5F Farming 2022

3rd National Conference

REALIGN AGRICULTURE FOR SUSTAINABLE DEVELOPMENT

March 10-12, 2022

Bhubaneshwar

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5F Farming 2022

3rd National

Conference

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PREFACE

5F Farming – 2022

3rd National Conference

Theme: Realigning Indian Agriculture for a Sustainable Future

Aim & Scope

The 5F Farming – 2020, 3rd National Conference on '**Realigning Indian Agriculture for a Sustainable Future**' is being organized at Bhubaneshwer, Odisha between March 10-12, 2022. This is a multi-disciplinary conference covering advancement in the area of plant breeding, value addition through crop improvement, farm automation, policy development and skill enhancement in the area of crop improvement.

Agriculture has always been challenged by the need to develop climate resilient, high yielding crop varieties for Food, Feed, Fiber, Fuel & Fine chemicals (5F).

This is the time to '**Realign Indian Agriculture for a Sustainable Future',** through redefining the performance metrics for the robustness of agribusiness, create resilient markets for economic sustainability and shorten food travel for adequate food availability. Agriculture should be poised for recovery through implementation of innovative policies and strategies, acquisition of science and technology, development of local content, and tailor-made local solutions to kickstart the sustainable development of agriculture. Some of the key considerations for '**Realigning Indian Agriculture for a Sustainable Future**' are:

- Comprehensive integration of cutting-edge science and precision technology required for the sustainability and tapping full potential of agriculture stake holders
- Value chains must be diversified to meet the evolving consumer preferences, enhance nutritional intake, and develop market for new consumer - preferred products
- Agriculture and food processing industry must be

strengthened locally through successful FPO models to ensure future rural prosperity for development

- Reprioritizing skills sector and technology interventions for continuous learning as the key aspects to boost - individual and industrial agility to meet current and future challenges
- Array of policy reform required to support agriculture, input and output value chains, and remunerative markets to farmers to ensure national food and nutrition security
- Attract young and capable professionals to build a resilient ecosystem for sustainable primary and secondary agriculture ecosystem in the country

We have a relevant and interesting program to discuss the typical issues that concern all of us in the industry. We have invited leading scientists and administrators from the Industry and Academic institutions, regulators, policy experts, Government Officials, farmer leaders and other opinion makers. Knowledgeable keynote and invited professional practioners of agricultural sciences will review the latest progresses of enabling technologies for gene revolution that can add value to the product, increase profitability to the farmers and attract youth and talent pool to join the work force in agriculture. Experts will also deliberate on the challenges of marketing faced by the growers, and formulate strategies to reinforce policies supporting development of agriculture in India. This event will provide a networking opportunity for the Professionals, Scientists, Industry Leaders, Policy-Makers, Farmers, Students and other stakeholders and a platform to learn from each other.

Grouping of all components together while closely scrutinizing practices, problems and trends, 5F Farming-2022, emphasizes on integration of advanced technologies, skill development and state of the art management practices in the field of crop improvement. This annual event is addressed jointly by seed industry experts, academicians & practitioners of several prospective areas and foster their dialogue and exchange of ideas for the furtherance of crop improvement. We would like to thank each and every one of the participants who have contributed directly and indirectly for the success of this, National Conference Our special thanks to:

1. Advanta Seeds for the Gold Sponsorship
2. I&B Seeds Pvt Ltd for the Gold Sponsorship
3. Nunhems/BASF for the silver sponsorship
4. Indian Council of Agricultural Research (ICAR) for financial assistance in partially defraying the cost associated with the conference management
5. Indo American Hybrid Seeds Pvt Ltd for Bronze Sponsorship
6. The Financial assistance received from Ramadevi Women's University, Bhubaneshwar, for the conference is gratefully acknowledged
7. Mahyco Seeds for the Award Sponsorship
8. Bayer for the Award Sponsorship
9. Kalash Seeds for the Exhibition Sponsorship
10. Rijk Zwaan India Seeds Pvt Ltd and Vokkal Seeds Pvt Ltd for providing advertisement in souvenir book
11. Foundation for Advanced Training in Plant Breeding (ATPBR) for developing the theme of a good quality conference which adds value proposition for the realistic and futuristic development of crop improvement
12. Kalinga Institute of Industrial Technology, Bhubaneshwar for hosting the event and ensuring quality management at all levels of execution
13. Odisha University of Agriculture & Technology (OUAT), and Institute of Life Sciences, Bhubaneshwar for intellectual support from conceptualization to execution of the program
14. All the speakers, panelists and honorable guests for their intellectual contribution
15. Conference-Chair (Dr. KK Narayanan), Co-Chair (Dr. Mrutyunjay Suar), Program Chair (Dr. S Tikoo), Conference Secretary (Dr. Aparna Tiwari) Award committee Chair (Dr. CL Laxmipathi Gowda) and all members of organizing committee for their continuous support in planning, & communication before, during and after the conference to make this a memorable event.

Foundation for

Advanced Training in Plant breeding (ATPBR)

- Professional Training, Start-up support, Customize Training
- Awareness Session, Conference, Workshop, Mentoring
- Training and Liaoning Support for Advance technologies
- R&D Support - design and execution of plant breeding program

Mob.: +91 8793988121

E-mail : info@atpbr.com www.atpbr.com

The soul of our Incredible India: ODISHA

Odisha, the Emerald of the East is a land where spirituality meets modernism. A land where its people dream of a brighter future, while holding on to their past traditions and culture, is presently a world leader in a number of fields. Spread over an area of 1,55,707 km2, Odisha houses a large number of 62 individual tribes, native to the region. Geographically, Odisha has a peculiar position that places it in close proximity with both the northern and southern part of the subcontinent. Thus, this land notices an intermingling and harmonization of different cultures.

Historically, Odisha has had massive contributions to the course of Indian history, right from the time of the Battle of Kurukshetra, fought in Mahabharat. Back then Kalinga (i.e present day Odisha) was ruled by King Srutayudha, who sided with the Kauravas in the battle, and died heroically in the Battle of Bhimasena. Post Mahabharat, Kalinga was ruled by a new dynasty of Kshetriya Kings, and then the Nandas. Finally, the scion of the Mauryan Empire, Emperor Ashoka, invaded and occupied Kalinga in 216 BC, after fighting what is presumably one of the deadliest battles ever experienced in the history of our great country, the Kalinga War. The battlefield of the war, Dhauli on the banks of the river Daya, has become one of the most visited tourist spots in Odisha.

The land of Odisha is blessed with the cornucopia of nature. From the blue-hued hills of the Eastern ghats to the sunlit, beautiful beaches washed by the sparkling waters of the Bay of Bengal, it is a land of charm and tranquillity. The pristine land of Odisha offers the experiences of unsullied beaches, lofty waterfalls, scores of naturally occurring water bodies and magnificent forests teeming with wildlife. The people of Odisha, have recognised their blessings and have developed a vibrant culture, that is truly unique to the land. Any visitor to this state is sure to have an experience of a lifetime!

Puri- Konark- Bhubaneshwar, situated at a distance of less than 65 km from one another is the holy trifecta of Odisha, popularly known as the Golden triangle. These iconic places are frequently visited by hundreds of travellers everyday for a glimpse of the

exquisite temples, spectacular beaches, delicious local food and rich cultural heritage including striking tribal art, the immaculate Odissi dance and the luxurious silk sarees.

Bhubaneshwar is the key IT hub of Eastern India and yet firmly rooted in its past. The ancient city was believed to have about 7000 temples, of which only a few remain today. The city houses the Lingaraj Temple complex which was built in the 11th century and is dedicated to the patron deity of Tribhubaneswara, Shiva and many shrines. Parshurameswara, said to be the oldest surviving temple from the 7th century, and Mukteswara, from the 10th century, acts as a bridge between early and later styles. Rajarani temple from the 11th century, gets its name from the two coloured stones used in construction and Brahmeswar are some of the other popular temples situated in Bhubaneshwar. The Udaygiri and Khandagiri caves, Nandankanan Zoological Park are famous amongst the visitors and if one is interested in the arts, Kala Bhoomi or the Odisha Crafts Museum, Ekamra Haat and the state emporiums are the places to go for local food and handicrafts.

Puri, the other vertex of the Golden triangle is globally famous as the homeland of the state's presiding deity, Lord Jagannath. Also known as Jagannath Puri (the abode of Lord Jagannath), it is believed to be one of the four 'dhams' for the Hindus. This mystical land of Lord Jagannath has the world's largest kitchen, where the food is cooked in earthen pots on wood fire. The annual Rath Yatra is believed to be the oldest chariot procession in the world, and every year attracts a huge number of devotees, irrespective of their caste and religion. Besides being the land of divinity, Puri is famous for its golden sand beach and is a favourite spot for all those who love to frolic and have fun. There are a myriad of stalls and shops situated on and around the beach; some showcasing the handicrafts of the state, while others selling a plethora of mouth watering delicacies.

Situated on the northeast of Puri is the historic town of Konark. It is home to the 13th century Sun Temple or Surya Deula. It was dedicated to the Hindu God, Surya and was designed to represent his chariot, with 12 huge carved stone wheels and 7 stone horses

around it. The exterior of the temple is adorned with sculptured decorations and in 1984 the complex was given the designation of a UNESCO World Heritage Site. It has the Ramchandi temple on the banks of Kushabhadra river and in the month of December the town comes alive with the jubilation of the Konark Festival organised by the department of Tourism.

Odisha is a state that witnesses a harmonic coexistence of various religions, castes and communities. It houses the largest brackish water lagoon, Chilika Lake, zoological and national parks like Nandankanan and Simlipal, and a major biodiversity zone, Bhitarkanika that harbours the largest known rookery of Olive Ridley sea turtles in the world.

Despite being blessed by nature's bounty, Odisha has its limitations. It is one of the most cyclone-prone states in the country that has experienced 10 major cyclones in a span of the last 23 years. In 2019, the Odisha coast was hit by the worst cyclone since 1999. This super cyclone named "Fani" was an extremely severe cyclonic storm, where the wind speed reached a maximum of 280 km/hr. Despite its catastrophic nature, the Odisha Government tackled the situation with such finesse that the loss of lives and livelihoods were minimised. The quick response and massive evacuation strategies of the government earned Odisha not just national, but global acclaim, with BBC news covering and praising the efforts undertaken by the government.

Besides being recognised for its unadulterated beauty, today Odisha is a leader in providing quality education and is the hub for small to large scale startups in Eastern India. The KIIT Technology Business incubator provides a unique platform for entrepreneurs, investors, researchers, policy makers to collaborate and develop businesses. It is one of the largest incubators in Eastern India and that is recognised by the Government of India, and it massively contributes to the technology-driven future of Odisha.

It is Odisha that synthesises India's fascinating past with its pulsating present, and is truly the soul of this incredible country.

KIIT:

KIIT University, Bhubaneswar, Odisha, recently awarded as "Institute of Eminence" by the MHRD, Govt. of India is a rapidly emerging center in higher education. The University has 23 constituent schools with about 100 programmes having 27,000 students. Accredited in "A" Grade (highest CGPA among self financing universities) by NAAC and ranking amongst Top 5 Private Universities of India. KIIT is one of the most progressive Universities and the best in Eastern India, ranked 24th as per the prestigious NIRF rankings 2020. (kiit.ac.in)

KSBT:

School of Biotechnology at KIIT having laid its foundation stone by Nobel Laureate Prof. Richard R. Ernst (Nobel Laureate, 1991) & inaugurated by Prof. Hans Hengartner, Noted immunologist & Prof. Rolf Zinkernagel (Nobel Laureate 1996) in 2007, set up with a clear mission to pursue excellence in the field of biotechnology. The School has been awarded the "Centre of Excellence" by Department of Biotechnology (DBT), Govt. of India. The School has a very strong research fora, currently with about 52 research projects funded by various government / international / industry are running and our research work has been published in journals of international repute.

TBI:

KIIT-Technology Business Incubator (TBI) started in 2009 as an initiative of KIIT with the humble support of DST, NSTEDB, MSME, BIRAC, TDB, GoI, to boost innovation and entrepreneurial ecosystem. It has been recognized as "center of Excellence in Incubation" by DST, GoI. Till date KIIT-TBI has nurtured 230+ startups and entrepreneurs.

Our Inspiration:

Dr. Achyuta Samanta, a visionary philanthropist is the founder of KIIT & KISS Universities. Coming from a very humble background with a vision to eradicate poverty through education, has developed a unique model of social transformation by building side by side two great academic institutions - Kalinga Institute of Industrial Technology and Kalinga Institute of Social Sciences. This unique symbiotic model has grown over the past 25 years into two distinct excellent centers of educations. Over 20 Nobel laureates and over 100 Heads of States have visited KIIT and KISS and applauded the developmental model.

Dr. P. K. Agrawal
VICE CHANCELLOR

ODISHA UNIVERSITY OF AGRICULTURE & TECHNOLOGY
BHUBANESWAR-751003, ODISHA

Dated the March, 2022

MESSAGE

Agriculture plays a vital role in providing food, feed, fibre, fuel and fine chemicals (5Fs). The agricultural production system needs to be strengthened for sustaining uninterupted supply of these valuable components. It gives me immense pleasure to know that the Foundation for Advanced Training in Plant Breeding is organizing a National Conference on "Realigning Indian Agriculture for a Sustainable Future" in partnership with the Kalinga Institute of Industrial Training, Bhubnaeswar; Odisha University of Agriculture and Technology, Bhubnaeswar; Institute of Life Sciences, Bhubnaeswar and Indian Council of Agricultural Research, New Delhi under the banner "5 F Farming".

The outcome from the deliberations of the National Conference will be of immense use for preparation of action plan for overall development of the agriculture sector.

I wish the endeovour all success.

4.3.22

(P. K. Agrawal)

Tel : (0674)2397700 (O), 2561606 (R) FAX : 0674-2397780 Email: vcouat@gmail.com, vc@ouat.nic.in

Room No.: 51, Western Court
Janpath, New Delhi - 110001
Mobile : +91 9849797705

#5L/28, Opp : Prasad Petrol Pump
Noonepalli, Nandyal - 518 502, A.P.
Email : pochaanand1@gmail.com

POCHA BRAHMANANDA REDDY
M.Sc., (Agri)

MEMBER OF PARLIAMENT
(LOK SABHA)
017-NANDYAL. A.P

Message

It gives me a great pleasure to know that ATPBR is organising its third national conference in collaboration with KIIT,OUAT and ILS at Bhubaneswar ,Orissa.

We all and particularly the farming community have passed through a very tough time in the last two years due to the COVID-19 pandemic. In addition to this there have been natural calamities mostly due to very heavy, excess rains causing floods in many parts of the country. Nature is completely disturbed and we see total climate change effects all over the globe. All these have impacted directly on our agriculture and making it more challenging in the years to come.

We need more and more improved varieties to withstand the natural challenges and yield to their full potential through better crop management. The ATPBR team having senior experienced agriculture scientists has a big role to play and make this deliverable by further developing the plant breeding capabilities in the country by training and engaging the plant breeding community on a continuous basis.This conference will definitely be a good platform for this mission.

Another area of immediate concern is the non availability of agricultural labour in the farming areas due to migration of workers to urban areas looking out for better wages and comforts of life.The only solution for this is to maximise farm mechanisation as much as possible from land preparation, planting, weeding, fustigation, irrigation, plant protection and harvesting. I am sure the conference is looking into this aspect on priority.

Our farmers have achieved record production successively in the last two years in spite of the pandemic. This has been possible mainly because of the elite but versatile hybrids developed by our plant breeders from various agricultural universities and private organisations.

We still need to go a long way in further developing new varieties of various crops which can withstand to the biotic and abiotic stress to perform to the full plant potential for food, feed and fibre.

We are aware that Indian agriculture is dominated by the dedicated small holder farmers. Providing market linkages particularly for these small holder farmers should be our priority area for a sustainable future for our food security and employment creation.

Our Government has taken the challenge of doubling the farm income in the coming couple of years as the immediate priority in the agricultural improvement policies. There is lot of timely debate going on on the further improvement of Minimum Support Price(MSP) and other farm policies to reinstate the confidence in the farming community.

With my agriculture background –plant breeding, seed production, seed conditioning and seed supply chain management, I am fully aware of the challenges in agri sector and more particularly in the seed sector.To supply the most important input –the quality seed should be the focus area for our discussions.

I am sure the conference will have meaningful and productive discussions on improving plant potential ,quality seed supply, efficient farm mechanisation, market creation and doubling the farm income....

Let us all work together in this great mission for sustainable future for agriculture by improving the per acre productivity to match with the global benchmarks in all the crops being cultivated in India.

I wish the conference a grand success.

23.02.2022

P.Brahmanand Reddy

A proud seed man,

Managing Director, Bharati group of Industries

Member of Parliament, Nandyal constituency

Prof. Achyuta Samanta
Founder & Mentor – KIIT & KISS
KISS Foundation India, UK & USA

KIIT UNIVERSITY · KALINGA INSTITUTE OF SOCIAL SCIENCES · ART OF GIVING

Date: March 9, 2022

MESSAGE

We all know that Climate change has ushered in multifarious challenges for the whole world in the 21st century. Modern day agriculture is no exception to it. The unpredictability of environmental condition has resulted in stunted growth, development, and productivity of the crop plants. Hence, the development of stress tolerant and climate resilient plants is the need of this hour. Modern day agriculture can nourish a growing world population with the collective efforts of farmers, scientists, industry leaders, and policy makers for a sustainable future.

KIIT Deemed to be University contributes to the national efforts of sustainable growth with high quality academics, research and has been attracting academicians, students and scientists of repute to exchange and enhance their knowledge in different field of science and technology like computer science, electronics, mechanical, civil engineering, biomedical research, biotechnology including agriculture sciences. This is reflected with the University topping the ARIIA Rankings consecutively for 2020 & 2021 amongst all private Universities in the country working in the field of innovative Research.

In this regard, I am very pleased to learn that School of Biotechnology and Technology Business Incubator (TBI) of KIIT University are organizing National Conference on 'Realigning Indian Agriculture For a Sustainable Future' in association with Foundation For Advanced Training in Plant breeding (ATPBR). As the Founder, I welcome all the esteemed delegates, speakers, dignitaries, farmers, start up companies, and participants to this conference. I am sure this will provide a good platform to all to exchange and share their ideas and establish networking for a better tomorrow.

I wish the Conference all success.

(Achyuta Samanta)
Founder, KIIT & KISS

www.achyutasamanta.com /AchyutaSamant /achyuta_samanta /dr.achyutasamanta

I am delighted to know that KIIT School of Biotechnology in association with Foundation for Advanced training in Plant Breeding is organizing the conference '5F FARMING' on "Realigning Indian Agriculture for a Sustainable Future" on 10th-12th March, 2022.

Agriculture has been practiced in India since time immemorial. It not just provides food and nutrition to the population, but also contributes majorly to the country's economy and progress. It has always been a major research area particularly for developing crops that are resilient to climate change, have high productivity for Food, Feed, Fuel, Fiber and Fine Chemicals.

I trust the deliberations from various distinguished speakers will benefit the participants to enhance their knowledge. I extend my greetings and congratulations to the organizers and the participants and wish the conference all success!

Vice Chancellor

MESSAGE

Dr. K.K. Narayanan
Co-founder, Director, ATPBR

Dr. KK Narayanan is an expert in Agricultural technologies with track record of founding and leading successful companies. He is an opinion leader on food and agriculture related subject

Dear Colleagues,

Welcome to the 3rd edition of our Annual Conference!

As you are all aware, the last two years have been riddled with lock-downs and restrictions of several kinds, all owing to the spread of the COVID 19 pandemic. The Conference that was to be held last year, 2021, had to be cancelled in spite of all the preparations being completed. The situation, thankfully, has considerably eased and we have been able to pick up the threads from where we left off, and put together a very exciting program.

The last two years have been disastrous for almost all sections of the economy. However, it is notable that the agriculture sector held its own in the midst of the pandemic onslaught and was key to propping up the Country's GDP from further slump. The days of the agriculture-dominated Indian economy is long gone; however, this experience, in the last two years, underlines its continued importance. Many lessons have been learnt, which prompt us to re-imagine the way we have been practicing farming and the agricultural trade. The emphasis on productivity and production is surely giving way to sustainability and farm incomes. There is a need to address emerging challenges like climate change, dearth of farm labour, local value-addition,

widening income disparity and rural distress. Along with many other interventions, the march of science is opening up many more technological options to potentially address these issues. The theme of this Conference, **'Realigning Indian Agriculture for a Sustainable Future'** has been framed to allow each one of us to look at these issues from different angles and discuss different perspectives, so that the synthesis of the outcomes will help us produce a meaningful set of recommendations and action plan for the various stakeholders.

I thank all members of the Organizing Committee for their invaluable contributions in putting together the program and for the various arrangements needed for such an event. The host Institution, KIIT and its leaders have been extremely generous in extending all support to make this even happen in Bhubaneswar, and ancient city which is also a modern Capital of the state of Odisha. My gratitude also goes out to other supporting institutions and the sponsors, but for whose contributions, this event would have been significantly diminished, in both grandeur and scale.

I look forward to meeting each of you, renewing the old bonds, making new ones, and together, make it a rewarding experience for all.

Best Wishes to you and your families!

Dr. K. K. Narayanan
Conference Chair

MESSAGE

Dr. Surinder K Tikoo
Co-Founder, Tierra Seeds Sci. Pvt Ltd, &
Independent Director, ATPBR

Dr Surinder Kumar Tikoo has five decades of experience as a successful vegetable breeder, teacher, and research & development manager. Has held global leadership positions in three largest MNC's, as well as spent 20 years with the Indian Council of Agricultural Research (ICAR). He has bred several nationally & internationally released varieties and hybrids of tomato and okra. He has served on several research advisory committees of the Government of India, APSA, and also as a supervisory board member of Access to Seed Index, Netherlands.

Future Of Crop Improvement Research

Current Status

The biggest issue facing crop improvement researchers is to meet feeding 9 billion people by 2050 and to produce that food within same or lesser arable land. Five decades have passed since the green revolution brought to the small farmer the benefits of crop improvement research in the fields of plant breeding through changes in plant architecture (e.g wheat & rice), enhanced disease resistances and improved agro-techniques. Last three decades have seen improvements in almost all field & vegetable crops that took a century to achieve before, because of great advances in tools available over the years. Molecular biology is

making precision introgression of traits and speed breeding is cutting that time to introgress by three to five-fold. Agronomic interventions have helped farmers to maximize the genetic yield potential of the products he/she is growing, and crop protection advances have helped the farmers to save yield losses through pests that couldn't yet be controlled through plant breeding. Genetic engineering is another field that has transformed crops like cotton, corn, soyabean, mustard in the countries where regulators have allowed inter generic transfer of genes. This field is on the cusp of achieving next gen breakthroughs if only regulators allow these to be commercialized. On the other hand, indiscriminate use of fertilizers have caused soils to deteriorate. When soil microbes get in touch with nitrogen fertilizer, they emit nitrous oxide. Agriculture has become the largest source of carbon and these gases in atmosphere.

Following issues face the farming sector in India where even available technologies are not used well in the interior parts of the country, thereby reducing our average yields. Following are key challenges & potential remedies:

1. **Lower Yields:** Yield gains have been best harvested by the resource rich farmers in the more developed countries, like USA/Canada/EU/Argentina/Brazil/Japan/Korea and to a certain access by China but not by resource poor farmers from developing countries like India/Africa/SEAsia. The average yields of most crops are one half of China and one fourth of USA. This, even though many farmers in these countries do obtain yields that are on par with the best. Hence, we need to widen the reach of existing genetics through excellent extension for which skilled technical force on the ground is required

2. **Fertilizer Use Efficient Genetics and Use of Biologicals**: It is increasingly becoming apparent that indiscriminate use of synthetic fertilizers, constant ploughing of soil season after season is depleting our soil structure and reducing its fertility. The clamour for organics is an area is an idea in the right direction, but a lot of effort is going towards remedies that are not very scientific which negatively and significantly affect yield of existing products making the produce very expensive and beyond reach of a common man. This needs to be addressed through breeding for nutrition efficient

genetics, moving to use of biologicals (fertilizers, pesticides) in all screening trials

3. **Water use efficiency:** Water is not an infinite resource and the way we still carry on with flood irrigation to grow our crops is wasting a lot of water and even then, doesn't help harvest potential yields from existing genetics. There is an urgent need to move to water conservation practices. This can be addressed with a) mandatory **drip Irrigation** b) breeding for Water Use Efficiency/drought tolerance and c) protected crop cultivation that uses & other inputs water more efficiently but yields manifolds over open fields, urban horticulture/smart farms/hydroponics etc- **Grow more from Less**

4. **Carbon sequestration & Global warming:** Climate change is a reality and average temperatures are rising and this is directly related to the increase of carbon in the air. Among the field crops it means more tolerant products for higher temperatures as well as humidity in some of them and in case of vegetables which are needed throughout the year there is need to breed for products for cool, to high summers to high humidity. There is need to address this along with ensuring enhanced carbon sequestration in the soil. **Hot & Humid resistance** breeding, No Tilling research needs huge investment.

5. **Postharvest losses**: Vegetables are a perishable commodity and estimates are that forty percent of our produce is lost from farm to the fork. There is need to mitigate this through two areas of work. One way is to **breed for better shelf life** by bringing in the known shelf-life traits in some of the crops (e.g., tomato, melons) to commercially acceptable products and conduct discovery research in crops where these traits are not known yet. Second way is to **increase our capacity to process & preserve** the production matching the developed countries who process over 60% of their produce. There is need to **breed for processing and frozen quality**- e.g.: tomatoes, hot pepper, melons, watermelons, leafy vegetables, sweet corn.

6. **Labour Efficient Genetics**: Labour in India is no longer cheap & not available at right time as they prefer easier

jobs & are moving to industry. Breeding for synchronous maturity in crops like cotton, mustard, rice, tomato; uniform placement of cobs in corn will allow mechanical harvesting which will reduce dependence on labour. Farm automation for small farmer to not only for one time harvesting of crops but for efficient sowing and cultivation is the need of the hour. This area needs research & industry support in a big way.

7. **Improving Nutritional Quality & Crop Diversity Research:** The onset of Covid19 across the globe has made it very clear that we need to eat food that improves our natural immunity against diseases. Research has focused on only a few key field and vegetable crops and focus has been on disease resistances and yield at the cost of utilizing genetic diversity for nutritional quality parameters. Besides that, the narrow focus of crops has minimized our consumption of diverse food crops that are available in nature and have excellent nutrients which can help us to eat better and be healthier. Holistic food availability is, hence, a challenge. Millets, Legumes, Leafy & root Vegetables need to get equal importance as subjects for intensive crop improvement research.

8. **Genetic Engineering**: There are still diseases and pests that may not be possible to control through conventional means. Tools like Intergeneric transfer of genes like Bt and other similar research is lying on shelf due to regulatory issues. The latest tool of **Gene Editing** using Crispr Cas9 technology allows us carrying out precision transfer or many simple as well as complex traits. Do we wait for investment in this area, or do we move to TILLING as a technology to address some of these as it doesn't face regulatory challenges? Speed of decision making is required at highest levels

9. **Speed to Deliver Traits**: Speed is the essence of achieving goals. A challenge that all plant researchers face every day. **I**nvesting in this area reduces time to deliver new products. Speed breeding units for rapid generation advance are required across board in places wherever recognized R&D is going on.

10. **Skill development**: All above need specific skill development programs to prepare professionals able to attend to these & succeed in making these results happen

ATPBR has been trying to get key experts in various areas mentioned above in its national conferences since 2019. The current one is the third such conference that will help deliberate on each of these areas so that solutions can be developed and shared with policy holders to take the ideas forward.

Dr. S. K. Tikoo
Conference Program Chair

MESSAGE

Dr. Aparna Tiwari
Chief Executive Officer – ATPBR

Dr Aparna Tiwari is the cofounder and Chief Executive Officer at 'Foundation for Advanced Training in Plant breeding (ATPBR). She worked with FAO, Monsanto India Pvt Ltd., ICRISAT in various roles and responsibilities. She has published several research papers in peer reviewed international journals and conferences & one book with Springer on Commercial Plant Breeding. She obtained her M.Sc. & PhD from Wageningen University, The Netherlands.

Indian Seed sector has the potential to become global hub for quality seed production because it has robustness and resilience against adverse ecosystem. The best example can be seen during COVID-19 pandemic when other sectors were disrupted severely, agriculture was the only sector that register a positive growth, beside labor and logistical constraints that affect the production and marketing chain.

During pandemic, all stakeholders of seed value chain were negatively impacted and wreaked physically, socially and emotionally. Also, increased food price and negative income restrict the marker access and consumption pattern. These challenges have a long-term impact on value chain.

To recover and prosper post pandemic, Indian seed sector including production, marketing, consumption need to be

strengthened by potential strategies and effective collaborations between stakeholders. This challenging situation is also an opportunity to revoke a long-pending reformation in agriculture.

I, secretary of 5F Farming conference would like to invite you all to attend 5F Farming conference. This is 3rd national conference, organized by ATPBR (a non-profit organization) in collaborator with Kalinga Institute of Industrial Technology (KIIT) Bhubaneswar, Odisha University of Agriculture, Technology (OUAT) & Institute of Life Sciences (ILS) and Indian Council of Agricultural Research (ICAR) from March 10 to12, 2022. The 5F Farming is the platform that helps to discuss and understand the most crucial aspects like capacity building, government policy, value chain, start-up promotion, farm automation for small land, and investments that are required for competitive developments of plant breeding sector in India. This platform will give an opportunity to Industry, Academic institutions, technocrats, regulators, policy experts, government officials, leaders of the farming community and other opinion makers to have meaningful discussions on various issues that are facing the crop improvement space. Together, all stakeholders can discuss and formulate strategies to restructure Indian seed sector that includes evolving business dimensions, growing consumer's preferences, implementing progressive policies, assimilating advanced technology and changing market dynamics.

I and sure this conference provides valuable insides on post-covid situation and guide all stakeholders to initiate necessary policy initiatives and interventions for inclusive and equitable growth of Indian Seed sector.

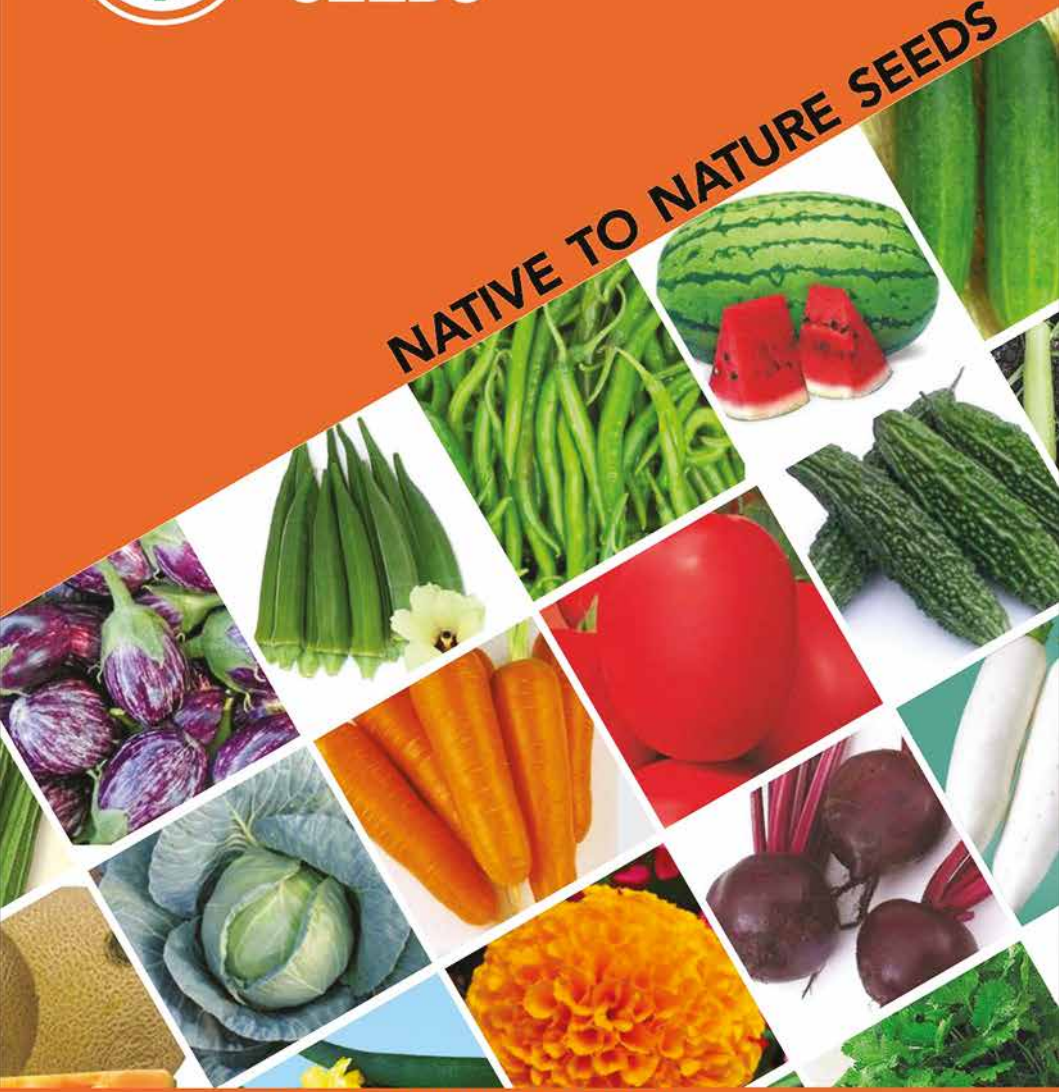
Dr. Aparna Tiwari
Conference Secretary

Dr. Srinivas Patnaik
Professor and Dean
School of Biotechnology.
KIIT Deemed to he University

It's my pleasure to welcome you to the 3rd National 5F conference on Realigning Indian Agriculture for a sustainable future organized by ATPBR, in association with the School of Biotechnology, KIIT Deemed to be University. The topic is very apt and suited to the current needs in the view of global climate change and its repercussions on global agriculture. My heartiest thanks to ATPBR for choosing our School as an organizing partner. It is an institute that nurtures education, research and incubates new technology. I really value the training and exposure that our students will receive from this conference. Today's dynamic industrial environment is competitive, far-reaching, and transcends boundaries while seamlessly connecting economies across the globe. The use of biotechnological tools in improving agriculture has always been levered for the benefit of society at large and its myriad applications in the field of agriculture make them a unique field of study. I wish a grand success to the conference and hope our students will gain deeper insights into Indian agricultural scenarios.

VOKKAL SEEDS

NATIVE TO NATURE SEEDS



VOKKAL SEEDS PRIVATE LIMITED
NO.4, 8th Block, BDA Layout, Nagarabhavi 2nd Stage,
BANGALORE - 560 072
Phone: 080-23186014/6016, email : info@vokkalseeds.com
website : www.vokkalseeds.com

Laureate Citations

Lifetime Achievement Award
to
Late Dilip Gokhale

Born to lead: Dilip Shripad Gokhale (1947 – 2020) was a person with a sharp mind who with an MBA from IIM-A, was someone destined to lead – to build and manage big things, and provide new ideas to others. While testing his skills in divergent domains, from industrial financing to metal engineering, and then agribusiness, he set up a small formulation plant, where he approached Sandoz – a Swiss MNC, to be his client. However, the top boss of the company, impressed with his extraordinary talents, convinced Gokhale to join their company. There he went through varying managerial assignments, until in a few years when the company entered seeds business he became their obvious choice to lead it.

Gokhale used his business acumen to enter the market with a few likely winners such as hybrid sunflower 'Sunbred-212', cauliflower 'Serrano' (1st hybrid in India), cabbage 'Quisto', pepper 'Picador', and in due course the blockbuster tomato 'Avinash-2' which was price-tagged four times higher than the prevailing rate, setting a new benchmark for a value-added market segment. With the help a strong professional team built by Gokhale, he not only led the company's seeds division to emerge as a profitable and leading seeds operation of India, but also its team members to evolve as group leaders within and outside the company.

A harbinger and global leader: Dilip Gokhale soon evolved as a harbinger in Indian seed industry. Not only did he convince the company to invest in R&D in rice and cotton, as the new age of biotechnology ushered in, he joined hands with the Government in sponsoring its nationwide series of biosafety awareness workshops in late Nineties. Recognising his leadership, Dilip Gokhale was moved to global headquarters in Basel as a part of its core management. Subsequently, with the transition of Novartis into Syngenta, Gokhale as head Seeds for Asia-Pacific was part of major business reforms aimed at achieving greater excellence. He also successfully launched tropical sugar-beet in India. In February 2009, he played a key role making a two-

day National Seminar on Agriculture Extension happen under the Govt. of India in partnership with Syngenta Foundation. He was also a part of the Foundation's team undertaking a major study that led to the publication of book *'Transforming Indian Agriculture: India 2040 – Productivity, Markets & Institutions'*, released in January 2013 by Montek Singh Ahluwalia, Deputy Chairman, Planning Commission.

Final expedition: Later, while delivering lectures on building locally suited seed systems in Africa, on behalf of 'AGRA' and other programmes, the idea setting up a seeds enterprise of his own in Africa was rekindled in his mind. With his partner for life Shubhada Gokhale being on his side as always, the business that was started in Tanzania, was spreading in East Africa, and growing in size comparable to well-established entities. That is when the tragic news of his passing away on Oct 16, 2020, in Arusha struck like a bolt from the blue. The void of a leader par excellence and a great human being Dilip Gokhale will be missed forever.

The organizers of this conference consider it their profound privilege to present this Scroll of Honour in recognition of the invaluable contributions made by Dilip Gokhale to Indian agriculture.

Woman Achiever in Seed Sector

to

Dr Malavika Dadlani

for Year 2022

Dr. Malavika Dadlani has made significant contribution as a seed technologist, capacity builder, seed program manager, and promoter of public bred varieties through Public-Private partnership during her career of nearly four decades. She started her career in Seed Science & Technology with her doctoral research (1974 - 1979) and developed a simple farmer-friendly technology of '*seed hydration-dehydration treatment to prolong longevity*' of wheat seed by quenching the build-up of free radicals during storage in hot and humid environment. This was widely adapted by farmers in West Bengal and similar ecosystems.

Dr. Malavika Dadlani is a former Joint Director (Res) of ICAR-IARI, New Delhi, and led the teams to standardise protocols for protein and DNA markers for variety identification and hybrid purity testing in rice, pearl millet, sunflower, soybean and capsicum spp. A number of seed companies adopted these for in-house quality control**.**

As the Principal Investigator (PI) of NSP (Seed Technology Research), she led (1990's - 2004) the standardisation of poly-lined packaging requirements for seed storage of many crops that are being used by seed companies in public and private sectors. She also standardised the seed testing protocols for medicinal plants and on-farm seed invigoration protocols for field crops which are included in the Package of Practices by the SAUs.

She was instrumental in reorganising IARI's Seed Production Program that enhanced adoption of IARI's improved varieties in field crops and vegetables in the farmers' fields. During 2006 to 2013, IARI's *Breeder Seed production increased by 2 times in field crops and 85 times* in vegetables; whereas production of TL seed of IARI varieties (Pusa Beej) increased by *>4 times in field crops and >300 times in vegetables*.

Dr. Malavika Dadlani played key role in organising group of seed producing farmers to start a Farmer Producer Organisation in 2012 for seed production of self-pollinated crops such as wheat, paddy, chickpea under a registered FPO *"BeejIndia"*. The

company was incubated by the BPD-ITMU wing of IARI under her guidance**.** She guided 23 students for MSc & PhD degrees, and received **Best Teacher Award** by IARI in 2001. Conducted several national and international training courses for FAO, SAARC, AARDO in India

The Foundation for Advanced Training in Plant Breeding (ATPBR) is pleased to recognize Dr. Malavika Dadlani for her rich contributions in seed technology, capacity building and strengthening the public-private-farmer partnerships in seed production and distribution by awarding the *"Woman Achiever in Seed Sector"*

Lifetime Achievement Award

to

Dr. M. J. Vasudeva Rao

for Year 2021

Dr M J Vasudeva Rao started his Plant Breeding career as an Agricultural Research Services (ARS) Scientist at AICRIDA and AICSIP, Hyderabad of ICAR. He joined ICRISAT, Hyderabad to work as Sorghum Breeder and later as Groundnut Breeder. He then shifted to private sector Seed Companies (ICI Seeds/ ITC Zeneca/Advanta India), and finally served at Metahelix Life Sciences, Bengaluru as President Ag Technologies.

At ICRISAT, his unique "Checker-board" layout field-screening methodology was adopted for AICSIP national *Striga* resistance screening trials in India. He also developed the Cumulative Thermal Time (CTT) concept to select for earliness in groundnut. Among the many successful varieties and hybrids developed by him, Kharif grain sorghum variety SAR -1 (ICSV 145), was recommended for cultivation in *Striga*-endemic areas in India. Early maturing groundnut variety ICGV 86015 developed at ICRISAT, is released in Nepal, Pakistan, Sri Lanka, Vietnam, Mali, and Niger. ICGV 86143, another Spanish early maturing groundnut variety, is released in India, Vietnam, and Zambia and is widely grown.

While working with Advanta India, he and his colleagues developed grain sorghum hybrids PAC 501 (ICI 501) and PAC 537, for heavy black cotton soils of Karnataka and Maharashtra. Forage sorghum hybrids Jumbo and Sugargraze were successfully adopted in the north Indian fodder sorghum areas for their fodder quality. Sunflower hybrids, PAC 36, PAC 8699, and PAC 302 were market leaders widely grown for their high yield, oil content and drought tolerance.

Rice hybrids PAC 801, PAC 807, PAC 837, and PAC 832 have made their impact with farmers in India across Bihar, Jharkhand, Gujarat, Assam, Karnataka and other states. PAC 432 was the world's first commercial mustard hybrid bred in India with high oil yield and white rust tolerance. Hyola 401 (PAC 401) having Zero erucic acid and Zero glucosinolate was the first commercial

Canola quality rapeseed hybrid to be released in India. At Metahelix Life Sciences, he piloted the commercial release of two Bt Cotton hybrids expressing synthetic cry lC gene Event MLS9124, and this event is one among the five Bt Cotton events released in India. Most of these hybrids are nationally notified for cultivation.

Dr Vasudeva Rao was born in Mysuru and completed BSC (Agri) and MSc (Agri) at College of Agriculture, Dharwad and PhD at IARI, New Delhi. He was awarded Gold Medal by Government of Karnataka for getting first rank in 1970 and was conferred with Hari Om Ashram Trust Award in 1986 by ICAR for research in *Striga* resistance breeding at ICRISAT. He is a Fellow of Indian Society of Genetics and Plant Breeding, and has more than 50 books, book chapters and research papers to his credit.

The Foundation for Advanced Training in Plant Breeding (ATPBR) is pleased to recognize Dr. M. J. Vasudeva Rao's contributions in genetically enhancing sorghum, groundnut, rice, sunflower, and rapeseed/mustard by awarding "*Lifetime Achievement Award*".

Woman Achiever in Seed Sector
to
Dr. K. Madhavi Reddy
for Year 2021

Dr. K. Madhavi Reddy has contributed significantly to the development of Chilli varieties 'Arka Abhir' with high carotenoids and 'Arka Suphal' with resistance to powdery mildew, and suitable for green & red chilli markets. She has developed stable cytoplasmic genic male sterile lines of Chilli; and developed high yielding chilli F1 hybrids (Arka Meghana, Arka Harita, Arka Sweta and Arka Khyati), for diverse market segments with tolerance to powdery mildew, ChVMV & CMV for commercial cultivation. The parental lines of all these hybrids have been licensed to about 20 private seed companies on a non-exclusive basis.

She worked at the ICAR-Indian Institute of Horticultural Research, Bengaluru in Solanaceous Vegetable Crop Improvement programmes and is the Principal Investigator (PI) for Chilli and Bell pepper crop improvement and co-Investigator in Tomato and Brinjal crop improvement. She served as PI for six GTZ-AVRDC projects on Development of multiple disease resistant high yielding Chilli cultivars for Asia. She also served as PI for DBT, DST and NASF/ICAR network projects. PPV&FRA, New Delhi has recognized her as Nodal Officer for development of DUS guidelines and DUS testing of Chilli, Sweet pepper and Paprika.

Dr. Madhavi has also contributed to the development of four tomato and four brinjal varieties, and has guided 10 Ph. D. and 8 M. Sc. students and published more than 100 research articles in reputed journals. Dr Madhavi has organized four national and two international conferences and workshops and has also participated in several national and international conferences.

Dr. Madhavi was born in Chittoor town, Andhra Pradesh where she completed early education. She completed her B.Sc.(Ag.) (1983); and M.Sc.(Ag.) (1985) from S. V. Agriculture College, Tirupati and Ph.D. from College of Agriculture, Hyderabad, in 1990. She has received ICAR awards for multidisciplinary

research twice (2010 and 2016), and is also the recipient of ICAR-IIHR Best Teacher Award during 2021. She is a Fellow of National Academy of Agricultural Sciences (NAAS), National Academy of Horticultural Sciences (NAHS) and Indian Society of Vegetable Science.

The Foundation for Advanced Training in Plant Breeding (ATPBR) is pleased to recognize Dr. K. Madhavi Reddy's contributions in enhancing chilli, tomato and brinjal production and productivity, by conferring on her this 2021 Award for the "*Woman Achiever in Seed Sector"*.

Lifetime Achievement Award
to
Dr. Narendra Kumar Singh
for Year 2022

As a tomato breeder in Syngenta, Dr Narendra Singh developed many leading tomato hybrids for India and the Middle East market in the 2000s. A few of the hybrids excelled in north African region, especially in the Libyan market. He initiated a platform called ASRT (Asia Solanaceous Round Table) in 2014 to address farmers' issues, via Public- private partnerships. He also initiated the ACRT (Asia Cucurbits Round Table) platforms to foster Public-Private partnership in Asia. Both ASRT and ACRT had two successful rounds, and a few successful collaborative projects have emerged from these conferences in partnership with World Vegetable Center, Taiwan and BIOTECH, Thailand.

Dr Narender Singh started his career as post-doctoral fellow with IARI, New Delhi in 1991. He Joined TERI in 1993 and worked to developing "00" rapeseed mustard varieties and registered two rapeseed varieties. He joined Syngenta (in 1995) as tomato breeder and developed several leading tomato hybrids for South Asia, SEA and Middle East market. Cultivar Abhinav (resistant to TYLCV, TMV, F2 and powdery mildew, firm fruit with high yield at high temperature), is a leading hybrid for summer market in India, Pakistan, and Libya. It made US$ 11milion in a year at its peak, topping Syngenta hybrids globally. Another hybrid, TO1389, for rainy season, had a seed sale value around US$ 5million/year. Several other hybrids like Trishul, All-rounder, Amlik and TO 687 resistant to BW, TYLCV, TMV,F2,V,St & powdery mildew, for niche markets in India, South East Asia and African countries.

He developed 3 very successful tomato hybrids "Super jackal, Tomaland and Yasameen " highly resistant to TYLCV, TMV with 140-180g fruit size for Middle East markets. Launched in 2001 the hybrids fetched around Euro 3-5 Mill/ year after 3 years of launch. They are still sold in Egypt, Jordan, Syria and Algeria markets.

Dr Narendra Singh lead Vegetable Research teams for Asia

Pacific Region at Syngenta from 2007 to 2011 & H M Clause from 2011 to 2019. He was member of Global R&D Management team at both, and under his leadership at HM Clause developed Asia crop breeding strategy, and delivered many leading hybrids of Tomato, Okra, hot pepper, tropical cauliflower, cucumber, bitter gourd, and sunflower for Asian markets. Successfully lead the global Brassica team of Limagrain for 5 years.

The Foundation for Advanced Training in Plant Breeding (ATPBR) is pleased to recognize Dr Narendra Singh's contributions in genetically enhancing tomato, Brassica and okra by awarding the "*Lifetime Achievement Award"*.

Lifetime Achievement Award

to

Dr. R. S. Mahala

For year 2021

Pearl millet hybrids developed by Dr. R. S. Mahala were grown on an average of 2.5 – 3 million hectares or 25-30% of total hybrid volume every year for last two decades in India. His biggest volume hybrids were 86M32 and 86M52, and86M52 lasted for more than 11 years. This is a very significant contribution towards improving the total productivity and production of the country and increasing the profitability of resource poor farmers. Pearl millet hybrid 86M86 was first private sector high yielding hybrid in India that had highest iron 56 ppm and Zinc 40 ppm and approved by Govt. of India for Nutri Farm scheme.

Dr. Mahala started his career as production officer in 1986 with Corteva (formerly known as Pioneer Seeds), and later worked as lead pearl millet breeder in 1990. He built the pearl millet breeding program, research team and processes to make millet one of the most successful crops in Corteva Agriscience. During his 32 years of career, he developed 40 plus commercial millet hybrids.

He was born in village Bhatiwar, district Jhunjhunu, Rajasthan. He completed his schooling in his native village and BSc (Agri) from University of Rajasthan. He did his MSc. in Plant Breeding from G B Pant University of Agriculture & Technology, in 1986 and Ph.D. in Biotechnology from University of Mysore in 2009. He regularly contributes towards scientific publications, seminars and research papers pertaining to pearl millet. He co-authored two books on "Twenty-five Years of Pearl Millet Improvement in India" and "Pearl millet seed production technology" released by AICPMIP, ICAR.

Dr. Mahala was the recipient of "Gene Dalton Evolutionary Impact Award" in 2013, One of the highest honors within Corteva for the remarkable contributions in plant breeding. Pearl millet research team under Mahala's leadership received several Pioneer global awards such as "Highest Impact Product Award" in 2008 and 2013, "Outstanding Team Performance Award" in 2012

Dr. Mahala joined Seedworks International Pvt. Ltd. in January 2019 and currently working as Research Director. He serves as Adjunct faculty at CCSHAU, Hisar, and member of corporate advisory board, School of Agriculture at Lovely Professional University.

The Foundation for Advanced Training in Plant Breeding (ATPBR) is pleased to recognize Dr R. S. Mahala's contributions in genetically enhancing pearl millet crop by awarding the *"Lifetime Achievement Award"*.

Woman Achiever in Seed Sector
to
Dr. R. SARASWATHI
for Year 2022

Dr. R. Saraswathi has developed eleven rice varieties suitable for different rice growing seasons in the Cauvery Delta Zone. They include the extra –early variety ADT(R) 48; four early maturing varieties [ADT(R) 47, Rice ADT 53, ADT 57 and ADT 55]; two long duration varieties [ADT 50 (fine rice) and ADT 51] for single crop wetlands; and four medium duration varieties [ADT(R) 46, ADT 49, TKM 13 and ADT 54] ideal for second season. TKM 13 with fine grains is very popular among farmers and the new two-in-one variety ADT 54 with high yield and grain quality has good acceptance.

She started her career as Assistant Professor in Plant Breeding and Genetics at Rice Research Institute, Aduthurai (TNAU) and continues to develop rice varieties and hybrids and seed production for over 24 years. Dr.R. Saraswathi had been responsible for nucleus seed production of 12 early maturing and four medium duration rice varieties at Aduthurai for more than 12 years. For about six years, she produced and distributed breeder seeds of 10 early, medium and long duration rice varieties. Truthfully labelled seeds of eight rice varieties that were produced have directly reached the farmers from TNAU.

She is presently the hybrid rice breeder of TNAU at Coimbatore (from 2015) under AICRIP, using three-line and two-line hybrid breeding technology. Hybrid CO 4 was commercialized to three private seed companies. She is also actively involved in development of new CMS lines, maintainer lines and diversification of restorers in hybrid rice program. She serves as an Advisory Committee member representing TNAU for Hybrid Rice Development Consortium (HRDC), IRRI, Philippines (2017-23).

Dr.R.Saraswathi serves as Principal investigator of ICAR funded projects and Co-Principal Investigator of DBT, DST-FIST, IRRI, NADP-RKVY, UGC and private sector sponsored projects. As Project Director of Centre of Excellence in Molecular Breeding at TNAU for one and half years, strengthened its infra-structure facilities. She was awarded as best trainer on 'Rice Seed Production Technology' to rice farmers by IRRI. She has 103 publications that include book chapters, research articles and conference papers and guided six M.Sc (Ag) and four Ph.D scholars.

The Foundation for Advanced Training in Plant Breeding (ATPBR) is pleased to recognize Dr R. Saraswathi for her rich contributions in development and large-scale seed production and dissemination of high-yielding rice varieties by awarding the "*Woman achiever in Seed Sector*".

Excellence in Supporting Indian Seed Industry
to
Gubba Cold Storage
for Year 2022

Gubba Cold Storage is offering world class services to the Indian Seeds Industry for more than three and half decades in safe storage of their hybrid seeds and parental material, especially valuable germplasm.

Gubba has been serving and partnering with Indian Seed industry, and thus the Indian farmers indirectly by way of carefully preserving the seed vigor and viability of seeds used for sowing. The high-performance packed seeds have helped the smallholder farmers to harvest bumper yields and contribute to the national food security.

Gubba Cold Storage is serving >500 seed companies handling millions of tons of valuable seeds, especially nucleus, breeder, foundation and Truthfully Labeled Seed. Gubba Cold Storage is aptly called the "lifeline" and a catalyst in the growth of the Indian Seeds Industry.

In addition, Gubba Cold Storage is providing value added services, such as Seed Quality Laboratory Services (SQLS); Biotechnology Laboratory Services (BTLS), and Multi Location Product Testing Services (MLTS).

The Foundation for Advanced Training in Plant Breeding (ATPBR) is pleased to recognize and honor Gubba Cold Storage for its yeoman service to the Indian Seed Industry by Awarding the "*Excellence in Supporting Indian Seed Industry*".

Excellence in Indian Seed Industry

to

Mr. N. Krishna Bhat

for year 2021

Mr. Noojibail Krishna Bhat is one of the pioneers of Indian vegetable seed industry. His inspiring vision, strong leadership, selfless attitude, and tireless efforts have been instrumental in establishing a professional and viable vegetable seed industry in India. He specialized in this field after receiving a BSc (Ag.) and MSc in Horticulture from Karnataka University, Dharwad.

Back in 1967, Mr. Bhat acted as a venture capitalist, an unprecedented move for the agricultural sector during that time. He joined Indo-American Hybrid Seeds as a Partner when the company needed funds to expand into unchartered territories. Along with Dr Manmohan Attavar, Mr. Bhat was an integral part of the foundation and pillars of Indo- American Hybrid Seeds. He traveled the length and breadth of India to demonstrate the effectiveness of hybrid vegetable seeds to the Indian farmers and to train farmers in production of hybrid vegetable seeds. After more than 40 years of selfless and silent contribution, Mr. Bhat retired as Joint Managing Director of Indo- American Hybrid Seeds in 2004.

He represented India as member of the Trade Delegation that visited Holland in January 1993 to explore the possibility of export of cut flowers from India. He was also a member of the Indian delegation to Turkey and Netherlands in September 1993 to study the Plant Quarantine procedures. Mr. Bhat served in the Board of State Bank of Mysore and APEDA (Agricultural Processed Food Products Export Development Authority). He also served as Vice-President of All India Seed Growers, Merchants & Nurserymen Association, Madras.

Mr. Bhat has been an active participant in cultural and social organizations, such as the Rotary Club, Indo-American Chamber of Commerce and the Federation of Karnataka Chamber of Commerce. He is a keen philanthropist and is a major donor for many Rotary projects, Educational Scholarship Funds, and gives funds for the needy. He has sponsored construction of many classrooms for schools in rural areas and for needy children.

The Foundation for Advanced Training in Plant Breeding (ATPBR) is pleased to recognize Mr N Krishna Bhat's outstanding contributions to nurture seed sector by awarding the "Excellence in Indian Seed Industry".

Women Achiever in Seed Sector

to

Ms. A.K. Jayalekha

for year 2021

At a time when plant breeding in the Private Sector Seed Companies was dominated by men, a few women breeders entered the field of crop improvement and made a mark. Ms AK Jayalekha has excelled in pearl millet. She started as a Research Associate at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Hyderabad and then moved to Proagro Seeds, which later became Bayer Crop Science. After working for nearly 3 decades, she took early retirement in 2019 to devote her time with the Isha Foundation for uplifting of poor girl children.

She spent her entire career working on pearl millet, a short duration and hardy crop in the harsh arid and semi-arid regions globally, including India. She developed more than 12 hybrids that were adopted by the farmers. Important among them are: Proagro 9444, a high grain and fodder hybrid with tolerance to heat, drought tolerance and to downy mildew, smut and ergot diseases. 9444 was commercialized in 2000 for both kharif and summer seasons, and is still in the market. Proagro 9450 hybrid was adopted in >1.8 lakh ha at its peak.

Tejas and Marutej are short duration (70 days) hybrids commercialized for A1 zone, tolerant to rust, downy mildew and blast. Proagro 9072 was commercialized in 2018 in Rajasthan and Haryana and covered > 20, 000 hectare in 2020. Proagro 9444Gold is a medium maturity (75-78 days) hybrid commercialized in 2013 for A1 zone in western India.

New hybrids released include 9001, 9180 and 9285, and are showing very high level of tolerance to blast and downy mildew in addition to being very high grain and fodder yield. These three new hybrids together covered 2 lakh ha in 2019. Another hybrid PB 1720 was identified for its high Fe content

Ms. Jayalekha was born in Kadirur village of Thallssery district of Kerala and completed her early education in Secunderabad. She completed her B.Sc. (Ag) (1985) and M.Sc. (Ag) in 1987 at College of Agriculture, Rajendranagar, Hyderabad. She received the Best Private sector scientist award in the year 2000 by All India Pearl millet Improvement Program (AICPMIP) and Achievement of Excellence award by Bayer in 2006. She was a member of the Advisory Committee of Pearl millet Hybrid Parent Research Consortium at ICRISAT, Hyderabad.

The Foundation for Advanced Training in Plant Breeding (ATPBR) is pleased to recognize Ms AK Jayalekha's contributions in enhancing pearl millet production and productivity by awarding the "*Women Achiever in Seed Sector*".

Laureate's Message

Laureate
Dr. R. S. Mahala
Research Director, Seedworks International Pvt. Ltd.

Food secure future through climate smart sustainable agriculture

Agriculture contributes close to 20% gross domestic product (GDP) of India and a source of livelihood for about 58% of India's population. India is among top 15 exporters of agricultural products in the world. Country's food grains production is going to touch around 310 million tonnes in the 2021-22 crop year (July-June). As per the estimates of Indian Council for Agricultural Research (ICAR), demand for food grain would increase to 345 million tonnes by 2030.

India's population in the next decade is going to be the largest and making sufficient quality food available for all is going to be a challenge. The average productivity is low in most of the crops. Since the 1990s, average yields of maize, rice and wheat at the global level have increased just over 1 per cent per annum. Farmers of India are struggling with multiple challenges in farming like increased cost of cultivation, small holdings, climate change, soil degradation, depleting water levels, less use of modern technologies, marketing and supply chain challenges. Hence it is important to increase focus on high yielding varieties with improved yield, quality and defensive traits, and environmentally sustainable technologies.

The good news is that investment in agricultural infrastructure is increasing year on year. Access to improved seed, and precision farming technologies might bring efficiencies in productivity improvement and integrated management of soil, water and biological resources. Diversification of crops and agri-allied sectors such as fisheries, animal husbandry, and forestry will increase the income of farming household.

2070 carbon neutrality target set by India at the CoP26 in Glasgow, the Union Budget for 2022-23 has listed "climate action" and "energy transition" as one of the four priorities. The impact of climate change on agriculture is a growing concern and the need of hour is to start exploring news ways of "climate smart agriculture" to address food security and increase farmer's income in a sustainable way.

Laureate
Dr. M. J. Vasudeva Rao
Co-Founder, GRSV Consulting Services,
Bangalore

Dr. M. J. Vasudeva Rao *is currently Co-Founder of GRSV Consulting Services, Bangalore. Dr. Rao completed graduate education in agriculture and post-graduate education in Plant Breeding from UAS Dharwad with outstanding performances. His Doctorate in Genetics was from IARI in 1976. He clocked one and a half decades of Plant Breeding-related work experience in UAS-Bangalore, ICAR, and ICRISAT, the leading public sector institutions. Later, for close to three decades, he worked in multinational and national seed companies in India in a range of responsibilities from Crop Breeding to Research Management to Supply Chain, Sales, Marketing, and Business responsibilities.*

Past, Present and Future of Plant Breeding

Historically human beings have evolved significantly from their wild status when they were nomadic hunter-gatherers to meet their food needs. Agriculture started when they became settlers, and they started cultivating plants as crops and started rearing animals in captivity which provided their food and other needs. Since then, by selectively propagating and growing the plants of choice, humans have, intentionally or otherwise, changed the genomes of virtually every plant grown for food or other non-food purposes. More recently, changing of genetic structure of plants has continued more vigorously and precisely as plant

breeding based on the science of genetics developed. Further, as the humans migrated across the globe and the human societies evolved, they adapted a more organized way of life and started adapting early agricultural practices for their food requirement. These changes, along with an explosion of human population, in turn, had major impacts on the environment of agriculture and evolved into conscious or unconscious selection of traits that helped to improve yields or quality. Original traits that were not suitable for agriculture were rapidly lost, for example, seed shattering. At the same time traits favoured by humans increased in frequency, for example, seed size, shape, quality, retention, etc. There are studies to show the evolution in plants which is parallel to human evolution and migration. In this process, humans have used, knowingly or unknowingly, the same basic methods of plant breeding, which are taught today, in directing the evolution of plants. Plant Breeding has been, therefore, part of history of mankind. Four phases of Plant Breeding can be recognized in its history. The earliest phase, where plants evolved only through competition among themselves without the intervention of human beings. The next phase, where plant improvements happened due to intervention of human beings during the stage, when man became a settler from his hunter-gatherer stage, and brought out plants useful as food, fodder, fuel, timber, etc., from their natural habitat to be grown as crops. The third phase started when scientific principles were enunciated through Laws of Mendel, and the current phase, when New Breeding Technologies (NBTs) are adopted to make plant breeding more precise and promise faster rate of gains. Plant Breeding, as a science and contributor to human well-being, appears to be headed in future towards becoming more efficient and more precise in delivering better-defined trait targets. It may be predicted that in future, more genes from highly diverse sources across the species, genera, other higher orders are likely to be used in plant improvement.

Laureate
Dr. R. Saraswathi
Professor (PB and Genetics), Department of
Rice, Tamil Nadu Agriculture University

R. SARASWATHI, *Professor (PB&G), Department of Rice, Centre for Plant Breeding and Genetics, TNAU, Coimbatore, Involved in rice varietal, hybrid breeding and seed production spanning over 24 years. Contributed for 11 rice varieties released in Tamil Nadu State, three varieties as National releases and experience in seed production for 12 years in varietal program and 6 years in hybrid program.*

Among the various disciplines of agricultural science, the technological innovation by a plant breeder through the conventional and also assisted by biotechnological interventions finally ends up in a new variety/breed which is the real need of a farmer. If we line up the factors contributing for high productivity thereby production in a crop, definitely varietal innovation contributes upto 70% followed by other disciplines like crop management, protection, seed and extension. Reverse breeding based on field study about the requirements of farmers, millers, processers, traders and local demands and then formulating our objectives, choosing parents, hybridization or adopting correct breeding procedure, selection and advancement of right phenotype will result in a stable breeding line which will be accepted by the stakeholders and last long as a mega variety. Such innovations need no special efforts for popularization by extension personnel but the variety will percolate itself in the market and that will bring the real satisfaction and further motivation to the innovator(s). A plant breeder is the person who has knowledge in other disciplines also like seed science, crop agronomy, protection, extension and recently molecular tools which is a holistic approach to find solutions. The foremost requirement of a farmer is a good varietal choice and availability of seeds in that variety. On these fronts, the seed sector plays a definite role in making the innovation to reach the farmers by making available good quality and quantity of seeds of the variety with genetic purity. Together in this noble profession, let us strive to fulfill the scientific demands of the farming community.

Laureate
Ms. Jayalekha AK
Former Lead Breeder- Pearl Millet (Bayer)

I thank the organizers of the Annual conference of 5F farming on 'Realigning Indian Agriculture for a Sustainable Future 'especially ATPBR and the other organizing partners (KIIT, OUAT, ILS and ICAR & Ramadevi Women University) for inviting me to receive an award as one of the women achievers in Seed Industry Award.

I am Jayalekha a postgraduate in Agriculture with specialization in genetics and plant breeding from the then Acharya NG Ranga Agricultural University (presently known as PJTSAU- Professor Jayashankar Telangana State Agricultual University), Hyderabad. I started my career in 1988 as a Research Associate in Chickpea Breeding in ICRISAT (International Crops Research Institute for Semi-arid Tropics).

Later in March1991 I joined Proagro Seed company limited (which later became part of Bayer) as a Research Associate in Pearl millet Breeding and went on to lead the Pearl millet Breeding program in Bayer. In those days where women were not the choice for any field work it was Dr Suri Sehgal who owned Proagro seeds who gave the women an equal chance to work in these areas. Being a private seed company focused on commercial breeding this is where I learnt how to breed for varieties that suit different market segments. Pearl millet being a short duration hardy crop resilient by itself gave me a chance to be in the fields for most part of the year. Keen observation of the progenies to select the ideal parental lines and then thorough screening of the hybrid combinations in two or more target locations was the key in identifying the right hybrids for a region. I always got

support of my team members and also the other departments like pathology, seed production Sales &Marketing which is very essential for the success of any product. I cherish the moments spent with the other scientists during AllIndia Workshops and Seminars and also meetings in ICRISAT. I owe my learnings to all those with whom I got a chance to interact.

During my career of 28 years 1991-2019 in Bayer, I got the opportunity to be part of the team that developed several long running hybrids for the main pearl millet markets of the country. One amongst them is 9444 developed in 2002 for both kharif and summer and still being sold in North and Northwest India. Other hybrids that became popular are 9450 for all India, early duration hybrids Tejas , Marutej , 9072 and the most recent 9001, 9180 and 9285. Even now it is very heartening to hear about the performance of these hydrids and the growth each of these hybrids are taking each year. Inspite of the Covid situation the company sold approximately 2500 MT and planning for crossing 3000 MT this year.

I took voluntary retirement from Bayer in 2019 to focus on my personal commitments and also to spend more time as an Isha Volunteer. I wish to dedicate whatever time I can for the overall wellbeing of people around me and through the programs that I did in Isha live a more conscious and responsible life. I feel privileged to be able to participate in the ongoing Global movement known as SAVE SOIL- A conscious planet initiative which presently is focusing on bringing awareness amongst the human population across the globe about the sad state of the soil and the urgent need to bring policies that revitalize soil and ecology. It is said that by 2050 90% of earths soil could be degraded if we don't act now. I request each one of you here to voice your support for this movement in your own capacity and your circle by giving a missed call to **80000 30003.** Those of you who wish to know more about this feel free to contact me

Jayalekha AK
Former Lead Breeder- Pearl Millet (Bayer)
Jayalekha1989@gmail.com
Mobile 9849989743

Laureate
Mr. Kiran Gubba
CEO & Director, Gubba Cold Storage Ltd

Mr Gubba Kiran, CEO, Gubba Cold Storage is a philanthropist, extreme professional, workaholic, eloquent, a proud husband, a mentor to all his colleagues and a lot more. With 27 years (and counting) of immense experience of struggle and growth, his commitment is to contribute to the Indian Seed, Pharma & Food sector in the aspects of Research & Development & Cold storage preservation.

Seed warehousing for vigor retention

Seed is life. As we start sowing the very seed, the next and every step gets equally important in value Retaining its vigor and viability is evidentially the most crucial in the entire process. The harvested seeds of most of the orthodox crop seeds are usually dried and stored for at least one season until the commencement of the next growing season. In most of the Agricultural crops ageing starts at physiological maturity, which is irreversible. Hence seeds become practically worthless if they fail to give adequate plant stands in addition to healthy and vigorous plants.

It would rather be just a myth to claim that the prime reason for seeds to be stored is that there is an interval between harvesting and planting. The prime reason is to retain the physical and physiological quality of the seed and we attain satisfactory capacity for germination and emergence. Also, some kinds of seeds are stored for extended periods to improve the percentage

and rapidity of germination by providing enough time for a "natural" release from dormancy.

Different seeds have different characteristics and hence need to be treated and stored accordingly. If there is any room left for tampering in storage, then seeds dry up, lose its moisture content, viability, develop fungus. A study revealed on an average 12-15% of seed production in India is wasted due to improper storage.

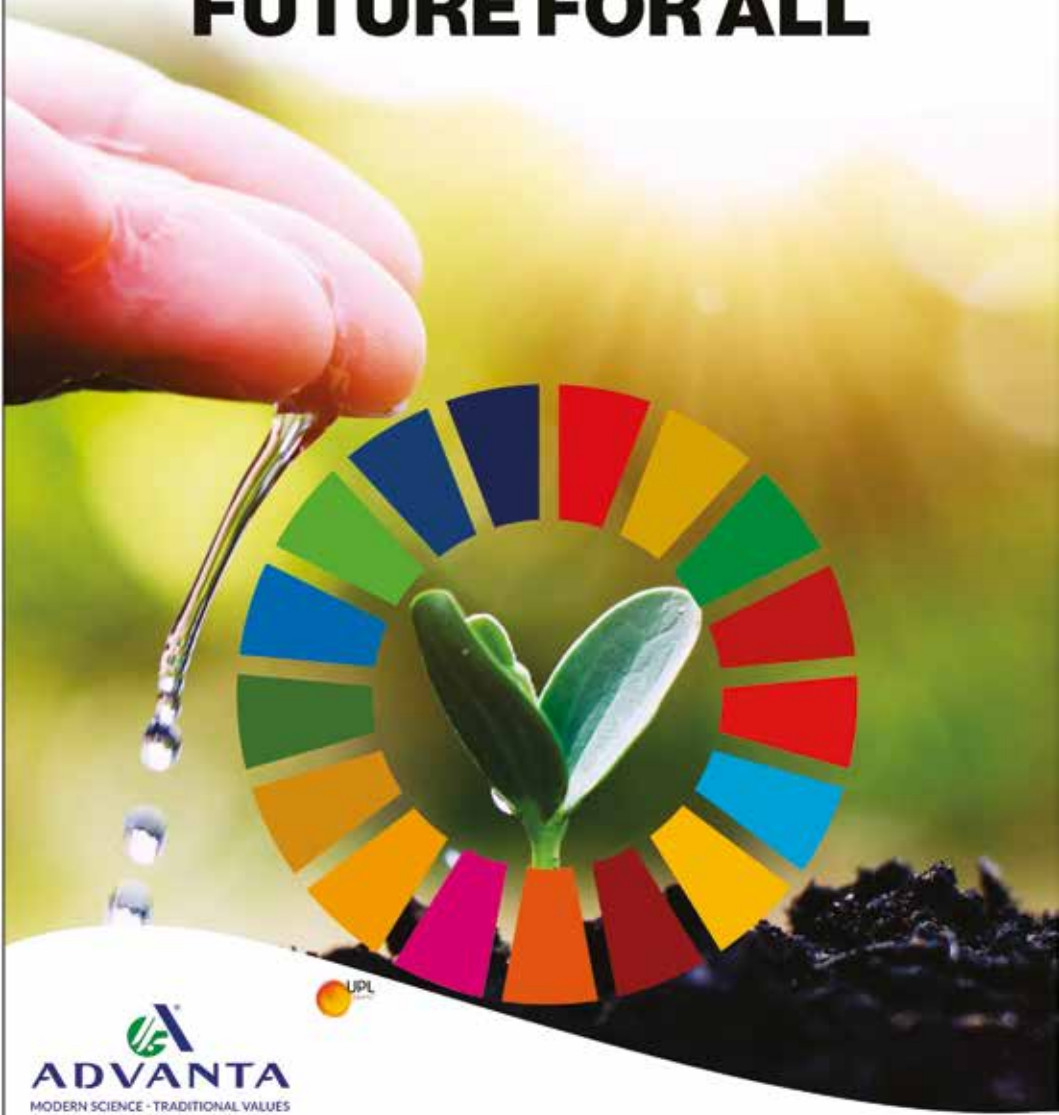
In 1987, we realised the utmost need for a climate-controlled facility provision to preserve the seeds to secure our farmer's handwork and also to create a way to have our country walk towards the path of development. Gubba is not only the first but also the biggest seed cold storage, to add on to that, we have also been the first one in India to introduce Jumbo bag seed preservation. We started off with 500 MT and now we are at 1.35cr cubic feet capacity. We preserve the seeds @ 10-15*C while maintaining a relative humidity of 40-50%.

Our Indian Seed Industry spends numerous valuable resources that go into the research & development of seed in the domain of gene, hybrid, resistance and other experiments, these foundation seeds are nothing less than a treasure of India's development. India's progress in seed industry could go back in time to not less than an average of 40 years if there a slight tampering in the preservation of germplasm. The seed moisture is maintained in equilibrium & stored at the temperature of -20*C in the Gubba Germplasm bank.

We @ Gubba are catering ourselves to be the lifeline of Indian Seed Industry, providing world class technologies & apex services. India soon shall be self-reliant!

HIGH QUALITY SEEDS &
INNOVATIVE TECHNOLOGY FOR

A BETTER AND MORE SUSTAINABLE FUTURE FOR ALL



UPL

ADVANTA

MODERN SCIENCE - TRADITIONAL VALUES

Speakers Abstract

"Small Farmers, Large Fields (Sflf)": An Innovative Model Towards Doubling Farmers' Income – The Concept And Evidence From Eastern India Pilot Project

Dr. Bidhan K. Mohapatra

In the past few years, "Small Farmers, Large Field (SFLF)" schemes have received significant attention in Vietnam, Thailand, etc. (Mohanty et al., 2017). This is to introduce scale efficiency by developing a model of community farming which pools small and marginal farmers together; enabling them with efficient, cost-effective input use, technical knowledge and infrastructural facilities that will help overcome the constraints faced by small farmers in accessing inputs, formal credit system, extension and marketing. Through systematic, planned and synchronized agricultural practices, farmers can utilize scale to procure inputs at a lower price, and gain more bargaining power for their produce. Raising productivity and profitability of small farmers' demand timely access to quality seeds, fertilizer markets and agricultural machinery, technology sensitization, irrigation systems, post-harvest storage and marketing strategies. Agriculture will be profitable and attractive only if farmers are empowered and their produces are linked to markets or a value chain. Connecting the "community farmers" directly to input and service markets, millers/organized retailers or such super/ global markets has the potential of shortening the value chain, translating into higher farm incomes. At the same time, these market actors can reduce their transaction costs considerably by sourcing quality and uniform products from a bigger unit rather than from very heterogeneous small farming communities producing low graded rice with the mixing of several varieties and assure the demand of inputs/ supply of produce from community farms. This enables lowering the input/service cost as well as fetching higher sale prices. The model of community farming would not only ensure better access of small farmers to quality services but will also mobilize & build their collective capacity to leverage their production and marketing strength.

Piloting in Odisha, an eastern India state: International Rice Research Institute (IRRI) in support of its ongoing projects

then like Cereal Systems Initiative for South Asia (CSISA) and Stress-Tolerant Rice for Africa and South Asia (STRASA) piloted SFLF customized model at in Odisha. We also engaged a local NGO/CBO for better facilitation. The evidence from our piloting revealed – 1) cost of production reduced, paddy yield increased, paddy was sold at a higher price, farmers' income raised. Etc. Besides economic gain; most importantly farmers could able to save about around a month time by doing activities in a group. The time they saved, was used for other income-generating activities and spent quality life with family and relatives.

A sustainable farming system can be planned with a suitable cropping system and livestock development for smallholders' upliftment and conservation of biodiversity. An efficient scale-up of this model in the medium and long term can facilitate effective implementation of government policies, thereby improving the livelihood of millions of small farmers.

A BRIEF PROFILE OF BIDHAN K. MOHAPATRA

Bidhan is a development practitioner, socio-economist and program manager with 18+ years of experience and exposure in the development sector related to socio-economic action research, strategic planning, project/study management, impact assessment, monitoring-evaluation-learning, strategic partnership, community mobilization, training and capacity building and team management. He is trained by reputed institutes on updated research techniques.

Presently Bidhan is working at the International Rice Research Institute (IRRI), a member of the Consultative Group for International Agricultural Research (CGIAR). Bidhan has worked in more than 66 studies/projects for/funded by International Organizations – IRRI, ILO, FAO, UNDP, WFP, USAID, BMGF, DFID, IFAD, etc., and various Ministries of Government of India and State Governments.

Bidhan has a good number of publications of international, national and local levels focusing on rural and agricultural development for poverty reduction and food security for all. Some of his recent publications are:

- Poverty and Food Insecurity Disparities and Their Causes in the Eastern Indian State of Odisha (Sage Publication)
- Assessing technologies with sustainability lens in rice production system of Eastern India (Journal of Cleaner Production)
- Gender differences in rice value chain participation and career preferences of rural youth in India (Development in Practice)
- Weed management approaches in direct-seeded rice in eastern Indian ecologies – A critical and updated review (Indian Society of Weed Science)
- Agricultural development and food security in Odisha (Indian Journal of Economics and Development)
- Small farmers, Large field: An innovative model towards doubling farmers' income in Eastern India (India Farming, ICAR)
- Coping with climate extremes: Development interventions through strategic collaboration – A case from Odisha (Agricultural Extension in South Asia)

Dr. Binay Kumar Choudhury
Chairmen
CU Inspections & Certifications India Pvt. Ltd.

Role of Sustainable Certification Standards in the Development of Sustainable Farming

Sustainable agriculture is farming in sustainable ways, which means meeting society's present food and textile needs, without compromising the ability for current or future generations to meet their needs. One of the myths linked to sustainable agriculture means going back to past farm practices, which were followed by our ancestors. In fact, sustainable agriculture can be achieved by combining some of the wisdom of past practices, with careful use of current technology, including the vast array of information technologies now available. There are over 400 such standards across the world. Most standards refer to the triple bottom line of environmental quality, social equity, and economic prosperity. Sustainable agriculture is a key element of sustainable development and is essential to the future well-being of humans and the planet

Scope for Development

Sustainability standards and certifications are voluntary, usually third party-assessed, norms and standards relating to environmental such as IFGICT Standard, social, ethical and food safety issues, adopted by companies to demonstrate the performance of their organizations or products in specific areas. The trend started in the late 1980s and 90s with the introduction of Ecolabels and standards for Organic food and other products in regards to first introduction IFOAM (International Federation for Organic Agriculture Movement) standard followed by EEC (European union), NOP (USDA- National organic programme) and JAS (Japanese Agriculture Standard). Most of the countries started their own standards and accreditation programme like

India started its own organic standard called NPOP (National Programme for Organic Production). Mostly all the agriculture and food products are covered with Government standard and in India under FASSAI and APEDA jurisdiction making the food system most robust for sustainable business. NPOP certified production is able export the products to various countries with additional requirements and most of the countries have defined system for accepting the sustainable products as per the consumer norms of those countries. Certification has become an essential tool to give the third party guarantee to the claim mentioned in the label. There are lot of private standard where value addition of the certified products with low impact chemicals are accepted to many buyers and consumers in many countries. In clothing sector where agriculture fibre is used with colorant, many standard like GOTS (Global Organic Textile Standard), Textile Exchange (TE) standards have taken a lead role for the organic and sustainable textile business. These organic standards cover wide range of products from agriculture, animal and bee keeping prospective thus making consumer aware about the sustainable product use. The social standard adopt in the industry is based on the ILO (International Labour Organisation) principle covering many aspects based on the country and buyer requirements. Such social standards like SMETA, Sedex, ETI, SA8000, BSCI, WRAP etc is based on product and buyer and is well Governed by private organisation. The environmental standards is mostly based on ISO principles covering, waste, water and energy requirements and some of the principles is based with private standard with life cycle analysis, water and carbon foot print for the products. These standards are well accepted and adopted by countries with norms on social, technical and environmental compliances. A compelling need exists for restorative of sustainable agriculture to help address the pressing trends of population, climate, energy, water, soil and food. Eliminating child labour is one of the important aspects of sustainability working towards UN's goal of eliminating child labour by 2025. Additional differences between standards might relate to the certification process and whether it is conducted by a first, second or third party; the traceability system in place and whether it allows for the segregation or mixing of certified and non-certified materials; and the types of sustainability claims that are made on products is important from standard point of view. In recent years, the business-to-business focus of sustainability standards has risen as it has become clear that consumer demand alone cannot drive the transformation of major sectors and industries.

Krishi Ratna Shri Chandrashekhar H. Bhadsavle
Founder and Managing Trustee, Saguna Rural Foundation (SRF)

A FoodTech MS from USA, an innovator farmer with mission to get dignity for farming. His three innovations are bringing happiness to farmer (SRT), forests and hills (SVT), and the waterbodies (SJT). No Tilling Farming is his mission. Recipient of several state & national awards.

'Realigning Indian Agriculture through the regenerative farming method SRT, an agronomic intervention.'

Intensive and extensive tillage in modern day agriculture has proved to be 'degenerative agriculture' practice and is resulting in extreme land degradation. Agriculture, deforestation and other factors have degraded and eroded topsoil at alarming rates. Globally, 52% of agricultural land is already degraded.

Global warming and food shortage are the two most detrimental problems faced by our planet today. Both of them can be taken care of only by the farmers. But farming today pictures, "lack of dignity, drudgery of labor and poverty." This has resulted in farmers getting old; the average age of a global farmer today is 60!

These problems proved to have been solved magically by Saguna Rice Technique (SRT), an agronomic intervention. We define it as "a conservation agriculture (CA), No-till method of farming which does not cause atrocity of tillage, completely stops soil erosion, promotes natural production of earthworms, increasing organic carbon of the soil, considerably increases productivity of the land and added effect of amazing happiness & confidence of the farmer." (www.srt-zerotill.com)

The results of adopting and practicing SRT method of farming have improved the soil health by increasing soil organic carbon, thus increasing its productivity significantly. Being a zero-till method of agriculture, it has reduced labor and costs of inputs for crop cultivation. It is thus, the holistic capacity-building tool for today's farmer. SRT is an aerobic method of cultivation, preventing methane emissions, naturally mitigating greenhouse gas emissions.

Digitalization Approaches for improvement in Agricultural production

Sanjeev Panwar[1] and Susheel Kumar Sarkar[2]
[1]Principal Scientist, ICAR-HQ, and [2]Senior Scientist,
ICAR-IASRI, New Delhi
sanjeevp.icar@gov.in

Abstract

In agriculture and natural resources research and development, the role of researchers is as crucial as the role and value of timely information received from various sources. With the management task of decision-making and problem-solving, their quality and effectiveness are affected by the accuracy, sufficiency, and timeliness of information. In agriculture too, research programmes are based on digital information as one of the basic endeavours of information processing, an appropriate availability of information through different databases and research pipelines.

An effort is being made to utilise the modern strategies in breeding program. There is huge opportunity for the researchers to enhance the genetic gain by practicing next generation breeding approaches in the research programs. It includes, system-oriented breeding approach, streamline the breeding processes, exploitation of the novel variations in the germplasm, accelerating the breeding cycle, precision techniques for phenotyping, high-throughput genotyping of diagnostic markers, reduction in recurrent costs, automation and digitisation of processes, informed-decision making systems, and so on.

Dr. CL Laxmipathi Gowda
Former Deputy Director General, ICRISAT and Co-Founder,
GRSV Consulting Services, Mysuru, Karnataka

Ensuring Sustainability of Organic Agriculture [#]

The current agriculture production (including food, feed, fiber and fodder) needs to be almost doubled to meet the demand for the projected ~ 9 billion populations by 2050. Organic agriculture is suitable for some agro-ecologies, and there are niches where OA can be practiced profitably and sustainably. Recent evidence indicates that organic agriculture (OA) is becoming unsustainable in many areas of the countries of tropical and sub-tropical regions of the world. We need to understand that organic agriculture is not a panacea, and a cure for all ills of modern agriculture. There are important scientific reasons why organic agriculture, in its present form, will not be sustainable. One of the essential elements of organic agriculture is to maintain good soil health, including soil fertility (organic carbon and essential macro and micronutrients), soil structure and soil moisture for good crop production. Most soils in the drylands of arid and semi-arid tropics of the world are low in soil fertility and will not be sustainable if proper care is not taken for maintaining soil health. A recent study from University of Western Australia has reported that it is not feasible to maintain organic matter in soils with less than 600 mm rainfall and daily average temperatures of >15C. Many smallholder farmers in developing countries cannot afford external inputs and hence follow traditional farming practices, and hence they are practicing organic-by-default. There is a need to take a holistic view of soil health, and consider soil as a "bank of nutrients". Farmers need to replenish the nutrients taken-up by a crop every season, especially in the tropical and sub-tropical lands where

soil nutrients are lost quickly. Organic manures (FYM, compost, and other animal manures) contain small quantities of nutrients, and hence need to be applied in huge quantities. But, organic manures are not available in large amounts. Hence, the needed macro-and micro-nutrients need to be supplemented based on soil test results. Using GIS for geo-referenced soil fertility mapping helps scientists to make appropriate recommendations of manures, bio-fertilizers, bio-enriched compost, fertilizers, and fertigation. We need to harness the synergies of integrating the valuable ancient knowledge and wisdom of organic agriculture with modern science-based technologies to meet the challenges of 21st century, through "Sustainable Agriculture Practices" (SAP). The researchers involved in agricultural research for development, policy makers, and the farmers should join hands to develop a basket of technological options for SAP and empower the smallholder farmers to choose appropriate farming practices that are suitable for their farms, agro-ecologies and economic conditions for the sustainability of organic agriculture.

Presented at the ATPBR Conference, 10-12 March 2022, Bhubaneswar, Odisha.

Exotic genes from *Oryza* species confer broad-spectrum disease and insect resistance of rice

Kshirod K. Jena[1,2]
[1]Plant Breeding Genetics and Biotechnology Division, International Rice Research Institute, Manila, Philippines,
[2]School of Biotechnology, KIIT Deemed to be University, Bhubaneswar, Odisha, India

ABSTRACT

The genus *Oryza* has two cultivated species (*O. sativa* and *O. glaberrima*) with AA genome and 22 wild species of diverse genomes (BB, CC, BBCC, CCDD, EE, FF, GG, HHJJ, HHKK, KKLL). The exotic species from the primary and secondary gene pools of *Oryza* are rich sources of economically important genes for improving cultivated rice. There is frequent outbreak of diseases and insect pests in rice field and there are many instances of severe damage to rice crop in India resulting loss of yield. Advances in genetics and biotechnology research led to the identification of several highly beneficial genes from the exotic *Oryza* species. Several genes like *Xa40*, *Pi40* and *BPH18* from different wild *Oryza* species confer resistance to bacterial leaf blight (BB), fungal leaf and neck blast, and virulent biotypes of brown planthopper (BPH). It is imperative to transfer these disease and insect resistance genes into modern rice varieties of India. The potential of these exotic resistance genes will make varieties resistance to diseases and insect, and eventually lead to stable rice production. The results of this study will be presented.

Dr. Meera Kumari Kar
Principal Scientist, ICAR-NRRI, Cuttack, Odisha

Fusion of genomics and conventional breeding strategies towards breaking yield barrier of indica rice

The ultimate goal of any rice breeding programme is to develop varieties with high yield potential and desirable agronomic characteristics. Various breeding strategies were employed for increasing the yield potential of rice. Among those, conventional breeding is the time tested strategy for developing rice cultivars with higher yield potential. This involves the creation of genetic variability through hybridization between diverse parents followed by selection of desirable individuals on the basis of field observations and yield trials. However, conventional breeding has its own limitations. Rice yield has been plateaued for the past two decades and rice production will be insufficient to feed the increasing population in future. Advances in molecular genetics and genomics have identified several functional genes associated with yield enhancing traits. For further progress in increasing the yield potential, conventional breeding methods must be supplemented with innovative genomics tools. In our IRRI-India collaborative programme, attempts were made to transfer and fix four yield enhancing genes such as *Gn1a* (high grain number), Os*SPL14* (panicle architecture and high grain number), *SCM2* (lodging tolerance) and *TGW6* (1,000 grain weight) in the background of three elite cultivars (MTU1010, Improved Samba Mahsuri and Swarna). Some of the advanced breeding lines have ideal plant architecture with high yield potential. These lines are performing very well in all India coordinated trials. The results of this research will be presented.

Dr. Partha R Das Gupta[1]
Former Head, Syngenta Foundation

Partha R Das Gupta *was trained as an agronomist with specialization in seed science. His professional journey that began sixty years ago, took him through diverse domains of academics, agribusiness and rural development. He is a veteran of the seed industry who is also acknowledged for his work on development of smallholder agriculture in backward regions.*

Getting smallholder farmers to practice commercial agriculture[2]

Agriculture in India is passing through a crisis of multiple dimensions. It centres round 85% of its 100 to 145 million farming households who are smallholders i.e., owning 2 hectares or less land; more than 80% of whom possess I Ha or less and are deemed "marginal". The crisis is further aggravated due to the fact that their farm land is often fragmented into smaller parcels, due to inheritance pattern and other reasons. Meanwhile, the average size of landholding kept on shrinking from 2.28 Ha in 1970-71 to 1.08 Ha in 2015-16 (last agriculture census report).

- Demographic distribution of farm land holdings is rather

[1] Advisor Emeritus, Syngenta Foundation for Sustainable Agriculture.
[2] Abstract of text to be discussed at the Panel Discussion – 'FPOs, and Marketing Strategies for Doubling Farmers' Incomes', at 3rd National Conference on Realigning Indian Agriculture for A Sustainable Future to be held at Bhubaneswar from March 10 to 12, 2022.

skewed. Whereas >86% of all farming households have holdings less than 2 ha, they only own a little more than 47% of the total land area. The remaining 53% of land is held by 14% of medium and large farmers.

- Notwithstanding the lesser share of land area held by small farmers, they contribute 51% of total agricultural output, and produce 70% of high-value crops. This indicates that by and large smallholder agriculture is more efficient than that the bigger farmers.
- Although the smallholders are generally more efficient, yet they remain handicapped due to their poor access to technology, credit and markets, and even to full benefits of the government schemes.
- Top agriculture policy experts of the country and the planners have always been in agreement that some form of aggregation (especially of smallholder farmers) was essential in order to revive Indian agriculture into a vibrant form i.e., from subsistence farming, to a commercial operation.
- Major post-independence initiatives for "consolidation" of landholdings undertaken by Govt. did bring about some results but its impact varied from state to state. Thereafter, starting with the cooperative societies in the beginning, to including aggregation among the priorities of Five Year Plans, RKVY, ATMA, etc., the various attempts made by the government did not bring about the desired results. The key role played by SFAC since 2010-11, in vigorously promoting FPOs, initially showed encouraging results.
- According to SAS report of NSO released in September 2021, the net average monthly income of farming households in India has gone up to Rs. 8,337/-, as compared to ~ Rs. 6,000/- according to NSSO's 70th Round survey of Jan – Dec 2014. According that last report, only 40% of the farmers were able to subsist on agricultural income alone. According to the SAS report the income from cultivation and farming of animals contributed 53% of household monthly income, 7% less than what was reported by the earlier NSSO survey. Only 40% of

Indian farmers were able to subsist on their income from agricultural operations. That means majority of them were dependent on income from other sources, including earning as labour wages, and others. Side by side with the increase in gross income of farmers, rural indebtedness has also gone up by 58% as per the SAS report.

- The present mission of Govt. to launch 10,000 FPOs, across the country to be facilitated by SFAC, NABARD and other agencies, is a commendable initiative. However, considering the fact that there are 75 to 80 million smallholder farmers in the country, 10,000 is too small a number, if each FPO had to have 1,000 members.
- Also very important is to do a critical assessment of performance of the existing FPOs, and to determine the course of action for those that are not up to the mark, or soon likely to become non-viable.
- These and other related issues based on the experiences from the work done on farmers' aggregation by Syngenta Foundation and others, and their likely solutions, are going to be shared in course of this Panel Discussion.

Dr. Radha AnandaLakshmi
Vice President (Research)
I &B Seeds Pvt Ltd
Bangalore

Resistance breeding in vegetables–Modern technology to the aid of Non GM crops

Conventional breeding for several centuries was dependent on phenotypic selection for crop improvement. Several high yielding varieties and hybrids were released by both public institutions and private companies using this method of selection. Developing cultivars tolerant to biotic stresses caused by pathogens and pests have always posed a challenge to the breeders. In the present scenario, vagaries of climate, crop monoculture and increase in international trade have led to the evolution of new and resistance breaking strains as well as introduction of new species of pathogens even in geographies which were previously secluded. The bright side is that, today, breeders have at their disposal, several methods and tools of modern technology which could be utilized for trait breeding. This talk will attempt to outline few of those technologies that could be effectively used at different stages of crop resistance breeding

Mr. Prashant Belgamvar
Business Director, South Asia, Advanta Seeds

Prashant Belgamwar is the Business Director, South Asia, Advanta Seeds. He has 32 years rich industry experience in driving seed business of Field crops, Vegetable crops and Forages seeds. He had been instrumental in providing value added products to farmers to improve the "ROI" of growers. He worked on delivering localized, innovative and sustainable products for growers.

Sustainability initiatives in Agriculture

Advanta Seeds has over 60 years of experience in plant genetics, with 24 stations of seed production and processing sites across 21 countries. We have a commercial presence in 81 countries, with 19 R&D stations worldwide. We combine the strengths of UPL to provide innovative solutions to farmers, to improve the ROI of farmers.

At Advanta, we focus on the 'Farmer First'. We develop high quality seeds and new seed technologies that allow farmers to grow higher yielding crops and more nutritious food. Advanta has its own breeding programs in Field crops, vegetable crops and Forages to leverage its strength in terms of wide distribution, team on ground and knowledge of the requirement of the small holder farmers.

We follow our commitment commitment to contribute to improved access to seeds for smallholder farmers in our operating countries. We conduct on-ground activities to educate farmers through agronomy, IPM and provide post-harvest support. Our

on-ground team visits individual growers on an average of 3 times during a season.

We also support small holder vegetable growers in identifying the right crop suitable for them based on the soil type and seasonality. We also encourage Forages farmers to use the unused land for vegetables cropping. We further educate them on the importance of the same and help them in this.

Through our on-ground activities, we estimate to have touched at least 8.5 million farmers in FY 2020-21. We educate them on the product features, modern & sustainable agricultural practices, crop suitability, etc.

We take our commitment to the United Nations Sustainable Development Goals very seriously. We promote sustainable agriculture practices to smallholder farmers in regions facing food security challenges. We also focused on educating the farmers on better agricultural practices for water conservation, by using drip & mulch. Additionally, we are using eco-friendly packaging material for our products.

Further, we focus on tree plantation and, educating rural women on nutritional requirement for their families and child labour policies. We have also partnered with a local school in Narayanpet, Telangana to educate rural women on cultivation of vegetable crops. We have donated around 400 kitchen garden kits to the school. The produce was used to address nutritional requirements of children and pregnant women in the area.

Recognizing our efforts towards localization & sustainability, Access to Seeds Foundation has ranked Advanta Seeds 2nd in South & Southeast Asia among 31 seed companies. We are also recognized with Rank 1 for genetic resources and IP Management, seed production and capacity building.

Mr. R. S. Hiremath
MD, Flexitron

R.S.Hiremath *is a Mechanical engineer. He served at the Indian Institute of Science in Bangalore immensely contributing to various innovative and new projects in the field of alternative energy. His hands on experience in the rural areas where his work carried him became the foundation for starting a company called FLEXITRON a social enterprise which focused on developing and marketing products for the people at the bottom of the pyramid, the poorest population of the world.*

Innovation has been the bottom line of all his activities, he has to his credit over 675 innovations with many of them commercialized. His commercialized products are used by millions of people globally.

Empowering farmers through one step post-harvest conversion

Agro and horticulture produce in India is directly sold after harvesting to buyers or at an APMC. The value addition of this raw produce is nil, and many a times just covers the cost of farming for the farmer. The farmer also has an urgency to market it as any delay could lead to perish ability. In situation of grain or pulses produce there would be storage issue and hence they dispose their produce at earliest.

My talk focuses on methods and procedures to enhance the value of post-harvest produce by using simple low-cost equipment for a one step value addition to the produce and also increase their self-life. All equipment's are self-powered via solar energy or human power inputs.

Mr. Ram Kaundinya
Director General, Federation of Seed Industry of India

Ram Kaundinya *is an expert in the field of management especially in the business of agriculture. He has a total corporate experience of about 36 years at very senior positions in agrochemicals and seed industries. He is an author, strategic management consultant, teacher and a policy analyst in India. He is currently Director General of Federation of Seed Industry of India.*

Resetting future priorities in seed industry

Research based seed industry has a huge role to play in upgrading the genetic potential of the seed cultivars used by farmers in the country – looking at next 15 years the priorities have to be modified to suit the future that awaits us – fighting climate change, need for natural resource conservation, withstanding biotic and abiotic stresses, facilitating value chain development and increasing yields will drive the development of new cultivars – research has to orient itself to the changing face of agriculture and develop new cultivars to suit new technologies - Some of the new agronomic practices like DS Rice, HDPS cotton and technologies like mechanization, Greenhouse cultivation, Micro irrigation, herbicide tolerance and others need specific and specially developed seed varieties which will help farmers to extract the right value from these practices and technologies – scope for making India a seed export hub – need to develop varieties that suit export markets – varietal development using modern biotech tools like Gene Editing will help in developing precisely targeted varieties for nutrition enhancement and disease tolerance – special efforts needed to enhance yield potential of oilseeds, pulses and vegetable crops to meet country's priorities – enhance research investments to global standards of 10% of revenue and bring out the highest performing varieties – upgradation of manpower and infrastructure to global standards in all functions – investment in seed production research to decentralize seed production from the currently concentrated areas – upgradation of quality standards to global standards through use of modern technology and infrastructure – adoption of digital and satellite technologies to modernize the way the seed industry works in different functions – Creating, protecting and respecting Intellectual Property is a habit to be inculcated among all the seed industry players to make the Indian seed industry truly world class – industry has to work together to bring cutting edge technologies and practices to India and engage continuously with the governments and regulatory authorities to achieve a supportive ecosystem for introduction of new seed technologies – need to move towards making Indian seed industry a world class sector with a size of 8B$ including exports by the end of this decade.

Dr. B. R. Athani
Executive Director
Future Greens Organization, Bagalkot- Karnataka

Climate Resilient Production and Expansion of Value chain for Food Crops through women lead producers' organizations

"Innovations and the appropriate technology for systemic intervention are based on conviction that changes in market system would lead to improved access to growth and hence poverty reduction".

The primary objective is to double the income of small and marginal farmers over the next 3 years. This involves the following comprehensive and inclusive interventions.

I) Conducting an analysis with involvement of farming communities using the specially designed tool (by WOTR) to understand how these communities in dry land terrain may be vulnerable to climate change, how and why.

II) To incorporate the appropriate mechanisms based on analysis to develop clusters of small/marginal farmers interested in adopting right crops / mixed farming that are appropriate to situations

III) To train target area farmers for such farming practices through technical training programs. FFS and visits to demo model farmers who are following best practices are a few means.

IV) To facilitate access to fair and remunerative markets as collective efforts by linking organized producer groups through FPO partners to fair and appropriate marketing opportunities for getting higher returns for their produce both as raw and value added products. This can be achieved through several initiatives, in turn, including direct buy back from the farmers, the certified organic produce and the integrated livestock, ultimately to help increase their net income by double the baseline- through the project interventions.

Dr. CL Laxmipathi Gowda
Former Deputy Director General, ICRISAT and Co-Founder,
GRSV Consulting Services, Mysuru, Karnataka

Skill Development for Future Plant Breeders @

Plant breeding is possibly as old as human civilization and has helped produce required quantities of grain, fruits and fodder and the quality (nutrition, taste, color, etc.) of crops, fruits and fodder. It began when the ancient nomadic humans were settling down and started domesticating animals and plants near the water sources in the valleys, marking the beginning of what we now call plant breeding. This reiterates the importance of skills with regard to visual observations and selection over successive crop seasons. Currently, we consider that plant breeding is both science and art of selecting desired plants to meet the set objectives of increasing quantity and/or quality of crop plants. The basic principles of current day plant breeding include: identifying and defining the objectives, introduction and creating new variability (including hybridization, etc.) and selecting desired plant types for large-scale testing and farmer adoption.

More recently, conventional breeding is being relegated to history under the misconception that the "Molecular breeders" can do wonders. However, we need to understand that the new breeding technologies (NBTs) are only "tools" that assist the plant breeders to enhance the efficiency and speed of delivery of products to the farmers. It is also recognized that plant breeding is 'Team Work' involving breeders, agronomists, physiologists, pathologists, entomologists, etc., and often requires multidisciplinary and multi-institutional collaboration. In addition, good knowledge of biometrics, quantitative and population genetics, genomics and

bioinformatics is essential to the current and future generation of plant breeders.

There is an urgent need to resurrect 'conventional plant breeding' and integrate it with the NBTs. There should be 'Centralized Labs for Genomics and Bioinformatics' to reduce duplication of efforts, improve efficiency, better cost-saving, and avoid re-inventing the wheel. Plant breeders should make the best use of open-source domains such as IBP (Integrated Breeding Platform), GOBII (Global Open-access Breeding Informatics Initiative), and others to reduce costs and increase efficiency of operations.

Future generation of plant breeders will need "Mentors" to provide on-the-job mentoring for various field-based breeding activities and processes. We should also consider "Industry Internship" for potential plant breeders to get hands-on training from senior breeders in private sector plant breeding firms. Most importantly, plant breeders must visit the fields daily during the crop season to 'talk' to the plants before making selections.

@ Presented at the ATPBR Conference, 10-12 March 20221, Bhubaneswar, Odisha

Skill and knowledge developments for future career in Seed Industry

Kanokwan Chodchoey, PhD Executive Director,
Asia and Pacific Seed Alliance (APSA)

Abstract

The Asia and Pacific Seed Association (APSA) is a regional seed association comprised of more than 450 seed companies from both inside and outside Asia-Pacific region. We represent members from 29 countries in the region and 23 countries outside the region. Eighty (80%) of our total seed company members are medium and small sized companies. Fifty (50%) of total company members are integrated seed companies, whose operations include research and development facilities, seed production, seed processing, sales, and marketing. APSA's mission is sustainable agriculture through the production and trade of quality seeds for the world. Our focus areas are intellectual property rights protection, biodiversity, seed trade, innovation in agriculture and public-private partnership. One of the objectives of ASPA is to strengthen the capacity of human resources in agriculture through a collaboration with National Seed Associations and our stakeholders. The knowledge enhancement and the capacity building are the key to achieve the sustainability in Agriculture as well as the Sustainable Development goals (SDGs). Starting from last year, APSA initiated the learning program to develop the skills and knowledge of our member companies. The main topics we focused are plant breeding and seed technology as these 2 areas are crucial for career development in seed industry. These topics are foundation of the seed related policy especially gene editing regulation, plant breeders' rights, access and benefit sharing and phytosanitary regulation. Thus, the knowledge and skills development in these areas will eventually help to reach the enabling environment for seed policy in the future. APSA has created the train the trainer program, the University connect program and the webinar series on breeding, seed technology and technology in field crops. We started to include students from Universities under University connect program to join our learning platform. The survey has been sent to our participants

seeking their view on the topics that the participants see the need to include in the learning plan or in our next webinar program. For the breeding program, the results showed that the topics proposed are mainly relating to the new plant breeding tools, plant breeders 'rights and advanced plant breeding techniques in vegetable crops. The results also shown that the hands-on training is required for young breeders to succeed in their career. For seed technology related topics, the results shown that the knowledge on seed vigor testing, seed dormancy, inventory management by using quality result data, seed upgrading, seed treatment, phytosanitary regulation and new technology in seed testing are the main topics proposed by the participants. Beside technical knowledge, the business acumen, problem solving skills and strategic thinking skills are important for career development in seed industry. These results are clearly shown that these topics are in need for their career development and hence, these topics should also be included in the training courses as well as in the University's curriculum. In this panel discussion, APSA will bring our views regards the skills and knowledge development referring to the results we have surveyed, and we are looking forward to seeking the suggestions and comments from the forum to develop our program to ensure we provide our support to help developing skills for future leaders in seed industry.

Keyword: knowledge, plant breeding, seed technology, seed industry and skills

Dr. Sharan Angadi
Director, ATPBR Foundation

Dr. Sharan Angadi worked for 17 years in public sector research institutions as a plant breeding researcher before making a foray into the private seed sector in 1993. After superannuating from the position of Head of Breeding for the Asia Pacific region from Nunhems a Dutch MNC in 2014 he has been working as an &D adviser to seed companies in India and abroad. As a Director at ATPBR, he is actively supporting various training programs and related activities.

Skill Development and Entrepreneurship- Foundation for Start-ups and for Success in Farming

Because of the latest developments in farming, many new dimensions like Agri-warehousing, cold-chain, supply-chain, dairy, poultry, fisheries, horticulture, agricultural mechanization and micro irrigation have emerged as professional opportunities for the youth.

Skill is the ability coming from one's knowledge, practice, aptitude to do something well. In every profession there are certain must have skills to be successful. Careers in agriculture cover diverse specialties such as science, finance, engineering, and management among others. Among the most important skills are interpersonal skills, analytical skills, management skills, technological skills, problem solving skills. For a career in agriculture, it is important to consider both the hard and soft skills.

When we talk about careers in agriculture, we often think about the technical skills necessary to do the job, the experience and know-how for a particular sector of agriculture, or as someone

possessing market, machine and mechanics knowledge. These are important core skills and knowledge needed, for sure! What people are beginning to discuss that is just as important are soft skills.

Hard skills are job-specific and can be taught or acquired through class room training or through hands-on experience. Soft skills are defined as one's ability to work with and interact with others. They are also known as personal skills, non-technical skills and interpersonal skills. Employers place emphasis on such skills because they are often the most difficult to teach. Soft skills, when combined with hard skills, have a complementary impact.

Skill sets

Soft skills are highly sought after because they are not easily taught and difficult to acquire. They are often seen as personality traits and behavioural traits of an individual. It is important to acquire these skills and aptly sharpen them by regular practice and updating.

Technological Skills One should be in a position to understand related technologies and their applications. The ability to apply technology in irrigation, cultivation techniques, harvesting, storage, and transportation in the agriculture industry is vital.

Today, agriculture is facing many challenges such as extreme weather conditions and pressure to produce more from shrinking resources, among others. They have to be tackled through adoption of new technologies such as Internet of things (IOT) for use in livestock monitoring, smart greenhouses, and agricultural drones and robots in farm management systems, crop management systems.

Monitoring and Evaluation Skills Agricultural professionals should strive to have the knowledge on how to make efficient agricultural policies to enable them in addressing the rising demand for sustainable food production and nutrition. Agricultural professionals should be trained on policy evaluation sufficient enough to address the various challenges in the industry. Skills in monitoring and evaluation in agriculture can help in ways such as allowing project managers in adjusting their activities to the needs and constraints of farmers, and providing planners and the

policy makers with relevant information on agricultural changes. M&E also helps the agricultural professionals in removing any policy dis incentives to resilience and sustainability.

The other important must have skills are

Creativity-Often referred to as "thinking outside the box". Being able to view a problem from multiple angles helps to generate ideas so business can move forward.

Teamwork-Being able to work with others to move towards a common goal. Being able to effectively be part of a team which includes co-workers, colleagues and managers. Teamwork allows the group to work on tasks efficiently and in an enjoyable environment.

Dependability-This means one is trust-worthy and reliable. Dependable employees are trusted to finish tasks and meet deadlines.

Assertiveness-Being assertive shows, you have confidence in your work abilities and are not afraid to be held accountable. Being assertive also means you are able to express your opinions and contribute.

Problem-Solving-Employers see problem-solving skill as the ability to handle difficult or unexpected situations. Good problem solvers can calmly analyse a situation and identify possible solutions.

Communication-This refers to one's ability to give and receive information. When employers are asked to rank soft skills, communication is most often at the top of the list. Being able to give information (speak) and to receive (listen) information is an important balance. It is important to have a solid understanding of communication skills.

Flexibility-Working in agriculture can be unpredictable, and one may be asked to complete a task outside of the normal work duties or pivot in a new direction. Flexibility is important and tells employers they can trust the employee will be able to continue moving forward even under unexpected change. Being flexible also means that one is willing to learn something new.

Time Management-The ability to effectively manage multiple tasks simultaneously. Also refers to ability to prioritize time in order to complete tasks in a timely manner. Good time management can also indicate one is organized, all of which is very important to employers.

Accountability-Being accountable means, willing to take responsibility for work and actions. Holding oneself accountable shows one can be trusted.

Leadership-Most positions in agriculture require some degree of independence. When you show leadership that means you are able to handle tasks on your own. Even if your position is not one of leadership, there will be instances where you can show leadership in the work you are doing.

There are many other skills one needs to possess that are often considered by employers. It is normal for individuals to vary in their soft skills. It is important to evaluate ones' levels of skills in each area and work on the ones that need growth.

Skill development in crop improvement

Plant breeding professionals seeking job opportunities with Government research organizations, Commercial plant breeding companies, Specialist seed producers Biotechnology and genetic engineering firms, and International research institutes have to effectively carry out the responsibilities of clearly setting up aims and objectives of their research programs, and estimate the project cost. They have to be conversant with the research methods and techniques for improving plant breeding, identify and select plants showing desirable traits, based on natural genetic variation, cross plants to produce new breeding material for field and glasshouse trials, analyse and scientifically assess plant breeding in laboratory and field trials and select the best varieties, conduct laboratory based scientific projects, multiply and produce virus-free plants maintain detailed records throughout the R&D cycle, manage, support and train technical and field staff, keep themselves up to date with the rapid developments in science and translate ideas from scientific literature into new approaches to breeding problems etc.,

Enthusiasm, commitment and a strong interest in plants and plant science, Good problem-solving skills, Excellent oral and written communication skills, The skills to manage a busy laboratory, Strong team-working skills, An analytical and investigative mind, Computer literacy and technical skills, as most laboratories are highly computerised, Cell biology skills to manipulate crop growth stages leading to rapid generation advancement, Regulatory issues in agribusiness and skills to protect and defend IPRs.

All these will be presented for discussion among the expert panellists to develop practical skill development programs.

Mr. Brahmanand Reddy
Member of Parliament

Mr Brahmanand Reddy MSc (Agri) is present MP from Nandyal constituency in AP. With his immense passion for agriculture and rural development he initiated Bharathi Research programme in 1989 for Cotton Research, hybrid seed production and also to provide post-harvest services like delinting, drying,seed conditioning & packaging- aimed at benefiting the farming community & improving their quality of life through meaningful long term collaborations with the pvt seed companies. In a satisfying journey of more than 30 years, Bharathi seeds developed high yielding, drought tolerant hybrids of Cotton like Sandocot-35,Brahma,Krishna,Atal & Lakshmi which were introduced to the market successfully through private seed companies. Today Bharathi seeds is in the forefront in providing the services to the industry for the entire supply chain (i.e. Production to the finished goods level) with full reliability for both Quality & Quantity along with safety,security in a cost effective manner. A proud farmer & a true seed man with passion for agriculture Mr. Reddy has made a silent revolution in the farming community by uplifting their economic status and quality of life

Mr. Hari Gopal Krishna Gutlapalli
Team Lead-PD, Kaveri Seeds Pvt Ltd

Mr. G. Hari Gopal Krishna *is a postgraduate in Agriculture with specialization in Agricultural Entomology from Dr. PDKV Akola (Gold Medalist) and am working with Kaveri Seed Co. Limited since 2011 responsible for carrying out Product evaluation trials for Major field crops across the country and Product registrations for inclusion in state seed license.*

Realigning Indian Agriculture to a sustainable Future is utmost essential, since the Indian population is increasing year after year and the availability of cultivable and arable land is decreasing due to fast urbanization, added to it erratic rainfall, drought, biotic & abiotic problems lower the agricultural production & productivity. One way of achieving it is through use of improved genetics. Improved seeds can be developed by careful scientific research and planning in agriculture, providing the right resources at right time and right place and the technical knowhow to using them in right order. For developing a new prospective product, conducting appropriate trials over a period of time in the targeted environment against key existing products plays a critical role. The data generated from these trials are analysed by employing appropriate statistical method which will help us in identifying the prospective new products that are better than the existing products in terms of wider adoptability or to a specific adoptability or more tolerant to biotic and abiotic stress so as to fit well under different environments. The new product identified thus makes a way to improve the farmer's yields and thereby to increase their socio-economic condition. The topic discusses about the importance of effective product evaluation, its need, type of trials, and management of trials, data analysis and interpretation for identifying new products for future needs of farmers/ consumers.

Mr. Sanjog Sahu
CEO of Mati Farms Private Limited

Sanjog Sahu is the CEO of Mati Farms Private Limited, a tuber food production and processing start up in Odisha that works with small and marginal farmers across Orissa in creating and fostering robust agroecological farm systems.

Prior to founding Mati Farms, Sanjog worked as a legal researcher on the implementation of Forest Rights Act (2006) and has over five years of experience in western Orissa working at the intersection of agriculture and the environment. Sanjog attended the PhD program in Ecological Anthropology at University of Arizona. He was a Young India Fellow at Ashoka University

Prospects of Food Processing in Orissa – Mati Farms' journey

Mati Farms was born five years ago as an experiment initially to understand if farming can be made profitable for the small and marginal farmers without compromising our land and environment. While high value crops like cherry tomatoes, kale, leeks seemed like an ideal solution at first, soon we realized that the market demand for those can easily be met only by a handful of farmers. That meant thousands of vegetable growers across the state would continue to stick to the same old traditional crops and practices that are neither profitable nor environment friendly. Those were the burning issues we wanted to address. A lot of brainstorming, experimentation, ideation and collaboration with scientists over the years have led us to understand that food processing could be an ideal tool towards bringing about sustainability in agriculture in the long term.

With Mati Farms the idea is to get as many farmers to work with us by providing them with the training and support they need along with buyback assurance, so that eventually we can maximize the area under sustainable farming across state and country. Currently we are working with 170 farmers across high lands of Odisha who are growing purple and orange fleshed sweet potatoes (varieties developed by CTCRI) following the sustainable farming practices recommended by us. Soon we are planning to expand to other crops as we increase our processing capacity. We are also developing an app so as to optimize our farmer's farming experiences. For easier application it is going to be in vernacular languages. Connectivity to distant farms, communication gap, timely collection of field data and remote monitoring has definitely been some of the pain points that we are working on. We believe onboarding the farmers on the app will certainly streamline that.

For past one year we have been receiving a lot of support and help from the district administrations, CTCRI as well as local NGOs for our ground works that has enabled us to work efficiently across different districts. Going forward we hope that through sustainable farming and efficient food processing we will be able to contribute towards restoring our land and environment.

Medi-Hub, Technology Business Incubator Enabling Enterprise Development in Medicinal and Aromatic Plants

Nagaraja Reddy R*, Deepa Patel, Basak BB,
Saran PL, Satyanshu Kumar

ICAR-Directorate of Medicinal and Aromatic Plants Research (DMAPR), Anand, Gujarat 387310, India.

*E-mail: medihubtbi@gmail.com

Medicinal and aromatic plants (MAP) provide important medicaments to our Indigenous systems of medicines such as Ayurveda, Yoga, Naturopathy, Unani, Siddha, Sowa-Rigpa and Homoeopathy (AYUSH). Medicinal and aromatic plants have contributed immensely by producing diverse range of plant based intermediary compounds and value-added downstream end products used in several applications such as drug formulation, food flavouring, perfumery, culinary, toiletry, health products, food supplements, cosmetics, incense and other anthropogenic applications and animal care products. Use of medicinal and Aromatic Plants has begun since time immemorial with the recognition that smelling, chewing, and/or eating of some plant materials could provide relief from nausea, pain, and/or other infirmities. According to WHO, more than 80 percent of people worldwide rely on herbal medicines for some aspect of their primary health care needs. More than 80% modern medicines are also derived from plants and even natural products are also directly used as medicines. Herbal sector is growing at the pace of 7-15% per year and is expected to reach US$ 5 trillion by the year 2050. Medicinal and aromatic plants are not only important for the healthcare system but also important to boost economy and can impart a significant role in economic development. Thus, herbal sector is a sun rising sector and offers promising future for enterprise development. There is a wide scope for enterprise development MAPs viz., in cultivation, post-harvest management, Value addition, Marketing and application of ICTs. Recognising the importance of MAPs for business development and to boost the economy of India, Indian Council of Agricultural Research (ICAR) with its National Agricultural Innovation Fund (NAIF) has commissioned Medi-Hub, Technology Business Incubator, an Agri-Business Incubator (ABI) at the ICAR-

DMAPR, Anand in the year 2020. Medi-Hub TBI is encouraging the budding Entrepreneurs to promote the growth of Medicinal and Aromatic Plants sector. The main motto of Medi-Hub TBI is to accelerate business development by rendering incubation support to the start-ups and others enterprises in the field of herbal sector. It is envisioned to commercialize innovations and to bring-in startups in Medicinal and Aromatic plants with best-in-class support for entrepreneurs. Medi-Hub TBI is working with the mission to create platform and to explore business services through entrepreneurship development, innovation and value addition for strengthening value chain in medicinal and aromatic plants. Medi-Hub TBI offers technology consultation, Business consultation, Mentoring and Networking, infra facilities, accesses to funding and Knowledge sharing on enterprises for wide acceptance by the consumers. Since inception, Medi-Hub TBI supported 15 business ideas to develop businesses. Domain knowledge to 300 clienteles through Enterprunership Orientation program in medicinal and Aromatic plants (EOPMAP) (half yearly program) was imported. We also conduct Enterpruneship development program (every fortnightly), company management seminars, road shows and boot camps for enterprise development in the agriculture in general and MAPs in particular. Medi-hub TBI received accolade from Prime Minister Shri Narendra Modi in his Man ki Baat program in October, 24, 2021 for rendering virtuous incubation support various incubatees. Business aspirants with novel ideas in business can join the incubator to develop enterprises in medicinal and aromatic plants.

Utilization of Marker-Assisted Backcross Breeding Approach in Development of Bacterial Blight-Resistant, Submergence-Tolerant, and High-Yielding 'Swarna' Rice Variety

Shibani Mohapatra[1], Alok Kumar Panda[2] and Sharat Kumar Pradhan[1]

[1] Crop Improvement Division, National Rice Research Institute, Bidyadharpur, Cuttack, India

[2] School of Applied Sciences, KIIT Deemed to be University, Patia, Bhubaneswar, India

Swarna is a highly popular rice variety in the eastern region of India. Farmers in eastern India primarily cultivate rainfed rice and are frequently affected by climate change. Rice production in this area isn't consistent. Swarna is highly susceptible to bacterial blight (BB) disease and flash floods, both of which reduce yield significantly. Using a marker-assisted backcross breeding approach, five target genes/QTLs were transferred into the Swarna variety. In the backcross progenies, direct markers for Sub1A, OsSPL14, and SCM2 QTLs, as well as closely linked markers for xa5 and Xa21 BB resistance genes, were screened. The donor parents used in the breeding program were Swarna-Sub1, CR Dhan 800, and Swarna–Habataki near-isogenic lines (NILs). For backcrossing, true multiple F1 plants were identified, and 796 BC1F1 seeds were produced. Foreground selection detected all the five target genes in six progenies in BC1F1 generation. The progeny containing all the target genes and, more similar with the recipient parent, was backcrossed. 446 BC2F1 seeds were produced. Foreground screening-detected four BC2F1 plants carrying the five target genes. 2,145 BC2F2 seeds were obtained from the best BC2F1 progeny. After screening the progenies, one plant had all five desirable genes, three plants had four, and three more progenies had three genes in homozygous condition. Swarna, the recipient parent, had lower BB resistance and submergence tolerance than the pyramided lines. The recipient parent, Swarna, had a higher breaking force than the culm strength of the pyramided lines. The pyramided line, SSBY-16-68-69 yielded the highest grain yield of 7.52 t/ha followed by the lines SSBY-16-68-511 (7.34 t/ha) and SSBY-16-68-1633 (7.02 t/ha). The best-pyramided line showed a yield advantage of 18% over the recipient parent and 6.8% over the yield component donor parent. Seven pyramided lines showed higher yield than the recipient parent, while five lines were better yielders than the yield component donor parent. The pyramided line SSBY-16-68-69 produced 365 grains/panicle, while the recipient had 152. The main morphologic and grain quality features of the recipient parent were retained in the pyramided lines.

Genetic Engineering for Cold Tolerance in Crop Plants

Simanchal Sahu* and Rajesh Kumar Kar
Department of Plant Breeding and Genetics,
College of Agriculture, OUAT
Bhubaneswar, Odisha
Email id*: sahu.millet@gmail.com

Abiotic stresses adversely affect growth, productivity and trigger a series of morphological, physiological, biochemical and molecular changes in plants. The most common abiotic stresses are drought, extreme temperature, flood, high wind, cold stress, salinity, low PH etc. Among this cold stress is a major environmental factor that limits the agricultural productivity of plants in hilly areas. Low temperature resistance in plants is a very complex trait, involving many different metabolic pathways and cell compartments. Conventional breeding methods have met with limited success in improving the cold tolerance of important crop plants involving inter-specific or inter-generic hybridization. It is therefore, important to search for new alternative strategies for development of cold stress tolerant crops. Biotechnology offers new strategies that can be used to develop transgenic crop plants with improved tolerance to cold stress. Genetic engineering would be a faster way to insert beneficial genes than through conventional or molecular breeding. Also, it would be the only option when genes of interest originate from cross barrier species, distant relatives, or from non-plant sources. The development of genetically engineered plants by the introduction and/or over expression of selected genes seems to be a viable option to hasten the breeding of improved plants. Applications of genomic approaches and gene knockout strategies are progressing to accelerate efforts to assess systematically and understand complex quantitative traits such as acquired tolerance to temperature extremes. By using genetic and molecular approaches, a number of relevant genes have been identified and new information continually emerges to enrich the CBF cold-responsive pathway. Thus, the CBF/DREB1 genes are thought to be activators that integrate several components

of the cold acclimation response by which plants increase their tolerance to low temperatures after exposure to non-freezing conditions.

However, the results of the transcriptome study demonstrated the highly complex nature of plant adaptation to low temperature. To overcome this problem, a transgenic approach to promoting cold tolerance has been widely adopted, with some success. For example: increasing the accumulation of two compatible solutes, *i.e.* glycinebetaine and trehalose in transgenic rice by over expressing either *E. coli* choline-oxidase or trehalose-6-phosphate synthase fused to trehalose-6- phosphate phosphatase, enhanced tolerance to both salt and cold. In fact a large number of genes identified in different studies have currently annotated with unknown function and involve new genes and new pathways indicates that our knowledge of the transcriptional control of the low temperature response is limited, and the regulation of these transcriptional responses is far more complex than previously believed. Information on the low-temperature transcriptome, proteome and metabolome is expected to continue to increase in the near future. A well focused approach combining the molecular, physiological and metabolic aspects of cold stress tolerance is required for bridging the knowledge gaps between short-term and long-term effects of the genes and their products and between the molecular or cellular expression of the genes and the whole plant phenotype under stress.

Key words: Cold tolerance, genetic engineering, transcriptome, proteome

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Introgression of Bacterial Blight Resistance from Oryza glaberrima to Mega Variety Samba Mahsuri

Udaya V[1†], Reddisekhar M[1], Raveendra Ch[2], Anantha M S[2], Laha G S[2], Honnappa[2], Aleena D[2], Sundaram R M[2] and Gireesh C[2*†]

[1] Acharya N G Ranga Agricultural University (ANGRAU), Lam, Guntur, Andhra Pradesh, India
[2] ICAR-Indian Institute of Rice Research (ICAR-IIRR), Ranjendranagar, Hyderabad 500030, India
[†]Authors have contributed eqaully
[*]Corresponding author: giri09@gmail.com

Rice is one of the staple food crops for half of the world population and the need for rice is spiking up due to exponential growth of population. The demand for rice is consistently increasing but the production is affected by different biotic and abiotic stresses due to climate change. In biotic stresses, Bacterial blight (BB) caused by *Xanthomonas oryzae* pv. *oryzae* is one of the major devasting diseases across the globe especially in areas with high yielding cultivars. The chemical management of BB is difficult, owing to high variability of pathogen strains and also it is hazardous to environment. As a part of sustainable management, identification and introgression of novel sources of BB resistance genes from the available germplasm to popular variety is an alternative to control the disease. To identify the novel source of BB resistance we screened thirty four BRILs (Bacterial blight Resistance Introgressed Lines) which were derived from *O.glaberrima* and selected a line which having high recovery estimation along with high degree of disease resistance. That particular line was screened with major BB genes (*xa5*, *xa13* and *Xa21*) as well as with *xa41* and *xa45* which were reported in the *O.glaberrima*. Interestingly, none of the reported genes were found in that introgressed line, indicating the presence of novel BB gene. The particular line which doesn't contain any reported line was crossed with Samba Mahsuri to develop the F_1 and BC_1F_1. The phenotypic and genotypic screenings as well as recovery estimation was carried out in BC_1F_1 to identify the plants with novel gene in the background of Samba Mahsuri. The identified plants may be advanced to develop the pre-breeding lines for mapping of new gene and will also be used in gene pyramiding with major BB for broad spectrum resistance to the disease.

Functional Characterization Of C_2h_2 Zinc Finger Transcription Factors In Pepper (*Capsicum Annuum* L.)

Richa Sharma, Dr. Raj Kumar Joshi*
Department of Biotechnology
Rama Devi Women's University, Vidya Vihar,
Bubaneswar, Odisha, India

ABSTRACT

C_2H_2-type zinc finger transcription factors play vital roles in plant growth and development, and stress responses. However, the C_2H_2-ZFP repertoire in *Capsicum annuum* (chilli pepper) is not yet fully explored especially under pathogenic infection. In the present study, we used a high throughput computational and bioinformatics analysis to understand the C_2H_2-ZFP mediated defense mechanism against anthracnose pathogen caused by Colletotrichum truncatum in pepper. 79 C_2H_2-ZFgenes (CanZFs) were identified from *C. annuum* and clustered into five major groups. Predicted functional analysis resulted in the assignment of multiple functions to different CanZFs including roles in nucleic acid binding, response to stimulus, metabolic processes, and cellular processes. Sequence comparisons revealed paralogs within the CanZFs and orthologs with *Solanum tuberosum*. 38 miRNA target sites were predicted in 11 CanZFgenes. CanZF genes expressed differentially in the pepper cultivars Punjab Lal and Arka Lohit after *Colletotrichum truncatum* infection. CanZFs were significantly induced post treatment with MeJA and ethylene indicating their role in defense signaling. Overall, our study represents an overview of the C_2H_2-ZF gene family in *C. annuum* and their specific involvement in the resistance response against pepper anthracnose.

RNA Interference: A Functional Genomics Approach Towards Disease Management

Shubhranshee Sanshlishta Sahu[1], Rukmini Mishra[2]

[1]Department of Biotechnology, Rama Devi Women's University, Vidya Vihar, Bhubaneswar, Odisha, India.

[2]School of Applied Sciences, Centurion University of Technology and Management, Odisha, India.

Abstract

Crop plants are often infected by a wide range of phytopathogens that results in huge yield losses. Thus, plant biologists have adopted numerous methods to engineer resistant plants for effective management of plant diseases. Among them, RNA silencing-based resistance has been a powerful tool that has been used to engineer resistant crops during the last two decades. Host-induced gene silencing (HIGS) employing RNA silencing mechanisms and, specifically, silencing the targets of invading pathogens, has been successfully applied in crop disease prevention. A spray-induced gene silencing (SIGS) strategy is another innovative RNAi-based disease control strategy, which has been successfully used for developing resistance against fungi and pest infection in both monocots and dicots. The current study highlight the various RNAi strategies could be adapted to provide robust protection and durable resistance response against multiple phytopathogens through transgene expression of dsRNAs within susceptible plant tissues. These strategies will be suitable alternatives to traditional agrochemicals towards crop protection.

Profiling of candidate microRNAs responsive to fluoride toxicity in rice (*Oryza sativa* L.)

Tamarapalli Sravya Sruti*, Sasmita Mohanty, Raj Kumar Joshi

Post Graduate Department of Biotechnology, Rama Devi Women's University, Bhubaneswar, Odisha, India

Abstract

Fluoride is a toxic xenobiotic compound whose accumulation often results in oxidative stress leading to overall reduction in plant biomass. MicroRNAs (miRNAs) are a class of small non-coding RNAs that regulate the expression of genes in post transcriptional stage through gene silencing. However, there is no report on miRNA expression in response to fluoride toxicity in rice. In the present study, two popular high yielding varieties of rice-Gobindabhog (GB) and IR64 which differ in their level of tolerance towards fluoride toxicity were used to analyse the expression of miRNAs under fluoride stress. Fourteen conserved rice miRNAs with proven role in multiple stress response mechanisms were analyzed through qRT-PCR to study their role in fluoride stress response in the two rice genotypes. Results revealed that 8 out of 14 miRNAs were differentially expressed. miR156, miR166 and miR171 were significantly induced in the fluoride tolerant GB while miR160, miR390, miR396 and miR444 were prominently induced in the fluoride sensitive IR64. Additionally, miR393 was significantly induced post treatment with fluoride stress in both the genotypes exhibiting a basal response to fluoride toxicity. Further, we computationally predicted the miRNA targets many of which encoded transcription factors associated with stress response mechanism. qRT-PCR analysis revealed simultaneous reciprocal changes in the expression pattern of the miRNAs and the corresponding target genes suggesting their critical involvement in the modulation of fluoride stress response in tolerant and sensitive rice genotypes. These results indicate that multiple miRNAs are involved in fluoride toxicity and miRNA like miR156, miR166 and miR171 might be involved in augmenting fluoride tolerance in rice genotypes.

Role of Acid Phosphatase in Abiotic Stress Tolerance in *Solanum Lycopersicum*

Sabiha Tarafdar[1], Sigrun Reumann[2] and Gopal Chowdhary[1#]

[1]Plant Molecular Biology Laboratory, School of Biotechnology, Campus-XI, KIIT, Bhubaneswar-751024, Odisha, India

[2]Plant Biochemistry and Infection Biology, Institute of Plant Science and Microbiology, Department Biology, Faculty of Mathematics, Informatics and Natural Sciences, Universität Hamburg, Ohnhorststr. 18,22609 Hamburg, Germany.

[#]Corresponding author: gkchowdhary@kiitbiotech.ac.in

Phosphorous is a crucial mineral for the life of plants. As there is a lack of availability of phosphorous in most of the soil in agricultural fields, plants have developed a strong regulatory mechanism to overcome this deficiency. Hence purple acid phosphatases (PAPs) are primarily linked with the remobilization of phosphorous from the soil within plants by hydrolysing compounds of organic phosphorous otherwise there is a lack of availability of phosphorous in such compounds for assimilation. PAPs are ubiquitous in plants and play role in different processes of plants such as the development of seed, metabolism of carbon, flowering, response to the stress factors of abiotic and biotic environmental conditions, signalling pathways etc. Therefore, it becomes a potential target for improving the crop yield here in *Solanum lycopersicum* commonly known as 'tomato', which plays a significant role in human nutrition and is an economically important vegetable crop, but is sensitive to various types of biotic and abiotic stresses. In the present study, the tomato peroxisome proteome was studied with reference to the *Arabidopsis* peroxisome proteome. The majority of the candidate proteins were falling under canonical peroxisome targeting signal type 1. *Arabidopsis* peroxisomal proteins were obtained from The Arabidopsis Information Resource (TAIR) database and *Solanum* orthologs were identified using BLASTp searches. The protein sequences were further used for the prediction of subcellular localization. The abiotic stress induction was predicted using web-based microarray databases. One such potential candidate protein is identified as purple acid phosphatase (PAPs), which

is capable of calcium-dependent binding to phospholipids of the endo-membrane system, thereby able to regulate cellular calcium signature. The phosphorylation of protein by protein kinases and dephosphorylation by protein phosphatases are important for the signal transduction mechanism in plants during abiotic stress conditions. The phosphatases regulate different mechanisms in plants which include ABA signalling, opening and closing of stomata etc. Also calcium signature is very important for stress signalling. Here we have PCR amplified 'purple acid phosphatase' gene from tomato having an amplicon size of nearly 1000bp and cloned into pGEMT vector by TA-cloning and subcloned in PCAT EYFP vector. The sequence has been verified by automated DNA sequencing. The expression analysis of the same is underway.

Keywords: Peroxisome, *Solanum lycopersicum*, *Arabidopsis*, PTS 1, PTS 2, Calcium signature.

Early peroxisome targeted polyamine oxidase from *Oryza sativa* mediating abiotic stress tolerance via a feedback loop

Ishita Samanta, Pamela Chanda Roy, Shweta Chaturvedi, and Gopal Chowdhary[#]

Plant Molecular Biology Laboratory, School of Biotechnology, KIIT, Bhubaneswar – 751024, Odisha, India.

[#]Corresponding author- Email: gkchowdhary@kiitbiotech.ac.in

Polyamines (PA) are low molecular weight aliphatic amines, present in all eukaryotic and prokaryotic organisms. They are produced by organisms during metabolism. In, plants polyamines are predominantly present in the free state. They play an essential role in cell proliferation, growth as well as mitigation of abiotic stress. Most studies have shown that plants accumulate PA in environmental stress conditions. The most common forms of polyamine in plants are putrescine, spermidine, spermine, thermospermin and cadaverine. The polyamine level is controlled by two types of amine oxidase; copper-containing amide oxidases (CuAOs) and FAD-dependent polyamine oxidase (PAO). Polyamine oxidases are flavoproteins that catalyze the degradation of polyamines like spermidine to form putrescine along with H_2O_2 and NH_3. This H_2O_2 produced upon catabolism acts as a signalling molecule when present in lower concentration inducing stress tolerance response to plants and becomes toxic at higher concentration leading to plant death. Thus the balance maintained between PA catabolism and biosynthesis is a crucial factor for plants under abiotic stress. With the advancement in proteomics and localization techniques, polyamine oxidase has been identified in both lower plants, like diatoms as well as higher plants, like *Arabidopsis thaliana*, *Oryza sativa*, *Triticum aestivum*, *Solanum lycopersicum*, *Citrus sinensis*, and *Malus domestica*. In the case of *Oryza sativa*, PAO3, PAO4, and PAO5 isoforms have been reported to be localized in peroxisomes. Our study mostly involves, early peroxisomal targeting of PAO3 combined with upregulation of OsPAO3 by different abiotic stresses making it a suitable candidate for crop resilience in response to harsh abiotic stress conditions.

Artificial Intelligence in Agriculture

Sambedika Jena & Ritul Mishra
Dept. of Biotechnology, Rama Devi Women's University, Vidya Vihar, Bhubaneswar

Due to climate change and population explosion, the agriculture industry has been massively hit around the world. Therefore, it is imperative to combine modern scientific technology with age-old practices in Agriculture. In this age of internet and web, the advance in Artificial intelligence is a rapidly developing area of technology. In agriculture, we can combine AI in cognitive computation, database structuring and case studies to impact crop growth, yield and improvement. AI in agriculture is now tested in many pilot projects by state run government bodies and private organisations. With AI, we can monitor and predict climate changes or the weather pattern, in checking soil quality, new developments in soilless cultivation like hydroponics, chemical culture, organic farming and artificial food production ,disease and pest control, rainfall predictions and monitoring, innovation and robotics in the field of machineries used in irrigation, harvesting and storage, developing apps and other services for market analysis and profit predictions for farmers (Databases), and in disaster management issues to do pre and post disaster inventory assessment, as surveillance chips, sensors, drones and cameras etc. With the help of AI, we can surely transform the agricultural horizon for good.

GIGANTEA increases susceptibility to *Fusarium oxysporum* infection in *Arabidopsis thaliana* by inhibiting the salicylic acid pathway

Alena Patnaik[a], Anamika Singh[a], Anshuman Behera[a], Aman Kumar[a], Anath Bandhu Das[b], Kishore CS Panigrahi[a*]

[a]School of Biological Sciences, National Institute of Science Education and Research (NISER) Bhubaneswar, Jatni, Odisha, 752050

[b]Department of Botany, Utkal University, VaniVihar, Bhubaneswar 751004, Odisha, India

Abstract:

Plants have evolved a network of highly complex signal transduction mechanisms that allow them to cope with variations in both internal and external environmental cues. Plant's growth and development are fine-tuned by the diurnal and circadian regulatory control, which are governed by the biological clock. GIGANTEA (GI), a plant-specific nuclear protein and a clock component, has been shown to play pleiotropic roles in plant growth and development. GI regulates the timing to flower, circadian clock function, and various types of abiotic stress tolerance at least in *Arabidopsis*. in plants. However, very little is known about the role of GI to susceptibility of *Fusarium oxysporum* (*F. oxysporum*) infection in *Arabidopsis thaliana* (*At*). In this study, we showed an increase in the abundance of GI transcript and protein in wild-type Col-0 plants after *F. oxysporum* infection, making the Col-0 plants more susceptible comparable to the *gi-100* mutant plants. We also found that the GI's effect is mediated by salicylic acid (SA) signaling and GI is PHYTOALEXIN DEFICIENT4 (PAD4)-dependent that contributes susceptibility to *F. oxysporum*-caused vascular wilt disease. GI also promotes early flowering during *F. oxysporum* infection, allowing plants to shorten their life cycle and produce seeds before succumbing to severe stress. This is FLOWERING LOCUS T (FT)-dependent in Col-0 plants after *F. oxysporum* infection. Taken together, our findings show that the SA-signaling pathway, which is controlled by GI, regulates plant-pathogen interaction during *F. oxysporum* infection in *Arabidopsis thaliana* and may lead to the development of disease-tolerant crop trait.

Screening and evaluation of potential plant growth promoting and antimicrobial activities of bacterial endophytes from rice cultivar

Slipa Kanungo, Omar Aweiss Ali, Nirmalya Pal, Ritesh Pattnaik*

School of Biotechnology, Kalinga Institute of Industrial Technology, Deemed University, Bhubaneswar, India

Corresponding author: Dr. Ritesh Pattnaik, School of Biotechnology, KIIT-DU

Email: rpattnaik@kiitbiotech.ac.in

Rice (Oryza sativa L.), is a staple food for more than one-third of the world's population and an important cereal crop in India, grown under diverse agro-climatic conditions. In an estimate, the wetland paddy cultivation contributes for the major supply of rice crop world-wide. However, this flooded condition leads to accumulation of iron [Fe(II)]) which may be toxic and often causative agent for the bronzing of the leaves and eventual loss in the production of rice, particularly in the low land region. Additionally, the extensive application of chemical fertilizers in order to increase the yield often deteriorate the condition of the environment contributing to soil degradation, eutrophication, accumulation of heavy metals and nitrates. In view of this current scenario, use of plant growth promoting rhizobacteria (PGPR) can be a preferred alternative. The present work was envisaged to screen for potential endophytic microbial isolates from roots and stem of rice plant. The strains were screened for their growth-promoting activity in rice plants because rice shows a quick and easy response to the bioactive compounds present in the culture filtrate (CF) of the potent endophytic strains. The rice plants were cultivated in pots containing 30 mL of 0.8% w/v water-agar medium. The pots were placed in a growth chamber, operated at 28 ± 0.3°C for 14 h (day); and 25 ± 0.3°C for 10 h (night), at 70% relative-humidity. Among the isolated strains, R1, R2, S2, S3 and R6 showed visible growth promotion in rice plants. The biochemical analysis revealed that the strains were able to produce indole acetic acid (IAA) and flavonoids in higher quantities. Moreover, the strains also produced bioactive compounds that inhibited growth of *Escherichia coli* using the well diffusion method. From the results, it was concluded that these strains can secrete potent compounds that can promote the host plant growth and inhibit the growth of pathogenic microorganisms and, therefore, can be used as bio-fertilizer and bio-control agents.

Evolutionary progression and comprehensive transcriptional profiling of WRKY gene family in pearl millet

Jeky Chanwala[12], Suresh Satpati[1], A. Dixit[1], M. Giri[3], Ajay K. Parida[1] and N. Dey[1]

[1]Institute of Life Sciences, Bhubaneswar

[2]Regional Centre for Biotechnology, Faridabad, 121001 Haryana, India.

[3]School of Biotechnology, KIIT University, Bhubaneswar

The members of WRKY TF family are well known for their role in plant development, phytohormone signaling and particularly in developing resistance against biotic or abiotic stresses. In this study, we did in-silico mining and characterization of WRKY members in pearl millet (*Pennisetum glaucum*), which is one of the most widely grown cereal crop in the semiarid agriculture region of Africa and South East-Asia including India. A total of 97 putative *PgWRKY* genes were identified and classified into three major groups (I, II and III) with five subgroups (IIa-IIe) based on presence of WRKY DNA binding domain. Phylogenetic analysis and Synteny relationship showed evolutionary progression of WRKY family in Pearl millet. *In-silico* analysis of PgWRKYs revealed the presence of various motifs and cis-regulatory elements like ABRE, DRE, ERE, EIRE, Dof, AUXRR, G-box, etc., that play vital roles in plant growth, development, hormonal and stress responses. Further, relative expression analysis of *PgWRKYs* showed differential expression pattern under abiotic stress and phytohormone treatments. Findings of this study have potential to establish the putative role of identified *PgWRKYs* in various stress conditions and further characterized *PgWRKYs* can be employed for crop improvement.

Key words: Pearl millet, WRKY, Abiotic stress, phytohormone.

Probiotic formulation optimization using *Levilactobacillus brevis* and its effects on HCT116 and gut dysbiosis

S. Mahanta[1], S. Elangovan[1], S. K. Panda[1]

[1] School of Biotechnology, KIIT University, Bhubaneswar, Odisha, India

Correspondence: Sachin Mahanta (Research Scholar), School of Biotechnology, KIIT University, Bhubaneswar, Odisha, India. E-mail: mahanta.sachin06@gmail.com

Abstract

Introduction: Formulation of new food supplements/food and beverages that contain probiotic ingredients and exhibit health-promoting properties has been one of the important focuses of the food scientists and the preference of the health-conscious consumers. The objective of the study was to develop a novel probiotic mixed carrot and beetroot juice with appropriate fermentation parameters using *Levilactobacillus brevis.*

Methodology: The current study demonstrates a multivariate statistical optimization to determine the suitable conditions (proportion of starter culture, additional sugar, proportion of beetroot juice) for fermentation of probiotic carrot and beetroot juice. Artificial Neural Networking (ANN) was also used to validate the optimization. The optimized fermented juice was subjected to biochemical, infrared, and GC-MS (Gas chromatography-mass spectrophotometry) studies. MTT [3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide] assay and wound-healing cell migration assay were performed to study the anti-carcinogenic property of the optimized juice on the colon cancer cell line HCT116. In vivo studies showed that the *L. brevis* MTCC 4460 could colonize in the colon of the mouse fed with the optimized product. In addition, the formulation effectively prevented *Salmonella*-induced colitis in the mouse model. Based on the aforesaid findings, the optimized formulation can be recommended as a potential dietary supplement for a healthy lifestyle.

Results: The optimized parameters for the production of the juice were 2% inoculum (*L. brevis*), 0.67% additional sugar (dextrose), and 30.1% beetroot juice obtained from RSM. Both RSM and

ANN models yielded good quality predictions, but ANN model results were accurate due to higher R^2 and lower absolute average deviation (AAD) values. GC-MS study revealed the generation of novel bioactive compounds and flavouring compounds during the fermentation such as piperidine, 2,2,6,6-tetramethyl-, 1,3,5-benzenetriol, γ-decalactone, 1,2:5,6-dianhydrogalactitol, and strychnine. The MTT assay after 72hrs treatment with samples showed that in a dose of 10 µl and 15 µl, the cell viability ratio was 25% and 13% in the fermented juice treated cells whereas it was 42% and 28% in the unfermented juice treated cells, respectively. The wound closure cell migration assay in different time intervals of 0h, 12h, 24h, 36h, and 48h, also exhibited a decrease in the cell migration (HCT116) at a dose of 10 µl and 15 µl of concentrated optimized fermented formulation as compared to the unfermented formulation. The administration of the formulation was able to counter the effect of *Salmonella* colonization at the gut level as well as the systemic level. In the current study, the protective property of the optimized formulation against *Salmonella* infection could be attributed to the competition in colonization in the colon, virulence properties, such as adherence, invasion, cytotoxicity, etc.

Conclusion: The current study illustrates the formulation of a novel lactic acid fermented product and its effectiveness against cancer cell proliferation, cell migration, and gut infection. The study proves the antiproliferative and anti-migratory properties of the novel formulation in HCT116. The unique formulation can also be considered as a protective dietary supplement in gut infections caused by *Salmonella* sp. The raw materials are commonly available throughout the globe; hence they possess a scope of commercial exploitation for the preparation of the developed formulation. The formulation can be commercialized under the category of functional foods, nutraceuticals, or food for the special dietary purpose for enhancement of immunity and other health promotions.

Deciphering the role of candidate WRKY TFs in biotic stress responses of pearl millet

Baisista Saha[1], Jeky Chanwala[2], Mufeeda KT[1], Nrisingha Dey[2] & Mrunmay Kumar Giri[1]

[1]School of Biotechnology, KIIT (Deemed to be) University, Bhubaneswar, India
[2]Institute of Life Sciences, Bhubaneswar, India

Transcription factors (TF) are involved in plants defence system against several biotic and abiotic stress. They bind to respective cognate cis element of target genes and changes their expression level under specific stress. WRKY TFs are one such group of biological regulators in plants. Importance of WRKY TFs in many plant species including Arabidopsis, Rice, Wheat, Foxtail millet, Tobacco, Cotton etc. are published in several studies. However, it's familiarity in Pearl millet is still in its infancy. Though these species are highly tolerant to extreme environmental stresses as compared to others, it is continuously being affected by various diseases caused by few oomycete pathogens viz. *Sclerospora graminicola* (Sacc.) and *Claviceps fusiformis* which cause loss of crop up to 40% and 58 to 75% grain loss respectively. Our *in silico* database mining has identified 97 putative WRKY TFs in pearl millet. BlastP software used to search for sequence homologs against WRKY families of *A. thaliana, O. sativa, G. hirsutum, Vitis vinifera, Triticum aestivum* and *Capsicum annum* having more than 50% query coverage and identity. The MCScanX software was used to identify the orthologous pairs, tandem and segmental duplications among WRKY genes. Compiling these datasets obtained from BlastP and MCScanX, 27 PgWRKYs genes were selected which could play a major role in biotic stress response. Transcriptome sequences deposited in NCBI's SRA database by Kulkarni et al. was used to select putative WRKT TFs by comparing their expression upon 100µM of Salicylic acid, Methyl Jasmonate hormone treatment to the mock treated samples. Four PgWRKY TFs viz., PgWRKY28, PgWRKY44, PgWRKY47 and PgWRKY52, were picked up for wet lab analysis. A modified pCAMBIA1300 vector with Maize ubiquitin promoter and Nos terminator was used to clone these genes for their overexpression in downy mildew susceptible variety (7042S) of pearl millet. A novel peptide mediated plant transformation method is in use to generate the transgenic lines. Further studies are needed to establish the roles of these WRKY TFs in regulating disease defence responses in pearl millet.

Effect of Polysaccharide-capped silver nanoparticles on the growth and development of IR-64 rice seedlings under salinity stress

Jagatjeet Nayak[1], Mufeeda KT[1], Baisista Saha[1], Chiranjib Mohapatra[1], Abhisek Singh[1], Luna Goswami[1], Mrunmay K Giri[1]
[1] School of Biotechnology, KIIT Deemed to be University, Bhubaneswar

The environmental stress is a major area of scientific concern because it restricts plant development as well as crop productivity and also significantly contributed in limiting the availability of land for sustainable agriculture. The abiotic stresses such as salinity, drought, cold, and heat adversely affected the survival, biomass production and yield of staple food crops. Thus, salinity stress is a major factor to regulate plant development and subsequently crop productivity. Development of the nanotechnology is the trending and effective strategy in recent times to counter the salinity stress and promote plant growth. Nanomaterials synthesized using different biopolymers considerably contribute more effectively than chemically synthesized nanoparticles. Here in this study, the nanomaterial was synthesized using aqueous solution of carboxy methyl tamarind polysaccharide (CMT) as a reductant and capping agent. The structural characterization of this CMT-capped AgNPs was confirmed by UV, FE-SEM and SR-TEM. Depending upon the dose of CMT-capped nanoparticle followed by the salt stress (20µM), IR64 rice plants exhibited significant amount of change in the growth of the shoots, increase in biomass and chlorophyll content. Further investigation needs to be done for evaluating the mechanism behind the stress tolerance and growth promoting activity of these biologically synthesized nanoparticles.

Keywords: AgNPs, Salinity stress, IR64, rice

Biochar amendment influence soil health and iron availability in paddy field: Insights into sustainable crop production and food security

Abhilipsa Sahoo, Pranjal Shah, Omar Aweiss Ali, Subrat Kumar, Ritesh Pattnaik*
School of Biotechnology, Kalinga Institute of Industrial Technology, Deemed University, Bhubaneswar, India

Corresponding author – Dr. Ritesh Pattnaik,
School of Biotechnology, KIIT-DU
Email: rpattnaik@kiitbiotech.ac.in

Soil degradation and climate change pose extensive challenge to global food security for the rapidly growing population. Climate-smart soils are constantly being urged to build up soil resistance against climate change impacts for stabilizing crop productivity. Although several strategies are employed to improve crop yield, yet agriculture soil functioning and health have been poorly addressed. As a carbon rich biomass, biochar could potentially alleviate soil fertility decline and enhance iron availability for plant growth and metabolism. In the present investigation, laboratory incubation experiment and field trials were done to assess the effect of organic soil carbon amendment including acetate, rice straw and biochar at different levels on temporal changes of microbially reducible iron, plant root oxidase activity and performance of the crop in both simulated and field conditions. Results suggested that in comparison to the laterite soil, the contents of reduced iron in alluvial soil supplemented with acetate were in the range of 3.5 to 23 μmol g^{-1} soil. The addition of rice straw stimulated the process of iron reduction, as evident from the increased contents of reduced Fe(II) till 14 days of incubation. However, application of biochar along with glucose showed inhibitory effect on Fe(II) production. Extensive field trial studies suggested that control plants and addition of biochar at varying levels led to concomitant decrease in the iron reduction potential and α-naphthylamine root oxidase activities. The crop performance as evaluated by grain yield of rice cultivars showed high yield content and improved harvest index when amended with 10 Mg ha^{-1} biochar. Thus, obtained experimental data suggest that organic carbon amendment in particular biochar could be a mechanistic driver towards improving plant nutrient uptake and iron availability for sustainable crop production.

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