ETHNOBOTANICAL STUDY OF MEDICINAL PLANTS OF HADOTI REGION OF RAJASTHAN

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Abstract

Ethnobotany can be defined as the total natural and traditional relationship and the interactions between man and his surrounding plant wealth from times immemorial, due to sheer, necessity, intuition, observation and experimentation. The present study highlights the importance of ethno-medicinal plants from different regions of Rajasthan. Detailed survey had been conducted in four districts (Kota, Bundi, Jhalawar and Baran) of Rajasthan. Mostly Hadoti region and the information regarding the use of medicine were collected on the basis of frequent interviews with local physicians practicing indigenous systems of medicine, villagers, priests and tribal folks. The plants were identified by using standard monographs and flora. Some past researchers also quoted uses of ethno-botanical plants in diseases severe curing like cancer, diabetes, AIDS, skin disease and depression etc. This study is focused to provide an effective knowledge of medicinal properties of selected medicinal plants, so that this will be a pave way to cure diseases by herbal medicines without any side effect. Medicinal plants have great importance in providing health care to about 80% of the population in India. Plants have been an important source of precursors and products used in a variety of industries, including those of pharmaceuticals, food, cosmetics and agrochemicals. Gradually the folk medicines led to the rise of traditional system of medicine like Ayurveda in India. In Rajasthan (India), tribals are using herbal medicine for long time.

SORGHUM (*SORGHUM BICOLOR* L.) BASED INTERCROPPING SYSTEM UNDER RAINFED CONDITION

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Abstract

A field experiment was conducted during *Kharif* season of 2016 at Soil Conservation and Water Management Farm of the C. S. Azad University of Agriculture and Technology, Kanpur to find out effect of intercropping systems on growth, yield, water use efficiency, splash loss and economics of crops under rainfed condition. The treatments comprised of 10 intercropping systems i.e. (i) Sorghum sole, 45 cm apart (ii) moong sole, 45 cm apart (iii) blackgram sole, 45 cm a part (iv) soybean sole, 45 cm a part (v) sorghum + moong (2:1) (vi). sorghum + blackgram (2:1) (vii). sorghum + soybean (2:1) (viii). sorghum + moong (3:1) (ix). sorghum + blackgram (3:1) and (x) sorghum + soybean (3:1) were tested in Randomized block design with 3 replications. Results obtained that yield of sorghum, moong blackgram and soybean were highest in their sole stands. The yield of sole and intercropped moong, blackgram and soybean in terms of sorghum equivalent grain yield showed significant variation, whereas sorghum + blackgram (2:1) brought out significantly the highest production as compared to other cropping systems. Moreover, the land equivalent ratio, water use efficiency, gross return, net return and cost : benefit ratio were also found to be the highest. Simultaneously, maximum splash loss was observed under sole maize and minimum under blackgram treatment.

TRANSFORMATION OF AGRICULTURE - FROM SUBSISTENCE LEVEL TO PROSPERITY STAGE

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Abstract

The role of agriculture for development of an economy has evolved since the 1950's. In the last decades, in particular, the agricultural sector has been rediscovered as one Area with great potential to speed up development, to reduce poverty and inequality, provide food security and deliver environmental services. In this research paper, the researcher has been taken an attempt to explore the possibilities and problems of transformation of agriculture from subsistence level to prosperity stage through suggesting a new economic policy. Along with it, the researcher has seeks to study the status of agriculture sector and trying to find out the pattern of different type of agricultural output of Uttarakhand. A subsistence level is a non-monetary



stage of economy which relies on natural resources to provide for basic needs, through hunting, gathering, and subsistence agriculture. "Subsistence" means supporting oneself at a minimum level; in a subsistence economy, economic surplus is minimal and only used to trade for basic goods, and there is no industrialization. While the prosperity means is the state of flourishing, thriving, good fortune or successful social status. Prosperity often encompasses wealth but also includes other factors which can be independent of wealth to varying degrees, such as happiness and health.

FARMER PRODUCER ORGANISATIONS : AN INNOVATIVE FARMERS' INSTITUTION

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Abstract

Major proportion of India's farmers is small and marginal farmer. The marginal and small farm holders together, they account for a whopping 85.0 percent of the total farm holdings in India. About 1.5 to 2.0 million new marginal and small farms are being added every year due to continued land fragmentation. Small and marginal farmers in India are highly vulnerable to risks and face multifold problems. A variety of approaches have emerged in response to the problems faced by them. Collectivization of small and marginal farmers into Producer Organizations has emerged as one of the most effective pathways to address the challenges of them as POs improve access to investments, technology and inputs and markets. The intervention and role of Farmer Producer Organizations (FPOs) has been acknowledged as crucial for upliftment of the agrarian community. Farmer producers organisations or collectivities are being argued to be the only institutions which can protect small farmers from ill-effects of globalization or make them participate successfully in modern competitive markets. Producers organizations not only help farmers buy or sell better due to scale benefits but also lower transaction costs for sellers and buyers, besides providing technical help in production and creating social capital. This is an opportunity for small producers to collectivise without losing control on their lands, as well as get into collaborative arrangements with big companies at a later stage for larger value for their produce.

ROLE OF UNDERUTILIZED VEGETABLES IN CROP DIVERSIFICATION AND SUSTAINABLE PRODUCTION SYSTEM

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Abstract

Agriculture is under increasing burden to produce greater quantities of food, feed and fuel. Therefore it is imperative that our food production system be sustainable and diversified in order to meet society's food and textile present needs and also safeguard for the upcoming generations without any compromise with the ecology. It is now mostly established that climate change will have a major impact on biotic as well as abiotic stresses in agricultural production systems and threaten yield and crop sustainability. Dependence on only a few of major crops has inherent agronomic, environmental, nutritional and monetary risks and is perhaps unsustainable in the long run, especially in view of global climate change. Bio diverse agro ecosystems are therefore seen as a viable option to increase agro ecosystem health and make agricultural production system a sustainable one. Crop diversification by growing some underutilized vegetables along with some major crop species in the same field will not only add variety to the diet but also to lead to disease suppression, climate change buffering and increased production but also add to monetary benefits and livelihood security. There are approximately over 600 species that comprise the global diversity in vegetable crops, but at the moment barely one fourth is utilized as a major vegetable crops and rest are named as minor, underutilized, rare vegetables or wild edible vegetables. Some of the underutilized vegetables commonly used in Indian context are Amaranthus, Basella spp., Pointed Gourd, Gherkin, Ivy Gourd, Sweet Gourd, Karchikai, Drumstick, Elephant foot yam, Nymphaea spp., Nelumbo nucifera, Clove bean, Winged bean, Sword bean and Jack Bean Velvet bean, Tree Bean, Adzuki bean, Rice bean, Aerial yam, Air potato, and Chow-Chow. Underutilized vegetables or minor vegetables are rich in vitamins, minerals and other health promoting factors including high antioxidant activity. They play a major role in the diversification of diet leading to more balanced source of micronutrients. Their enhanced use can bring about better health



and nutritional management. Their cultivation, utilization and acceptability can never be problematic. Except for the leafy vegetables, most underutilized vegetables have longer shelf life. Underutilized vegetables can, thus, make an impact on the dietetic status of population, though they are usually neglected in comparison to other major cereal and vegetable crops. They are adapted to fragile environments and can contribute to the stability of agro ecosystems. They provide a broad spectrum of crops to improve productivity. Thus, underutilized vegetables are more effectively set to address malnutrition, poverty and economic prosperity. The potential role of underutilized vegetables in sustainable agriculture through diversification of the agricultural environment has to be fully exploited. Most research on production system covers only a few economically important vegetable crop species. Keeping the vagaries of climate change in mind, it would also be very wise to formulate some novel researches and policies to tap the extraordinary ability of most of the underutilized vegetables to stand against several stress conditions like susceptible soil, moisture stress, and unfavourable temperature and ever unpredictable rainfall in order to make agricultural production system a sustainable one.

HOST-PLANT RESISTANCE IN PIGEONPEA EXPLAINED BY SOME CHEMICAL COMPOUNDS TO POD BUG *CLAVIGRELLA GIBBOSA* (SPINOLA)

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Abstract

Tur pod bug, *Clavigralla gibbosa* (Spinola) is an important pod-sucking insect pest of the pigeonpea crop causing significant damage to it. In this study 15 long duration pigeonpea genotypes were assessed for their reaction against pod bug damage by comparing biochemical traits of the plants for two years (2017-19). The chemical compounds assessed for the study were phenol, carbohydrate, protein, reducing sugars, and chlorophyll. According to the results lower carbohydrate content ($r = 0.553^*$, 0.538^*) of the pod, and higher phenol content ($r = -0.642^{**}$, -0.554^*) of the grain appeared as non-preferential attributes for *C. gibbosa* damage in both the years respectively. The genotypes IVT-705 and IVT-706 were least susceptible with minimum pod damage (11.17%, 12.83%), also supported by lower pest susceptibility rating. Hence these traits have a potential role in conferring resistance to *C. gibbosa* demanding further research on more such compounds.

ANTIBIOTIC SUSCEPTIBILITY PATTERNS IN BACTERIA ISOLATED FROM DIFFERENT NATURAL THERMAL ZONES OF SIKKIM HIMALAYA

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Abstract

Prokaryotic life has dominated most of the evolutionary history of our planet, evolving to occupy virtually all available environmental niches. Sikkim Himalayas are unique as in a short distance three different kind of natural thermal conditions exists i.e., psychrophilic, mesophilic and thermophilic due to the presence of hot spring in snow covered mountain in Sikkim Himalayas. The microorganisms surviving in the psychrophilic condition are called as psychrophiles (the microorganisms which optimally grows below 20°C) whereas the thermophiles are which grow at temperature above 40°C. Microbes which can grow at very high temperature (above 100 °C) or nearly at freezing point of water challenges our understanding of the physical and chemical constraints on life. Understanding how living communities survive and are structured under various environmental conditions is not only important but is also very fascinating. These extreme or exhilarating environments and the microorganisms living in them has open the doors for search of life exterior to earth and also the leeway to transfer life from one planet to another. The culturable bacterial diversity was performed of three natural thermal conditions and presence or absence of three different kind of bacteria, i.e., thermophilic, mesophilic and psychrophilic bacteria along with bacterial diversity we had performed antibiotic resistance Testing (AST) of the isolates. The culture dependent bacterial diversity showed the dominance of phyla Firmicutes and genus *Geobacillus*. Most of the collected isolates from psychrophilic and thermophilic zones showed susceptible to at least 10 different antibiotics which were further supported by the absence of antibiotic resistance.



EFFECT OF ENDOPHYTES, BIOAGENTS AND *PSEUDOMONAS FLUORESCENS* (PF) BASED ZINC NANO PARTICLE ON PLANT GROWTH PROMOTION OF SORGHUM SEEDS

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Abstract

Selective pomegranate fungal (*Trichoderma harzianum*, *T. asperellum*) and bacterial (*Bacillus vallismortis*) endophytic suspension, bioagents (*T. viridae* and *B. amyloliquifaciens*) and green nanoparticles (*Pseudomonas fluorescens* based Zinc Nanoparticles (Pf-ZnNPs) @ 0.15 %) were prepared and evaluated for their Plant growth promoting activity on sorghum seeds by the standard roll towel method (ISTA, 1993). Among all treatment tested for their growth promotion activities, the higher per cent seed germination was recorded in Pf-ZnNPs @ 0.15 % (86.67 %) which was on par with *B. amyloliquifaciens* (84.33 %), *T. harzianum* (83.33 %) and *B. vallismortis* (83.33 %) and were significantly superior to the untreated control (75.33 %). The maximum shoot length and root length was recorded in *B. vallismortis* (12.18 and 20.11 cm), which was on par with shoot length of *T. harzianum* (11.50 cm). The minimum shoot length and root length was recorded in untreated control (9.59 and 15.60 cm). The higher seedling vigor index was observed in *B. vallismortis* (2127.86) which was on par with Pf- ZnNPs @ 0.15 % (1990.52) and *T. harzianum* (1984.62). The lower seedling vigor index was recorded in untreated control (1516.57). This study proves that endophytic microorganisms and nanoparticles can also influence the plant growth either directly or indirectly.

EVALUATION OF CERTAIN NOVEL INSECTICIDES AGAINST SAP FEEDERS OF SESAME

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Abstract

Sesame (*Sesamum indicum* L.) is one of the world's oldest oil seed grown for diverse uses. India is the world's largest producer of sesame with largest cultivation area; however, the crop's productivity in India is much lower than the world average. Apart poor agronomic management, insect pests are one of the major factor for lower yields, especially sucking pests which damage the crop directly by sap sucking and indirectly by virus and mycoplasma transmission. Owing to undesirable effects of sole dependence on traditional chemicals, novel insecticides, which are comparatively more eco-friendly need to be evaluated. In this context, field experiment was conducted Agricultural Research Station, Yellamanchili, Visakhapatnam, Andhra Pradesh, during *kharif* and *rabi*-summer, 2018-19. All the insecticide interventions were significantly superior to check in reducing the population of sucking pests. Seed treatment with imidacloprid (7.5 grams per kg of seed) was found efficacious till 30 days after sowing. Statistically significant reduction in sucking pest incidence was noticed in foliar sprays of imidacloprid 17.8 SL (0.25 ml/l) and diafenthiuron 50WP (1.25g/l) at 30 and 60 days after sowing. Application of imidacloprid 17.8 SL (0.25 ml per liter) foliar spray was effective in reducing thrips (0.43/plant), leaf hoppers (0.43/plant) and aphids (0.43/plant) populations which was on par with diafenthiuron 50WP (1.25g/l), which recorded thrips (0.60), leaf hoppers (0.53) and aphids (0.43) per plant at 60 DAS. The imidacloprid 17.8 SL (0.25 ml/l) foliar spray was also found to be economically viable by registering higher benefit-cost ratio of 3.25.

IMPACT OF CLUSTER FRONTLINE DEMONSTRATIONS OF SUMMER BLACK GRAM IN MAHASAMUND DISTRICT OF CHHATTISGARH STATE

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Abstract

Black gram (*Vigna mungo*) is a highly prized pulse, very rich in phosphoric acid. Black Gram is one of the important pulse



crop grown throughout India. Generally it is consumed in the form of ‘Dal’. It is the chief constituent of ‘papad, idly and dosa. It is generally grown in kharif/rainy and summer season. It grows best in hot and humid condition with ideal temperature range between 25 to 35°C. Black gram is an important summer pulse crop in Mahasamund district but due to unavailability of improved variety and non adoption of improved cultivation practices in the district, its average productivity (406 kg/ha) is far below the average national productivity (970 kg/ha) and its potential yield of 1000 kg/ha. A field demonstration was conducted by Krishi Vigyan Kendra, Mahasamund during summer season of 2019-20 to study the yield gaps between improved package of practices under cluster frontline demonstration (CFLD) and farmer’s practice (FP) of Blackgram crop. The experiment was laid out in two clusters FLDs and each cluster FLDs comprises of 10 hectare (Total 20 hectare). MASH479 variety, 20 kg/hectare was sown by line sowing method and seed was treated by Rizobium and Bavistin. The study found that the yield of Black gram in CFLD conditions is 7.53 q/ha whereas in FP is 6.40 q/ha. The per cent increase in yield with Improved Practices (IP) over FP was recorded 1.13 q/ha. The extension gap and technological index were 0.94 q/ha and 26.60 per cent, respectively. The benefit cost ratio was 3.03 under demonstration, while it was 2.79 under farmer’s practices. The present study resulted to convincing the farming community for higher productivity and returns.

FACTORS CONTRIBUTING FOR THE ADOPTION OF AGRO ADVISORY SERVICES DISSEMINATED THROUGH THE INTERACTIVE INFORMATION DISSEMINATION SYSTEM IN THE STATE OF TELANGANA

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Abstract

The study was conducted in the pilot tested districts of Interactive Information Dissemination System i.e. Nalgonda and Khammam Districts of Telangana state of India. A total of 120 farmers at the rate of sixty from each selected district were selected for the study. Ex-post facto research design was adopted for conducting the study. From the results it could be concluded that majority of the registered farmers were with middle age possessing high school level of education and medium level of farming experience. 56.67 percent of the farmers had medium level of Information acquisition behaviour with high innovativeness and 66.67 per cent of respondents were visiting KVK specially to get agriculture information. It was also observed that, education, annual income, farming experience, socio- political participation, information acquisition behavior, use of ICT tool, innovativeness and access to KVK were factors found to had positive and significant relationship with the extent of adoption of the respondents.

INFORMATION COMMUNICATION TECHNOLOGIES IN AGRICULTURE DEVELOPMENT

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Abstract

In India Agriculture is a very important sector with a majority of the rural people in country depending on it. Information Communication Technology based smart agriculture enhance agriculture productivity and sustainability. ICTs appear ideally suited to the task of enhanced interaction because they can expand communication, cooperation, and ultimately innovation among the growing array of actors in agriculture. The Indian telecommunication industry is the world’s fastest growing telephone (landlines and mobile) subscribers and 670.60 million mobile phone connection in Aug. 2010. ICT helps in growing demand for innovation. Numerous electronic tools increase interaction among the actors involved in agriculture. On a macro level, e-Science (e-Research) draws on increasingly connected and extensive digital infrastructure to facilitate collaboration and knowledge exchange nationally, regionally, and globally. On a micro level, m-Agriculture, powered by increasingly affordable mobile digital devices such as phones, laptops, and sensors, connects millions of rural people to sources of information. In India ICT applications such as E-Chaupal, E-Seva, e-Extension, AGRISNET, AGMARKNET, Agri Business Centres, e-KRISHI VIPANAN, Query Redress Services, Kisan Call Centres, Tata Kisan Kendra, AKASGANGA are quite successful in the communication of information, Transfer of Technology, procurement of Input and marketing in a way to help



farmers by reducing their usage of material resources and manpower. This review article explores the use of ICT applications for farmer's innovation.

TRAINING NEEDS OF BANANA CULTIVATORS IN TULI BLOCK, MOKOKCHUNG, NAGALAND

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Abstract

Nagaland is the 16th state of India and is popularly known as the Land of Festivals. The study deals with the Training need assessment of banana cultivators in Tuli block under Mokokchung district hailing from the state of Nagaland. Structured interview schedule was prepared to collect the primary data of the respondents. Nagaland is a state of agriculture and more than half of the population depends on agricultural activities for livelihood. In Nagaland, Banana is popularly grown due to its favourable climatic condition and soil suitability and also a good source of healthy nutrition and a stable means for high income generation. Majority of the respondents, (68.33 %) had 'medium' level training needs towards banana cultivation. Where as, based on an overall rank obtained, the 'training need' was found to be highest in respect of pest and diseases management (I) followed by irrigation schedule(II), land preparation(III), nutrient management (IV), spacing (V), post harvest management technique (VI),harvesting (VII), seed and sowing (VIII) and intercropping operation (IX).

EVALUATION OF INTEGRATED WEED MANAGEMENT IN TRANSPLANTED RICE

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Abstract

A field experiment entitled "Evaluation of Integrated Weed Management in Transplanted Rice" was conducted during *Kharif* 2019 at Instructional Research Farm, Krishinagar, Adhartal Department of Agronomy, JNKVV, Jabalpur. The experiment was laid out in randomized complete block design with six integrated weed control treatments comprising of MoC 0.5 t ha⁻¹ + Bispyribac sodium 25 g ha⁻¹, Bispyribac sodium 25 g ha⁻¹ + conoweed, MoC 0.5 t ha⁻¹, MoC 0.5 t ha⁻¹ + conoweed, hand weeding twice (20 and 40 DAT) and weedy check (control) replicated four times. The rice variety Kranti sown in nursery with seed rate 30 kg ha⁻¹ and transplanted at 20 cm X 20 cm spacing. Among all kind of dicot as well as monocot weeds *Echinochloa colona* was the most dominant with mean relative density of (27.98%) followed by *Cyperus iria* (22.60%), *Cynodon dactylon* (18.79%) *Cyperus defformis* (18.52%), *Alternanthera sessilis* (12.11%) . Maximum weed control efficiency at 40 DAT and at harvest (95.52% and 99.06%) was registered under hand weeding twice at 20 and 40 DAT followed by Bispyribac sodium @ 25 g ha⁻¹ + conoweed with weed control efficiency of (89.78% and 97.44%) followed by MoC 0.5 t ha⁻¹ + conoweed (86.28% and 95.71%) respectively at 40 DAT and at harvest. Growth parameters of rice (viz. plant height, number of tillers m⁻¹, LAI, CGR, dry matter accumulation) as well as yield attributes viz. Effective tillers hill⁻¹, panicle length, filled grains panicle⁻¹, grain yield, straw yield, biological yield) were higher under hand weeded plots followed by plots receiving Bispyribac sodium @ 25 g ha⁻¹ + conoweed . Application of Bispyribac sodium @ 25 g ha⁻¹ + conoweed found more remunerative as it received higher value of NMR (Rs. 49820.88 ha⁻¹) and higher B:C ratio (2.37) respectively, relative to other treatments .

BIO-FERTILIZERS FOR IMPROVING SOIL HEALTH

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Abstract

Indiscriminate use of chemical fertilizers, herbicides and pesticides deteriorates the soil fertility and productivity. With the



increase in the usage of chemical inputs microorganisms population in soil is declining rapidly because of which physical, chemical and biological reactions in soil are not happening. In order to improve soil health and to increase soil fertility and productivity there is need of replacing chemical inputs by organic inputs which include organic manure, vermicompost, green manures and bio-fertilizers. Bio-fertilizers are one of the organic fertilizers which contains only micro organisms. By supplying this bio-fertilizers crop can take atmospheric nitrogen, unavailable phosphorus which is not available to crop in ready form. These bio-fertilizers not only makes unavailable form of nutrients to available form but also adds microorganisms to soil which in turn improves organic carbon & organic matter content in soil which makes soil more fertile and productive. On-farm trials were conducted in farmers fields in Chittoor dt by Krishi Vigyan Kendra, Kalikiri in 5 locations. Bio-fertilizers like *Azospirillum* and Phosphorus Solubilizing Bacteria were supplied. In a tub 70 litres of water were taken and 300-500 ml of each bio-fertilizer were mixed and roots of seedlings were dipped for 10 min and then transplanted. *Azospirillum* fixes atmospheric nitrogen and make it available to plants and also adds nitrogen to soil. Phosphorus Solubilizing Bacteria solubilizes unavailable toxic form of phosphorus to available form and make it available to crop. Usage of bio-fertilizers along with 50% recommended dose of chemical fertilizers reduced the cost of cultivation by 50% and there was no difference in yield in on-farm trial fields and fields where indiscriminate use of fertilizers were supplied. It not only reduced cost of cultivation but also reduced pests and disease incidence, improved soil nutrient status, soil fertility, improved grain quality also. It has been concluded that usage of bio-fertilizers by reducing chemical fertilizers will give quality yield, reduces cost of cultivation and improves net returns and income per rupee invested and soil fertility.

ACCUMULATION CAPACITY OF HEAVY METALS IN PLANTS FROM SOIL: AN ALTERNATIVE TECHNIQUE TO PURIFY THE SOIL

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Abstract

Soil is being contaminated by various anthropogenic activities like emission effluents, vehicle exhaustion, metal loaded discharge from industries and from the use of pesticides, insecticides in the field. Pollutants from these sources are threat to the mankind, it become a serious source of health risk and cause several disease throughout the world. There are several known chemical methods which are being used to remove these pollutants from the soil but due to their high cost, tedious procedure which takes long time and problem to dispose their waste make them less convenient. Phytoremediation is an organic technique which can be opting as an option to remove heavy metal concentration from the soil. This is cost effective and environmental friendly technique. Several studies have been done on the heavy metal accumulation capacity of *Populus*, *Brassica*, *Thlaspi*, and *Arabidopsis*. Study has been done on the accumulation of heavy metals in natural environment of *Origanum vulgare* L, *Ocimum ammericanum* and *Craniotome furcata*. *Origanum vulgare* L, *Ocimum ammericanum* showed the results which were under permissible limits of Indian standards. Objective of this paper is to systematize some information about heavy metal sources, effect and their treatment and to promote the phytoremediation as an alternative method in place of chemical methods.

STABILITY ANALYSIS FOR GRAIN YIELD AND IT'S CONTRIBUTING TRAITS IN BREAD WHEAT (*TRITICUM AESTIVUM* L.)

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Abstract

The present investigation carried out by to assess the phenotypic stability for grain yield and its contributing traits under three varied environmental conditions using 10 diverse wheat genotypes and 45 F₁S. The mean sum of squares due to genotypes and environments found to be significant for all the characters, indicating differential effect of environment on the genotypes. G x E interaction found significant for all the characters except spike length and biological yield per plant. Similarly the pooled analysis of variance showed that the mean squares due to E + (G x E) interaction was partitioned into G x E (linear) and pooled



deviation (nonlinear components). Mean sum of squares due to G x E (linear) component and pooled deviation (nonlinear component) was significant for all the characters. The genotypes Raj 3765, Raj 3777, Raj 4238 x WH 1021, Raj 3077 x Raj 3777 had higher yield and were suitable for variable environmental conditions. These genotypes could be utilized as a donor in routine breeding programme to improve grain yield and its contributing traits in bread wheat.

IMPACT OF BIO-INTENSIVE INTEGRATED PEST MANAGEMENT PRACTICES ON INSECT PESTS AND GRAIN YIELD IN RICE

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Abstract

Food production process in India during the green revolution period has been based on the use of more chemical fertilizers and pesticides. The challenge before the crop protection scientists is to boost the yield from the available land without harming the environment. Incorporating ecological and economic factors into decision making and addressing public concerns about environmental quality and food safety is the need of the hour. There is now wide array of techniques available to replace the use of conventional chemical insecticides in IPM programmes. These issues can be sorted out by adopting eco-friendly Bio-intensive Integrated Pest Management strategy. Bio-intensive IPM is defined as a systems approach to pest management based on an understanding of pest ecology. On Farm Trail on bio intensive pest management in rice was conducted during wet season 2018-20 in farmer's participatory mode in Visakhapatnam district of Andhra Pradesh with two treatments comprising of farmers' practice (FP) and Integrated pest management (IPM) in three villages having two locations in each village. In case of FP, the crop suffered less incidence of insect pests viz. stem borer (4.3%), leaf folder (1.4%); diseases viz. brown spot (2.47%), sheath blight (10.56%), BLB (1.18%) and false smut (6.24%), in contrast to Bio intensive pest management practices in which crop suffered with stem borer (2.4 %), leaf folder (0.2 %); sheath blight (6.79%), BLB (1.10 %) and false smut (6.21%). The yield data of various treatments indicates that the FP plots recorded highest yield i.e., 6.2 t ha⁻¹ in comparison to IPM (5.8 t ha⁻¹). Even though there was a difference in yields gained, the highest cost benefit ratio was recorded in BIPM (2.52) followed by FP (1.94). The incremental benefit cost ratios of IPM and FP were 21.5 and 18.3 respectively. The study revealed the cost effectiveness of integrating non-pesticidal strategies with additional benefits like safety to beneficial organism and reduction in cost of cultivation.

AGRO METEOROLOGICAL INDICES OF FENUGREEK AS INFLUENCED BY DIFFERENT SOWING TIMES

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Abstract

The field experiment comprising fenugreek genotype HM-348 with three different sowing times (15 Oct, 31 Oct & 15 Nov 2018) and three different level of cuttings (no cutting, one cutting & two cuttings) to access the agro meteorological indices such as thermal units, helio thermal units, photo thermal units and thermal use efficiency during the *Rabi* seasons 2018-19 at CCS, Haryana Agricultural University, Hisar. The results revealed that the fenugreek crop respond very well for flowering, no. of pods per plant, plant height and seed yield for the 15 November sowing. While for the agro meteorological requirement, the fenugreek genotype crop required maximum accumulated heat units for 15 November sown crop for 50% flowering, no. of pods per plant, plant height and seed yield, while lowest accumulated heat units was observed in 15 Oct sown crop. On the basis of results the fenugreek crop required 1397.66, 1436.66 and 1455.77 day °C accumulated heat units for flowering in different level of cuttings, 1983.88, 2000.88 and 2019.00 day °C accumulated heat units for no. of pods per plants in different level of cuttings, 2325.77, 2509.22 and 2615.33 day °C accumulated heat units for plant height in different level of cuttings and 2595.33, 2666.88 and 2731.66 day °C accumulated heat units for seed yield in different level of cuttings, respectively. Photo thermal units was highest at 15 November sowing (two cuttings) in all the phenological stages such for flowering (16,331.00), no. of pods per plants (22,911.00), plant height (30,608.33) and seed yield (32,561.00). Helio thermal units was highest at 15 November sowing (two cuttings) in all the phenological stages such for flowering (7,848.33), no. of pods per



plants (11092.33), plant height (15,673.33) and seed yield (17017.67). Efficiency of thermal energy conversion for seed yield depends upon the genetic makeup of the plant, seed germination, flowering and yield of the genotype. The thermal use efficiency was maximum (1.11) for 15 November sowing at no cutting and lowest was observed at 31 October cutting at two cuttings (0.22). It is evident here that high yielding advance lines accumulated lower thermal energy.

VISIT OF STUDENT AND FACULTY MEMBERS FOR READING PURPOSE IN CENTRAL LIBRARY YEAR 2018: A CASE STUDY OF SVP UNIVERSITY OF AGRICULTURE AND TECHNOLOGY MEERUT (U.P.)

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Abstract

The present study students and faculty members visited Central Library of Sardar Vallabhbhai Patel University of Agriculture and Technology Modipuram, Meerut Uttar Pradesh (India) from January to December, 2018. The statistical package for social science was used to collect and analyze data on monthly frequency of visit of library by students and faculty members? The findings of the study revealed a total of 19059 respondents, 16343(85.75%) Male and 2716 (14.25%) Female visited the central library in year 2018. The 14.92% of the Ph.D student and 13.9% of the M.Sc students visited in the library in month of October 2018. The 25.54% of the M.Tech student visited in the library in month of February 2018 whereas, 15.54% of the B.Sc students visited the library in month of May 2018. The 14.41% of the B.Tech students visited the library in month of September 2018. The 33.11% of the B.V.Sc students visit in the library in month of December 2018. The 16.83% of the faculty member visit in the library in the month of March 2018 for reading of books, journals, news paper, magazine, Information resources, Information services, Print sources and other purpose Book issue- return and reference purpose.

TO STUDY POLYMORPHIC VARIATION IN DRUPE AND SEED OF *BUCHANANIA LANZAN* SPRENG

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Abstract

Buchanania lanzan is a member of family Anacardiaceae, commonly known as Achar or Chironjee. It is found throughout the greater part of India in dry deciduous forest upto an altitude of 1200 msl and sub Himalayan tract upto 900 msl. It is a medium sized tree known for its high medicinal value. Polymorphic studies include morphological parameter of drupe seed, their weight analysis and emptiness of seed. Drupe were collected from seven different seed sources. The experiment were conducted at Forest Research Institute, U.P. This studies include the length ,breadth and thickness of both drupe and seed .Seed source Malva (S6) found be the best i.e 1.044 cm, 0.918 cm, 0.688cm for drupe and 0.683 cm, 0.510 cm and 0.338 cm in case of seed .In the same way seed source sirsi (S2) shows maximum value in different parameters seed weight analysis i.e weight of fresh kernel (59.00), number of drupes in 10 grams (29.25) and weight of 100 drupes in gram (23.75) whereas weight of 100 fresh kernel found to be 3.625 for Sukrut (S5). The maximum percentage of emptiness of seed was found to be 21.75 for Ghoraval (S1) and Muirpur (S6) seed sources.

PLANT GROWTH PROMOTING BACTERIA (PGPB) *AZOSPIRILLUM* SPP.

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Abstract

The old genus *Azospirillum* as a plant associated bacteria and as a plant growth promoting bacteria (PGPB), two main characteristics of the genus is fixation of N₂ and production of phytohormones. *Azospirillum* species include a single phytohormone activity, multiple phytohormone, N₂ fixation, assortment of small size molecules, enzymes, enhanced



membrane activity, proliferation of root system, enhanced water mineral uptake by xylem, mitigation of environmental stresses. Analyzing all these mechanisms, it was concluded this versatile genus *Azospirillum* possesses large potential mechanism and proved as “Multiple Mechanism Theory” Inoculation of *Azospirillum* brasilence significantly induced root cell membrane to release protons (Proteins) *Azospirillum* produces lactins which helps in growing cell mitosis. *Azospirillum* strains produce indole acetic acid (IAA) in vitro form. Inoculation of *Azospirillum* lipoferum and *Azospirillum* brasilence in paddy crop showed N₂ fixation 20% (A. lipoferum) and 19.9% (A. brasilence) in Basmati rice and 58.9% (A. lipoferum) and 47.1% (A. brasilence) in super Basmati rice. *Azospirillum* halopraferans inoculation under saline stress conditions saline tolerating over 3% NACL sea water. Inoculation of *Azospirillum* on wheat plants alleviated water stress under drought hit, rain failure and increased moisture holding in soil. *Azospirillum* biofertilizer could be stored for 31 weeks without disturbing viability of the organism. Production of Phytohormones: *Azospirillum* spp. Are known to produce phytohormones such as gibberlins (GAs), IAA (Indole Acetic acid), cytokinin’s, Polyamines and ethylene. *Azospirillum* brasilnese known to enhance seed generation of soya bean and wheat seeds. N₂ fixation: most common mechanism fixation of N₂ by *Azospirillum* spp. Contribution of N₂ increase in green house plants and enhances nitrogenase enzyme activity in inoculated host plant. “Multiple mechanism theory” of *Azospirillum* spp. concludes that ecological viability (eco-friendly) and biological feasibility (in general).

POST-HARVEST TREATMENT ON STORAGE BEHAVIOR OF TOMATO FRUITS

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Abstract

A laboratory experiment was conducted to study the effect of different CaCl₂ treatments (0, 1, 1.5, and 2% under different dipping durations 10 min., 20 min. and 30 min) and different storage conditions (low temperature storage and room temperature storage) in the tomato variety Hisar Arun with sample size one kg per treatment. The results revealed that lowest mean physiological loss in weight (%) was overall 30 mins dipping duration in both the low & room temperature storage at 2.0 % solutions concentration .However lowest physiological loss in weight (plw)was observed in 2.0 % solutions concentration (1.93) in 30 mins dipping duration in low temperature storage .Highest mean plw (%) was recorded in 10 mins dipping duration low temp. (3.31) & room temperature (4.80) storage at 1.0 % solutions concentration. Similarly, mean decay loss was highest in 10 mins dipping in both the low & high temperature storage at 1.0 % solutions concentration 20.86 (low) & 27.83 (room temp.) , while lowest decay loss was recorded in 30 mins both the low (13.67) & room temperature (15.13 storage at 2.0 % solutions concentration. However,treatment 2.0% was found effective with 30 mins dipping in low temperature among the all treatments.

EVALUATION OF MANDIPROPAMID 23.4% W/W SC (REVUS 25 SC) ON BITTER GOURD AGAINST DOWNY MILDEW DISEASE UNDER FIELD CONDITION

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Abstract

Bittergourd is one of the most popular vegetable cultivated throughout India and extensively grown in Maharashtra. This vegetable is also known as bittermelon in other parts of the world. In India this vegetable is called as “Karela”. The fruits are used in a variety of culinary preparations and possess high nutritive and medicinal value. The fruits are rich in vitamin C and contain alkaloids which are medicinally important. The major constraint faced in the cultivation of bittergourd is the incidence of diseases. Among the various diseases inflicting bittergourd, downy mildew is one of the most serious disease leading to heavy economic losses. It is caused by *Pseudoperonospora cubensis* (Berk. and Curt.) Rostow. which is one of the most destructive pathogens of all cucurbits that affects the crop. Therefore, a field experiment was carried out on the effect of Mandipropamid 23.4% w/w SC (Revus 25 SC) against downy mildew during 2018-19 at Plant Pathology Section, College of



Agriculture, Pune. Experimental results revealed that all the treatments significantly reduced the downy mildew disease severity over untreated control. Amongst all the treatments Mandipropamid 23.4% w/w SC @ 500 ml/ha showed significantly less disease intensity of downy mildew 8.87% and highest yield 70.56 q/ha which was at par with Mandipropamid 23.4% w/w SC @ 400 ml/ha 9.40% disease intensity and 66.11q/ha yield.

RESPONSE OF COWPEA (*VIGNAUNGUICULATA* (L.) WALP) GENOTYPES TO DIFFERENT MOISTURE STRESS REGIMES

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Abstract

The present investigation entitled “Response of Cowpea (*Vigna unguiculata* (L.) Walp.) genotypes to different moisture stress regimes” was carried out at PGI Farm, Department of Agril. Botany, M.P.K.V., Rahuri, Dist. Ahmednagar (M.S.). The field experiment was carried out in Split plot design with three replications provided with four main treatments comprising of I1: irrigation given at the time of germination, I2: irrigations at the time of flower initiation (25DAS), I3: irrigation at the time of 50% flowering (40DAS) and I4: irrigation at the time of pod development (55DAS) and five sub-treatments comprising of five (varieties) namely: PhuleVithai, PhuleRakhumai, PhulePandhari, PCP-1123 and PCP-1124. Significant differences exhibited amongst the varieties for phenological, physiological parameters and yield attributes under moisture stress conditions. Among these varieties PCP-1123 recorded minimum days to 50% flowering, highest total chlorophyll content, dry matter production, Drought Tolerance Efficiency, yield per hectare, harvest index followed by varieties PCP-1124, Phule Vithai, Phule Pandhari under first irrigation i.e., Non-Stress condition which was optimum for high yield and variety Phule Rakhumai showed lowest yield attributes. Therefore these varieties can be used for the improvement programme as well as efficient management practices for cowpea production in drought prone areas.

PROBIOTIC ADVANCED DAIRY PRODUCTS AS EFFICIENT FOODS AND ENHANCE GUT MICROBIOTA VARIABILITY

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Abstract

Dairy food that influences explicit capacities or frameworks in the human body, giving medical advantages, for example, focusing on gut microbiota with probiotics has arisen as a promising nutritional approach for the anticipation of weight and metabolic condition, previous energy, and nutrients utilitarian food sources have encountered rapid market development in recent. These mechanical advancements and the expanding number of health-conscious consumers intense on products that improve life quality. Since the worldwide market of utilitarian nourishments is expanding yearly, food item advancement is a key examination need and a test for both the business and science areas. Probiotics show impressive assurance for the extension of the dairy business, particularly in such explicit areas as yogurts, cheeses, beverages, ice creams, and other desserts (Granato *et al.* 2010). Dairy products can be a compelling vector for the delivery of probiotics to the gut due to their dietary benefit, acidic nature, and long shelf-life. Mice were nourished a standard low fat, plant polysaccharide-rich (LF/PP) diet enhanced with the probiotic-advanced milk and dairy products for 5 weeks. Cutting edge sequencing of DNA from mouse fecal examples was utilized to portray the bacterial relative wealth. Mice fed care of an eating routine enhanced with camel milk exhibited trademark changes in the gut microbiota, which remembered an expansion for the relative wealth of request *Clostridiales* and family *Anaerostipes*. Mice fed care of an eating regimen enhanced with the probiotic-advanced dairy animals cheddar displayed an expansion in the general plenitude of request *Clostridiales*, family *Ruminococcaceae*, and family *Lachnospiraceae*. The outcomes acquired and their bioinformatics investigation upholds the end that camel milk and the probiotic bovine cheddar instigate changes in the mouse gut microbiota, which can be described as conceivably valuable to



healthy contrasted with the progressions related to a standard eating regimen. This review infers that probiotic-improved milk and dairy products can be profoundly viable for the conveyance and backing of probiotic microbes of the gut (Aljutailyet *al.* 2020).

ECO-FRIENDLY MANAGEMENT OF BLAST DISEASE IN FINGER MILLET

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Abstract

Finger millet is one of the most important cereal crops supporting the lives of millions of people across the globe and particularly in the developing world. It is adapted to a wide range of environments and is known for withstanding harsh environmental conditions including high temperature, moisture deficit and water stagnation. Finger millet is most vulnerable to blast disease caused by *Pyricularia grisea* and seed loss of more than 50% is reported. This disease occurs severely during kharif season but the extent of the crop loss depends on the severity and the time of onset of rains. A study was initiated at Agricultural Research Station, Perumallapalle to examine biocontrol options for the management of blast disease of finger millet. This will be useful not only in minimizing the loss to farmers, but also helps in obtaining higher yield. In the present study, a total of 17 pseudomonas isolates and 10 Bacillus isolates were isolated from phyllosphere of finger millet leaves. *In vitro* evaluation of phyllosphere microflora against *P. grisea* revealed that *Bacillus* isolate-10 and *Pseudomonas* isolate, P-7, recorded maximum inhibition of 85.54 and 90.4 per cent respectively. These two isolates were tested positive for PGPR activity i.e., HCN production, Siderophore production, protease and phosphate solubilization. *Bacillus* isolate B-10 and *Pseudomonas* isolate -7 found potential against *P. grisea* were identified as *Bacillus subtilis* and *Pseudomonas fluorescens* based on 16S rRNA sequence and these isolates were tested for their efficacy under field condition. Combined application of these bioagents as Seed treatment+ seedling dip+ foliar spray recorded minimum PDI of leaf (19.49), neck (10.34) and finger blast (12.4) with maximum grain yield (3077 kg/ha) as against control with leaf (74.45), neck (56.74) and finger blast (49.65) with grain yield (1566 kg/ha).

EFFECT OF PANDEMIC OF COVID-19 ON SPICES MARKETING AND CULTIVATION IN THE TRIBAL AREA OF VISAKHAPATNAM

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Abstract

Visakhapatnam is identified by the NITI-AYOG as aspirational District in the state of Andhra Pradesh. The District has about 14.5% of the total tribal population in the state. Out of three Divisions, Vishakapatnam, Narasipatnam and Paderu in the district, a major proportion of tribal communities (89.98%) are dwelling in Paderu Tribal Agency area. Agriculture, Horticulture and collection of the minor forest produce are the only livelihood option for the tribal communities in this zone. The agro ecological conditions of this area provide immense opportunity for the commercial exploitation of the horticultural crops. Among the horticultural crops, spices crops viz., black pepper intercrop with coffee, turmeric and ginger are the important crops cultivated by tribal farmers of Visakhapatnam for their livelihood. At present nearly 58,000 ha, 8000 ha and 50 ha area is being under cultivation with black pepper, turmeric and ginger respectively. Since tribal farmers grow ginger, turmeric and black pepper organically by incorporating farm yard manures only and they never apply inorganic manures, pesticides and fungicides, so there is lot of demand for the spices crops growing in this area. Since there is no storage facilities available at high altitude and tribal area of Visakhapatnam, farmers usually sell their produce immediately after drying turmeric and black pepper. Every year, buyers from different places of Andhra Pradesh, Kerala, Tamilnadu, etc., come and buy the turmeric and black pepper produce from tribal farmers. In this tribal area, black pepper and turmeric ready for harvesting during February of every year and produce ready for sell by March onwards. In India, lockdown started from 22nd March 2020 onwards including Visakhapatnam of Andhra Pradesh. The pandemic Covid-19 affects the tribal farmers to sell



their produce of black pepper, turmeric since buyers from different areas unable to reach the farmers. Due to lockdown the buyers from other places could not reach farmers, local buyers reduce the prices of black pepper and turmeric. So, tribal farmers loosed net returns in these crops. Generally in turmeric local cultivar is predominant. Recently tribal farmers adopting improved varieties of turmeric for cultivation. For this purpose, farmers have to bring seed from other areas of Andhra Pradesh. Due to lockdown affect, farmers unable to brought seed material in time. So this year, tribal farmers unable to sown improved varieties of turmeric seed.

ROLE OF AZOLLA AS A BIOFERTILIZER ON GROWTH AND YIELD OF PADDY CROPS

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Abstract

The modern-day intensive crop cultivation requires the use of chemical fertilizers, but fertilizers are not only short supply but also expensive in developing countries. Therefore, the current trend is to explore the possibility of supplementing chemical fertilizers with organic ones, more particularly biofertilizers of microbial origin. Paddy is the major crop in the south and south-east Asia and covers an area of about 36 million hectares in India. This work is focused on the use of biofertilizer on growth and yield of paddy (*Oryza sativa* L. var. Saket) crops. In this work, the application of Azolla as organic manure up to 200g Azolla/kg soil till 120 days. The results indicated that during the interval (30, 60 and 120days) of analysis of plant parts showed that the dry matter yield of paddy plants increased with an increasing amount of Azolla. Along with this, there were biochemical changes like chlorophyll, ascorbic acid, catalase, peroxidase and uptake of the mineral nutrient element (Ca, K, P, Mg, S, Fe, Mn, N) and crude protein value also increased.

DIRECT MARKETING DURING COVID LOCKDOWN

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Abstract

Covid-19 Pandemic has been a threat to many farmers in terms of inaccessibility to market the produce grown because of lockdown situation. Many of the farmers had left yield unharvested. But the intervention of KVK, Chintamani developed the hope among the farmers and made them to sell their produce directly to the consumers. Mr. Prashant Reddy, a youth farmer who was earlier working in software company was successful in marketing the organically grown produce using the information communication technology with the assistance of KVK, Chintamani Scientists. Farmers were able to sell 4 tons of carrot, 1.08 tons of capsicum, 4 tons of beetroot, grapes (15tons), papaya (1 ton), tomato (0.5 ton), Onion (3 tons) while other farmers left the field unharvested. Further, because of direct selling to consumers, farmers realized good returns for their produce in pandemic situation also. It was recorded that there was 52.83 per cent increased price realization in carrot, 66.66 per cent in beetroot, capsicum (56.25%), grapes (63.63%), papaya (50.00%), tomato (60.00%) and Onion (70.00%). Price spread was reduced to great extent and producers share in consumer rupee increased. This was win to win situation where farmers got the better price for their produce on one side and on other side consumers got the good quality fruits and vegetables at their door steps without moving out of their homes during the COVID situation.

VACCUM IMPREGNATION : TO TAILOR NEED BASED PROCESSED PRODUCTS

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Abstract

Vacuum impregnation is a non-thermal and non-destructive method of infusing the porous food matter with intended compound. It works on the basic principle of osmosis, under the intentionally induced pressure difference mediated by the hypotonic solution. It's more a pre-treatment technique given to the fresh fruits and vegetables slices, where partial water and



air is emptied from the tissues of fresh produce. Accordingly, the intercellular spaces of fruits and vegetables can be easily filled up using vacuum impregnation through hydrodynamic mechanism. Further, various factors decide the physico-chemical and organoleptic properties of product. Few paramount attributes include, external attributes *i.e.*, vacuum pressure, vacuum retention time, relaxation time, concentration of the solution, temperature of the solution and internal tissue attributes *i.e.*, size and shape of the capillary, thickness of slices and porosity. Vacuum impregnation would serve as superior avenue to produce calorie densified foods, fortified foods, minimal processed foods and functional foods. The greatest thing is, fabricating the bioactive level of the food products by introducing them together with impregnating solutions having target implications thus improving health-promoting properties of the product and facilitating production of functional food. The functional foods are nothing but target oriented medicine foods to treat specific disease or disorder. Affixing to it, thermal properties, total solids, sugar: acid blend, water activity, pH, texture, color, taste, and aroma of the product can be controlled. Therefore, vacuum impregnation is one among the effective method to design the need based processed food products.

EVALUATION OF SUGARCANE GERMPLASM FOR RESISTANCE TO YELLOW LEAF DISEASE

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Abstract

Sugarcane is second major industrial commercial crop next to cotton supporting agro based industries located in rural India. Yellow Leaf Disease in sugarcane is one of the important viral disease causing a grave concern in commercially grown sugarcane varieties world wide. The disease was first reported in Hawaii islands (1980) and in India during 1999. The virus is mainly transmitted through infected planting materials and secondary spread is through aphid vectors. Symptoms consist of an intense yellowing on the abaxial surface of the mid-rib in mature leaves. Leaf yellowing with a diagnostic deep or bright yellow mid-rib occurs often when the rest of the lamina is still green. Pink colouration may occur on its adaxial surface. The disease infection results in reduction in sucrose content in stalks, accumulation of sucrose in mid-rib and yield losses. The disease incidence up to 100% of ScYLV in commercial fields in susceptible cultivars was reported in Florida, India and Thailand. In the present study, detection of yellow leaf virus using RT-PCR was standardized and characterized the virus from commercially cultivated sugarcane varieties in the zone. Hence in an attempt to identify resistant genotypes for YLD, the available sugarcane germplasm with 130 accessions and 40 clones maintained at Agricultural Research Station, Perumallapalle were evaluated for ScYLV based on rating scale from 0 to 5. Among the 170 clones, only 5 clones have shown '0' scale (0 = Immune). These five clones were further evaluated for the presence of virus through RT – PCR detection. The results revealed that only two entries viz., 94V101 and 97 R167 have shown negative amplification of the coat protein gene of virus. These two genotypes were further evaluated for insect transmission studies under glass house conditions and were proved to absolutely resistant to YLD. Hence, these two genotypes can be used in resistance breeding for developing YLD resistant clones.

ENTREPRENEURSHIP OPPORTUNITIES UNDER TRIBAL AREA OF VISAKHAPATNAM IN HORTICULTURE SECTOR

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Abstract

Visakhapatnam is identified by the NITI-AYOG as aspirational District in the state of Andhra Pradesh. The District has about 14.5% of the total tribal population in the state. Out of three Divisions, Vishakhapatnam, Narasipatnam and Paderu in the district, a major proportion of tribal communities (89.98%) are dwelling in Paderu Tribal Agency area. Agriculture, Horticulture and collection of the minor forest produce are the only livelihood option for the tribal communities in this zone. The tribal area is traditionally rich in horticulture production due to its diverse and unique agro-climatic conditions which are conducive for growing a wide range of horticultural crops like coffee intercrop with black pepper, turmeric, black pepper,



pineapple, jackfruit, exotic vegetables and strawberry. The tribal area has blessed by nature with an abundance of natural resources which provides numerous opportunities to invest and venture in processing and value addition of turmeric, black pepper, coffee; cultivation of exotic vegetables with marketing linkage. This area is also having a lot of scope for the medicinal and Aromatic plants sector which was a neglected area could take up systematic cultivation. The tribal area of Visakhapatnam also has a lot of scope for eco-tourism due to prevailing peculiar climatic conditions. By using these opportunities in this tribal area, the tribal youth can become entrepreneurs.

EFFECT *TRIGONELLA FOENUMGRAECUM* AND *TINOSPORA CORDIFOLIA* FEED ADDITIVES ON CARCASS TRAITS OF BROILERS IN KONKAN CLIMATIC CONDITIONS OF INDIA

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Abstract

The different types of feed and combination of feeds are the major element in growth and getting high net return from the poultry. Feed additive plays important role in improving the efficiency of feed utilization and animal performance. The current study attempted to determine the influence of herbs i.e. fenugreek (*Trigonella foenumgraecum*), guduchi (*Tinospora cordifolia*) and in combinations of both at different levels in diet of broilers. The experimental trial was conducted with one hundred sixty two unsexed day-old Vencobb-400 broilers chicks. The nine treatments were given with three replication and each replicates had six birds. The herb stem powder were fed for six weeks at 0, 0.1 and 0.2 per cent level of each herb in combinations. In order to evaluate the seasonal variation it was conducted throughout the year viz. summer, rainy and winter. The chicks were fed with maize crumble at 0-4 days then starter feed from 5-21 days and 21-42 days with finisher feed. All the birds were managed under uniform management conditions in three seasons of Konkan climatic conditions. The experimental results showed that the significant increased dressed weight, dressing per cent, giblet, breast, drumstick thigh and meat to bone ratio in broiler fed with 0.2 per cent fenugreek seed and guduchi stem powder during winter season than rest of the treatments and seasons. It would be suggested that the supplementation of broiler chicks' diets with 0.2 per cent fenugreek seed and guduchi stem powder improved the carcass characteristics of broilers.

ASSESMENT OF PROMISING GENOTYPES OF PIGEONPEA AGAINST DRY ROOTROT CAUSED BY *RHIZOCTONIA BATATICOLA* (TAUB.) BUTLER AND STEM CANKER CAUSED BY *MACROPHOMINAPHASEOLINA* (TASSI) GOID]

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Abstract

Pigeonpeas are one of the protein rich legume crops grown in tropical and subtropical regions of the world. It is the second most important pulse crop of India after chickpea. It is infected by many fungal diseases. Among them dry root rot is an emerging disease as the most destructive constraint to pigeonpea productivity and production, as the disease is more prevalent during hot temperature of 30 to 35°C and low soil moisture conditions. Dry root rot in pigeonpeas is caused by *Rhizoctonia bataticola* and stem canker caused by *Macrophomina phaseolina* is a seed as well as soil borne necrotrophic fungal pathogens infect more than 284 plant species including monocots and dicots throughout the world. It is the most destructive disease and causes severe yield loss in pigeonpea. The resistant sources against these diseases were found to be scarce. Hence the present investigation was undertaken to identify resistant genotypes against dry root rot and stem canker at Zonal Agricultural Research Station (ZARS), Kalaburagi. Among 174 pigeonpea genotypes screened against dry root rot and stem canker diseases under field conditions 15 genotypes were found to be resistant, 120 genotypes recorded moderately resistant and 38 genotypes recorded susceptible reaction for dry root rot whereas seven genotypes showed resistant reaction, 47 genotypes showed moderately resistant



reaction, 79 genotypes showed moderately susceptible reaction, 26 genotypes showed susceptible reaction and 15 genotypes showed highly susceptible reaction for stem canker.

MEDICINAL AND THERAPEUTIC VALUES OF ENDANGERED SPECIES *COMMIPHORA WIGHTII*

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Abstract

Commiphora wightii plant commonly also name is guggul. It is belong to family Burseraceae and class magnoliopsida. The guggul plant present in arid and semi arid region. It is distributed in Asia India, Pakistan and Bangladesh. In India it is found in Rajasthan, Gujarat, and Karnataka. Guggul plant is a shrub or small tree reaching maximum height of 3 to 3.5 meter. *Commiphora wightii*, guggulu, has emerged as a good source of the traditional medicines for the treatment of inflammation, arthritis, obesity, microbial infection, wound, pain, fractures, tumor, and gastrointestinal diseases. It is one of the oldest and the most prominent herbs in Ayurvedic medicine. Guggulu is a versatile drug and, because of its paranormal properties, it is very valuable in treating variety of disorders. Pharmacological results have validated the use of this plant in the traditional medicines. This plant contains a number of bioactive constituents including terpenoids, steroids, flavonoids, guggultetrols, lignans, sugars, and amino acids. The guggul plant seed contains 10% oil content and this oil in oleo-gum resin. The plant *Commiphora wightii* has vast economic value and a wide array of medicinal uses in both ancient and modern therapeutics. The plant medicinally important natural gum resin. In Rajasthan and Gujarat enlisted the guggul plant in Red Data List of endangered species. Guggul plant is endangered because it slow growing nature and poor seed germination.

BIOCIDAL EFFICACY OF *STEINERNEMA CARPOCAPSAE* AGAINST CATTLE TICKS

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Abstract

Entomopathogenic nematodes have been successfully used as biological control agents of insects of economically important crops. In the present study, the biocidal efficacy of two different strains of entomopathogenic nematodes, *Steinernema carpocapsae* STSLU and *S. carpocapsae* STUDR against two different cattle ticks, *Rhipicephalus microplus* and *Hyalomma savignyi* was evaluated on the basis of percentage mortality under laboratory conditions. The adult female cattle ticks were inoculated with infective juveniles (IJs) of both the strains of *S. carpocapsae* at different inoculum levels. All the treatments were replicated four times at 20° C in a B.O.D. incubator. The percentage mortality of the cattle ticks was determined every 24 hours up to 120 hours from the time of inoculation. *Rhipicephalus microplus* was more susceptible to both strains than *H. savignyi*. *S. carpocapsae* STSLU was more efficient than *S. carpocapsae* STUDR and cause 100 and 97.5 % mortality of *R. microplus* and *H. savignyi*, respectively at a concentration of 250 IJs/Petri dish after 120 hours. As both the tested strains were promising to control *R. microplus* and *H. savignyi*, those may be evaluated further in field conditions.

GENOME EDITING; NOVEL APPROACH FOR RESISTANCE AGAINST PLANT PATHOGENS

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Abstract

Plants are continuously attacked by a multitude of pathogens and pests, including viruses, bacteria, oomycetes, fungi, insects, nematodes, and even parasitic plants. Collectively, these pathogens and pests cause substantial crop losses, threatening efforts to meet the food security needs of an evergrowing world population. During pathogen attack, a multilayer defense system is engaged to fight invading organisms. This system consists of a two-tier immune perception system that involves molecular receptors that detect potential pathogens at the cell periphery and also inside the cytoplasm. Genome editing has been revolutionizing plant biology and biotechnology by enabling precise, targeted genome modifications. Editing provides new methods for genetic improvement of plant disease resistance and accelerates resistance breeding. Several traditional breeding



methods were developed for resistance breeding like pureline method, mutation breeding. However, they are time consuming, sometimes resistance alleles are also linked with plant development. The core of genome editing technology is the use of sequence-specific nucleases for recognizing specific DNA sequences and producing double-stranded DNA breaks (DSBs) at targeted sites. Genome editing has great potential to overcome the limitations of conventional resistance breeding. Altogether, genome editing has become a powerful tool for both molecular plant-microbe interactions and disease resistance breeding. We will certainly witness more applications of genome editing in generating plants that are resistant to various pathogens and accelerating breeding for robust and broad-spectrum resistance. Undoubtedly, environmentally sustainable agriculture will benefit from these developments in genome editing.

EVALUATION OF CEREAL-LEGUME FORAGES CROPS ON SOIL NUTRIENT STATUS IN INDO-GANGETIC PLAINS

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Abstract

The present study was conducted to evaluation of production potential of different forage crops commonly grown by farmers. The experiment was carried out in randomized complete block design with eight treatments and three replications at research farm of Agronomy Section, ICAR-NDRI, Karnal (Haryana). Among eight treatments, two perennial forage crops napier bajra hybrid (NBH), guinea grass cultivated sole as well as intercropping with cowpea and four seasonal fodder crops (cowpea, sorghum, baby corn and maize) were tested for their physio-morphological, biomass yield responses and economic efficiency. Experimental results showed that among the different forage crops significantly highest green as well as dry fodder yield were revealed from NBH intercropped with cowpea 63.79 and 11.95 t/ha green biomass fodder yield (GBY) and dry fodder yield respectively; which were found at par with sole NBH treatment (60.69 & 11.68 t/ha GBY and DFY). Among the different forage crops lowest GBY and DFY 33.1 and 5.68 t/ha was produced by baby corn and cowpea respectively. The magnitude of the yield advantage was observed maximum and in the tune of 20.69% with guinea intercropped with cowpea against sole guinea. Highest net return was obtained from dual purpose baby corn (₹ 1.60 lakh/ha) with B:C ratio (5.26) and economic efficiency (₹ 2471/ha/day), followed by in NBH intercropped with cowpea. Based on the study, it is clearly indicated that dual purpose baby corn followed by NBH + cowpea intercropping could be feasible option for increasing the overall productivity of dairy farmers in Indo-Gangetic plains and elsewhere similar conditions prevails.

CULTURAL, MORPHOLOGICAL AND BIOCHEMICAL CHARACTERIZATION OF BOVINE MILK SAMPLE AND COMPARISON OF MICROBIOTA IN HEALTHY AND MASTITIC MILK SAMPLE

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Abstract

Mastitis is an inflammatory disease of bovine's mammary gland that led to the loss in milk production and has a huge impact on economy of the country. The present study was conducted primarily based on clinical signs of mastitis from different breeds of bovine which includes a total of 15 milk samples. All the samples were screened by different parameters as pH, SCC count, Chloride test and Whiteside test to find out whether the milk sample was from bovine having clinical, sub-clinical mastitis or the healthy one. After cultural, morphological and biochemical identification 15 isolates were observed included 8 *E. coli*, 5 coagulase negative *Staphylococcus spp.*, and 2 yeasts. These were confirmed by the PCR based amplification with specific primers. The genus and species of all the isolates were confirmed by Sanger sequencing and BLAST based analysis as *Staphylococcus gallinarum*, *Staphylococcus succinus*, *Staphylococcus sciuri*, *Diutina rugosa* and multiple strains of *E. coli*. It seems to be the first report of *Diutina rugosa*, *Staphylococcus gallinarum*, *Staphylococcus succinus*, *Staphylococcus sciuri* in subclinical mastitis in Indian cattle. The antibiotic sensitivity pattern revealed multidrug resistance in all the isolates of *E. coli* and *Staphylococcus spp.* The resistance was highest against Amoxycylave (100%), followed by Cephalexin (87.5%), Moxifloxacin (75%), Enrofloxacin (67.7%), Cloxacillin (66.7%), Ceftriaxone and Oxytetracycline (62.5%) and Gentamicin



and Streptomycin (58.4%). The antibiotyping revealed 14 different antibiotypes. For comparison of Healthy and Mastitic milk samples, the isolated DNA were pooled and then outsourced for Illumina sequencing and the data was analyzed using MG-RAST against the RDP (Ribosomal Database Project) database available within MG-RAST. The refraction curve obtained from sequenced data clearly indicates the presence of large number of microbes in mastitic milk sample as compared to healthy sample. Similarly, the α -diversity suggests the more diversified microbial population in diseased milk samples. Data showed the taxonomical diversity, 1 domain, 2 phylum, 7 classes, 12 orders, 34 families, 81 genus and 197 species were missing from the milk sample of healthy animals. It signifies the diversification of udder environment in the cases of sub clinical mastitis. Moreover, in healthy udder archaea contributed 99.68% and bacteria were only 0.31% of total population as compared to 0.25% and 99.74% in mastitic udder. It can be concluded that the use of metagenomic pyrosequencing of the 16S rRNA appears to be an important tool for the advancement in the knowledge about the pathogenesis of mastitis. Also the present study recommends a.) use of discriminant analysis to discriminate microbial community of clinical and healthy mastitis and b.) regular use of antimicrobial susceptibility testing of mastitis.

EVALUATION CHEMICAL CONSTANT, MOISTURE & DRY MATTER OF PRE-MICROWAVE TREATED PM 21 & PDZ VARIETIES OF INDIAN MUSTARD.

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Abstract

Pusa mustard 21 (LES 127) is a low Erucic acid (single zero) variety of Indian mustard whereas PDZ-1 [Pusa Double Zero Mustard-31(PDZM-31)] is the first Double Zero (erucic acid <2% and glucosinolates<30ppm) Indian mustard [Brassica juncea (L.) Czern&Coss] variety. The aim of the present study was to investigate the impact of treatment of microwave radiation on several parameters of 2 varieties of Indian mustard i.e., PM21 & PDZ-1. Microwave treated seeds have shown higher oil yield due to the formation of permanent pores in the cell wall, enabling the oil to move through them rapidly. 5gm seeds of both PM21 & PDZ-1 were microwaved for 0, 2, 4, 6 & 8 mins. The seeds were then incubated in a thermostat controlled oven at 105°C for 6 hours. The microwaved seeds were then extracted using soxhlet extraction unit for 7 hours. The solvents used were hexane and petroleum ether. Saponification value, Iodine number, % dry matter & moisture were calculated for different treatments. The weight of the seed samples decreased linearly after giving the microwave treatment. PM 21 seeds have low moisture content than PDZ-1 seeds at all the stages of microwave treatment except at 8mins. The saponification value ranges from 140-280 for PM21 seeds & from 133-406 for PDZ-1 seeds in petroleum ether extracts whereas for hexane extract of PM 21 seeds it ranges between 140-350, the highest being of PM 21- 8mins. There was no significant deviation in the iodine values of both the extracts and of both the varieties from the control value i.e., 0mins. The iodine value ranges from 9-11 in both the extracts.

STUDIES ON ANTHRACNOSE OF CHILLI (*CAPSICUM ANNUUM* L.) INCITED BY *COLLETOTRICHUM CAPSICI* (SYDOW) BUTLER AND BISBY

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Abstract

Survey conducted during 2016-17 and 2017-18 revealed overall mean incidence of Anthracnose of chilli in Madhya Pradesh to be 22.44 %. The lowest anthracnose incidence was noticed in Jabalpur district, while highest anthracnose incidence was recorded in Burhanpur district. The fungus infects the leaves, branches, green as well as ripe fruit. Severely infected leaves fall off leading to defoliation. The infection of growing tips leads to necrosis of branches and die back. Symptoms on fruit initially started as water-soaked lesions and convert into fruit rot. *Colletotrichum capsici* was isolated from diseased samples and identified on the basis of cultural and morphological characters. Sixteen isolates were isolated from diseased samples those were collected from sixteen locations/blocks of eight chilli growing districts of Madhya Pradesh. In present investigation, pathogenicity of the sixteen isolates of *C. capsici* obtained from eight districts of Madhya Pradesh was tested on green and ripe chilli. On green chilli, significantly maximum anthracnose severity was recorded in JHB-2, while minimum anthracnose severity was recorded in CHN-2. On ripe chilli, significantly maximum anthracnose severity was recorded in BHP-1, while



minimum anthracnose severity was recorded in CHN-2 which was found at par with BRW-1. Cultural variability of *C. capsici* isolates exhibited that the colonies were cottony, compact or fluffy with colour ranging from white to dark grey, colony margins varied from regular or irregular. The considerable variation in the mycelial growth was observed within the isolates on PDA. Morphologically the isolates significantly varied in conidia length, conidia width, conidia shape, setae length and acervuli types. The molecular technique, RAPD was used to detect the genetic variation among the 16 isolates of *C. capsici*. Total 02 primers OPD 07 and OPL 05 were used to access molecular variation. The dendrogram constructed from the pooled data of primer OPD 07 and OPL 05 indicated two major clusters I and II in each primer. Detection of seed borne inoculum in the samples done by employing standard blotter revealed that the dominance of *Colletotrichum capsici*. Minimum percent of *C. capsici* was recorded in Anjad, while maximum percent of *C. capsici* was recorded in Raipuriya and Khatla.

To find out the best source of nutrients for fungal growth, different media were tested against *C. capsici*. Maximum mycelial growth was observed in Potato dextrose agar and minimum in Ashby's mannitol agar. Sporulation was observed in Czapek dox agar, EMB agar, Red chilli powder agar, Chilli leaf extract agar, Chilli green fruit extract agar, Chilli red ripe fruit extract agar and Potato dextrose agar. Based on visual observation on colony colour, the culture media were divided into four groups and two groups on the basis of colony type. *In vitro* evaluation of carbon and nitrogen sources against anthracnose revealed that among the carbon sources, highest dry biomass of *C. capsici* was recorded in Dextrose, while lowest in Maltose. Poor sporulation was recorded in Fructose, Lactose and Galactose. Among the nitrogen sources, Potassium Nitrate supported the maximum mycelial dry weight while lowest in Ammonium Molybdate. Poor sporulation was recorded in Ammonium Molybdate, Zinc Nitrate and Barium Nitrate.

The present experiment was conducted to determine the correlation between disease severity and environmental factors. Minimum temperature, maximum relative humidity, minimum relative humidity and rainfall influenced the disease severity positively and significantly whereas sunshine hours influenced it negatively and significantly. The maximum temperature negatively influenced the anthracnose severity but their impact was non-significant.

Moderately resistant response against anthracnose was observed in the cultivars Arka Harita, Arka Meghna, Pant C-1, Pusa Jwala, US 611 and US 918, while remaining cultivars found susceptible and highly susceptible. In the present investigation, eleven chemical fungicides were evaluated against the growth of *C. capsici* under *in vitro* condition. Among the fungicides, Propiconazole and Tricyclazole completely inhibited (100 %) mycelial growth of *C. capsici*. Maximum spore germination inhibition percent was recorded in Propiconazole and Tricyclazole. A field experiment was conducted to evaluate eight chemical fungicides against anthracnose of chilli. Among the fungicides, Propiconazole and Tricyclazole were found highly effective to reduce the anthracnose severity in chilli.

SCREENING AND EVALUATION OF PEARL MILLET [*Pennisetum glaucum* (L.) R. Br.] GENOTYPES FOR RUST AND BLAST

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Abstract

Pearl Millet is one of the important sources of staple food to the large masses of the people in India and sub-Saharan Africa and also an important fodder crop. It is majorly rainy season cereal crop, but can be grown in summer season also under irrigated condition. It is nutritionally preferred cereal as it contains higher level of micronutrients specially Fe and Zn compared to other cereal crops like maize, wheat, rice, sorghum etc. India ranks top in the production of Pearl Millet globally. Like many other crops, it is also affected by several biotic stresses, among them, downy mildew, ergot, smut, rust and blast are major diseases of pearl millet. Recently, rust and blast diseases have emerged as serious concerns causing yield lost to the tune of 72 and 62 per cent respectively. Blast is caused by *Pyricularia grisea* (Cooke) Sacc, whereas rust by *Puccinia substriata* var. *indica*. Looking into the quantum of yield gets affected due to these diseases, it is very important to breed for stable and durable disease resistant lines. To identify the superior disease tolerant genotypes, fourteen entries including eight test entries and six checks were evaluated at AICRP (PM), Regional Agricultural Research Station, Vijayapur during *kharif* 2019. Among the varieties tested, VPMV-9 was found to be moderately resistant for rust and blast diseases with score of 3 for both the diseases and recorded yield of 2420 kg per ha as compared to check ICTP 8203 (1866kg/ha) with moderately susceptible disease reaction for both the diseases. Among the hybrids, VPMH-14 was found to be superior with yield of 2872



kg per ha with moderately resistant disease reaction (Score-3) for both rust and blast diseases as compared to check GHB-558 (2003 kg/ha) showing moderately susceptible reaction for both the diseases. VPMV-9 is in pipe line for release while VPMH-14 hybrid is in advanced yield trial (AYT). These superior genotypes with disease resistance ability can greatly help the farmers to reduce the yield loss and improve the income.

SUSTAINABLE EMPOWERMENT OF WOMEN THROUGH VALUE ADDITION IN FINGER MILLET (*ELEUSINE CORACANA*)

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Abstract

Rural Indian women are extensively involved in agricultural activities, but the nature and extent of their involvement differs with variations in agro-production systems. In addition to their role in agricultural production, women are gainfully employed in agri-based allied activities like dairying, animal husbandry, poultry, goatery, rabbit rearing, beekeeping, floriculture, horticulture, fruit preservation, value added food products etc. This would also help in generating self-employment and women entrepreneurship. Entrepreneurship skills can help in building confidence and self-awareness through income generation. Various activities can be taken up by rural women for income generation while being at home and by organizing themselves in Self Help Groups (SHGs). Usually, women's representation is greater in allied agriculture than in grain production, and poor households require the greater involvement of women in income-generating activities than financially stable ones. Different extension methods like on campus training programs and group discussions were developed on the value addition of tamarind to create awareness among the public. In this perspective Seethe Byraveshwara Self Help Group of 15 farm women was identified to be trained in KVK for the development of value added products and an on campus training programme for a week was provided to disseminate technology on production of finger millet value added products like Ragi laddu, ragi mixture, ragi chocolate, ragi malt and ragi kurkure and to estimate cost benefit ratio. Raw materials, branding, labelling and packaging materials were distributed to the SHG to encourage them for the product development and selling of the products. Advertising and marketing of the products initially was carried on in the free stalls of exhibitions in krishi melas and in district melas where the products created huge demand. Results showed that processing of quintals of ragi for five products like ragi laddu (70Kg), ragi mixture (51.25 Kg), ragi chocolate (80.50Kg), ragi malt (130Kg) and ragi kurkure (48.5 Kg) respectively. Ragi laddu, ragi mixture, ragi chocolate, ragi malt and ragi kurkure production procured was 18,560, 27,850.50 and 29,250.75, 27,640.75 and 28,648.50 respectively. The total processing cost of Ragi laddu, ragi mixture, ragi chocolate, ragi malt and ragi kurkure was 13,470, 14,500.00 and 15,250.00, 17,560 and 15,550 respectively. The ragi laddu of marketing efficiency ratio were 1.37, ragi mixture was 1.92, ragi chocolate was 1.91, ragi malt 1.57 and ragi kurkure was 1.84 respectively. The value addition of finger millet has helped to improve their family income per month from 20,000/- to 25,000. These trained individuals of SHGs now serve as the resource persons in training the budding up SHGs.

APPLICATION OF HERBS AND SPICES IN FUNCTIONAL DAIRY PRODUCTS

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Abstract

Herbs and spices are harvested from different parts of the plant. Herbs are generally obtained from the leaves of the plant while spices usually come from different seeds, root, bark, fruit berries, aril and flowers of the plants. Herbs and spices are used to fortify foods as flavour, preservatives and therapeutic agents. Herbs and spices are low-cost commodities, they are used for many centuries in dairy and food products. Now a days, it can be used to increase the acceptability of food stuffs and improve their health. All over the world, herbs and spices have been utilized as food additives to enhance the sensory properties of food, and also increase the shelf life of food. Several herbs have possessed therapeutic properties like antioxidative, antidiabetic, anti-inflammatory, anti-hypertensive and antimicrobial activities. Therefore, fortification of dairy foods with different herbs and spices could help to provide functional dairy products with nutritional advantages and medicinal values.



Herbs and spices are used to improve the appearance and attractiveness of foods for consumers acceptance. Today, only the highest quality of herbs and spices can be added for value addition in dairy and food products. In the dairy sector, addition of several herbs and spices in different forms like powder, fresh, extract and essential oils. Now a days, different types of herbs and spices are widely used on the quality of dairy products such as yoghurts, cheeses, butter, ice creams and ghee.

SOCIO-ECONOMIC PROFILE OF MIGRATORY DECCANI SHEEP REARING FAMILIES IN BELAGAVI DISTRICT

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Abstract

Migratory sheep rearing is one of the oldest method of rearing the sheep. Deccani sheep is one of the important breed being reared by a majority of the migrating shepherds of Belagavi district. The migratory Deccani sheep rearing families were selected by purposive snow ball sampling method. A total of 180 respondents (90 men and 90 women) were selected. The primary data was collected with the help of well-structured pre tested interview schedule. The profile of the migratory shepherd families revealed that majority of men (68.00 %) and little over half of the women (54.40 %) belonged to middle aged group (36-50 years). It is seen that majority of men (84.50 %) and women (94.40 %) were illiterates. Cent per cent of migratory shepherds belonged to backward caste i.e Kuruba. Majority of migratory shepherds (71.11 %) have nuclear families. Majority of the respondents (67.80 %) belonged to medium family size (5-8 members). Majority of men (95.60 %) and all the women were married. Majority of the families (71.10 %) did not possess land. Majority of migratory shepherd's families (82.22 %) annual income was high (Rs. 80,000 and above). Majority of men (88.89 %) and women (84.44 %) had medium to low urban contact. Social participation was high among women (75.86 %) and half of men (50.00 %) respondents had medium social participation. Majority of men had medium level (68.88 %) and women consultancy pattern was low (92.22 %). About 37.78 per cent of migratory shepherd possess less than 165 sheep, followed by 34.44 per cent medium size (166- 243). As sheep rearing contribute to sustainable livelihood, there is need to provide trainings and enhance their educational level to make the sheep rearing as profitable enterprise. Providing extension and mobile veterinary services on their fixed migratory routes will improve their socio-economic condition and standard of living.

ROLE OF BIOCOMPOST IN IMPROVING SOIL HEALTH IN FINGER MILLET

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Abstract

Finger millet (*Eleusinecoracana* L.) is an important principal staple food crop mainly grown in the states of Karnataka, Andhra Pradesh, Odisha and Tamil Nadu in India. It is commonly known as "Nutritious millet". In India, Finger millet is cultivated in an area of about 1.13 million hectares with an annual production of 1.82 million tonnes with a productivity of 1601 kg ha⁻¹. In Andhra Pradesh, it is grown in an area of 32000 hectares with a production of 43000 tonnes and a productivity of 1344 kg ha⁻¹. This crop has much significance in Chittoor district, being grown in an area of 5000 hectares with a production of 9000 tonnes and a productivity of 1580 kg ha⁻¹. Biocompost is a combination of pressmud and distillery spent wash along with consortium of efficient microbial cultures and also enriched with FeSO₄, ZnSO₄ and bio fertilizers. It is a dark brown to black coloured by-product of sugarcane industry which provides beneficial quantity of organic matter, nutrients and favourable condition for soil micro-organisms. Biocompost plays an important role in improving soil physical (WHC, porosity and bulk density etc.), chemical (pH, CEC etc.) and biological properties (soil enzymes and microbial population) which leads to increase in nutrient supplying capacity of soil and reduces the dependency on inorganic fertilizers. Addition of bio-compost either alone or in combination with inorganic fertilizers significantly improved the organic carbon and availability of nutrients (N, P, K and S) with reduction in bulk density of soil. It has best potential to improve soil organic carbon, WHC and decreased bulk density. Application of bio compost reduced the recommended dose of fertilizers and improved organic matter and physical properties of soil like WHC, porosity and decreased the bulk density during the crop production. The increase in OC



content may be attributed to recycling of roots, above ground residues and stubbles due to higher biomass production with application of bio compost. Bio compost is organic in nature and contains high organic compounds and addition of these organics to soil, the soil organic carbon content increases due to decomposition by microorganisms. Balanced and integrated use of organic and inorganic fertilizers enhance the accumulation of soil organic matter and improve soil chemical properties. The cation exchange capacity (CEC) of soils was also higher with bio compost due to higher basic cationic content of bio compost and also smaller sized particle which increases the surface area. The use of bio compost have made soil more porous, allowing better root growth and development, thereby resulting in higher CEC, leads to more nutrient uptake and higher yield.

STUDY ON THE EXISTING BREEDING AND FEEDING MANAGEMENT PRACTICES OF THE COMMERCIAL DAIRY FARMERS OF PUNJAB

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Abstract

Punjab is contributing approximately 10 per cent towards total milk production with only three percent of the total bovine population of India. Understanding the livestock management practices followed by the farmers is of utmost importance to identify the strengths and weaknesses of the rearing system and to formulate suitable intervention policies. The study was conducted in two high productivity regions of Punjab, Ludhiana and Chandigarh to ascertain the existing breeding and feeding management practices of farmers. A total of 60 commercial dairy farmers were selected which were further divided into two groups of 30 each on the basis of number of dairy animals being reared by them. Semi structured interview schedule and observation method were selected for data collection. The study revealed that under breeding management majority of the farmers followed the practices like insemination of animal in mid heat (100%), practicing AI (83.35%), pregnancy diagnosis (76.70 %), manual observation of heat symptoms (96.66%), maintaining manual records (71.70%). Under feeding management majority of the farmers followed supplementation of mineral mixture and salt (100%), bypass fat and proteins (93.33%) and feeding of fodder and concentrate twice a day (53.35% and 85% respectively). No significant gap was noticed between existing and recommended scientific management practices of the dairy farmers of Punjab.

CFLD : AN EFFECTIVE MEAN FOR INCREASING YIELD SOYBEAN

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Abstract

The present study was carried out during *kharif* season in 08 villages of Sheopor district of Madhya Pradesh during 2019. A total 75 frontline demonstration covering an area of 30 ha were conducted on soybean crops. Under frontline demonstration, improved variety RVS 2001-4, seed treatment, balanced fertilization, integrated pest management etc. were included as improved technologies. The results of these demonstrations revealed that the soybean under improved technologies yielded 29.50 percent higher than farmer's practices. The average yield of soybean under demonstration was 15.97q/ha which was much higher than yield 12.33 q/ha under farmer's practices. The improved technology gave higher gross return, net return with higher benefit cost ratio. In spite of increasing in yield technology gap, extension gap and technology index existed.

IN VIVO EFFICACY OF NEW FUNGICIDES AGAINST PHOMOPSIS VEXANS CAUSING FRUIT ROT DISEASE OF BRINJAL (*SOLANUM MELONGENA* L.).

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Abstract

Fruit rot of brinjal caused by *Phomopsis vexans* is an important disease of eggplant that inflicting heavy losses. The present



investigation was carried out at the experimental field of Krishi Vigyan Kendra Majhgawan, Satna (M.P.) during *rabi* season of 2019-20 to know the efficacy of new fungicides for the management of fruit rot disease *in vivo*. The six fungicides with three replications were taken up by using Randomized Completely Block Design (RCBD). Fungicides *viz.*, tebuconazole + trifloxystrobin 75 % (Nativo 75 % wg) @ 0.1 %, boscalid + pyraclostrobin (Visma 38 % wg) @ 0.16 %, hexaconazole + captan 75 % (Taqat 75 % wp) @ 0.2 %, difenoconazole (Score 25 % ec) @ 0.07 %, carbendazim (Bavistin 50 % wp) @ 0.1 % and copper oxychloride (Blue copper 50 % wp) @ 0.3 % were tested against brinjal fruit rot pathogen (*Phomopsis vexans*). The fungicidal spray was given twice at 10 days interval. Observations were recorded at 10 and 20 days after the spray. All the tested fungicides were found to be significantly superior over check in reducing the disease incidence. Among the tested fungicides the minimum per cent disease intensity and maximum disease control was recorded with boscalid + pyraclostrobin @ 0.16 % (9.35 % and 71.25 %), followed by tebuconazole + trifloxystrobin @ 0.1 % (10.41 % and 68.12 %). The highest yield of brinjal fruits was obtained with boscalid + pyraclostrobin 186.53 q ha⁻¹, followed by tebuconazole + trifloxystrobin 184.78 q ha⁻¹. The highest incremental cost: benefit ratio 1:14.48 was recorded by tebuconazole + trifloxystrobin.

BACKYARD POULTRY FARMING WITH IMPROVED POULTRY BREEDS

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Abstract

Backyard poultry farming is a potent tool for uplift of rural economy. Mostly desi/indigenous birds' are being reared with very little health care and management, their growth potential is low which affects the quality of meat and egg. To provide good quality meat and to get sustainable income through improved poultry breeds, the growth performance of Kadaknath breed under free range system was assessed in different agro-climatic zones of Dharwad district of Karnataka *vis* Northern dry Zone – III (Navalgund taluk), Northern transitional Zone – VIII (Dharwad, Hubli & Kundagol), Hilly Zone – IX (Kalaghatagi taluk). The present study showed that, the Kadaknath breed is very sturdy, with stand both cool and hot climate, has high hurdling behavior, resistant to various diseases and highly suitable for free range system rearing as compared to cage system. Mortality percentage (7.5%) was high during first three weeks old chicks, body weight gain at 10th week was 0.8 kg and 2.3 was feed conversion ratio. Age at first laying varies from 25 to 26 week and the total eggs production was 120-130 annually. Egg colour is white to light brown and weighs approximately 40 -45 g, meat is grey to black in colour and rich in protein (25%), calcium (25 mg), phosphorous (221 mg), low in fat (11.20g) and cholesterol (79.50 mg), also faecal matter rich in nitrogen (1.82%) as compared to local Desi and Giriraja poultry birds. Hence backyard poultry farming with improved breed of chicken like Kadaknath breed helps in providing healthy nutritious meat and egg to the farming community and improves the income status.

COMPOSITE INLAND FISH FARMING IN FARM POND AS ADDITIONAL SUBSIDIARY INCOME

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Abstract

ICAR-KrishiVigyan Kendra, Saidapur Farm, UAS, Dharwad effectively experimented to promote the inland fisheries in underutilized farm pond in the last six years (2015 to 2020) through front line demonstration (FLD) in Dharwad district of Karnataka state. The State Government, Department of Agriculture had implemented scheme on farm pond (Krishi Honda) in different villages mainly in rainwater dependent area during the year 2014-15 with aiming to recharge and rejuvenate ground water table, mitigate drought situations, provide water to farming, people and animals during drought situations etc. Farmers were utilizing these farm ponds mainly for crops, drinking purpose etc. Scientist of KVK Dharwad implemented composite inland fisheries by rearing Catla (40%), Rohu (30%) and Common carp (30%) of total 6000 no. stocks in underutilized farm pond of farmers field itself for 8-12 months and the input cost per demo is 2800/-. Total of 30 demonstrations were conducted to 30 small holder farmers from Navalugund, Hubli and Dharwad taluk. Upon consideration of six year data, there was significant increase in weight gain (800-950 gram) and length (20-25 centimeter). About 3.16 t per ha fish production was obtained and makes extra profit (Rs.50/kg, 2000*50) of Rs. 150,000/- by this technology in consideration with mortality and



other factors. Such production technology improves farmers' economic conditions by better utilization of farm pond besides protective irrigation to field crops.

BIOMASS AND ESSENTIAL OIL VARIATION IN DIFFERENT ACCESSIONS OF *TAGETES MINUTA* COLLECTED FROM HIMACHAL PRADESH

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Abstract

The study was conducted to generate information on the extent of genetic diversity and to identify better strains in terms of higher conventional yields in *Tagetes minuta*. Observations on biomass yield and essential oil recovery were conducted at two stages of plant growth i) at preflowering stage and ii) at flowering stage on independent plants. Both in terms of fresh biomass yield as well as essential oil content, considerable variation amongst the studied accessions was noticed. The fresh leaf biomass yield ranged between 33.69 q ha⁻¹ (accession 5) to 57.43 q ha⁻¹ (accession 9) on the basis of pooled data of two years. The essential oil content ranged between 0.26% (accession 17) to 0.37% (accession 30) in leaves. Fresh flowering portion ranged between 20.46 q ha⁻¹ in accession 19 to 47.76 q ha⁻¹ (accession 10) on the basis of pooled data of two years. The oil percentage ranged between 0.41% in accession 19 to 0.75% (accession 30) on the basis of two years data. On the basis of maximum biomass and yield parameters, five accessions were identified: i) Accession 6(highest in flower oil yield), ii) Accession 9(highest in leaf biomass and leaf oil yield), iii) Accession 10(highest in flower biomass yield) iv) Accession 30(highest in leaf and flower oil content) v) Accession 32(highest in leaf oil yield). These five accessions can be a source of useful germplasm for producing elite strains in terms of biomass and oil yield in *Tagetes minuta*.

EFFECT OF MODIFIED FLY ASH ON SOIL PROPERTIES AND BIOAVAILABILITY OF CADMIUM, LEAD AND CHROMIUM IN A CONTAMINATED VERTISOL

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Abstract

Environmental pollution is the biggest menace the world faces today. Recently fly ash was used as a potential soil amendment for remediation of contaminated soil. An incubation studies and pot culture experiment was conducted to study the effect various amendments (fly ash, acid (HCl) modified fly ash, Alkali (NaOH) modified fly ash and humic acid modified fly ash) and their application rates (1, 2.5 and 5% dry w/w basis) on heavy metal (Cd, Pb and Cr) stabilization in a Cd, Pb and Cr contaminated soil. Plant bioavailable (DTPA extractable) content of Cd, Pb and Cr was significantly reduced as a result of fly ash and/or acid, alkali and humic acid modified/treated fly ash as soil amendment in cadmium, lead and chromium contaminated soil. Among these amendments, the performance of NaOH modified fly ash was significantly higher in stabilizing the Cd in a cadmium contaminated soil to an extent of 37.43% and Pb in a lead contaminated soil to an extent of 16.43% at highest rate (5%) of application. Likewise, acid modified fly ash application in a chromium contaminated soil proved to a better option in stabilizing the Cr to an extent of 22.79% at highest rate (5%) of application. The results from the pot culture experiment also revealed that highest per cent reduction of 44.9% and 55.6% in spinach leaf Cd and Pb content as compared to control was observed in a Cd and Pb contaminated soil amended with alkali modified fly ash, respectively. Similarly, the highest per cent reduction of 64.6% in spinach leaf Cr content as compared to control was observed in a Cr contaminated soil amended with acid modified fly ash. Further, the lowest transfer coefficient value (0.33 and 0.02) was observed in the alkali modified fly ash amended Cd and Pb contaminated soil and the acid modified fly ash amended Cr contaminated soil indicates greater reduction in mobility of heavy metal (Cd, Pb and Cr) from soil to plant system. From the study, it was clearly evident that alkali modified fly ash addition as soil amendment has greater potential in reducing the mobility of heavy metal in soil and its subsequent transfer to edible plant parts (spinach leaf) as evidenced by reduction in DTPA extractable Cd & Pb in soil and lower transfer coefficient value in a Cd and Pb Contaminated soil (artificially spiked soil). However, both acid and alkali (NaOH) treated fly ash was proved as a better option for spinach yield and also reducing the translocation of potentially toxic heavy metal (Cr) to spinach leaf in a Cr contaminated soil.



WHATSAPP : AN EFFECTIVE COMMUNICATION TOOL FOR DISSEMINATION OF AGRICULTURE TECHNOLOGY AMONG FARMERS

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Abstract

A study was carried out during Kharif 2020 by KVK, Baroda, Sheopur (M.P.) for management of rice blast disease in aromatic rice. Rice is the major Kharif crop of district, it occupies an area of 44.00 thousand ha. Rice blast, specially neck blast disease of rice is the most dominate rice production constraints in the district in every year. On the basis of farmers opinion it was found that rice blast (neck blast) is the major threat to aromatic rice causing highest loss to crop due to untimely application and wrong selection of fungicide during crop period, this is mainly due to lack of knowledge among farmers. To overcome the hurdles that are hindering the use of whatsapp in agriculture there need to be a multipronged approach at institutional level to reach farmers in large scale in district. Selection of E-farmers was done through Kisan Mobile Advisory (KMA), training programme, farmers field visit and during KVK visit. Timely message were delivered from pre-sowing and sowing to harvest of crop. Maximum no. of respondent having age group of 20-35 year 40% followed by 35-50 year and above 55 years 42% and 13% respectively. Whatsapp contents shared by respondents maximum 72% agreed with pictures with text contents. About 90% farmers indicated that the content of the message was accurate followed by 79 % farmers who responded that the language used in whatsapp messages was easy to understand & accurate and 71% of the farmers reported that due to timely availability of messages; they adopted newly disseminate technology. The results revealed that in future; this app should be exploited by the farmers, for the farmers for effective communication between scientist/ expert- farmers as well as farmers-farmers.

CFLD : AN EFFECTIVE APPROACH FOR INCREASING YIELD OF CHICKPEA

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Abstract

India is the largest producer of chickpea accounting for about 67 per cent of global production. India produced 7.48 mt. from 8.21 m ha. In India, Madhya Pradesh is the largest producer of chickpea; but productivity in comparison to other states is low. Its cultivation on marginal land as well as lack of quality seed of improved varieties, inadequate and imbalance fertilization, uneven plant population, severe infestation of weeds and other pests, are predominant reasons to limiting the potential yield of chickpea. Keeping above consideration in view the present study was conducted at farmers' field in participatory mode by RVSKVV, Krishi Vigyan Kendra, Sheopur (M.P.) during rabi 2018-19. A total of 75 demonstrations were laid out on farmers' field with chickpea variety JG- 14 according to recommended package of practices of RVSKVV, Gwalior. The farmers' practice was considered as control plot in demonstrations. Grain yield of demonstration plot of chickpea was 17.31 q/ha. There was significant increase in yield of chickpea over the control by 21.47%. This showed the positive impact of CFLDs on Chickpea crops.

THE INTENSITY OF COMMUNICATIVE ENGLISH IN AGRIBUSINESS

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Abstract

Communication is the heart of every organization. Everything we do in the workplace results from communication. Good Communicative skill is essential to allow others and yourself to understand information more accurately and quickly. In contrast poor communicative skill lead to frequent misunderstanding and frustration. People with effective communication are more confident because they know that they can tell other people exactly what they need. In order to communicate effectively



one has to think ahead and organize one's thoughts. In every walk of life language that we use for communication is very important. The importance of communicative skill in English needs to be viewed as a core value in agribusiness. In the present scenario youth are interested in doing agribusiness by making use of hi- technology in agricultural field. Therefore good communicative skill in English is importance for agriculture researchers and hi-tech farmers on agribusiness .Researchers study how present farm practices endanger sustainability and how sufficient food can be produced , all these innovations can exclusively communicate with hi- tech farmers by fabricating practice of English communicative skill. The hi- tech farmers problems can be solved in a way which is less dangerous for agricultural productivity in the future by adoption of communicative English .

TOWARDS EFFECTIVE ASSESSMENT OF NGO ACTIVITIES: RELEVANCE OF RCT EXPERIMENTS IN POLICY ADVOCACY

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Abstract

Non-governmental organizations (NGOs) contribute to the betterment of agrarian landscape either through mobilization of resources to the rural community or by helping in their social transformation and raising their standards of living. In short, NGOs aid in strengthening the reach and grasp of public schemes and policies. At the same time, the effective assessment or evaluation of NGO activities in the form of outputs, outcome and impact have always been a hotly contested issue. Impact assessment holds the key to the success and proliferation of any NGO activity. The Randomized Controlled Trial (RCT) experimental design is so far the best evaluating method of any intervention as it can be devised in such a way to negate any kind of intrinsic or external bias that is always possible in an NGO activity. The distinguishing feature of an RCT is the random assignment of units to the intervention or control groups. The RCT experiments can be used to find the difference that a NGO intervention makes along with the quantification of outcomes or impact of the activity concerned over the time period. In this study, the effectiveness of RCT in the evaluation of NGO activities has been elaborated with the help of five different case studies from India and across the world. The purpose of this study is not only to show how effective the RCT technique is but also how impactful the NGO activities are in serving the needs of intended beneficiaries.

PLANT RHIZOSPHERIC MICROBIAL INTERACTION TO IMPROVE P USE EFFICIENCY

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Abstract

Phosphorus is the second most important nutrient for plants, after nitrogen. It exists in soil as mineral salts or as organic compounds. Despite these phosphorus compounds being abundant in agricultural soils, the majority of them occurs in an insoluble form. The fixation of P into insoluble complexes renders these compounds inaccessible for absorption by plants and therefore, results in severe P insufficiency in both acidic and alkaline soils. Even application of soluble forms of phosphorus in the form of phosphate fertilizers has constraints too, as P is rapidly immobilized to insoluble forms due to its reaction with aluminium and iron minerals. The efficiency of applied phosphorus rarely exceeds 30% due to its fixation in soil. P is lost due to run-off and leaching, leaving only 10-20% available for plant utilization. Microbes and plants have evolved biochemical mechanisms to communicate with each other. The molecules responsible for such communication are secreted during beneficial or harmful interactions. The rhizosphere is the most important area for plant-soil-microorganisms interactions and a hub for controlling nutrient transformation and plant uptake, particularly for P due to its high fixation, low mobility and low bioavailability in soil. Several reports have indicated that different bacterial species, particularly rhizosphere colonizing bacteria, have the ability to liberate organic phosphates or to solubilise insoluble inorganic phosphate. These bacteria make phosphorus available to the plants, and in return acquire root borne carbon compounds, necessary for bacterial growth. Soil microorganisms which exhibit these beneficial traits and are responsible for bio-solubilization of insoluble forms of P are *Phosphorus Solubilizing Bacteria* (*Pseudomonas*, *Bacillus* etc) which solubilise P-metal complex to release P in the form of



orthophosphate through specific mechanisms implying mainly siderophore and organic acids production. In addition to PSB, *arbuscular mycorrhizal fungi* (AM) are also key microbial component of agro-system defined by a symbiotic relationship involving a bidirectional exchange of nutrients between the two organisms. Their contribution to P mobilization and uptake could be beneficial and increase up to 80% of total P uptake. Therefore, plant rhizospheric microbial interactions are useful to improve P use efficiency in crops.

SPEED BREEDING TECHNIQUES : ACCELERATING GENETIC GAINS IN CROPS

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Abstract

The changing climate, evolving pathogens and to feed a global population of 9–10 billion by 2050 have raised significant concern for global food security, with the current improvement rate of several important crops inadequate to meet future demand. This slow improvement rate is attributed partly to the long generation times of crop plants. Plant breeders are exploring more efficient crop improvement strategies among which, shuttle breeding, doubled haploid techniques and various tissue culture methods and hormone application have hastened the rapid advance of the breeding material with accelerated genetic gains. ‘Speed breeding’ method now emerging as a revolution among them, which greatly shortens generation time and accelerates breeding and research programmes. Speed breeding can be used to achieve up to 6 generations per year for spring wheat (*Triticum aestivum*), barley (*Hordeum vulgare*), chickpea (*Cicer arietinum*) and pea (*Pisum sativum*), and 4 generations for canola (*Brassica napus*), instead of 2–3 under normal glasshouse conditions. Speed breeding techniques have been used successfully in breeding for various traits in crops such as drought tolerance, multiple disease resistance, and seed dormancy. Integrating speed breeding protocol with other breeding techniques such as genomic selection and rapid phenomic screening platform found to be promising in achieving a better genetic gain.

SHELF LIFE ASSESSMENT OF PEARL MILLET IN DIFFERENT STORAGE CONDITIONS AND DURATION

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Abstract

Feeding a growing population of 10 billion people by 2050 with a healthy and sustainable diet is a huge task. It will be impossible without changing eating habits, improving food production, and reducing food waste. Transformation of the global food system is urgently needed as more than 3 billion people are malnourished (including people who are undernourished and overnourished), and food production is extremely affected by climate change, biodiversity loss, and unsustainable changes in water and land use. In this scenario pearl millet can be one of the non-staple options by understanding the consumer's need of malnourished affluent and malnourished resource poor people. Pearl millet is a multi-purpose cereal crop providing food, fodder and fuel worldwide. With its deep rooted nature it effectively uses residual nitrogen, phosphorus and potassium and hence survives in infertile soils and high temperatures, in excess of 40°C. These characteristics enhance pearl millet's desirability in lower input and dry land production systems. Pearl millet has a potential to contribute food and nutritional security of the country as it is a powerhouse of nutrients possessing unique nutritional characteristics. It is enriched with vital nutrients like vitamin-B, folic acid, iron, magnesium, calcium, phosphorus, manganese, potassium, copper, zinc, and chromium. It is known to have the highest levels of potassium, calcium, and iron amongst other cereal crops. Pearl millet is gluten free, ideal for celiac patients; rich in resistant starch, ideal for diabetic patients and good to tackle obesity. Although being a nutrient dense crop and providing immense health benefits to the consumer, it is yet not widely acceptable or quantitatively highly utilized in food industry. Major constraint in its diversified utilization is the rapid development of off odour in its flour during storage. Compared to processing techniques, development of pearl millet varieties and hybrids with improved inherent capacity of the grains to produce flour with longer shelf life is a better alternative approach. Identification of genotypes with desired character (low rancidity) and testing of these for stability of the character is a prerequisite for any breeding programme. Thus, a study is being conducted to evaluate the pearl millet genotypes for rancidity parameters viz., acid value (indicates enzymatic rancidity) and peroxide value (indicates oxidative rancidity). The flour of



diverse genotypes viz., inbreds, CMS lines and landraces were analyzed for shelf life indicators. For this, the grains were ground and stored under refrigerated (4-5°C) and ambient temperature (25°C to 28°C) storage conditions. The study clearly established the existence of diversity in the rancidity profile among the select varieties/hybrids of pearl millet studied. Pearl millet varieties/hybrids that are least susceptible to rancidity can be promoted for use in production of shelf-stable pearl millet flour, in conjunction with appropriate processing and packaging technologies.

MORPHO-PHYSIO AND BIOCHEMICAL CHARACTERIZATION OF HEAT STRESS TOLERANCE AT SEEDLING STAGE IN PEARL MILLET ((*Pennisetum glaucum* (L.) R. BR.)

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Abstract

Climate change and global warming are serious problems in agricultural production, particularly in arid and semi-arid regions of the world. The global temperature is increase with a rate may reach 1.5 and 3.5°C by 2050 and 2100, respectively (Zhou et al., 2020). The high temperature or heat stress is considered one of the most devastating abiotic stresses. As the heat stress influences the seed germination, plant growth and development, resulting in severe reduction in yield. Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is the most widely cultivated and ranks 6th after wheat, rice, maize, sorghum and barley around the globe. It is grown on an area of 31 million hectare (ICRISAT 2016) in the world. Pearl millet is a multipurpose crop grown for grain, stover and green fodder. Government of India recognized immense nutritional properties of pearl millet and put it in a basket of 'Nutri Cereal'. It is one of the cheapest sources of protein, iron and zinc, fibre, vitamins and minerals. Pearl millet is a rich source of energy (361 Kcal/100g) which is comparable with commonly consumed cereals such as wheat (346 Kcal/100g), rice (345 Kcal/100g) maize (125 Kcal/100g) and sorghum (329 Kcal/100g). Pearl millet is a drought and heat-tolerant cereal crop that gives a stable grain and forage yield on poor, sandy soils under hot, arid and dry environments. But, for commercialization of this crop in market improvement for thermo tolerance is of immediate need. Therefore, to develop or identify heat tolerant genotypes, knowledge of screening methods, heat tolerance mechanisms along with breeding techniques are important. Heat stress decreases the rate of germination and may also inhibit the germination depending on heat tolerance of the genotype. A lot of genetic variability is available for heat tolerance in pearl millet. In this study germplasm of pearl millet is utilized for searching of heat tolerant line. Different screening techniques, viz. MSI, RWC and chlorophyll content are utilized for screening the germplasm for heat tolerance. To overcome the heat stress, plants may changes various mechanisms such as maintenance of membrane stability, scavenging of reactive oxygen species (ROS), production of anti-oxidants, osmo-regulation of solutes and synthesis of heat stroke proteins (HSPs). In this study, we are focusing to understand these mechanism specially on production of anti-oxidants, maintenance of membrane stability. In further study, both conventional as well as molecular breeding techniques will be utilized for genetic improvement for heat tolerance.

REACH OF AGRICULTURAL VIDEOS ON YOUTUBE—AN ANALYSIS

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Abstract

Information is an invisible input in agriculture, and it acts as a foundation for decision making for a farmer from the purchase of seed to sell produce. The way of information dissemination changing along with the technology of ICTs development. Extension system also adopting and making full use of ICTs in disseminating farm information to reach farmers. Youtube is one of the social media platforms, which is gaining popularity all over the world including the farming community. This paper focused on the potentiality of youtube in the dissemination of farm information. Secondary data was collected and presented in this article regarding a case of fall armyworm. Totally 40 video modules published on youtube platform data was collected. It was found that 40 video modules reached the views of 6,28,918. Among 40 video modules, 28 were published by the mass media channels which are popular on television and the average reach of video modules of mass media channel was 10,733. In total, 12 videos are published by specific agricultural channels on agriculture running by SAU, farmer development



organisations and individual farmers on fall armyworm in Telugu language and the average reach of video module was found to be 27,273 views. From the analysis it was found that average reach of video modules of agriculture specific channels was more than mass media channels.

ANALYSIS ON THE MEDIA COMMUNICATION BARRIER AND SUITABLE INTERVENTIONS FOR EFFECTIVE ADOPTION OF ADVANCED BANANA CULTIVATION TECHNOLOGIES IN TAMIL NADU, INDIA

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Abstract

The knowledge levels of farmers on science and technology are very less or negligible and are the major obstacle in achieving the potential growth and development in the agricultural production in the country. Though the growth of Information and Communication Technology (ICT) in the developing countries offers new avenues in transferring the technology/knowledge from lab (source) to land (receiver ends), the access to the farmers in accessing of information is rated as poor. Also without a strong willingness of the media in disseminating the advanced technologies to the farmers, it is impossible to assimilate, adopt, and generate new farm technologies. Under the circumstances, the present research was attempted to examine the media communication barriers and constraints and also to assess the satisfaction level of media communication intervention in dissemination of cultivation technology among the banana farmers. The study was conducted in five selected major banana growing blocks of Tiruchirappalli district in Tamil Nadu. In this study, adoption of the quantitative survey method for the collection of opinion data from 750 respondents revealed that there is communication barriers and constraints in effective transfer of technologies on banana cultivation and delivery of seasonal based related information. The major barriers and constraints associated with institutions and extension centers are financial crisis, lack of man power, lack of in-service training. It is imperative that the mass media such as print, electronic and new media is involved in dissemination of the emerging science and technology information meaningfully for the better understanding of the target groups and to avoid communication barriers and constraints. It is also learnt that in the digital era it is the responsibility all TV and Radio channels' to dedicate more sufficient timeslots and regular broadcast timings for agricultural programmes in local language which will motivate the people to involve in the agricultural occupation. Further, this will bring the sustainability, relevance and responsiveness among farmers and significant changes in their behavior to adopt new innovations in agriculture.

NANOTECHNOLOGY IN AGRICULTURE AND APPLIED SCIENCES

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Abstract

Nanotechnology can be defined as the science and engineering involved in the design, synthesis, characterization and application of materials and devices whose smallest functional organization in at least one dimension is on the nanometer scale. Nanotechnology has opened up by rapid advances in science and technology, creating new opportunities for advances in the fields of medicine, electronics, foods and the environment. It offers potential developments in pharmaceuticals, medical imaging and diagnosis, cancer treatment, implantable materials, tissue regeneration, and multifunctional platforms combining several of these modes of action. It provides new agrochemical agents and new delivery mechanisms to improve crop productivity and it promises to reduce pesticide use. Its applications include: Nanoformulations of agrochemicals for applying pesticides and fertilizers for crop improvement; the application of nanosensors/nanobiosensors in crop protection for the identification of diseases and residues of agrochemicals; nanodevices for the genetic manipulation of plants, plant disease diagnostics, animal health and postharvest management. In recent times, some packaging materials integrated with "nano-sensors" to detect the oxidation process in food. In such packaging materials when the oxidation occurs in the foodstuffs, nano-sensors indicate the color change and inform about the contamination of the foodstuffs like milk and meat. This property of metal nanoparticles is very helpful in increasing the shelf-life of foodstuffs. Nano-pesticides may have key



role in the control of pests and insect and host pathogens due to its properties like enhanced solubility, specificity, permeability and stability. Thus, synthesis of nontoxic, eco-friendly and promising nano-pesticide delivery systems for increasing agriculture production is mandatory; On the other hand, helps in reducing the destructive environmental impacts to ecosystem. In past few years nano-fertilizers are spontaneously accessible in the market. Nano-fertilizers may contain zinc, silica, iron and titanium dioxide, gold nano-rods etc.

EVALUATION OF THE VARIATIONS IN FRUIT PARAMETERS OF DIFFERENT PHALSA GERMPLASM (*GREWIA SUBINAEQUALIS* DC.) UNDER SEMI-ARID REGIONS OF HARYANA

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Abstract

Phalsa (*Grewia subinaequalis* DC.) is one of the commercially important sub-tropical, tropical and arid fruit crop of India and Southern Asia which belongs to family Tiliaceae. The present investigation was conducted at the experimental orchard of CCS Haryana Agricultural University, RRS, Bawal (Rewari), Haryana with an objective of evaluation of various phalsa germplasm for its fruiting parameters under the semi-arid regions of Haryana. Thirteen genotypes (4 tall double seeded, 5 tall single seeded, 3 dwarf single seeded) showed a wide range of variability in fruiting traits. Results showed that the fruit maturity was observed early in dwarf germplasm, whereas it was delayed in tall germplasm. The fruit length, breadth, and weight were maximum in Bawal Phalsa 4, while minimum in Bawal Phalsa 12, whereas number of fruits picking were maximum in Bawal Phalsa 5 and minimum in Bawal Phalsa 1. Productivity per plant was high in tall germplasm and less in dwarf. Fruits were observed juicier in tall single seeded and dwarf germplasm, however, less juicy fruits were observed in tall double seeded.

ENHANCE AGRICULTURAL SUSTAINABILITY THROUGH POLYMERS

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Abstract

The greatest challenge of today's agriculture is to feed the growing population and restore the natural resources. Global food production must be increases to feed this ever increasing population. Modern crop production technology has considerably raised output but has created problems of land degradation, pesticide residue in farm produce, gene erosion, atmospheric and pollution. The task of meeting the requirements of this generation without eroding the ecological assets of the longer term generation should be the prime objective. This objective are often achieved only by adopting such technologies which improve resource use efficiency in agriculture. during this context use of polymers could also be a completely unique technology which may improve food production without threatening the environment and therefore the natural resources. the utilization of polymer in agriculture is gaining popularity in science, particularly within the field of polymer chemistry. Polymers are wont to improve soil permeability, density, structure, increase moisture content in soil, increase the efficiency of pesticides and herbicides, allowing lower doses to be used and to indirectly protect the environment by reducing pollution and clean-up existing pollutants.

ADVANCES IN DEVELOPMENT AND DISTRIBUTION OF SOIL HEALTH CARDS

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Abstract

A healthy life is not possible without healthy soils. According to the Director General of the FAO, Da Silva, today, world has more than 805 million people facing hunger and malnutrition. (Patel, 2016). Invention of HYV led to intensive cultivation of



soils and application of fertilizers resulted in change in native soil fertility. Hence there is a need for soil testing so that soils can be cultivated as per their potential and fertilized based on soil fertility. Soil health card is field-specific detailed report of soil fertility status and other important soil parameters that affect crop productivity. In India, the current consumption of NPK ratio is 6.7:2.4:1, which is highly skewed towards nitrogen as against ideal ratio of 4:2:1. India is spending nearly Rs. 70,000 crore on fertilizer subsidy every year. Hence, there is a need for balanced use of fertilizers, keeping this government of India introduced Soil Health Card Scheme across India. The Ministry of Agriculture recently introduced the soil health card (SHC) scheme on 5th December 2015 and has been approved for implementation during the remaining period of 12th plan. Under this, SHC had been provided to all farmers in the country at an interval of 2 years to enable the farmers to apply recommended doses of nutrients based on soil test values to realize optimum crop yields apart from improved and sustainable soil health and fertility thus reducing cost of cultivation to get higher profits.

During 2015-2017 (cycle-I), 2.54 crore samples were collected, out of which 2.36 crore samples were analysed and 12.36 crore SHCs were distributed, indicating that 100% target archived in sample collection and 97% of the SHCs printed were distributed among the farmers as on 24th September 2017. The cycle-II is already started across many states and is under progress (Reddy, 2017). In Maharastra, More than 39 lakh (2015-16) and more than 81 lakh SHCs (2016-17) were issued to the farmers at the state level. (Jayanti and Sangeeta, 2017). In Assam, As per report of the Directorate of Agriculture, Government of Assam has so far issued 64,168 Soil Health Card (SHC) up to Aug/2016, 1.39 lakh cards have been distributed to the farmers of Assam as on 14.03.2017 (Jotin and Anup, 2017). In Telangana, 28.07 lakh cards have been distributed to the farmers of Telangana as on 14.03.2017. An application software was developed by IISS – Bhopal to recommend fertilizer doses for the targeted yields of various crops. It will aid the farmer in improving the efficiency (appropriate dose) of fertilizer use to achieve a specific crop yield. A Soil Health Card mobile App has been launched to help the farmers. The app will benefit field-level workers as it will automatically capture GIS coordinates while registering sample details at the time of sample collection in the field and indicate the location from where the sample has been collected. This app works like other Geo-tagging apps developed for the RKVY. The app contains farmers' details including name, Aadhaar number, mobile number, gender, address etc. and gives information to farmers about nutrients status of their soils along with the recommendation on appropriate dosage of nutrients to improve soil health and fertility. Till 1980, STL's used to analyze soil samples for pH, texture, EC and available N, P & K but not for analysis of micronutrients. At present, secondary nutrients and micro nutrients like Zn, B, Fe, Mn, Cu and Fertilizer recommendations for various crops is also included.

DEFICIT IRRIGATION : A POTENTIAL CONCEPT OF IRRIGATION FOR SUSTAINABLE FRUIT PRODUCTION UNDER WATER SCARCE CONDITIONS

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Abstract

Water scarcity in almost all areas of the world is becoming a major threat to crop production. The shortage of freshwater resources has prompted research into water-saving agriculture techniques with the goal of growing more crops per drop. India accounts 18% of the world population, consist of 4% of world's fresh water, out of which 80% is used in agriculture because of rapid ground water depletion and poor irrigation infrastructure. Due to less efficiency of surface irrigation system i.e. 38 %, irrigated area accounts for nearly 48.8 % in India. This area can be increased with utilization of micro-irrigation techniques (drip and sprinkler) and also further increased by utilizing deficit irrigation technique in water scarce areas. These technologies efficiently uses irrigation water which is the foremost priority for sustainable fruit production systems. Drip and sprinkler irrigation are preferred over traditional methods, and have been further refined to evolve the concept of deficit irrigation (DI). The application of water below the evapotranspiration (ET) requirement of a crop is termed as deficit irrigation (DI). New DI approaches such as regulated irrigation deficit (RDI) and partial rootzone drying (PRD) based on best use of allocated water as per plant physiology rather than full water requirement were developed to optimize the efficiency of water use. Deficit irrigation is more effective in fruit crops and vines as compared to field crops because the return in fruit crops is also attributed to quality of produce, not directly linked to biomass production and water use. Several research publications have recorded the benefits of using DI in citrus, mango, pomegranate, grapes and other temperate fruit crops. Thus, application of deficit irrigation with drip irrigation method in fruit crops can lower irrigation water up to 50% of the commercial irrigation, and enhance water use efficiency up to 80-92%.



SOIL HEALTH MANAGEMENT FOR CROP PRODUCTIVITY

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Abstract

Soil health is defined as being a state of dynamic equilibrium between flora and fauna and their surrounding soil environment in which all the metabolic activities of the former proceed optimally without any hindrance, stress or impedance from the latter. For establishment of a healthy and sustainable ecosystem, soil health is of prime importance. In order to fulfill the demand of coming generations, we have to follow the practices for making our soil healthy. According to USDA-NRCS, 2019, the four main principles that are promoted to maximize the soil health are: Minimize disturbance (no till), Maximize plant diversity, Maintain living roots throughout the year, Maximize soil coverage. Experiments performed from time to time indicated the yield benefits of adopting crop rotations over adopting monoculture practices. As crop rotations helped in increasing the nutrient availability and decreasing the infestations of weed, insect and disease. In temperate, water rich environments, negative yield impacts of cover crops can be minimized or negated by selecting cover crops with low C/N ratios, increasing the proportion of legumes in mixtures and applying additional N fertilizer. Soil health management practices can have different economic and environmental benefits but it is still unclear as to where and when yield and yield stability benefits of soil health management may occur.

STUDIES ON PREVALENCE OF BRUCELLOSIS IN BUFFALO AND HUMANS

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Abstract

Brucellosis is a widespread and economically important infectious disease of animals and humans caused by a member of the genus *Brucella*. The study was conducted to estimate the prevalence of brucellosis in buffalo by serological and molecular tests viz. Rose bengal plate test (RBPT), Standard tube agglutination test (STAT), indirect enzyme-linked immunosorbent assay (I-ELISA) and PCR. A total of 1500 serum samples (buffalo-200, cattle-985 and goat-315) collected from Bandhavgarh region were screened for the prevalence of brucellosis, all samples were negative by RBPT and randomly tested 50 samples were also negative by STAT, I-ELISA and PCR. Twenty six samples from Dindori district was examined which revealed all samples were negative with RBPT. Two hundred twenty seven samples screened from Gaushala Jabalpur which revealed 13.21% (30/227) by RBPT and 36.23% (25/69) by I-ELISA. Later on 304 samples of buffalo from Jabalpur dairy farms were examined which revealed 46.71% (142/304) were positive with RBPT, 49.15% (58/118) were positive by STAT and 62.50% (150/240) were positive with I-ELISA. Out of 70 sera samples tested with PCR, 19 (27.14%) sera samples were positive with *bcs31* primer (222bp), none of the samples positive with the *16S rRNA* primer (905bp), whereas *16S rRNA* and *bcs31* gene revealed product with *Brucella* strain 19 vaccine. In our study relative sensitivity was 74.67% and 61.70% with RBPT and STAT and relative specificity was 81.11% and 95.83% with RBPT and STAT. The study revealed presence of brucellosis in Jabalpur area and absence of disease in Bhandhavgarh and Dindori district.

QUINOA (CHENOPODIUM QUINOA WILLD) : WAY TO SUSTAINHEALTH AND INCOME

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Abstract

Introducing new crops which are adapted to environmental stresses is one of the most effective methods for sustainable crop production and food security in arid regions. Accordingly, exploring the possibility of quinoa (*Chenopodium quinoa* Willd) production as a drought-and saline – tolerant pseudo-cereal is of high importance. This plant is even able to develop in regions



where the annual precipitation is between 200–400 mm. The planting season of quinoa varies from August in the Andean highlands through to December, and in some areas from January to March. Planting was done in 30–cm spaced rows and the desired plant populations were achieved by thinning and changing plant distance within the row. The irrigation interval was every 10 days. 130 kg ha⁻¹ Urea (46% pure N) was used during the plant growth. In the last phase of vegetative stage, six plants were randomly sampled and then some vegetative (plant height, plant dry weight, number of lateral branches) and reproductive (panicle number, length and dry weight, grain number per plant, 1000-grain weight) traits were measured. The remaining plants were used to measure grain yield, biological yield and harvest index. Data analysis was done using SAS 9.2 and means were compared by LSD test at the 5% level of probability.

EFFICACY OF VARIOUS PLANT MATERIAL AS SEED PROTECTANT TO WHEAT SEED AGAINST GRAIN WEEVIL (*SITOPHILUS ORYZAE* L.)

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Abstract

The role of chemical insecticide is more important for control of storage pests. However, these chemicals are hazardous to human beings. Among the cereals, wheat is the most advantageous and pivotal crop of the country. Among the several insects attacking stored grains, *Sitophilus oryzae* L. has got economic importance. It is the most destructive insect pest of the stored raw cereal grains in the world. *Sitophilus oryzae* causes substantial losses to stored grain amounting 18.30 per cent. For control of stored pests different methods are used. Use of insecticides is one of the methods used for control of store grain pest which is widely adopted. None of these methods and products can be declared as safe to the human beings, birds and beneficial insects. There is need to find the alternatives to the chemicals. The present study was conducted to find the effective plant material against *S. oryzae* in the stored wheat seed grains. A laboratory experiment was conducted at Agricultural Research Station, Niphad Dist. Nasik during 2016-17 in completely randomized design having eleven treatments and three replications. Neem leaves (*Azadirachta indica*), Vekhand powder (*Acorus calamus*), Jangliimli Powder (*Phyllanthus niruri*) and Giloe (*Tinospora cordifolia*) 10 g each per kg seed alone and in combination with each other @ 5g+ 5g each were compared with untreated control. Freshly harvested 1 kg wheat seed (NIAW1415) with very high germination percentage and low moisture contents was taken in cloth bags. Seed was treated with various plant materials before inoculation of grain weevil in each treatment. Five pair of adults of *S. oryzae* was inoculated in each treatment. Observations were taken at 45 days after inoculation of insects and continued fortnightly up to 180 days. The counts of the insects were taken at each 15 days interval and the dead insects were removed. The data of the percent reduction in the insect population over untreated control was worked out. The weight of seed grains was taken at the same interval. The observation on per cent germination and per cent infestation of seed were also recorded at 180 days after inoculation. The statistical analysis was done by using completely randomized design (CRD). Among the various plant material, the seed treatment with Vekhand powder @ 10 g/kg seed was found most effective and promising in reducing the per cent grain weevil population (100.00%) and maintained highest seed weight (946 g), maximum germination of seed (93.33%) and highest seedling vigour index (1905.60). The untreated control recorded lowest seed weight (593.33), seed germination (31.33) and seedling vigour index (313.36).

EFFECT OF ORGANIC AND INORGANIC SOURCES OF N ON THE POPULATION BUILD UP OF INSECT PESTS OF GROUNDNUTS

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Abstract

Field experiments were conducted in red loamy soils to compare the influence of effects of organic and inorganic forms of Nitrogen on the incidence of insect pests of groundnut. The population build up of pests was assessed using different treatments viz., recommended dose of N in inorganic form, 50% Organic (FYM) +50% inorganic (Urea), 100 % organic form, 25% organic +75% inorganic form, 75% Organic +25% inorganic form and a check plot where no 'N' was applied. Phosphorous and Potash were applied in the form of single super phosphate and murate of potash. The treatments were fitted



in a randomised block design and were replicated thrice. Application of 25% organic and 75% inorganic form had the highest yield and was found to have the second highest number of leaf miner larvae and percent thrips damaged leaflets. The best treatment with regard to pest incidence was 100% organic form N supplied plot where 34.64% thrips damaged leaflets and 1.33 leaf miner larvae per plant were recorded and was followed by 75% organic +25% inorganic with 40.71 and 1.97, respectively. the incidence of peanut bud necrosis disease (PBND) and peanut stem necrosis disease (PSND) were 5.5 and 5.0 % in 100% Organic form plot. Maximum incidence of pests and PBND and PSND were reported in recommended fertiliser applied plot. The occurrence of bioagents like *Chrysopa*, Coccinellid beetles and *Syrphid* flies were observed more in recommended dose of fertiliser applied plot. It can be concluded from the results that application of Organic and inorganic form of N will give good yield and less build up of insect pests.

VARIABILITY STUDIES IN FOXTAIL MILLET [*SETARIA ITALICA* (L.) P. BEAUV].

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Abstract

The present study was carried out to assess the nature and magnitude of genetic variability for yield and quality related traits in 52 genotypes of foxtail millet, carried at Agricultural Botany field Dr. PDKV, Akola during *kharif*, 2019. The analysis of variance revealed presence of significant differences for all the traits under study, indicating that the genotypes under study were genetically diverse for most of the traits. Coefficient of variation studies indicated that the estimates of GCV were lesser than the corresponding PCV values for all the traits indicating the influence of environment on expression of the characters under study. High variability existed for number of tillers per plant, grain yield per plant and fodder yield. High heritability with high Genetic Advance as percent Mean was recorded for total number of tillers per plant, number of productive tillers per plant, panicle length, panicle girth, fodder yield, Fe content, Zn content and grain yield per plant suggesting primarily additive nature of gene action which responds well to selection.

STUDY OF GENETIC DIVERGENCE ANALYSIS FOR SEED YIELD AND ITS COMPONENT TRAITS IN FABA BEAN (*VICIA FABA* L.) GENOTYPES.

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Abstract

Faba bean (*Vicia faba* L., $2n = 2x = 12$) is a facultative cross-pollinating species with outcrossing rates varying between 1 and 55% depending on its environment; it belongs to the *Fabaceae* family, *Faboideae* subfamily, tribe *Fabeae*, and is not interfertile with any other *Vicia* species. Faba bean is among the oldest crops in the world. Globally, it is third most important feed grain legume. Currently, 58 countries produce this bean on large scale. Probably faba beans are one of the best performing crops under global warming and climate change scenario because of its unique ability to excel under all most all type of climatic conditions coupled with its wide adaptability to range of soil environment. Faba bean being incredible and crop complete food, unfortunately some part of world including India, it is still underutilized crop and not fully exploited so far. An experiment was conducted during winters of 2018-2019 at Vegetable Research Farm of CSAUAT, Kanpur. The 50 genotypes of *Vicia faba*, shared from ICARDA were laid in a randomized complete block design with three different replications. Significant difference for various traits indicated substantial amount of variability existed among the genotypes for various traits. High heritability coupled with high genetic advance was observed for seed yield, 100 seed weight, pod length, number of pods per plant, number of branches per plant, number of clusters per plant and days to 50% flowering. In general phenotypic correlation coefficients were higher in magnitude than their genotypic correlation coefficient. Seed yield per plant was found to be positively and significantly correlated with days to 50% flowering, days to maturity, number of branches per plant, number of cluster per plant, number of pods per plant, pods length, number of seeds per pod and 100 seed weight. The non hierarchical euclidean cluster analysis of 50 genotypes were grouped into 6 clusters with variable number of genotypes. The



highest inter cluster distance was observed between cluster II and cluster VIII followed by cluster IV and cluster VIII, cluster I and cluster VIII suggesting wide diversity among these groups. So these genotypes may be used in further crop improvement programme.

COMPATIBILITY OF NEONICOTINOIDS, PYRETHRINS, SPINOSYNS AND ORGANO-PHOSPHATES GROUPS OF INSECTICIDES WITH ENTOMOPATHOGENIC FUNGI VIRULENT AGAINST WHITEFLY *BEMISIA TABACI*

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Abstract

The use of entomopathogenic fungi (EPFs) is an important alternative to chemical insecticides for managing whitefly-*Bemisia tabaci*. EPFs alone may not always provide adequate management of sucking pests, but the concept of using EPFs in conjunction with pesticides in an integrated pest management programme is successful when both the pest management strategies implemented together are compatible. We evaluated 10 virulent EPFs against nymphs of *B. tabaci* and for their compatibility with insecticides belonging to neonicotinoids, pyrethrins, spinosyns and organophosphates groups under *in vitro* conditions. The highest nymphal mortality was recorded with *Beauveria bassiana* strain Bb-4511, Bb-4565 and *Metarhizium anisopliae*-Ma-1299 at 1×10^6 conidia /ml compared to other EPFs. The lowest LC_{50} values 0.2×10^4 and 0.5×10^4 conidia ml^{-1} were observed with *Cordyceps javanica* Cj-089 and Bb-4511, respectively. The toxicity index values were ranged from 19.5 to 106.9 irrespective to all EPFs and chemicals. Comparatively, the neonicotinoids, spinosyns were found to be compatible to moderately toxic to all the 10 EPFs, except Bb-4543, Bb-4565. Organophosphates (ethion) and pyrethrins (bifenthrin) were toxic to very toxic to all the EPFs except Bb-4511, Fv-083 and Ma-1299. However, the EPF strains Cj-102, Cj-089 were compatible with the half doses of bifenthrin, ethion and full doses of neonicotinoids and spinosyns. The results indicated that the most virulent EPFs can be used in conjunction/pairing with the compatible insecticides in IPM program for *B. tabaci* and CLCuD.

PRADHAN MANTRI FASAL BIMA YOJNA(PMFBY) FOR MINIMISATION OF FARMERS' RISK IN AGRICULTURE; STATUS AND PROGRESS

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Abstract

Agriculture is one of the most important sectors of the Indian economy. Thus, the development of agricultural sector is essential for overall economic progress of nation. Agricultural production is an outcome of biological activity which is highly sensitive to changes in weather. The erratic and uneven distribution of monsoon rains perpetuated yield/price volatility and hence increased farmer's exposure to risk and uncertainty. In this scenario of high risk and uncertainty of rain fed agriculture, allocating risk is an important aspect of decision making to farmers. The risk burden of the farmers can be reduced through crop insurance, which is primarily a way of protecting farmers against the element of chance in crop production. Crop insurance spreads the crop losses over space and time, provides social security to the farmers, helps in maintaining their dignity, offers self-help, encourages large investments in agriculture for improving crop yield and increasing agricultural production. In this direction, Pradhan Mantri Fasal Bima Yojana (PMFBY), was started on 18th February 2016 and implemented from Kharif 2016. Its main purpose was to provide insurance cover to farmers suffering crop loss due to any natural calamities and other risks for sustainable income. Since implementation in the Kharif 2016, the scheme has entered in the tenth season that is Rabi 2020-21. This ambitious scheme is open for all types of farmers and tenants in all states and UTs of India. Under PMFBY, since starting from Kharif 2016 and by the end of Kharif 2020, a total of 1866.44 lakhs farmers have registered for the scheme, total area insured 2235.82 lakh hectares, total sum insured Rs 879345.18 crores and total premium paid by the farmers Rs 17004.21 crores. Up to 2018-19, about 32.67 percent of insured farmers have received the claims for the losses they incurred up to 2018-19.



EVALUATION OF BIO-RATIONAL INSECTICIDES AGAINST FALL ARMY WORM, *SPODOPTERA FRUGIPERDA* (J. E. SMITH)

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Abstract

Maize (*Zea mays* L.) is the most completely domesticated crop among the cereals. Mexico or Central America is most likely being the origin of corn (Martin *et al.*, 2002). It is one of the most important cereal crops next to wheat and rice in terms of total production in the world, ranks third in area and first in production in the world. The fall army worm, *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) larvae feed on the leaves, stems and reproductive parts of more than 100 plant species. Its caterpillar can attack the corn plant in the seedling stage until the tasseling and silking stages. It feeds on all growth stages of maize but most frequently in the whorl of young plants up to 45 days old. In Brazil, it is estimated that the fall armyworm is responsible for losses of more than 50% of the damage caused by insect pests that attack corn and most of the spending on pesticide sprayings. A field experiment was conducted at Research Cum Instructional Farm at IGKV, Raipur (C.G.) during kharif 2019 to determine the bio-efficacy of bio-rational insecticides against fall armyworm, *S. frugiperda* on maize. Among the all tested bio-rational insecticides T1, Spinetoram 11.7% SC@ 130 ml/ha proved best in per cent reduction of larval population of fall army worm (91.54%) over control followed by T2, Chlorantraniliprole 18.5% SC @ 250 ml/ha (88.04%) against fall army worm on maize.

SUSTAINABILITY OF ORGANIC FARMING : A THREE DIMENSIONAL PERSPECTIVE

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Abstract

Organic farming has gained a good momentum and farmers are being motivated to adopt organic farming through different extension strategies. Scientific school of thought claims organic farming as sustainable. In this background, in order to assess the opinion of farmers about organic farming, a study was conducted in Bengaluru rural and Chikballapur district of southern Karnataka to assess the sustainability of organic farming. Data were collected from 120 organic farmers. Ex post facto research design as employed for the study. The results revealed that 47.50 per cent of the respondents opined that organic farming is highly sustainable followed by less sustainable (29.16%) and sustainable (23.33%). With respect to ecological sustainability of organic farming is concerned, 47.50 per cent of respondents responded that organic farming is highly sustainable followed by less sustainable (28.33%) and sustainable (24.16%). While economical sustainability of organic farming is concerned, it can be noticed that 52.50 per cent of respondents felt that organic farming is sustainable followed by highly sustainable (30.00%) and less sustainable (17.50%). In case of social sustainability of organic farming, 47.50 per cent of organic farmers considered organic farming as highly sustainable, 28.33 per cent of organic farmers considered organic farming as sustainable and 24.16 per cent perceived organic farming as less sustainable.

STUDY ON THE PERFORMANCE OF IMPROVED VEGETABLE VARIETIES THROUGH COMMUNITY APPROACH IN TIKAMGARH DISTRICT OF MADHYA PRADESH

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Abstract

The experiment was laid out from 2017 to 2019 at farmer's field through Krishi Vigyan Kendra Tikamgarh. The trial was conducted of six improved vegetable varieties viz Kashi Vishesh and Kashi Amrit (Tomato), Kashi Nandani and Kashi Uday in Pea, Kashi Kanchan in Cowpea and Kashi Anmol in Chilli along with recommended production technologies were conducted at randomly selected 72 farmer's field in area of 14.40 hectare covering 3 Blocks of district with 24 farmers in each



block. The results revealed all the trial of improved varieties of vegetable performed significantly better in yield with a minimum of 12.30% in cowpea to a maximum of 32.70 % in Chilli over the existing cultivars. The horizontal area spread index of 10.20 to 18.80 % indicates the opportunities of seed replacement in the district. Low technology index of 5.20 to 16.04 % also indicated the better feasibility of adoption of above vegetable varieties by the farmers of the district.

STUDIES ON ENHANCING SEED QUALITY BY PRIMING TECHNIQUES IN SOYBEAN [*GLYCINE MAX (L.) MERRILL.*]

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Abstract

Quality seeds are those which germinate evenly, imbibe water rapidly and produce stand in the shortest possible time under wide range of field conditions (Dighe *et al.*, 1982). Seed priming provides physical and microbial protection to seeds. Similarly it also gives protection against stress and acts as an efficient carrier for nutrients and pesticides. The seed priming can thus be helpful to obtain good crop stand through improved germination and seed vigour. The present investigation was carried out during kharif season of 2019 at experimental farm of Department of Agricultural Botany, Dr. P. D. K. V., Akola (MS), India. Different priming treatments were done with nine treatments with three replications viz. (T1) untreated seeds as control, (T2) hydro priming for 2 hr, (T3) hydro priming with CaCl_2 (1.5%) 2 hr, (T4) hydro priming with 60 ppm GA_3 for 2 hr, (T5) hydration with 1.5% KNO_3 for 2 hr, (T6) hydro priming with Tricodermaviride (0.5 %), (T7) hydro priming with Rhizobium culture 2.5%, (T8) hydro priming with Carbendazim @ 0.2%, (T9) seed priming with IAA @ 80 ppm for 2 hr. From the experimental observations, it may be concluded that soybean seeds positively responded to treatments of priming. Nevertheless, priming generally improves the seed quality parameters of soybean through improving germination percentage, seedling length, seedling dry weight, vigour index, field emergence, initial plant stand, days to 50 per cent flowering, plant height, and yield per hectare. The highest benefit of priming can be obtained from seeds primed with CaCl_2 (1.5% for two hours) treatment.

PROFITABILITY IN BERSEEM SEED PRODUCTION FOR SELF RELIANCE IN FODDER AVAILABILITY

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Abstract

Agri-business startup or Entrepreneurship in agriculture sector or agripreneurship is the order of the day. There are tremendous opportunities in the agriculture and allied sector for promotion of agri-start-up. Among various agri-business startups, Berseem (*Trifolium alexandrinum* L.) seed production is also highly beneficial business to farmers as berseem seed has high demand in rural areas. India imports about 75 thousand quintals to 1 lakh quintal of Berseem seed every year and the value of which is about more than Rs 75 crores to Rs 100 crores. Study was conducted at ICAR- IGFR, Jhansi. Keeping in mind, the business opportunity, demand and profitability in production of quality seed of berseem, 105 farmers were guided in Jhansi, UP. and from that 11 farmers have successfully produced and sold the quality seed of berseem in year 2013-14. Average total cost of cultivation at farm is found as Rs 62329.01 per hectare in production of crop and the Total cost per hectare is found as Rs 64858.10. Ungraded berseem seed was produced is 417.27 kg. Quality seed was 70.64% of total ungraded seed. In production process, 491 quintal of green fodder and 23.53 quintal of dry fodder was also produced. The total return from sale main products and by products is found as Rs 78172.04 per hectare and net return per hectare is found as Rs 13313.94 per hectare and B:C ratio (on total cost basis) is found 1.21 and B:C ratio with variable cost only is found as 1.80. The price of quality berseem seed with 10 % margin will be Rs 83.19 per kilogram, while the import price of berseem ranges from Rs 95-110 per kilogram and sale price in India is Rs 150-180 per kilogram. Thus, berseem seed production by farmers will save about 100 crore rupees that otherwise go in purchase of imported berseem seed.



EXPLORING POSSIBILITIES OF ENHANCING SEED YIELD BY SEED PRIMING TECHNIQUES IN SOYBEAN [*GLYCINE MAX* (L.) MERRILL.]

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Abstract

An investigation was carried out at experimental farm of Department of Agricultural Botany, Dr. P.D.K.V., Akola during kharif season of 2019. Different priming treatments such as (T1)(untreated seeds) as control, (T2)hydro priming for 2 hr, (T3) hydro priming with CaCl_2 (1.5%) 2 hr, (T4)hydro priming with 60 ppm GA_3 for 2 hr, (T5) hydration with 1.5% KNO_3 for 2 hr, (T6) hydro priming with Tricoderma viride (0.5 %), (T7) hydro priming with Rhizobium culture 2.5%, (T8) hydro priming with Carbendazim @ 0.2%, (T9) seed priming with IAA @ 80 ppm for 2hr were given with three replications. Priming significantly influenced the seed yield and yield contributing characters of soybean. Highest value for seed yield per hectare was recorded by treatment T3 CaCl_2 @ 1.5% (25.01 qt/ha) followed by T5- KNO_3 @ 1% (23.61 qt/ ha), treatment T4- GA_3 @ 50 ppm (23.35 qt/ha). All other treatments recorded higher yield than untreated control (19.17 qt/ha) showing to the corresponding favourable improvement in number of pods per plant, number of seeds per pod, test weight (g), seed yield per plot (g), seed yield per Ha (q).

RESPONSE OF SULPHUR APPLICATION ON QUALITY ASPECTS, YIELD AND YIELD CONTRIBUTING PARAMETERS OF SOYBEAN [*GLYCINE MAX* (L.) MERRILL.]

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Abstract

A field experiment entitled "Response of soil application of various doses of sulphur on morpho-physiological parameters, quality aspects, yield and yield contributing parameters of soybean" was undertaken at Regional Research Centre, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Amravati during kharif season 2013-2014 in the Randomized block design with four replications having six treatments including viz., 0, 30, 40, 50, 60 and 70 kg sulphur/ha. The recommended dose of 30 kg N, 75 kg P_2O_5 per hectare was given, sulphur was given through the Bensulf 90% (Mahadhan). The present investigation was carried out in the kharif 2013-2014 to determine the morpho-physiological and bio-chemical, quality and yield of soybean. Highest growth contributing parameters like plant height, number of leaves, number of branches and dry matter per plant and quality parameter like nitrogen, protein and oil content was recorded highest with the treatment 40kg/ha Sulphur application. Similarly highest number of pods, no. of root nodules/plant, Seed yield/plant and seed yield kg per hectare along with net monetary returns and benefit cost ratio was recorded with 40 kg/ hectare sulphur application. However, it will be helpful to carry out similar studies over years for drawing a strong conclusion.

VIABILITY OF SCLEROTIA OF *RHIZOCTONIA SOLANI* AG 1-IA UNDER DIFFERENT STORAGE CONDITIONS

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Abstract

Soil borne fungus *Rhizoctonia solani* Kühn [teleomorph *Thanatephorus cucumeris* (Frank) Donk] is a devastating basidiomycete fungus attacking 188 plant species. New strains of the fungus are emerging in nature and colonizing newer crop ecologies. The fungus survives in soil by producing black coloured asexual spores- the sclerotia which survive in soil and



transmit the fungus the next crop. The present investigation was undertaken to examine the viability of sclerotia produced by *Rhizoctonia solani* AG 1-IA isolates (causing banded leaf and sheath blight in maize) under optimum growth conditions after storing at different temperature conditions and storage methods. The *R. solani* isolates were selected based on texture of sclerotia (pitted/non-pitted), surface (smooth/rough), size (small/medium/large), weight (light/medium/heavy) and days for initiation on PDA plate (0-10 days/10-20 days/20-30 days). The study revealed that *R. solani* isolates viz., *Rhs-Alm* (Almora), *Rhs-Khp* (Kohlapur), *Rhs-Dhau* (Dhaulakuan) and *Rhs-Ahr* (Auhar) with non pitted, smooth surfaced sclerotia having size and weight in medium range were more viable both at -20°C and -80°C temperature in sterilized field soil. Sclerotia germination percentage was very poor when stored in 30% glycerol. Interestingly, isolates *Rhs-Bpn* (Barapani) and *Rhs-Umi* (Umiam) from Meghalaya formed sclerotia after 23 and 21 days of growth on PDA respectively. These isolates showed loss of viability in sclerotia under all the treatments viz., storage at 4°C, -20°C and -80°C for 6, 12, 18, 24, 30 and 36 months in sterilized soil and 30% glycerol, but germination of sclerotia from colonized barley seeds was observed after 6, 12 and 18 months of storage at 4°C, -20°C and -80°C. The germination rate of sclerotia stored at three different temperatures in sterilized field soil reveals that the fungus can survive in soil even without soil organic matter and active soil microbial activity.

DETERIORATION OF YIELD PARAMETERS AND JUICE QUALITY DUE TO POKKAH BOENG OF SUGARCANE AND THEIR MANAGEMENT

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Abstract

Pokkah boeng disease (PBD) caused by *Fusarium sp.* complex is considered a serious and emerging threat in sugarcane industry throughout the world. The disease caused 5-90 % reduction in yield and quality parameters by reducing plant height, number and length of internodes, stem diameter, pol %, and sucrose %. The occurrence and severity of PBD differ greatly from year to year depending on varieties grown and different environmental considerations. This disease spreads through windblown rain, infected cane cuttings, pupae and adults of sugarcane stem borers. Now this disease has become a matter of concern as it is spreading rapidly in India having monoculture of single variety and due to lack of effective management strategies. Predominantly cultivated variety Co 238 in North-West zone showed the highest disease incidence. Fungicides like carbendazim (0.1%) or copper oxychloride (0.2%) or tebuconazole (0.1%) and use of resistant varieties were found effective for reducing the PBD. Thus pokkah boeng is responsible for economic losses for farmers as well as millers to reduction in yields and quality of sugarcane.

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT (INM) IN CUSTARD APPLE CV. “ARKA SAHAN”

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Abstract

The present investigation was carried out at 7 years old custard apple cv. Arka Sahan during rainy season of 2019-20 to standardize the dose of NPK with organic manures and biofertilizer under AICRP on Arid Zone Fruits, Department of Horticulture, JNKVV, Jabalpur, M.P. The experiment having ten treatments in Randomized Block Design (RBD) with three replications and one plant per unit. The doses of FYM and vermi-compost were calculated on the basis of nitrogen requirement. The AZB and PSB @ 80g/tree have been applied. The data on morphological characters viz, plant height, stem diameter, Plant spread in East-west and North-south directions, and number of branches were recorded. The data revealed that among different treatments the plant height varied from 237.24 cm to 327.36 cm, stem diameter from 19.33 cm to 56.57 cm, number of branches from 14.76 to 54.14 plant spread east-west direction from 286.53 cm to 475.37 cm and north south direction from 257.67 to 426.44cm. Among the various treatments, T₉ (75% RDF , NPK+ VC @ 2kg/plant+AZB+PSB) showed maximum plant height (327.36cm), plant spread east- west (418.73 cm), North-South (475.37 cm) and number of branches (54.14). Whereas, maximum stem diameter was observed in T₁ (56.57cm).



GENETIC EVALUATION OF FARMER'S RICE VARIETIES FOR PHYSIOLOGICAL AND YIELD ATTRIBUTING RESPONSES EXPLOITING PRINCIPLE COMPONENT ANALYSIS

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Abstract

An experiment was conducted on 30 farmer's rice varieties collected from different districts of Madhya Pradesh to identify the genetic components contributing to phenophasic development, physiological, yield attributes and biochemical traits. Principal component analysis was performed to rank the farmer's varieties based on PC scores acquired as per the trait studied. Out of twenty-six traits, only five principal components (PCs) exhibited more than 1.00 Eigen value and showed 85.80% of total cumulative variability. The PC1 showed 58.55%, while PC 2, PC 3, PC 4 and PC 5, exhibited 10.29%, 7.03%, 5.23% and 4.69% variability, respectively. The PC 1 reported the highest variability, which was associated with physiological and yield related traits. The PC 2 was dominated by biochemical traits, while PC3 was mostly dominated for yield traits. The PC 4 was dominated by physiological traits, and PC5 for phenological and yield-related traits. Farmer's variety Pandu was superior for Chlorophyll content index (38.27), total dry matter production (38.15 g plant⁻¹), Leaf area index (4.09), Leaf area duration (17982 cm² days) and crop growth rate (0.00282 g m⁻² day⁻¹). PCA revealed that genotype Pandu (7.224) acquired highest PC score followed by Raibua (5.364), Bahurupi (5.103) and Chinnor 1 (4.750) respectively. Farmers varieties Pandu, Chhindi kapoor, Bahurupi, Sitha Chandan, Chinnor 2, Chinnor 1 and Chhota Sathiya were contributed their presence in maximum PCs of this investigation. The identified lines will be utilized in the rice breeding programme to develop improved rice varieties for high yield and maximum physiological efficiency.

GENETIC ANALYSIS OF FIELD PEA GENOTYPES FOR YIELD AND YIELD ATTRIBUTING TRAITS

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Abstract

Genetic parameters for morphological, yield and yield attributing traits were evaluated on 42 field pea genotypes for identification of hereditary genes associated with changing climatic scenario. Results indicated significant variation among all the traits however, maximum variability was observed for pod bearing length and minimum for harvest index. Phenotypic coefficient of variation estimates was slightly higher than the genotypic coefficient of variation for all traits under study. High estimate of heritability was recorded for all traits however, high heritability coupled with high genetic advance was recorded by traits viz. pod bearing length, plant height, number of secondary branches per plant seed yield per plant, biological yield per plant, number of primary branches per plant, pod length, harvest index, number of effective pods per plant, number of nodes per plant, number of effective nodes per plant and 100-seed weight. Visualising the results of correlation analysis, the phenotypic and genotypic correlation revealed positive and highly significant association for seed yield per plant expressed strong significant positive association with biological yield per plant followed by number of effective pods per plant, number of seeds per pod, harvest index, 100 seed weight, number of nodes per plant, number of effective node per plant and days to maturity. Path coefficient analysis resulted highest positive direct effect with biological yield per plant and harvest index. The indirect effect of biological yield and harvest index via other yield contributing under study was high and positive. From the overall study it can be concluded that yield can be improved by selecting the plants with high values of pod bearing length, biological yield/plant, number of effective pods/plant, number of seeds/pod, harvest index and 100 seed weight. Thus these traits were found to contribute towards seed yield per plant and direct selection may be possible to improve seed yield. Pea genotypes viz. FP 13-73, FP 13-7I, FP 13-37 and FP 13-101 were reported superior for yield and yield attributing traits and might be utilized for the hybridization programme as a donor for the development of superior field pea varieties in relation to high yield potential.



EMPOWERMENT OF TRIBAL WOMEN THROUGH SHGS : A STUDY

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Abstract

The present study was carried out at Paraswada block of Balaghat District. In this block tribal population living in a majority. The Self Help Group (SHG) has developed from the poverty initiatives by various organizations. SHGs bring together people with common experiences planned socio economic development, Women have not achieved success, especially rural women and also tribal women in many parts of the country lead the SHG, have cognizable success in bringing women into main stream of decision making, family and financial oriented activities. In India, many SHGs are 'linked' to banks for the delivery of micro credit. The government is focusing on their participation in rural development and Economic developmental activities with tribal women. The Self Help generally refers to groups that involve people who have similar needs, and are operated on informal and non-profit basis. SHGs are member-based microfinance intermediaries inspired by external technical support. SHGs have made important contributions to the economic development of tribal women family unit and the economic development of the financial system. SHGs plays a significant role in empowering tribal women by progressive their socioeconomic condition, decision making power, increasing children literacy as well as higher education rate and Improve health etc.

EFFECTS OF PRE-TREATMENT AND FOLIAR APPLICATION OF ZINC ON ANTIOXIDANT LEVEL OF MUNGBEAN (*VIGNA RADIATA* L.) LEAVES UNDER INDUCED SALINITY

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Abstract

Mungbean (*Vigna radiata* L.) is an excellent source of high quality proteins. In sprouted mungbean, high level of ascorbic acid, riboflavin and thiamine is found. But the production of mungbean is threatened by salinity. In the present study, observations were made for two consecutive years regarding morpho-physiological biochemical and yield attributes of mungbean under induced salinity conditions. Ten different treatments comprising of various levels of NaCl and Zn separately and in combinations i.e. 40mM NaCl, 80mM NaCl, 120mM NaCl, 40mM NaCl+2×10⁻⁵M Zn, 80mM NaCl+3×10⁻⁵M, 120mM NaCl+ 4×10⁻⁵M, 2×10⁻⁵M Zn, 3×10⁻⁵M Zn and 4×10⁻⁵M Zn were applied to salt stress mungbean along with control. The treatments were replicated thrice and statistical analysis was done using CRD. Effects of various salinity levels on SOD activity U g⁻¹ (FW) min⁻¹ and CAT activity µg H₂O₂ min⁻¹ g⁻¹ of salt-stressed mung bean (*Vigna radiata* L.) pre-treated with zinc at five days interval was studied. The treatment 120mM NaCl+ 4×10⁻⁵M Zn showed the maximum percentage reduction as compared to control. The SOD and CAT activity levels in leaves expressed overcome the oxidative stress.

GROWTH AND PRODUCTION OF PADDY VARIETIES UNDER *DALBERGIA SISSOO*-PADDY BASED AGROFORESTRY SYSTEM IN CENTRAL INDIA

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Abstract

The present investigation was taken up with 20 years old agrisilviculture system (*Dalbergia sissoo* + Paddy-Mustard/Gram/Wheat) during Kharif season of 2018-19 under AICRP on Agroforestry, Department of Forestry, JNKVV, Jabalpur, M.P. The planting geometry of *Dalbergia sissoo* was 5× 5 m. The treatment combinations involved five treatments viz., four pruning intensities (viz., no pruning, 25% pruning, 50% pruning and 75% pruning) and one open



(without tree) in main plot and three varieties of paddy viz., V₁- Early duration paddy (Danteshwari), V₂- Medium duration paddy (MTU-1010) and V₃ - Late duration paddy (Kranti) in sub plot replicated five times. The soil of the experimental area was medium black clay loam with pH 6.0 (acidic), high in organic matter (0.81), medium in available nitrogen (288.1 kg ha⁻¹), high in available phosphorus (20.38 kg ha⁻¹) and low in available potash (170 kg ha⁻¹). In intercropping of *Dalbergia sissoo* with three paddy varieties were sown in 20 cm row spacing. The result revealed that crop under open condition recorded significantly higher plant height (85.6 cm), number of effective tillers/MRL (35.1), length of panicle (26.8 cm), number of filled grains/panicle (93.0) and 1000 grain weight (30.1 gm). Open condition (no tree) recorded significant maximum grain yield of paddy (22.4 q ha⁻¹) at par with 75% pruning (17.6 q ha⁻¹). No pruning recorded significantly lowest grain yield (11.9 q ha⁻¹) at par with 25% pruning (13.2 q ha⁻¹) and 50% pruning (15.3 q ha⁻¹). The percent reduction in grain yield under no pruning, 25%, 50% and 75% pruning as compared to open condition was 46.5%, 40.7%, 31.7% and 21.1%, respectively. Medium duration paddy variety i.e. MTU-1010 recorded higher grain yield (20.4 q ha⁻¹) at par with late maturing kranti variety (17.4 q ha⁻¹) and both were significantly superior to early maturing Danteshwari variety (10.4 q ha⁻¹). The percent increase in yield under MTU-1010 over Danteshwari was 48.8 percent. 25% pruning recorded significantly higher monetary return (Rs. 73101 ha⁻¹) at par with 50% pruning (Rs. 58614 ha⁻¹), no pruning (Rs. 55560 ha⁻¹) but significantly superior to 75% pruning (Rs. 35727 ha⁻¹). Managed agroforestry system (i.e. pruning treatments) recorded higher monetary return (Rs. 55815 ha⁻¹) as compared to crop alone (Rs. 23092 ha⁻¹) and tree alone (Rs. 41017 ha⁻¹).

MICROGRAFTING FOR PROPAGATION OF FRUIT CROPS

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Abstract

Micrografting is a new in vitro grafting technique and consists of the placement in aseptic conditions to maintained scion in vitro grown rootstock. The results of in vitro micrografting and the plant material derived from it can be further multiplied in tissue culture conditions or acclimatized to outdoor conditions. The technique has been used in woody species, especially fruit trees. Successful micrografting protocols have been developed for various fruit crops including almond, apple, cherry, chestnut, Citrus, grapes, mulberry, olive, peach, pear, pistacio, walnut, etc. Special techniques have been used for increasing the percentage of successful micrografts with the use of growth regulators, etiolation treatments, antioxidants, higher sucrose levels, silicon tubes, etc. The technique has great potential for improvement and large scale multiplication of fruit plants. Major work was carried out in different Citrus species for the elimination of various viral diseases. Micrografting is a technique that potentially can combine the advantages of rapid in vitro multiplication with increased productivity that results from grafting, superior rootstock and scion combinations. Among various methods of micrografting, slit or wedge grafting has been found most suitable in case of fruit crops. In vitro shoot tips are better as compared to in vivo shoot tips for carrying out micrografting resulting in higher graft success, less contamination, less vitrification, lower shoot tip necrosis and good vigour of micrografts. Media used for growing micrografted plantlets also affects grafting success, vitrification, contamination and vigour. Use of appropriate medium depends on genotype and growing conditions. scion length and rootstock development stage also influences graft success, vitrification, shoot tip necrosis, vigour and contamination.

HEAT PENETRATION CHARACTERISTICS AND PHYSICO-CHEMICAL PROPERTIES OF RETORT PROCESSED SHELF STABLE READY TO EAT PALAK PANEER

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Abstract

A convenient ready to eat thermally processed *palak paneer* has been developed using retort processing. The processing parameters like temperature and time 110 to 125°C for 10 to 25 min respectively optimized on the basis of sensory evaluation



and thermal parameters. Palak paneer were packed in retortable pouches and processed in a horizontal stationary air–steam retort. The product was characterized by a short lag period for the heating curve j_h (from 0.25 to 1.939), small heating rate index f_h (3.43–16.22 min) and a short lag factor for the cooling curve, j_c (0.65 to 1.31) implying essentially convective heating regime. The total process time (B') was 7.9 to 32.5 min for F_0 value of 2.81–55.19 min. Process time of 10 min at 116 °C yielded a product that was microbiologically safe as well as sensorily acceptable.

MULCHING TECHNIQUE USEFUL TO CONSERVE SOIL, WATER AND ENHANCED AGRICULTURAL PRODUCTION

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Abstract

India is an agriculture country should have a good respect towards conservation strategies especially of water and soil. We have been suffering from a great stress of water scarcity as well as soil erosion. Each and every drop of water is important for us but unfortunately because of carelessness, we often waste huge amount of water. One of such practices is over and excessive irrigation. Mulching is a soil and water conserving as well as weed management practice through soil solarisation also in which any suitable material is used to spread over the ground between rows of crops or around the tree trunks. This practice helps to retain soil moisture, prevents weed growth and enhances soil structure. There are various types of mulching such as surface mulching, vertical mulching, polythene mulching, pebble mulching, dust mulching live vegetative barriers, straw mulching etc. Mulching also shows some limitations beyond many advantages as it may harbor some insects, pests and diseases and also create some weed problems sometimes. The current analysis deals with argument of every single feature of mulching and it's beneficiary effects.

DEVELOPMENT OF USLE / MUSLE MODELS FOR SOIL EROSION STUDIES IN VIDISHA DISTRICT OF MP

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Abstract

Land degradation such as soil erosion has been continuing in many regions of India due to ongoing deforestation and slow paced adoption of conservation agriculture (CA), faulty cultivation practices and intensive agricultural activities with aims to expand farm land in view of obtain more production. A study has been conducted in the Central Vindhyan plateau of Madhya Pradesh in the Betwa river basin at Vidisha district which are at moderate to high risk of land degradation. Approximately 93.68 M ha is severely eroded out of total nearly 147.75 M ha area subjected to various types and degree of erosion an estimated area of approximately 2.06 M ha is in the form of ravines in the country. These land forms are almost totally devoid of fertility and can hardly sustain any vegetation. Out of estimated 20.06 lakh hectare area under ravine in the country about 6.83 lakh hectare is occupied in the Madhya Pradesh. Out of that nearly 1.88 lakh hectare ravine area is estimated to belongs to Betwa river basin. Bhopal division of the state indicating that the Betwa basin suffers most severely from the problem of land degradation due to ravine formation. The phenomenon of gully erosion expended in the lateral direction all along river courses. Gullies and ravine flank for about two km along the bank. The Vidisha and adjoining districts suffers badly due to its erosion prone soil characteristics viz. (Sandy clay loam with increase in sand with depth, poor organic carbon content, low binding capacity, high infiltration rate, poor aggregation and high dispersion ratio). And further ravine broaden & got deepen due to subsurface flow also. To make effective use of the region's soil & water resources at a watershed scale, soil & water conservation techniques have been proposed and evaluated, maximized the use of resources by classifying arable lands into vegetation zones, *insitu* runoff water harvesting techniques, conservation agricultural areas



depending on specific land and topographic features of the watershed. Evaluation of effects of introducing the above mentioned techniques using the soil & water assessment tools (SWAT) and predictive USLE / MUSLE models have been examined with using recent advanced RS & GIS powerful tools for facilitating proper erosion estimation of soil loss for ravines on watershed basis in view of sustain crop productivity, profitability of agricultural household using predictive models based on a survey of farmer's existing conditions.

EVALUATION OF FRONTLINE DEMONSTRATIONS ON THE YIELD AND ECONOMICS OF LINSEED (*LINUM USITATISSIMUM*) IN MANDLA DISTRICT OF MADHYA PRADESH

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Abstract

The present study was carried out during *Rabi* season in seven villages of Mandla district during 2018-20 to 2019-20 in 20ha. Frontline demonstrations were conducted on linseed by active participation of farmers with the objective to demonstrate the improved technologies of linseed production potential. The improved technologies consist of replacement of old variety with promising high yielding improved variety, balanced fertilizers application (soil test based) and integrated pest and disease management. One of the major constraints of traditional linseed farming is low productivity because of non-adoption of advanced technologies like-improved varieties. To increase the production, productivity and quality of agricultural produce, front line demonstrations are being conducted at various farmer's field. All the recommended practices were provided to the selected farmers. Result of the present study revealed that linseed variety, JLS-66 recorded the higher yield (8.57 q ha⁻¹) as compared to the farmers practice (4.78 q ha⁻¹) traditionally adopted by the farmers. The percentage increase in the yield over farmer's practice was 50.27%. The technology gap, extension gap and technology index values were 9.43 q ha⁻¹, 3.79 q ha⁻¹ and 52.38%. The research practice gave higher gross return (Rs. 34,280 ha⁻¹), net return (Rs. 20,030 ha⁻¹) with B:C ratio (2.40) as compared to farmer's practice. The result of the study indicated the gap existed in the potential and demonstration yield is due to soil fertility and weather conditions. Present results clearly show that the yield and economics of linseed can be boost up by adopting recommended technologies.

NGOS ROLE IN RURAL DEVELOPMENT AND AGRICULTURE IN INDIA

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Abstract

Role of non-governmental organizations (NGOs) in rural development the main role of NGOs in agriculture and rural area development are; catalyze rural population, build models experiment, supplement government efforts and organizing rural poor. So we can conclude that NGOs play very important roles in agriculture and rural development which is lead to economic development of any economy. India is a highly populated and predominantly rural country, non-government organizations and voluntary action have been part of the historical legacy.. Since ancient times, social service has been an integral part of Indian culture. Soon after Independence, a number of NGOs had emerged in India. Mahatma Gandhi even pleaded to dissolve the Indian National Congress and transform it to a Lok Seva Sangh (Public Service Organization). Though his plea was rejected, but the followers of Mahatma Gandhi started many voluntary agencies to work on various social as well as economic issues of the country. In this way the NGOs can bring the awareness among the poor rural people. It is now the need of the society as well as the nation to make these rural area and people competent to be aware about their fundamental rights. NGO's are the only organizations that could make the rural area developed and agriculture development means providing assistance to the crop producer with the help of various agricultural resources. Providing protection assistance in the research sphere employing latest techniques controlling pests and facilitating diversity all fall within purview of agriculture development. As economic reform and liberalization saw the government vacating several areas to let private sector entrepreneurship flourish and contribute to the high growth rate of the economy in recent years, similar paradigm shifting is needed to transform NGOs



from their dependence on aid and grants from within and outside from transforming the rural scenario in the country this is sought to be achieved for the NGOs through engaging them in microfinance, micro insurance and micro entrepreneurship activities for overall development of the rural areas and to promote the welfare of the people of rural India.

CLIMATE SMART AGRICULTURAL PRACTICES FOR SUSTAINABLE LIVELIHOODS UNDER RAINFED AGRO-ECOSYSTEM

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Abstract

Agriculture represents a core part of the Indian economy and provides food and livelihood activities to much of the Indian population. Food security and sustainable livelihoods is the all-time concern of people across the globe. Agriculture is in the midst of threat due to climate change and decline in area under crop cultivation. The impact of climate change on agriculture could result in problems with food security and may threaten the livelihood activities upon which much of the population depends. In this frame, Climate Smart Agriculture (CSA) is an approach that calls for integration of the need for adaptation and the possibility of mitigation in agricultural growth strategies to support food security. Climate resilient technologies are promising tool to guard a farming system from climatic variations. National Initiative on Climate Resilient Agriculture (NICRA) has demonstrated, and promoted application of climate resilient technologies in most vulnerable 100 districts. This study has been conducted to recognize the technological and socio-economic impact in rainfed of these technologies upon the society. To enable impact assessment the study employed with –without and before-after comparison, of samples of adopted CSA practices and non-adopted CSA practices constituting 25 respondents and research. Among the technologies demonstrated in the NICRA villages and adopted CSA practices, improved soil and land management practices, water management practices, crop production interventions, rain water harvesting, increased ground water level and soil moisture, and cropping system. So, this study indicate that Adopting various CSA practices can help to mitigate the effects of climate change, enhance productivity of crops, and conserve soil and soil fertility also protecting environment by elimination of burning of straw and recycling of residues and plant nutrients. Rainfed agriculture has huge potential and help us to sustain the agricultural production even in climate change scenario.

SUITABILITY OF MEDICINAL PLANTS IN MELIADUBIA BASED AGROFORESTRY IN NORTH EASTERN DRY ZONE OF KARNATAKA

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Abstract

The field experiment was conducted in farmer's field at College of Agriculture, Bheemaranagudi, UAS, Raichur during 2019-20. Eight medicinal plants were planted in one and half year old *Meliadubia* plantation placed at 2 m x 1 m spacing. Eight medicinal plants viz., *Coriandrum sativum*, *Carum copticum*, *Ocimum basilicum*, *Ocimum sanctum*, *Withania somnifera*, *Cymbopogon citratus*, *Adhatodavasica* and *Andrographis paniculata* were planted as an intercrop in *Meliadubia* based agroforestry system. Among the different medicinal plants, well flourished growth was observed in *Cymbopogon citratus* and *Adhatodavasica*, which was noticed in terms of higher plant height, number of leaves and number of branches or tillers per plant when compared with other medicinal plants. Comparative performance was also observed in *Ocimum basilicum* and *Ocimum sanctum*. Higher economic yield in terms of herbage yield was observed in *Cymbopogon citratus* (62.30 q ha⁻¹) followed by *Adhatodavasica* (38.25 q ha⁻¹). Lower economic yield was observed in *Coriandrum sativum*, *Carum copticum*, *Withania somnifera* and *Andrographis paniculata*. Poor establishment of seedlings was observed in *Withania somnifera*. As far as the economic is concern, higher gross return was noticed in *Cymbopogon citratus* (Rs.186900 ha⁻¹) with net returns (Rs.161400 ha⁻¹) and benefit cost ratio (7.33) followed by *Ocimum basilicum* of Rs.176600 ha⁻¹ as gross return, Rs. 151100 as net returns and 6.93 as B:C ratio. Lower gross returns, net returns and B:C ratio was noticed in *Andrographis paniculata* species.



EFFECT OF FERMENTED MILK FOODS ON NON-SPECIFIC IMMUNOMODULATION

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Abstract

Fermented milk products containing live starter culture bacteria are reported to possess a beneficial health effect on human including enhanced immune performance, reducing the lactose intolerance, increased resistance to diseases causing microbes, alleviation of food allergies and inhibition of cancer growth. An optimally working system is important for defense against infectious diseases and cancers. Deficit in any component of the system can expose human being to a greater risk of infection or may increase the severity of disease. There is sufficient reports to suggest that lactic cultures apply their immunomodulatory effects by augmenting both non-specific (e.g. phagocyte function, NK-cell activity) and specific (e.g. antibody production, increase in production of cytokine, lymphocyte proliferation, delayed-type hypersensitivity) host immune responses but still uncertainty exist on specific mechanisms. The action of LAB is species and strain specific and depends on dose also. It is noteworthy that most of the reports supporting these immunomodulatory effects are derived from in vitro and/or animal trials and there is a dearth of carefully designed and suitably controlled clinical trials indicative of immunity development in humans. This review discusses the effect of Fermented products and LAB on non-specific immune reaction and highlights gaps in our knowledge that require further research.

SCIENTIFIC RATIONALITY OF INDIGENOUS CROP MANAGEMENT PRACTICES OF TWO AGRO-ECOLOGICAL ZONES OF KARNATAKA

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Abstract

Indigenous information systems are dynamic and this knowledge system is usually not found in written form and is transmitted from generation to generation through word of mouth. It was built up on farmer's own knowledge generated over centuries, unlike modern technologies, which are exogenous. The present study was aimed at collecting crop management Indigenous Technical Know-how (ITK) followed by farmers and to test their scientific rationality. Present study was undertaken in zone-8 (Northern transitional zone) and zone-9 (Hilly zone) of Karnataka. ITKs related to crop management were collected through checklist guided discussions in 8 villages. Thirty agronomists were consulted to know the scientific rationality of collected ITKs. Results were analyzed using chi-square to know whether sampled agronomists opinion about ITKs match with that of population of experts or there exist any difference of opinion towards the ITK. Seven ITKs (2C, 3C, 5C, 6C, 17C, 18C and 19C) were categorized as highly rational and four ITKs (8C, 10C, 12C and 13C) as least rational. Experts expressed multiple opinions about ITKs 1C, 2C, 5C, 6C, 8C, 13C and 18C thus indicating difference between sampled experts with that of population.

SYNTHESIS AND CHARACTERIZATION OF DERIVATIVES OF "ANIL"(3-AMINO-2-NAPHTHOL AND AROMATIC ALDEHYDE) AND THEIR COMPLEXES WITH ZN(II), CU(II), NI(II)

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Abstract

Metal complexes of Schiff Bases have occupied a central role in the development of coordination Chemistry. A number of varieties of stable chemical species have been synthesized, containing transition metals and multifarious ligands. Metal complexes also find a wide application in the field of Industrial Chemistry, Analytical Chemistry, Pharmaceutical Chemistry, Agricultural Chemistry and Bioinorganic Chemistry. Recently, heterocyclic Schiff bases and their metal complexes are



frequently used as Anticancers, Herbicides, Bactericides, Plant growth regulators and Anticovulsants. The end result of this reaction is a compound in which C = O is replaced by a C = N. This study reported the synthesis of the new ligands formed by 3-Amino 2-Naphthol 4-Sulphonic Acid with Furan-2 Carbaldehyde, Thiophene-2 Carbaldehyde and Pyrrole-2 Carbaldehyde. These formed Schiff base type ligands respectively obtained Furan-2 Aldimine-2-N-3 Hydroxy-1-Sulphonic Acid Nephthalene, Pyrrole-2 Aldimine-2-N-3 Hydroxy-1-Sulphonic Acid Nephthalene, Thiophene-2 Aldimine-2-N-3 Hydroxy-1-Sulphonic Acid Nephthalene. The above synthesized Schiff bases were then condensed with CuSO₄, NiCO₃, Zn (II) Acetate, [Cu(II) By CuSO₄, Ni(II) By NiCO₃, Zn(II) Acetate] to get their complexes. The synthesized complexes have been analyzed and characterized with help of elemental analysis, conductance, magnetic susceptibility measurement, IR and U.V. visible spectroscopy. The complexes have been screened for their biocidal activity. The antifungal and antibacterial activity of all the synthesized Schiff bases and their metal complexes has been determined on *Aspergillus Flavous*, *Aspergillus Niger Fungi* and *Escherichia Coli*, *Staphylococcus Aureus* and *Bacillus Subtilis* bacteria by cup plate agar diffusion method. The result of above investigation metal complexes of these Schiff bases, the Cu(II) metal complexes showed highest activity (in both antifungal and antibacterial) while Zn(II) metal complexes showed better activity than Ni(II) complexes.

INTEGRATED MANAGEMENT OF AGRICULTURAL INSECT PESTS USING ENTOMOPATHOGENIC FUNGI

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Abstract

Entomopathogenic fungi are diverse group of insect pathogenic fungi, playing a vital role as biological control agent of insect pests. These fungi are found in a wide adaptations and show promising results due to its broad host range. Entomopathogenic fungi are reported from different fungal divisions including Deuteromycota, Ascomycota, Zygomycota, Oomycota, and Chytridiomycota. These fungi have ability to infect insects with sap sucking as well as chewing and biting mouthparts. Mode of action of these fungi is mostly through contact and penetration. The infection cycle of entomopathogenic fungi involves several steps like adhesion and germination of spore, development of infection structure, penetration of the cuticle and production of toxins. After successful infection the fungus starts conidiogenesis which is the main cause of disease dispersal by both passive and active process. There are estimated 700 species of entomopathogenic fungi in approximately 90 genera are known till now. The most of the commercially available fungal-based biopesticides are produced from *Beauveria bassiana*, *Beauveria brongniartii*, *Metarhizium anisopliae*, and *Isaria fumosorosea* species. The use of entomopathogenic fungi against the insect pest of agricultural and horticultural crops has several benefits like they are non-toxic, environment friendly and mostly specific to a single group or few species of insect. In agriculture system these fungi or biopesticides can be used to control insect pest population directly in the field as well as in storage houses.

LIVESTOCK FEEDING PRACTICES FOLLOWED BY DAIRY FARM WOMEN IN BELAGAVI DISTRICT OF KARNATAKA

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Abstract

A balanced scientific feeding practices supplies all the essential nutrients to the livestock in required proportion and which helps in enhancing milk production. The present study is undertaken to know the feeding pattern followed by dairy farm women. The study is an “survey based research” conducted in the Belagavi district. The respondents were selected proportionately from Raybag and Gokak taluks, further two villages from each taluk were selected randomly, thus



constituting 120 dairy farm women as a sample size for the study by employing proportionate random sampling technique. The primary data was collected by personal interview method with the help of pre-tested structured interview schedule and data was analyzed using suitable statistical tools. The investigation found that large majority (89.17 %) of the respondents practiced stall feeding method, 80.84 & 67.50 per cent of dairy farm women used to provide water and concentrate feed twice a day, 55.83 per cent fed purchased feed twice a day followed by just above half (51.66 %) of them were given fodder more than three times in a day and almost half (49.16 %) of the dairy farm women fed mineral mixture, 49.17 & 50.83 per cent of respondents practiced chaffing and direct feeding of green and dry fodder respectively and 31.67 per cent of the dairy farm women were given home made feed. Further with respect to enrichment of fodder the study noticed that none of the farmers were practicing hay making, silage making, salt water, urea and jaggery treatment of fodder, soaking of dry fodder (7-8 hrs), There is a need for organizing need based well planned training by concerned department to raise the awareness with regard to scientific feeding practices of livestock and efforts should also made to disseminate fodder conservation technologies and enrichment methods to enhance milk production.

EFFECT OF TILLAGE AND INTEGRATED NUTRIENT MANAGEMENT ON GROWTH, SEED COTTON YIELD AND YIELD CONTRIBUTING CHARACTERS

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Abstract

The experiment was carried out at the Research farm, Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola to study the "Effect of Integrated Nutrient Management on Soil Quality and Cotton Productivity under Different Tillage Practices in Vertisol". The treatments thus involved two main treatments and eight sub treatments. The *experiment main plot comprises of two treatments i.e. conservation tillage (CNS) and (CNV)* in which one harrowing and two weeding and in conventional tillage (CNV) one ploughing and one harrowing, two hoeing and two hand weeding operations were carried out in eight sub plot treatments of nutrient management. Plant height and dry matter accumulation is higher under conservation tillage as compared to conventional tillage under different growth stages. The *seed cotton yield was slightly higher under conservation tillage* as compared to conventional tillage and highest seed cotton yield in conservation tillage (15.00 q ha^{-1}) over conventional tillage (13.07 q ha^{-1}). Highest seed cotton yield was recorded in the *treatment receiving 100 % RDF (60:30:30 NPK kg ha⁻¹)* (15.57 q ha^{-1}) followed by 50% RDF + 50% N (FYM) (14.84 q ha^{-1}). *Highest bolls per plant in conservation tillage (19.95 bolls per plant)* than in CNV (17.51 bolls per plant) while bolls per plant was recorded in the *treatment receiving 100 % RDF (60:30:30 NPK kg ha⁻¹)* ($20.38 \text{ bolls per plant}$) followed by 50% RDF + 50% N (FYM) (T_3) ($19.47 \text{ bolls per plant}$). *Highest boll weight in CNS (3.82 g)* and in CNV (3.77 g) whereas highest boll weight was recorded in the *treatment receiving 100 % RDF (60:30:30 NPK kg ha⁻¹)* (3.86 g) followed by 50% RDF + 50% N (FYM) (3.85 g).

APPLICATION OF VARIOUS TECHNIQUES FOR CURING AND SOMOKING OF LIVESTOCK MEAT

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Abstract

Since the pre-historic time. Meat is consumed by human as a part of diet. Meat is an animal as an excellent source of high biological values protein, zinc, iron, magnesium, phosphorus and vitamins. The total meat production in country is 8.11 million tonnes and increased by 6.0 per cent as compared to previous years. meat is very susceptible product due to present in some chemicals and enzymatic activities. The breakdown of fat, protein, and carbohydrates of meat result in the development of off odors, off-flavor and slim formation, which make the meat objectionable for the human consumption. Several factors such as moisture, light, microbes, atmospheric oxygen, temperature, and endogenous enzymes influence the freshness and



shelf life of meat. Microbes are ubiquitous in distribution and can reach the meat from different sources thus causing its spoilage. Therefore various techniques are used in curing and smoking of livestock meat as salt, sugar, sodiumnitrite (150mg/kg), Ascorbates is maximum limit in used (550 mg/kg), Alkaline phosphates (0.5% of added phosphate) and water .Meat curing refers to the production of the characteristic thermally stable pink meat pigment and cured meat flavour by the action of sodium nitrite(150mg/kg)/nitrate to meat helps in preservaton, colour development and flavour enhancement.

VACCUM IMPREGNATION : TO TAILOR NEED BASED PROCESSED PRODUCTS

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Abstract

Vacuum impregnation is a non-thermal and non-destructive method of infusing the porous food matter with intended compound. It works on the basic principle of osmosis, under the intentionally induced pressure difference mediated by the hypotonic solution. It's more a pre-treatment technique given to the fresh fruits and vegetables slices, where partial water and air is emptied from the tissues of fresh produce. Accordingly, the intercellular spaces of fruits and vegetables can be easily filled up using vacuum impregnation through hydrodynamic mechanism. Further, various factors decide the physico-chemical and organoleptic properties of product. Few paramount attributes include, external attributes *i.e.*, vacuum pressure, vacuum retention time, relaxation time, concentration of the solution, temperature of the solution and internal tissue attributes *i.e.*, size and shape of the capillary, thickness of slices and porosity. Vacuum impregnation would serve as superior avenue to produce calorie densified foods, fortified foods, minimal processed foods and functional foods. The greatest thing is, fabricating the bioactive level of the food products by introducing them together with impregnating solutions having target implications thus improving health-promoting properties of the product and facilitating production of functional food. The functional foods are nothing but target oriented medicine foods to treat specific disease or disorder. Affixing to it, thermal properties, total solids, sugar: acid blend, water activity, pH, texture, color, taste, and aroma of the product can be controlled. Therefore, vacuum impregnation is one among the effective method to design the need based processed food products.

SURVEY, AND TAXONOMY OF HYMENOPTERAN PARASITOIDS IN KASHMIR VALLEY AND THERE MITIGATION

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Abstract

Preliminary survey of thirteen maize growing areas representing six districts of Kashmir valley, revealed an average of 1.53 to 13.45 per cent plant infestation caused by *C. partellus* during May to July. Among the areas surveyed, Kralpora (K.D. Farm), Lar and Kangan exhibited comparatively high level of infestation as compared to others. Extensive fortnightly surveys in the above mentioned three hot spot areas indicated an average of 19.89, 24.53 and 22.04 per cent plant infestation during July to October, at Kralpora, Lar and Kangan, respectively. At all these locations, larval infestation was found to increase from July to September and declined in October. Highly infested plants during September showed an average of 2.2 to 4.0 larvae/plant which was found positively correlated with number of exit holes in them. Among natural enemies, *Trichogramma chilonis* Ishii, *Cotesia ruficrus* (Haliday), *Euplectrus coimbatorensis* Ferriere and one unidentified species each of ichneumonidae and tachinidae were found associated with *C. partellus*. *Cotesia ruficrus* was distributed at all the studied locations, whereas *T. chilonis* was found at three studied hot spot locations. Negligible and sporadic occurrence of remaining species was found from one location only. On individual basis, average egg parasitism by *T. chilonis* was determined as 4.98, 7.7 and 6.08 per cent whereas larval parasitism by *C. ruficrus* was worked out to be 9.76, 14.43 and 11.25 per cent at Kralpora, Lar and Kangan, respectively. Together these two egg and larval parasitoids afforded an average of 14.73, 22.13 and 17.33 per cent parasitism with a maximum of 30.14 per cent at Lar. Comparatively better performance of *C. ruficrus* was due to its higher population density and manifestation of super parasitism. Per cent emergence both in *T. chilonis* and *C. ruficrus* ranged 83.67-93.32 and 86.26-90.38 respectively, with female oriented sex ratio in both cases. Pattern of parasitism was found varying in the studied three locations due to many abiotic and biotic factors.



TO IMPROVE YIELD AND QUALITY OF ALMOND AND TO REDUCE THE INCIDENCE AND INTENSITY OF GUMMOSIS BY THE USE OF DIFFERENT COMBINATION OF TREATMENTS ON GROWTH AND VIGOR OF YOUNG PLANTS

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Abstract

Present investigation “Influence of Different Nutrient Sprays on Fruit Quality of Almond cv. Guigne Pourpera Precece (*Awal Number*)” was carried out in the Division of Fruit Science, of OPGS university Rajasthan But I Done My Work In SKUAST Kashmir Under the guidance Kashmiri scientists, who help me in all respects. Agricultural Sciences and Technology of Kashmir Shalimar, Srinagar during 2018-2020. Fruit set, yield, leaf area was noticeable more with combined application of zinc sulphate, boric acid and potassium sulphate. Annual shoot growth was significantly enhanced by the foliar application of zinc sulphate plus boric acid. Content of leaf nitrogen, phosphorus, potassium, calcium and zinc was significantly enhanced by the combined spray of Zn + B + K with or without calcium oxide. Leaf boron content was significantly increased by the combined foliar application of zinc sulphate and boric acid. Physical characteristics like fruit size, volume, pulp stone ratio, flesh thickness was significantly increased by the combined application of zinc sulphate, boric acid and potassium sulphate. Fruit cracking was effectively reduced by the foliar application of calcium oxide plus boric acid and potassium sulphate. Incidence and intensity of gummosis was drastically reduced by the foliar application of calcium oxide plus boric acid. Improved Organoleptic rating was observed in fruits treated with combined foliar application of calcium oxide, boric acid and potassium sulphate. Chemical characteristics like juice content, acidity, total soluble solids, total sugars, ascorbic acid and anthocyanin were significantly enhanced with the combined foliar treatment of zinc sulphate, boric acid, potassium sulphate with or without calcium oxide. Higher fruit potassium content was observed in trees treated with combined application of boric acid and potassium sulphate. Fruit calcium and boron content was significantly enhanced by the combined application boric acid, potassium sulphate and calcium oxide. Fruit zinc content was increased by the combined application of zinc sulphate and boric acid. From the present study it can be concluded that the foliar application of nutrients such as zinc, boron, calcium and potassium at floral bud burst, 70% petal fall and pit hardening stages of the fruit resulted in improvement of vegetative, physical and chemical characters. In general foliar application of Zn+B+K with or without calcium oxide showed a significant increase in terms of fruit set, fruit yield, leaf area, fruit size, fruit weight, fruit volume, pulp-stone ratio, flesh thickness, leaf nitrogen, potassium and zinc when applied at floral bud burst, 70% petal fall and pit hardening stage of the fruit. Zn + B + K with or without calcium oxide sprays also resulted in significant increase of chemical parameters like total soluble solids, total sugars, juice content, anthocyanin content, ascorbic acid, acidity. Fruit nutrients Ca and B increased with the combined foliar application of boric acid, potassium sulphate and calcium oxide sprayed at different phenological stages which were also significantly effective in alleviating to some extent the physiological disorders. From the present study it can be concluded that the foliar application of nutrients such as, Zn + B + K with or without calcium oxide sprays also resulted in significant increase of chemical parameters like total soluble solids, total sugars, application of boric acid, potassium sulphate and calcium oxide sprayed at different phenological stages which were also significantly effective in alleviating to some extent the physiological disorders like gummosis and fruit cracking, this is authentic results because I repeated these treatments again in 2017, the result will be same little that is negligible that is due to environmental fluxions, like gummosis and fruit cracking.

OPINION AND NUTRITIONAL KNOWLEDGE OF VEGETABLES IN THE DIET AMONG THE GARDENERS IN DHARWAD DISTRICT OF KARNATAKA

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Abstract

Vegetables constitute an important component of the human diet. They are recognized as health food globally and play an important role in overcoming micronutrient deficiencies and providing good health. They are natural sources of vitamins



and minerals, like calcium, phosphorus & iron, carbohydrates and proteins. These nutrients are necessary for growth and build resistance against diseases and one of the way to get vegetables is by kitchen garden. Kitchen garden is a healthy activity which improves the nutritional status of the family as vegetables produced in the garden are consumed by household members. Kitchen garden can be described as a mixed cropping system that encompasses vegetables, fruits, plantation crops, spices, herbs, ornamental, medicinal plants as well as livestock that can serve as a supplementary source of food and income. The present study was conducted in Hubli and Dharwad taluks of Dharwad district during 2019-20. Snowball sampling technique was used to select 60 respondents. Of these 45 were urban and 15 were rural. The data was collected through personal interview method and analysed with suitable statistical tests. The findings of the study revealed that, large majority of both (rural 93.33 %, urban 84.44 %) the respondents had favourable opinion towards kitchen gardening. None of the respondents (rural & urban) are found in less favourable opinion category. With respect to knowledge, most (93.33 %) rural respondents had medium knowledge. Whereas, 53.33 per cent of the urban respondents had medium level of knowledge and 46.67 per cent of them had high level of nutritional knowledge. None of them fall under low level category of knowledge. The kitchen garden could be an effective motivational tool that could mitigate the problem of malnutrition. Hence the present study was conducted to study the opinion and nutritional knowledge of vegetables in the diet among the gardeners.

LIVESTOCK FEEDING PRACTICES FOLLOWED BY DAIRY FARM WOMEN IN BELAGAVI DISTRICT OF KARNATAKA

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Abstract

A balanced scientific feeding practices supplies all the essential nutrients to the livestock in required proportion and which helps in enhancing milk production. The present study is undertaken to know the feeding pattern followed by dairy farm women in Belagavi district. The study is an “survey based research” conducted in 2019-20. The respondents were selected proportionately from Raybag and Gokak taluks, further two villages from each taluk were selected randomly, thus constituting 120 dairy farm women as a sample size for the study by employing proportionate random sampling technique. The primary data was collected by personal interview method with the help of pre-tested structured interview schedule and data was analyzed using suitable statistical tools. The investigation found that large majority (89.17 %) of the respondents practiced stall feeding method, 80.84 & 67.50 per cent of dairy farm women used to provide water and concentrate feed twice a day, 55.83 per cent fed purchased feed twice a day followed by 51.66 per cent of them were given fodder more than three times in a day, almost half (49.16 %) of the dairy farm women fed mineral mixture, 49.17 & 50.83 per cent of respondents practiced chaffing and direct feeding of green & dry fodder respectively and 31.67 per cent of the dairy farm women were given home made feed. Further with respect to enrichment of fodder the study noticed that none of the farmers were practicing hay making, silage making, salt water, urea & jaggery treatment of fodder, soaking of dry fodder (7-8 hrs). Hence, there is a need for organizing need based well planned training by concerned department to raise the awareness with regard to scientific feeding practices of livestock and efforts should also be made to disseminate fodder conservation technologies and enrichment methods to enhance milk production.

APPLICATION OF DIFFERENT STRAINS OF BIOFERTILIZER FOR UPLIFTMENT OF NURSERY IN BUNDELKHAND REGION

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Abstract

Agroforestry, the deliberate cultivation of trees or other woody plants with crops or pasture for multiple benefits, is an important category of planted forests that has the potential to provide farmers, communities, and society-at-large with a wide array of forest-related goods and services. Along with complementing forestry sector in resolving many burning issues



providing sustainability and socio economic benefits are the foremost. But the supply of planting stock to farmers is a major problem. Thus, role played by the nursery become crucial for agroforestry systems. In nursery, biofertilizer plays an important role not only in germination of seeds but for further growth and development of good quality seedlings, which are biologically active products or microbial inoculants of bacteria, algae and fungi etc. Main categories of biofertilizers include nitrogen fixing biofertilizers such as *Azospirillum* and Phosphorus Solubilising Bacteria. Like agriculture, in nursery too, the good quality planting stock material can be produced by applying biofertilizers and nutrients at the nursery level. But still the application of biofertilizer is very limited in nurseries for raising of tree species. Further, the soil used for the production of planting stock in nurseries is very poor in nutrient content and beneficial microbial population. Restoration and maintenance of soil fertility of soil used in nursery is a basic but critical ecological problem especially in region like Bundelkhand where the soils are nutrient deficient particularly P and N. Considering the multitudinous advantages of biofertilizers for nursery growers like low cost, easy availability, no harm to environment, no health hazards, long term maintainance of soil fertility thus resulting in lesser requirement of manure and fertilizers, production of healthy stock, fast growth and lesser mortality of seedlings etc, biofertilizers can serve as the most appropriate option for agroforestry nursery in Bundelkhand region.

SEASONAL VARIATION OF FLOWER BUD MAGGOT, *DASINEURA GOSSYPHII*(FLETCHER) (CECIDOMIDAE: DIPTERA) AND NATURAL ENEMIES IN *BT* COTTON

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Abstract

Population fluctuation studies on flower bud maggot, *Dasineuragossypii* Fletcher were conducted at Main Agricultural Research Station (MARS), Dharwad, Karnataka, India, during *kharif* 2016-17 and 2017-18. MRC 7351 *Bt* cotton crop was raised under unprotected conditions during the month of June-July. The two years pooled data indicated that the population of maggot commenced from 38th MSW and incidence continued with a peak at 45th MSW (26.65 maggots/ damaged flower) and gradually reduced from 46th MSW onwards. Whereas, activity of adult fly commenced from 38th MSW and reached a peak at 48th MSW (10.68 adults/ flowers) and then onwards, there was a gradual decrease. The damaged flowers were noticed from 37st MSW (2.80%). The flower damage went on increased gradually with a maximum of 29.73 per cent during 50th MSW. Later on from 51st MSW onwards, the flower damage decreased. The peak populations of coccinellids, chrysoperla and spiders were recorded during 49th, 42nd and 44th MSW, respectively. Weather parameters and natural enemies correlated with the population of flower bud maggot showed negative association with maximum temperature, minimum temperature and rainfall and showed non-significant relationship. Whereas, maximum and minimum relative humidity were positively correlated and showed non-significant relationship except in adult midge which showed negative correlation with non-significant relationship. Correlation studies of natural enemies revealed that, coccinellid (0.478**), chrysoperla (0.784**) and spiders (0.867**) showed positive and highly significant relationship with mean number of flower bud maggots. The adult flower midge showed positive and highly significant relationship with coccinellids (0.568**) and spiders (0.518**) and chrysoperla (0.376*) had positive significant relationship. All the weather parameters and natural enemies influenced flowers bud maggots and adult fliesto an extent of 81.4 and 50.20 per cent, respectively.

IDENTIFICATION OF KEY ROOT PHENOTYPES FROM THE WORLD MUNGBEAN MINI-CORE SELECTION (MMC)

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Abstract

Breeding requires understanding main root traits for improved nutrient and water absorption and better adaptation to harsh environments. At the seedling stage, 296 mungbean (*Vignaradiata*) mini-core accessions reflecting a wide range of crop



diversity were tested using WinRhizo software on a semi-hydroponic phenotyping platform for root morphological traits. There was significant variation in 14 root-related features, most of which were associated with each other. The mini-core was divided into eight clusters on the basis of trait diversity. The highest variation was shown by the total root length, surface area, root length/volume ratio, and total number of root forks. In breeding mungbean varieties with more effective nutrient and water uptake for successful productivity in abiotic stresses, knowledge on phenotypic variation and correlations of key root traits will aid. Phenotypic diversity among the root traits was depicted by the Shannon–Weaver diversity index (H'), where low H' values stand for unbalanced frequency distribution and lack of diversity of the trait, while high H' signifies high genetic diversity in traits. Root traits i.e., TRL, TSA, LPV, and TRF had a relatively high level of H' (>0.9) showing high diversity for these traits in the mungbean mini-core. The high H' value and the positive correlation of these traits with PLR and TPA indicated that these traits are suitable to improve water and nutrient uptake efficiency in mungbean at the seedling stage. Besides, variation for ARD, TRV, and TRT would be useful to enhance nutrient productivity and crop yields also in stressful environments.

CALMODULIN BINDING PROTEIN MEDIATED DISEASE RESISTANCE IN RICE

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Abstract

Rice is a staple food for more than 2/3rd of the world population. The dependency of livelihood on rice makes it a backbone for food security as well as nutritional security in most of the South East Asian countries including India. However, stagnation in rice yield has been reported in recent decade owing to several factors including the emergence of pests and phyto-pathogens, climate change, and other environmental issues posing great threat to global food security. Controlling these diseases has largely relied on breeding resistant cultivars and applying chemical fungicides. However, the frequent appearance of new races of the pathogen has reduced the effectiveness of resistant cultivars in the field. Thus, there is an urgent need to have more advanced and improved technologies that can develop new rice varieties with higher yield potential and improved resistance to major pests and pathogens. We have employed CRISPR-Cas9 technology in rice to enhance disease resistance against pathogens. Our primary target is Calmodulin binding proteins as calcium/calmodulin (Ca^{2+} /CaM) complex plays vital roles in plants in sensing various biotic stresses.

PRINCIPAL COMPONENT ANALYSIS FOR ASSESSMENT OF GENETIC DIVERSITY IN RAINFED SHALLOW LOWLAND RICE (*ORYZASATIVA* L.)

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Abstract

The genetic diversity was estimated using seventy two genotypes of rice in a randomized block design with three replications at the rice research farm of Bihar Agricultural University, Sabour (Bhagalpur) during Kharif, 2019-20 to determine the contribution of fifteen quantitative traits to the total variability in rice using Principal component analysis. In the present investigation PCA was performed for fifteen quantitative traits of rice. All the 3PCs exhibited more than 1.0 Eigen value and showed about 95.00% variability. Therefore, these PCs were given due importance for the further explanation. The PC1 showed 77.28 per cent variation of total variation followed by second to third components which accounted 15.65 and 2.05 per cent of total variation presented among the genotypes, respectively. PC1 contributed 77.28% of the total variation and correlated with total carbohydrate, generation of H₂O₂, days to 50% flowering, biological yield, number of fertile grains per panicle, panicle length and flag leaf area while PC2 explained an additional 15.65% of the total variation and dominated by total carbohydrate, days to 50% flowering, harvest index, biological yield, total number of spikelets and plant height. PC III accounted 2.05 per



cent of the total variability and correlated with the traits like days to 50% flowering, biological yield, total number of spikelet's, 1000-seed weight, plant height, harvest index, generation of H₂O₂ and panicle length had maximum positive contribution. Since, a total of 95.00% of the total variation was contributed by PC1 and PC2, therefore, these two principal components can be allowed for simultaneous selection of yield contributing traits in desi chickpea. Genotype usually found in more PC, were CR3933-13-2-1-4-1-2-1, TTB1011-14-171-2-2-1-2-1, TTB1032-45-937-2-3-3-1-1, (Santepheap3/IR49830-7/ RajendraMahsuri)-1-3-1, (BR11/IR8041OB)-2-1-1, (RajendraMhasuri/CN1039)-4-2-1, TTB1011-14-243-1-2-2-2-1, TTB1032-45-937-2-3-3-1-1, CR4138-3-1-1, CR4139-9-2-1, CR4139-9-2-1 and CR4128-9-1-1. Similar type of genotypes on a common principal component permitting to designate them as seed yield factors. These genotypes may further be utilized in breeding programmes for improving seed yield and these genotypes can be considered an ideotype breeding material for selection of traits viz. more total number of seed per plant and 100-seed weight further utilization in precise breeding programme.

GENETIC VARIABILITY IN TAINTED SHALLOW LOWLAND RICE FOR GRAIN YIELD AND IT'S COMPONENT TRAITS

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Abstract

The present investigation was carried out using seventy two genotypes of rice in a randomized block design with three replications at the rice research farm of Bihar Agricultural University, Sabour (Bhagalpur) during *kharif*, 2019-20. The analysis of variance revealed that there was highly significant variation among the genotypes for all the traits studied. This in turn indicated that there was sufficient variability present in the material studied which could be utilized in further breeding programme. Maximum range of variation was found for total number of spikelets, number of fertile grains per panicle, biological yield, generation of H₂O₂ and plant height. The characters, namely, harvest index, total carbohydrate, fertility percentage, grain yield per plant, days to maturity, days to 50% flowering, flag leaf area, 1000- seed weight and number of effective tillers per hill in order, showed comparatively moderate range of variation. In the present investigation, a higher estimate of genotypic coefficient of variation was noticed for total carbohydrate, biological yield, harvest index, number of fertile grains per panicle, generation of H₂O₂, total number of spikelets, grain yield per plant, 1000-seed weight and number of effective tillers per hill. This is an indicative of less amenability of these traits to environmental fluctuations and hence, greater emphasis should be given to these characters, while breeding cultivars from the present material. High estimate of PCV was observed for total carbohydrate, biological yield, harvest index, number of fertile grains per panicle, total number of spikelets, grain yield per plant, generation of H₂O₂, number of effective tillers per hill, 1000-seed weight and flag leaf area. However, fertility %, plant height and panicle length had moderate PCV only under rainfed shallow lowland condition. GCV varied moderately for flag leaf area, fertility%, plant height and the remaining traits recorded low estimates of phenotypic and genotypic coefficient of variation. These findings clearly indicated that selecting genotypes through these traits will be effective for rainfed shallow lowland condition. Interestingly, the differences between GCV and PCV values were minimum implying least influence of environment and preponderances of additive gene effects; indicating genotypes can be improved and selected for these characters under rainfed shallow lowland rice. Study of *per se* performance of individual genotype suggests the importance of the materials under study and it becomes first-hand information for the breeders. The mean (Kour and Pradhan, 2016) of different quantitative characters including grain yield per plant as performed by the available genotypes suggested that selection of desirable genotypes based on the traits from materials evaluated, can be effective. In this study, heritability in broad sense were found to be high for total carbohydrate, generation of H₂O₂, 1000-seed weight, days to 50% flowering, biological yield and days to maturity, harvest index, total number of spikelets, plant height, number of fertile grains per panicle, grain yield per plant, number of effective tillers per hill, flag leaf area and panicle length. High genetic advance was recorded for total number of spikelets, biological yield, number of fertile grains per panicle, generation of H₂O₂, plant height, harvest index (%) and total carbohydrate, while, traits like grain yield per plant, days to 50% flowering, days to maturity, fertility % and flag leaf area showed moderate genetic advance. In the present investigation, high heritability coupled with high genetic advance over mean was observed for total carbohydrate, biological yield, harvest index (%), grain yield per



plant, generation of H₂O₂, 1000-seed weight, number of fertile grains per panicle, total number of spikelets, flag leaf area, number of effective tillers per hill and plant height which suggested that these characters can be considered as favourable attributes for the improvement through selection and this may be due to presence of additive genes effect and thus, could be improved upon by adapting selection without progeny testing. Hence, direct selection can be done through these characters for future improvement of genotypes for higher grain yield.

EFFECT OF LOW PHOSPHORUS STRESS ON ROOT ARCHITECTURAL TRAITS IN MUNGBEAN

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Abstract

Roots enable the plant to survive in the natural environment by providing anchorage and acquisition of water and nutrients. The change in root architecture explores the soil space and thus enhanced root-soil contact increases P efficiency. In this study, root architectural traits of 153 mungbean genotypes were compared under optimum and low phosphorus (P) conditions. The experiment was conducted in greenhouse with maintaining 30/18°C day/night temperature, photoperiod of 12 h and relative humidity at 90%. The two levels of P were maintained using KH₂PO₄ as optimum P (250 M) and low P (3 M). Roots were scanned using root scanner (Epson professional scanner) and greyscale images obtained in TIFF format were analyzed using WinRhizo software (Pro version 2016a; Regent Instrument Inc., Quebec, Canada). The mean values of primary root length and root average diameter were significantly high in LP as compared to OP condition. The higher percentage distribution for studied root traits (was recorded in 0–0.5 mm diameter class as compared to other diameter classes under two P regimes. For root diameter classes 0.5–1.0 mm, 1.0–1.5 mm and 1.5–2.0 mm RL, RSA and RT percentage were higher in LP in comparison to OP condition. The first principal component explained the 61% and 59% of total variation under OP and LP condition, revealed that TRL and TSA, and their highly correlated traits TRV and RF are the most important contributing traits. The genotypes PUSA 1333 (1714.43 cm) and PLM 271 (1530.46 cm) under OP condition and genotypes M 723 (1249.23 cm) and China Mung (1231.59 cm) under LP condition recorded highest TRL among the tested genotypes. This study clearly shows that root traits total root length, total root surface area and total root volume are the ideal selection criteria at the seedling stage for predicting the nutrient use efficiency in the field.

NITROGEN RESPONSE TRIALS ON SELECTED EARLY RICE CULTURES UNDER HIGH AND LOW INPUT MANAGEMENT

Vivek Yadav and Rajendra Singh

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ABSTRACT

An experiment was designed to study the grain yield potential of promising early cultures of rice under high & low input management under transplanted conditions. Highest grain yield (4.90t/ha) and panicles (273) was recorded with 150% RDN which was significantly superior over other treatments. Different varieties failed to bring any significant difference in grain yield however highest grain yield 4.40 t/ha was recorded with IET 23300. Differences in number of panicles between IET 23300 and IET 23275 was non significant.

CHEMICAL WEED CONTROL IN DIRECT SEEDED RICE

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ABSTRACT

Rice is one of the most important cereal crop as it is staple food of more than 70 % of the world population. weeds are a major impediment to rice production through their ability to compete for resources and their impact on product quality. Out of the losses due to various biotic stresses, weeds are known to account for nearly one third. Uncontrolled weeds reduced the grain yield by 75.8, 70.6 and 62.6% under dry-seeded rice (DSR), WSR and transplanted rice (TPR), respectively. Among the



methods highest grain yield and number of panicle/m² was recorded under wet seeding (4.66t/ha) however the differences with dry seeding in term of grain yield was non significant. Among the weed treatments highest grain yield was recorded with need based hand weeding 5.58t/ha which was at par with the treatment pre emergence application fb post emergence herbicide application fb post emergence herbicide application (1, 2 and 3rd flush of weed). At 40 DAHA the differences in weed dry weight between both methods was non significant. In weed control treatments lowest weed dry weight 3.37 g/m² was recorded with pre emergence application fb post emergence herbicide application fb post emergence herbicide application (1, 2 and 3rd flush of weed) however the differences between need based hand weeding and pre emergence application fb post emergence herbicide application (1, and 2nd flush of weed) was non significant.

NITROGEN RESPONSE TRIALS ON SELECTED BASMATI CULTURES UNDER HIGH AND LOW INPUT MANAGEMENT

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ABSTRACT

An experiment was designed to study the grain yield potential of promising basmati cultures of rice under high & low input management under transplanted conditions. Highest grain yield (4.31t/ha) and panicles (349) was recorded with 150% RDN however it was found at par with 100% RDN. Highest grain yield (4.22q/ha) was recorded with entry IET 24577 which was found at par with the entries and checks however it was significantly superior over entry IET 24570 & IET 24575. Highest number of panicles/m² was recorded with entry 24566 which was at par with IET 24576, IET 24577, IET 24565, IET 24573 and was significantly superior over all the checks and entries under test.

INFLUENCE OF BIOAGENTS POPULATION UNDER DIFFERENT WEATHER PARAMETERS IN RICE FIELD ECOSYSTEM OF EASTERN UTTAR PRADESH CONDITONS

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Abstract

An intensive study was undertaken to investigate the influence of bioagents population under different weather parameters in rice field ecosystem of Eastern Uttar Pradesh conditions for two consecutive years, 2014 and 2015. The population of bioagents were observed under particular weather parameters, i.e. temperature maximum, temperature minimum, relative humidity, and rainfall in different growth stages of rice. The influence of weather parameters on population of bioagents were inferenced by correlation coefficient. Of the total observed population of most bioagent groups in all growth stages of rice under temperature maximum, temperature minimum, relative humidity, and rainfall, the correlation coefficients were - 0.602, - 0.581, - 0.490, and 0.768 for predators; - 0.459, - 0.436, - 0.337, and 0.649 for parasitoids respectively. The abundance of most bioagent groups, both predators and parasitoids were inferenced negative correlation with particular weather parameters, except rainfall was inferenced positive correlation. The correlation coefficients were inferenced non-significant between most bioagent groups and particular weather parameters in all growth stages of rice. The correlation coefficients between major bioagent species and particular weather parameters in all growth stages of rice were inferenced non-significant except between relative humidity and Field longjawed spider (*Tetragnatha maxillosa*) were inferenced significant correlation. The population of most of the major bioagent species were highly decreased with increasing temperature maximum, temperature minimum, and relative humidity and decreasing rainfall in seedling stage, and highly increased with moderately decreasing temperature maximum, temperature minimum, and relative humidity and increasing rainfall in transplanting stage, while moderately decreased with highly decreasing temperature maximum, temperature minimum, and relative humidity and increasing rainfall in flowering stage respectively.



IMPORTANCE OF BIOFERTILIZER IN AGRICULTURE

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Abstract

Smallholder farmers account for the majority of agricultural production in India, and they require the development of sustainable technology at affordable prices. Biofertilizers composed of free-living bacteria promote plant's growth, improve productivity through the strengthening of its roots, and reduce the amount of synthetic fertilizer applied to the crops. Numerous scientific studies assure the benefits of PGPR in the growth and yield of several crops, including: corn, rice, cucumber, wheat, sugar cane, oats, sunflower, flax, beet, tobacco, tea, coffee, coconut, potato, cypress, sudan grass, pepper, peanuts, alfalfa, tomato, sorghum, pine, black pepper, strawberries, soybeans, cotton, beans, lettuce, carrots, among others. The most important microorganisms that have been used in biofertilizer formulations are Rhizobium, Azotobacter, Azospirillum, Pseudomonas, Bacillus, and vesiculo-arbuscular mycorrhizae. The efficiency of the experimental biofertilizer was proved in multiple studies in the green house and field. In comparison to traditional farming techniques, the use of biofertilizer with 50% of the required chemical fertilization resulted in a 25-30% increase in yield and a 15-20% drop in the cost of production per kilogramme, according to the evaluations conducted on farmers' fields. Through the use of this technique, farmers may reduce the usage of synthetic fertilizers while increasing agricultural yields in a sustainable manner.

GOVERNMENT INITIATIVES TO DOUBLING THE FARMERS 'INCOME BY 2022

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Abstract

The Government has set a target of doubling of farmers' income by the year 2022 and constituted the DFI. There are seven sources of income growth namely, improvement in crop productivity; improvement in livestock productivity; resource use efficiency or savings in the cost of production; increase in the cropping intensity; diversification towards high value crops; improvement in real prices received by farmers; and shift from farm to non-farm occupations. Encouraging contract farming through the State Governments by promulgating of Model Contract Farming Act, Up-gradation of Gramin Haats to work as centers of aggregation and for direct purchase of agricultural commodities from the farmers, e-NAM to provide farmers an electronic online trading platform, Distribution of Soil health Cards to farmers so that the use of fertilizers can be rationalized, Increase water efficiency through Pradhan Mantri Krishi Sinchayee Yojana, Better insurance coverage to crops for risk mitigation under Pradhan Mantri Fasal Bima Yojana (PMFBY), providing total interest subvention up to 5 per cent (inclusive of 3 per cent prompt repayment incentive) on short-term crop loans up to R3 lakh, thus making loan available to farmers at a reduced rate of 4 per cent per annum and extended the facility of Kisan Credit Card (KCC) for animal husbandry and fisheries related activities as well as Interest Subvention facilities to such categories of farmers.

ISOLATION AND QUANTIFICATION OF *FUSARIUM FUJIKUROI* DNA IN DIFFERENT TISSUES OF BAKANAE RESISTANT AND SUSCEPTIBLE GENOTYPES OF RICE

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Abstract

The host pathogen interaction between the fungi and host plants depends upon the degree of resistance of the different plant genotypes against the pathogen. The pathogen *F. fujikuroi* which can move through vascular tissues will accumulate into different plant parts. The present study was done to find out how the pathogen transfers from seeds to different tissues in



resistant and susceptible genotypes. First the pathogen was isolated from five different tissues (roots, nodes, stem, leaves and panicle) of two resistant (PUSA 1342 and GP 50) and two susceptible (PB1121 and RASI) genotypes. Then to further confirm the presence of *F. fujikuroi* in different tissues the DNA of *F. fujikuroi* was quantified through qPCR using the species-specific primer NRPS31. The total DNA from the infected plant tissues was isolated using CTAB method and real time qPCR was performed. The DNA of F309 isolate of *F. fujikuroi* was used as standard in different known concentrations (100ng, 10ng, 1ng, 0.1ng and 0.01 ng per μ l). The Ct values of the F309 isolate were used to draw standard curve and the concentration of *F. fujikuroi* DNA was calculated using the standard curve. *F. fujikuroi* was isolated from all the tissues of the PB1121 genotype and in RASI it was isolated from every tissue except the leaves. In both the resistant genotypes the pathogen was isolated from roots only. The concentration and copy no. of *F. fujikuroi* DNA was found highest in roots of PB1121 (10.88 ng per 200 mg plant sample) and followed by roots of RASI (10.65ng), nodes of PB1121, stem of PB1121, stem of RASI and nodes of RASI. Very low copy number of *F. fujikuroi* was detected in panicle and leaves of susceptible genotypes. In resistant genotypes low copy numbers were detected in roots and nodes but in other tissues very negligible amount of *F. fujikuroi* DNA was detected. The study showed that the pathogen can move to different tissues from seeds but its concentration is more in lower tissues like roots, lower stem and nodes. The pathogen is not able to multiply and move freely in the resistant genotypes.

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Late Sau. Kesharbai Sonajirao
Kshirsagar (Kaku)
Ex-MP



'A' Grade



Hon'ble Secretary
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About the Conference Chairman



CONFERENCE CHAIRMAN

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 **21** years of experience in Research and Extension Education Works. **He authored many books** such as Plant Breeding, Agriculture at a Glance, Hand Book of Agriculture (Hindi), 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** (both Journals are NAAS recognized), **Secretary**, Society for Scientific Development in Agriculture & Technology and also **Chief Managing Director**, 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; CSAUAT, 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, CSAUAT, 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, CSAUAT, 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.

Glimpse of SSDAT & Astha Foundation's Conferences



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