PROCEEDINGS HANDBOOK

Evation

AGRI Vision 2021

International Conference on

Plant Science in Post Genomics Era

March 14-16, 2021 | Institute of Life Sciences, Bhubaneswar, Odisha, India

www.evationbusiness.com/agrivision-2021

Sponsors & Supporters

Acknowledgement

The financial assistance received from Research and Development Fund of National Bank for Agriculture and Rural Development (NABARD) towards publication of Book of Abstract is gratefully acknowledged

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Evation is indebted for your unconditional support & kind help. Thank You!

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AGRI Vision 2021

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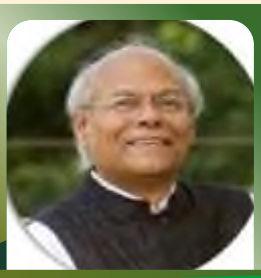

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DDG (Agricultural Education)
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Dr. Kuldeep Tripathi
Scientist, ICAR-NBPGR,
New Delhi

Dr. Raghunath Sathpathy
Asst.Professor,
Gangadhar Meher University, Odisha

ପ୍ରତାପ ଚନ୍ଦ୍ର ଷଡଙ୍ଗୀ
ପ୍ରତାପ ଚନ୍ଦ୍ର ଷଡଙ୍ଗୀ
Pratap Chandra Sarangi

राज्य मंत्री
सूक्ष्म, लघु और मध्यम उद्यम और
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MINISTER OF STATE FOR
MICRO, SMALL & MEDIUM ENTERPRISES AND
FISHERIES, ANIMAL HUSBANDRY & DAIRYING
GOVERNMENT OF INDIA
NEW DELHI-110011

Message

I am happy to know that the 'Evation Business Solutions' is hosting the Agri Vision- 2021 a International Conference on Agriculture, on the theme "Plant Genomics in Doubling Farmers' Income" during March 14-16, 2021 at the Institute of Life Sciences, Chandrasekharpur, Bhubaneswar, Odisha

Agricultural productivity assumes critical importance in augmenting farmers' income. The role of genomics in this direction is well acknowledged. I am sure, the agricultural scientists attending the conference will reflect on varied facets of plant genomics to find credible solutions facing the agricultural sector.

I wish the Agri Vision 2021 Conference all success.

(Pratap Chandra Sarangi)

रामेश्वर तेली
RAMESWAR TELI

खाद्य प्रसंस्करण उद्योग राज्य मंत्री
भारत सरकार
MINISTER OF STATE FOR
FOOD PROCESSING INDUSTRIES
GOVERNMENT OF INDIA

MESSAGE

It gives me immense pleasure to know that Evation Conferences is organizing Agri Vision 2021: An International Conference on Agriculture from 14 to 16 March, 2021 at Odisha. I am happy to note that that the event will discuss all the issues concerning the agriculture sector e.g. Agriculture, Horticulture, Livestock & Dairy, Poultry, Fisheries & Aquaculture & Agribusiness which are the key drivers of economic prosperity of our country.

I am sure that the event which will be attended by eminent national and international experts in various fields would be able to throw more light on the theme of the conference i.e "Plant Genomics in doubling farmer's income."

I convey my best wishes to the organisers, exhibitors, delegates and all those associated with Agri Vision 2021 and wish the event a great success.

Warm wishes

Yours sincerely

(Rameswar Teli)

कार्यालय : पंचशील भवन, अगस्त क्रांति मार्ग, नई दिल्ली-110 049
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Dr. P. K. Agrawal
VICE CHANCELLOR

ODISHA UNIVERSITY OF AGRICULTURE & TECHNOLOGY
BHUBANESWAR-751003, ODISHA

Dated the 12 March, 2021

MESSAGE

The advancement of technological options for analysis of plant genomics has helped immensely to modify the plant phenotype and physiological traits to obtain desired result. Plant genomics has played a vital role in the enhancement of yield and resistance against biotic and abiotic stresses. Many crop varieties developed using marker assisted selection and other genomic tools have been released in India. I am glad to know that Evation Business Solutions Pvt. Ltd. is organizing an International Conference on agriculture on the theme 'Plant Genomic in Doubling Farmer's Income'. The deliberations will be made by the scientists and other stakeholders during the conference to take experience of each other and find ways to use the genomics tools for their wider applications for crop improvement and other aspects of agriculture. This will also help in better livelihood, income and nutrition of the farmers of India and other developing nations.

I wish this endeavor all success.

12.3.21

(P. K. Agrawal)

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जीव विज्ञान संस्थान
INSTITUTE OF LIFE SCIENCES
(An Autonomous Institute of the Department of Biotechnology, Govt. of India)

डा. अजय परिड़ा, एफएनएएससी,एफएनएएएम
निदेशक
Dr. Ajay Parida, FNASc, FNAAS
Director

MESSAGE

I am pleased to know that Evation Business Solutions is hosting the Agri Vision-2021: International Conference on Agriculture during March 14-16, 2021 at Institute of Life Sciences, Bhubaneswar, Odisha with the theme of "Plant Genomics in doubling farmer's income".

Agriculture sector is the backbone of Indian economy. Increasing the income and empowering the farmers are vital for sustainable development of Indian agriculture. To achieve this various sources of farmers income i.e., improvement in productivity of crop, livestock and fisheries; improving resource use efficiency and diversification to high value crops and shift from farm to non-farm occupations need to be addressed. Researchers, policy makers, farmers and other stakeholders are required to work together to find a long-lasting solution for addressing farmer distress.

I wish Agri Vision 2021 a great success and I am confident that the deliberations will be useful for the stakeholders.

(Dr. Ajay Kumar Parida)

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ईपीएबिएक्स : २३००१३७, २३०१४६०, २३०१४७६, २३०१२१९
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भाकृअनुप-राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान
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समतुल्य विश्वविद्यालय/Deemed to be University
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Indian Council of Agricultural Research, Department of Agricultural Research & Education
कृषि एवं किसान कल्याण मंत्रालय, भारत सरकार
MINISTRY OF AGRICULTURE & FARMERS WELFARE, GOVERNMENT OF INDIA
मालेगाँव, बारामती, पुणे, महाराष्ट्र ४१३ ११५, भारत
Malegaon, Baramati, Pune, Maharashtra 413 115, India

भाकृअनुप ICAR

राअस्ट्रैप्रसं NIASM

Dr. H. Pathak
Director

MESSAGE

I am pleased to know that Evation Business Solutions is hosting the Agri Vision-2021: International Conference on Agriculture during March 14-16, 2021 at Institute of Life Sciences, Bhubaneswar, Odisha with the theme of "Plant Genomics in doubling farmer's income".

Agriculture sector is the backbone of Indian economy. Increasing the income and empowering the farmers are vital for sustainable development of Indian agriculture. To achieve that various sources of farmers income i.e., improvement in productivity of crop, livestock and fisheries; improving resource use efficiency and diversification to high value crops and shift from farm to non-farm occupations need to be addressed. Researchers, policy makers, farmers and other stakeholders need to work together to find a long-lasting solution.

I wish Agri Vision 2021 to be a success and the deliberations will be useful for the stakeholders.

Date: March 6, 2021

(Dr. H. Pathak)

Produce tuber reduce hunger

भाकृअनुप-केन्द्रीय कन्द फसल अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद)
श्रीकार्यम, तिरुवनन्तपुरम -६९५०१७, केरल,भारत
ICAR-CENTRAL TUBER CROPS RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
Sreekariyam, Thiruvananthapuram-695 017, Kerala, India

Message

Tropical root and tuber crops (TRTCs) including cassava, sweet potato, yams, elephant foot yam, taro and tannia and other minor tuber crops such as arrow root, yam bean, and Chinese potato occupy important niche in the food basket of Indian population. They are climate-smart crops and tolerant to adverse climate conditions such as drought, heat stress, low light. However, they have short shelf-life and are perishable. In India, they are cultivated in almost all states in 5 lakh hectares producing 5 million tones of tubers. Although, these crops occupy lesser area compared to other crops, they are food and livelihood security crops of food insecure population living in remote villages in hilly regions and coastal plains. TRTCs also can be good source of animal feed. In India, 60% crop area is under rainfed conditions. Also, 80% of farmers are small land holders and are vulnerable to climate change. So, this sector needs to be paid attention. TRTCs also have newly emerging pest and disease problems due to climate change which needs to be addressed. TRTCs can contribute for combating mal-nutrition in India through naturally biofortified varieties, particularly for women and children. Considering the sufficiency in food production in terms of cereals such as rice, wheat and maize, TRTCs have to find alternate means of utilization in terms of diversification in value added products and other industrial and pharmaceutical uses. Nevertheless, TRTCs have their own stand of diet preference by Indian population besides having a fairly reasonable consumer price in markets. The state of Odisha cultivates TRTCs such as sweet potato, taro, yam bean, elephant foot yam in considerable area and high yielding, biofortified TRTCs are being popularized under RKVY-RAFTAAR funded project by the Regional Centre of ICAR-Central Tuber Crops Research Institute in Bhubaneswar. However, constraints like marketing TRTCs, strategies for tackling the surplus production/ or block in marketing channels in situations like COVID-19 need to be addressed. A well organized FPOs and farmers Societies can aid in marketing TRTCs produced by farmers. Through organizing trainings, small scale entrepreneurs need to be educated about the TRTCs based value added products. This will enhance the export potential of TRTCs based value added products. Considering great demand for quality planting materials, there is great opportunity for increasing farmer's income in selling planting materials of TRTCs.

I hope the AGRIVISION will serve as a good platform for different stakeholders to share their ideas and gain insight into the recent advances in agriculture. The Director and the staff of ICAR-CTCRI wish the programme a grand success.

Dr. V. Ravi
Director
ICAR-CTCRI

भा.कृ.अनु.प – केन्द्रीय मीठाजल जीवपालन अनुसंधान संस्थान
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I.C.A.R. - Central Institute of Freshwater Aquaculture
(An ISO 9001:2015 Certified Institute)
Indian Council of Agricultural Research
Kausalyaganga, Bhubaneswar-751002, (Odisha), India

डॉ सरोज कुमार स्वाई
Dr. Saroj K. Swain
निदेशक (कार्यवाहक)
DIRECTOR (Acting)

Dated 9 March, 2021

MESSAGE

I am glad to note that the **Agri-Vision 2021: An International Conference on Plant Science in Post Genomics era** is being organized during 14-16 March, 2021 by the Evation Business Solution Pvt. Ltd., Cuttack. I am sure that the main objective of this conference which aims to gather information on innovative approaches of "Plant Genomics in Doubling Farmers Income" made by the stakeholders for the overall agricultural development and bringing new heights to its recent times.

I extend my best wishes for this important event which would certainly be a grand success.

(Saroj K. Swain)
Director

Phone: 0674 - 2465421, 2465446, 2465502 (O), Fax : 0674 – 2465407
E-mail:director.cifa@icar.gov.in/Saroj.Swain@icar.gov.in, Website:http://www.cifa.nic.in

पहचानें नारियल की खूबियों को

वित्तीय सहायता प्राप्त करें

नारियल आधारित उद्योग स्थापित करने के लिए नारियल प्रौद्योगिकी मिशन (टीएमओसी) के अधीन

नारियल आधारित इकाइयाँ स्थापित करने हेतु वित्तीय सहायता उद्यमियों के लिए परियोजना लागत का 25% अधिकतम 50 लाख रुपए तक और अनुसूचित जाति/अनुसूचित जनजाति की महिला उद्यमियों के लिए परियोजना लागत का 33.3% अधिकतम 50 लाख रुपए तक।

सभावी उद्यमी/गैर सरकारी संगठन/सहकारिताएं/किसान उत्पादक संगठन/ व्यक्तियों वित्तीय सहायता के हकदार हैं।

नारियल आधारित मूल्य वर्धित उत्पाद जैसे डेसिकेटेड नारियल पाउडर, फ्लेवर्ड नारियल दूध(तुरंत पीने योग्य), डाब पानी, नारियल दूध पाउडर, वर्जिन नारियल तेल, नारियल दूध, बीज, नारियल खोपरी आधारित पाउडर, एक्टिवेटेड और सक्रियित कार्बन आदि के लिए वित्तीय सहायता प्रदान की जाएगी।

नारियल विकास बोर्ड

For more details visit Board's website www.coconutboard.nic.in

Coconut Development Board

MINISTRY OF AGRICULTURE & FARMERS WELFARE

GOVERNMENT OF INDIA, KOCHI, KERALA, PH: 0484 2377266 67

Agenda

Day-1 March 14, 2021 — **Place: Auditorium**

09:00-10:00	**Registration**
10:00-10:05	Opening Ceremony, Candle Lightening & Opening Remarks
10:05-10:20	Welcome Speech **Padma Shri Dr. Ajay Kumar Parida** Director, Institute of Life Sciences, Bhubaneswar, India
10:20-10:50	**Plenary Session: Role of Trichoderma Diversity in Sustainable Agriculture** **Dr. Arup K Mukherjee** Principal Scientist, ICAR-NRRI, Cuttack, India
10:50-11:10	**Coffee Break & Networking** — **Ground Floor (Exhibition Area)**
	Keynote Speech:
11:10-11:35	**Title: Technology-led smart agriculture for sustainable development** **Dr. Himanshu Pathak** Director, ICAR-NIASM, Baramati, India
11:35-12:00	**Title: Tuber crops for food and nutrition** **Dr. M. Nedunchezhiyan** Head (I/C) Regional Centre of ICAR-CTCRI, Bhubaneswar, India
12:00-12:25	**Title: Sustainability of Tea in anticipated changed climatic situation** **Dr. Sauren Das** Associate Scientist, Indian Statistical Institute, Kolkata, India
12:25-12:50	**Title: Molecular breeding for development of high antioxidant rice with low glycemic load** **Dr. Narottam Dey** Asst. Professor, Visva-Bharati, Kolkata, India
12:50-12:55	**Q & A Session**
12:55-13:35	**Lunch & Networking** — **Ground Floor (Exhibition Area)**
13:35-14:00	**Title: Principles of Germplasm Characterization and Evaluation** **Dr. Kuldeep Tripathi** Scientist, ICAR-NBPGR, New Delhi, India
14:00-14:25	**Title: Assessment of variation in 300 rice (Oryza sativa L.) genotypes for yield and its attributing traits** **Dr. Dhirendra Kumar Singh** Banaras Hindu University, Varanasi, India
14:25-14:50	**Title: Conservation agriculture in cereal systems of India for sustainable production and higher resource-use efficiency under changing climate** **Dr. Tapas Kumar Das** Professor, ICAR-IARI, New Delhi, India
Oral Presentation	**Chair: Dr. Arup K Mukherjee & Dr. M. Nedunchezhiyan**
14:50-15:10	**Title: Sequence based markers for Darjeeling tea in pre- and post-genome era** **Dr. Anjan Hazra** Indian Statistical Institute, Kolkata, India
15:10-15:30	**Title: Environmental effect on global lentil collection (*Lens culinaris* Medikus subsp. *culinaris*) accessions in India** **Dr. Reena Mehra** Scientist, ICARDA - Food Legumes Research Platform, Amlaha, India

15:30-15:50	**Title: Exploring the biochemical variation in the germplasm of *Vigna stipulacea* (Lam.) Kuntz for enhancing quality traits** **Dr. Padmavati G Gore** Scientist, ICAR-NBPGR, New Delhi, India
15:50-16:00	**Q & A Session**
16:00-16:40	Coffee Break & Networking **Ground Floor (Exhibition Area)**
16:40-17:00	**Inauguration of Stall Exhibition, Inaugural Speech and Felicitation** **Shri. Pratap Chandra Sarangi** Hon'ble Union Minister of State, Ministry of MSME and AHD&F, Government of India as Chief Guest, AGRI VISION 2021
17:00-17:25	Felicitation & Valedictory ceremony: Day-1
17:25-17:30	**Closing Remarks & End of Day One**

Day-2 March 15, 2021 — **Place: Auditorium**

09:00-09:50	**Registration**
09:50-10:00	Opening Remarks, Session, Keynote Speech and Session Introduction
10:00-10:30	**Plenary Session: Genetic Resources Management and Conservation at National Genebank, ICAR-NBPGR** **Dr. Veena Gupta** Principal Scientist, Head, Dept of Germplasm Conservation, ICAR-NBPGR, New Delhi, India
10:30-10:55	**Special Session: NABARD** **Ms. Smita N. Badajena** AGM, NABARD (RO) Odisha, Bhubaneswar India
10:55-11:15	**Coffee Break & Networking** **Ground Floor (Exhibition Area)**
	Keynote Speech:
11:15-11:40	**Title: Way Forward with Genomics** **Dr. Pushpalatha G.** Head, Dept. of Biotechnology, Centurion University of Technology and Management, Parakhemundi, India
11:40-12:05	**Title: Overexpression of cytoplasmic C4 Flaveria bidentis carbonic anhydrase in C3 Arabidopsis thaliana increases photosynthetic potential and Biomass** **Prof. Baishnab C Tripathy** Professor, Jawaharlal Nehru University, New Delhi, India
12:05-12:30	**Title: Role of Molecular Breeding in Hybrid Rice** **Prof. Shravan Kumar Singh** Professor, Banaras Hindu University, Varanasi, India
12:30-12:55	**Title: SSR marker-based Polymorphism survey between a drought QTL donor and recipient for marker-assisted backcross breeding in Rice (*Oryza sativa* L.)** **Ms. Mounika Korada** Banaras Hindu University, Varanasi, India
12:55-13:20	**Title: Modern Breeding approaches and translating technologies for enhancing the rate of genetic gains** **Dr. Manish Roorkiwal** Sr. Scientist, ICRISAT, Hyderabad, India
13:20-14:00	**Lunch & Networking** **Ground Floor (Exhibition Area)**
14:00-14:25	**Title: Jellyfish as a human food and their fisheries: Odisha perspective** **Dr. Subal Kumar Roul** ICAR-Central Marine Fisheries Research Institute, Cochin, India
14:25-14:50	**Title: allelopathic effect of aqueous extract of *Ageratum conyzoides* L. ON Seed germination and seedling growth of Vigna radiate (L.) Wilczek (MUNG BEAN)** **Dr. Gyanranjan Mahalik** Centurion University of Technology and Management, Odisha, India

14:50-15:15	**Title: Integrated Farming system** **Dr. Samarendra Mahapatra** Professor & Head, Agribusiness Management, OUAT, Bhubaneswar, India
Oral Presentation	**Chair: Dr. Veena Gupta & Dr. Pushpalatha G.**
15:15-15:40	**Title: Seed biopriming with Trichoderma isolates improves plant growth and antioxidative defense system in rice** **Harekrushna Swain** Ph.D. Scholar, ICAR-National Rice Research Institute, Cuttack, India
15:40-16:00	**Coffee Break & Networking** **Ground Floor (Exhibition Area)**
16:00-16:20	**Title: Integrated farming system: A viable farming option for small and marginal farmers** **Kumar Sambhav Giri** S'O'A University, Bhubaneswar, India
16:20-16:40	**Poster Presentation**
P1	**Title: Evaluation of differential reaction of black gram germplasm to pulse beetle, *Callosobruchus maculatus* under artificial infestation conditions** **Sandip K. Panigrahi** ICAR-Indian Agricultural Research Institute, New Delhi, India
P2	**Title: Identification and efficiency study of novel *Azotobacter vinellandii* SINAz1 in rice plant under salinity stress** **Suchismita Prusty** CUTM, Bhubaneswar, India
P3	**Title: Isolation and molecular characterization of wild rice endophytes as biocontrol agent in effective management of rice diseases** **Rupalin Jena** ICAR-National Rice Research Institute, Cuttack, India
P4	**Title: Salt Stress Mediated Physiological Responsiveness in Rice Landraces** **S. R. Harish Chandar** Centurion University of Technology and Management, Paralakhemundi, India
P5	**Title: Salinity Stress Responsiveness of Rice Landraces** **Manogna G Salavurao** Centurion University of Technology and Management, Paralakhemundi, India
P6	**Title: Salinity Stress Responsiveness among Rice Landraces cultivated in Coastal Region of Odisha** **Mounika A** Centurion University of Technology and Management, Paralakhemundi, India
P7	**Title: Salinity Stress Physiological and Agronomical Responses in Rice Landraces** **Seri Subba Santosh** Centurion University of Technology and Management, Paralakhemundi, India
P8	**Title: Physiological and Agronomical Trait Salinity Stress Responsiveness of Rice Landraces** **Ponselvan A.** Centurion University of Technology and Management, Paralakhemundi, India
16:40-17:00	**Felicitation, Closing Remarks & End of Day- Two**

Day-3 March 16, 2021 — **Place: Auditorium**

09:00-09:50	**Registration**
09:50-10:00	Opening Remarks, Session, Keynote Speech and Session Introduction
10:00-10:30	**Title: TBA** **Dr. Bijoy Kumar Sahoo** Dean, Institute of Agricultural Sciences, S'O'A University, Bhubaneswar, India
10:30-10:55	**Title: Pea DNA helicase: Salinity stress tolerance gene for crop plants** **Dr. Ranjan Kumar Sahoo** Head, Dept. of Biotechnology, CUTM, Bhubaneswar, India

10:55-11:15	**Special Session on Kadaknath & Goat Farming** **Shri. Sudhansu Ranjan** Founder, The Farm Enterprise, Cuttack, India	
11:15-11:30	**Coffee Break & Networking**	**Ground Floor (Exhibition Area)**
11:30-11:55	**Title: Bio-fortification: An investment for improving Nutrition** **Dr Asna Urooj** Professor, University of Mysore, India	
11:55-12:15	**Title: Molecular Modelling Techniques in Plant Pathology Research** Dr. Raghunath Satpathy Assistant Professor, G.M. University, Sambalpur, India	
12:15-13:15	**Session-1:** **Panel Discussion & Special Sessions by Govt. stakeholders with Farmers**	
	Agencies: • **APEDA** • **NAFED** • **Coconut Development Board (CDB)** • **CTCRI** • **NRRI**	• **NBPGR** • **NMPB** • **CIFA** • **CMFRI** • **ICARDA**
13:15-14:00	**Lunch & Networking**	**Ground Floor (Exhibition Area)**
14:00-15:00	**Session-2:** **Panel Discussion & Special Sessions by Govt. stakeholders with Farmers**	
	Agencies: • **APEDA** • **NAFED** • **Coconut Development Board (CDB)** • **CTCRI** • **NRRI**	• **NBPGR** • **NMPB** • **CIFA** • **CMFRI** • **ICARDA**
15:00-15:20	**Coffee Break & Networking**	**Ground Floor (Exhibition Area)**
15:20-15:45	**Award Session (By: Padma Shri Dr. Ajay Kumar Parida)**	
15:45-16:00	**Closing Remarks & End of Day- Three**	

Virtual Sessions

AGRI Vision 2021

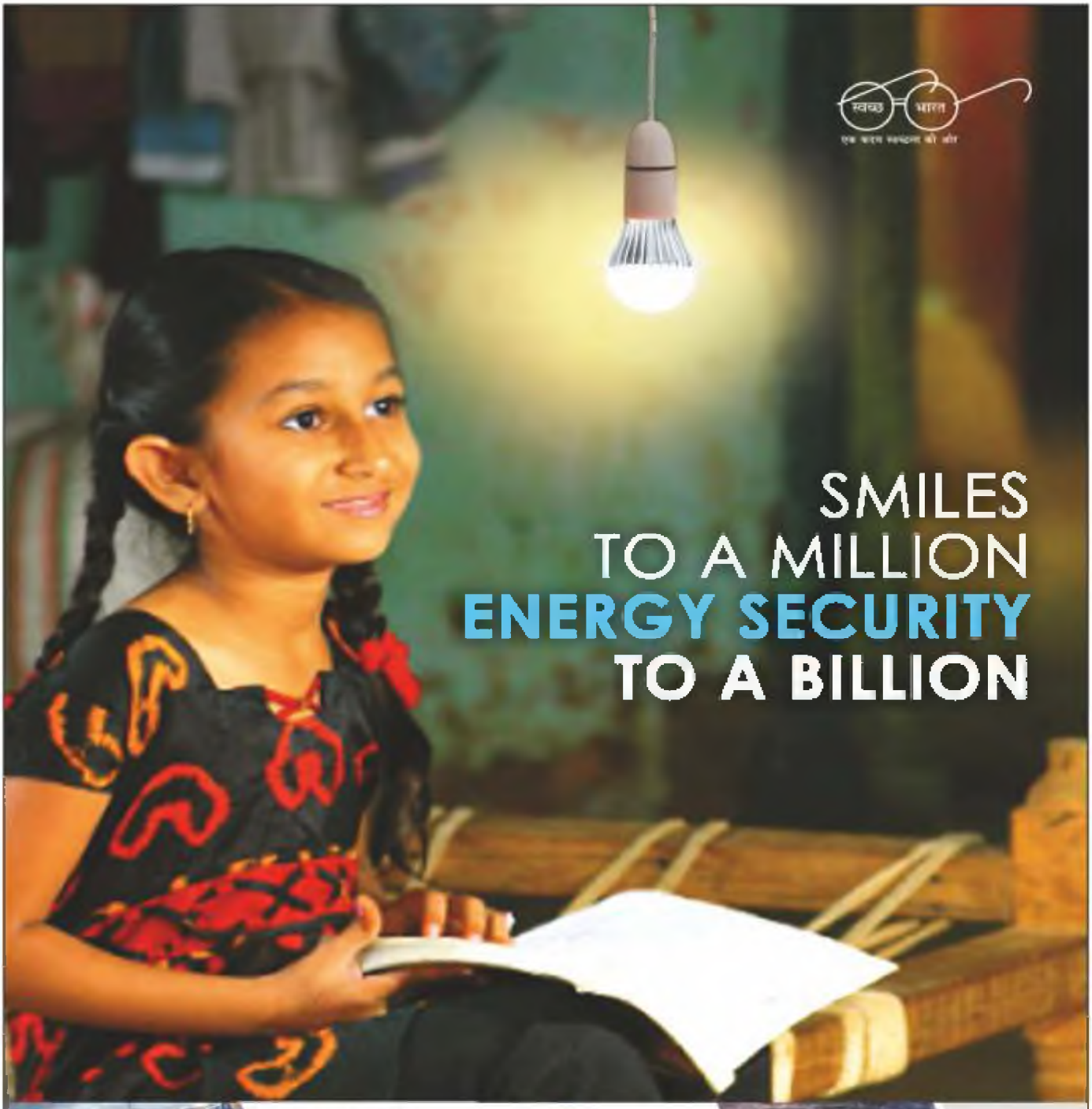
March 24-26, 2021 | ICAR-NRRI, Cuttack, Odisha

Keynote Speakers

Day -1

14 March

2021



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Role of Trichoderma Diversity in Sustainable Agriculture

Arup K Mukherjee[1]*, Harekrushna Swain[1], Totan Adak[1], Pratap Bhattacharyya[1], Pankajini Samal[1], Rupalin Jena[1], Soma Samanta[1], S. Lenka[1], and ST Mehtre[2].

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Arup K Mukherjee

Biography:

Dr. Arup K Mukherjee completed his B.Sc. and M.Sc. from the Visva Bharati University and joined ICAR-Central Rice Research Institute as SRF for his Ph.D. degree on "Components of Slow Blasting Resistance (SBR) in Rice". He studied in details about the different components of SBR and their interactions which have been published in many International and national journals of repute. As DBT-Post Doctoral Fellow in the National Research Centre on Plant Biotechnology, Indian Agriculture Research Institute, New Delhi he worked on "DNA Fingerprinting, Gene Tagging and Mapping of Economically Important Traits of Indian Mustard by Using Molecular Markers" and he published his research in 'Plant Breeding' and 'Journal of Plant Biochemistry and Biotechnology'. After successful completion of the DBT-PDF ship he joined as Scientist in Plant Biotechnology at the Regional Plant Resource Centre, Govt of Orissa and worked on "Genetic Diversity of Forest trees and Horticultural Crops of Orissa". His research activities as scientist has been published in many reputed international journals. In 2006 he was awarded with the Prestigious DBT-Overseas Associateship and worked as Visiting Scientist in the Department of Biology, Israel Institute of Technology, Technion, Haifa 32000, Israel, on "Common pathways to

Abstract :

The sustainable agriculture includes the use of all the agricultural products including the agricultural wastes in a beneficial way without any harm to the environment. In the present era when the demand of food is increasing with the increase of population the use of different chemicals like chemical pesticides, fertilizers, herbicides etc are increasing. These chemicals are not only poisoning the environment by polluting air, water, soil but also having ill effects to human and animal health. Overuse of ground water is another serious threat to the animal kingdom. So, it is obvious that if we don't take measure at this point, there is a threat of losing the human civilization. The huge microbial diversity will be of immense help to sustain the green revolution by decreasing the pesticide use, use of chemical fertiliser, conversion of agricultural wastes to agricultural resources.

We have isolated different Trichoderma spp. and tested them for sustainable crop production. One of our formulation 'Trichocash' is able to manage soil and seed borne pathogens of cotton and also promote its growth. While working for rice health management we have identified T. erinaceum and T. atroviride which protected rice, black gram, niger, small millet from different pathogens and

Biography Contd...:

leaf senescence and defence response: proteomic approach." His high standard work brought him two publications in Journal of Proteomics and BMC Plant Biology. In 2009 he joined ICAR-Central Institute for Cotton Research as Senior Scientist and worked on "Molecular Diagnostic of Cotton Diseases and their Management". In 2013 he was transferred to the ICR-Central Rice Research Institute and working on "Host-pathogen Interaction, Biocontrol, and marker Assisted Selection". He has published 107 research papers in International and National reputed journals which includes prestigious Phytopathology, Scientific Reports, Frontiers in Plant Sciences, Frontiers in Microbiology, Functional Plant Biology, European Journal of Plant Pathology, Plant Breeding, Euphytica, Physiological and Molecular Plant Pathology, Biological Control, Crop Protection, Journal of Proteomics, BMC Plant Biology, Industrial Crops and Products, Science of The Total Environment etc. He also published 52 research articles in journals of national repute. He is involved in release of 8 rice varieties. He has guided 10 Ph.D. and 15 M.Sc. students. He has authored 2 books and 27 book chapters. He has been invited to present his research activities in many international and national seminars/symposia. He has received many awards and member of editorial board of national and international journals.

enhanced yield even upto 20% without addition of any extra input. We also identified Trichoderma sp as natural decomposer of rice straw by virtue of producing higher straw degrading enzymes like total cellulase, endoglucanase, xylanase, and laccase. They also produced higher quantities of indole acetic acid, soluble phosphate and prussic acid which are responsible for plant growth promotion and the inhibition of rice pathogen populations. Higher expression of defense enzymes like catalase (both in shoot and root), peroxidase, superoxide dismutase, polyphenol oxidase, and total phenolics as compared to the control indicates stress tolerance ability.

We have also identified Trichoderma spp. which are able to induce drought tolerance thereby reducing extra irrigation.

Technology-led Smart Agriculture for Sustainable Development

Dr. Himanshu Pathak
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Dr. Himanshu Pathak

Abstract :
India has a 5000 years long history of agriculture. The country grows the largest number of crops in the world, making it most diverse food growing country. Indians also consume most diverse kinds of food in the world. It is the centre of origin of several crops with large biodiversity. Agriculture started to take its shape in ancient and medieval India. Cultivation practices of various crops, rearing of animals and irrigation and drainage systems were developed in Harappa and Mohenjo-Daro civilization. Agriculture revenue and farmers' welfare systems were introduced during the Gupta and Mughal periods. Spices of India had a special attraction since a long time, which attracted many western countries for trade and commerce. Silk, cotton, indigo dye, tea and opium were other important commodities for trade. Some of these traders also enlarged their influences and got control of some parts of the country. The East India Company, formed to trade in the Indian Ocean region, seized control of large parts of the India to enforce British rule for 190 years. Though several new initiatives were taken the British rule, the progress of Indian agriculture was rather slow and the country witnessed several famines including the Great Bengal Famine of 1943.

After independence Indian agriculture progressed tremendously and achieved the Green, White and Blue revolutions. The technological advancements of the Green Revolutions with dwarfing gene and high-yielding new plant types; White Revolution with new animal breeds, milk cooperatives, modern dairying systems, poultry, disease and diagnostics; and Blue Revolutions in marine and inland fisheries alongwith the good policy and extension systems contributed significantly in this phenomenal development. The technologies such as semi-dwarf, multi-stressed tolerant, bio-fortified high yielding varieties of crops; improved breeds of livestock, poultry and fish; and improved technologies for natural resource management including soil health card, neem-coated urea and micro-irrigation were adopted by the farmers in large scale. These successes brought self-sufficiency in food production and now the country has surplus of food for export.

However, Indian agriculture has to travel a long way to achieve the goals of improving income, equity and sustainability. Agriculture's primary focus so far, has been on production enhancement with more and efficient use of external inputs. The environment has been degraded in the process. It's services to society compromised, equity has been disturbed, and sustainability is in question. Now we need improve the profitability and sustainability with technology-smart, climate-proof, precision agriculture for sustainable development of the country. Climate change management, precision agriculture, sensor-based automated agri-food systems and food factories along with modern tool-kits for sustainable management of natural resources should be suitably utilized. We need smart plant, smart technology, smart product, smart market and smart farmers. Students, scientists policy makers and farmers need to be equipped with new skills and modern tools and technologies to make Indian agriculture more productive, profitable and sustainable.

Tuber crops for food and nutrition

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Dr. Maniyam Nedunchezhiyan

Biography:

Dr. Maniyam Nedunchezhiyan, Principal Scientist & Head (i/c), Regional Centre of ICAR-Central Tuber Crops Research Institute, Bhubaneswar – 751 019, Odisha, India is a renowned agronomist in root and tuber crops. He has completed B.Sc. (Ag) in 1986, M.Sc. (Ag) Agronomy in 1988 and Ph.D. (Agronomy) in 2001. He has 30 years experience in tropical root and tuber crops. He is specialized in root and tuber crops based farming and cropping systems, weed and drip fertigation management. He is also looking after production and distribution of quality planting materials of root and tuber crops. He has more than 200 research papers in International and National peer reviewed journals and more than 90 popular articles. He has authored 14 books, 30 book chapters, 7 technical bulletins and 6 training manuals. He has organized a 21 days winter school training programme for scientists and assistant professors and above cadres during 2008-09. He has also organized 8 days model training course on 'Root and tuber crops based integrated farming system: a way forward to address climate change and livelihood improvement' for development officers during 19-26 September 2016. He has organized en-number of on and off farm trainings to the farmers on tuber crops technologies for sustainable livelihoods and commercial cultivation. Last twenty years he is working in hilly areas for food and nutritional security of tribal farmers of Eastern and North-Eastern India through tuber crop technologies. He has co-ordinated the Global Conference on Aroids during 2011 and the National Seminar on Root and Tuber Crops during 2004. He has visited Thailand, LAO PDR, Philippines and China for presenting research papers. He has guided 4 Ph.D. students and 3 M.Sc. students. He is a life member of 7 scientific societies. He is a reviewer and referee of 7 scientific research journals including international journals.

Abstract :

India with 2.2 per cent of global geographical area supports more than 15 per cent of the total world population, 70 per cent of whom depend on agriculture. It also supports nearly 15 per cent of the total livestock population of the world. During 2050 A.D., 349 m. tones of food shall be needed for approximately 1667 million people. Tuber crops are the alternative for filling the deficit food production. The productivity of tuber crops is as high as 60 t/ha. The most important tuber crops are cassava, sweet potato, yams, aroids, yam bean arrowroot etc. Tuber crops are the main sources of energy and nutrients (fibre, calcium, iron and vitamins) and have health benefits such as antioxidative, hypoglycemic, hypocholesterolemic, antimicrobial, and immunomodulatory. A number of bioactive constituents such as phenolic compounds, saponins, bioactive proteins, glycoalkaloids, and phytic acids are rich in various tuber crops. The Regional Centre of ICAR-CTCRI, Bhubaneswar has released vitamin A rich sweet potato variety Bhu Sona (14 mg per 100 g fresh tuber) and anthocyanin rich sweet potato variety Bhu Krisha (95 mg per 100 g fresh tuber). Tuber crops supply up to 24% of the energy required. These underground treasures offer tremendous opportunity for entrepreneurial initiative, employment generation and income from wide range of value added products as food, feed, bio-fuel, pharmaceuticals, nutraceuticals and industrial starches, etc. They are able to grow in different agro-climatic conditions and fit very well with different cropping systems and home stead gardens for year round production and employment generation for social upliftment of economically weaker sections.

Sustainability of Tea in anticipated changed climatic situation

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Dr. Sauren Das

Abstract :

From tropical humid to temperate cold environment, tea plants endure a wide range of diverse climatic parameters. Climatic divergence has a great impact on the dense tea plantation which also serve as a natural exhauster by capturing and storing excess atmospheric CO_2 in their compact green coverage along mountain slopes and valleys. Tea is a popular and widely consumed beverage, hence some major secondary metabolites including polyphenols, amino acids and alkaloids collectively account for 35-50% of its dry weight which offer some unique taste, colour and flavour on infusion. Since time immemorial, those secondary metabolitesdeliberated as a potential source of extensive health benefit traits on consumption. Agroclimatology have definite regulatory impression oncharacteristic chemical components of tea plant as well. These biochemical phenotypes are extremely prone to environmental disparities and thus, the plantsare adapted to certain stress tolerance ability too.

The quality parameters of tea are essentially modulated by the eco-physiological responses of the plant. Leaf temperature and intercellular carbon concentration (Ci), which varies as a consequence of transpiration and net photosynthesis respectively, leading tosubstantialimpact on the biochemical traits of the leaves.Occurrence of H_2O_2, in leaves, being influenced by Ci, in turn, inclined to lipid peroxidation. With the increment of Ci, total phenolics, epicatechin gallate(ECG), reducing power, and radical scavenging activity is lowered but the amount of total catechin and non-gallylatedcatechin derivatives (e.g. epicatechin or EC, epigallocatechin or EGC) have amplified. Leaf temperatureis concomitantly associated ($p \leq 0.01$) with phenolics, flavonoids, proanthocyanidins, tannin content,reducing power, iron chelation and free radical scavenging activities. Increment of phenolic concentrationin leaf cells, conceivably inhibit photosynthesis and moreover, gallic acid, in turn conjugated tocatechin derivatives. In the course of adaptation, it is hypothesized that impacts of global climatic change might lead to offer tea cultivars having improved tea qualities than what at present. The natural variations in the eco-physiological response and corresponding multifaceted chemical phenotypes within the existing gene pool of some tea cultivars with contrasting characteristics have been studied. Observations conclude to the fundamental information regarding eco-physiological impact on the quality determining biochemical characteristics of tea, as well as factors responsible for their climate smart attributes.

Keywords

Climate change; Carbon assimilation; Eco-physiology; Secondary metabolites; Tea

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Molecular breeding for development of high antioxidant rice with low glycemic load

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Dr. Narottam Dey

Biography:

Dr Narottam Dey is working as Assistant Professor (Stage-III), Department of Biotechnology, Visva-Bharati , Kolkata, Indi. He has been Selected as visiting scientist by Indian National Science Academy (INSA) and visited Central Agricultural Research Institute, Hungarian Academy of Sciences, Matoonvasar (Hungary) in 2012.

Abstract :

Most of the indigenous rice lines possess variable amount of antioxidant which are beneficial for human health particularly protection against cancer and different cardiovascular diseases. But as regular preparation of rice needs two steps of boiling, majority of the available antioxidants lost before human consumption. So modification of regular practice for rice preparation may be one of the way by which the available amount of antioxidant can be increased. Keeping this objective, the softness nature for which perboiled soft rice don't require cooking during preparation was attempted to introgress in high antioxidant and improved genetic background. Khara, a drought tolerant rice commonly grown in upland field of South Bengal was selected as antioxidant rich lines with IR36 and Vogoliborah as improved and soft rice respectively. The parental lines and F1 plants were studied for all the valuable cooking and eating parameters including resistant starch contents and antioxidants. Glycemic load was measured in in vivo mice model. Expression profile of few valuable genes associated with antioxidant and starch synthesis regulatory pathway were also studied for their potentiality. The information generated in this study will enrich the scope for development of super hybrid rice from the point of nutritional quality and yield

Principles of Germplasm Characterization and Evaluation

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Kuldeep Tripathi

Biography:

Dr. Kuldeep obtained his Masters and PhD degree in Plant Genetic Resources from ICAR-IARI, New Delhi. He has been contributing in PGR research activities since last ten years including Post Graduate research. In his present capacity, he is working as Scientist, Division of Germplasm Evaluation, ICAR-NBPGR, New Delhi. While working at ICAR-NBPGR, He has developed and registered nine genetic stocks for agronomic, biotic and quality traits (6:lentil; 3:cowpea) and contributed in two varieties (Lentil :L4729: Extra early: Notified; Mungbean: Pusa1641: Summer season: Identified) for commercial cultivation. He initiated large scale characterization of minor pulses where he has identified trait specific sets for agronomic, quality and abiotic & biotic stresses including an Indian core collection in lentil. During large scale characterization and evaluation of pulse germplasm, he has developed promising genetic resources which are being evaluated by NARS partners for enhancing utilization of germplasm. Unique accessions such as atypical lentil and pubescent cowpea was first time reported globally. He has published >26 research papers in peer reviewed national and international journals (two with >10 NAAS rating). He has been awarded with Chancellors Gold Medal, Dr KL Mehra award of ISPGR, Rashtriya Krishak Smriti Pratibha Puraskar, ICAR-SRF Fellowship; INSPIRE Fellowship; Best poster award, Harlan Travel Grant for participating in Harlan III in France.

He conducted three exploration trips and collected valuable germplasm and reported a new distribution record of Vigna nipponensis, a closest wild relative to adzuki bean in India. He contributed in Descriptors for CWR conserved in situ developed by ITPGRFA. Presently, He is handling four externally funded projects (PI:1; Crop Coordinator:1; Co-PI:2) funded by ICARDA, DBT, UNEP-GEF and ICAR. I am a PG School faculty of ICAR-IARI for last four years and contributing in teaching of four PGR courses for award of MSc and PhD.

Abstract :

Plant Genetic Resources (PGR) refers to germplasm‖ or genetic diversity of actual or potential value that exists among individuals or group of individuals belonging to a species. The full spectrum of PGR consists of diverse type of collections such as those derived from the centres of diversity, centres of domestication and from breeding programmes. PGR broadly includes landraces, farmers'varieties, breeding material, genetic stocks, obsolete and modern varieties, wild and weedy relatives of cultivated plants, and potential domesticates such as wild species. Amongst the total number of species of higher plants which have been identified worldwide (250,000), PGR comprise 40% of these species, while the crop plants (cultivated as agricultural or horticultural species) cover only 2.8% of the species. Nevertheless, it is often stated that only 30 species "feed the world" providing more than 90% of calories or prote into human nutrition (FAO, 2010). Intensive modern breeding efforts in these staple food crops for higher yields have led to a narrowing of the gene pool by concentrating more on favorable alleles. Furthermore, the increasing genetic uniformity of crop varieties combined with climate change effects makes crops more vulnerable to various biotic and abiotic stresses. Characterization, evaluation and regeneration of germplasm are an integral component of Plant Genetic Resources management. Characterization and evaluation of germplasm is the key to accelerate utilization in crop improvement programme by exposing the actual value of germplasm. The characterization of germplasm deals with the understanding and recording of highly heritable characters which may be used in establishing taxonomic identity, while, the germplasm evaluation deals with assessing the agronomic potential of an accession including quality parameters and response to various abiotic and biotic stresses. Maintenance of germplasm without losing genetic integrity is also a prime objective in PGR management. PGR are therefore important for maintaining genetic diversity for and preventing such losses, which may have serious consequences for food, nutrition and environmental security.

Assessment of variation in 300 rice (Oryza sativa L.) genotypes for yield and its attributing traits

Dr. Dhirendra K. Singh*, S. K. Singh and Amrutlal Khaire
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**Email: dksinghgpb@gmail.com*

Dr. Dhirendra K. Singh

Biography:

Dr. Dhirendra is Serving as 'Project Scientist-II' under DBT funded Project entitled "Development of superior haplotype based near isogenic lines (Haplo-NILs) for enhanced genetic gain in rice" in Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, BHU. Served as 'Research Associate' under Harvestplus Project entitled "Develop High Zinc Rice for Eastern India" in the same institute from Sep, 2016 to October, 2020. Served as 'Senior Research Fellow' entitled "Identification of CMS based drought tolerant hybrid rice for eastern U.P. through participatory mode" from March, 2015 to Sep, 2016 and Engaged in teaching activities from September-2015 to June 2018. Served as 'Research Associate' for ICAR Niche Area project on "Molecular Breeding for Improvement of Major Crops of Eastern Indo-Gangetic plains" in Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, BHU, Varanasi from November, 2010 to March, 2014. He Published 51 research papers, wrote 03 review articles, 04 Souvenir Articles, 03 Books, 13 Book/Book Chapters, 08 Popular articles, and published 29 papers/abstracts presented in various seminars/ symposiums.

Abstract :

Worldwide rice (*Oryza sativa* L) is a crop of prime importance and is the major source of energy for more than half of the world's population. The success of any rice breeding program mainly depends upon the selection of the best genotype and its utilization as a parent. In this context, the present investigation was carried out with a set of 300 rice genotypes in an augmented design with 8 replicated checks (Swarna, BPT 5204, Sahababhgidhan, MTU1010, HUR 105, NDR 359, Swarna, IRRI123 and IR 64) at Agricultural research farm, Institute of Agricultural Sciences Banaras Hindu University, Varanasi, UP, India during *Kharif*-2020 for nine quantitative traits *viz.*, days to first flowering, days to 50 % flowering, plant height (cm), numbers of effective tillers per plant, panicle length (cm), 1000 grain weight (gm), plot yield (kg), biomass (kg), harvest index (%) and grain yield per hectare (kg). The data was recorded on ten randomly selected plants in each genotype while, days to first flowering, days to 50 % flowering, grain yield per plot and biomass were recorded on a plot basis. Statistical analysis was done using R-software (*Version 0. 1.2*) (Arvind *et al*., 2020) where a significant amount of variation was found for all traits included in the study.

The highest Phenotypic Coefficient of Variation (PCV) and Genotypic coefficient of variation (GCV) were recorded for grain yield per hectare, plot yield and harvest index. GCV ranged from 89.96% (for grain yield per hectare and plot yield) to 12.6% (panicle length). PCV of all the traits is higher than GCV representing some degree of environmental influence on the phenotypic expression of these characters. High estimates of heritability were observed for all traits understudy and ranged from 98.63 % (days to first flowering) to 63.63% (number of effective tillers per plant). Genetic advance as percent of mean (GAM) is high for harvest index, grain yield per hectare and plot yield. High heritability with high genetic advance as percent of mean was observed for harvest index (h^2=89.53, GAM=176.58), and plot yield and grain yield per hectare (h^2=80.38, GAM=160.84) indicating the presence of additive gene

action. Therefore, it helps in effective selection for the improvement of these characters in early generations. From the above study,s overall result indicates the presence of enough variability for the development of improved rice varieties.

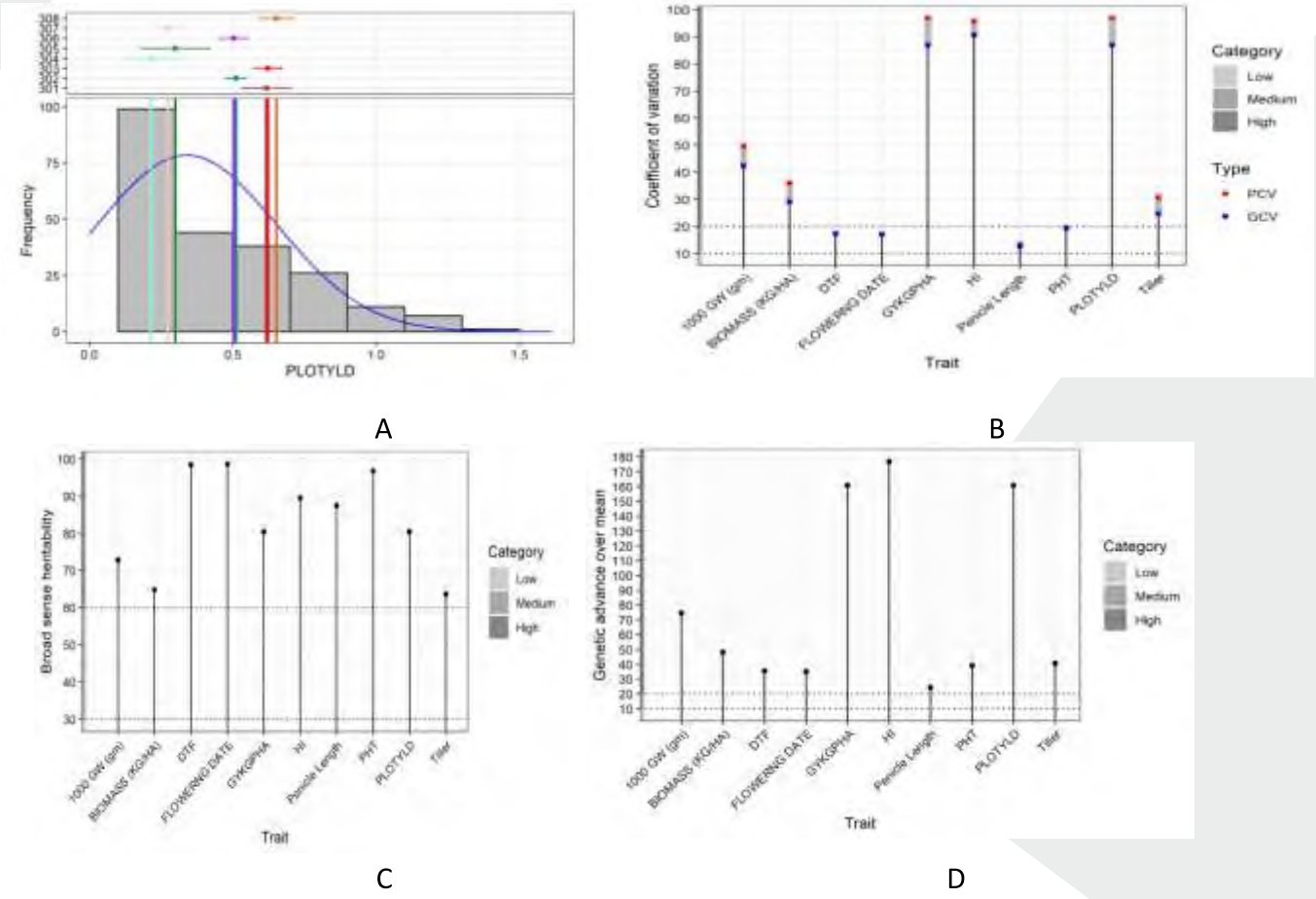

Fig A: Plot yield (kg); Fig B: Phenotypic and Genotypic Coefficient of Variability (%); Fig C: Broad Sense Heritability (%); Fig D: Genetic Advance Over Mean (%)

Conservation agriculture in cereal systems of India for sustainable production and higher resource-use efficiency under changing climate

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Dr. T. K. Das

Biography:

- **DR. T. K. DAS is Professor & Principal Scientist**, Division of Agronomy, ICAR-Indian Agricultural Research Institute (IARI), New Delhi, formerly Associate Professor, Alemaya University, Ethiopia (2001-2005); Scientist-Trainee, EICA, Egypt (2009); and Visiting Scientist, Iran (2012).
- Dr. Das has pursued novel pioneering research on weed management and conservation agriculture for last **30 years** in **18** inter-disciplinary institutional/ inter-institutional and **14** externally-funded research projects as **PI, CCPI, CCCo-PI, Co-PI or CI**. His extensive research came out as nearly **30** promising weed management- and conservation agriculture-inclusive technologies, concepts and products.
- Dr. Das to his credit has 348 publications including 80 international & 96 national research papers; 9 books/ manuals; 70 book chapters; 10 reviews; 25 reports; 11 scientific news; 18 extension pamphlets/folders; 2 bulletins; 1 e-publication; 26 popular articles.
- He taught **UG/PG students** of three countries, **India, Ethiopia and Afghanistan**; he has guided 57 students: 23 PG (Ph.D. & M.Sc.) students as Chairman; 8 PG students as Co-chairman and 26 PG students as Minor Member/Member.
- Among the students guided, 39 are Indian and **18 are foreign nationals from Ethiopia (6), Rwanda (1), Iran (3), Nigeria (2), Sudan (1), Nepal (1), Afghanistan (3) and Guyana (1).**

Abstract :

History repeats itself. Recently, conventional agricultural system has encountered a host of problems due to intensive tillage, clean cultivation (bare soil with no cover), mono-cropping or fixed crop rotation, imbalanced fertilizer use with little/no use of organics, and indiscriminate use of irrigation water and resources. This has led to decline in factor productivity (water, nutrient, energy, labour, pesticide); deterioration in soil (physical, chemical and biological) health; decline/stagnation in crop yield and farm income; higher surface run-off and erosion; global warming; higher biotic interference and declining biodiversity; secondary salinization and sodicity problems; susceptibility to climatic variability; and air and ground water pollution. Conservation agriculture (CA)-based system can provide higher productivity and profitability through rational and sustainable use of natural resources (soil, water, biological resources, etc) combined with man-made external inputs and reverses the declining trend. A perfect CA system has three interdisciplinary and inter-linked principles: minimum soil disturbance, permanent soil cover (crop residues on soil surface as cover/mulch), and diversified crop rotations with a legume (for cover crops, green manures, brown manures).

The most dominant transplanted puddled rice (TPR) - conventional till wheat (CTW) system has encountered a host of problems, relating to water, nutrients, labour, fuel/energy, and GHGs emission. Our experiments under long-term CA-based direct-seeded rice (DSR)-wheat system revealed that a triple zero-till (ZT) system with three crops (rice, wheat, mungbean) residue,

- Dr. Das wrote a **Text-cum-Reference Book on Weed Science,** which has been of immense use to UG/ PG students and weed scientists/agronomists. It is appreciated by the students in **India, Pakistan, Afghanistan, Iran, Iraq, Israel, Bangladesh (Asia); Ethiopia, Kenya, Nigeria, Sudan, Rwanda (Africa)** and **USA.**
- He has received several **Awards/Honours**: NAAS Fellow; IARI Hooker Award; IARI Best Teacher Award; ISA Gold Medal; ISWS Gold Medal; ISA Fellow; ISWS Fellow; SPPS Fellow; Outstanding Reviewer, ELSEVIER-Crop Protection, The Netherlands; PP Singhal Memorial Award, SPPS; Outstanding Scientist Award, SBSM, Kolkata; Letter of Appreciation, The Islamic Republic of Afghanistan; Meritorious Scientist Award, SPPS; AAAS Award, Indian Society for Plant Physiology; Best Book of Weed Science Award, ISWS, Hisar; Young Scientist Bursary (1997); Member, Review Committee, TIFAC, DST, GOI; Best Poster Award (4); Best Article Award (2); Honorary Membership of ABI, USA; Editor of five NAAS-rated Journals; Reviewer of 15 international and 19 national journals; Selection Committee Member for Assistant Professor/Senior Scientist of ICAR/ CSIR/SAUs.

which involved ZT DSR with summer mungbean residue (MR) - ZT wheat (ZTW) with rice residue (RR)– ZT summer mungbean (MB) with wheat residue (~MR+ZTDSR - RR+ZTW-WR+ZTMB) could be a superior alternative to conventional TPR-CTW system and an important adaptation strategy to climate change. Performing better consistently over the years, this system gave 33.5% higher system productivity than TPR-CTW system and led to a saving of 25% N in rice and wheat (~60 kg N/ha). Also, in a bid to more diversification of the TPR-CTW system in the IGP, crops substitutive to rice (i.e. similar with or more remunerative than rice) was studied under CA-based long-term cotton-wheat, maize-wheat and pigeon pea-wheat systems. It was found that all CA-based practices [i.e., ZT permanent broad bed (~ZTPBB), flat bed (ZTFB), narrow bed (ZTPNB) with residue] were superior to CT practice in terms of system productivity over the years. The ZTFB and ZTPBB with residue and 100% N resulted in 15% and 13% higher system productivity, respectively than CT system and a saving of 25% N (~67.5 kg N/ha) in cotton-wheat system. The ZTPBB with residue gave highest system water productivity (SWP), net energy gain and energy productivity under the cotton-wheat system and lowest was in ZT flat bed under the pigeon pea-wheat system. This CA-based cotton-wheat system can be a superior alternative to rice-wheat system and an important adaptation strategy to climate change.

These studies also revealed that the CA resulted in higher aggregate stability, higher aggregate size values and total organic carbon in soil aggregates than CT, and improvement in water distribution, NH_4^+-N, and NO_3^--N in the root zone of wheat. DSR resulted in relatively less compaction than transplanted rice. CA had higher total N (TN), organic fractions of TN and NH_4-N. CA-based system can moderate temperature and reduce terminal heat stress more than CT due to ZT helping timely sowing of wheat, and residue conserving moisture. Also leads to similar improvement in soil enzyme activities, glomalin and aggregate stability. The triple ZT+R system resulted in ~13% higher total soil organic C (SOC) in 0-5 cm soil, and an increase in total SOC stock by almost 396 kg/ha/yr over TPR-CTW. Macro-aggregate associated SOC was highest with the ZT flat bed with residue at 0-5 cm, while micro-aggregate-associated SOC (<53µm) was highest with the CT. The global warming potential was reduced by 34% upon shifting to DSR from TPR. The cotton-wheat system under PBB+R, pigeonpea-wheat system under PNB+R and maize-wheat system under ZTFB+R had highest C-sequestration potential at 0-30 cm soil depth. The CA systems had relatively lower weeds but encountered huge weed dynamics. Pre- and post-emergence herbicides with CA practices reduced weeds in DSR. Weed flora shifted to perennial *Cyperus rotundus* and *Cyperus esculentus* to a large extent. The triple ZT+R system (mungbean residue + DSR– rice residue + ZTW – wheat residue+ZT summer mungbean) brought about a significant reduction in weed interference.

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Sequence based markers for Darjeeling tea in pre- and post-genome era

Dr. Anjan Hazra*, Sauren Das
Indian Statistical Institute, Kolkata, India

Dr. Anjan Hazra

Biography:

I am working as a project linked personnel at Agricultural and Ecological Research Unit, Indian Statistical Institute, Kolkata. After my Masters in Botany in 2015, I have accomplished my Ph.D. degree from University of Kalyani in 2019. Alongside, I have qualified CSIR-UGC NET, ICAR NET, GATE, WBSET and now involved in plant based research programs including agricultural and evolutionary genomics, environmental adaptation and crop improvements etc. I have authored 16 research articles in various SCI/Scopus indexed journals of international repute and three book chapters. I also have received four awards for best oral presentations in various national/international conferences across the country.

Owing to its predominant refreshing value, tea is globally consumed as a potential health benefit beverage. These useful traits primarily rely on some regulatory networks of different metabolic pathways. In tea, the trait-specific markers are still insufficient, which could be used for marker-assisted breeding technique. Prior to the availability of whole genome sequences in tea, EST datasets in the public domain were employed for marker development exercise. MicroRNAs are endogenous, non-coding, short RNAs directly involved in regulating gene expressions at the post-transcriptional level. It has been found that differences in miRNA precursor gene sequences interfere with their structure formations and obstruct subsequent functions. Utilising EST datasets of tea, miRNA precursor sequences were predicted computationally. Subsequently, SSR motifs within the putative miRNA precursor genes have been identified followed by experimental validation in a set of Darjeeling tea cultivars. Simultaneously, diverse commercial accessions were undergone rigorous phenotyping during three plucking seasons to assess 20 chemotypic traits by high-throughput techniques. Six miRNA-SSR marker-generated bands consisted of the putative trait-associated loci. Newly developed microRNAs (mi408, miR5021a and miR2863) precursor-derived SSR markers, miSSR-03, miSSR-11 and miSSR-14, executed convincing results in distinguishing tea cultivars with contrasting health benefit traits. This is in accordance with the earlier reports where mi408, miR5021a and miR2863 have been found to be involved in cellular pathways conferring tolerance to oxidative stress.

Genotyping by sequencing and identification of functionally relevant nucleotide variations in crop accessions are the key steps to unravel genetic control of desirable traits. Following the availability of

chromosome scale genome sequence in tea, annotation of the trait related variants became easier. Here, elite cultivars of Darjeeling tea were undergone SNP genotyping by double-digest restriction site associated DNA sequencing method. The study resulted in a set of 54,206 high-quality SNP markers discovered from ~10.4 GB sequence data, encompassing 15 chromosomes of the reference tea genome. Genetic relatedness among the accessions conforms to the analyses of Bayesian clustering, UPGMA, and PCoA methods. High percent of heterozygous loci in the majority of the cultivars reflect their 'hybrid' ancestry as reported earlier. Genomic positions of the discovered SNPs and their putative effect on annotated genes designated a thoughtful understanding of their functional aspects in tea system biology. A group of 95 genes was identified to be affected by high impact variants, most of them are involved in signal transduction, biosynthesis of secondary metabolite, transcriptional and translational regulation. Genome-wide association analyses of 21 agronomic and biochemical phenotypes resulted in trait-linked polymorphic loci with strong confidence ($p < 0.05$ and 0.001). The selection of significant marker-trait associations with the Bonferroni correction threshold retained a set of 57 SNPs distributed across 14 chromosomes to be linked with eight phenotypic traits. High impact and trait-associated nucleotide polymorphisms perceived in this study can be exploited in worldwide germplasm of contrasting origin to depict their heritability and to unlock their potentiality in marker-assisted breeding.

Keywords

Darjeeling tea; ddRAD; marker trait association; miRNA-SSR; SNP; tea

Theme: Genetic resources & germplasm conservation: Strategies & future challanges

Environmental effect on global lentil collection (*Lens culinaris* Medikus subsp. *culinaris*) accessions in India

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Dr. Reena Mehra

Abstract :

Lentil (*Lens culinaris* Medikus subsp. *culinaris*) is predominantly grown in South and West Asia, North and East Africa among the developing countries for food, feed and sustainable cereal-based farming system. Lentil seed contains high amount protein, quality carbohydrate, vitamins, fiber, macro and micronutrient, thus provides support to human health. Lentil is grown in throughout the world under different photoperiod and temperature-regimes which influence phonological adaptation and trait expression.

A lentil diversity panel consisting of 324 accessions originated from (forty countries) was evaluated in augmented design during 2016-17/2017-18 crop season at the Food Legume Research Platform, Amlaha, Madhya Pradesh, India. The descriptive statistics for various traits with minimum to maximum range and mean values over year are; Days to Emergence: 5.71-7.10 mean of 6.51, Emerged plants:18.6-26.29 mean of 23, Days till 10% of plants have one open flower: 39.86-65.75 mean of 54.65, Days to 50% Flowering: 46-107 mean of 43, Nodes on Primary stem: 1-5,Days till 10% of plant have fully swollen pods: 81.98-97.93 mean of 92.36, Days till 10% plant have 1/2 Pods mature:, 91.11-108.35 mean of 102.16, Straw Biomass: 3.33-152.69 (g) mean of 31.06 (g),Total seed Mass- 68.07-496.38 (g), Total seed Count: 2-1039, Canopy Width: 10.53-11.39 (cm) mean of 10.99, Canopy Height: 14.01-25.49 (cm) mean of 19.00 (cm). Symptoms of viral and root disease were noted at various stages. Over the years among 324 some entries like; ILL 5888 (Bangladesh), ILL 7663(ICARDA), ILL 6002(USDA), ILL 7716(India), ILL 8009(Bangladesh), IPL 220(India), LIRL-22-46 (ICARDA), PI472569-LSP (Egypt), PI472561-LSP (India) exhibited excellent trait expression with respect to phenology and yield contributors and found promising to use in lentil breeding program in India.

Keywords: Lentil, Genetic Diversity, Adaptation.

Title: Exploring the biochemical variation in the germplasm of Vigna stipulacea (Lam.) Kuntz for enhancing quality traits

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Dr. Padmavati G Gore

Biography:

Dr. Padma obtained her Masters and PhD degree in Plant Genetic Resources from ICAR-IARI, New Delhi. She has been contributing in PGR research activities since last five years. In her present capacity, she is working as Scientist, Division of Germplasm Conservation, ICAR-NBPGR, New Delhi. While working at ICAR-NBPGR, she is looking after pulses and medinical germplasm as genebank curator. She is working on seed biology and conservation aspects of these crops. She has published >20 research papers in peer reviewed national and international journals. She has been awarded with Dr KL Mehra award of ISPGR, New Delhi and IARI Merit Gold Medal. She received Harlan Travel Grant for participating in Harlan III in France. She is a PG School faculty of ICAR-IARI for last four years and contributing in teaching of four PGR courses for award of MSc and PhD.

Abstract :

Pulses are major sources of carbohydrates and plant protein and other nutrients like phosphorus, vitamins, minerals, riboflavin and essential amino acids, commonly known as “poor man's meat”. The genus Vigna is one of the most important genera among all the pulse crops, containing more than 200 domesticated and wild species. Wild Vigna species possess a high potential for utilization as human food and fodder for animals. The nutritional composition plays a crucial role in food acceptability and food choices as it is directly linked to consumers' health and well-being. V. stipulacea is being utilized in southern part of India particularly in Tamil Nadu as livestock feed, manure production and making some traditional dishes like “Idli” and “Vada”. There are a very few reports available on the investigation of the biochemical constituents of V. stipulacea. Hence, in the present 94 accessions of V. stipulacea were analysed for 13 biochemical parameters, i.e., moisture, ash, protein, sugars, phenols, antioxidants, phytic acid, calcium, sodium, potassium, iron, zinc and copper. Significant variation was observed for all the parameters among accessions. Protein content was highest in the accession, IC553560 (24.32%). The maximum phenol content was recorded in the IC251435 (2.47%). Antioxidant was ranged from 0.16 % to 0.37 % with mean 0.24 %. The lowest phytic acid content was observed in IC550532 (1.27%) and IC251016 (1.29%). Food legumes have been known as vital sources of numerous minerals in Indian diets. Sodium content was ranged from 18.1 to 34.03 mg/100g. The highest calcium content was registered in accession IC256259 (150 mg/100g). Highest iron content was reported in IC261321 (13.07 mg/100g) followed by IC622861 (12.93 mg/100g) and IC 331456 (12.59 mg/100g). Similarly, zinc content was ranged from 1.93 to 8.19 mg/100g. Highest copper content was reported in accession IC552528 (1.40 mg/100g). A significant negative correlation was observed between protein and phenol. Sugar was highly positively correlated with phytic acid and sodium and negatively with calcium. Phenol was highly positively correlated with antioxidant and phytic acid and negatively with sodium. Within minerals, sodium washighly positively correlated with iron. Zinc was highly positively correlated with iron and copper. Principal component analysis (PCA) was used to analyse the diversity level among all accessions by considering all variables concurrently. The first five components have eigenvalue >1.0 which explained 62.82 %of the total variation among accessions.

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Genetic Resources Management and Conservation at National Genebank, ICAR-NBPGR

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Dr. Veena Gupta

Biography:

Dr. Veena Gupta, an alumni of Delhi University, in presently heading the world's second largest genebank at ICAR-NBPGR, New Delhi. Since last 34 years, she has actively contributed in the area of Plant Genetic Resources Management and Conservation. She had published more than 80 research papers and four books/manuals in her area of expertise and has been endowed with many awards and fellows of the leading scientific societies of India. She had visited various Laboratories in United State of America engaged in the conservation and management of plant genetic resources. Her skills in the area of Intellectual Property Rights governing regulation were developed at Swedish International Development Co-operation Agency, Uppsala Sweden and subsequently at Agricultural Research Council of South Africa, Pretoria and National Institute of Agricultural Biology, Cambridge, U.K.

She has been also entrusted with teaching responsivity of plant genetic resources as Professor, PGR under Post Graduate School of Indian Agricultural Research Institute leading to masters and doctoral degree. Under her guidance, two M.Sc and four Ph.D. students have been awarded degree and three students are continuing their Doctoral research. As a partner in NAHEP-CAAST programme at PG School, IARI, she had visited the Millennium Seed Genebank and Royal Botanical Gardens, Kew, UK with PGR students.

Her life long contributions in the field of Plant Genetic Resources, are well recognized as she is presently at the panel of Central Council of Research in Ayurvedic Sciences, Ministry of Ayush, Indian Council of Forestry Research and Education, Dehradun, Indian Industrial Hemp Association and National DD Kisan Channel as subject matter expert.

Abstract :

The National Bureau of Plant Genetic Resources (ICAR-NBPGR) under the aegis of Indian Council of Agricultural Research (ICAR), has been entrusted to act as a nodal institute at the national level for acquisition and management of indigenous and exotic plant genetic resources (PGR) for agriculture, and to carry out related research and human resources development for sustainable growth of agriculture. The Bureau also acts as a single window system for exchange of germplasm with the authority to issue Import Permit and Phytosanitary Certificate and to conduct quarantine examination in seed material and vegetative propagules (including transgenic material) introduced from abroad or exported for research purposes. At present the mandate includes management and promote sustainable use of plant genetic and genomic resources of agri-horticultural crops capacity building in PGR management and policy issues related to PGR utilization of their use and molecular profiling of release varieties and GM detection technology research. All these activities are carried by five different divisions viz. Divisions of Plant Exploration and Germplasm Collection, Germplasm Evaluation, Germplasm Conservation, Genomic Resources and Plant Quarantine.

ICAR-NBPGR has the network of 10 Regional Stations covering different agro-climatic zones to carry out PGR activities including collection, characterization, evaluation and maintenance of various crops.

Genetic resources can be conserved in the form of seeds, vegetative propagules, tissue/ cell cultures, embryos, gametes. India has taken a lead in this direction, by establishing a National Genebank (NGB) for conservation of PGR, almost 25 years ago. The NGB has been playing a silent but very important role in contributing towards the vibrancy, resilience and growth of India's crop production, productivity and diversification, besides offering safe conservation to the rapidly disappearing diversity of PGR. The National Genebank facility comprised a seed genebank, Invitro genebank and a cryo-bank to conserve the whole gamete of biodiversity. The seed genebank has 12 long term storage modules, each maintained at -20 o C temperature, is the second largest genebank in the world. The Seed Genebank is complimented by the Cryo-genebank (9 major cryo-vaults) and In Vitro Genebank (6 culture rooms) to carry out conservation of those plants that do not produce seeds or whose seeds are difficult to store in seed genebanks. The Cryogenebank at NGB is one of the largest in Asia, and its In Vitro Genebank is the largest multicrop collection in the world (>150 species). At present NGB holds a total of 448738 accessions in Seed Genebank, 1903 accessions in in vitro genebank, 11855 accessions in cryo-genebank and 2194 samples as genomic resources. Bureau not only conserves PGR safely to meet the needs of future generations, but also provides these to the nation's crop improvement programmes to sustain continued advances in agricultural productivity and stabilize production. The Bureau has strong network of national plant genetic resources system by linking up the National Base Collection (kept under long-term storage at ICAR-NBPGR with National Active Germplasm Sites (NAGS) responsible for different crops where germplasm collections are evaluated and multiplied under field conditions and shared for various crop improvement programmes.

Way Forward with Genomics

Dr. Pushpalatha G.,
Centurion University of Technology and Management, Parakhemundi, India

Dr. Pushpalatha Ganesh

Biography:

Possesses 11 years of research and teaching experience in Agricultural Biotechnology and Crop Physiology at several national level organizations including DRR, Hyderabad and NRCPB, IARI, New Delhi, India. She has been felicitated with many publications and awards. At present, she is working as the Professor & Head in the Department of Plant Biotechnology, M. S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Odisha, India. She has received IASc-INSA-NASI Summer Research Fellowship for Teachers during 2018. She was an invited Visiting Faculty at Graduate School of Agriculture, Kyoto University, Kyoto, Japan. She has been felicitated with 'Scientist Associate Award' by Society for Scientific Development in Agriculture and Technology (SSDAT) at National Conference organised by ECOBASM – 2014 at Directorate ofRice Research, Hyderabad, India. She was also an Invited Young Scientist by IRRI-PHILIPPINES to present a part of the doctoral research work at 4th International Rice Congress (IRC2014) at Bangkok, Thailand

Abstract :

Despite a big data availability in plants, the attempts made and achieved in producing disease/stress tolerant and high-yielding crops is not absolute. The complexity is all due to the information about genome function, related gene regulation, the DNA sequence or genes that is bound with proteins within specific chromosomes and within the nucleus. Our work is in to the allele mining of such hidden candidate genes in the genome that regulate the functions in normal conditions as well as stress conditions.

The multidisciplinary approach of genomics using genetic, genomic and various functional genomics, in plant models, to understand genome spatial organisation and how it contributes to gene regulation is the major objective of the work. Present research work is the use of different mining concepts particularly for abiotic stress tolerance like salinity, drought and heat in rice.

The spatial organisation of plant chromosomes and the alleles associated with the complex mechanism of ion homeostasis, cellular level tolerance, translocation of assimilates and its involvement in abiotic stress tolerance, etc., are been studied in rice. The recent approaches like priming, genome-wide association and identification of genes specific for superior traits, etc., are been studied. Hence, the approaches to improve various crops using the technologies beyond genomics is preferred, inculcated in the research, improve crops for stress tolerance and yield so as to reach the farmers.

Overexpression of cytoplasmic C4 Flaveria bidentis carbonic anhydrase in C3 Arabidopsis thaliana increases photosynthetic potential and Biomass

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Prof. Baishnab C Tripathy

Abstract :

One of the important ways to improve photosynthetic capacity in C_3 crops, such as rice and wheat, is to transfer efficient C_4 characters to them. Here, cytosolic carbonic anhydrase (*βCA3*) of the C_4 *Flaveria bidentis* (*Fb*), having low Km for CO_2, was overexpressed under the control of 35S promoter in *Arabidopsis thaliana*, a C_3 plant, to enhance its photosynthetic efficiency. Overexpression of *CA* resulted in higher [HCO_3^-] in the cytosol of the overexpressors, and increased endogenous phosphoenolpyruvate carboxylase activity generating oxaloacetate that feeds into the tricarboxylic acid cycle. This provided more carbon skeleton for increased synthesis of amino acids and proteins. Further, transgenic expression of *FbβCA3* in Arabidopsis led to pleiotropic expression of several genes/proteins involved in chlorophyll biosynthesis and photosynthesis leading to higher chlorophyll content and photosynthetic capacity in the transformants. Due to the presence of higher CO_2 in the chloroplast, pleiotropic effect overexpressors had enhanced CO_2 assimilation, starch content, and plant dry weight. In addition, transgenic plants had lower stomatal conductance, reduced transpiration rate and higher water use efficiency. These results, taken together, show that expression of C_4 *CA* in the cytosol of a C_3 plant can indeed improve its photosynthetic capacity with enhanced water use efficiency.

Role of Molecular Breeding in Hybrid Rice

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Prof. Shravan Kumar Singh

Abstract :

Rice is a major source of livelihood for more than 250 million households, mainly of South and Southeast Asia where more than 90 per cent rice is produced and consumed. Worldwide, rice is grown in 162.76 million ha area with production of 495.86 million tonnes and productivity of 30.46 q ha^{-1}. In India it is grown on 44 million ha of land with production of about 111.00 million tonnes and productivity of about 25.22 q ha^{-1}(Foreign Agricultural Service/USDA/Office of Global Analysis, 2018-19). The dramatic increase in population coupled with climate change, reduced agricultural land, water and more environmental pollution pose a big challenge for food security in the country and in the world as well.

The global rice demand is estimated to rise from 495.86 mt in 2018-19 to 555 mt milled rice in 2035. India's rice demand is estimated to rise from 111.0 mt in 2018-19 to 156 mt in 2030. As such, increasing rice production is critical to sustain and improve people's livelihood, national economy, and even national food security. Hybrid rice (*Oryza sativa* L.) has provided a fundamental guarantee for food supply all over the world (Cheng *et al*. 2007). The commercial hybrids in rice is estimated to outperform conventional inbred rice by >20% in grain yield. In China, it has contributed 65% of the total rice production accounting for 57% of the total rice planting area (Yuan, 2014). But, the hybrid rice area in India is around 3.0 mha, which is 6.8% of the total rice cultivated area. This is only because of non-availability of good quality hybrids meeting the acceptance of the Indian consumers. Due to the quantitative nature of yield attributing traits, many genetic mechanisms are regulating the heterosis; therefore, it is probable that no single genetic mechanism can adequately explain all aspects of the heterosis phenomenon (Birchler*et al*., 2010). Molecular breeding with the help of Marker-Assisted Selection (MAS), used to infer phenotypic or genotypic data for breeding material have great potential to improve the efficiency and precision of conventional Plant Breeding. It will ultimately lead to accelerate the release of new crop varieties. The potential advantages of Molecular Breeding demonstrated by numerous examples of MAS in rice (e.g- Improved Pusa Basmati with *xa13*,

Xa21, Improved Sambha Mahsuri with *xa5*, *xa13*, *Xa21*, Swarna-Sub1 with Submergence tolerance, Swarna-Sub1+Drought with $qDTY_{1.1}$, $qDTY_{2.1}qDTY_{3.1}$) and in other crops for identification and introgression of major genes and QTLs for biotic and abiotic stresses and quality traits. In the past twenty years, genetic mapping of the loci controlling heterosis in rice using molecular markers has been performed. The accuracy of early genetic mapping suffered from the use of low-density markers. So population based mapping approaches like Genome-wide association study (GWAS), genome sequencing using high-density genetic markers has been widely used to dissect the genetic mechanisms underlying quantitative traits in crop species (Huang and Han, 2014). In rice, GWAS has proven to be a useful tool for identifying important genes related to agronomic traits. These studies indicate that genetic mapping in a multi-parental population using high-density markers could be utilized to discover the genetic basis of heterosis. Molecular breeding also helps in transferring the desirable traits lacking in parental lines of best heterotic hybrids. For example if a particular cross has given outstanding heterotic performance but it is may not be commercialized due to non availability of proper hybrid seed production method due to higher plant height of the male sterile line than its pollen parent. In such situation the molecular assisted back cross breeding (MABB) approach will be helpful to address such problems. Similarly, if we wish to improve some characteristics of the hybrids then we have to improve the parental lines of the hybrids through MABB , whether for the resistance to biotic and abiotic stresses or for developing good cocking and biofortified hybrids. Availability of molecular markers for fertility restorer genes, the molecular approach is also helping to search the restorer lines in rice for developing high yielding hybrids.

Hence, to meet the challenges of food security, hybrids rice technology is one of the most promising technologies and the molecular technique is one of the most useful helping tools to develop better hybrids in rice which may cater the need of the farming community and the Indian consumers as well..

SSR marker based Polymorphism survey between a drought QTL donor and recipient for marker-assisted backcross breeding in Rice (Oryza sativa L.)

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Mounika Korada

Biography:

Bhandari, A., Jayaswal, P., Yadav, N., Singh, R., Singh, Y., Singh, B., ... & Singh, N. (2019). Genomics- assisted backcross breeding for infusing climate resilience in high-yielding green revolution varieties of rice. Indian J. Genet., 79(1) Suppl. 160-170. DOI: 10.31742/IJGPB.79S.1.5
Gramene marker database available at https://www.gramene.org/.
Sanjeeva Rao, D., Neeraja, C. N., Madhu Babu, P., Nirmala, B., Suman, K., Rao, L. V., ... & Voleti, S. R. (2020). Zinc biofortified rice varieties: challenges, possibilities, and progress in India. Frontiers in nutrition, 7:26. doi.org/10.3389/fnut.2020.00026.

Research Interest: *Plant breeding, Molecular breeding, biotic and abiotic stress breeding in rice and Genomics*

Abstract :

Rice (*Oryza sativa* L.) is an important cereal and is consumed by more than half of the world's population (Rao *et al*., 2020) and the staple food of India. With the growing population and rising standards of living, the demand for rice is expected to increase further, but global warming has shown high temperatures and erratic rainfall patterns causing unpredictable drought, flooding and salinity stresses that are adversely affecting rice production in more than fifty percent of the rice cultivated areas (Bhandari *et al*., 2019). Among the abiotic stresses, drought occupies the first place causing major yield losses in rice. Selection for yield under drought stress either by conventional or molecular breeding strategies would help in the development of drought-tolerant varieties and in this context, marker-assisted backcross breeding is a technique to convert an otherwise well adapted and high yielding but drought susceptible variety into drought-tolerant variety with its different levels of selection using molecular markers. With this background information, In this experiment, a set of 438 Simple Sequence Repeat (SSR) markers (Table), equally distributed on all the 12 chromosomes of rice were selected from gramene marker database (http:/www./gramene.org/) and used to study parental polymorphism, which is a pre-requisite for marker-assisted backcross breeding. HUBR 2-1, a drought susceptible variety, and CR dhan 801 a drought donor with 3 QTLs-$qDTY_{1.1}$, $qDTY_{2.1}$, and $qDTY_{3.1}$ were used as parents in this study. Out of the 438 SSRs used for screening, 109 markers were found polymorphic between the two parents indicating a total polymorphism of 24.88%. At the chromosome level, the highest polymorphism was seen for chromosome 1 followed by chromosome 3, and the lowest polymorphism was recorded for chromosome 12. This set of genome-wide polymorphic markers (SSRs) will be used during the background selection for the recovery of the recurrent parent genome.

Keywords : *Drought, Polymorphism, QTL, Rice, Simple Sequence Repeats.*

Modern Breeding approaches and translating technologies for enhancing the rate of genetic gains

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Dr. Manish Roorkiwal

Biography:

Dr Manish Roorkiwal is Senior Scientist (Genomics and Molecular Breeding) at International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) based in Hyderabad, India. He is also associated with Institute of Agriculture, University of Western Australia as Adjunct Associate Professor. With a basic background in molecular genetics and applied genomics, Manish has over 15 years of research experience. At the core of his work is the improvement of crop productivity of legumes in marginal environments using modern genetics and breeding approaches, including genomic selection and GWAS. Manish has strong interest in the area of modern breeding approaches such as genomic selection and next generation sequencing-based re-sequencing and low-cost genotyping for enhancing the use of markers in routine breeding. He is known for leading the efforts in developing cost-effective genotyping platform enabling use of markers in routine breeding program.

Expertise: *Genomics, forward breeding, next generation sequencing, modern breeding approaches such as genomic selection and Marker Assisted Backcrossing*

Abstract :

Chickpea (*Cicer arietinum*) is one of the most important food legume globally, which plays a key role in ensuring the nutritional food security. Enhancing drought tolerance in chickpea is crucial for improving its productivity in the context of changing climatic scenarios. Conventional breeding approaches have been effective but could not elevate the yield levels and enhance productivity as required. In order to provide nutritional food security, it is essential to develop the superior chickpea varieties with improved yield that can sustain these stresses under expected climate change scenario. Major hurdle in developing the improved variety is low level of genetic diversity present in the cultivated chickpea gene pools. There is need to tap the potential of germplasm wealth stored in global gene banks for identification of novel alleles related to genetic variations, single base mutations, insertions and deletions. Next generation sequencing technology (NGS) has potential to develop improved varieties by identification of superior alleles. NGS technologies were extensively used at ICRISAT to undertake whole genome re-sequencing (WGRS). These WGRS data along with extensive phenotyping data were used to identify candidate gene(s)/ superior haplotypes that can directly be deployed in chickpea breeding for developing improved chickpea lines. In parallel, modern breeding approaches including genomic selection are being actively used in chickpea breeding to accelerate the rate of genetic gains. In addition, epigenetics based approaches are also being used to understand the mechanism involved in drought tolerance in chickpea. Some recent examples of chickpea improvement using integrated genomics approach will be presented in the meeting.

Jellyfish as a human food and their fisheries: Odisha Perspective

***Dr. Subal Kumar Roul, Pralaya Ranjan Behera, Rajesh Kumar Pradhan, Raju Saravanan, Shubhadeep Ghosh and Prathibha Rohit**

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Dr. Subal Kumar Roul

Abstract :

Some species of jellyfish are considered to be a delicacy in many South East Asian countries. Jellyfish are said to have beneficial medicinal properties but lack randomized clinical trials. Some species of jellyfish belong to the order Rhizostomeae and class Scyphozoa are considered to be suitable for human food, and about 38 species have reportedly been consumed by humans around the world. In India only four species of jellyfish are actively contributing to the fisheries and processed products are exported mostly to South East Asian countries. A study was undertaken to document the edible jellyfish fisheries and its utility as human food along the coast of Odisha during 2020-2021.The present study confirmed that more than 10 species of jellyfish are found along the Odisha coast. These jellyfish are caught by shore seines and gillnets as by catch. However only one rhizostomatids jellyfish species, *Crambionella annadalei* forms a targeted fishery along the coast. The fishing season was from December to March. The species are caught in gillnets operated from both motorised and non-motorised fishing crafts at a water depth of 5-12 m during day time.The gillnet are set in water for 1-2 h and usually 2-3 hauls per boat are performed based on the availability of jellyfish in water. Each boat brought nearly 20-500 kg of oral arms per fishing trip. Fishermen usually cut off the umbrellas on-board and discarded in the sea and only the oral arms are transported to the shore. The fishers sold the oral arms to the local traders @ Rs. 15-22 ($0.21-$0.30) per kg at landing centres. Altogether three temporary jellyfish processing units are operational along Odisha coast. Oral arms of jellyfish are processed into a semi-dried product through a stepwise procedure of soaking in various mixtures of salts and alum. Oral-arms are first cleaned in a circular tank containing sea water with a rotor for churning the water for 2 h to remove the dirt, sand, mucus, membranes, and gonads. The oral arms were then removed from the cleaning tank and rinsed with the clean sea water before transferring to the soaking tank. In soaking tank, common salt @ 50 kg/t and alum 2 kg/t of oral arms are added in to the 300 L of sea water (25 ppt) and kept for 12 h. This process is called as salt mixing which helps in penetration of the salt into the tissues, allowing osmosis and dehydration, and thus minimizing the spoilage. This process is followed by a second soaking (in salt and alum water), wherein it is kept soaked for 12-18 days prior to packing. The semi-dried oral arms are graded into different export categories depending on the size of oral arms before packing and are packed in 20 L buckets with each containing 16 kg oral arms, 3 L salt water and 1 kg common salt. Processed oral arms of jellyfish are exported to China via Chennai @ Rs. 500-550 ($6.88-$7.57) per kg oral arm as it has a very good demand in South East Asian countries. No market has yet been developed for edible jellyfish in India. In order to improve the jellyfish business in the country, creating awareness among consumers on positive health aspects of consuming edible jellyfish and establishing safe and quick processing amenities, both for ensuring stable and good quality of the final product and for exporting edible jellyfish to foreign markets. Therefore, prospects for escalating jellyfish food uses in India will depend on the development of new processing technologies and on market demand, which in turn will depend on the increased knowledge of jellyfish as food and from its public awareness, respectively.

Allelopathic effect of aqueous extract of *Ageratum conyzoides* L. On seed germination and seedling growth of *Vigna radiate* (L.) wilczek (mung bean)

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Biography:

Dr. Gyanranjan Mahalik, is presently working as Assistant Professor, Department of Botany, School of Applied Sciences, Centurion University of Technology and Management. He was awarded with UGC- JRF for carrying out his M. Phil Research work and RGNF-SRF Fellowship in Science by Union Grants Commission (UGC) in 2014, to undertake the Ph.D Programme at Utkal University, Bhubaneswar. Dr. Mahalik has published 2 books, 18 book chapters and more than 60 number of research papers in peer reviewed journals of national and international repute. He is currently working on different aspects of Plant taxonomy, Ethnobotany, Microbiology, Antimicrobial activity, Plant stress biology, Environmental science, Ecology and Biological sciences.

Abstract :

An allelopathic study using aqueous extract of *Ageratum conyzoides* L. were carried out to investigate the possible allelopathic effects of its flower, root, stem and leaf extracts on the seedling growth, percentage germination and seedling evaluation of Mung bean at treatment concentration 10mg/ml 20mg/ml 50mg/ml 100mg/ml respectively. Concentration were evaluated on seed germination root length and height of seedling of *Vigna radiate* (L.) Wilczek (mung bean) after 10 days in vitro. Results obtained showed significant differences among the different concentration of aqueous leaf extracts used when compared with the control in all three parameters studied. Significant reduction in seed germination, growth of root and height of seedlings were observed in all the treatments but at varying levels from moderate to severe effects for aqueous leaf extract of *A. conyzoides* respectively, while on the contrary, aqueous of Mung bean enhanced seed germination, root elongation and plant height. The radicle length of mung was inhibited by aqueous extracts of *Ageratum conyzoides*. This growth-inhibiting effect from weed plant extract was also evident in mung radicle length, biochemical parameters and cumulative germination percentage. The present study indicates that *Ageratum conyzoides* plants have high allelopathic potential towards *Vigna radiate.*

Keywords*:* Allelopathic, Biochemical parameters, Germination, Seedlings, Treatment

Integrated Farming system

Dr. Samarendra Mahapatra
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Dr. Samarendra Mahapatra

Abstract :

Integrated farming is a commonly and broadly used word to explain a more integrated approach to farming as compared to existing monoculture approaches.It refers to agricultural systems that integrate livestock and crop production and may sometimes be known as Integrated Biosystems. Basic natural resources at farm level such as land and water is declining day by day. Per capita land availability in Orissa, which was 0.39 ha in 1950 has reduced to 0.12 ha in 2000 and is projected to further decline to 0.05 ha by 2020.With such small holdings it would not be possible to sustain a farm family of five members with a single rainfed crop. Marginal (<1ha) and small (1-2 ha) farmers comprise about 84% occupying nearly 56 % of total farm land and the rest being owned by the medium (2-4 ha) and large (> 4 ha) farmers. There are 40.5lakhs operational holdings in Orissa. To meet their basic needs including food (cereal, pulses, oilseeds, milk, fruit, honey, fish, meat, egg, etc.), feed, fodder, fibre, employment, etc, they have been doing their own farming system for a long time. At national as well as state level, lot of efforts have been made for last four decades, aiming at increasing the productivity of different components of farming system like crop, dairy, piggery, goatery, poultry, duck keeping, pisciculture, apiculture, sericulture, horticulture, mushroom culture, etc.But as per the farming scenario of the state is concerned, a farm family normally maintains multi-enterprise systems, depending upon his/her family requirements, knowledge base, socio-economic setup, agro-climatic conditions and available farm resources.However, to have a systematic integration of multi-enterprise systems in a scientific manner, components need to be chosen in such a manner that product or by-product of one component becomes the input for other, becoming complementary and are organically well interlinked to each other without wastage. Farming system is an integratedresource management strategy for obtaining economic and sustained crop and livestock production and preserving the resource base with high environmental quality.All over the world, farmers work hard but do not make money, especially small farmers because there is very little left after they pay for all inputs (seeds, livestock breeds, fertilizers, pesticides, energy, feed, labour, etc.). The emergence of Integrated Farming Systems (IFS) has enabled us to develop a framework for an alternative development model to improve the feasibility of small sized farming operations in relation to larger ones. Integrated farming system (or integrated agriculture) is a commonly and broadly used word to explain a more integrated approach to farming as 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 Biosystems.In this system an inter-related set of enterprises used so that the “waste” from one component becomes an input for another part of the system, which reduces cost and improves production and/or income.IFS works as a system of systems. Since it utilizes wastes as resources, we not only eliminate wastes but we also ensure overall increase in productivity for the whole agricultural systems. We avoid the environmental impacts caused by wastes from intensive activities such as pig farming. Sustainable practices need to be technically as well as economically efficient. Intermediate technological solutions such as light machinery and affordable tools can encourage small-scale farmers to test them and practices can be better tested to the local conditions farmers have identified local crops build up soil fertility and organic matter – all with minimal cost and labour.The preliminary investigations clearly states that integration of agricultural enterprises viz., crop, livestock, fishery, forestry etc. have great potential towards improvement in the agricultural economy. These enterprises not only supplement the income of the farmer by increasing the per unit productivity but also ensure the rational use of the resources and further create employment avenues.

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Seed biopriming with Trichoderma isolates improves plant growth and antioxidative defense system in rice

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Harekrushna Swain

Abstract :

Different spp. of *Trichoderma* were characterized according to morphological and molecular tools. All the strains controlled four important rice pathogens i.e. *Rhizoctonia solani*, *Sclerotium oryzae*, *Sclerotium rolfsii* and *Sclerotium delphinii*. Seed bio-priming with the formulated strains reduced the mean germination time, enhanced the seedling vigour and total chlorophyll content which could be related to higher yield observed in two rice varieties. All the seven strains not only promote the formation of rice straw compost by producing higher straw degrading enzymes like total cellulase, endoglucanase, xylanase, laccase but also produce higher quantity of IAA, inorganic phosphate and prussic acid which can be promote plant growth and inhibit the population of rice pathogens. The out flow of antioxidant enzymes like catalase, peroxide, superoxide dismutase, polyphenol oxidase and total phenolics as compared to control indicates stress tolerance ability to rice crop. The expression of all the above mentioned enzymes were confirmed by the expression of prominent antioxidant defense genes like PAL, DEFENSIN, POX, LOX and PR-3 as compared to the non treated control plants. This investigation demonstrates that *Trichoderma* strains got from tree coverings might be considered as biofertilizer and decomposer for rice crop.

Integrated Farming System: A Viable Farming Option For Small And Marginal Farmers

Kumar Sambhav Giri and Bijoy Kumar Sahoo
S'O'A Deemed to be University, Bhubaneswar
Email: kumar.sambhav202@gmail.com

Kumar Sambhav Giri

Biography:

Mr. Kumar Sambhav Giri have pursued his B.Sc. Agriculture (Hons.) from the Siksha 'O' Anusandhan Deemed to be University and M.Sc. (Agri) Agronomy degree from Central Agricultural University, Imphal. Presently he is pursuing a Ph.D. (Agronomy) at Siksha 'O' Anusandhan Deemed to be University. Mr. Giri has published 3 research papers in international reputed journals, more than 20 abstracts, extended summaries, book chapters, technology bulletin and popular articles. He is also a life member of five national professional societies. Mr. Giri has been awarded with University Gold medal, best student award, best master thesis, best oral/poster presentation award at various national/international seminars.

Research Interest: Agronomy, Nutrient Management, Conservation Agriculture, Water Management and organic farming.

Abstract :

Ancient Indian families were mostly joint and having a large acreage of land for farming. But recent age shows that separate living instead of joint family living leads to indiscriminate fragmentation of large landholdings. More than 85 percent of farm families have been converted into marginal and small categories of farmers having land less than one hectare. A small/ marginal farmer can't afford all the inputs like machinery, draught animals, water source, manuring material and all the intercultural operation implements. In general, marginal and small farmers are illiterate, financially handicapped, their holdings are small and scattered not suited for high-tech agricultural machinery, work in resource-poor and risk-prone diverse conditions. The farming system being the most viable option is a set of agro-economic activities that are interrelated and interact with themselves in a particular agrarian setting. It is a mix of farm enterprises to which farm families allocate resources to efficiently utilize the existing enterprises for increasing the productivity and profitability of the farm. To fulfill the basic needs of the household including food (cereal, pulses, oilseeds, milk, fruit, honey, fish and meat etc.) for humans, feed and fodder for animals and fuel & fibre for general use warrant attention about Integrated Farming System. The integrated farming system is a commonly and broadly used word to explain a more integrated approach to farming as compared to monoculture approaches.

Keywords: *Integrated Farming System (IFS), Marginal Farmers, Enterprises and Productivity*

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Evaluation of differential reaction of black gram germplasm to pulse beetle, Callosobruchus maculatus under artificial infestation conditions

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Sandip K. Panigrahi

Biography:

The presenting author is currently pursuing his Masters at Indian Agricultural Research Institute, New Delhi-100112 at Division of Plant Genetic Resources. He has completed his graduation (B.Sc. (Ag)) from Odisha University of Agriculture and Technology, Bhubaneswar-751003.

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Abstract :

Black gram [*Vigna mungo (L.)* Hepper] being a tropical crop of Indian origin is a promising grain legume for South and Southeast Asia. Bruchid damage in pulses like black gram assumes considerable significance when viewed in terms of acute protein shortage and consequent protein malnutrition. Black gram is highly susceptible to *C. maculatus* infestation during storage where loss in seed weight and protein may reach up to 55-60% and 45.4-66.3% respectively. Host plant resistance remains to be simple, cost-effective, durable and eco-friendly approach to reduce post harvest infestation in pulses from bruchids. No reliable source of cultivated black gram germplasm has been found to be immune or resistant to *C. maculatus* infestation. As a result studies on genetics and breeding for bruchid resistance in black gram are very scarce. Therefore, the present study was undertaken to screen a diverse set of black gram germplasm against pulse beetle, *C. maculatus* using no-choice method under artificial infestation conditions.

The experimental seed material comprised of 55 cultivated 10 wild accessions of black gram along with 4 checks. Physical characteristics of the black gram seed such as, width, length, shape, test weight, seed coat color, hilum, lustre, moisture content ,seed hardness, and texture were recorded to comprehend the physical basis of resistance of *V. mungo*, *V. stipulacea, V. trilobata*, species to *C. maculatus.*

Simple linear correlation analysis was performed using PAST software version 4.02 to indicate the measure of correlation and strength of the relationship between physical parameters of seed and specific life parameters of bruchids. IC 424616 and IC 259504 were found to be resistant and immune respectively based on growth parameters viz. Growth index, adult emergence % and percent seed weight loss.

Keywords: bruchid, black gram, germplasm, physical resistance, *Vigna mungo*

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2. Tripathi, K., Prasad, T. V., Bhardwaj, R., Jha, S. K., Semwal, D. P., Gore, P. G., Sharma, P. K., & Bhalla, S. (2020). Evaluation of diverse germplasm of cowpea [Vigna unguiculata (L.) Walp.] against bruchid [Callosobruchus maculatus (Fab.)] and correlation with physical and biochemical parameters of seed. *Plant Genetic Resources: Characterisation and Utilisation*, 1–10. https://doi.org/10.1017/S1479262120000180

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Research Interest: bruchid resistance in pulses, genetic diversity in germplasm, plant genetic resources, economic botany

Identification and efficiency study of novel Azotobacter vinellandii SINAz1 in rice plant under salinity stress.

Suchismita Prusty[1] and Ranjan Kumar Sahoo*

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Biography:

Suchismita Prusty is a doctoral candidate at Centurian University of Technology and Management, Bhubaneswar after completing her MSc from OUAT, Bhubaneswar. Her current work focus on tissue culture techniques after being certified from MSME skill development program on tissue culture and completed dissertation work from NRRI, cuttack. Her previous work include comparative analysis of miRNA expression in androgenic and organogenic Calli of Arize 8433DT rice variety and current work focus on role of native efficient Azotobacter and Azospirillum spp. Formulations for Var. IR64 rice variety in field exeriments.

RESEARCH INTEREST: *Plant Biotechnology*

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Abstract :

We have isolated one novel nitrogen fixing bacteria, and it was biochemically identified as *Azotobacter vinellandii* and we named it as *Azotobacter vinellandii* SINAz1. The 16s rRNA was isolated and the sequence was submitted to NCBI data base and got the Accession number as MN135308.1. The presence of *nif D*, *nif K* and *nif H* gene was studied by PCR amplification. The nitrogen fixing efficiency of these bacteria was studied in laboratory by acetylene reduction assay (ARA) and also by pot culture experiments. The plant growth promoting (PGP) activities also studied by isolating and estimating the secretion of hormones like IAA, GA3, ABA and zeatin. These bacteria also provide salinity stress (200 mM NaCl) tolerance to rice plant for 15 days as compared with the control. The phenotypic growth and yield of rice crop by the application of these bacteria was studied which found to be significantly better than the control. This novel bacterium can be used as a substitute for the chemically synthesized nitrogen fertilizer for better productivity under normal as well as salinity stress condition.

Isolation and molecular characterization of wild rice endophytes as biocontrol agent in effective management of rice diseases

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Abstract :
Microorganisms that inhabit inside of the plants, especially leaves, stems, roots and show no apparent harm to the host are known as endophytes. Organisms such as fungi, bacteria, actinomycetes and mycoplasma are reported as endophytes of plant. Endophytes are known to promote plant health and productivity by several ways like increasing mineral nutrient availability, fixation of atmospheric nitrogen, production of phytohormones and other metabolites, and imparting stress tolerance against biotic and abiotic stress.Understanding of the evolutional, ecological, and physiological roles of these endophytes in plant-microbe interactions and exploration of their potential use (e.g., as delivery vehicles of desirable properties for crop production and phytoremediation) are essential. In contrast, wild species of *Oryza* such as *Oryzarufipogon*, *Oryzanivara*, *Oryza granulate*, *Oryzabarthii*, *Oryzalatifolia*, *Oryzaofficinalis*, *Oryzagrandiglumis*etc grow in marshlands of the tropics and subtropics and can survive as perennial plants. Therefore, wild rice are likely to harbor unique populations of endophytes that differ from those in extensively bred modern varieties of rice subjected to the application of various fertilizers and agrochemicals.

In the present study, we focusedon the isolation and characterization of endophytes from the root, leaf and seed of wild rice species. In addition, we studied the antagonistic effects of the identified endophytes against different rice diseases and also focused the better health management of rice crops. Till now twenty-four endophytes were identified on the basis of their morphological characteristics under microscope and by molecular markers like ITS, TEF, RPB-II. The endophytes were screened for their biocontrol efficiency against *Sclerotium oryzae, Rhizoctonia solani etc.* Endophytes were selected and used for seed treatment and were experimented on pot in net house to know about their effect on rice plants both for protection against pathogens and growth promotion.Total chlorophyll content, root length, shoot length, dry shoot weight and dry root weightof the treated plants were also statistically analyzed. Biochemical characterization was performed for isolated endophytic bacteria for their identification.

Salt Stress Mediated Physiological Responsiveness in Rice Landraces

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S. R. Harish Chandar

Abstract :
Salinity stress imposes and triggers cellular mechanism. In the present paper, we aim study a comprehensive examination on the physiological, biochemical and molecular traits of high yielding landraces of rice at germination and seedling stage. The germination percentage of six (PLA1100, CR-DHAN1009, Sampath, MTU1061, MTU3626 and Pooja) high yielding varieties were analysed at control and 150 mM NaCl concentrations. Varieties treated with 150 mM NaCl concentration resulted in low germination percentage. Among the selected landraces, Pooja exhibited significantly better physiological and biochemical performance compared to other landraces. These landraces are also examined for Proline content, Pooja, CR-DHAN 1009, which showed significantly increased content of proline compared to control. The chlorophyll content was high in Sampath whereas, proline content was relatively low. Thus, the high yielding rice landraces would be used further for genomics study to impart and enforce salt stress tolerance.
Keywords: *Salinity, Omics, Proline, Chlorophyll, Landraces*

Salinity Stress Responsiveness of Rice Landraces

Manogna G Salavurao, Pushpalatha G., S. R. Harish Chandar, Mounica A, Ponselvan A, Seri Subba Santosh

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Manogna G Salavurao

Abstract :

The potential of high yielding varieties is not fully realized. Several breeding lines are evaluated for the purpose of study to observe the physiological, biochemical and molecular traits in high yielding landraces. In the current study, the salinity stress tolerance is tested at germination and seedling stage the germination percentage of six varieties (MTU1075, RGL2537, MTU2716, SARALA, BPT5204, MTU1064) were analyzed at 150 mM concentration of NaCl. Germination percentage was observed high at lower concentrations and comparatively low at higher concentration. The proline content for this sample was analyzed and sarala was observed with high proline content with other landraces. The chlorophyll content for this sample was analysed and MTU 1075 has significantly high chlorophyll content compared to other varieties. Sarala has high proline content but the chlorophyll content is low comparatively to MTU 1075.

Keywords: *Salinity, Proline, High-yielding, Chlorophyll, Landraces*

Salinity Stress Responsiveness among Rice Landraces cultivated in Coastal Region of Odisha

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Mounika A

Abstract :

Salinity is the major problem in rice along tropical cost in predominantly rice farming systems high salt stress occurs during dry season and it affects growth and dry matter production by reducing chlorophyll content and decreases carbohydrate synthesis. In the current study, germination percentage of six varieties (RJL, KUDRUTH-5, Manipuri black rice, Basmathi, Small CR, Balima) were studied. At 30 days after sowing, the analysis for physiological parameters under 150 mM salt stress conditions showed differences. The Manipur black rice showed significant performance and Balima with least significant among the landraces.

Keywords: *Salinity, Proline, Rice, Carbohydrates, Chlorophyll*

Salinity Stress Physiological and Agronomical Responses in Rice Landraces

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Seri Subba Santosh

Abstract :

The rice is the mostly consumed staple food for a large part of the the world's human population. The aim of the present study is to evaluate the rice landraces at physiological, biological, anatomical and molecular traits in the high-yeilding rice landraces of the eastern part of India at germination and seedling stage for low to \medium salinity stress tolerance. The germination percentage of six high-yielding varieties (MTU4001, MTU1156, MTU1121, MTU1091, MTU1201 and Telangana). The Telengana variety performed better for parameters like root length, plant height, chlorophyll, phenol and proline. The chlorophyll content showed very low in MTU 4001. Thus, these contrasting TELENGANA variety would further be explored for molecular studies with omic approach.

Keywords: *Salinity, Rice, Proline, Chlorophyll, Omics*

Physiological and Agronomical Trait Salinity Stress Responsiveness of Rice Landraces

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Ponselvan A.

Abstract :

Salt stress hinders the productivity at coastal region of the country. In the present study, we have used rice landraces BPT2231, BPT3291, MTU7029, MTU1010, RNR2465 and MTU1224 to evaluate salt tolerance. The landraces were analysed for germination rate under 150 mM NaCl and moderately tolerance. However, an increased level of salinity deteriorates the condition when analysed for other biochemicals like phenols, proline, chlorophyll, antioxidants, etc. Further, the stress was imposed on these landraces with 150 mM NaCl and analysed for various physiological and biochemical traits. Among the landraces, MTU1224 exhibits significant physiological and biochemical parameters. Proline content increased two folds in salt stress imposed MTU1010 whereas, all other landraces showed less difference. Phenolic content differed among the landraces but significant induction was observed in MTU1224 on the contrary to BPT3291. The chlorophyll content was significantly high in MTU1224 whereas, BPT2231 exhibited very low content under stress conditions. A similar observation was recorded in MTU1224 with better performance for carbohydrate content and BPT2231 with contradictory action. Thus, these two-contrasting MTU1224 and BPT2231 would further be explored for molecular studies with omics approach.

Keywords: *Salinity, Omics, Proline, Chlorophyll, Landraces*

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Pea DNA helicase: Salinity stress tolerance gene for crop plants

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Ranjan Kumar Sahoo

Biography:

Professor Ranjan Kumar Sahoo has 11 years teaching and 10 years research experience in the field of biotechnology. He has published 2 books, more than 50 research publications in reputed Indian and foreign journals. He has 1 patent and he has developed 2 new techniques/ protocols for generation of transgenic crop plants. He has published several publications on soil microbes, plant microbe interaction. He was working as a researcher in International Centre for Genetic Engineering and Biotechnology (UN organization), New Delhi, and School of Life Sciences, Jawaharlal Nehru University, New Delhi for 10 years.

Abstract :

The role of Pea DNA helicase 45 (PDH45) in salinity tolerance have been reported in different crops including rice, but they also carry some unnecessary antibiotic marker and reporter genes along with *PDH45* gene which may creates obstacles during approval for commercialization from regulatory agencies. These regulatory agencies advice not to have antibiotic marker genes in transgenic crops, as the antibiotic marker genes has raised public concern about the consumption and cultivation of genetically modified (GM) food. Therefore, to solve this problem we have raised marker and reporter-free salinity tolerant *PDH45* overexpressing transgenic rice (*Oryza sativa* L. cv. IR64) driven by CaMV35S promoter through an unique *in vivo* inexpensive salt selection method, instead of expensive antibiotic selection.

Journey from Engineer to Farmer

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Sudhanshu Ranjan

Abstract :
Sudhansu Ranjan, Youngest son of Nishakar Sahoo and Sanjukta Sahoo, resident of Gurudijhatia, Choudwar, Cuttack is the founder of an Agri Start-up named "The farm enterprises". The farm is spread across 7 acres of land. In the farm they are working on integrated farming. Main focus is on horticulture plants like Coconut, Mango, Guava, Lemon, Litchi, Chikoo, Falsa and many other fruits varieties. In animal Husbandry they have a breeding stock of female goat 70, Breeding Native chicken breed 300 pcs, Desi cows, 2 acres Fish farming and some seasonal Vegetables. They provided employment to 10+ villagers. Mr. Sudhansu Ranjan always believe on the philosophy "Farming is not about earning money; it's about living a life close to nature with harmony and peace."

He spent his childhood in the village and inspired by the surroundings as most of the people in around including his father was from agriculture background. This surrounding around him makes him to incline towards organic agriculture and the sustainable way of living. He completed his schooling from Yugashrashta Sovaniya Sikhyashram, Cuttack where again he grown in a Vedic culture that further motivated him towards a sustainable and traditional way of living with scientific essence. His dream was to be an Agriculture graduate, but unfortunately not able to secure a seat in the Agriculture university. With the passion towards agriculture he joined B.Tech Chemical Engineering. During his technical education he started exploring further on profitable agriculture system, Agri food processing and how to create employment through traditional organic agriculture.

After completing his engineering education, he convinced his family on how to generate profit from agriculture (animal husbandry, dairy, meat, egg, fish and organic vegetables and cage free poultry). Then his father took me to one of his friend who is a renowned veterinarian, Ex-CDVO Malkangiri Dr. Pravat Kumar Sahoo. He used to visit his house and he taught me about how profitable agriculture can be with the application of new technologies and proper training and keeping the data which will help in future analysis. Then he started farming with animal husbandry with the guidance of Dr. Pravat Kumar Sahoo.

He has been the main source of my motivation and inspiration to work in this sector. Whenever I feel demoralized, he always helped me and motivated me to stand strong and move on. Staying actively in Farm with time my involvement and learning increased. He kept doing experiment all the time and it helped me a lot. With time demand of manpower increases in his farm now he provided employment 4 to 5 people daily and they are so happy working here. And somehow his idea of giving employment is getting fulfilled.

In the year 2020 he gave interview on YouTube and news channels where many younger and educated people started agriculture and he is so happy that many more people are coming into this sector. Then he never looked back and decided to make it as a movement so that many more youth will actively participate in agriculture and create job opportunity for other people. Also, we will be able to provide good quality food for our state.

His family, teachers and friends always motivated him. Also, his personal interest in need of good food for a good life and a life with sustainability also helped. Initial years of 2017 and 2018 were very challenging for him. In the year 2019 he started getting back some money from the investments that he has done. Best part about faming is that you will get the love of mother nature and also if you didn't obey her, she will scold you and show her cruel face also.

He has not taken any financial support from state or Central govt. But normal support like veterinary assistance, Technical support sometimes and fodder seeds he got freely from NATIONAL SEEDS CORPORATION. He has not applied for any financial subsidy projects.

Bio-fortification: An investment for improving Nutrition

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Dr Asna Urooj

Biography:

Dr. Asna Urooj, is serving as the Professor and Chairperson of the Postgraduate Department of Studies in Food Science & Nutrition, University of Mysore, Mysore, India. Her areas of research interest are Diabetes, Starch digestibility & glycemic responses, chemistry and applications of Natural antioxidants, Anti-hyperglycemic and hypolipidemic effects of medicinal plants, Disease-specific food formulations and Women's health and nutritional issues. She has completed 14 research projects funded by UGC, DST, MHRD, and BBSRC-UK. She is the coordinator for the UGC – Special Assistance Program. She, serves as a reviewer and editor for several National and International journals. She has 180 research papers published in peer-reviewed journals, with 2821 citations and h-index of 26, i10-index of 63. 16 candidates have completed PhD under her guidance, while 8 are working. She is a recipient of Dr. Kalpana Chawla State award (2009), Prof G.S. Bains Lifetime achievement award (2011), Dr. Rajammal Devadas Oration award (2017). She was the first President of Indian Dietetic Association, Mysore chapter.

Abstract :

Over the last 50 years, agricultural research for developing countries has increased production and availability of calorically dense staple crops, but the production of micronutrient-rich non-staples, such as vegetables, pulses and animal products, has not increased in equal measure.

Global food security concerns impact greatly on the United Nation's Sustainable Development Goals, which are heavily focused on eradicating hunger by 2030. Bio-fortification, the process of breeding nutrients into food crops, provides a sustainable, cost-effective strategy for delivering micronutrients to populations that may have limited access to diverse diets and other micronutrient interventions. More than 20 million people in farm households in developing countries have adopted cultivation and consumption of bio-fortified crops. The implementation of large scale bio-fortification to improve nutrition globally faces several challenges such as – mainstreaming bio-fortified traits into public plant breeding programs, building consumer demand and integration of bio-fortification into public and private policies. Evidence from eight target countries on willingness of farmers to grow and consumers to eat them is encouraging. From the nutritional viewpoint, retention of nutrients and their bioavailability in bio-fortified crops is a matter of concern. Large scale intervention studies are needed to establish the efficacy of bio-fortified crops in alleviating micronutrient deficiencies in various target populations.

Molecular modeling Techniques in plant pathology research

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Dr. Raghunath Satpathy

Biography:

Dr. Raghunath Satpathy received his M.Sc in Botany from Berhampur University Odisha, (Post M.Sc.) Advanced P.G Diploma in Bioinformatics from University of Hyderabad, M. Tech. degree in Biotechnology from VIT University, Vellore India, also he was awarded the degree for the doctor of philosophy (PhD) in Biotechnology by Sambalpur University, Odisha. Currently he is continuing as the Assistant Professor in the School of Biotechnology, Gangadhar Meher University, Odisha. His current research interest is application of Bioinformatics methods in the areas of environmental science and human therapeutics. He has authored 31 journal papers, eleven book chapters and one book to his credit and he is the recipient of many academic and research award.

Abstract :

Throughout the world, plant diseases are accountable for losses of about 10% of global food production, which leads to food security problems. The Plant pathologists concerning about the impact of environmental factors influence on the establishment of plant disease development for a long time. However, the recent investigations have been reported about the several molecular factors of the host plants and the pathogens as well as their interaction are actually having the key role in disease establishment. Many types of molecular techniques are being utilized such as: Fluorescent In-situ hybridization (FISH), PCR variants such as nested PCR multiplex PCR, real-time PCR (RT-PCR), also the DNA fingerprinting, and ELISA-based serological studies so on to identify these molecular factors. Still, the knowledge about the plant-pathogen interactions is limited. However, due to the advancement of genome sequencing technologies, there is a huge flow of sequence information coming on a regular basis. The availability of genomic data in popular repository systems provides an opportunity to retrieve, annotate, analyze and identify the functional elements for characterization at gene and genome levels, in case of both host and pathogen lead to uncovering the molecular interaction details. In this context, the Bioinformatics based application such as molecular modeling methods has great potential in its application. For example different agrochemicals can be tested against the pathogenic target proteins in order to develop a novel effective molecule. Starting from the sequence information of the target, (if the structure is not available) different structure prediction methods can be used to predict the three-dimensional (3D) structure. The molecular information of the chemicals can be utilized to perform the docking process. Molecular docking establishes the binding pattern of the ligand molecule with its target receptor molecule also provides the binding affinity in terms of docking score. Hence ultimately used for ranking the different ligands. Similarly, the molecular dynamics simulation can be subsequently used to study the stability of the binding pattern of the ligand with respect to its receptor by considering several parameters. Therefore, the application of this integrated knowledge would help to understand the complex host-pathogen molecular interaction in a deeper manner.

Keywords: *plant disease, food security, bioinformatics, docking database, molecular modelling, plant –pathogen interaction, molecular dynamics simulation*

Fruit metric traits characterization in Scarlet eggplant using high-throughput Tomato analyzer software

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Abstract :

Scarlet eggplant (Solanum aethiopicum [L.]) is an indigenous, underutilized fruit vegetable in Africa. Preference for fruit shape and size is high among growers and consumers. Fruit metric traits are important for improvement in yield. Fruit metric descriptors are important contributors to variation, phenotypic and genotypic variation, and heritability. However measurement of these traits are cumbersome and subjective. Forty-three accessions were evaluated in 2016 and 2017. At maturity, 5 fruit were randomly harvested from each accession, digitalized and processed with Tomato Analyzer software. Sixteen fruit metric traits were automatically generated and submitted for analysis of variance and multivariate analysis. The accessions differed for fruit size and shape due to genetic make-up. Fruit metric traits variation among S. aethiopicum groups were less influenced by environment. The cv. Gilo group have oblong fruit, the cv. Shum group are circular and ovoid; cv. Kumba group are less circular, lobed and flattened. AE/113 (C3), FUO 1 (C1) and FUO 5 (C2) 'Gilo' group are promising for fruit size. There was phenotypic plasticity and overlap for fruit metric traits between the 'Gilo' and 'Shum' groups due to a common genome. The Tomato analyzer software was able to discriminate accessions based on fruit phenomic traits, and the information could be used to establish commonalities between groups.

Keywords: *Solanum aethiopicum, fruit area, fruit size, genetic diversity, heritability*

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NAFED

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NAFED BIO FERTILIZER DIVISION

NSBFD, Indore has developed the expertise and infrastructure for production of Bio Fertilizers and Seeds in the interest of the farmers

NAFED Bio Fertilizers

- Excessive usage of chemicals in agriculture has given rise to problems like high cost of cultivation, low quality of agricultural outputs, soil and water pollution.
- Bio Fertilizers are preparations containing live cells of nutrient-mobilizing microorganisms used for application to seeds or soil with the aim of increasing the population of such microorganisms to augment the availability of nutrients in a form which can be assimilated by the plants

Role of NAFED in Bio-Fertilizers and Promotion of Bio-Agri-Inputs

- Being a responsible organization, NAFED endeavors to operate beyond its business activities for safe guarding the environment. It is under this backdrop that NAFED ventured into production of Bio Fertilizers long back and set up its first unit for manufacturing bio fertilizers in 1984-85 at Indore (Madhya Pradesh) and the second unit in the year 2000-01 at Bharatpur (Rajasthan)
- Efforts of these units in terms of capacity utilization, quality control and extension & promotion of this noble biotechnology have been duly recognized by the National Productivity Council (Govt. of India) by way of giving away prestigious Best Performance Awards for 11 times until-now
- Continuous dedicated efforts of R & D team of NAFED Bio Fertilizers, have resulted in production of following products which are extremely popular owing to superior quality and reasonable prices:
  - Rhizobium - for leguminous crops
  - Azotobacter - for cereals, millets, vegetables and other horticultural crops
  - Azospirillum - for maize, bajra, potato, etc
  - Acetobacter - for sugarcane and sugarbeet
  - P.S.B. - for all the crops
  - Composting Culture for decomposition of organic waste
  - Trichoderma Viride Biofungicides- for all crops
- Unit at Indore also produces liquid Bio Fertilizers which are also becoming increasing popular amongst the farmers.

NAFED

National Agricultural Cooperative Marketing Federation of India Limited

Nafed House, Siddhartha Enclave, Ring Road, Ashram Chowk, New Delhi-110 014 (INDIA)
Tel.: +91-11-2638 0615 website: www.nafed-india.com, twitter: @nafedindia

NAFED's Seed and Bio-fertilizer

National Agricultural Cooperative Marketing Federation of India Ltd. (NAFED) is an apex organization of marketing cooperatives for agricultural produce in India, established on 2nd October 1958 and is registered under the Multi State Co-operative Societies Act. NAFED was founded with the objective to promote the trade of agricultural produce and forest resources across the nation. The activities of NAFED add to the betterment of agriculture and post harvest of the produce. NAFED is one of the Central Seed Agencies of DAC & FW, Govt of India and has been undertaking production / distribution / marketing of seeds under various schemes of Government of India like NFSM-Pulses/ NFSM- Oilseeds & Oil palm and ensuring supply of quality seeds for better yields & benefit of farming community.

The Indian seed industry currently stands at the fifth position in the world with well developed breeding, production and marketing infrastructure and capabilities. It was valued at USD 4.8 billion in 2019, having grown in the last five years with a double digit CAGR. Various reports put the India's seed sector share in global seed sector between 1-4 % of the global trade. Indian seed industry, both public and private, has laid stress on production of quality seeds. The public sector units, viz. National Seeds Corporation, Seeds Corporations of various states, Other Central Seed Agencies including NAFED take care of the bulk of the supply of seed varieties of crops like Moong, Urad, Soybean, Ground Nut, Rice, Wheat, Mustard, Pulses, Jowar and Vegetables.

Seed is the progenitor of the next generation for plants. For the farmer, seed is an invaluable asset for getting a good harvest. Indian philosophers and sages placed great importance on seed quality for a good harvest and prosperity. Quality seeds ensure strong germination, rapid growth and robust yield. Seed industry today is market driven and set to work with a 'farmer centric' approach. Following traditional methods, most farmers use leftover produce of the previous year's crop as seed for succeeding crop. At present, less than 50% seeds demand of farmers is met through the organized seed sector. Seeds often lose genetic purity and vigour after three to four generations which results in poor yield even after all the standard agronomic practices are meticulously adopted. The high cost and poor availability of certified seeds is a challenge. NAFED being an apex cooperative federation owned by the farmers of India through primary cooperative societies across the country puts the requirements of the farmers on top of the priority list of its charter of activities and has been successfully organizing certified seed production programmes based on Annual Action Plan (AAP) under NFSM-Pulses/ NFSM- Oilseeds & Oil palm and achieving the targets set up by DAC&FW, Govt. of India.

Key Certified Seed Crops of NAFED

Oilseeds: Groundnut, Soybean, Mustard, Linseed, Sesamum, Niger

Pulses: Gram, Moong, Urad, Lentil, Peas, Arhar,

Cereals: Wheat, Barley & Paddy Page 2 of 6

Seed Multiplication Programme

NAFED takes adequate safeguards for quality assurance in the seed multiplication chain to maintain the purity of the variety as it flows from the breeder to the farmer. NAFED through its Seed Nodal Officers and technical team conduct Field Inspection (Vegetative/ Flowering/Harvesting stage) of Certified Seed production programmes being carried out across the country to ensure that the best agricultural practices are being followed by the farmers. The produced seed is again tested to conform to the prescribed seed

standards. The seed production system generally involves three generations namely breeder, foundation and certified seeds.

Breeder to Foundation Seed

NAFED purchases breeder seed of recently notified seed varieties from ICAR institutions/SAUs/NSC etc., the allocation of which is done by DAC & FW, Govt. of India on its online portal i.e. SEED NET PORTAL (www.seednet.gov.in), which is a national initiative for information on quality seed. The purchased breeder seed is further multiplied into foundation seed through National Horticultural Research and Development Foundation (NHRDF) or NAFED's empanelled seed producers across the country.

Foundation to Certified Seed

NAFED undertakes certified seed production programme of Oilseeds & Pulses under NFSM scheme of DAC & FW, Govt. of India who provides financial assistance for the same and 75 % of which is meant for the beneficiary farmers. The farmer's share of financial assistance is directly credited into bank account details of beneficiaries under DBT. During 2020-21 (Kharif/Rabi/Summer), DAC & FW, Govt. of India has conveyed the administrative approval of Rs. 7.80 crores (for production of 15600 Qtls. Pulses certified seed) and Rs. 5.57 crores (for production of 21,931 Qtls Oilseeds certified seed) to NAFED as a financial assistance for production of certified seed.

Farmers' field Inspection under NAFED's certified seed production programme 2020-21

Seed Stock verification by NAFED Officials

Seed Distribution Programme

Certified Seed Minikits

In order to promote quick spread of new varieties of certified seed of Oilseeds and Pulses among the farmers, NAFED supplies seed minikits under Seed Minikits Distribution Scheme (NFSM-Pulses & NFSM-OS & OP) of DAC & FW, Govt. of India. During 2020-21, total quantity of 5122.04 Qtls. Oilseeds (Soybean, Sesamum, Mustard & Linseed) and 3178 Qtls. Pulses (Lentil, Moong & Urad) was supplied by NAFED in the form of certified seed minikits. NAFED covered 11 states (UP, MP, AP, Gujarat, Haryana, Jharkhand, CG, Odisha, Tamil Nadu, Punjab and Rajasthan) under the seed minikits distribution scheme of 2020-21.

NAFED's Certified Seed Minikits – (Linseed-2 KG, Gram-16 KG, Lentil-8 KG)

Direct supply to state govt.

After contributing in Seed Minikits Distribution Scheme (Oilseeds & Pulses) of DAC & FW, Govt. of India, NAFED supplies residual seed quantities to State Governments under general supplies through tenders and direct orders. Further, NAFED also supplied other certified seed of Wheat, Peas etc.

New Initiatives

Vegetables seed/ Fodder seed/ Green Manures seed:

In an effort to expand the existing seed business, NAFED has recently started the marketing of vegetables seeds (Hybrids & OPV), other hybrid seeds, barseem seed & green manures seed like Dhaincha by empanelling major seed producers/suppliers across the country through closed ended Expression of Interest (EOI). In the line, NAFED supplied 1051 Qtls. Barseem seed (T/L) during Rabi 2020-21. Further, vegetable seed (Certified, Hybrid & Research) of different crops is also being supplied in Chhattisgarh state by NAFED under state schemes of Deptt. of Horticulture, Govt. of CG. During Summer 2020-21, NAFED is going to supply 2000 Qtls. Dhaincha seed (T/L) to Punjab Agro Industries Corporation (PAIC), Chandigarh. Page 4 of 6

Seed Distributors Network

NAFED is actively involved in supply of seed to Govt. institutions. However, marketing network for sale of seed in the open market is yet to be established fully. Therefore, NAFED is empanelling seed distributors at district level through closed ended EOI. Seed Distributors Network will be helpful in easy liquidation of seed stock in the open market.

Seed infrastructure facilities

Seed infrastructure facilities include seed processing plants, machineries for seed cleaning, grading, treating, packing, seed storage godowns etc., which are vital components for post-harvest operations and

ensuring maximum seed viability, vigour and health. NAFED put the quality of seeds on top priority; therefore, NAFED is planning to establish its own Seed processing plants cum godowns in order to strengthen the seed infrastructure facilities.

Onion Seed Production

DAC & FW, Govt. of India has allocated the production target of 250MT (100MT of Kharif & 150MT of Rabi) of Onion seeds to NAFED for 2021-22. In order to achieve the aforesaid seed production target, NAFED identified Nashik branch (Maharashtra) based on the hefty production of onion crops therein. NAFED has made a stringent mechanism for assuring the quality of seeds at various production programme stages of onion seed. In the same context, NAFED prepared the guidelines for engaging the vegetable seed production organizers containing therein the eligibility for empanelment. Accordingly, the empanelled agencies will organize Onion Seed Production with the help of FPC'S under tripartite agreement. FPC's will thus look after the selection of farmers based upon their experience in seed production, type of land & availability of necessary infrastructure for maintaining the required agronomic practices. After the selection of farmers by FPC's, NAFED with FPC's will be carrying out Joint Field Inspection in order to maintain the quality of seeds & ascertain the good agronomic practices being followed by the farmers. The same will be done in two stages, viz.

A. Mother Bulb Production Stage &

B. Seed Production Stage.

A. Mother Bulb Production Stage: A minimum of two inspections shall be made as follows;

1. First inspection shall be made after selecting bulbs and transplanting of seedlings.
2. Second inspection will be done after the bulbs have been lifted to verify the true characteristics of bulbs.

B. Seed Production Stage: A minimum of two inspections shall be made as follows;

1. First inspection will be done before flowering.
2. Second & Third will be done during flowering.
3. Fourth will be done at maturity.

Selection of Bulbs

Transplanting of bulbs

Lecture delivered by NAFED expertise

Inaugural Onion Field Inspection

First Stage Field Inspection

Second Stage – Field Inspection

NAFED is also organizing a two-day workshop on **25th-26th February, 2021** at Nashik city for upgrading the knowledge & skills of the concerned officials, producers, and FPCs involved in Onion Seed Production. It will create awareness amongst the farmers about various technological advancements related to Onion seed production.

Bio-fertilizer / Bio-agri-inputs :

Bio-fertilizers being essential components of organic farming play a vital role in maintaining long term soil fertility and sustainability by fixing atmospheric nitrogen, mobilizing fixed macro and micro nutrients in the soil into forms available to plants. Considering the cost and environmental impact of chemical fertilizers, excessive reliance on chemical fertilizers is not practicable in the long run. Therefore, bio-fertilizers would be the viable option for farmers to increase productivity per unit area. Bio-fertilizer products containing cell of different types of beneficial microorganisms can be important components of integrated nutrients management. Microorganisms that are commonly used as bio-fertilizers component are nitrogen fixers (N-fixer), solubilizer (K-solubilizer) and phosphorus solubilizer (P- solubilizer), or with the combination of molds or fungi. These potential biological fertilizers would play key role in productivity and sustainability of soil and also protect the environment as eco-friendly and cost effective inputs for the farmers. With the use of biological and organic fertilizers, a low input system can be carried out and it can help achieving sustainability of agricultural farms.

NAFED's Bio-fertilizer production unit at Indore is one of the oldest bio-fertilizer production facility and is still catering to the needs of nearby farmers and different Agril./Horti. Institutions across the country. The major bio-fertilizer products are NAFED- Rhizobium, Phosphorous Solublizing Bacteria (PSB), Potash Mobilizing Bacteria (KMB), Trichoderma viride (Bio-fungicide), Composting Culture. As per the direction of DAC & FW, Govt. of India, the certified seed minikits (Oilseeds & Pulses) are mandatory to be tagged with Bio-fertilizer culture. The tagged cultures are used for seed treatment before sowing, thus plays an instrumental role in increasing the crop yield. Besides NAFED's own production facility of Bio-fertilizers, marketing of other bio-agri-inputs is also being done by NAFED through empanelment of major manufacturers of Bio-agri-inputs across the country.

NAFED Indore –Bio-fertilizer Production Unit

Inoculation of Bacteria under Laminar Air Flow

Culture Multiplication on Lab. Shakers

ଓଡ଼ିଶା କୃଷି ଶିଳ୍ପ ନିଗମ

The Odisha Agro Industries Corporation Ltd.

(A. Govt. of Odisha Undertaking)
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4. FERTILIZER, PESTICIDES, BIO-FERTILISER AND SURAVI BRAND GOOD QUALITY CATTLE FEED.

All as per the subsidized rate approved by the Government.

Please contact our District Offices throughout the State

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Bargarh	06646-234865	Jajpur	06728-222102	Nawarangpur	06858-222450
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Boudh	06841-222259	Kendrapara	06727-220836	Puri (Pipili)	06758-241038
Cuttack	0671-2301390	Keonjhar	06766-255347	Rayagada	06856-222536
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AGRI Vision 2021

The green farmlands, the golden harvest, the livestock represent life.
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