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IARI NEWS

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From Director's Desk...

In this quarter, our major research highlights included development of promising biofortified wheat varieties HI 1636 and HI 8823 and low phosphorus and drought stress tolerant mungbean accessions. The evidence for SO_2 and NO_2 being used by crop plants as source of S and N has been established in vegetable species in response to gaseous pollutants. Identification and characterization of a potyvirus, begamovirus and phytoplasma was confirmed in carrot associated with mottling, leaf curl and phyllody symptoms from New Delhi and Uttar Pradesh. Transcriptome analysis of tomato during interaction with *Chaetomium globosum* and *Alternaria solani* revealed that most of DEGs were belonging to metabolic pathways, biosynthesis of secondary metabolites, plant-pathogen interaction, chlorophyll metabolism and plant hormone signal transduction associated with resistance to early blight of tomato. We also organized and celebrated 28th Dr. B.P. Pal Memorial lecture, Teachers Day, Hindi *Rajbhasha* day and Poshan Maah. In addition, the capacity building programme for the extension personnel and farmers through training programme, field days and visits were organized.

I am sure that the technical and applied scientific information included in newsletter would be useful to readers and stakeholders. I wish to congratulate all the scientists and staff of publication unit for bringing out the newsletter in time.

Dr. A.K. Singh
Director, IARI

RESEARCH

Wheat varieties identified for release

Two wheat varieties (HI 1636 and HI 8823) developed at IARI, Regional Station, Indore were identified for release during 60th All India Wheat and Barley Research Workers' virtual meet from August 23-24, 2021. Both of these varieties were dedicated to the nation by Hon'ble Prime Minister, Shri Narendra Modi on September 28, 2021 as biofortified wheat varieties.

HI 1636: It is a bread wheat genotype identified and released for timely sown, irrigated conditions of Central Zone. It was high yielding (56.6 q/ha) genotype compared to check varieties HI 1544 (56.0 q/ha) and GW 322 (55.7 q/ha). It has yield potential of 78.8 q/ha and wider yield stability across the zone. It exhibited seedling resistance (all stage resistance) to all stem rust and leaf rust pathotypes. It has also high levels of field resistance to stem and leaf rusts, Karnal bunt and flag smut. It has high zinc (44.4 ppm) and protein content (11.3%) with excellent chapati quality (8.24), biscuit quality (6.50), test weight (80.6 kg/hl) and high sedimentation value (42.6 ml).

HI 8823: It is a durum wheat genotype identified for timely sown, restricted irrigation conditions of Central Zone. It is a high yielding durum wheat genotype with an average yield of 38.5 q/ha in comparison with durum wheat checks HI 8627(36.7 q/ha) and DDW 47 (37.2 q/ha). It has a yield potential of 65.6 q/ha.

HI 1636: Field and grains view

News Index

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HI 8823: Field and grains view

It has higher number of ear head/m^2 and thousand grain weight as compared to both the check varieties to the tune of 11.3 and 3.9% over HI 8627 and 6.3 and 9.1% over DDW 47, respectively. HI 8823 has high levels of field resistance to stem (ACI: Mean-2.2) and leaf (ACI: Mean-1.7) rusts screened under artificial conditions. It has also good levels of resistance to flag smut and Karnal bunt.

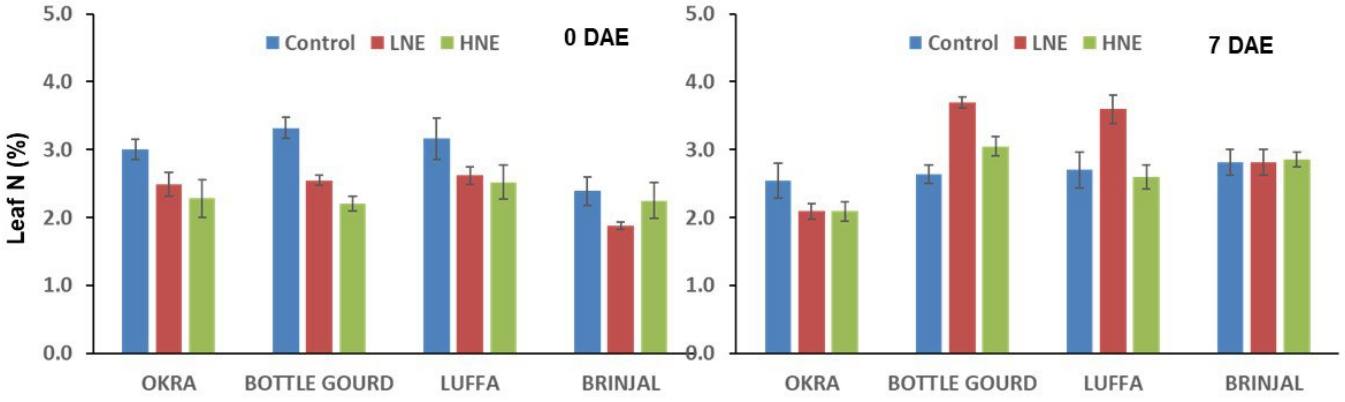
It has good levels of protein content (12.1%), yellow pigment content (5.8 ppm), test weight (85.3 kg/hl), sedimentation value (~37 ml), iron content (37.9 ppm), zinc content (40.1 ppm) with an overall good pasta acceptability (5.9).

Low phosphorus and drought stress tolerant mungbean

Four mungbean accessions identified were categorized as low P and drought stress tolerant (IC333090 and IC507340) and sensitive (IC488526 and EC397142). Transcript abundance of candidate genes related to drought (*VrP5CS, VrRAB18, VrDHN3, VrDREB, VrNCED*) and low P(*VrSPX1*, *VrPHO1*, *VrSQD1, VrPEPCase*, *VrMDH*) was significantly higher in leaves of IC333090 than IC488526. Conversely, low-P-induced genes in IC488526 were either down regulated or did not significantly change under combined stress. The drought recovery was better in IC333090 due to enhanced expression of stress-responsive genes. The tolerant accession may be used as potential donor in *Vigna* breeding program.

SO_2 and NO_2 as source of plant nitrogen nutrition

Sulphur dioxide and nitrogen dioxide are regarded as the major air pollutants emerging out of the industrial development and human activities. Plants exhibit differential sensitivity to these gaseous pollutants and utilize them as mineral nutrients. We examined the effect of SO_2 enrichment at ambient (7-25 µg m^{-3}, Control), ambient + 10 µg m^{-3} (LSE), ambient + 40 µg m^{-3} (HSE) and NO_2 enrichment at ambient (25-35 µg m^{-3}, C), ambient + 10-15 µg m^{-3} (LNE), ambient + 40-50 µg m^{-3} (HNE) in field grown okra, bottle gourd, luffa and brinjal crops; exposed to these gaseous pollutants in specially designed field chambers for a duration of 1 hour daily continuously for seven days. An increase in superoxide radical was recorded under both LSE and HSE. Brinjal appeared to be sensitive to SOx as evident from more than 85% foliage turning necrotic following the HSE at 7 DAE stage however at 14 DAE with the emergence of new healthy leaves, the % necrotic tissue for the experimental crops was significantly reduced. Contrary to this the necrotic tissues accumulated a higher N than the healthy tissues across the experimental crops under the LNE and/or HNE when compared to control. These studies provide evidence for SOx and NOx being used by crop plants as source of S and N and further unravel the mechanisms that regulate these inter species difference in crop response to gaseous pollutants.



Effect of low and high NO_2 enrichment (LNE and HNE respectively) on leaf nitrogen of okra, bottle gourd, luffa and brinjal

Impact of biostimulants on seed germination potential of tomato under low temperature conditions

The impact of thirteen plant growth-promoting microorganisms (PGPM) and two different plant-derived extracts (PDE) on germination ability of tomato seeds (var. Pusa Rohini) under low temperature (11^{0}C) and optimum temperature conditions (25^{0}C) was studied. Results revealed that moringa leaf extract (MLE) treated seeds showed higher seed germination percentage (+9%) and seedling vigour index (+149%) over untreated seeds under low temperature.Under optimum temperature conditions, MLE treated seeds reported less seedling vigour index (+91%) over control. Under the stress condition, the seeds treated with MLE recorded highest percentage of germination followed by *Aloe vera* derived extract treated seeds. Under optimum temperature, the seeds treated with *B. subtilis* recorded higher germination percentage (92%). Shoot weight was observed higher in ALE treated seeds. Based on cluster analysis, seeds treated with MLE, ALE and *B. subtilis* under low temperature and seeds treated with *B. subtilis* and *B. subtilis* + *T. harzianum* under control condition performed better in response to all parameters in germination assay.

Detection of viruses and phytoplasma in carrot

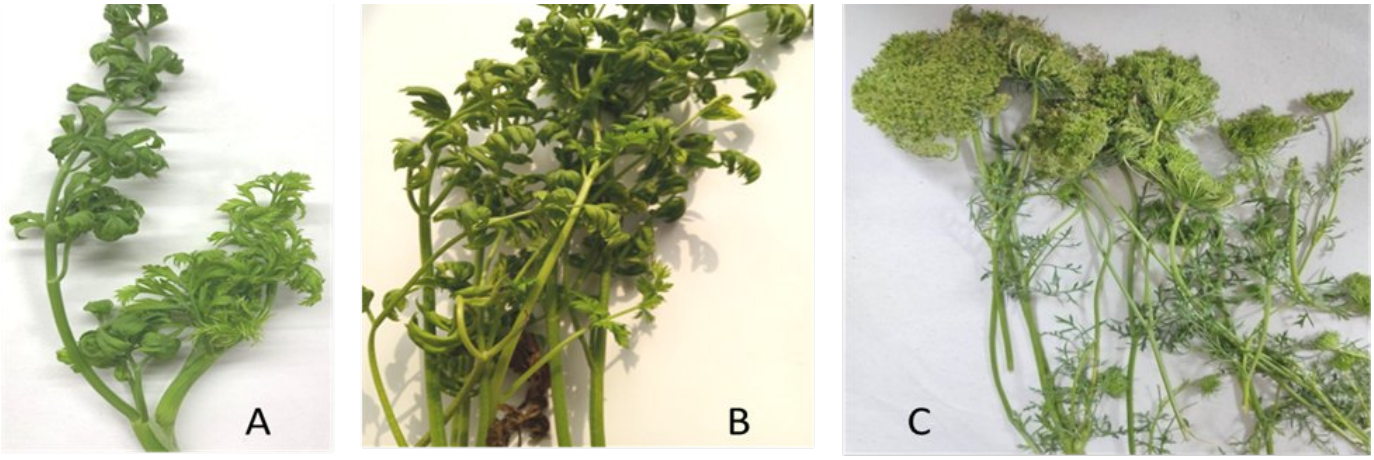
Carrot (*Daucus carota* L.) is an important vegetable crop worldwide. In India, it is grown in an area of 1.08 lakh hectares with annual production of 18.65 lakh tonnes. Recently two new viruses and one phytoplasma strain were identified in carrot samples collected from division of vegetable science and Kusumi Jungle, Gorakhpur, Uttar Pradesh showing mild mottling, leaf curl and phyllody symptoms. Carrot thin leaf virus, a potyvirus, was identified from carrot samples at Delhi by electron microscopic observation showing mild mottling. Samples showing flexuous particles were reacted ELISA and RT-PCR assay with PVY antibodies and further confirmed by RT-PCR assay using potyvirus specific degenerate primers.

A begomovirus was also amplified from DNA isolated from sample showing typical leaf curl symptoms in carrot. Sequencing result analysis of ~2.7 kb product had maximum similarity of 97.88% to the cherry tomato leaf curl virus (CtoLCV) while the initial results of 1.4 kb amplicon shared maximum similarity of 87.86% with croton yellow mosaic alpha satellite.

Carrot phyllody symptoms from Gorakhpur and Delhi were identified to be associated with *Ca.* P. australasia related stains (16SrII-D subgroup) on the basis of sequence analysis of 16Sr RNA and *sec A* partial gene sequences from carrot samples (Kushmi village, Gorakhpur and IARI, New Delhi). This is a first report of CTLV, CtoLCV and *Ca.* P. australasia related stains infecting carrot crops in North India.

Transcriptome analysis of tomato during interaction with *Chaetomium globosum* and *Alternaria solani*

A study conducted on comparative transcriptome analysis of tomato plant under di and tri-trophic interaction with biocontrol agent and pathogen revealed that 2627, 1774 and 907 DEGs with fold change of -2 to +2 with $p<0.05$ were expressed in tomato in interaction with *C. globosum* (Cg2), *Alternaria solani* (As) and both. The KEGG



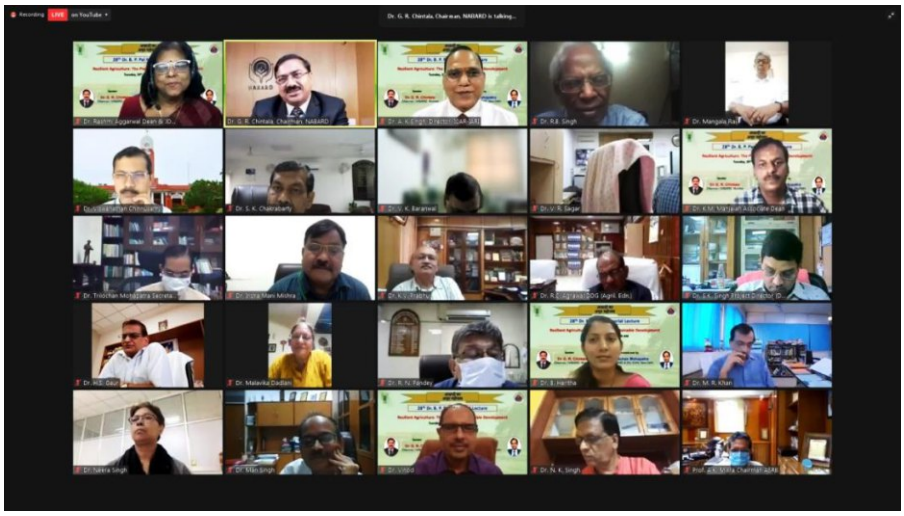
Viruses and phytoplasma symptoms on carrot (A) carrot plant with mild mottling and leaf chlorosis (B) leaf curl symptoms (C) phyllody

pathway analysis revealed that most of the DEGs were belonging to metabolic pathways, biosynthesis of secondary metabolites, plant-pathogen interaction, chlorophyll metabolism and plant hormone signal transduction. GO analysis revealed that DEGs were enriched mainly related to binding activity (GO:0005488), catalytic activity (GO:0003824), metabolic process (GO:0008152), cellular process (GO:0009987), response to stimulus (GO:0050896), biological regulation (GO:0065007) and transcription regulator activity (GO:0140110). The analysis of expression pattern of genes related to hormone signaling pathways revealed that 9 DEGs were upregulated in Cg2 treated plants, 2 DEG in only As inoculated plants, whereas the number of DEGs upregulated in Cg treated-As inoculated plants were quite high (26 DEGs). The modulation in gene expression of plant–pathogen interaction pathways was observed. The 13 DEGs of the pathways such as PAMP-triggered immunity, Ca^{2+} signaling or other WRKY genes were upregulated in tri-trophic interaction whereas only 7 genes and 1 gene in di-trophic interaction of tomato with Cg-2 and As respectively. It revealed that plant signaling system for defense becomes active in biocontrol treated plants, but is highly boosted up when those plants are challenged with pathogen *i.e.* under tri-trophic interaction.

EDUCATION

28th Dr. B.P. Pal Memorial Lecture

Post Graduate School, IARI, New Delhi and Genetics Club of IARI organised 28th Dr. B.P. Pal Memorial Lecture on July 20, 2021 through online mode. Dr. G.R. Chintala, Chairman, National Bank for Agriculture and Rural Development (NABARD) graced the event as speaker and enlightened the audience. The event was presided over by the Dr. Trilochan Mohapatra, Director General, ICAR. Dr. A.K. Singh, Director, ICAR-IARI, New Delhi in his address introduced the Chair to the participants and highlighted his significant contributions to the ICAR, IARI, and human resource development for the nation.



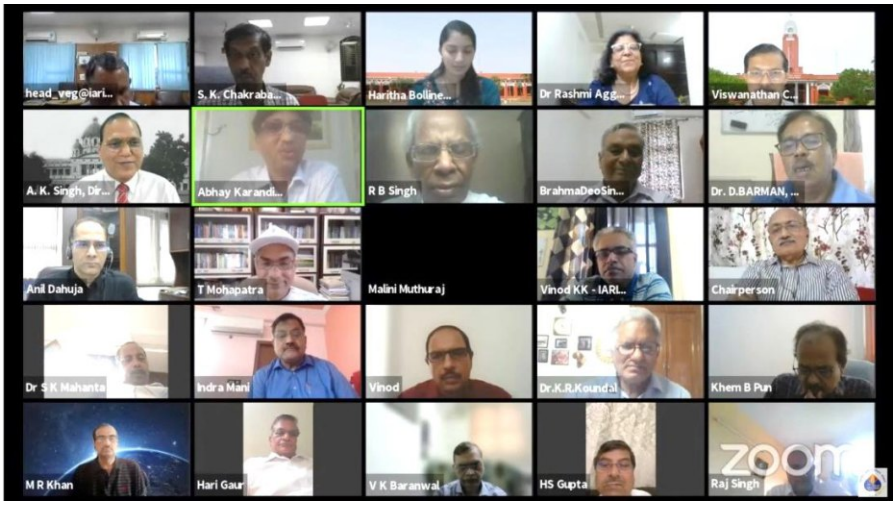
Dr. B.P. Pal Memorial Lecture

Dr. Chintala delivered lecture on “Resilient Agriculture: The Pivot of Sustainable Development”. Dr. Chintala emphasized the role of Indian National Agricultural Research System in strengthening food security and boosting horticultural sector in the nation and contributions of NABARD in India's agricultural and rural infrastructural development.

Teachers' Day Lecture

The Teachers' Day Lecture-2021 was organised through virtual mode on September 5, 2021, on the birthday of former Hon'ble President of India, Dr. S. Radhakrishnan,

Dr. Abhay Karandikar, Director, IIT, Kanpur delivered the Teachers' Day Lecture on the very interesting topic "Managing



Teachers' Day Lecture

Innovations". In his lecture, Dr. Karandikar spoke on managing innovations in the context of Atmanirbhar Bharat and stressed that scientists, academicians and technocrats have a great role to play in this direction. Dr. Karandikar also emphasized on the need of enhancement of the IPR and patents, global standardization efforts, interaction between academia and industry and number of Indian product companies. Dr. Trilochan Mohapatra, Chairman of the Session gave the concluding remarks.

A special invited lecture in Hindi *Rajbhasha*

A special invited lecture on a burning topic entitled "Value Addition through Strategic Management of Plastic, Electronics and Agricultural Waste" was organized by the Division of Environmental Science in the official language (Rajbhasa) during the Hindi Chetna Mas (September 14 to October 13, 2021) on September 25, 2021. The lecture was delivered on the virtual mode by world-renowned Scientist Dr. K.K. Pant, Dean (Faculty) and Professor, Department of Chemical Engineering, IIT, Delhi.

Shri Keshav Dev, Deputy Director (Official Language), highlighted the efforts and achievements of the institute to promote and disseminate the use of *Rajabhasa* in agricultural science and research. Dr. K.K. Pant, made a detailed action of his efforts, achievements and impacts in the area of value addition through strategic management of plastic, electronic and agricultural waste in a very simple and concise manner which evoked great interest and discussion from the participants.

Nutri-cereals and nutri-grains for health and wellness

In order to commemorate the 75th Anniversary of Indian Independence, Division of Biochemistry organized a three days workshop cum hands-on-training on "Creating Healthy World through Agriculture Base and Balanced Diet" during September 6-8, 2021. More than 300 participants including scientists, research fellows, entrepreneurs, start-ups and farmers got themselves registered and attended this workshop. Dr. A.K. Singh, Director, ICAR-IARI and Dr. S.L. Mehta, President, SPBB presided over the function and released the bulletins named "POSHAN III" (Pearl millet-Maize Oriented Substitution for Healthy All Inclusive Nutrition), "POSHAN IV" (NutriGreens for health and wellness) and a book "NutriTwist" - Zest of flavors, Hallur soft bajra atta recipes. Mr. Kamal Kant Pant, Principal, IHM, Pusa, New Delhi, the key-note speaker of the workshop, delivered a talk on 'Challenges of hidden hunger and food security'. The IARI technologies, found its place, in IHM kitchen; varieties of bakery products, and exotic dishes were displayed from the technologies of

Dr. A.K. Singh, Director, ICAR-IARI interacting with IHM faculty people and appreciated their efforts for bringing in IARI technologies in IHM kitchen

Farmers-scientist interaction on climate resilient agriculture

the Division of Biochemistry, ICAR-IARI.

EXTENSION

KVK, Shikohpur's activities

- **Field day on pearl-millet:** During the reported period, three field days on pearl millet was organized from September 16, 18 and 22, 2021 in Langra, Joniawas and Harchandpur villages of Gurugram, respectively. In these field days, 26, 58 and 39 farmers were participated. Soil health campaign, awareness camp under Jal Shakti Abhiyan were also organized during July and September, 2021.
- **Kisan Gosthi:** KVK organized Kisan Gosthi on "Food & Nutrition for farmers" to celebrate the 75th Azadi ka Amrit Mahotsav on August 26, 2021.
- **Farmers-Scientist interaction on "Climate Resilient Agriculture and Suitable Varieties":** KVK organized farmers-scientist interaction on "Climate Resilient Agriculture and Suitable Varieties" on September 28, 2021 at KVK campus, in which 100 farmers and farm women were participated.

Celebration of Important Days

- **Celebration of ICAR Foundation Day:** KVK celebrated ICAR foundation Day on July 16, 2021 by planting 150 plants of moringa, ber, *Ficus* sp. and lemon at KVK campus.
- **Poshan Vatika Maha abhiyan**: KVK organized *Poshan Vatika Maha abhiyan evam Vriksharopan Karyakram* at KVK on September 17, 2021 to celebrate the Rashtriya Poshan Diwas, in which 118 farmers and farm women and 71 girl students participated. The participants were distributed 100 seed kits of seasonal vegetables and 1500 seedlings of fruits, agro-forestry plants and vegetables and motivated them to establish a nutria-garden in the space available in the backyard or around their houses.
- **Celebration of Poshan Maah:** KVK, Gurugram celebrated Poshan Maah from September 01 to 30, 2021 during which a total of 5 awareness programme *viz.* on September 22, 2021 at Fazilpur Badli village, September 23, 2021 at Sakatpur village, September 24, 2021 at Tajnagar village, September 25, 2021 at Garhi Harsaru village and September 29, 2021 at village Kherki Majra village were organized on topics like Nutrient, their role in human body and food sources, health benefits and processing of nutria-cereals and balanced diet, poshan thali and establishment of nutri-garden.

CAPACITY BUILDING

Trainings

On the occasion of *Amrit Mahotsav* of India's Independence, Division of Agricultural Extension organized seven one-day training

Celebration of Poshan Maah

programme on processing and value addition based entrepreneurship development under the DBT's Bio-tech KISAN hub project during July 14-16, 2021 in collaboration with the KVKs of the aspirational districts Shravasti, Bahraich and Balrampur in Uttar Pradesh; Mewat in Haryana; and Dholpur, Karauli and Baran in Rajasthan

The subjects covered in these trainings were fruit processing and value addition in banana, tomato and guava; processing and value addition of mango; integrated farming systems; turmeric and coriander processing and value addition; fruit processing and value addition: post-harvest and value addition of seed spices, potato processing and value addition and milk products preparations. A total of 112 women farmers were benefitted.

Farmers Trainings

- Nine trainings on topics like establishment of nutri-garden, ICM and INM in pearl-millet, soil and water conservation in *kharif* crops, income generation through value addition, organic farming, IPM and weed management in pearl-millet etc. were organized for practicing farmers and farm women to create awareness among them, in which a total of 157 participants benefited.
- One day capacity building programme for FPO & farmers for exports on millet based export oriented food product during Vanijya Saptah has been organized by KVK Gurugram on September 26, 2021 at KVK Gurugram in hybrid mode funded by APEDA, New Delhi where in 140 farmers and farm women has participated physically and nearly 500 joined online during the training programme. The present export scenario and opportunities of millets for farmers and FPOs was explained in details by Smt Rekha Mehta, Assistant General Manager, APEDA, New Delhi. She suggested for registration in APEDA website and portal for APEDA app. The scientists of IARI, New Delhi discussed with the farmers to aware about the package of practice, nutrition and health benefits and processing of millets.

MISCELLANEOUS

Externally funded Projects

- "Harnessing haplotype diversity of genes controlling yield, stress tolerance and resource use efficiency traits in rice for accelerating genetic gains" funded by NASF, ICAR with sanctioned budget of ₹54.27 lakhs for four years (PI: Dr. Ranjith Kumar Ellur, Scientist, Division of Genetics).
- "Identification of genes/genomic regions associated with *Fusarium* head blight resistance in wheat" funded by ICAR with sanctioned budget of ₹15.50 lakhs for five years (PI: Dr. M.S. Saharan, Principal Scientist, Division of Plant Pathology)
- "Fine Mapping of recessive leaf and stem rust resistance gene in wheat-rye recombinant stock 'Selection 212" funded by CSIR with sanctioned budget of ₹ 27.23 lakhs for three years (PI: Dr. Shailendra Kumar Jha, Senior Scientist, Division of Genetics)
- "Intervention of improved agricultural technologies for transforming agriculture in Uttar Pradesh for enhancing Farmer's income" funded by PUCAR with sanctioned budget of ₹160.65 lakhs for four years (PI: Dr. J.P.S. Dabas, Incharge, CATAT)
- "Gender advancement for transforming institutions (GATI)" funded by DST (KIRAN Division) with sanctioned budget of ₹7.99 lakhs for 18 months (PI: Dr. Alka Singh, Professor & Head, Division of Agril. Economics)

Farmer's trainings conducted by KVK Shikohpur

Training Title	Date	No. of Farmers	Venue
Household food security through establishment of nutria-farm	14-7-2021	14	Village -Tripari
ICM in perl millet	06-07-2021	18	Village- Tajnagar
INM in *kharif* crops/ pearl millet	17-07-2021	14	Village Mailawas
Soil test based nutrient management in pearl millet	12-8-2021	17	Village- Farrukhnagar
Soil and water conservation in *Kharif* crops	16-8-2021	21	Village FazilpurBadli
Income generation through value addition activities	27-8-2021	14	Village Sakatpur
Organic farming	18-9-2021	19	Village Daboda
Integrated pest management in pigeon pea	3rd/6th/7th/8th-9-2021	16	Village Tripari
Weed management in pearl millet	22-9-2021	24	Village Harchandpur
Total		**157**	

- "Assessment of old and new wheat varieties for genetic variability in quality traits and their relationship with pizza extruded and baked product making" funded by CSIR with sanctioned budget of ₹22.83 lakhs for three years (PI: Dr. Anju Mahendru Singh, Principal Scientist, Division of Genetics)

Contract Research Project

- Implement the contract research project entitled "Evaluation of seaplant extracts and its effect on viral disease management in vegetables (cucumber and okra)" with IARI and Sea Energy Pvt Ltd, Bangalore at a total cost of ₹ 6.77 lakhs for one year (PI: Dr. Swati Saha, Scientist, Regional Station, Pune)
- Implement the contract research project entitled "Development and Evalution of high yielding and nutrient rich Oats variety for value addition" with IARI and M/S. Marico India Pvt. Ltd. at a total cost of ₹56.72 lakh for three years (PI: Dr. M. Sivasamy, Principal Scientist & Head, Regional Station-Wellington)
- Implement the contract research project entitled "Effect of Seaweed extract based growth promoter on crop productivity and soil health" with IARI and IFFCO at a total cost of ₹ 16.50 lakhs for two years (PI: Dr. M.C. Meena, Senior Scientist, Division of SS&AC)
- Implement the Contract research project entitled "Foliar fertilization using new fertilizer formulations and bio stimulant for enhancing nutrient-use efficiency and crop productivity" with IARI and Yara Fertilizer India Pvt Ltd. at a total cost of ₹ 18.88 lakhs and duration of two years (PI: Dr. R.S. Bana, Senior Scientist, Division of Agronomy)
- Implement the Contract Service project entitled "Evaluation of bio-efficacy of SYN 547407 10% w/v DC against mites in apple" with IARI and Syngenta India Ltd. at a total cost of ₹ 15.19 lakhs for two years (PI: Mr. Santosh Watpade, Scientist, IARI Regional Station, Shimla)
- Implement the Consultancy project entitled "Audit of tree plantation survival of Horticulture, East Delhi Municipal Corporation" with IARI and East Delhi Municipal Corporation at a total cost of ₹ 6.49 lakhs for 90 days (PI: Dr. S.S. Sindhu, Head, Division of Floriculture and Landscaping)

Technology Commercialization

During July to September, under Lab to Land Initiative, seven technologies (onion cv. Pusa Riddhi, okra cv. Pusa Bhindi-5, cauliflower cv. Pusa Meghna, cauliflower cv. Pusa Deepali, cauliflower cv. Pusa Sharad and Gynoecious line of cucumber and rice variety PB 1718) of ICAR-IARI were transferred to three industry partners resulting in total revenue generation of ₹ 3.55 lakhs.

Incubation Activities

- **ABIC**: The incubation programme was launched on July 8-15, 2021 to call the application under ABIC programme. A total of 55 applications have been received under ABIC 2021. Finally, 4 startups (Farm Mechanization, Supply Chain & Agricultural logistics, Precision farming and Post-Harvest & Value Addition) were selected for Incubation support under ABIC project.
- **Launch of 2-month online incubation programme :** The Unit organized two-month incubation program virtually wherein the cohorts of ARISE (pre-seed) 2021 and (Seed) 2021 were combined into one big cohort of 54 startups from August 02 to October 02, 2021. During this programme various session, one-on-one technical, business, IP financial management mentoring sessions were arranged for the startups.

During two months on incubation program, startups underwent a mix of business and technical mentoring sessions from eminent IARI scientists Dr. K.V. Prabhu, Dr. Indermani, Dr. Lata, Dr Viswanathan, Dr R K Sahoo, Dr. Sudeep Marwaha to name a few and Industry experts like Mr Satish Chintamani, Mr. Jagdeesh Sunkad. A total of 27 sessions on various topics like Design Thinking, IP Management, Business Model Development & Strategy, Product Market Fit and Unlocking Innovation potential, Primer for Startup Finances, Digital Marketing for Startups, Supply Chain & Logistics, Venture Capital Funding etc by Industry experts like Mr. Hemendra Mathur, Mr. Ashish Khare, Mr. S. Bhaskar Reddy, Dr. Kalpesh Kumar Gupta, Ms. Subhaprada Nishtala etc. were organized for the cohort.

Corporate Membership

In this quarter, Unit enrolled 80 industry partners for membership and generating revenue of ₹3.93 lakhs.

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