ICAR Research Complex for Eastern Region, Patna

भारतीय कृषि अनुसंधान परिषद का पूर्वी अनुसंधान परिसर, पटना

ICAR RCER NEWS

Vol. 16, No. 2 July-December, 2023

Strategic and adaptive research for efficient integrated management of natural resources to enhance the productivity of agricultural production systems in the Eastern Region

Transform low productivity-high potential eastern region into high productivity region for food, nutritional and livelihood security

Utilization of seasonally waterlogged and perennial water bodies for multiple uses of water

Promote network and consortia research in the Eastern Region

From Director's Desk

The Eastern part of India is endowed with a wealth of natural resources. Almost 83% of the people living in the Eastern States rely primarily on agriculture for their livelihood, making it the economic backbone of the region. Despite the plentiful natural resources for agriculture and favorable agroclimatic conditions, agricultural productivity in this region stays at the subsistence level. The unpredictable monsoon, poor water management, lack of affordable high-quality inputs, and scattered, small, and dispersed land holdings are the main challenges in this region. Weather extremes, such as droughts and floods, exacerbate the consequences of climate change on agricultural output and farmer income. Agricultural development, including the provision of land, water, markets, and extension services, has also been severely underfunded, which has impeded the regions' growth momentum. Therefore, there is enormous space available for the introduction of innovations to improve agriculture in the region. Eastern India can ensure a robust and thriving agricultural sector by empowering farmers and encouraging agricultural diversity. Adoption of climate-resilient agriculture, integrated farming systems, and diversifying agricultural practices towards high-value produce, such as dairy, horticulture, fisheries, etc holds immense potential for boosting farmers' incomes. To maintain fair prices and low transaction costs, it is also necessary to enhance marketing facilities through public-private partnerships. Nevertheless, a significant financial and physical infrastructure investment is required to boost agriculture in this region, including agro-processing facilities, remote warehouses, cold chains, and cold storage. To fully use the agricultural potential of Eastern India, concentrated efforts are needed to address the neglected areas. To set the stage for a sustainable green revolution in the area, a multifaceted strategy involving technological breakthroughs, policy support, institutional bolstering, capacity building, and calculated investments in agri-infrastructure is required. ICAR RCER through its headquarters at Patna, Research Centre at Ranchi, and its two KVKs (one each at Buxar and Ramgarh) strives hard to contribute towards the overall development of the region with a focus on agriculture. Considering the farmers' needs in this region, RCER Patna has developed several technologies including improved seed systems and integrated farming options for sustainable intensification of rice-wheat systems, horticultural crops, and greening rice fallow areas. Our institute has been emphasizing partnerships and collaboration with universities, state and central government agencies, NGOs, and commercial partners to strengthen agricultural innovation and the spread of proven technology in eastern India. It gives me great pleasure to see the major outcomes and initiatives of the past six months like IARI Hub (ICAR RCER, Patna), initiatives on natural farming, multiple uses of water (MUW) models for sustainable agriculture in waterlogged areas and other details in this issue. I heartedly congratulate the editors and contributors of this newsletter for their efforts.

Anup Das

CERTIFIED TECHNOLOGY

Following 12 technologies have been certified by the Council

Solar Irrigation Pump Sizing Tool (ICAR-NRM-RCER-Technology-2023-005): It is a decision support system that works out the optimal size of solar irrigation pump considering the water requirements, cropped areas, water source and type of irrigation systems. The Ministry of New and Renewable Energy (MNRE) of the Government of India has adopted the tool in its PM-KUSUM scheme for designing right-sized solar irrigation pumps to farmers.

Design and Development of Solar Operated Hold on Type Paddy Thresher (ICAR-AE-RCER-Technology-2023-029): This ergonomically designed thresher uses a 975Wp solar panel to carry out threshing and winnowing operations simultaneously. It has an output capacity of 500-550 kg/day when operated 6-7 h/day. With control over drum and winnower fan speed, it is suitable over a wide range of straw moisture levels.

Modified Drip Fertigation Technology for Vegetable Production in Eastern India (ICAR-NRM-RCER-Model-2023-031): The technology has a significant impact on the yield and water productivity of vegetable crops. The technology has a wider impact under "Per Drop, More Crop" mission under National and State Horticulture missions.

Carbon Stock Quantification Models for Important Fruit Trees of Eastern India (ICAR-NRM-RCER-Model-2023-030): The certified model can be an alternative to the currently used destructive methods for assessing the C-sequestration potential of trees. The models use collar diameter of trunk at 30 cm height above the ground as the only input. The developed models can be used in the national climate change program.

Socio Economic Status Scale for Farmers of Bihar and Jharkhand (ICAR-AEXT-RCER Technology-2023-021): The developed scale can be used for assessing socio-economic status of farmers, and community health studies. It can be helpful in implementing government welfare schemes and agricultural planning.

Integrated Farming Systems for different ecologies of Eastern India (ICAR-NRM-RCER-Technology-2023-027): The Specific IFS models have been developed for rainfed, waterlogged and irrigated ecosystems wherein complementarities of animal husbandry, fisheries and agr-horti crops were harnessed.

Multitier cropping system for rainfed uplands of Eastern India (ICAR-NRM-RCER-Technology-2023-028): The model integrates fruit and timber tree with rice and finger millet, thereby giving relative income advantages over the monoculture alternatives.

Sustainable intensification of rice-wheat cropping system with summer greengram using resource conservation technologies in Eastern India (ICAR-NRM-RCER-Technology-2023-029): The technology has demonstrated that CA-based production system comprising pulse crops during cool season could be a sustainable approach for intensification of rice-fallow cropping system in south Asia

Seed based technology delivery model through Farmers Producer Organization (FPO) (ICAR-AEXT-RCER-Technology-2023-004): This delivery model comprises need-based selection, testing and multiplication of crop varieties at specialized FPO farmers' fields, and their certification, processing and sale to other farmers.

Policy measures for Tenant farmers of Bihar (ICAR-AEXT-RCER-Policy Paper-2023-020): This technology facilitates to understand the ground realities on the status of tenant farming and its impact on productivity and income of agricultural household in Bihar.

Developed a method for serological diagnosis (Indirect ELISA) of *Theileria annulata* using recombinant spm2 antigen (ICAR-AS-RCER-Technology-2023-105): The method aims to diagnose theileriosis in crossbred cattle on a large scale. This is a low-cost diagnostic method using ELISA for seroepidemiological studies.

Identification of CCL8 and CXCL10 as early pregnancy biomarker in buffaloes (ICAR-AS-RCER-Technology-2023-106): These chemokine biomarkers aim to help in determination of positive pregnancy during early gestation in buffaloes, thereby improving their fertility.

VARIETAL DEVELOPMENT

Chickpea variety released and notified

Swarna Lakshami:

The advance breeding line 'DBGC 3' (Swarna Lakshami) of *Desi* chickpea has been identified for release and notification by the *Varietal Identification Committee* during the *Annual Group Meet on Rabi Pulses* held at MPKV, Rahuri on September 01, 2023 for cultivation in the states of Bihar, UP, Jharkhand, WB and Assam. This genotype, derived from a cross 'ICC 13124' × 'WR 315' following pedigree method, has recorded an overall mean yield of 1750 kg/ha weighted over 15 locations in the national AICRP trials under timely sown irrigated conditions in the NEPZ. It has several unique characteristics including double flower per peduncle, presence of waxy-like substances on the exterior surface of leaves and high *Dal* recovery. It is management responsive, and it yields more than 2.8 t/ha under well managed timely sown condition. Seeds are medium large (21.27 g/100 seeds) and rich in protein (20.04%) and Zn (> 46 ppm) contents. It is resistant/moderately resistant to root diseases, such as wilt, dry root rot and collar rot. It has also shown tolerance to Botrytis grey mold and chickpea stunt at some AICRP testing locations. Its release and notification is likely to impact chickpea area and productivity in the NEPZ.

Fig 1. Field view of 'DBGC 3' (Swarna Lakshami)

NEW INITIATIVES

IARI Hub, ICAR RCER, Patna

Indian Council of Agricultural Research (ICAR) has taken initiatives to upgrade the Indian Agricultural Research Institute, New Delhi as the IARI Mega University by creating multiple Hubs at different locations pan India involving ICAR institutes of the given locations based on the Sun-planet-satellite model. Since the academic session 2023-24, the IARI Hub at ICAR RCER, Patna started to operate as one of the IARI hubs for the eastern part of the country. ICAR RCER, Patna is a nodal institute of the planet, and ICAR-ATARI (Patna), Central Potato Research Station (Patna) and NRC on Litchi (Muzaffarpur) are the satellite institutes under IARI Patna hub. Being a Research complex, it has the advantage of having faculties from different disciplines as well as research and seed production farms for practical exposure to the student. At present, 21 UG students [BSc Agriculture (Hons)], 2 PG students and 01 Ph D student (Soil Water Conservation Engineering) are studying at IARI Patna hub. The students are from Assam, Bihar, Chhattisgarh, Jharkhand, Haryana, Himachal Pradesh, Maharashtra, Kerala, Rajasthan, West Bengal and other parts of the country.

Fig 2. (a) Sun-planet-satellite model of IARI Hubs, and (b) Director of the institute with students at IARI Hub, Patna

Initiatives on Natural Farming

An experiment was initiated to observe the efficacy of natural farming (NF) over organic farming (OF), integrated nutrient management (INM) and conventional practices (CP) starting from July 2022 following rice-wheat-green gram cropping system. In the case of NF, a standard methodology was adopted in which seeds of rice were treated with beejamrita before sowing. The application of ghanjeevamrita was done at the time of land preparation, and jeevamrita was applied at 15 days intervals after transplanting of rice variety 'Swarna Shreya'. Rice yield under NF practices was 3.0 t/ha, whereas 3.90, 4.33 and 5.01 t/ha were produced, respectively under OF, CP and INM practices. Although lodging due to heavy rain and wind was observed in rice crop under CP and INM-treated plots, no lodging was observed under NF and OF plots, establishing a conditional advantage of NF and OF over other practices.

Fig 3. Natural farming trial at ICAR RCER Patna

Standardization of Organic Farming Practices for Middle Indo-Gangetic Plains

An experiment was initiated at ICAR RCER, Patna in *Kharif* 2023 to investigate the potential of organic farming to improve productivity, sustainability and ecological balance in the region. The study included three vegetable-based cropping systems, each with different nutrient management strategies: (i) 100% farm yard manure (FYM), (ii) 50% FYM + 50% vermi-compost (VC), and (iii) 50% FYM + 50% VC + bio-fertilizer (BF) + humic Acid (HA). The selected cropping systems were: (i) cowpea-cauliflower-onion, (ii) cowpea-cabbage-red amaranthus, and (iii) cowpea-broccoli-sponge gourd. The highest cowpea yield of 951 kg/ha was recorded under the third scenario (50% FYM + 50% VC + BF + HA).

Fig 4. Organic farming trial at ICAR RCER Patna

Enhanced Multiple Use of Water (MUW) Model for Sustainable Agriculture in Waterlogged Areas

An enhanced MUW model is being envisioned for establishment at Sabajpura farm of ICAR RCER, Patna, with a specific aim to improve productivity and livelihood in waterlogged areas. This comprehensive model will encompass diverse components, viz., fisheries, livestock, vermi-compost, mushroom, horticulture and vegetable crops, fodder crops, agroforestry, cereals, oilseeds, pulses and millets. All these components will be supplied water from a pond source, filled by runoff and tubewell, using the solar-powered pump. Water management technologies like raised bed furrow irrigation, plastic/straw mulching, drip, micro-sprinkler and impact sprinkler irrigation systems, water pumping devices, sensors and stage level recorder to measure water level, rainwater harvesting and ground water recharging are also being planned. Total area of the model is 0.65 ha with pond dimension of 47.5 m × 30 m.

Fig 5. Excavated pond and doob grass transplantation going on for pond side slope stabilization

"Weekly Seminar Series" for Scientists, Administrative staff and Students

"Weekly Seminar Series" on each Friday during 4.30 to 5.30 pm has been initiated for scientists, administrative staff and students with an object to discuss the latest advancements in science and technologies, burning issues of agriculture and several topics related to environmental protection, climate change, financial management and social development. This initiative was intended to help the staff of ICAR RCER Patna to improve their debating and leadership skills besides encouraging teamwork and peer mentorship. A total of 19 weekly seminars were organized during July-December, 2023 focusing on several important aspects relevant to agriculture like *Understanding Livestock behavior for better management and welfare, Intellectual property and trademark filing, Management of salt-affected soils, Standard for competency in the research laboratory, Pesticide formulation and its safe usage, Crop residue management, Scope for mushroom cultivation in India, Opportunities and challenges in transfer of technologies to FPO by KVKs, Soil health management under changing climate, Importance of farmers producer organizations*, and the like.

Fig 6. Glimpses of Weekly Seminar Series

Initiative on Igniting Mind and Nurturing Innovation

To stimulate intellectual curiosity, encourage inventive concepts in agriculture and provide a platform for innovative ideas to flourish, a new committee on "*Initiative on Igniting Mind and Nurturing Innovation*" has been constituted at the Institute. The primary objective of this initiative is to invite and encourage novel ideas related to agriculture from scientists, technical staff and others within the institute. Out-of-the-box ideas, pushing the boundaries of conventional thought, are explicitly welcomed in this initiative. The staff member(s) with the most outstanding idea will receive recognition and accolades at the institute level.

RESEARCH HIGHLIGHTS

Vegetable-Based Integrated Farming System Model Developed

A vegetable-based integrated farming system model has been developed for livelihood improvement. The model has been designed for one-acre land, keeping in view of average holding size of the farmers for midlands of Middle Indo-Gangetic Plains where more than 85 percent of the farmers are small and marginal. The major integrations include:

Field crops: rice - vegetable crops/ maize/ pulses (2000m^2); livestock: poultry (200 birds/ cycle of 40-45 days: 30m^2), goat unit (20+1; 250 m^2); mushroom (year-round: 150m^2); fodder: rabi (berseem, oat and maize), summer (cowpea and sorghum), kharif (maize and MP Chari; 700 m^2) and allied enterprises, viz., goat/poultry manure, vermi-composting and kitchen-*cum*-nutri garden. A horticulture unit is also being established in an area of 700 m^2 for planting of guava/lemon/banana. All around the field, fencing with wire and bamboo poles were made on which creeper vegetables/red gram would be grown. Studies on resource recycling, nutrient dynamics, energy budgeting, GHG emissions, carbon stock, water productivity and economics of the model have been initiated.

Fig 7. Glimpses of components of vegetable-based one-acre IFS system

Pilot Project for Crop Diversification

A mega project Pilot Project for Crop Diversification was launched for crop diversification in the East and West Champaran districts of Bihar. In this program, the traditional rice-wheat cropping system is to be diversified with maize, millets, soybean and pigeonpea pea in 100 ha in each district during *kharif*

season to enhance the productivity of the area, livelihood of the farmers, curtailing cost of production and soil sustainability.

In order to create awareness about the selected crops for diversification, other than the traditional crops (rice) during the *kharif* season, four capacity building programs were conducted for the farmers and extension functionaries in the East Champaran (November 7-9, 2023) and West Champaran (December 6-8, 2023). The intervention sites comprise Baikunthwa, Pakadiya, Jagdishpur, Jamuniya, Jhakhada and Vardahan villages in the West Champaran for implementation of the diversification program during the upcoming *kharif* season (2024)

Fig 8. Glimpses of the capacity building program at (a) East and (b) West Champaran districts of Bihar

Promising Progenies Identified in Pea and Edible Podded Pea through Pre-breeding Approach

Edible podded pea 'RCEP 2' (green podded snap pea having short stature, white flower and sweet seeds) was crossed with 'EC598581' (purple podded having pink flower, vigorous growth habit, seeds devoids of sweetness and thin pod wall) as a pre-breeding approach to utilize wild germplasm for introgression of desirable traits. F_1s were selfed to get F_2 progenies. Among segregating population of 272 F_2 plants, duplicate dominant epistasis (15:1) was observed for flower and stipule colour; however, incomplete dominance was recorded for pigmentation on pods, parchment layer, plant height and other traits. Sixteen promising progenies based on pod traits, sweetness and yield per plant were selected for advance generation studies and fixation of traits. Selections were made for determinate type pea with more than 300 pods per plant, pole type pea with sweet seeds and pigmentation in edible podded pea.

Meenu Kumari, R S Pan, P Bhavana and A K Singh

Fig 9. (a) F_2 population segregants for pod traits and anthocyanin pigmentation, (b) selected progenies for higher number of pods per plant, (c) anthocyanin pigmentation on edible podded pea, (d) pole type pea for higher yield and sweet seeds, and (e) anthocyanin pigmentation in pole type pea

Inbred vs Hybrid Rice Cultivars' Performance under Dry Direct-Seeded Condition

A field experiment was conducted during *kharif* 2023 to study the performance of inbred and hybrid rice cultivars in dry-direct seeded conditions. A total of 24 rice cultivars (11 early and 13 medium/late maturing) were tested during the experimentations. Inbred varieties 'Swarna Samriddhi Dhan' and 'MTU 7029' (Swarna) were taken respectively as check I and check II. Our results revealed that among tested short duration inbred/hybrid cultivars 'Arise 6129' performed better in terms of yield (4.80 t/ha). Similarly, '27P37XRA37923' had a better crop yield (5.74 t/ha) in case medium/long-duration inbred/hybrid cultivars. In conclusion, hybrids yielded better than inbred varieties by 25-40 percent under the dry direct-seeded rice production system of Bihar.

Rakesh Kumar and Santosh Kumar

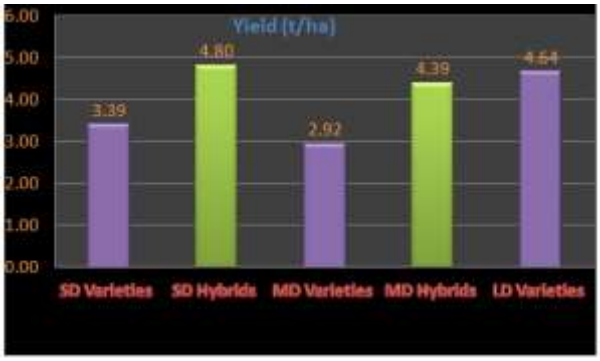


Fig 10. Yield of inbred vs. hybrid rice varieties; SD: short duration, MD: medium duration, LD: long duration

Yellow Mosaic Disease Resistant Genotypes Identified in Yardlong Bean Genotypes

In a comprehensive screening of 144 yardlong bean genotypes for resistance to yellow mosaic disease (YMD), five genotypes (IC626170, IC630412, IC20514, IC20298 and IC586954) exhibited complete resistance with no visible symptoms of YMD. Fourteen genotypes (IC622570, IC622574, IC626139, IC166140, IC626143, IC630388, IC630390, IC630391, IC626163, IC630413, IC398083, IC202893, IC361502 and IC471938) demonstrated high levels of resistance, with only a few leaves displaying mosaic symptoms. The remaining genotypes were classified into moderately resistant, moderately susceptible, susceptible and highly susceptible based on their observed reactions to the disease.

Abhishek Kumar Dubey, Kumari Shubha and A.K. Choudhary

(a) Resistant genotype

(b) Susceptible genotype

Fig 11. (a) Resistant, and (b) susceptible genotypes of yardlong bean to yellow mosaic disease

Tephrosia Biomass Mulching Technology for Improving Soil Health and Productivity of Fruit Orchard

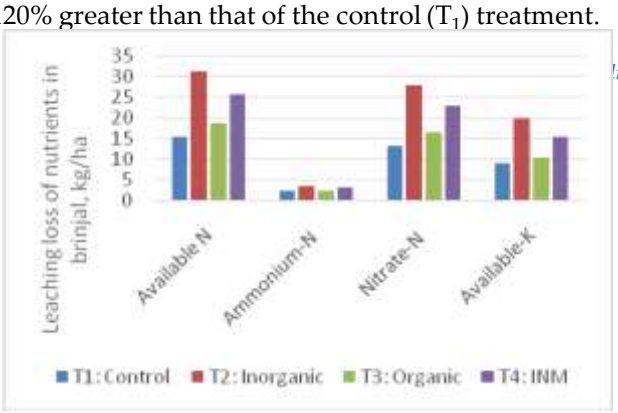
Enriching the plant basins with leafy biomass can effectively improve soil organic matter and nutrient content. A number of perennial biomass-yielding plant species including Subabul (*Leucaena leucocephala*) are being used in agroforestry systems worldwide for improving soil fertility. However, keeping in view the difficulties in the eradication of and high seed dispersal of Subabul plants, there was a need for the identification of an equally effective substitute biomass yielding plant. The present technology includes improvement in soil fertility of fruit orchards through biomass mulching of *Tephrosia candida* in the basin of fruit trees, viz., mango, guava and bael growing under rainfed conditions of EPHR. *Tephrosia candida* is a leguminous perennial shrub with high biomass producing capacity (4.0-5.0 kg dry biomass/m^2) and a lifespan of five to six years under regular lopping conditions. The *Tephrosia* plants can be grown either in the alley area in young orchards, as a hedge in the orchard border or the harvested biomass which can be used in basin enrichment. Application of *Tephrosia* biomass @ 3.0 kg dry wt/m^2 during September has resulted in improvement in soil properties, viz., total soil organic carbon (18.43-21.32%), available nitrogen (13.68-23.02%), available phosphorus (73.18-96.76%) and exchangeable potassium (41.60-47.47%), leading to an increase in the content of leaf nitrogen (35.59-39.06%), phosphorus (27.58-35.01%), potassium (103.3-111.11%) and fruit yield (mango-25.03%, guava-42.25%).

Bikash Das, MK Dhakar, SK Naik, PK Sarkar, S Maurya, and BP Bhatt

Fig 12. Tephrosia biomass mulching technology for different fruit orchards

Nutrients Leaching Loss Quantification

The leaching loss of nutrients were measured by an indigenously developed non-weighing field lysimeter. The 5-year old ongoing treatments comprised of T_1: control ($N_0P_0K_0$); T_2: inorganic (100%-recommended dose of fertilizer (RDF); T_3: organic (100% RDF as vermicompost); T_4: INM (50% RDF as inorganic +50% RDF as organic). Nitrogen leaching loss under the brinjal crop ranged from 15.54 to 31.27 kg/ha in the entire crop growth period among all the treatments. The available-N leaching loss was the highest in the T_2 (inorganic) treatment (31.27 kg/ha) followed by T_4 (INM), while the minimum loss (15.54 kg/ha) was observed in the T_1 (control). The total amount of ammonium-N lost through leaching varied from 2.35 to 3.38 kg/ha. The nitrate leaching loss of the T_2 and T_4 treatments was respectively around 111 and 70 percent more than that of the T_1 treatment. The total leaching loss of available potassium was the highest in the T_2 treatment (19.97 kg/ha), which was approximately 120% greater than that of the control (T_1) treatment.



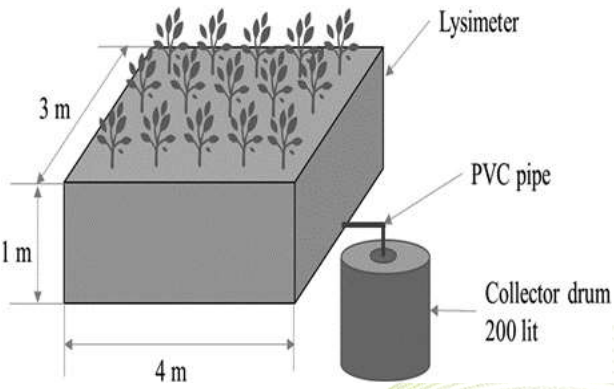


Fig 13. (a) Leaching Loss of Nutrients in different treatments, (b) Schematic diagram of the non-weighing type lysimeter

Evaluation and Characterization of Pointed Gourd Germplasm Using Morphological and Molecular Markers

Forty six germplasm of pointed gourd were evaluated for fruit yield and fruit quality traits in a randomized design with three replications. Swarna Alaukik recorded the highest fruit yield (23.73 t/ha) followed by HAP-79 (20.61 t/ha). Significant variations among genotypes were observed for both fruit yield and quality traits. Important traits like the number of fruits per plant, harvest frequency, pulp seed ratio and total phenol content showed significant positive correlations with total fruit yield (t/ha) at both genetic and observable levels. Selection based on characteristics such as the number of fruits per plant, pulp weight and pulp seed ratio is expected to enhance yield significantly. Promising genotypes, such as Swarna Alaukik, HAP-79, HAP-70 (for yield-related attributes) and HAP-106 (for quality traits), were identified and recommended for cultivation in the Eastern Plateau and Hill Region.
Clustering analysis using 15 ISSR markers grouped 46 genotypes into two main clusters with HAP-76 in one cluster and the remaining 45 into another cluster. The subcluster was again divided into two clusters with the cultivated varieties (3) in one sub-cluster, and the remaining 42 in another subcluster.

P Bhavana, AK Singh, Ankit Kumar Sinha, Reshma Shinde and Sajiya Ekbal

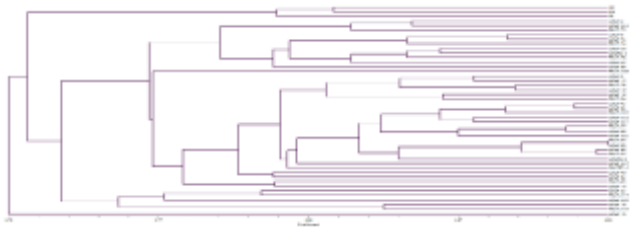


Fig 14. Cluster analysis using 15 ISSR markers in pointed gourd

Phosphorus Solubilization in Acidic Soil through Organic Amendments

During the *rabi* season (2023-24), a field experiment at ICAR-RCER FSRCHPR Ranchi farm was conducted to explore phosphorus mobilization in acidic soils using various organic amendments among nine treatments. These nine treatments included control, lime, phosphorus solubilizing bacteria (PSB), vermicompost and green manuring, each with variations in application rates. Different

treatments using organic sources significantly impacted soil phosphorus fractions after three cropping cycles of maize and French bean. Saloid-bound P, representing the labile pool, increased across treatments, possibly due to microbial mobilization and organic acid dissolution of fixed phosphorus. Inorganic fractions like Al-P and Fe-P were dominant, with total phosphorus ranging from 516 to 801.5 mg/kg, highest in treatments with inorganic fertilizer application. The different forms of inorganic phosphorus found in all treatments were in decreasing order of Fe-P > Al-P > Saloid-P > Reductant Soluble-P > Ca-P > Occluded-P. T8 (vermicompost @7 t/ha) showed superior P solubilization, and improved crop yield and soil fertility compared to other treatments.

Reshma Shinde, SK Naik and AK Jha

Fig 15. Phosphorus solubilization in acidic soil through organic amendments

Evaluation of Vegetable Soybean Genetic Resources for Yield and Nutritional traits

Out of 34 vegetable soybean lines evaluated, AGS-404 {graded green pod yield (GGPY): 17.34 t/ha; green seed yield (GSY): 8.77 t/ha}, AGS-402 (GGPY: 15.74 t/ha; GSY: 7.80 t/ha), the aromatic line AGS-458 (GGPY: 13.19 t/ha; GSY: 7.26 t/ha) and Swarna Vasundhara (GGPY: 12.71 t/ha; GSY: 6.55 t/ha) were found high yielding. AGS-458 was early (Ist harvest at 60 DAS), and had bold green seeds (100-green seed weight: 71.42 g). AGS-406 (22.26 mg/100 g DW), AGS-336 (21.97 mg/100 g DW) and EC 595823 (21.97 mg/100 g DW) were promising for isoflavone, which is health benefitting for cardiovascular diseases, cancer and osteoporosis. AGS-357 (177.41 mg/100 g DW), EC595824 (142.94 mg/100 g DW) and AGS-460 (127.35 mg/100g DW) were promising for tocopherol (Vitamin E) content. AGS-190 (18.67%), AGS-456 (18.60 %) and AGS-333 (18.40 %) were promising for oil content. Oil contains health benefitting unsaturated fatty acids (82.51-85.67%) more than saturated fatty acids (14.33-17.49%).

RS Pan, Meenu Kumari, Reshma Shinde and Sujit Bishi

Edible Coating for Fresh Cut Jackfruit

Unripe jackfruits (ICAR-RCER JS-4/2) were harvested and cut into uniform-shaped pieces. The edible coating experiment was designed with different pre-treatments (Acid Dip: 2% citric acid + 2.5 g/L KMS followed by 1% $CaCl_2$ for 4 min) and different coating agents, *viz.*, guar gum (0.5-1.5%), pectin (1.33-3.99), starch (2-6%) and their combinations. Coated samples (from 32 treatments) were stored at low temperature (4-8°C) for a shelf study of 15 days. Observations for PLW, pH, TSS, color change, and texture were recorded at an interval of one day. Based on principal component analysis (PCA), treatment no. 30 was found to be the best coating treatment which comprised guar gum + starch (75:25) (1% concentration) without pre-treatment having PLW, BI, texture, and appearance values of 11.29%, 74.56, 106.34 N and 4, respectively.

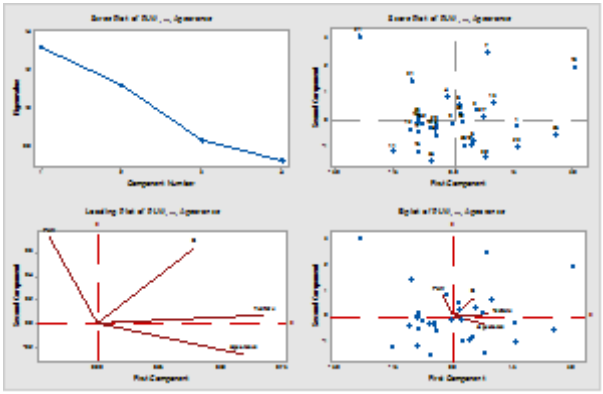


Fig 16. Plots for principal components for quality traits

Optimized Steeping Preservation Method for Immature Tender Jackfruits

Steeping is the process of preserving vegetables in a solution containing food additives in permissible limits. Steeping solutions were prepared using sodium chloride, acetic acid, ascorbic acid and potassium metabisulphite. Response surface methodology (RSM) was used for optimization. A total of twenty steeped jackfruit (JF) samples were kept for a shelf-life study of 90 days at room temperature (25-28°C). Observations were recorded for antioxidant activity, phenol, color, texture and microbial load. Optimization was done using RSM on 90th day of storage; it was observed that the optimum steeping solution comprised of 10% NaCl, 0.83% acetic acid and 0.5% ascorbic acid (Fig 17a). The samples kept at optimum treatment were further used for their value addition into snack items (JF pakora), JF pickle and JF curry with a sensory score >8.0 (Fig 17b).

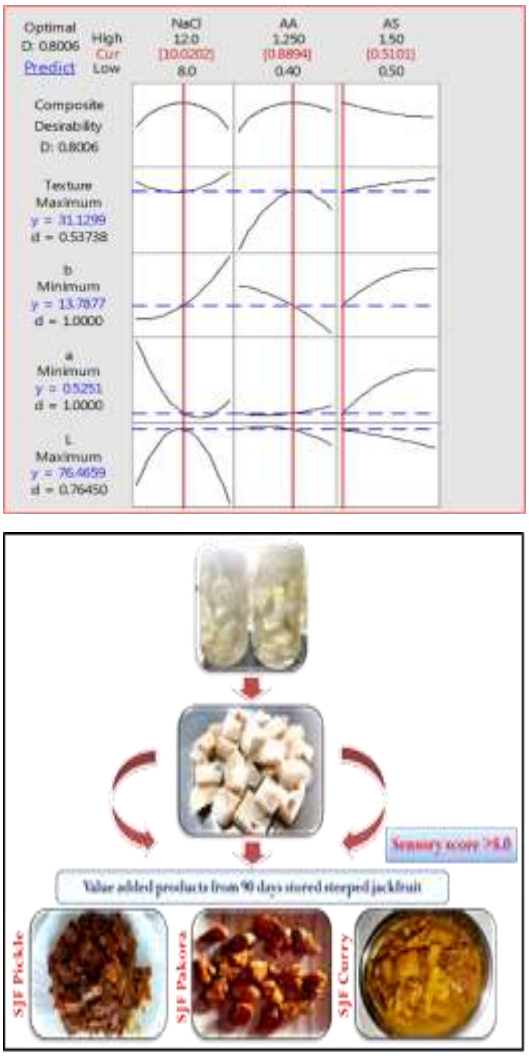


Fig 17. (a) Desirability plot of RSM, and (b) Value-added products from steeped jackfruit

River Ranching for Wild Fish Germplasm Restoration in the Ganga River

ICAR-RCER, Patna participated in river ranching at Raja Ghat, Patna on July 20, 2024. This river ranching program was organised by ICAR-CIFRI, Barrackpore under the central government scheme *Namami Gange*. The objective of this program was to revive the depleted fish stocks entrusted with sustainable fisheries in the Ganga River to enhance income and livelihood security to the fisher communities directly or indirectly dependent on the Ganga River. A total two lakh of advanced fingerlings of catla, rohu, and mrigal were released at Raja Ghat in the Ganga river for the restoration of fish stock. The river ranching was successfully completed in the presence of Dr N Vijaya Lakshmi (Principal Secretary) and other officials of the State Government, Dr BK Das (Director) and other scientists from ICAR-CIFRI, Barrackpore, West Bengal and Dr Vivekanand Bharti from ICAR-RCER, Patna.

Vivekanand Bharti

Fig 18. River ranching at Raja Ghat, Patna

Initiative for Development of a Model Zero Technology Gap and Zero Hunger Village

Poverty reduction and achieving zero hunger are very important sustainable development goals (SDGs) laid out by the United Nations. Efforts are being made at various levels to achieve these goals, and this institute has also initiated a collaborative project on "Development of zero technology gap and zero hunger village through innovative interventions" with the support from ICAR-ATARI, Patna and KVK, Buxar. *Chotaka Dhakaich* village under Simri block in the Buxar district of Bihar has been identified for all types of technology interventions related to field and horticultural crops, livestock, poultry, water management, climate resilient varieties and technologies. The major objective of this project relates to the improvement of existing livelihood, and the creation of alternate sources of income generation through allied activities, viz., mushroom farming, poultry production, nursery raising, IFS models and the like. In order to achieve zero hunger in the village, interventions like the promotion of nutri-garden, use of bio-fortified seeds and foodgrains, pulses, oilseeds as well as enhanced production and consumption of fruits, vegetables, milk, meat and egg are being tried at mass level. Organization of capacity building programs like training, awareness camps, farmer-scientist interaction, and workshops are integral part of this initiative. The project will run for three years in the village to make it a *Model Village* for replicating the success at other locations as well.

Fig 19. Glimpses of farmer-scientist interaction

Microplastics Occurrence in the Ganga River System of Eastern Region

The prevalence of microplastics in different stretches of the Ganga, Sone and Punpun rivers in the eastern region was investigated by collecting and analyzing water, sediment and fish samples from August 2023 to December 2023. The sediment samples from the Ganga river encompassed the highest levels of microplastics, with an average count of 553 particles per kilogram, whereas 376 and 301 particles per kilogram were recorded in the Punpun and Sone rivers, respectively (Fig 20). The presence of microplastics in the water samples was also examined. Results revealed that the water of the Ganga river contained an average of 364 microplastics per liter, while the Sone and Punpun rivers had 223 and 180 microplastics per liter, respectively. Most of the microplastics were detected in the form of films, pellets, beads, and fibers, as illustrated in Fig 21.

Jaspreet Singh, Kamal Sarma, Tarkeshwar Kumar, SK Ahirwal and Vivekanand Bharti

Fig 20. Sampling sites and occurrence of MPs in different river systems

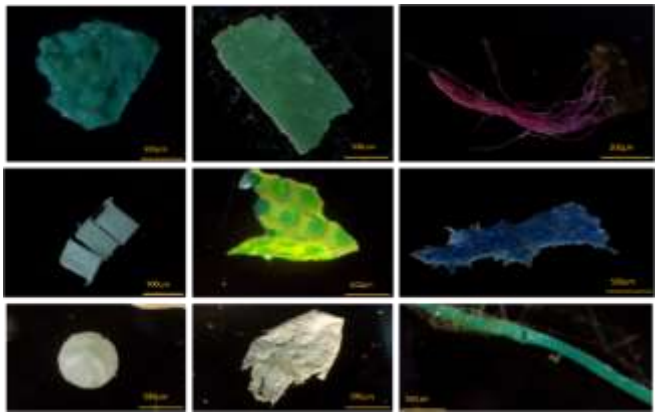


Fig 21. Microplastics detected in different rivers of the eastern region

TRANSFER OF TECHNOLOGY

Under Farmer FIRST Progamm, 40 demonstrations in crop-based module, 62 demonstrations in horticulture-based module, feeding the mineral mixture to more than 1000 animals in livestock-based module, 10 demonstrations in NRM module, 30 demonstrations in the enterprise based module and 6 demonstrations under IFS based module were organized during this semester.

EVENTS ORGANIZED

Krishak Vaigyanik Samvad Organized

A Krishak Vaigyanik Samvad was organized at FSRCHPR, Plandu, Ranchi on December 16, 2023 in the presence of the chief guest, Shri Arjun Munda, Hon'ble Minister of Agriculture and Farmers' Welfare, Govt of India. Over 150 farmers from Farmer FIRST Program villages participated in the event. While interacting with the Farmers Producer Organisation (FPOs) and the local Farmers, the Hon'ble Minister expressed his gratitude to the farmers who contributed a lot towards the country's economy. Shri Munda said that the country has become self-reliant in food production due to the hard work of our farmers. He also acknowledged that the technologies developed by the agricultural scientists had played key roles in easing farm activities by the farmers.

Fig 22. Glimpses of Hon'ble Minister of Agriculture and Farmers' Welfare visit at FSRCHPR

World Soil Day Celebrated on December 5, 2023

World Soil Day was commemorated on 5th of December, 2023 at ICAR-RCER, Patna on the theme "Soil and Water: A Source of Life". The program was successfully organised to create awareness about the importance of soil and water health in promoting a sustainable agri-food system. The event was attended by about 200 participants. Experts discussed the importance of integrated nutrient management and climate-resilient practices for sustaining soil health, carbon sequestration, soil test-based fertilizer recommendations, and soil and water quality in fish farming.

The world soil day was also celebrated at FSRCHPR, Ranchi with the participation of 51 farmers from Murhu, Rania, Karra block of Khunti district along with the staff of FSRCHPR. In this program, training *cum* kisan gosthi was organized to create awareness on soil health management among the farmers. The farmers were trained on balanced fertilization for soil health management, the importance of organic sources of nutrients for soil health, balanced use of water and nutrients using drip.

Fig 23. Dr Anup Das (Director, ICAR RCER) addressing the participants on World Soil Day

The world soil day was also celebrated at FSRCHPR, Ranchi with the participation of 51 farmers from Murhu, Rania, Karra block of Khunti district along with the staff of FSRCHPR. In this program, training *cum* kisan gosthi was organized to create awareness on soil health management among the farmers. The farmers were trained on balanced fertilization for soil health management, the importance of organic sources of nutrients for soil health, balanced use of water and nutrients using drip.

Inauguration of the Administrative Building of KVK, Ramgarh

Krishi Vigyan Kendra (KVK), Ramgarh marked a significant milestone on October 31, 2023 with the inauguration of its new administrative building. The ceremony was graced virtually by the chief guest Dr Himanshu Pathak, Secretary (DARE) and Director General, ICAR, New Delhi, along with guests of Honour Dr SK Chaudhari, Deputy Director General (NRM), ICAR, New Delhi and Dr US Gautam, Deputy Director General (Agricultural Extension), ICAR, New Delhi, was a momentous occasion.

Fig 24. Dignitaries inaugurating the new administrative building of KVK, Ramgarh

Mushroom Day Celebrated

Mushroom Day was organized at FSRCHPR, Plandu, Ranchi under AICRP on Mushroom on December 23, 2023 with the objective of disseminating the knowledge on '*Mushroom cultivation for livelihood and women empowerment*'. About 70 farmers from *Tetri* village of Ranchi district participated and benefited.

Swachhata Program Organized

Swachhata program was organized at Malti village in Namkum Ranchi, Jharkhand on December 31, 2023. Ms Anjali Lakra, Director of 4R4S Agro-producer Company Limited, was the chief guest of the program. In her address, she highlighted the importance of *swachhata* from the day-to-day household activities up to the national level to make the country clean and green. She also called for the recycling of organic waste to make compost for enhancing soil health, crop yield, and sustainability for future generations

Fig 25. Swachhata program organized at Malti village in Namkum, Ranchi, Jharkhand

Fig 26. Swachhata program with participation of school students at ICAR-RCER, FSRCHPR, Plandu, Ranchi

Kisan Gosthi Organized

A Kisan Gosthi was organized under TSP program of *AICRP on Vegetable Crops* on July 26, 2023 at *Tamar block* of Ranchi district (Jharkhand). In this program, quality seeds of improved varieties of several vegetable varieties, such as 'Swarna Yamini' (bitter gourd), 'Swarna Prafulya' (Capsicum), 'Swarna Raktim' (lal sag), 'Swarna Anmol' (tomato), 'RCCV-156' (cucumber) were distributed to 20 farmers of *Baru village* in Tamad block of Ranchi district.

MoU SIGNED

An MoU was signed between ICAR RCER, Patna and a-IDEA, Centre for Agri-Innovation, ICAR-NAARM, Hyderabad on August 23, 2023 for Entrepreneurship development in agriculture.

Fig 27. Signing of MoU with a-idea, ICAR-NAARM

DIGNITARIES VISITED

Dr Mangala Rai (former DG, ICAR) Interacted with Scientists on World Food Day

On the occasion of World Food Day, Dr Mangala Rai, former secretary (DARE) and Director General (ICAR), visited and interacted with the scientists of ICAR Research Complex for Eastern Region, Patna on October 16, 2023. He highlighted the importance of enhancing *water use efficiency* in India as our country harbors 17% of the world population with merely 4.2% of fresh water resources. He stressed the need for enhancing the budget in agricultural research at par with developed nations. Dr Rai urged the scientists for making a collaborative effort and called for working in the system mode for enhancing factor productivity at the grass root level in agriculture.

Fig 28. Dr Mangala Rai interacting with scientists of ICAR RCER, Patna

Dr Himanshu Pathak, Secretary (DARE) and Director General (ICAR), Visited FSRCHPR, Ranchi

Dr Himanshu Pathak, Secretary (DARE) and Director General (ICAR), Visited FSRCHPR, Ranchi on September 20, 2023. He was accompanied by Dr Anup Das (Director, ICAR-RCER, Patna), Dr Sujay Rakshit (Director, ICAR-IIAB, Ranchi), Dr Anjani Kumar (Director, ICAR-ATARI, Patna) and Dr Ujjwal Kumar (I/c Head, Socio-Economic Extension Division, ICAR-RCER, Patna). Dr Pathak inaugurated the litchi plantation program with the creation of *Dr Himanshu Pathak Litchi Mother Block* of 'Swarna Madhu'.

Fig 29. Dr Himanshu Pathak (Secretary, DARE and Director General, ICAR) performing a tree plantation at FSRCHPR, Ranchi

Dr US Gautam, DDG, Extension (ICAR) Visited ICAR-RCER, Patna

Dr US Gautam, DDG, Extension (ICAR) Visited ICAR-RCER, Patna on September 15, 2023. Dr Anup Das (Director, ICAR-RCER) welcomed him and apprised him about the research and extension activities of the institute. Dr Gautam interacted with the scientists of the institute, and recalled himself as a scientist of the research complex, as he started his career from this institute. During the interaction, Dr Gautam highlighted the new research areas like water footprint, ecosystem services, zero hunger, etc in which scientists should focus their research activities. The next day, he visited the research farm of the main campus and Sabajpura, planted the saplings in the office premises to mark the occasion and appreciated the efforts of the scientists as well as other staff for nicely maintaining the farms.

Fig 30. Dr US Gautam in the interaction meeting with the scientists

Training Imparted

Three farmers' training programs on "Integrated farming system under a changing climate" were organized at FSRCHPR, Plandu, Ranchi, one each respectively during August 28 – September 01, September 4-8, and September 11-15, 2023.

Two training programs, each on the "Integrated Farming System" sponsored by Extension Training Centre, Hehal, Ranchi, respectively on 05.12.2023 and 14.12.2023, were organized at FSRCHPR, Ranchi.

Five days Training Program on "Soil and Water Conservation for Sustainable Agriculture Development" sponsored by BAMETI, Patna, Bihar was organized at ICAR RCER headquarters during October 30 – November 03, 2023.

AWARDS & RECOGNITION

Dr MK Dhakar was awarded 'Associateship' by the *Indian Academy of Horticultural Sciences*, New Delhi.

FFP Centre, FSRCHPR, Plandu, Ranchi was conferred *Performance Excellence Award 2022-23 of Farmer FIRST Program* by ICAR-Agricultural Extension Division during the National Workshop (November 28-30, 2023) on "Farmers First Program" held at HPKVV, Palampur (HP).

New Joining

Dr Ujjwal Kumar, Principal Scientist (Agricultural Extension) joined as the Head, DSEE wef 06. 12. 2023.

Dr Sanjeev Kumar, Principal Scientist (Agronomy) joined as the Head, Division of Crop Research wef 17. 07. 2023.

Dr Sudhansu Shekhar, Senior Scientist joined as the Head, KVK, Ramgarh wef 06. 10. 2023.

Dr Deokaran, Senior Scientist joined as the Head, KVK Buxar wef 21. 08. 2023.

Shri Banda Sainath, Scientist (Agricultural Economics) joined ICAR-RCER wef 21. 07. 2023.

Shri Victor Thingujam, Scientist (Agroforestry) joined ICAR-RCER FSRCHPR, Ranchi wef 21. 09. 2023.

Transfer

Dr Dushyant Kumar Raghav, ACTO, KVK, Ramgarh transferred to KVK, Maldah, West Bengal wef 25. 09. 2023.

Dr Mandhata Singh, ACTO, KVK, Buxar transferred to KVK Deoria under ICAR-IIVR, Varanasi wef 26. 09. 2023.

Shri Prem Chandra, PPS ICAR-RCER, Patna transferred to IISR, Lucknow wef 08. 11. 2023.

Retirement/Death

Shri Arun Kumar, STO (Electricity) retired on August 31, 2023.

Shri Birsa Ekka, MTS (SSS) FSRCHPR, Ranchi died on November 08, 2023.

Editorial Committee

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