# वार्षिक प्रतिवेदन -२०१९

# ANNUAL REPORT | 2019

**भाकृअनुप - केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान**

**ICAR-Central Research Institute for Jute and Allied Fibres**

बैरकपुर , कोलकाता - 700121, पश्चिम बंगाल

Barrackpore, Kolkata - 700121, West Bengal


CRIJAF

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# PREFACE

Evolving with time and raising concern about environmental pollution, Jute and Allied Fibre (JAF) crops are going to play pivotal role in ecological and economic sustenance of our country. Besides being cash crop as the important source of raw materials for jute industries, in future these are the candidate crops ideal for ecosystem services in addition to commercial importance. Till date the environmental benefit of these crops have not been fully exploited. The research objectives must equally focus on the economic and environmental value of JAF crops. Being a premier research institute in the country, ICAR-Central Research Institute for Jute and Allied Fibres (CRIJAF) is the front runner in development, popularization and commercialization of varieties, agro-techniques and farm implements that have substantially reduced the cost of cultivation and enhanced the productivity and quality of fibres. In the backdrop of fluctuating and plateauing area under jute due to competition from new crops and synthetics, the paramount objective is to maintain the growth in productivity by continuously innovating new technologies, crop diversification and expanding the area under these crops based on feasibility study in different states of the country.

It gives me immense pleasure to bring out the Annual Report of ICAR-CRIJAF for 2019 (April-December). It's noteworthy to mention that during this year three improved JAF varieties (Tossa jute: JROMU 1, HS-Mesta: Central Roselle JRHS 1 and HC-Mesta: Central Kenaf JRHC 3) have been released for commercial cultivation by Central Varietal Release Committee. For the first time, a fertile sexual hybrid population of two cultivated jute species i.e. *C. capsularis* cv. JRC-212 and *C. olitorius* cv. JRO-524 were developed which may pave the way for higher variability in the breeding material, essential to boost the crop improvement programme in jute. Global and Indian flax accessions have been adequately used to develop $F_2$ populations with multiple promising traits of fibre flax. Promising roselle genotype, PB-142 and improved kenaf breeding lines resistant to stem rot can be used to develop resistant varieties in these JAF crops. Eleven galactouronosyltransferase (GAUT) genes, known to be involved in pectin biosynthesis, were identified and characterized from *C. capsularis* hypocotyl transcriptome among which the expression of CcGAUT3 was validated.

Climate resilience studies predicted ozone-induced risk in jute crop during early vegetative stage. On the other hand Carbon exchange value in jute based ecosystem acts as micro-sinks and plays important role in terrestrial carbon balance. To mitigate the adverse effect of climate aberration in jute cultivation the weather based agro-advisory services developed by the Institute delivers practical solutions for the JAF farmers. Right mixture of NPK fertilizer and crop-wise recommendation of fertilizers provided in the Soil Health Card can help the farmers in maintaining healthy soils. Integrated Farming System was taken up with aims to deliver more sustainable income from sisal plantations in fragile and marginal land of the country. The basic information on metagenomics of retting microbiome encompass a strong foundation with immense industrial significance towards

development of better performing microbial consortium with higher resiliency.

In regard to plant protection of JAF crops, preliminary information on molecular characterization and virulence of the entomo-pathogenic virus, *As*NPV of jute semilooper reveals its potential to be an effective bio-control agent for the control of jute semilooper. The superior isolates of *Trichoderma* spp. collected from resident soil needs systematic study to develop antagonist consortium for management of jute diseases. Promising accessions of *C. aestuans* and *C. pseudo-olitorius* that showed high degree of antibiosis against hairy caterpillar are the potential source for breeding insect resistant varieties. Foliar application of Fenpyroximate 5EC (0.005%) proved to be most effective in reducing the yellow mite egg and population density and increasing the fibre yield significantly. The mobile app 'JAF-Safe' is a perfect guide for decision making in pest and disease management in JAF crops.

During the year 2019, Jute-ICARE programme was extended to 72 blocks of jute growing states (West Bengal, Assam, Bihar, Odisha, Meghalaya) and mesta growing state, Andhra Pradesh. This is one of the mega outreach programmes of the institute implemented in collaboration with Ministry of Textiles, GoI. The Institute also created awareness, extended trainings and skill for improved jute farming and entrepreneurship development to sizable number of farmers, SHGs and FPOs through various central sector schemes.

I am highly grateful to Dr. Trilochan Mohapatra, Secretary, DARE and Director General, ICAR, New Delhi for his dynamic leadership and guidance. I express my sincere gratitude and thanks to Dr. T. R. Sharma, Deputy Director General (Crop Science) and Dr. R. K. Singh, Assistant Director General (Commercial Crops), ICAR, New Delhi for their constant encouragement and support. I also thank Dr. J. Mitra, then Director (I/c) for his support and contribution in successful compilation of this report. I acknowledge the efforts of the scientists of ICAR-CRIJAF who have done a commendable job to accomplish the volume of research and documentation work successfully.

(Gouranga Kar)
Director, ICAR-CRIJAF

Place: Barrackpore
Date: 01.07.2020

# Executive Summary

## Crop Improvement

- For the first time, a fertile sexual hybrid population of two cultivated jute species i.e. *C. capsularis* cv. JRC-212 (♀) and *C. olitorius* cv. JRO-524 (♂) was developed successfully. The bidirectional backcrossing of $F_1$-hybrid with founders showed variable fruit setting capacities. A recombinant inbred line (RIL) population of 194 lines was fixed from this interspecific cross. A population of 299 lines were successful from backcrossing of $F_2$ individuals with *C. olitorius* cv. JRO-524 (♀).
- Nuclear and mitochondrial simple sequence repeat (SSR) markers from jute genome were employed to assess hybridity of the interspecific cross in jute. Two of these mtSSR markers were from *C. capsularis* and one from *C. olitorius* mitochondrial genome, respectively. These mtSSRs revealed heteroplasmy and paternal leakage in jute interspecific crosses, which might be the reason of evolution of the two cultivated jute species.
- A total of 341 lines of multi-parent advanced generation inter-cross (MAGIC) population of *C. olitorius* was advanced to $ML_4$-$RI_7$ generation and along with their 20 parents were phenotyped for pre-mature flowering.
- Eleven galactouronosyltransferase (GAUT) genes, which are known to be involved in pectin biosynthesis, was identified and characterized from *C. capsularis* hypocotyl transcriptome. All the predicted CcGAUTs carried a glycosyl transferase family 8 (GT8) domain (PF0151.20). The CcGAUT proteins from phylogenetic classification were found highly diverged among the different sub-clades. Expression of CcGAUT3 was validated thorough real time qRT-PCR.
- Predicted jute Aquaporin proteins (CcAQPs & CoAQPs) were analyzed using 3 dimensional homology protein modelling. The best PDB hit was found with c2w2eA of the PDB database. The phosphorylation and glycosylation sites of jute AQPs were identified, which are possibly responsible for opening or closing of the AQP water channel pore. *AQP* gene family showed significant expression differences in different tissues, such as bast, root, and hypocotyl of cv. JRO-524 and its *bfs* mutant.
- A total of 164 NAC domain proteins and their genes were characterized from published flax genome and were physically mapped to 15 chromosomes. Phylogenetic grouping identified several LuNAC proteins from the SWN group known to regulate secondary cell wall development in xylem, phloem, and fibres. *LuNAC* genes revealed their differential expression profiles in JRF-2 seedlings exposed to various abiotic stresses.
- Plantlets from stem cuttings of *in vitro* derived mericlones of ramie were agronomically tested under field trial, which showed true to parent phenotypes.
- Six germplasm lines of different bast fibre species were collected from Andhra Pradesh, West Bengal, Telangana and Karnataka. A total of 1239 accessions have been regenerated and 163 accessions of JAFs were distributed to different indenters.
- Three improved varieties of jute and allied fibre crops (Tossa jute: JROMU 1, HS-Mesta: Central Roselle JRHS 1 & HC-Mesta: Central Kenaf JRHC 3) have been released for commercial cultivation by Central Varietal Release Committee.
- A tossa jute genotype, JROB-2 (Purnendu) with high biomass production potential and JRCJ 11, a white jute genotype with high fibre yield and less susceptible to hairy caterpillar were promising entries in coordinated trials under the All India Network Project on Natural Fibres.
- Five non-branching (lacking branch under short day) capsularis genotypes were found to have biomass production potential similar to fibre type varieties of *C. capsularis* under long day conditions.
- A total of 21 $F_1$ hybrids of roselle and 481 $F_3$ progenies of kenaf were evaluated and selected for superior genotype based on growth parameters and reaction to various diseases and pests.
- A total of eight $F_2$ populations developed involving global flax accessions and Indian flax accessions were raised and progeny of two crosses showed promising traits like tall height, bold stems, less axillary branches, late flowering, and stay green phenotype.
- Thirty five RILs derived from OIJ-248 (*C. olitorius)* x WCIN-136-1 (*C. aestuans*) inter-specific population

were identified exhibiting stable resistance for stem rot disease both in $F_4$ and $F_5$ generations under sick plot condition. Further, screening of genotypes for hairy caterpillar resistance showed RIL-25 and RIL-46 as moderately tolerant, and wild *C. aestuans* germplasm lines as highly resistant. Two aestuans germplasm lines (WCIN-136-1 and WCIN-183A) possess multiple biotic stress resistances.

- In order to map the genomic loci governing resistance/tolerance against jute stem rot disease, direct and reciprocal crosses were made between moderately high resistant (RS-6 and OIN-154) and highly susceptible (OIJ-272 and OIN-456) tossa jute cultivars.
- A roselle genotype, PB-142 exhibited moderate resistance and five improved kenaf breeding lines exhibited resistance to stem rot disease under sick plot conditions.
- The cultivated type *C. juncea* accessions were completely free from stem rot disease under sick plot, while the broad leaved wild species *C. spectabilis* (30 to 96.7% disease incidence) was the most susceptible species among the twenty-eight *Crotalaria* accessions including five different species.

## Crop Production

- Study on climate resilience in JAF crops revealed that there is ozone-induced risk in jute crop during early vegetative stage which may affect the fibre yield and its quality. The variability in rainfall suggests changing the sowing time of jute seed to April instead of going for early sowing in March or late sowing in May. Increased activity of antioxidant enzymes was observed in jute cultivar of JRO 204 which may help to withstand drought conditions. Carbon exchange value in jute based ecosystem act as micro-sinks and playing an important role in terrestrial carbon balance. Weather based agro-advisory services have been developed for contingent planning of jute and allied fibres.
- Regular application of NPK fertilizers with FYM significantly increased soil organic carbon and yield of jute based cropping system. Incorporation of FYM along with inorganic fertilizer was found best management practice for sustainable crop yield and maintenance of soil fertility under both LTFE and STCR studies. Right mixture of NPK fertilizer and crop-wise recommendation of fertilizers provided in the Soil Health Card can help farmers in maintaining healthy soils. Carbon sequestration study indicated a unique pattern in the utilization of carbon groups under ramie based cropping systems. Tillage practices and crop residues alter the surface properties of soil invariably affected the soil microbial biomass and enzymatic activities. Jute-rice-lentil and rice-flax cropping system with zero tillage improved microbial biomass and soil quality.
- Ipfencarbazone and Glufosiante ammonium as pre-emergence and Paraquat dimethoate as post-emergence herbicides could control 81-83% grass weed population without affecting jute germination and fibre yield under irrigated condition. In broadcast jute, CRIJAF nail weeder and herbicide applicator were found effective for weeding, thinning and making line arrangement. Irrigating the crop at 80% PE recorded higher yield in main crop and intercrops under sisal based cropping system. In jute-rice-MAPs cropping system, the highest jute equivalent yield (JEY) was recorded in ashwagandha followed by asalio. Integrated farming system was taken up under sisal farm management system with aims to deliver more sustainable sisal cultivation.
- The jute cultivar, JROB 2 is suitable for cellulose derived by-products (paper, cellulose nanocrystals). Findings of metagenomics of retting microbiome encompass a strong foundation for fundamental and evolutionary studies on microbial degradation of jute with immense industrial significance. The bacterial community analysis of retting water indicated that pectin degraders are the major part of total bacterial load. Retting trials of jute and mesta with spore based liquid formulation of 'CRIJAF Sona' was found quite efficient. A power operated jute ribboner machine has been developed which extracts ribbons from the freshly harvested jute plants without breaking the sticks.

## Crop Protection

- The entomo-pathogenic virus isolated from infected jute semilooper larvae was identified as NPV. The molecular characterization of polyhedral occlusion bodies ($POB_s$) of the virus on the basis of *polh* gene also confirmed it to be NPV. OB size ranged from 1.14-1.82 µm with an average size of about 1.60 µm. The median lethal concentration ($LC_{50}$) of *As* NPV was as $1.03 \times 10^5$ OBs/ml.

- Twenty four isolates of *Trichoderma* spp. collected from varying ecological and edaphic conditions were characterised for production of inhibition zone, colonization behaviour, and speed of growth over pathogen and lysis of pathogen. Among the resident isolates, on the basis of formation of inhibition and lysis zone, TV-1, TVC-2, TVC-4 and TV-H were superior.
- The biological parameters of hairy caterpillar larvae reared on different accessions of cultivated and wild jute species manifested significant variation. Possible sources of resistance against hairy caterpillar was observed in WCIN-19, WCIJ-123, WCIN-179 (*C. aestuans*) and WCIJ-34 and WCIN-114 (*C. pseudo-olitorius*) accessions as the insect failed to complete the larval stage due to high degree of antibiosis.
- Elite variety, JRO 204 was tolerant to yellow mite infestation on the basis of manifestation of least damage symptom and least fibre weight reduction due to the damage of the mite. Based on the length of the lesion developed in the stem of 68-day old jute plant after artificial inoculation with stem rot pathogen, OIN 112, OIJ 74, OIN 140 and OIJ 43 germplasm lines were noted to be least susceptible.
- The development rate of egg, larvae, pupae and adult of *Spodoptera litura* gradually increased with increase in temperature. The observed mean development times for all the immature life stages were fastest at 32-34°C. Similarly, mortality of *S. litura* was also influenced by temperature. Least mortality in immature life stages was observed at 26-28°C.
- Foliar application of Fenpyroximate 5EC (0.005%) in jute at 45 and 55 DAS in farmers' field was most effective in reducing the yellow mite egg and population density and increasing the fibre yield significantly. Integrated use of soil application of neem cake @10.0q/ha + foliar spray of mancozeb M 45@3.0g/l provided effective control of Alternaria leaf spot of sisal.
- Spraying of nano silica @10 ppm caused 75% mortality in hairy caterpillar. The molecular basis of action mechanism of nanosilica on hairy caterpillar through transcriptome analysis revealed that a significant number of apoptosis related genes involved in nanosilica stress response viz. mitogen-activated protein kinase (MAPK), SRC oncogene and apoptosis inducing pathway.
- JAF-Safe, an android based mobile app has been developed to guide the user to diagnose the pest and disease problem in JAF crops based on crop phenology, nature of damage, biology, life cycle and the image of the pest and disease; the knowledge of which is very much essential for proper decision making in initiating the pest management activities. Choice is also given for Integrated Pest Management module directly.

## Transfer of Technology

- A total of 681 frontline demonstrations on improved production technologies of jute covering 245.60 ha area were conducted in North 24 Parganas, Nadia, Hooghly and Purba Bardhaman districts of West Bengal. The improved variety, JRO 204 performed the best in terms of productivity. Besides, line sowing by CRIJAF Multi-row Seed Drill and weed management by CRIJAF Nail Weeder resulted in yield advantage of 2.16-3.83 q/ha and reduced the cost of cultivation by approx ₹ 10,000 to ₹. 20,000/ha. CRIJAF SONA-mediated retting improved the fibre quality by 1-2 grade in all locations which enabled the jute farmers to earn an additional income of ₹ 300-450/q.
- Study conducted on 60 jute growers of North 24 Parganas, Hooghly and Nadia districts revealed that farmers are more or less aware of adaptive measures like improved retting, diversified farming, improved crop husbandry, mechanization, rainwater harvesting, IPM etc. for climate variability. Mean awareness score of the respondents ranges from 1.67 to 1.00.
- Baseline study of two FPOs – Sabka Apna Farmer Producer Company (SAFPC) and Baduria Krishi Bikas Farmer Producer Company (BKBFPC) on the attitude of the FPC farmers towards value chain development in jute revealed that they had a favorable attitude towards it. Member jute farmers of FPOs reported problems like lack of knowledge about grades or grading pattern in jute, lack of capital to provide sufficient services, lack of storage and warehouse facility and backward and forward linkages.
- The beneficiaries of jute-ICARE in Uttar Dinajpur district could improve the jute yield in comparison to non-beneficiaries. The knowledge score of the beneficiaries about improved production practices of jute was also found higher than non-beneficiaries. Thirty six percent of the beneficiaries enhanced the area under jute cultivation.

- Jute and green gram intercropping model of ICAR-CRIJAF is being promoted in collaboration with Department of Agriculture, Govt. of West Bengal.
- During the year 2019, Jute-ICARE programme was extended to 72 blocks of jute growing states (West Bengal, Assam, Bihar, Odisha, Meghalaya) and mesta growing state, Andhra Pradesh. The programme was supported with HYV seeds (535 MT), agricultural implements developed by ICAR-CRIJAF (600 CRIJAF-MRSD; and 900 CRIJAF single wheel jute weeder) and CRIJAF-SONA (612 MT). Altogether 87 training-cum-demonstrations on line sowing, mechanical weeding and improved retting were organized in association with Jute Corporation of India and NJB in farmer's field condition.

## Krishi Vigyan Kendra

- In KVK, Burdwan, five OFTs were conducted on remediation measures for cold stress of rice seedling, effect of zinc and boron on productivity and oil content of mustard, potato late blight management, nutrient managements in marigold and mango. A total of 348 FLDs were conducted on improved production technologies of jute, rice, mustard, chickpea, black gram, onion, brinjal, banana and marigold. Altogether, 52 training programmes were organized for practicing farmers, rural youths and extension functionaries. A total of 1454 trainees were benefited through these training programmes. Important programmes like Partheniuam Awareness Week, *Jal Shakti Abhiyan*, and webcasting of National Animal Disease Control Programme (NADCP) for FMD and Brucellosis, Artificial Insemination (AI) Programme, Anti-Counterfeit Programme, Massive Plantation Programme, 150$^{th}$ Birth Day Celebration of Mahatma Gandhi, *Swachhta Hi Seva*, Vigilance Awareness Week, Awareness programme on Fertilizer Application, World Soil Day and DAESI Programme were also successfully organized. KVK, North 24 Pgs (Addl.) conducted 34 FLDs and 13 training programmes. Besides, the KVK also conducted awareness on Soil Health Card and seed production of rice and black gram.

## AINP on Natural Fibres

- Under All India Network Project on Natural Fibres, 62 projects comprising of 244 trials were conducted during 2019-20 across 8 SAU and 4 ICAR based centres. It includes 31 projects comprising of 140 trials under crop improvement, 21 projects comprising of 69 trials of crop production and 10 projects consisting of 35 field trials of crop protection programme.
- A total of 7 jute and allied fibre crop varieties namely, JROMU 1 of tossa jute; AMV 8, AMV 9 and JRHS 1 of roselle; JBMP 4 (Utkarsh) and JRHC 3 of kenaf and SUIN 3 (Kavita) of sunnhemp had been released and notified by the Central Sub-Committee on Crop Standard Notification and Release of Varieties, MoAFW, Govt. of India, New Delhi.
- Fifty accessions each of *olitorius* jute, *capsularis* jute, roselle and kenaf were evaluated for fibre yield and attributing traits in different locations of jute and allied fibre growing states. Besides, elite entries of jute and allied fibre crops were also evaluated as station trials, IETs, AVTs and adaptive trials at 8 SAUs and 4 ICAR based centres.
- In mesta, pre-emergence application of pretilachor @ 900 g/ha at 45-48 hrs of sowing with irrigation + one hand weeding at 15 DAE recorded highest fibre yield (27.5 q/ha), net return and weed control efficiency at Aduthurai and Amadalavalasa. At Rahuri, application of quizalofop ethyl 5 EC 60 g + Ethoxysulfuron @ 50 g/ha at 15 DAE + one hand weeding at 30 DAE recorded maximum seed yield (16.15 q/ha) of tossa jute, better weed control efficiency and net return.
- For integrated pest and disease management in jute, the seed treatment with carbendazim 50 WP @ 2g/kg seed + spraying of spiromesifen 240 SC@ 0.7 ml/l water at 35 DAS + spraying of tebucanazole @ 0.15% at 45 DAS + spraying of lamdacyhalothrin 5 EC @ 0.6 ml/l at 55 DAS gave the better result in managing the insect pests and disease with highest fibre yield in line sown crop at Nagaon, Katihar and Kendrapara.

# कार्यकारी सारांश

## फसल सुधार

- पटसन की दो कृषित प्रजातियों नामतः *सी. कैप्सुलरिस* की किस्म जेआरसी-212 (♀) तथा *सी. ऑलिटोरियस* की किस्म जेआरओ-524 (♂) के संकरण से पहली बार सफलतापूर्वक एक निषेच्य संकर विकसित की गई है। एफ$_1$ संकर की द्विदिशीय बैकक्रॉसिंग में विविध फलन क्षमता दर्ज की गयी। इस अन्तर्जातीय संकरण के माध्यम से 194 प्रभेदों की एक पुर्नसंयोजित इनब्रेड लाइन (आरआईएल) समुदाय विकसित की गयी है। एफ$_2$ संतति को *सी. ऑलिटोरियस* की किस्म जेआरओ-524 (♀) से बैकक्रॉसिंग के फलस्वरूप सफलतापूर्वक 299 लाइनों का समूह विकसित किया गया है।
- पटसन में अन्तर्जातीय संकरण के आकलन हेतु केन्द्रकीय एवं माइटोकॉन्ड्रियल जूट जीनोम आधारित एसएसआर मार्करों का अनुप्रयोग किया गया है। इनमें से दो तथा एक माइटोकॉन्ड्रियल एसएसआर मार्कर क्रमशः *सी. कैप्सुलरिस* तथा *सी. ऑलिटोरियस* जीनोम के थे। इन माइटोकॉन्ड्रियल एसएसआर मार्करों ने पटसन के अन्तर्जातीय संकरों में हेटरोप्लास्मी तथा पैतृक रिसाव का खुलासा किया जो कि पटसन की दो कृषित प्रजातियों के उद्भवन का कारण हो सकता है।
- *सी. ऑलिटोरियस* की बहु-पैतृक उन्नत पीढ़ी अन्तरसंकरण (मेजिक) समुदाय से कुल 341 प्रभेदों को एम एल 4 – आरआई 7 पीढ़ी में अग्रेषित किया गया तथा उनके 20 पित्रों सहित उन्हें पूर्व-परिपक्व पुष्पन हेतु चिन्हित किया गया है।
- *सी. कैप्सुलरिस* पटसन के हाइपोकोटाइल ट्रांसस्क्रिप्टोम से 11 गैलेक्टोरोनोसिलट्रांसफेरेज़ (जीएयूटी) जीन, जो कि पेक्टिन जैव-संश्लेषण के लिए जाने जाते हैं, की पहचान तथा उनकी विशेषताओं का चित्रण किया गया है। सभी अनुमानित सीसी-जीएयूटी में एक ग्लाइकोसिल ट्रांसफरेज़ परिवार 8 (जीटी 8) डोमेन (पीएफ 0151.20) पाया गया है। विभिन्न उप-वर्गों के बीच फ़ाईलोजेनेटिक वर्गीकरण के दौरान सीसी-जीएयूटी प्रोटीन में अत्यधिक विविधता पायी गयी। सीसी-जीएयूटी की अभिव्यक्ति क्यू आरटी-पीसीआर के द्वारा निरूपित किया गया है।
- पूर्व निर्धारित जूट एक्वापोरिन प्रोटीन (सीसी एक्यूपीएस तथा सीओ एक्यूपीएस) का विश्लेषण त्रीआयामी होमोलॉजी प्रोटीन मॉडलिंग के माध्यम से किया गया है। सबसे अच्छा पीडीबी हिट पीडीबी डेटाबेस के c2w2eA से प्राप्त हुआ। जूट एक्वापोरिन प्रोटीन (एक्यूपीएस) के फॉस्फोराइलेशन और ग्लाइकोसिलेशन साइटों की पहचान की गई, जो संभवतः एक्यूपीएस जल चैनल छिद्र को खोलने या बंद करने के लिए जिम्मेदार हैं। पटसन की किस्म जेआरओ-524 तथा बीएफएस उत्परिवर्ती के विभिन्न ऊतकों, जैसे तना, जड़ तथा हाइपोकोटाइल में एक्वापोरिन जीन परिवार के अभिव्यक्ति में सार्थक विविधता दर्ज की गयी।
- प्रकाशित फ्लैक्स जीनोम से कुल 164 एनएसी डोमेन प्रोटीन और उनके जीन को वर्गीकृत कर उनका भौतिक मैप 15 गुणसूत्रों में निरूपित किया गया है। फ़ाईलोजेनेटिक वर्गीकरण के द्वारा SWN समूह के कई LuNAC प्रोटीन की पहचान की गयी जो कि जाइलम, फ्लोएम और तंतुओं में द्वितीयक कोशिका भित्ति विकास को विनियमित करने के लिए जाने जाते है। LuNAC जीन फ्लैक्स की प्रजाति जेआरएफ-2 के अंकुरों में, जो कि विभिन्न अजैविक तनावों में थे, अपने अंतर अभिव्यक्ति को प्रकट किया।
- रेमी के स्टेम कटिंग से व्युत्पन्न इन-विट्रो मेरिक्लोन पौधों को प्रक्षेत्र परीक्षण के तहत सस्य क्रियाओं हेतु परीक्षण किया गया जो कि अपने पैतृक प्रजाति के ही अनुरूप पाये गये।
- आंध्र प्रदेश, पश्चिम बंगाल, तेलंगाना तथा कर्नाटक से विभिन्न रेशा फसलों के छह जननद्रव्यों का संकलन किया गया है। कुल 1239 जननद्रव्यों का पुर्नउद्भवन तथा विभिन्न मांगों के अनुरूप पटसन एवं संवर्गीय रेशा फसलों के कुल 163 जीनप्ररूपों का वितरण भी किया गया है।
- पटसन एवं संवर्गीय रेशा फसलों की तीन उन्नत किस्मों (तोषा पटसन की जेआरओएमयू 1; रोजेल की जेआरएचएस 1; केनाफ की जेआरएचसी 3) को केन्द्रीय प्रजाति विमोचन समिति के द्वारा इनकी व्यावसायिक खेती के लिए जारी किया गया है।
- उच्च जैव-भार उत्पादन क्षमता वाली तोषा पटसन की जेआरओबी-2 तथा उच्च रेशा उपज के साथ- साथ बिहार रोमिल सूड़ी के प्रति कम संवेदनशील सादा पटसन की जेआरसीजे-11 नामक प्रविष्टियां अखिल भारतीय नेटवर्क परियोजना के तहत समन्वित परीक्षणों में उत्कृष्ट पायी गयी हैं।
- पांच गैर-शाखायुक्त (छोटे दिन के तहत शाखा का अभाव) कैप्सुलरिस प्रभेदों की बायोमास उत्पादन क्षमता सी. कैप्सुलरिस के दीर्घ दिवसीय परिस्थिति वाली रेशा किस्मों के समान ही पायी गयी।
- रोजेल की कुल 21 एफ$_1$ संकर तथा केनाफ की 481 एफ$_3$ संततियों का मूल्यांकन तथा चयन उनकी वानस्पतिक वृद्धि के मापदंडों तथा विभिन्न रोगों एवं कीटों के संक्रमण के प्रति प्रतिक्रिया के आधार पर किया गया।
- फ्लैक्स के वैश्विक तथा देशज प्रभेदों के संकरण से कुल आठ एफ$_2$ सन्ततियाँ विकसित की गई जिनमे से दो संततियों की पौध ऊंचाई तथा तने की मोटाई अपेक्षाकृत अधिक, अक्षीय शाखाएं कम तथा पुष्पण मे विलंबिता दर्ज की गयी है।

- ओआईजे-248 (*सी. ऑलिटोरियस*) तथा डब्ल्यूसीआईएन-136-1 (सी. स्टूआन्स) के संकरण से प्राप्त अंतर-जातीय संकर से 35 आरआईल समष्टि की पहचान की गयी है जिन्हे एफ4 और एफ5 पीढ़ियों में भी तना गलन रोग के प्रति प्रतिरोधक पाया गया। इसके अलावा, बिहार रोमिल सूड़ी के प्रति प्रतिरोध के लिए स्क्रीनिंग के दौरान भी आरआईएल-25 तथा आरआईएल-46 को मध्यम सहिष्णु तथा जंगली पटसन *सी. स्टूआन्स* को अत्यधिक प्रतिरोधी पाया गया। दो *सी. स्टूआन्स* जननद्रव्यों (डब्ल्यूसीआईएन-136-1 तथा डब्ल्यूसीआईएन-183A) को बहु-जैविक तनाओं के प्रति प्रतिरोधक पाया गया।
- पटसन तना सड़न रोग के प्रति प्रतिरोधित निरूपित करने वाले आनुवंशिक लक्षणों को मैप करने के उद्देश्य से तोषा पटसन के मध्यम-उच्च प्रतिरोधी (आरएस-6 एवं ओआईन-154) तथा अत्यधिक संवेदनशील (ओआईजे-272 और ओआईएन-456) प्रभेदों के मध्य प्रत्यक्ष तथा परस्पर संकरण कराए गए है।
- रोगग्रसित खेत मे परीक्षण की स्थिति में रोजेल की एक प्रभेद, पीबी-142 ने तना सड़न रोग के प्रति मध्यम प्रतिरोधिता तथा केनाफ की पांच उन्नत प्रभेदों ने प्रतिरोधक क्षमता का प्रदर्शन किया।
- बीमार भूखंड मे परीक्षण की स्थिति में सनई की कृषित प्रजातियां उकठा रोग से पूरी तरह मुक्त पायी गयीं, जबकि चौड़ी चौड़ी पत्ती वाली जंगली प्रजाति *सी. स्पेक्टाबिलिस* (30 से 96.7% बीमारी का प्रकोप) की अट्ठाईस प्रभेद जिनमे पाँच अन्य प्रतियां भी शामिल थीं, अत्यंत संवेदनशील पायी गयीं।

## फसल उत्पादन

- पटसन एवं समवर्गीय रेशे वाली फसलों के जलवायु बदलाव अध्ययन से यह स्पष्ट हुआ है कि पटसन की शुरूआती वानस्पतिक अवस्था ओजोन प्रेरित खतरों के कारण प्रभावित होती है जिससे उपज के साथ-साथ गुणवत्ता भी प्रभावित होती है। वर्षा की असमान वितरण को देखते हुए पटसन बीज को जल्द (मार्च) या विलम्बित (मई के दूसरे पखवाड़ा) बुवाई की तुलना में अप्रैल में बुवाई करना चाहिए।
- पटसन की प्रजाति जे.आर.ओ. 204 में एन्टी आक्सीडेन्ट इन्जाइम की बढ़ी हुई गतिविधियां देखी गयी जो उसे शुष्कता को झेलने में मदद कर सकता है। भू-स्थित कार्बन संतुलन को एक बनाये रखने में पटसन आधारित पारिस्थितिकी तंत्र का कार्बन विनिमय एक सूक्ष्म बेसिन के रूप में काम करता है। इस संस्थान द्वारा पटसन एवं समवर्गीय रेशा फसलों के आकस्मिक नियोजन हेतु मौसम आधारित कृषि परामर्श सेवा की शुरूआत की गई है।
- दीर्घ अवधि उर्वरक परीक्षण (एलटीएफई) तथा मृदा जांच आधारित फसल प्रतिक्रिया (एसटीसीआर) के अध्ययनों में ये पाया गया कि एन.पी.के. उर्वरकों के साथ-साथ एफ.वाई.एम. के नियमित प्रयोग से मृदा के जैविक कार्बन तथा पटसन आधारित फसल चक्र की उपज में सार्थक वृद्धि होती है। मृदा स्वास्थ्य कार्ड में दिये गये एन.पी.के. उर्वरकों का उचित मिश्रण तथा फसल आधारित संस्तुत उर्वरकों के प्रयोग से मृदा स्वास्थ्य को बनाये रखा जा सकता है।
- रेमी आधारित फसल पद्धति में, कार्बन पृथक्करन के अध्ययन से ये देखा गया कि कार्बन समूहों के उपयोग में एक विशिष्ट तरीका था जहाँ भूमि जुताई के तरीकों तथा फसल अवषेश सतही मिट्टी में स्थित जीवाणुओं तथा इन्जाईम गतिविधियों को अचल रूप से प्रभावित करते हैं। पटसन-धान-मसूर तथा धान-फ्लैक्स फसल पद्धति में ज़ीरो टीलेज क्रिया से सूक्ष्मजीवीयों की संख्या तथा मृदा गुणवत्ता में वृद्धि हुई।
- सिंचित अवस्था में, पटसन के अंकुरण तथा रेशा उपज को क्षति पहुंचाये बिना, अंकुरण पूर्व शाकनाशी (इपफेनकार्बाजोन तथा ग्लूफोसिनेट अमोनियम) व अंकुरण पश्चात शाकनाशी (पारक्वाट डाइमेथोएट) के प्रयोग से घासीय खरपतवार को 81-83 प्रतिशत तक कम किया जा सकता है।
- क्रिजैफ नेल वीडर तथा शाकनाशी प्रयोगक यंत्र (हर्वीसाइड एप्लीकेटर) के प्रयोग से छिड़क के बोये गये पटसन में निराई, विरलीकरण तथा पंक्ति निर्माण में आसानी होती है। पटसन बीज बुवाई हेतु एक नयी हस्तचालित चार पंक्तियों वाली सीडर (क्षमता 0०19 है./घंटा) विकसित की गई है।
- सीसल प्रक्षेत्र प्रबन्धन के अंतर्गत टिकाऊ उत्पादन हेतु समन्वित कृषि पद्धति की शुरूआत की गई। सीसल आधारित फसल पद्धति में 80 प्रतिशत पी.ई., पर सिंचाई करने से मुख्य फसल के साथ-साथ अंतः फसलों के उपज में भी वृद्धि होती है। पटसन-धान-औषधीय व सुगंधी फसल पद्धति में अधिकतम पटसन समतुल्य उपज अश्वगंधा से तथा उस के बाद गार्डेन क्रेस (लेपीडियम साटाइवम) से प्राप्त हुई।सेल्यूलोज आधारित उत्पाद (कागज, सेल्यूलोज नैनोक्रिस्ट) के लिए पटसन की प्रजाति जे.आर.ओ. बी. 2 उपयुक्त है।
- सूक्ष्मजीवी सड़न के निष्कर्ष मौलिक तथा विकासपरक सूक्ष्मजीवी विघटन अध्ययन के लिये औद्योगिक महत्व का एक सशक्त आधार प्रदान करता है। पटसन सड़न वाले जल में बैक्टेरियल समुदाय का विश्लेषण करने पर समस्त जीवाणु में पेक्टिन विघटन करने वाले प्रमुख पाये गये। जीवाणु आधारित क्रिजैफ सोना का तरल सूत्रीकरण (फार्मुलेशन) पटसन एवं मेस्ता के सड़न परीक्षण में सफल पाये गये हैं।
- एक शक्तिचालित पटसन रिबनर यंत्र विकसित की गई है जो कटाई उपरांत तुरंत पटसन के डंठल को बिना तोड़े हरे छाल को निकालने में सक्षम है। कृषि विभाग, पश्चिम बंगाल सरकार के सहयोग से क्रिजैफ द्वारा अनुमोदित पटसन एवं मूँग की अंतः खेती को बढ़ावा दी जा रही है।

## फसल सुरक्षा

- संक्रमित जूट सेमिलूपर लार्वा के शरीर से निकाले रोगाणु की पहचान एन०पी० के रूप में की गई। पोलह( पोल एच) जीन के आण्विक

लक्षण ने भी इसकी पुष्टि की। ओबी (OB) का औसत आकार लगभग 1.60 µm थी। एन॰पी॰वी वायरस की औसत घातकता, (एल सी 50) 1.03 × 105 ओबी प्रति एमएल पायी गयी।

- ट्राइकोडर्मा जाति के चौबीस आइसोलेट्स, जिनको विभिन्न पारिस्थितिकी और मृदा क्षेत्रों से एकत्र किया गया तथा उन्हें निषेध क्षेत्र तैयार करने, कॉलोनी बनाने की व्यवहार, रोगज़नक़ से ज्यादा वृद्धि की गति और रोगाणु की अपघटन इत्यादि के आधार पर उनका चरित्र वर्णन किया गया। इन आइसोलेट्स में से, निषेध क्षेत्र तैयार करने और अपघटन जोन की विशेषता के आधार पर, टीवी - 1, टीवीसी - 2, टीवीसी – 4 , और टीवी-एच सबसे बेहतर पाये गए|
- पटसन की रोमिल सूँडी कैटरपिलर लार्वा को जब कृषित और जंगली पटसन की प्रजातियों के विभिन्न लाइंस पर उपयोग किया गया तो उसके जैविक मापदंडों में बहुत ज्यादा विविधता देखी गयी | डब्लू॰सी॰आई॰एन॰-19, डब्लू॰सी॰आई॰जे॰ – 123, डब्लू॰सी॰आई॰एन॰-179, डब्लू॰सी॰आई॰जे॰ – 34 और डब्लू॰सी॰आई॰एन॰-114 में इसके प्रति सबसे ज्यादा प्रतिरोधकता देखी गयी क्योंकि इनमें कीट अपने लार्वा चरण को भी पूरा नहीं कर पाया था।
- रेशे के वजन में कम कमी तथा पीली मकड़ी के कारण क्षति के कम लक्षण के आधार पर जे॰आर॰ओ॰ 204 को पीली मकड़ी के प्रति सहिष्णु पाया गया | अड़सठ दिनों के पौधे में तना सड़न रोगाणु का कृत्रिम संरोपण करने के बाद उसमें हुए चकत्ते की लंबाई के आधार प , ओ॰ आई॰ एन॰ 112, ओ॰आई॰जे॰ 74, ओ॰ आई॰ एन॰ 140 और ओ॰आई॰जे॰ 43 सबसे ज्यादा संवेदनशील पाये गए|
- स्पोडोप्टेरा लिटुरा के अंडे, लार्वा, प्यूपा और वयस्क की विकास दर तापमान में वृद्धि के साथ बढ़ती हुई देखी गयी। सभी अपरिपक्व चरणों के विकास की दर 32 – 34 डिग्री सेल्सियस पर सबसे तेज पायी गयी। इसी तरह स्पोडोप्टेरा लिटुरा की मृत्यु दर भी तापमान से प्रभावित थी और सबसे कम मृत्यु दर 26 – 28 डिग्री सेल्सियस पर देखी गयी।
- किसानों के पटसन के खेत में बुवाई के 45 से 55 दिन बाद फेनिप्रोक्सिमेट 5EC (1.5 मिली /ली.) पर्ण छिड़काव करने से पीली मकड़ी के अंडे और घनत्व में कमी के साथ ही रेशे की उपज में वृद्धि पायी गयी | सीसल के अल्टरनेरिया लीफ स्पॉट पर प्रभावी नियंत्रण के लिए नीम केक 10 क्विं प्रति हेक्टर + मैनकोजेब एम 45 3 ग्राम प्रति लीटर की दर से, एकीकृत पर्ण स्प्रे, करने से किया जा सकता है।
- नैनो सिलिका के 10 पीपीएम की दर से छिड़काव से रोमिल सूड़ी के कैटरपिल्लर में 75 % तक की मृत्यु दर पायी गयी। नैनोसिलिका के द्वारा रोमिल सूड़ी कैटरपिलर को मारने के तरीके का जब ट्रांस्क्रिप्तोम विश्लेषण के माध्यम से आणविक आधार देखा गया तो पाया गया कि नैनोसिलिका तनाव प्रतिक्रिया में काफी सारे एपोप्टोसिस संबंधित जीन शामिल होते है जैसे की माइटोजेन-एक्टिवेटेड प्रोटीन काइनेज (एमएपीके), एसआरसी ऑन्कोजीन और एपोप्टोसिस उत्प्रेरित मार्ग|
- पटसन और समवर्गीय रेशो में कीट और रोग की समस्या का निदान करने के लिए और कीट प्रबंधन गतिविधियों में उचित निर्णय लेने के लिए एक एंड्रॉइड आधारित मोबाइल ऐप "JAF-SAFE" बनाया गया है जो कि फसल आधारित फीनोलोजी, क्षति की प्रकृति, उसकी जैविकी, जीवन चक्र, कीट और बीमारी की फोटो पर आधारित है | इस ऐप में समेकित कीट प्रबंधन का मॉड्यूल भी एक विकल्प के रूप में दिया गया है |

## तकनीकी हस्तांतरण

- पश्चिम बंगाल के नदिया, मुर्शिदाबाद, उत्तर 24 परगना एवं पूर्व बर्द्धमान जिलों के 245.60 हेक्टयर क्षेत्रफल में पटसन के उन्नत उत्पादन तकनीकों का अग्रिम पंक्ति प्रक्षेत्र प्रदर्शन किया गया जिसमें 681 कृषकों की भागीदारी रही। उन्नत किस्मों से जहाँ उत्पादकता में बढ़ोतरी हुई, वहीं 'क्रिजैफ सीड ड्रिल' और 'क्रिजैफ नेल वीडर' द्वारा मानव श्रम के खर्च में कमी आयी ( प्रति हेक्टेयर दस से बीस हजार रुपयों की कमी) और उत्पादकता में भी 2.16-3.83 कु॰/है॰ की बृद्धि हुई। क्रिजैफ सोना द्वारा पटसन को सड़ाने के कारण रेशे की गुणवत्ता में 1-2 ग्रेड का सुधार हुआ जिसके कारण कृषकों को प्रति क्विंटल 300 – 450 रुपयों की अधिक आमदनी हुई।
- उत्तर 24 परगना, हुगली और नदिया जिलो के 60 पटसन उत्पादकों पर किए गए अध्ययन से ये पता चला है कि ये सड़न तकनीक, विविध खेती, उन्नत सस्य प्रक्रिया, यंत्रीकरण, वर्षा जल संचयन और समेकित कीट प्रबंधन के उन अनुकूली उपायों के बारे में जागरूक थे जो जलवायु परिवर्तन के उपायों के रूप में अपनाया जाना चाहिए।
- दो किसान उत्पादक संगठनों (एफपीओ) – "सबका अपना किसान उत्पादक संगठन" और "बादुरिया कृषि विकास किसान उत्पादक संगठन " के आधारभूत सर्वे से ये पता चला कि पटसन में मूल्य श्रृंखला विकास के प्रति इन उत्पादक संगठनों के किसानों में एक अनुकूल रवैया था। इनके सदस्यों ने, पटसन में ग्रेड या ग्रेडिंग पैटर्न के बारे में ज्ञान की कमी, पर्याप्त पूंजी की कमी, भंडारण और गोदाम की कमी और अग्र कड़ी व पीछे की कड़ी संपर्क ( forward linkage and backward linkage) जैसी समस्याओं की सूचना दी।
- पश्चिम बंगाल के उत्तर दिनाजपुर जिले में किए गए एक अध्ययन से पता चला है कि जूट –आई केयर कार्यक्रम के एक तिहाई लाभार्थियों (36%) ने पटसन के क्षेत्रफल में वृद्धि की थी। लाभार्थियों ने गैर-लाभार्थियों की तुलना में 23% अधिक उपज लिया । पटसन के उन्नत उत्पादन तकनीकों के बारे में भी लाभार्थियों का ज्ञान गैर-लाभार्थियों की तुलना में अधिक पाया गया।
- वर्ष 2019 में पटसन-आई केयर कार्यक्रम का विस्तार पटसन उत्पादक राज्यों (पश्चिम बंगाल, असम, बिहार, ओडिसा, तथा मेघालय) के 72 विकास खण्डों में किया गया। जिसमें पटसन के अंतर्गत 1,06934 है. क्षेत्रफल को कवर किया गया। इस कार्यक्रम में उच्च उपजवाली प्रजातियों के बीज (535 मि. टन), क्रिजैफ यंत्र

(600-क्रिजैफ बहु-पंक्ति सीडड्रिल तथा 900-सिंगल व्हील जूट वीडर) तथा क्रिजैफ सोना (612 मि. टन) का उपयोग किया गया। कृषकों के प्रक्षेत्र पर जे.सी.आई. के सहयोग से 87 प्रशिक्षण-सह-प्रदर्शन कार्यक्रमों (बुवाई, यांत्रिक खरपतवार प्रबन्धन तथा उन्नत सड़न तकनीक) का आयोजन किया गया।

## अखिल भारतीय पटसन एवं प्राकृतिक रेशा नेटवर्क परियोजना

- पटसन एवं प्राकृतिक रेशा पर अखिल भारतीय नेटवर्क परियोजना के अन्तर्गत 8 राज्य कृषि विश्वविद्यालय एवं 4 भा.कृ.अनु.प. आधारित केन्द्रों पर वर्ष 2019-20 के दौरान कुल 62 परियोजनाओं के तहत 244 परीक्षण किए गए। इनमे से फसल सुधार कार्यक्रम के तहत 31 परियोजनाओं के अन्तर्गत 140, फसल उत्पादन कार्यक्रम के तहत 21 परियोजनाओं के अन्तर्गत 69 तथा फसल संरक्षण कार्यक्रम के तहत 10 परियोजनाओं के अन्तर्गत कुल 25 परीक्षण शामिल हैं।
- पटसन एवं समवर्गीय रेशा फसलों के कुल सात प्रजातियों नामतः तोषा पटसन की जेआरओएमयू 1; रोजेल की एएमवी 8, एएमवी 9, जेआरएचएस 1; केनाफ की जेबीएएमपी 4 (उत्कर्ष), जेआरएचसी 3 तथा सनई की एसयूआइएन 3 (कविता) किस्मों का विमोचन भारत सरकार के अधीन फसल मानकों, किस्मों का विमोचन एवं अधिसूचना संबंधी केन्द्री य उपसमिति के सिफ़ारिश पर की गयी है।
- पटसन एवं समवर्गीय रेशा फसल उगाने वाले राज्यों के विभिन्न स्थानों में ओलिटोरियस पटसन, कैप्सुलरिस पटसन, रोजेल तथा केनाफ में प्रत्येक के पचास - पचास जननद्रव्यों का मूल्यांकन उनकी रेशा उपज तथा संबंधित गुणों के लिए किया गया। इसके अतिरिक्त 8 कृषि विश्विद्यालयों तथा 4 भारतीय कृषि अनुसंधान परिषद आधारित केंद्रों में पटसन एवं समवर्गीय रेशा फसलों के कुलीन प्रविष्टियों का मूल्यांकन स्टेशन परीक्षण, आईईटी, एवीटी और अनुकूली परीक्षण के रूप में भी किया गया है।
- आदुथूरई तथा आमादालावालसा केन्द्रों में मेस्ता बुवाई के 45-48 घंटों के बाद सिंचाई के साथ प्रेटीलाक्लोर @ 900 ग्रा./हे. की दर से प्रयोग तथा बुवाई के 15 दिनों के उपरांत हाथ से एक निराई करने पर सर्वाधिक रेशा उपज (27.5 कु./हे. ), शुद्ध आय तथा खर-पतवार नियंत्रण दक्षता दर्ज की गयी। राहुरी में पटसन बीज फसल की बुवाई के 15 दिनों के उपरांत क्विज़ालोफ़ॉप इथाईल 5 ईसी 60 ग्रा. + एथोक्सिसल्फ्यूरॉन @ 50 ग्रा./हे. का प्रयोग तथा 30 दिनों के बाद हाथ से एक निराई करने पर अधिकतम बीज उपज (16.15 कु./हे.), बेहतर खरपतवार नियंत्रण दक्षता और शुद्ध आय की प्राप्ति हुई।

नगांव, कटिहार और केंद्रपाड़ा में एकीकृत कीट और रोग प्रबंधन हेतु पंक्तिबद्ध बोई गई पटसन फसल में कार्बेन्डाजिम 50 WP @ 2 ग्रा./कि.ग्रा. बीज के साथ बीजोपचार; बुवाई के 35 दिनों बाद स्पाइरोमेसीफ़ेन 240 एससी @ 0.7 मि.ली./ली. पानी का छिड़काव; 45 दिनों के बाद टेबुकोनाजोल 0.15% का छिड़काव तथा बुवाई के 55 दिनों के उपरान्त लेम्डासायहेलोथ्रिन 5 ईसी @ 0.6 मि.ली./ली. पानी के छिड़काव से उच्चतम रेशा उपज के साथ-साथ कीट एवं रोग प्रबंधन में बेहतर परिणाम प्राप्त हुए।

## कृषि विज्ञान केन्द्र

- कृषि विज्ञान केन्द्र, बर्दवान के द्वारा – धान के पौध पर ठंढा का प्रभाव , सरसों की उत्पादकता और तैलीय मात्रा पर जस्ता और बोरोन का प्रभाव, आलू में लेट ब्लाईट प्रबंधन, और गेंदा और आम में पोषक तत्वों का प्रबंधन पर फार्म परीक्षण किया गया । पटसन, धान, सरसों, काबुली चना,उरद दाल, प्याज, बैंगन, केला और गेंदा की उन्नत उत्पादन तकनीकों पर कुल 348 अग्रिमपंक्ति प्रक्षेत्र प्रदर्शन (एफएलडी) आयोजित किए गए। कुल मिलाकर, किसानों, ग्रामीण युवाओं और विस्तार अधिकारियों के लिए 52 प्रशिक्षण कार्यक्रम आयोजित किए गए। इन प्रशिक्षण कार्यक्रमों के माध्यम से कुल 1454 प्रशिक्षुओं को लाभान्वित किया गया। एफ॰एम॰डी॰ और ब्रुसेलोसिस, कृत्रिम गर्भाधान (एआई) कार्यक्रम, एंटी-काउंटरटिट प्रोग्राम, बड़े पैमाने पर वृक्षारोपण कार्यक्रम, महात्मा गांधी का 150 वां जन्म दिवस समारोह, स्वच्छता ही सेवा, सतर्कता जागरूकता सप्ताह, उर्वरक अनुप्रयोग पर जागरूकता कार्यक्रम, विश्व मृदा दिवस और DAESI कार्यक्रम भी सफलतापूर्वक आयोजित किए गए थे। कृषि विज्ञान केंद्र, उत्तर 24 परगना (अतिरिक्त) ने 34 अग्रिमपंक्ति प्रक्षेत्र प्रदर्शन (एफएलडी) और 13 प्रशिक्षण कार्यक्रम आयोजित किए। इस के अलावा मृदा स्वास्थ्य कार्ड, धान और उड़द दाल के बीजोत्पादन के बारे में भी जागरूकता शिबिर का आयोजन किया गया।

# Introduction

ICAR-CRIJAF is a unique and only institute under the aegis of NARS spearheading the R&D on jute and allied fibre crops since pre-independence time. Jute and allied fibres have tremendous potential not only as economical commercial crops but also generates sizable employment, contributing significantly to the national exchequer through export of fibre based goods. These plant based biodegradable natural fibres are the only alternatives which can arrest the use of single use plastics and save the environment. Being much ideal for soil conservation, carbon sequestration, and fertility restoration, the JAF crops can also provide holistic ecosystem services. JAF crops and their by-products can be highly economical, re-newable, natural resource for bio-energy and environmental cleaning. These crops have a dominant role in sustaining the inclusive growth and especially enhancing the farm income of more than 20 lakh small and marginal farmers of India and the sub-continent.

The institute was initiated with the inception of Indian Central Jute Committee (ICJC) in 1936. Subsequently, Jute Agriculture Research Laboratory (JARL) was established in 1938 at Dhaka, now in Bangladesh which was later shifted to Chinsura in West Bengal in 1948, and then to Barrackpore, and finally established at the present place (Nilgunj, Barrackpore) in 1953 as Jute Agricultural Research Institute (JARI). ICJC was taken over by Indian Council of Agriculture Research (ICAR) in 1966. The Institute was rechristened to its present name, Central Research Institute for Jute and Allied Fibres (CRIJAF) in January, 1990.

The institute has four substations i.e., Ramie Research Station, Sorbhog, Assam; Sisal Research Station, Bamra, Odisha; Sunnhemp Research Station, Pratapgarh, Uttar Pradesh; and Central Seed Research Station for Jute and Allied Fibres, Budbud, West Bengal to cater the research on allied fibres crops and seed production.

CSRSJAF, Budbud

Sunnhemp Research Station, Pratapgarh

Sisal Research Station, Bamra

Ramie Research Station, Sorbhog

## Research Achievements

Institute has contributed holistically in solving the problems related to jute cultivation faced by the farmers from time to time. CRIJAF has great role in establishing jute as a profitable crop in the traditional jute belts of eastern India in the backdrop of competition from other field crops and synthetics. The research institute is credited for maintaining the only repository of jute germplasms. The JRO and JRC varieties developed by the institute are cultivated in 95% area in the country and sizable area under the crop in Bangladesh and Nepal. The sustained productivity growth of the crops in this sector is contributed to continued development of improved, well adapted, highly productive varieties, low cost farm implements, INM and IPM technologies. Researches in frontier areas like genomics, genetic transformation, high density genetic map, trait specific markers have the potential to make the breeding faster and precise. CRIJAF SONA-mediated retting technology has tremendous impact on quality fibre production in low volume retting in stagnant water. Sustainability and adoption of these technologies promoted through a mega outreach programme could reach one lakh ha jute area with a positive impact on productivity and quality of jute.

Instead of stagnant or decline in area under jute, the trend of raw jute production has been increasing over decades owing to the remarkable growth in productivity impacted by improved technologies for jute cultivation. Convergence of farm technologies developed by CRIJAF in synergy with government long term policy support for pricing, infrastructure for transport and marketing, strong outreach programme by state governments and overall awareness about the benefit of these crops in ecosystem services will certainly reverse the recent trend of sliding acreage under these crops.

Since inception, the institute has played major role in developing and popularizing more than 70 varieties of jute and allied fibre crops which has doubled the productivity with considerable reduction in harvest period which enabled this crop to establish in the cropping sequence of different jute and allied fibres growing states. Besides, the institute has developed important technologies related to crop production & protection, improved retting, improved machineries for fibre extraction, intercultural operation and seed production. CRIJAF is also leading in jute genomic research, maintenance of related database and germplasm of jute and allied fibre crops. The institute has following mission, vision and mandates.

## Mission

To explore traditional and new frontier areas of science for technology development, promotion and policy guidance for a vibrant, effectively productive and resilient jute and allied fibre agriculture.

## Vision

Provide leadership in research and technology development to make jute and allied fibre farming profitable and sustainable.

## Mandate

- Basic and strategic research on improvement of jute and allied fibre crops for biotic and abiotic stresses, yield and quality.
- Development of economically viable and sustainable production technology, cropping systems and post-harvest technology.
- Co-ordination and monitoring of applied research on national and regional issues to develop improved varieties and technologies.
- Dissemination of technologies and capacity building.

## Organizational set up and Infrastructural Facilities

The main institute has 3 research divisions *viz,* Crop Improvement, Crop Production, Crop Protection and Agricultural Extension section at the headquarters to meet research and extension needs in specific areas. The main institute has well-equipped laboratories pertaining to genomics, phenomics, biotechnology, biochemistry, fibre quality, physiology, soil science, microbiology and plant protection. The regional stations work on specific mandate crops and seed production. The research management is supported by different sections, cells like PME cell, AKMU, ITMU, administration, finance and accounts, purchase and store, library, farm, meteorological unit etc. The institute and the stations have the facility of well laid out research farm with irrigation facility for conducting the field experiments and seed production.

## All India Network Project on Natural Fibres (AINPNF)

The coordinating cell of All India Network Projects on Natural Fibres (AINPNF) is headquartered in the institute at Barrackpore. At present, this project has 14

centres including 8 SAU-based and 6 ICAR-institute based collaborative centres for multilocational evaluation of the varieties, validation of production and protection technologies and quality evaluation of the fibres.

### Krishi Vigyan Kendra

Two Krishi Vigyan Kendras i.e. KVK, Purba Bardhaman and KVK-II, North 24 Parganas (Additional) are functioning under the administrative control of ICAR-CRIJAF. KVK, Purba Bardhaman was established in 2005 in 18 ha area in the campus of Central Seed Research Station for Jute and Allied Fibres, Budbud, Purba Bardhaman. The KVK is well equipped with facilities like trainee's hostel, soil testing laboratory, seed production unit and demonstration units like vermicompost production unit, polyhouse, integrated farming system, well maintained mix-fruit orchard, portable carp hatchery, goatery etc.

KVK-II, North 24 Parganas (Additional) was established in 2016 in 12 ha area in the North Farm campus of ICAR-Central Research Institute for Jute and Allied Fibres, Barrackpore at Nilgunj. The KVK started functioning since December 2016 to take up the programmes related to on-farm trials (OFTs), FLDs, capacity building through hand-on training and other promotional extension activities in jute based farming system in the 11 Southern blocks of the District.

### Agricultural Knowledge Management Unit (AKMU)

Agricultural Knowledge Management Unit (AKMU) facilitates the infrastructure for e-governance, manages research information on jute and allied fibres, provides stable internet facility. The unit is responsible for maintenance and updating of institute website. The backbone for operating the e-extension, mobile advisory, agro-advisory services and other related activities are also supported by AKMU.

### Institute Technology Management Unit (ITMU)

Institute Technology Management Unit (ITMU) deals with protection of intellectual properties (IPs), their maintenance and commercialization of the technologies developed by the institute. It also looks after consultancy, contract research, patents, technology protection protocols, licensing etc.

### Prioritization, Monitoring and Evaluation (PME) Cell

The PME of the Institute is working as "Single window" system for priority setting, research monitoring and evaluation, maintenance of data bases related to projects, achievements, technologies developed, publication etc. PME cell co-ordinates in maintaining the information and documentation of all the on-going in-house as well as externally funded projects.

### Human Resource Development Cell

The institute has been recognized for research work for M.Sc and Ph.D programmes by the Presidency University, Calcutta University, R.K.M. Vivekananda University and Adamas University. Besides, the cell also conducts short term summer training for M.Sc students of SAUs and general universities (Govt. or private) on payment of appropriate fees. HRD cell developes the year wise training schedule for all categories of staffs and monitor the different training programmes.

### Women Cell

The institute women cell addresses the issues related to grievances of women employees in the HQ and in different regional research stations. This cell also organizes training and awareness programmes for the women on agriculture and other allied activities for enhancing their income and over all involvement in the management of family and welfare of the society.

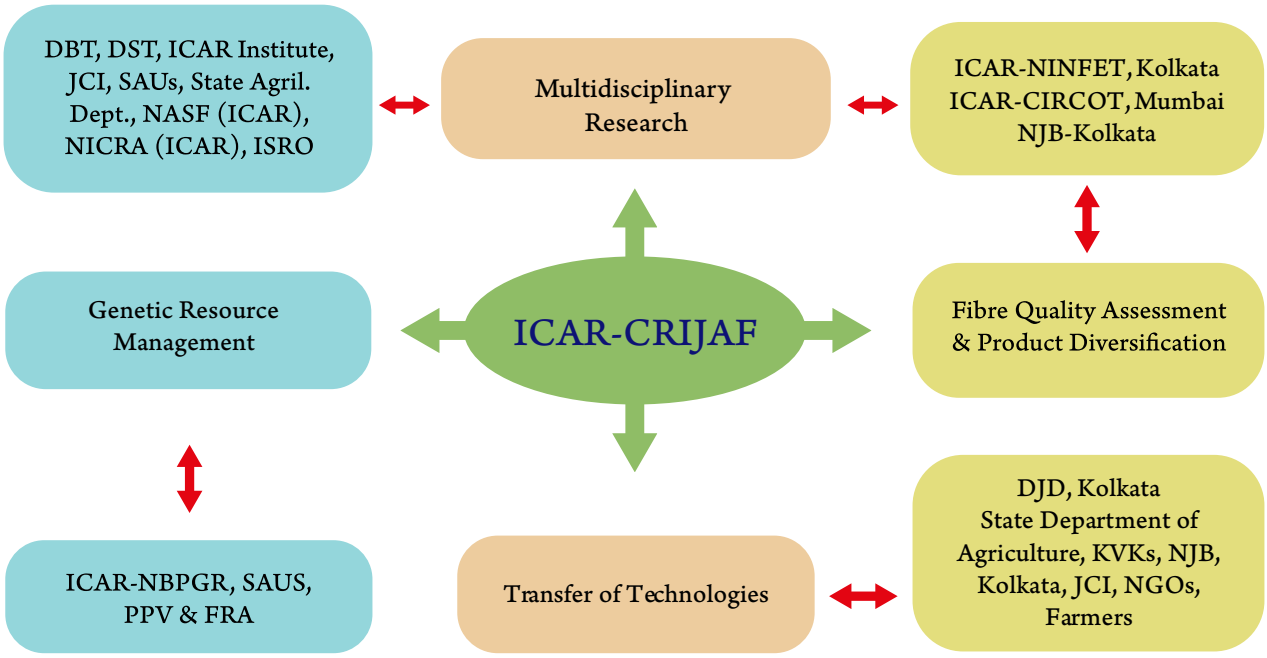
### Regional Centre of National Agricultural Education Accreditation Board

On recommendation of the accreditation board of ICAR, this institute (ICAR-CRIJAF) has been selected as the nodal centre for eastern and north-eastern region for facilitating the submission of self-study reports (SSRs) of the agricultural universities, colleges and other modalities required for accreditation.

### Linkages

Apart from the 8 SAUs engaged in research on JAF crops, the institute has strong linkage with national and international organizations in the field of research, training and policy matters. The institute has R & D collaboration with national funding bodies like DBT, ISRO, NASF, SRD, NICRA, NJB, DST (West Bengal), and RKVY (DAC, MoA and FW). Besides collaborative programmes are also going on with DJD, NINFET, JCI, NJB, PPV and FRA for research, training and developing effective policies for the sector. The International organization like BJRI, Bangladesh is also associated for R & D activities on jute.

## LINKAGES & COLLABORATION




### Infrastructural Facilities

**Laboratory and Research Facility:** The institute has well equipped laboratory for biotechnological research, fibre quality analysis, seed technology, gene bank for mid-term germplasm storage, advance crop protection laboratory, central soil analytical, microbiology laboratory and farm engineering workshop.

**Research Farm Facilities:** For conducting field experiment the institute has 61.04 ha farm at CRIJAF (HQ), Barrackpore. The farm section has tractors (2), rotovator, leveller, powertiller, sprayer, seed processing unit, retting facility to support execution of field experiments and seed production. The farm area has underground irrigation facility and has a Meteorology Station.

**Guest House/Hostel facilities:** Presently well-furnished guest house and training hostel facilities are available to provide accommodation to the visitors, trainees and trainers. The lodging arrangements are quite good for the guests, trainees and the trainers.

### Financial Statement

Financial Statement of ICAR-CRIJAF, Barrackpore for the year 2019-20

(₹ In Lakh)

| Head | RE (2019-20) | Expenditure up to Dec, 2019 |
|---|---|---|
| Grant in aid - Capital | 35.08 | 17.08 |
| Grant in aid - Salary | 2185.00 | 1808.05 |
| Grant in aid - General | 1356.60 | 920.28 |
| Total | 3576.68 | 2745.41 |

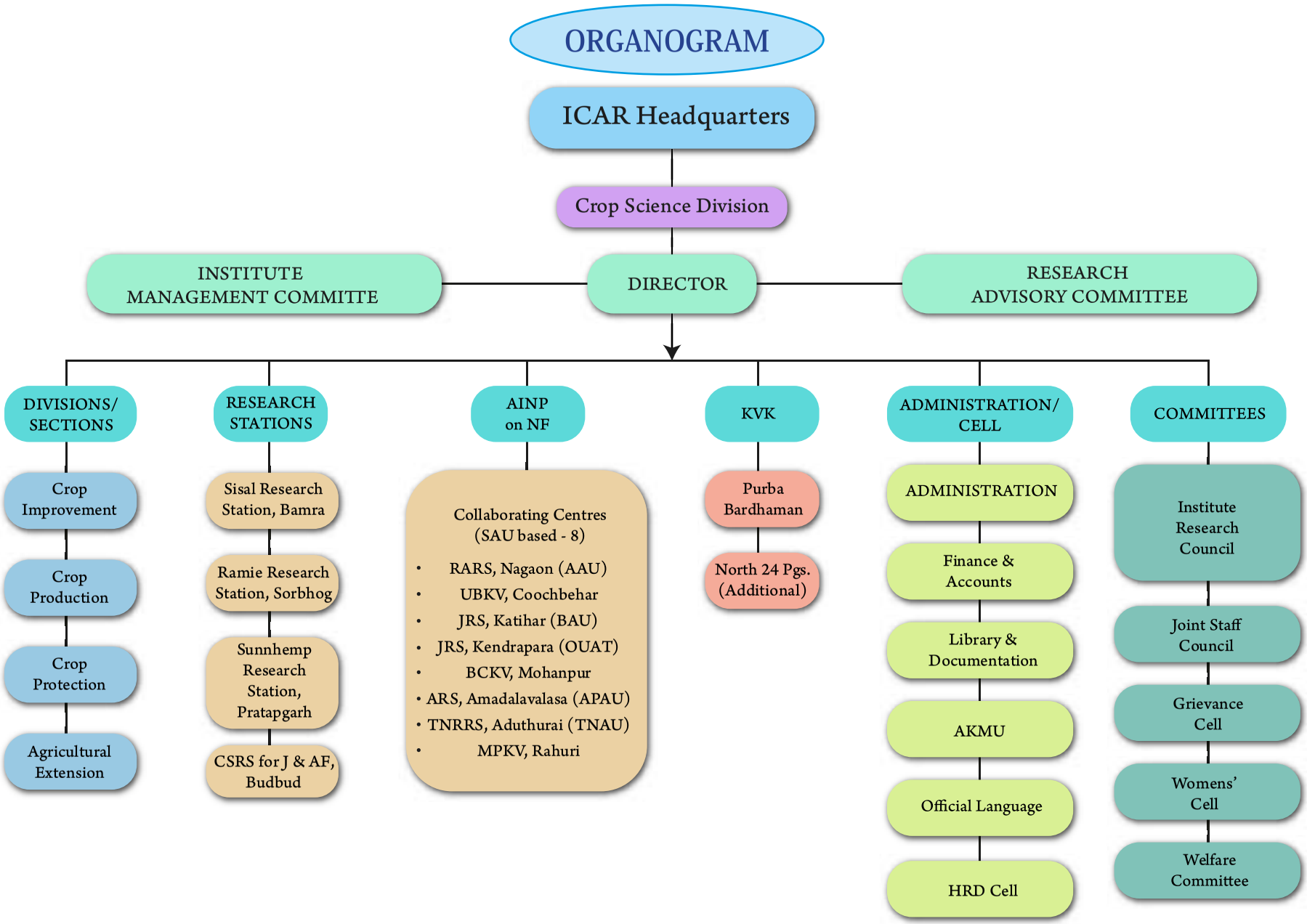
* detailed financial statement is given in chapter 24

### Staff Position

Cadre-wise staff position of ICAR-CRIJAF and its Regional Stations

| Cadre | Sanctioned | In position | Vacant |
|---|---|---|---|
| RMP | 1 | 1 | - |
| Scientist | 74 | 48 | 26 |
| Technical | 108 | 50 | 58 |
| Administrative | 62 | 40 | 22 |
| SSS | 92 | 8 | 84 |

# ORGANOGRAM


ICAR Headquarters
Crop Science Division
INSTITUTE MANAGEMENT COMMITTE
DIRECTOR
RESEARCH ADVISORY COMMITTEE
DIVISIONS/ SECTIONS
Crop Improvement
Crop Production
Crop Protection
Agricultural Extension
RESEARCH STATIONS
Sisal Research Station, Bamra
Ramie Research Station, Sorbhog
Sunnhemp Research Station, Pratapgarh
CSRS for J & AF, Budbud
AINP on NF
Collaborating Centres (SAU based - 8)
RARS, Nagaon (AAU)
UBKV, Coochbehar
JRS, Katihar (BAU)
JRS, Kendrapara (OUAT)
BCKV, Mohanpur
ARS, Amadalavalasa (APAU)
TNRRS, Aduthurai (TNAU)
MPKV, Rahuri
KVK
Purba Bardhaman
North 24 Pgs. (Additional)
ADMINISTRATION/ CELL
ADMINISTRATION
Finance & Accounts
Library & Documentation
AKMU
Official Language
HRD Cell
COMMITTEES
Institute Research Council
Joint Staff Council
Grievance Cell
Womens' Cell
Welfare Committee

# 1. Crop Improvement

## 1.1. Advanced Breeding in Jute

### 1.1.1. Fertile sexual hybrid of the two cultivated jute species (*Corchorus capsularis* × *C. olitorius*)

(Investigator: *D. Sarkar; Project Code: Externally Funded Project- ICAR-NPTC-3070)*

First fertile sexual hybrid of the two cultivated jute species from a cross between *C. capsularis* cv. JRC 212 (♀) and *C. olitorius* cv. JRO 524 (♂) have been developed. On average, the cross resulted in 82.8 % fruit-setting (Min 60.0 % and Max 100.0 %), with a mean capsule weight of 106.2 mg (Min 26.6 mg and Max 259.7 mg) and 19.5 seeds capsule$^{-1}$ (Min 6.0 and Max 44.0 seeds capsule$^{-1}$). Fifty three healthy seeds from 16 capsules were assessed by scanning electron microscopy (SEM) in comparison with those of their two parents.


Diagnostic phenotype of the *C. capsularis* × *C. olitorius* $F_1$-hybrid (B, E) in comparison with that of its two founders *C. capsularis* cv. JRC-212 ♀ (A, D) and *C. olitorius* cv. JRO-524 ♂ (C, F).

***Phenotypic characterization of the $F_1$-hybrid:*** The $F_1$-hybrid was highly heterotic (Pic. B), with diagnostic phenotypes in comparison with that of its two founders (Pic. A, C). Most notably, it was characterized by a cylindrical capsule (with 5 beaks, each measuring ~2.0-3.0 mm long; Pic. E), with an average weight of 429.4 mg (Min 215.6 mg and Max 535.7 mg) unlike its female parent *C. capsularis* cv. JRC 212, which is characterized by a globose capsule (Pic. D), with an average weight of 274.4 mg (Min 219.5 mg and Max 298.8 mg). The hybrid was fertile, with a mean pollen viability of 65.1 % (Min 50.6 % and Max 75.2 %) and recorded a mean fruit-setting of 82.5 % (Min 0.0 % and Max 100.0 %).

***Bidirectional backcrossing of the $F_1$-hybrid with its two founders:*** The $F_1$-hybrid (♀) was backcrossed with both *C. capsularis* cv. JRC 212 (♂) and *C. olitorius* cv. JRO 524 (♂), its female and male founders, respectively. Fruit-setting and number of seeds developed per capsule in bidirectional crosses are shown in Table 1. There were significant differences in fruit-setting (%) and seeds capsule$^{-1}$ between the two bidirectional crosses.

Table 1: Fruit-setting and seed development following bidirectional backcrossing of the $F_1$-hybrid with its male and female founders

| Parameter | $F_1$ × *C. capsularis* | | | $F_1$ × *C. olitorius* | | |
|---|---|---|---|---|---|---|
| | Min | Max | Mean | Min | Max | Mean[a] |
| Fruit-set (%) | 66.7 | 91.7 | 78.3 | 20.0 | 40.0 | 29.5*** |
| Seeds/capsule | 16.0 | 97.0 | 51.3 | 81.0 | 113.0 | 94.0** |

[a]** and *** = significantly different at $P \leq 0.01$ and 0.001, respectively, according to non-parametric Mann-Whitney U test

***Construction and fixation of the C. capsularis × C. olitorius lines (RILs):*** With an average of 36.7 % seed germination (Min 33.3 % and Max 40.0 %), we raised 694 $F_2$ plants that were finally relegated to 458 plants due to heavy seedling and plant losses for various sorts of phenotypic and phenological abnormalities. On selfing, $RI_3$ seeds were harvested from 348 $F_2$ plants. However, $RI_3$ onwards, the population was stabilized with a total of 194 lines and was fixed at $RI_8$ thus far.

***Backcrossing of the $F_2$ individuals with their male founder C. olitorius:*** All 458 $F_2$ individuals (♂) were backcrossed with one of their founder parents *C. olitorius* cv. JRO 524 (♀). Of the 458 backcrosses, 299 (65.3 %) were successful, with normal fruit-setting. Seed germination and seedling lethality were 62.04 and 23.41 %, respectively.

***Nuclear microsatellite genotyping for assessing the hybridity and segregation distortion:*** Of the 955 genomic SSR markers validated so far, 284 were found to be polymorphic between the two founders. Thus far, 26 genomic SSRs were assayed to amplify founder-specific diagnostic alleles in the $F_2$ population (Fig. 1 A and B) vis-à-vis to confirm the hybridity of the $F_2$ ($RI_2$) individuals.

Overall, based on the patterns of segregation distortion in the $F_2$ population so-called 'dominance of the female parent in $F_1$ and $F_2$ generations' of jute interspecific crosses is a myth because *C. olitorius* was used as a male parent, and there was a dominance of the male parent not only in $F_1$ and $F_2$, but also in $RI_6$ generations.

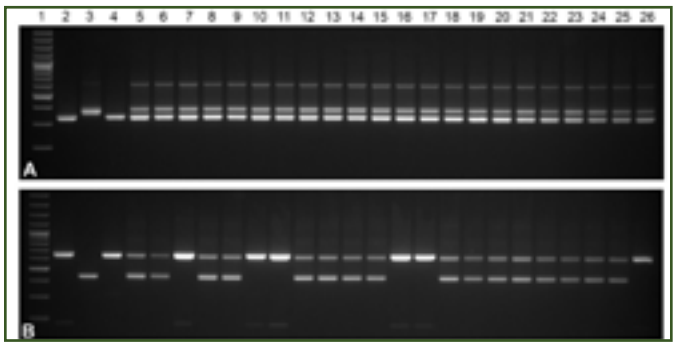



Fig. 1: Representative Metaphor® (agarose) gel electropherograms of the $F_2$ biparental interspecific populations of *C. capsularis* (♀) × *C. olitorius* (♂) in comparison with their founders and the $F_1$-hybrid assayed using genomic SSR markers JROm352 (A) and JROm660 (B) 1, 100-bp Plus Gene Ruler; 2, *C. capsularis* cv. JRC 212; 3, *C. olitorius* cv. JRO 524; 4, $F_1$-hybrid; 5-26, $F_2$ individuals

***Mitochondrial microsatellite haplotyping for assessing heteroplasmy and paternal leakage:*** A total of 17 mitochondrial SSR mostly representing di-, tri- and tetra-nucleotide repeats were used to haplotype the jute interspecific offspring. In a preliminary study, all mitochondrial SSRs were assayed in a subset (23 families) of the $RI_6$ population together with two founders in order to assess the parental polymorphisms (Fig. 2). Three diagnostic mitochondrial SSR markers, viz., CcmtSSR5 and CcmtSSR14 (both identified from the *C. capsularis* mitogenome) and ComtSSR2 (identified from the *C. olitorius* mitogenome) were selected, which were used to haplotype the $F_2$ population that comprises 175 individuals.

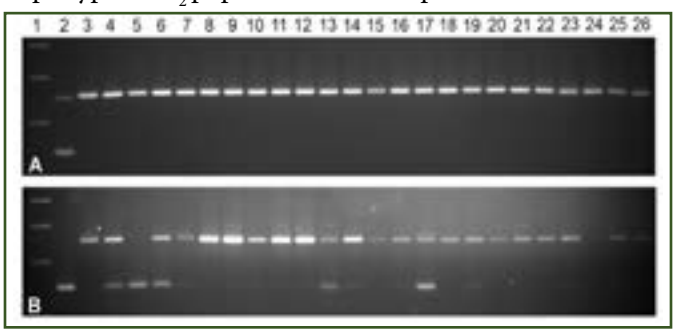



Fig. 2: Representative Metaphor® (agarose) gel electropherograms of a subset of the $RI_6$ biparental interspecific populations of *C. capsularis* (♀) × *C. olitorius* (♂) in comparison with their founders, using mitochondrial SSR markers CcmtSSR5 (A) and CcmtSSR14 (B). 1, 100-bp Plus Gene Ruler; 2, *C. capsularis* cv. JRC 212; 3, *C. olitorius* cv. JRO 524; 4-26, $RI_6$ individuals.

CcmtSSR5 and ComtSSR2 haplotypes were suggestive of paternal leakage (homoplasmic *C. olitorius*-variant) in all 175 $F_2$ individuals vis-à-vis $F_1$-hybrid offspring. Interestingly, however, CcmtSSR14 indicated an admixture of all variants, i. e. homoplasmic *C. capsularis*-variant (1 individual/ 0.6 %), homoplasmic *C. olitorius*-variant (125 individuals/ 71.4 %) as well as their heteroplasmic variant (27.4 %). Based on this mtSSR marker, *C. capsularis* cv. JRC 212, used as a female parent in our interspecific cross, was found to be homoplasmic.

The occurrence of heteroplasmy and paternal leakage in jute interspecific crosses is a new finding, and this might have played a significant role in the evolution of the two cultivated jute species, possibly via a sexual-like mode of mitochondrial genome evolution.

### 1.1.2 Fixation of a multiparent advanced generation inter-cross (MAGIC) population of *C. olitorius*

(Investigators: *D. Sarkar and P. Satya; Project Code: In-house Project- JBT 4.6)*

A total of 341 MAGIC lines were advanced to $ML_4$-$RI_7$ generation. In a preliminary investigation, 341 lines of $ML_4$-$RI_6$ together with their 20 parents were phenotyped for pre-mature flowering in an α-lattice design ($19^2$), with two replications at ICAR-CRIJAF, Barrackpore under long-day conditions. The $ML_4$-$RI_6$ population was also phenotyped for plant height, stem base diameter and bast fibre yield at ICAR-CSRSJAF, Bud Bud under long-day conditions.

## 1.2. Novel Biotechnological Approaches in Improvement of JAF Crops

### 1.2.1. Identification and characterization of GAUT genes from jute

(Investigators: *P. Satya, D. Sarkar, S. Ray, L. Sharma and S. Roy; Project Code: In-house Project-JBT 4.1, JB 10.4 and ICAR-NPTC 3070)*

Fig. 3: Homology of jute and Arabidopsis GAUT genes

*Galactouronosyl transferase* (*GAUT*) genes are the major pectin biosynthesis enzymes. To understand pectin biosynthesis, 11 GAUT genes (*CcGAUT1–CcGAUT11*) expressing in jute hypocotyl was identified from the hypocotyl transcriptome of *C. capsularis* cv. JRC-212 and one additional gene CcGAUT12 was identified from hypocotyl transcriptome of a mutant genotype dlpf. The gene size of *CcGAUTs* ranged from 2027 nt to 3162 nt, with average coding sequence of 1699 nt. All the

predicted CcGAUTs carried a glycosyl transferase family 8 (GT8) domain (PF0151.20). The CcGAUT genes were matched to their homologs from *A. thaliana*. Phylogenetic classification identified different subclades showing high divergence among the CcGAUT genes (Fig. 3). Of these, CcGAUT3 matched with AtGAUT3, and CcGAUT12 matched with AtGAUT1. CcGAUT8 was homologous to AtGAUT4 and CcGAUT7 was homologous to AtGAUT6. In a more distant subclade, AtGAUT7 was grouped with CcGAUT9. In another distant group, CcGAUT4 and CcGAUT2 grouped with AtGAUT15 and CcGAUT5 was grouped with AtGAUT12. All the enzymes carried galactose binding domain indicating that the predicted enzymes can bind to the pectin substrate. Expression of CcGAUT3 was confirmed thorough real time qRT-PCR in both *C. capsularis* and *C. olitorius*.

### 1.2.2. Mining novel alleles for stress tolerance in jute and allied fibres

(Investigators*: S. Datta, J. Mitra, D. Saha, P. Satya and A. Anil Kumar; Project Code: In-house Project-JBT 4.7)*

***Molecular modeling of Corchorus aquaporins:*** In order to understand the structural properties of aquaporins in jute, three-dimensional (3D) protein models of all AQPs were constructed using Phyre2 server with high degree of residue coverage. Most of these proteins generated best hit with c2w2eA of PDB database (Table 2). Broadly, the AQP 3D protein structure contains the conserved hour-glass model with a pore-forming integral membrane protein containing α-helical bundle forming six TM helices (H1 to H6) and two additional short (half) helices (HE and HB). The loops HE and HB each containing the conserved NPA motifs get close together in the center of the membrane (Fig. 4).

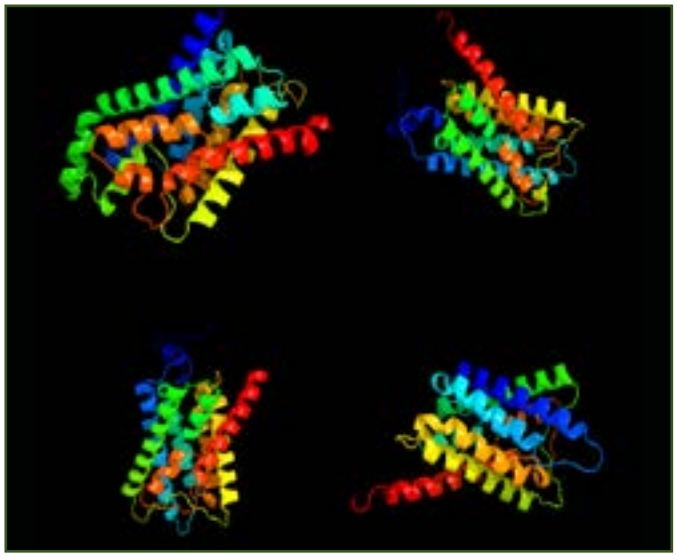


Fig. 4: Predicted 3D structures of four NIP genes

Table 2: Summary of PDB hits and sequence coverage in 3D model prediction of aquaporins

| Description | Hit | Confidence (%) | Alignment coverage (%) | PDB header |
|---|---|---|---|---|
| PIP1.1 | c2w2eA | 100 | 88 | MP |
| PIP1.2 | c2w2eA | 100 | 86 | MP |
| PIP1.3 | c2w2eA | 100 | 89 | MP |
| PIP1.4 | c2w2eA | 100 | 90 | MP |
| PIP1.5 | c2w2eA | 100 | 90 | MP |
| PIP1.6 | c2w2eA | 100 | 90 | MP |
| PIP2.1 | c2w2eA | 100 | 92 | MP |
| PIP2.2 | c2w2eA | 100 | 95 | MP |
| PIP2.3 | c2w2eA | 100 | 96 | MP |
| PIP2.4 | c2w2eA | 100 | 88 | MP |
| PIP2.5 | c2w2eA | 100 | 94 | MP |
| PIP2.6 | c2b5fD | 100 | 87 | MP |
| PIP2.7 | c2w2eA | 100 | 92 | MP |
| PIP2.8 | c2w2eA | 100 | 87 | MP |

*MP-membrane protein

***Phosphorylation and glycosylation sites for aquaporin gating:*** Aquaporin gating involves opening and closing of the AQP water channel pore and phosphorylation and dephosphorylation of AQPs are considered to be important mechanisms regulating their activity. The NetPhos 3.1 server was used to predict serine, threonine or tyrosine phosphorylation sites in AQP proteins.

Table 3: Predicted phosphorylation and glycosylation sites in *Corchorus* PIP aquaporins

| AQP | Predicted Phosphorylation Site | Peptide Sequence | Predicted N-Glycosylation Site | Predicted O-Glycosylation site |
|---|---|---|---|---|
| PIP1.1 | 138 S | QVLGSTLAS | 11 | T23 |
| PIP1.2 | 225 S | NPARSLGPA | 43 | T23 |
| PIP1.3 | 272 S | EITKSASFL | 275 | T83 |
| PIP1.4 | 118 T | IAFATCKRF | 169 | S24,T118 |
| PIP1.5 | 262 T | MVRYTDKPL | 78 | S11 |
| PIP1.6 | 114 S | LPSVSYGQA | 97 | S11 |
| PIP2.1 | 89 S | QVSASICAS | 50 | T68 |
| PIP2.2 | 93 S | SICASFALK | 78 | S126, S159 |
| PIP2.3 | 224 S | RQVRSFRR- | 50 | T98,S198 |
| PIP2.4 | 51 T | IILSTGHIS | 78 | S183 |
| PIP2.5 | 50 S | IIILSTGHI | 97 | T26 |
| PIP2.6 | 127 S | MVRGSVESL | 241 | S143 |
| PIP2.7 | 59 Y | SMAIYMSAA | 76 | T52 |
| PIP2.8 | 279 S | KAVASTEQR | 76 | S176,S228 |

Both generic and kinase specific predictions were performed for the following 17 kinases: ATM, CKI, CKII, CaM-II, DNAPK, EGFR, GSK3, INSR, PKA, PKB, PKC, PKG, RSK, SRC, cdc2, cdk5 and p38MAPK. The spread of known and predicted N-glycosylation and O-glycosylation sites were investigated using NetNGlyc and NetOGlyc server respectively (Table 3).

***Expression profile of Corchorus AQP genes:*** Sequence specific primers were designed using the IDT PrimerQuest oligo design tool. For each gene, five primer pairs were initially designed and analyzed for specificity, using *in silico* PCR in EMBOSS. These primers were further rechecked for amplification using gDNA and synthesized cDNA as template. Based on these results, primers producing multiple amplicons were redesigned so as to get one unique amplicon for each gene- primer pair combination. Qualitative PCR analyses were carried out with three independent total RNA samples using the fluorescent intercalating dye SYBR-Green. The 18S rRNA gene was used as internal control to normalize the quantification of targets. The fold change in mRNA expression was determined by the **ΔΔCt** method. For a graphical representation, the **ΔΔCt** values of various jute tissues were normalized to samples with lowest expression, whereas in stressed samples, the **ΔΔCt** values were normalized to untreated controls. Expression changes are expressed as log2 fold change. Expression analysis of the AQP genes indicated that distinct tissue specific differential expression differ widely between the WT and the mutant (Fig. 5). However, there are many genes which could not be specifically ascribed to genotype / tissue. The current study presents the first detailed genome-wide analysis of the AQP gene family in jute and provides valuable information through functional analysis about their role in bast fibre biogenesis and dehydration stress response.

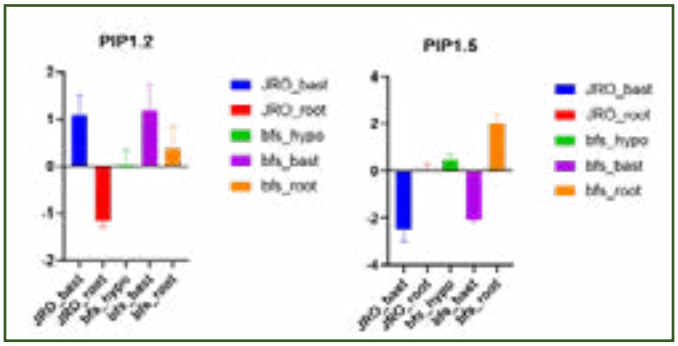



Fig. 5: Expression patterns of two PIP aquaporin genes in different tissues

***Gene features and promoter profiling of Corchorus AQP genes:*** Gene Structure Display Server (GSDS version 2.0) was used to predict gene features, such as the composition and position of exons, introns, and conserved elements. The number of introns per gene greatly varied from one to three. The cis-acting regulatory elements (CREs) are DNA region in the promoter, where a number of transcription factors can bind and regulate the transcription of nearby genes. Profiling of the promoter region for the CREs can provide information on gene regulatory networks. To predict the CREs, the promoter sequences (1000 bp upstream DNA sequences) of the predicted transcription initiation site of AQP genes were extracted and subjected to promoter profiling using PlantCARE web tool. The most common cis-acting elements present in AQPs were INRE, PTBP, TF2B, YTBP, ABRE, AHBP, AP2L, AREF, DREB, MADS, MYBL etc. (Fig. 6). Function wise, many of the cis elements were homeotic gene, involved in development; drought-inducible HLH transactivation factor; ethylene response factor which may be involved in mediating ABA-response; elements involved in light responsiveness and regulation of flavonoid biosynthetic genes etc.

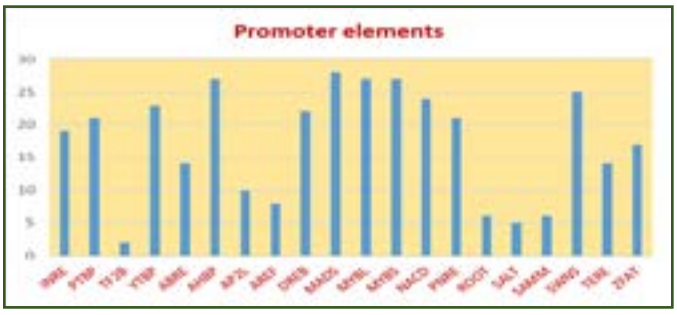



Fig. 6: Distribution of different promoter elements in *Corchorus* aquaporin genes

### 1.2.3 Characterization of NAC domain genes for abiotic stress response in flax

(Investigators: *D. Saha; Project Code: Externally-funded Project- EEQ/2018/274)*

NAC domain transcription factor genes mediate important abiotic stress response in plants. Flax genome sequence from the Phytozome database was used to retrieve 164 NAC-domain proteins and their corresponding gene sequences. These genes were named as *LuNACs*. Except few outgroups, majority of the LuNAC proteins were phylogenetically compared with Arabidopsis NAC proteins and categorized them into different NAC domain groups. Several LuNAC proteins were found categorized under the SWN group, which are known to regulate secondary cell wall development in xylem, phloem, and fibres. Chromosomal localization analysis showed distribution of all the LuNAC genes into 15 flax chromosomes. Gene structure and protein domain distribution analysis exhibited significant variations existing within the NAC domain genes and proteins, respectively. Semi-quantitative mode of gene expression analysis of five selected NAC genes was analyzed in cDNA from different plant tissues of flax variety JRF2 (Fig.

7). Also a real-time gene expression analysis of twelve selected LuNAC genes were carried out in two-week old JRF2 seedlings grown under hydroponics in a quarter strength MS medium supplemented with abscisic acid (ABA) (at 100µM for 3 days), cold stress (4±1 °C for 8 hours for two consecutive days), heat stress (42±2 °C for 4 hours), NaCl (at 200 mM for 3 days), and polyethylene glycol 6000 (PEG) (20% for 3 days). Several LuNAC genes produced significant gene expression changes in cDNA from seedlings with the above treatments in comparison to cDNA from control plant. Interestingly, LuNAC002 gene is upregulated in cold stress but downregulated under heat and NaCl stress in JRF2. LuNAC003, LuNAC009, LuNAC059, and LuNAC101 all are found downregulated under cold, heat, NaCl, and PEG induced stress. Strikingly, LuNAC144 and LuNAC145 were observed significantly upregulated in NaCl and PEG induced stress, but are downregulated by heat stress

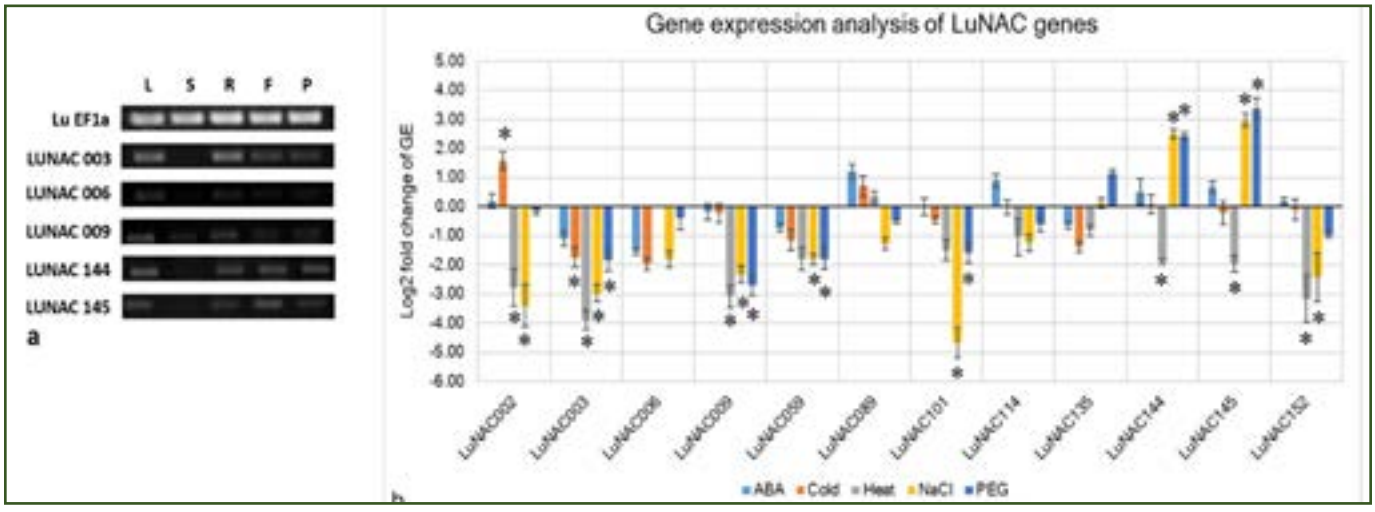
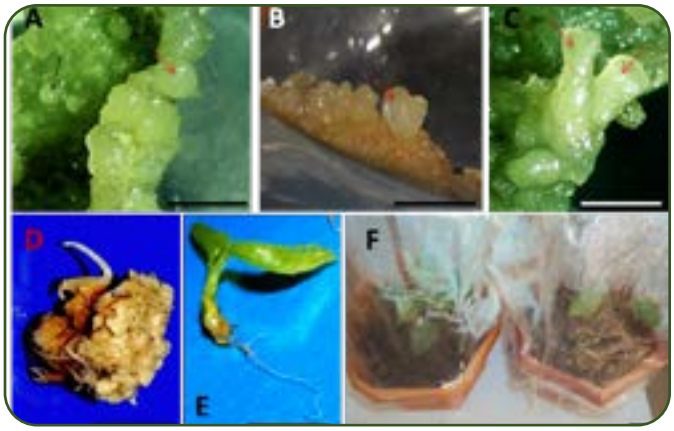



Fig. 7: (a) Semi-quantitative RT-PCR expression analysis of *LuNAC* genes in different tissues of JRF2 genotype. L: leaf; S: stem; R: root; F: flower; and P: pod. (b) Relative gene expression fold-change in qRT-PCR of *LuNAC* genes under different abiotic stress mimicking conditions compared to control. The $Log_2$ fold change of gene expression was normalized using LuEF1α as reference gene, calibrated against control $C_t$ values and calculated as per $2^{-\Delta\Delta Ct}$ (Livak and Schmittgen, 2001).

### 1.2.4. Somatic Embryogenesis in *Capsularis* Jute

(Investigators*: A.B. Mandal and K. Meena; Project Code: In-house Project-JB: 9.3)*

Based on our earlier observations efforts were made to induce direct & repetitive somatic embryogenesis(SE) using leaf explants in *capsularis* jute var. JRC 517 involving morpho-histological, ultrastructural & qRT-PCR studies.




Morphogenesis of direct and repetitive somatic embryogenesis

Legends: (A) Leaf explant showing initiation of swelling, proliferation of meristematic cells and development of globular SEs (arrow). (B-C) Typical heart and torpedo-shaped embryo (arrow). (D) Somatic embryo showing well-defined root and shoot poles. (E) Conversion of DSEs, green micro-plants. (F) Acclimatization and hardening of embryo-derived normal plantlets after 3 weeks in culture room

Plant growth regulators (PGRs) showed maximum response on MS basal medium fortified with 0.5 mg $l^{-1}$IAA and 0.03 mg $l^{-1}$ kin in SE. Germination of somatic embryos was 54.8% on ½ MS with 1 mg $l^{-1}$ GA3 and conversion to plantlets rate was 31.8%. Embryogenic competency was achieved in myo-inositol free medium with enhanced SOD expression in SDS-PAGE after 14 d of induction, which leads to SE. Expressions profiles of six SE related genes were assessed through qRT- PCR showed differential expressions of all the genes at varying levels with predominant expression of LEC1, SERK and BAK1 for induction of SE pathway.

### 1.2.5. *In vitro* micro propagation in ramie

(Investigators*: A.B. Mandal; Project Code: Externally funded Project-WB-DST)*

Field trial of *in vitro* micro propagated plants developed by using stemlet cuttings from the mericlones with proven clonal fidelity at molecular levels was initiated in 2018 and continued after the first cut. The agronomic characteristics like plant height, number of primary branches, biomass (fresh wt) /plant, cane (fresh wt)/plant, waste stalk (fresh wt)/plant, decorticated bark fresh weight/plant, fiber yield /plant were near similar and true- to-the parents,

which prospects ample scope of *in vitro* micro propagated plantlets as planting materials of ramie.

Field trial of *in vitro* micro propagated plantlets of ramie var R 67-34.

## 1.3. Germplasm Resource Management

(Investigators: *J. Mitra, A. Bera, A. Anil Kumar, R.T. Maruthi and S.K. Sarkar; Project Code: In-house Project-JB 1.1)*

***Germplasm collection:*** Six new germplasm lines comprising of different bast fibre species i.e., *C. olitorius* from Andhra Pradesh, *C. capsularis* from West Bengal, wild jute from Andhra Pradesh, wild *Hibiscus spp*. from Telangana and *Agave spp.* from Bengaluru were added to ICAR-CRIJAF gene bank.

***Acclimatization and conservation:*** A total of 824 white jute accessions, 14 tossa jute accessions and 26 wild jute accessions were regenerated. Further, 107 new accessions collected from previous years exploration programme were also grown for acclimatization and seed multiplication. A panel of 268 JAF germplasm received from ICAR-NBPGR were also regenerated.

***Evaluation:*** A total of 500 *C. olitorius* germplasm lines of recent exploration were evaluated for agro-morphological traits. Wide variation was observed among the exploration material for morphological and yield related traits. Rare yellow and pink stem genotypes were identified. The plant height ranged from 127 to 393 cm and fibre yield from 2.7 to 29.1g/plant.

***Distribution:*** A total of 163 (*C. olitorius*: 63, *C. capsularis*: 69 and wild *Corchorus* spp.: 31) germplasm accessions of JAF have been distributed to different indenters including scientists of CRIJAF, AINP on Natural Fibres and other institutes.

## 1.4. Varieties Released and Notified by CVRC

***JROMU 1: A Tossa jute variety:*** JROMU 1 is a gamma ray induced mutant selection from a popular tossa jute variety JRO 204 (Suren). It produces an average fibre yield of 32.9 q/ha with 40.3 q/ha potential yield. It has been released for the states of West Bengal, Assam, Bihar and

Field view of *tossa* var. JROMU 1

Odisha. The variety is tolerant to stem weevil, semilooper, hairy caterpillar, yellow mite and stem rot disease.

***Central Roselle JRHS 1: A HS-Mesta (Roselle) variety:*** A high yielding variety with an average fibre yield of 26.3 q/ha and potential yield of 43.6 q/ha was released for commercial cultivation under medium and highland rainfed agroecosystem of West Bengal, Odisha, Bihar,

Field view of roselle var. Central Roselle JRHS-1

Andhra Pradesh, Maharashtra and Tamil Nadu. It is tolerant to foot and stem rot disease and pests like aphids, white flies, semilooper and mealy bugs. The fibre of Central Roselle JRHS 1 showed 4.4-11.1% less root content, 2.8-7.9% less defects and 3.2 % finer than the national checks.

***Central Kenaf JRHC 3: A HC-Mesta (Kenaf) variety:*** A high yielding variety with an average fibre yield of 28.6 q/ha and potential yield of 40.1 q/ha was released for commercial cultivation under rainfed agro-ecosystem of West Bengal, Odisha, Bihar, Andhra Pradesh, Maharashtra and Tamil Nadu. Its fibre is 5.7 to 8.3 % finer than national

check varieties. The variety is tolerant to both foot and stem rot as well as yellow vein mosaic disease of kenaf.

Roselle var. Central Kenaf JRHC 3

## 1.5. Varietal Development

### 1.5.1. JROB 2 (Purnendu): A tossa jute genotype with high biomass production potential

(Investigators: *P. Satya, S.K. Pandey, L. Sharma, A.K. Jha, H.R. Bhandari and J. Mitra; Project Code: In-house Project-JB 10.4)*

A jute genotype, JROB 2 (Purnendu) has been developed by selection of superior lines from a gamma-ray mutated progeny of JRO 204. JROB 2 recorded 59.1 t/ha green biomass yield in coordinated trials (Table 4). It is the first proposed jute variety for green biomass production. JROB 2 also recorded 32.1 q/ha fibre yield which is 3.2% higher

Field view of JROB 2

than check varieties JRO 524 and JRO 204, respectively. The fibre of JROB 2 showed 37.5-66.7% less root content than check varieties, and it has 8.2% stronger fibre than JRO 204 and 10.3% finer fibre than JRO 524. Under fertilizer management trials, JROB-2 outperformed the check varieties for green biomass yield showing 10.6% superiority over JRO 524 and 8.3% superiority over JRO 204. JROB 2 can be recommended for cultivation under wide range of soil fertility. The variety is characterized by cylindrical, green, bristle free stem with a plant height of 410-430 cm and basal diameter of 1.9 cm at 120 days crop stage. It has large, broad, green, ovate-lanceolate leaf and large, bright yellow flower. It has a green biomass production potential of 86 t/ha.

Table 4: Green biomass yield (t/ha) of JROB 2 under AINPNF trials

| Year of testing | JROB 2 | JRO 524 | JRO 204 |
|---|---|---|---|
| 2016 (IET; 6 trials) | 73.2 | 66.1 | 69.7 |
| 2017 (AVT-I; 2 trials) | 64.3 | 56.2 | 56.6 |
| 2018 (AVT-II; 5 trials) | 52.3 | 49.9 | 50.4 |
| 2019 (Fertilizer schedule trial; 5 trials) | 46.7 | 43.3 | 43.2 |
| Average | **59.1** | **54.0** | **54.9** |

### 1.5.2. JRCJ 11: A capsularis genotype for high yield and BHC tolerance

(Investigators: *J. Mitra, A. Anil Kumar and R.T. Maruthi*)

A high yielding capsularis genotype was developed through selection from a cross between CIN-146 x JRC 321 for high fibre yield and BHC tolerance. It has recorded an average fibre yield of 31.45 q/ha under AINPNF coordinated trials, which is 7.62% and 4.19 % higher than check varieties JRC 698 and JRC 517, respectively.

Field view of JRCJ 11

The genotype has 3.13% finer than the popular variety JRC 517 with yield potential of 42.53q/ha. It is less susceptible to stem rot disease than check varieties. This genotype is suitable for sowing in third week of March to second week of April in all jute-growing areas and it

has a potential to replace popular variety JRC 517 due to its high yielding capacity coupled with fine fibre and tolerance to hairy caterpillar and stem rot disease.

### 1.5.3 Performance of low-branching lines of *C. capsularis* under long-day condition

(Investigators: *P. Satya, S.K. Pandey, S. Ray and S. Roy; Project Code: In-house Project-JB 10.4)*

A total of five low-branching lines (that do not produce branch under short day) were evaluated for their biomass production potential along with check JRC 212 (that produces branches under short day) at CSRSJAF, Bud Bud during 2019. Under long-day, none of the genotypes produced lateral branch, only 1-2 apical branches were observed. There was no significant difference in biomass production potential of the low-branching lines and the check variety JRC-212, indicating that the low-branching lines have good biomass production potential as the branched types (Fig. 8). Similarly, no significant difference was observed for plant height and basal diameter.

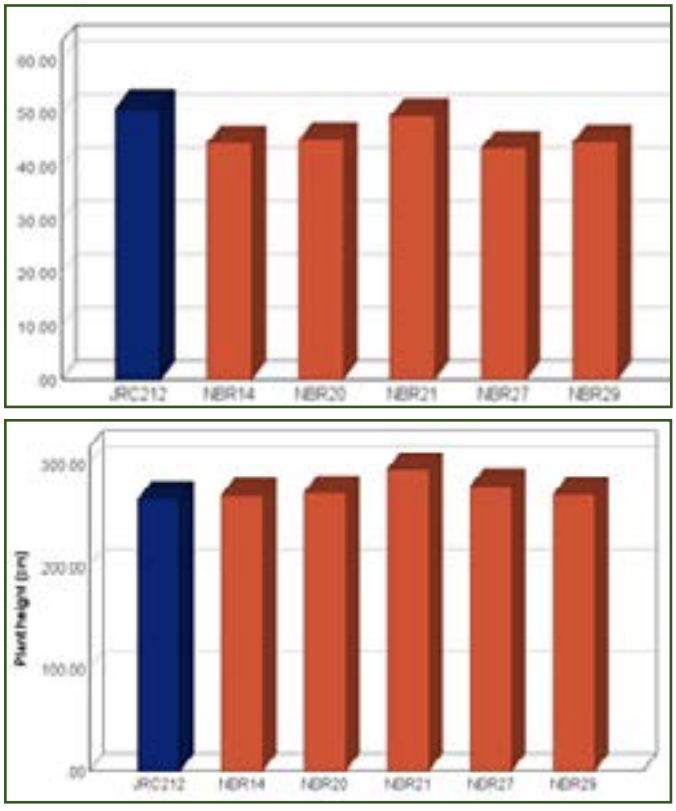



Fig. 8: Green biomass (t/ha) and plant height (cm) of low-branching lines of *C. capsularis*

The low-branching genotypes have biomass production potential similar to fibre type varieties of *C. capsularis* under long day. It is presumed that mutation in branching trait did not affect biomass production capacity under long day condition in the genotypes.

## 1.6 Conventional Breeding for Fibre Yield and Quality Improvement

### 1.6.1 Development of high fibre yielding jute genotypes through hybridization

*(Investigators: H.R. Bhandari, C.S. Kar, Vikas Mangal, J.K. Meena; Project Code: In-house Project-CSRSJAF 1.1)*

Fifty germplasm lines of *Corchorus capsularis* and 25 germplasm lines of *C. olitorius* were evaluated during Aug-Dec 2019 at CSRSJAF, Budbud. The capsularis accessions recorded plant height in the range of 76.1 to 209.4 cm. The entry CIN-93 recorded maximum height (209.4 cm). Seed yield per plant ranged from 1.5 to 6.2 g. The entry CIJ-44 recorded maximum seed yield (6.2 g) on per plant basis. The germplasm accessions were clustered into 5 group by $D^2$ analysis. Among all the traits, seed yield per plant had the maximum contribution (47.3%) towards total variability.

Among olitorius accessions, plant height ranged from 89.7 to 215.1 cm. The entry OIJ-161 recorded maximum height (215.1 cm). Seed yield per plant ranged from 1.7 to 4.1 g. Maximum seed yield per plant was recorded by the entry OIJ-93 (4.1 g). The germplasm accessions were clustered into 7 group by $D^2$ analysis. Among all the traits, seed yield per plant had the maximum contribution (43.3%) followed by plant height (24.7%) towards total variability.

### 1.6.2 Effect of foliar application of nitrogen on flowering in jute

(Investigators: *S. Roy, D. Sarkar, P. Satya, L. Sharma, A. K. Jha and H.R. Bhandari; Project Code: In-house Project-JA 7.5)*

The effect of foliar application of nitrogen in delaying flowering was investigated on six commercial jute varieties. Four olitorius variety namely JRO 524, JRO 204, NJ 7010 and S 19 and two capsularis variety namely JRC 212 and JRC 517 were taken for this study. All the varieties were sown on 04th February in 2018 and 2019. In 2018 the onset of flowering was noticed in normal crop. In 2019, 2% urea (w/v) was applied at 25 and 40 days after sowing (DAS) to a set of plants.

Table 5: Onset of flowering (DAS) with and without urea application in jute

| Variety | 2018 | 2019 (-N) | 2019 (+N) |
|---|---|---|---|
| JRO 524 | 37 | 40 | 40 |
| JRO 204 | 40 | 40 | 38 |
| S 19 | 42 | 38 | 40 |
| NJ 7010 | 43 | 45 | 47 |
| JRC 517 | 45 | 48 | 46 |
| JRC 212 | 46 | 43 | 43 |

Application of nitrogen as urea did not have any significant effect on onset of flowering in these six commercial varieties. Flowering in 90% of the population has been considered as the onset in both the years. It may be thus inferred that foliar application of nitrogen does not have any effect on delaying the flowering in jute.

### 1.6.3 Evaluation of roselle $F_1$ hybrids

(Investigators: *S.K. Pandey and P. Satya; Project Code: In-house Project-JB 10.0)*

A total of 21 $F_1$ hybrids of roselle were evaluated along with their 7 parents and 2 check varieties (AMV 5 and HS 4288). The average plant height and fibre yield of $F_1$ hybrids was 305 cm and 17.62 g/plant, respectively with a range of 234-349 cm and 10.00-34.00 g/plant. The mean plant height and fibre yield of superior check variety was 281cm and 13.0 g/plant with an economic superiority of 8.74% and 35.51%, respectively.

### 1.6.4 Evaluation of $F_3$ progenies of kenaf and selection of individual plants

A total of 481 $F_3$ single plant progenies derived from 12 promising $F_2$ populations and 2 check varieties of kenaf (HC 583 and AMC 108) were evaluated for plant height, basal diameter and other agronomic traits and reaction to various diseases and pests. Based on the performance 1853 single plants within and between the progeny rows were selected.

### 1.6.5 Evaluation of $F_2$ population in flax

(Investigators: *J. Mitra and D. Saha; Project Code: In-house Project-JB 10.3)*

$F_2$ population of four crosses involving genotypes from India, France, Russia, USA, and China and another four crosses comprising of Indian origin were raised in the current season. The $F_2$ plants exhibited segregation pattern for blue, white and intermediate type flower colour indicating the success of crosses (Pic. a). Using chi-square test, most of these crossed progenies produced a very good fit to monohybrid cross in terms of flower colour. The average height of $F_2$ plants from the crosses were observed between 93.5 cm to 140 cm compared to the average height of 112 cm of JRF 2. Progeny of two crosses showed promising traits like tall height, bold stems, less axillary branches, late flowering, and stay green phenotype even with the diurnal temperature elevations in the month of March (Pic. b).


Phenotype of flax hybrid progenies. (a) Blue, white, and intermediate flower colours represent success of cross between the parents; (b) one of the promising progenies with tall height, bold stem and stay green traits.

### 1.6.6 Protection of jute varieties and DUS testing

(Investigators: *A. Bera and H.R. Bhandari; Project Code: DA and FW (DUS Testing))*

Thirty one reference varieties of tossa jute, *viz.*, JRO 204, JRO 7835, JRO 2407, S 19, JRO 878, Bidhan Rupali, CO 58, JRO 524, JRO 632, JRO 620, KOM 62, JRO 128, JRO 8432, JRO 2345, JRO 3690, Sudan Green, JRO 66, JBO 1, Tanganyika-1, Tarun, JROM 1, Chinsurah Green, Ira, TJ 40, JROG 1, NJ 7005, NJ 7010, NJ 7050, NJ 7055, BCCO 6 and KRO 4

Field of reference collection of jute at ICAR- CRIJAF

Twenty one reference varieties of white jute, viz., JRC 212, JRC 80, JRC 698, JRC 7447, JRC 4444, Padma, JRC 321, Monalisa, UPC 94, Bidhan Pat 1, Bidhan Pat 2, Bidhan Pat 3, KC 1, KTC 1, D 154, JRC 517, JRC 532 , JBC 5, JRCM 2, KJC 7 and JRC 9057 were maintained through plant to progeny row method. All essential characters were recorded and database of all reference varieties was sent to PPV&FR authority.

### 1.6.7 Crossing barriers in inter-specifc crosses in the genus *Crotalaria*

*(Investigators: H.R. Bhandari, R.T. Maruthi, A. Anil Kumar; Project Code: In-house Project-CSRSJAF 1.0)*

Different pollination treatments like bud-pollination, delayed pollination and end-of-season pollination were attempted to obtain inter-specific hybrids between

sunnhemp (*Crotalaria juncea*) and other species of the *Crotalaria* genus (*C. spectabilis, C. paniculata, C. verrucosa, C. incana, C. pallida*). Efficacy of Gibberellic acid (100 ppm) was tested in setting pod in inter-specific crosses. The pods resulting from inter-specific crosses showed initial swelling of pods followed by abscission afterwards and indicated post-fertilization barriers. Application of Gibberellic acid (100 ppm) was found non-effective in setting pods. All the treatments had little success in setting pods in inter-specific hybrids. Overall, 7.14% of pod set was recorded across different combinations and different pollination treatments. The most successful crosses were *C. juncea* × *C. inacana* (25.0% success), *C. incana* × *C. juncea* (25.0% success) and *C. juncea* × *C. pallida* (35.3% success). End of season pollination (2nd week of Feb) was found most effective (22.9% success).

## 1.7 Breeding for Biotic Stresses

### 1.7.1 Wide hybridization in jute

(Investigators: *A. Anil Kumar, R.T. Maruthi, K. Mondal and B.S. Gotyal; Project Code: In-house Project-JB 10.1)*

Inter-specific population between *C. olitorius* with *C. aestuans* was evaluated under sick plot conditions in $F_4$ and $F_5$ generations during 2018 and 2019, respectively. A total of 35 RILs showed stable resistance both in $F_4$ and $F_5$ generations with 0% PDI and zero AUDPC values. Among these resistant RILs few lines recorded high fiber yield per plant (Fig. 9).

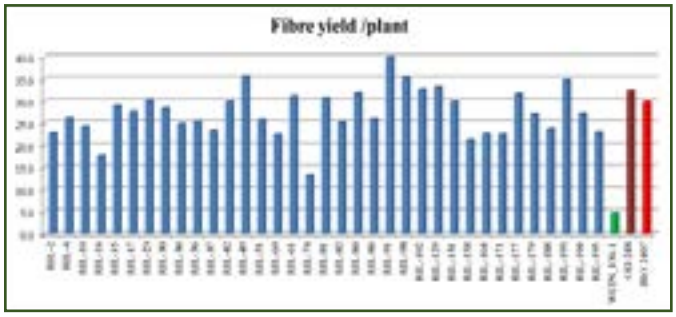



Fig. 9: Fibre yield (g/plant) of stem rot resistant RILs

Further, selected RILs along with parents and few *C. aestuans* germplasm lines were also evaluated for BHC resistance. Based on percent larval survival and percent larval pupation RIL-25, RIL-46 were recorded as moderately resistant and wild aestuans germplasm lines as highly resistant. Besides, few germplasm lines were screened for stem rot, BHC resistance and nematode resistance (2 isolates used) over the years for their stable expression (Fig. 9, Table 6 & 7). Lines WCIN-136-1 and WCIN-183A showing resistance to multiple biotic stresses and introgressions from these lines are in different generations.

Table 6: Performance of selected germplasm lines for stem rot and BHC resistance over the years

| Accession | Species | Stem rot screening (sick plot) | | | | | BHC screening (in vitro) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2015 | 2016 | 2017 | 2018 | 2019 | 2016 | | 2019 | |
| | | AUDPC values | | | | | larval mortality (%) | pupation (%) | larval mortality (%) | pupation (%) |
| WCIN-136-1 | *C. aestuans* | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 100 | 0 |
| WCIN-183A | *C. aestuans* | 0 | 0 | 0 | 0 | 0 | - | - | 100 | 0 |
| WCIJ-150-1 | *C. fascicularis* | 0 | 0 | 0 | 0 | 0 | - | - | - | - |
| OIN-154-1 | *C. olitorius* | 62 | 201 | 44 | 190 | 0 | - | - | 43.33 | 56.67 |

Table 7: Screening for root knot nematode in field and pot conditions

| Entry/screening | Year | Isolate | Galls/pl | Egg mass/pl | Root Gall Index |
|---|---|---|---|---|---|
| WCIN-183A_Pot | 2018 | Coochbehar | 7.0 ±2.08 | 0.0 ±0.00 | 2 ±0.00 |
| WCIN-183A_Field | 2018 | Coochbehar | 2.7 ±1.45 | 0.0 ±0.00 | 1.3 ±0.67 |
| WCIN-183A_Pot | 2019 | Dhupuri | 12.7 ±2.03 | 2.7 ±0.88 | 2.7 ±0.33 |
| WCIN-183A_Field | 2019 | Dhupuri | 7.7 ±1.20 | 0.0 ±0.00 | 2 ±0.00 |
| Nalte_Pot | 2018 | Coochbehar | 122.7 ±6.12 | 128.7 ±4.06 | 5 ±0.00 |
| Nalte_Field | 2018 | Coochbehar | 163.0 ±4.04 | 182.7 ±6.23 | 5 ±0.00 |
| Nalte_Pot | 2019 | Dhupuri | 141.7 ±7.80 | 137.0 ±4.58 | 5 ±0.00 |
| Nalte_Field | 2019 | Dhupuri | 180.3 ±9.56 | 130.7 ±30.91 | 5 ±0.00 |


Variation in Root Knot formation in two distinct genotypes

Another $F_4$ inter-specific population (142 RILs) derived from a cross between *C. olitorius* cv. JRO 2407 and *C. fasicularis* accession no. WCIJ-150-1 (stable stem rot resistant genotype) was characterized for morphological variation and evaluated for fibre yield parameters. Among the RILs, 26 lines were ex-stipulate and non-abscission type, leaves with leafy appendage at the base of setae. Few lines were showing high transgressive segregation for yield related traits (Table 8).

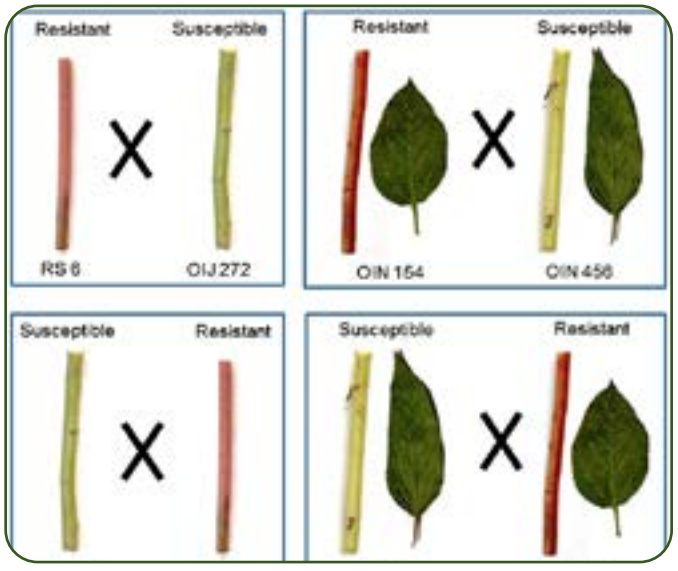
Table 8: Descriptive statistics of interspecific (*C. olitorius* cv. JRO 2407 × *C. fasicularis*) population for yield traits

| | Plant height (cm) | Basal diameter (mm) | Green weight (g/plant) | Stick weight (g/plant) | Fibre yield (g/plant) |
|---|---|---|---|---|---|
| Population mean | 342.2 | 17.5 | 256.2 | 36.2 | 18.2 |
| Range | 235.6-439.8 | 11.1-25.0 | 86.6-622.5 | 9.5-157 | 4.8-35.1 |
| JRO 2407 (P1) | 389.0 | 22.1 | 410.0 | 49.1 | 19.2 |
| WCIJ-150-1 (P2) | 158.0 | 6.8 | 31.7 | 19.2 | 8.5 |
| JRO 204 (C) | 351.2 | 15.0 | 245.7 | 40.4 | 18.3 |

### 1.7.2. Crossing between parents depicting tolerance and susceptibility responses towards stem rot disease of jute

(Investigators*: S. Ray, K. Mondal and P. Satya; Project Code: In-house Project-JBT 4.8)*

In order to map the genomic loci governing resistance/ tolerance against jute stem rot, direct and reciprocal crosses were made between jute germplasm RS-6 (resistant) and OIJ-272 (Highly susceptible), as well as, OIN-154 (resistant) and OIN-456 (highly susceptible). Stem colour served as morphological marker to identify true $F_1$ hybrids as red stem is dominant over green stem. Apart from stem colour variation, leaf shape variation was also observed between OIN-154 (ovate) and OIN-456 (lanceolate).




Crossing pattern for the development of mapping population for stem rot resistance in tossa jute

### 1.7.3. Development of mesta genotype for stem rot resistance

(Investigators*: R.T. Maruthi, A. Anil Kumar and A.R. Saha; Project Code: In-house Project-JB 9.6)*

A total of 98 mesta genotypes (35: calyx type roselle genotypes; 54: improved kenaf genotypes) were screened for stem rot (*Sclerotinia sclerotiorum*) resistance under field condition. Among roselle genotypes, PB-142 showed moderate resistance and in kenaf, five improved breeding lines showed field resistance to stem rot.

*Sclerotinia* rot of mesta

### 1.7.4. Wild and cultivated *Crotalaria* species reaction to stem rot disease

(Investigators*: R.T. Maruthi A. Anil Kumar and S. Datta; Project Code: In-house Project-JB 10.2)*

Twenty-eight *Crotalaria* accessions comprising five different species were screened against stem rot (*Sclerotinia sclerotiorum*) disease in field conditions. Among the species, cultivated type *C. juncea* accessions were completely free from the disease while the broad leaved wild species *C. spectabilis* (30 to 96.7% disease incidence) was the most susceptible species.

# 2. Crop Production

## 2.1. Climate Resilience in JAF Crops

### 2.1.1. Surface ozone induced risk in rice-jute cropping system

(Investigators: *A.K. Singh, M.S. Behera, S. Roy and R. Saha; Project Code: NICRA Project)*

Ozone-induced risk in jute and rice crops on four jute cultivars (JRO524, JRO204, S19 and NJ7010) and three rice cultivars (IR36, MTU1010 and BG3) were studied under field condition. Ethylenediurea (EDU) was applied from beginning of vegetative stage until the final harvest phase as a foliar spray in order to protect the plants from the adverse effects of surface ozone ($O_3$). Antioxidant activity, malondialdehyde content (MDA) and chlorophyll content at the vegetative and flowering phases and harvest-related parameters were studied. It was observed that day time ozone $O_3$ levels often exceeded 40 ppb and increased further throughout the experiment, attaining maximum levels at the peak vegetative and reproductive phase (>50 ppb) during boro rice season (Fig. 10). During jute crop field experiment, $O_3$ concentrations were low during the peak vegetative and maturity phase in June-July due to the onset of the pre-monsoon period, leading to wash-out of $O_3$ precursors. However, the hourly $O_3$ concentrations rose above 'the critical level', i.e., 40 ppb, in main vegetative stage (June) at village Site.

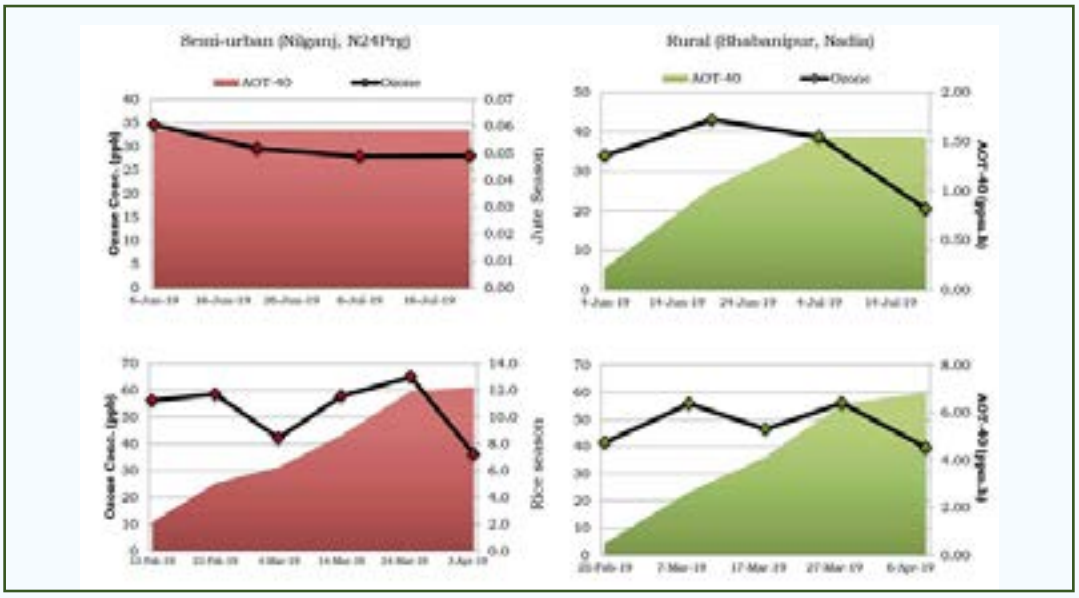



Fig. 10: $O_3$ concentration during rice (Jan-Apr) and jute growing season (Apr-Jul) in the year 2019

### 2.1.2. Drought tolerance in jute

(Investigators: *L. Sharma, J. Mitra, S. Mitra, P. Satya, D. Barman and S. Roy; Project Code: In-house Project-JA 7.4)*

Stress was imposed by withholding the irrigation on 30-day old potted jute (Cv JRO 204) plant. At soil moisture content of 8%, the relative water content was 61%. The membrane damage was measured in terms of membrane stability index and lipid peroxidation. Lipid peroxidation was found to be higher under stress condition. In addition, the proline content was approximately 7 times higher under drought. Chlorophyll content, carotenoid content, plant height and biomass were reduced under drought condition. In addition, the antioxidant enzymes like ascorbate peroxidase and peroxidase showed higher activity to quench the reactive oxygen species (ROS) (Fig. 11). At early onset of membrane injury, proline content and (ROS) content in leaves was increased. There was also increased activity of antioxidant enzymes which states that jute cultivar of JRO 204 activates its antioxidant mechanism to withstand drought conditions.

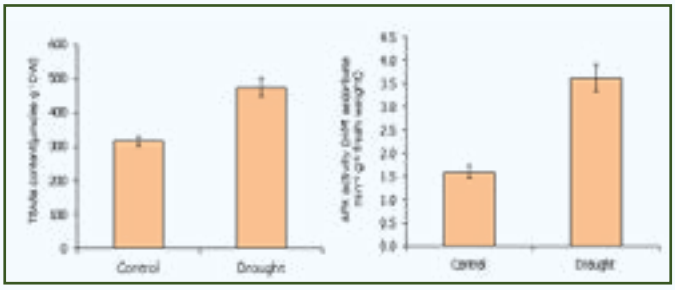
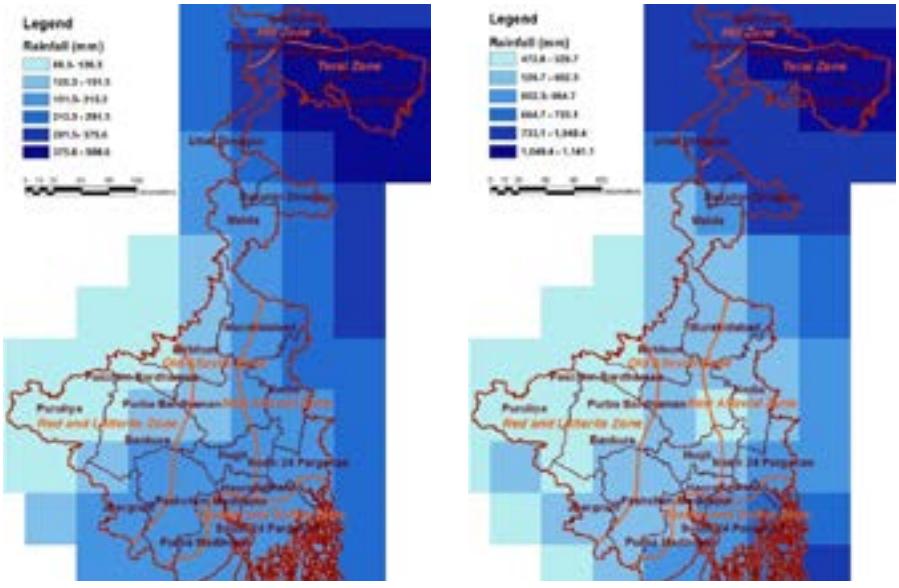



Fig. 11: Lipid peroxidation and ascorbate peroxidase activity in jute seedlings under drought condition

### 2.1.3. Rainfall variability in jute growing season of West Bengal

(Investigators: *D. Barman, R. Saha, and S. Roy; Project Code: DSTB, WB Project)*

Rainfall variability analysis was done using CRU TS (v. 4.02) precipitation data set with spatial resolution of 0.5° x 0.5° to find out positive or negative change in rainfall over 30-year period (1988 to 2017) in the jute growing areas of West Bengal. Sen's slope was computed to measure the magnitudes of changes. During sowing and crop establishment period (April-May) of jute crop, rainfall pattern showed an increasing trend only in Jalpaiguri and Uttar Dinajpur districts. During the active vegetative and maturity stages (June-July) of jute, the rainfall was in decreasing trend in most of the districts except Malda, Dakshin Dinajpur and Uttar Dinajpur. The rainfall trend clearly suggest to change the sowing time to April instead of going for early sowing in March or late sowing in the month of May.




Spatial variability (April & May) Spatial variability (June & July)

Spatial variability in rainfall over 30-year (1988-2017) in jute growing areas of West Bengal

### 2.1.4. Carbon and moisture fluxes in jute-rice ecosystem

(Investigators: *D. Barman, A. Chakraborty, R. Saha, P. K. Das, C. S. Murthy, A. K. Singh, S. Bandyopadhyay, S. Mitra, S. Roy and S.P. Mazumdar; Project Code: ISRO-NRSC Collaborative Project)*

The net ecosystem exchange (NEE) of $CO_2$ in jute-rice ecosystem was measured using the open path eddy covariance technique. The cumulative NEE of $CO_2$ in the jute ecosystem over the entire jute growing period (110 days) was -268.49 g C/m$^2$ (-2.68 t/ha) and that of in paddy rice ecosystem (95 DAT) it was -149.56 g C/m$^2$ (-1.49 t/ha). Carbon exchange value indicates that the jute and paddy rice ecosystem act as micro-sinks and plays an important role in terrestrial carbon balance.

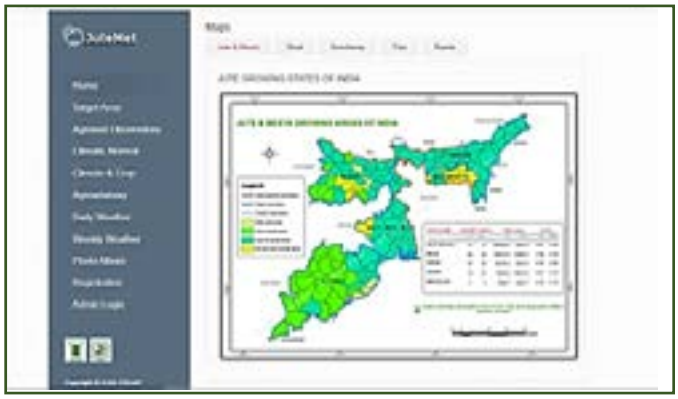
Eddy covariance system at ICAR-CRIJAF Research Farm and NEE trends of rice crop

### 2.1.5. Weather based agro-advisory services for contingent planning

*(Investigators: D. Barman, A.K. Chakraborty, A.K. Singh and R. Saha; Project Code: In-house Project-JA 7.1)*

A web-based Agro-advisory for jute crop has been formulated by the designated expert committee and regularly posted on the website on weekly basis. The registration form has been designed for users of two categories, viz. farmers and officer as per location-based KYC (Know Your Customer). Under Admin Login, four options such as *Database Management, New Advice, Print*

*or Download, Registered User Details* are added. Within the *Database Management* page, *Master Database* for Barrackpore, Bamra, Budbud, Pratapgarh and Sorbhog were created for storing climate data of the respective locations. Database table (eg. Barrackpore) contains 14 climatic parameters having 22 entry options both for morning and afternoon with four options such as *Insert, Update, Delete,* and *View* on the webpage. Such climatic data are helping farmers to anticipate and plan for pesticides applications, irrigation scheduling, predict disease and pest outbreaks and many more weather related agriculture-specific operations from cultivar selection to dates of sowing, planting, transplanting, intercultural operations, harvesting and post-harvest operations.



## 2.2. Soil Health for Sustainable Productivity

### 2.2.1. Soil fertility status after 48 years of multiple cropping and fertilization

(Investigators: *D. K. Kundu, A. R. Saha, B. Majumdar, S. P. Mazumdar, A. K. Ghorai and M. S. Behera; Project Code: JC 5.2-LTFE Project)*

Long-term (48 years) effects of continuous application of FYM and inorganic fertilizer on crop yields and soil properties under LTEF project in jute-rice-wheat cropping system was assessed. Regular application of NPK fertilizers significantly increased organic carbon (OC) content in the soil (Table 9). Among different fertilizer treatments, soils supplied with 100% NPK+FYM had the highest OC concentration (0.84%). Availability of N, P and K in the soil under the 100% NPK + FYM treatment was at par with 150% NPK treatment. Omission of P and K from fertilization schedule reduced N availability in the soil. Integrated use of organic manure and chemical fertilizers resulted in a positive influx of nutrients thereby

Long term fertilizer experiment in jute and rice crop

increased OC, N, P and K in the soil. Application of fertilizers alone or in combination with FYM significantly increased the yield of jute and rice over control. The highest yield of jute and rice was recorded in 100% NPK+ FYM. The 150% NPK treatment was found to be at par with the application of 100% NPK+FYM. The effect of Zn application on yields of the crops was not significant. Initial soil pH was 7.1 with organic carbon of 0.71% and available N:P:K of 223.1:41.5:142.7 kg/ha before the start of LTFE experiment in the year 1972.

Table 9: Effect of long term fertilizer and manures on soil fertility and crop yield

| Treatments | pH | % Org. C | Available Nutrient (kg/ha) | | | Yield (q/ha) | |
|---|---|---|---|---|---|---|---|
| | | | N | P | K | Jute | Rice |
| 50% NPK | 7.32$^{bc}$ | 0.66$^{d}$ | 233.75$^{e}$ | 32.00$^{c}$ | 165.50$^{b}$ | 15.08$^{e}$ | 24.40$^{c}$ |
| 100% NPK | 7.31$^{bc}$ | 0.71$^{c}$ | 253.50$^{b}$ | 47.50$^{b}$ | 177.00$^{b}$ | 21.20$^{b}$ | 37.23$^{ab}$ |
| 150% NPK | 7.35$^{bc}$ | 0.76$^{b}$ | 266.25$^{a}$ | 61.50$^{a}$ | 205.50$^{a}$ | 25.13$^{a}$ | 41.25$^{a}$ |
| 100% NPK + HW | 7.43$^{ab}$ | 0.65$^{d}$ | 241.00$^{d}$ | 44.65$^{b}$ | 175.00$^{b}$ | 21.20$^{b}$ | 35.08$^{ab}$ |
| 100% NPK +Zn | 7.30$^{bc}$ | 0.67$^{d}$ | 246.25$^{c}$ | 43.50$^{b}$ | 175.00$^{b}$ | 22.61$^{b}$ | 38.13$^{ab}$ |
| 100% NP | 7.34$^{bc}$ | 0.74$^{bc}$ | 231.25$^{ef}$ | 42.20$^{b}$ | 134.00$^{c}$ | 17.95$^{d}$ | 35.38$^{ab}$ |
| 100% N | 7.34$^{bc}$ | 0.69$^{d}$ | 229.75$^{f}$ | 10.20$^{d}$ | 129.00$^{c}$ | 15.90$^{e}$ | 33.17$^{b}$ |
| 100% NPK +FYM | 7.52$^{a}$ | 0.84$^{a}$ | 263.75$^{a}$ | 63.25$^{a}$ | 206.75$^{a}$ | 25.60$^{a}$ | 39.53$^{a}$ |
| 100% NPK -S | 7.33$^{bc}$ | 0.66$^{d}$ | 245.00$^{c}$ | 40.25$^{b}$ | 173.50$^{b}$ | 19.30$^{c}$ | 35.12$^{ab}$ |
| Control | 7.27$^{c}$ | 0.56$^{e}$ | 219.25$^{g}$ | 7.60$^{d}$ | 136.00$^{c}$ | 8.47$^{f}$ | 11.10$^{d}$ |

**Mean values in a column followed by a common letter are not significantly different by DMRT at 5% level*

### 2.2.2. Right mixture of NPK fertilizer use through soil health assessment

(Investigators: *A.K. Singh, A.K. Ghorai, M.L. Roy and R. Saha; Project Code: In-house Project-JA 7.6)*

The study on uses of fertilizer mixture finds that average N:P:K ratio being used in jute-rice-lentil/mustard/potato is about 1.1:2.6:1 as against recommended NPK ratio of 4:2:1 (Fig. 12). Farmer applies more amount of complex fertilizer ($NPK_{10:26:26}$) as compared to Urea, SSP and MoP. Besides $NPK_{10:26:26}$, they also add SSP and MoP in soil for each crop and urea is applied only as top dressing.

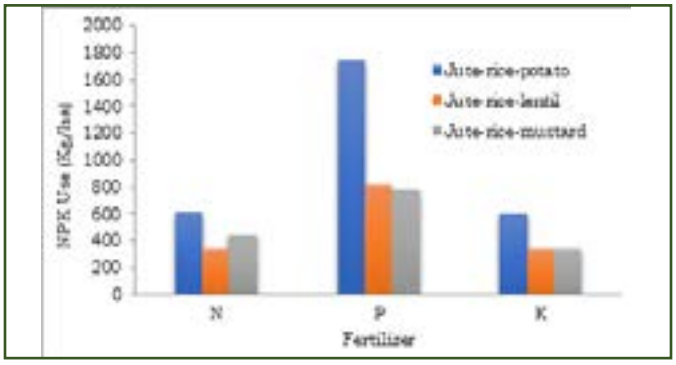



Fig. 12: NPK use in jute based cropping system in West Bengal

If farmer apply $NPK_{10:26:26}$ only to meet the 100% P and K and 40% of N requirement of each crop as basal dose, and Neem Coated Urea as top dressing to meet remaining amount of nitrogen than over use of phosphorus can be reduced. In this situation, farmer has to purchase about 4 kg of $NPK_{10:26:26}$ (₹110) and 3 kg of Neem Coated Urea (₹18) as top dressing to meet 1 kg of NPK requirement for each crop at lower cost (₹ 128) as compared to Urea (2 kg)+SSP (6 kg)+MoP (1.5 kg) which cost about ₹600. This combination saves about ₹472 per kg of NPK cost. Crop-wise recommendation of fertilizers provided in the Soil Health Card can help farmers to minimize nutrient pollution and maintaining healthy soils.

### 2.2.3. Soil carbon use pattern in ramie-based cropping system

(Investigators: *S.P. Mazumdar, B. Majumdar, A.R. Saha and S. Mitra; Project Code: In-house Project-JA 7.2)*

Carbon utilization pattern of microbial communities associated with ramie based cropping systems indicated a unique pattern in the utilization of six major carbon groups (carbohydrates, carboxylic, phenolics, amines, amino acids, polymers) within and between the treatments. Phenolics, amines and amino acids consuming microorganisms are dominant irrespective of the treatments (Fig. 13). During incubation, the capacity of soil microorganisms for using carbon sources was low among all treatments up to 24 hours.

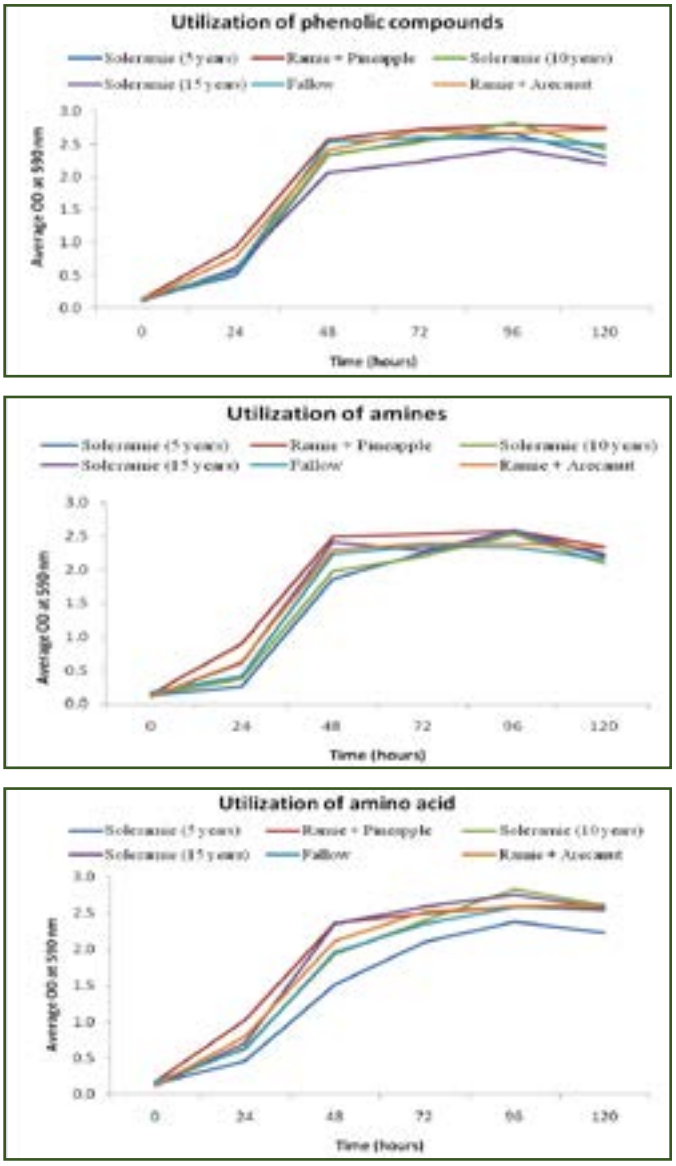



Fig. 13: Microbial consumption pattern of carbon in ramie based cropping systems

### 2.2.4. Impact of tillage and crop residues retention on soil microbial biomass

(Investigators: *R. Saha, B. Majumdar, S.P. Mazumdar, M.S. Behera, D. Barman, A.R. Saha, Laxmi Sharma and R.K. Naik; Project Code: In-house Project- JA 5.7)*

The effect of tillage systems i.e. conventional tillage and no tillage (with or without crop residue retention, NT +R/-R) on soil microbial properties and enzymatic activity was evaluated under jute based cropping systems (jute-rice-wheat, jute-rice-lentil and jute-rice-mustard). Irrespective of cropping systems, microbial biomass and enzymatic activities were much higher in surface soil (0-15 cm) and decreased with depth because of minimum soil disturbance and higher crop residue retention in soil. Microbial activities were much higher in no-tillage

(+R/-R) as compared to conventional tillage practice. Soil microbial biomass was significantly higher in NT +R (641.84 to 745.97 µg/g) followed by NT (631.42 to 678.46 µg/g) and conventional tillage (490.68 to 634.83 µg/g). However, the differences in enzymatic activities under no-tillage with residue (+R) and without residue (-R) were not significant. Soil microbial properties and enzymatic activities were much better in jute-rice-lentil followed by jute-rice-wheat and jute-rice-mustard cropping system. Tillage practices and crop residues alter the surface properties of soil invariably affected the soil microbial biomass and enzymatic activities.

### 2.2.5. Nitrogen dynamics in zero tillage under rice-flax cropping system

(Investigators: *S.P. Mazumdar, D. Barman and M.S. Behera; Project Code: In house Project-JA7.8)*

Application of nitrogen up to 80 kg N/ha increased fibre yield of flax and rice grain significantly. Soil organic carbon (5.6-5.9 g/kg), soil microbial biomass nitrogen (2.29-3.30 % at 0-15 cm soil depth), dehydrogenase activity and total nitrogen (937-1012 mg/kg) were higher in zero tillage soil than conventional tillage (Fig. 14). Rice-flax cropping system with zero tillage improved microbial biomass and soil quality.

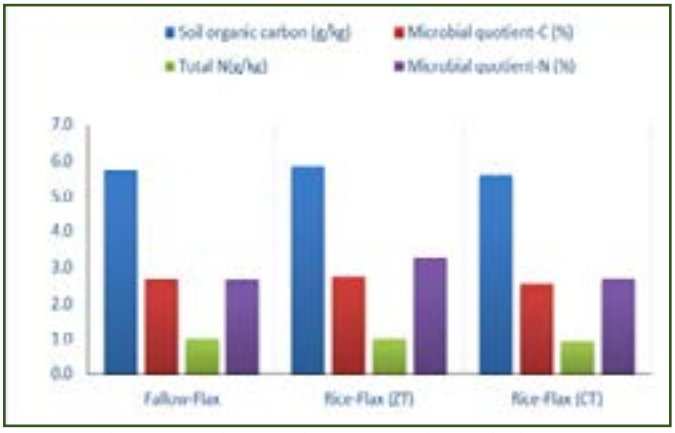



Fig. 14: Soil organic carbon, total nitrogen and microbial quotients under different treatments

## 2.3. Precision Water and Nutrient Management in JAF crops

### 2.3.1. Integrated fertilizer prescription system in JAF based cropping system

(Investigators: *A.R. Saha, B. Majumdar, S.P. Mazumdar and M.S. Behera; Project Code: In-house Project-JC 5.6a and STCR-JC 5.6)*

Targeted yield equations developed for jute, onion and mustard for verification trials in farmers field of Maheswarpur & Chakdah, (Nadia), Gopalnagar and Bridddhapalla (North 24 Parganas) of West Bengal. Application of fertilizers as per ST-TY without and with FYM achieved the targeted yield of jute (40 q fibre/ha), onion (22 t/ha) and mustard (12 q/ha) with (-) 13.8 & (-) 9%, (-) 10.45 & (-) 7.7%, and (+) 15.8 & (+) 20.8% yield deviation, respectively (Fig. 15). Under long term trial (9 year) on jute-rice-lentil sequence, application of fertilizers as per ST-TY could achieve the target of 40 q/ha of jute fibre with (-) 5% deviation. Integration of ST-TY with FYM given the targeted yield of jute fibre (35 q/ha) with (+) 2.8% yield deviation. Similarly, application of fertilizers as per ST-TY with FYM and biofertilizers resulted the targeted yield of rice with (+) 37.5% deviation. Incorporation of FYM along with inorganic fertilizer and biofertilizer was found best management practice for sustainable crop yield and maintenance of soil fertility.

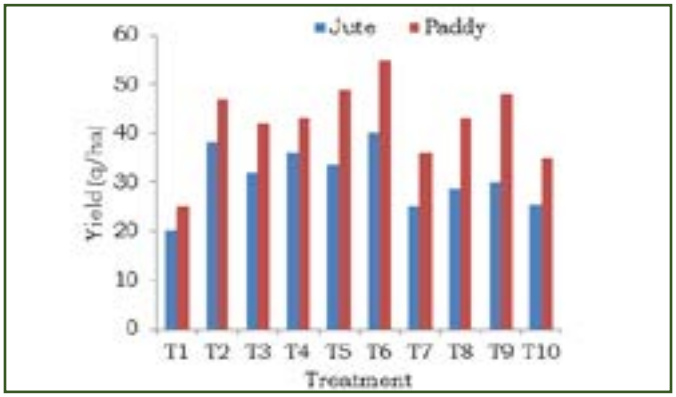



Fig. 15: Yield of jute and rice under different treatments

*T1-Control; T2-STCR-TY (40q/ha); T3-STCR-TY (35q/ha); T4-T3+FYM @ 5t/ha; T5-T3+Azotobacter + PSB; T6-T4+Azotobacter + PSB; T7-FYM @ 5t/ha; T8-T7+Azotobacter + PBS; T9-Recommended fertilizers; T10-Farmer's Practice;*


JAF based cropping system under STCR project

### 2.3.2. Drip irrigation forimproving soil-water-crop productivity in sisal-based plantation

(Investigators: *M.S. Behera and A .K .Jha; Project Code: In-house Project-SLA 1.6)*

Fruit plants viz. guava, sapota, custard apple and mango were grown in interspaces of 8 year and 3.5 year old sisal

plantation with drip irrigation facility. It was observed that irrigating the fruit plants at 80% PE recorded highest yield in all fruit plants compared to 100% PE and 60% PE. In case of 8 years old sisal plantation, highest sisal yield was recorded in combination with guava followed by mango (Table 10). Fruit yield and sisal equivalent yield also followed similar trend. Fruit yield was significantly higher for all crops in 8 year old plantation. In another experiment, pomegranate, ber, amla and lemon were grown in the interspaces of 4-year old hybrid sisal plantation. Irrigating the crop at 80% PE recorded higher yield compared to 100% PE and 60% PE. Maximum sisal yield of 16.47 q/ha was recorded in combination with ber followed by pomegranate (13.45 q/ha). The growth attributing characters also followed similar trend.

Drip system in sisal based fruit-fibre system

Table 10: Effect of different drip irrigation regimes on yield (q/ha)

| Treatments Sisal | | Yield under 8 years old sisal plantation | | | Yield under 3.5 years old sisal plantation | | |
|---|---|---|---|---|---|---|---|
| | | Fruit | SEY | Sisal | Fruit | SEY | Sisal |
| Main Treatment | Guava | 18.36 | 27.88 | 23.93 | 13.43 | 36.20 | 20.67 |
| | Sapota | 15.67 | 5.45 | 18.94 | 10.42 | 6.81 | 14.50 |
| | Custard Apple | 15.89 | 8.62 | 20.20 | 10.55 | 7.44 | 14.27 |
| | Mango | 15.97 | 18.76 | 20.66 | 9.60 | 22.6 | 15.25 |
| | CD (p=0.05) | 0.366 | 1.849 | 0.464 | 0.272 | 2.967 | 0.182 |
| Sub Treatments | 100 % PE | 16.62 | 15.17 | 21.08 | 10.85 | 18.26 | 15.97 |
| | 80 % PE | 17.85 | 17.68 | 24.28 | 12.61 | 20.64 | 18.26 |
| | 60 % PE | 14.94 | 12.67 | 17.44 | 9.59 | 15.87 | 14.28 |
| | CD (p=0.05) | 0.68 | 0.38 | 0.83 | 0.24 | 0.46 | 0.33 |
| Interaction CD (p=0.05) | | 0.66 | 0.48 | 0.91 | 0.39 | 0.26 | 0.50 |

## 2.4. Integrated Crop Management for Smart Farming

### 2.4.1 Low cost and eco-friendly integrated weed management in jute crop

(Investigators: *A.K. Ghorai, Suman Roy and B. Majumdar; Project Code: In-house Project-JA7.3)*

The short duration green gram varieties (cv. TMB 37 and Virat) were intercropped in 1: 1 ratio with jute as main crop. The jute population in intercropping system was minimized (3.0 lakh/ha) by closing alternate holes of seed drums. On an average, the labour savings in weeding and thinning was 26 man days/ha over conventional method. In spite of high rainfall in April and May (343 mm), green gram yield as intercrop was 9.58 q/ha, and jute equivalent yield was 45 q/ha. In another experiment, Ipfencarbazone (PE: 68.43 to 91.24 g ai/ha) as pre-emergence herbicide and Glufosiante ammonium 13.5% SL (10 DAS, 1.2 to 2.2 Kg SL/ha) and Paraquat dimethoate 24% SL (10 DAS, 1.8 Kg SL/ha) as post-emergence herbicides could control 81-83% grass weed population without affecting jute germination and fibre yield under irrigated condition (Table 11).

High density jute sowing for weed smothering (left: 30 DAS and right: 125 DAS)

Table 11: Weed population and its management in jute based cropping system

| Treatments | Weed population | | | Plant height (cm) | Fibre yield (q/ha) | Paira rice yield (q/ha) |
|---|---|---|---|---|---|---|
| | Grassy weeds/m² | Broad leaf weeds/m² | Sedge/ m² | | | |
| T1: NJ 7010+TMB 37 (1:1) Pretilachlor 50EC @ 0.9 l/ha + Nail weeder (10 DAS)– Paira crop of Rice in jute | 11.33 | 15.67 | 9.33 | 268 | 28.93 | 34.74 |
| T2: JRO BA-3+TMB-37 (1:1) Pretilachlor 50EC @ 0.9 l/ha + Nail weeder (10 DAS)–Paira crop of rice in jute | 14.67 | 24.00 | 18.67 | 270 | 27.13 | 38.33 |
| T3: NJ 7010 + Virat (1:1) Pretilachlor 50EC @ 0.9 l/ha + Nail weeder (10 DAS)–Paira crop of Rice in jute. | 17.33 | 6.67 | 14.67 | 266 | 27.43 | 37.35 |
| T4: Ipfencarbazone@ 68.43 g/ha +1HW- Paira crop of Rice – lentil ( zero till paira crop) | 18.67 | 16.33 | 26.00 | 324 | 28.00 | 39.14 |
| T5: Ipfencarbazone @ 91.24 g/ha + 1HW(Jute + Palak, mixed) Paira crop of Rice in jute - mustard (zero till paira crop) | 17.00 | 12.00 | 13.67 | 295 | 28.57 | 34.68 |
| T6: CRIJAF nail weeder (7 DAS) + Scrapper (15 DAS) – Paira crop of Rice - Pea (Zero till) | 48.00 | 21.33 | 17.33 | 310 | 37.99 | 35.69 |
| T7: Broadcast (6.0 kg/ha) and one manual weedings 18 DAS - Paira crop of Rice - Khesari (zero till paira crop) | 98.67 | 10.00 | 10.67 | 324 | 40.45 | 40.96 |
| T8: High density broadcast jute sowing (7.50 kg/ha) for weed smothering ( no weeding and thinning) | 193.33 | 14.67 | 52.0 | 274 | 38.37 | -- |
| T9: NJ 7010 + Glufosiante ammonium 13.5% SL (10 DAS) @1.2 Kg SL/ha)+1HW | 20.67 | 2.00 | 10.33 | 366 | 33.33 | -- |
| T10: NJ 7010+ Glufosiante ammonium 13.5% SL (10 DAS) @2.2 Kg SL/ha+1HW | 27.33 | 2.33 | 10.33 | 338 | 30.00 | -- |
| T11: NJ 7010 + Paraquat Dimethoate 24% SL (10 DAS) @1.8 kg SL/ha) l +1HW | 24.33 | 2.00 | 13.67 | 370 | 33.00 | -- |
| T12: Control – fallow | 118.67 | 19.00 | 51.67 | 218 | 15.00 | |
| S.Em± | 22.81 | 3.69 | 13.36 | 8.70 | 1.39 | 1.62 |
| CD (p=0.05) | 66.88 | 10.81 | 39.41 | 25.52 | 4.07 | 5.01 |

High density broadcast jute sowing (7.50 kg/ha) could control 70% grass weeds and 62% sedges weeds at 25 DAS (Table 11). It reduced the manpower requirement for weeding and thinning and saved 89 man days/ha over conventional method. Paira crop of rice (cv. MTU 1010) was done at 10-15 days before jute harvest followed by Pretilachlor 50 EC application @ 0.9 kg lit/ha to control germinating weeds. The rice yield varied from 35-41 q/ha.

### 2.4.2. Low density jute sowing to curtail labour cost in weeding

(Investigators: *A.K. Ghorai and Asim Kumar Chakraborty; Project Code: In-house Project-JA 8.0)*

A field experiment was conducted with low density live jute seeds (cv. NJ 7010) @ 1.20, 1.5, 1.9, 2.25 and, 2.6 kg/ha mixed with inert jute seeds @ 2.6 kg to 3.4 kg/ha in double crisscross pattern. At 48 hours after sowing with irrigation, Pretilachlor 50 EC @ 0.9 kg/ha was applied. This low density sowing significantly reduced ultimate plant population (Eq. 1 & 2), increased individual plant weight and fibre weight (Eq. 3 & 4) without affecting biomass production. Low density jute sowing methods curtailed man-days requirement in major operations and reduced cost of cultivation (Eq. 6 & 7).

Y popn/ha = 2.695 + 0.208X R2 = 0.81 ……(1)

Y fyield/ha = 33.517 + 0.953 X R2 = 0.259 ……...(2)

Y Plntwt = 291.52-20.95 X R2 = 0.641 ....…….(3)

Y fibwt = 13.49 – 0.69X R2 = 0.54 ……(4)

Y Biomass/ha = 73.714-0.965X R2 = 0.05 ……(5)

Y MD/ha = 37.62 +20.73XR2 = 0.86 ……(6)

Y savexpt/ha = 41714 -5181.5X R2 = 0.84……..(7)

Where, $Y_{popn/ha,}$ $Y_{fyield/ha,}$ $Y_{Plntwt,}$ $Y_{fibwt,}$ $Y_{MD/ha,}$ $Y_{savext/ha}$ are effective plant population (lakh/ha), fibre yield (q/ha), individual fresh plant weight (g), individual fibre weight (g), man days reduction in major operations and savings in major operations (₹/ha), respectively. X is the different doses of seed rates applied (kg/ha).

### 2.4.3. Jute-mungbean intercropping: A statistical perspective

(Investigators: *A.K. Chakraborty, N.M. Aalam and A. K. Ghorai; Project Code: In-house Project- JST 6.2)*

This study is based on secondary data obtained during investigations on mixed and intercropping in jute at ICAR-CRIJAF since 2002 to 2006. It had 3 distinct phases. Mixed cropping of short duration vegetable crops and few millets were tried during 2002-03 to 05-06. In the second phase, 2007-08 to 2009-10 strip cropping system were conducted. Jute (*cv.* JRO 204) was simultaneously sown as strip crops with mungbean (*cv.* RMG 62, K 851, Pant Mung 5 in 4:4 ratio), maize (in 3:1 ratio) and mothbean (*cv.* local, RMO 40 in 4:4 ratio). Red amaranth (*cv.* Jaba Kusum), summer radish and summer spinach were sown as mixed crops with jute.

Since 2010-11, the investigation started on 1:1 intercropping system with mungbean. Pre-flowering resistant Jute *cv.* NJ 2005 and NJ 2010 along with JRO 204 were introduced during this period. Gradually, experiments investigated for mungbean yield potential of *cv.* Pant Mung 4, Pant Mung 5, Pant Mung 6, RMG-62, Sonali, Meha, Samrat, Sukumar, Virat (IPM25), and YVMV resistant TMB-37. These experiments focused to study on the three components - early sowing (March 2$^{nd}$ week onward) of crops, pre-flowering resistant jute varieties and short duration mungbean varieties so as to complete harvesting of mungbean seeds before monsoon sets in early June. Jute fibre yield and mungbean seed yield varied between 26 to 37.34 q/ha and 7.73 to 8.34 q/ha, respectively in loamy soil. Whereas, sole jute and mungbean yield varied between 28 to 40 q/ha and 10 to16 q/ha, respectively. In clay soil jute fibre yield was 40.73 q/ha and mungbean seed yield was 6.41 q/ha. Jute equivalent yield (JEY) of successful intercropping system was significantly higher than sole jute yield.

### 2.4.4. Interactive effect of planting materials and fertilizer levels on sisal production

(Investigators: *S. Sarkar, A.K. Jha, D.K. Kundu, M.S. Behera, B. Majumdar and R.K. Naik; Project Code: In-house Project-SLA 1.7)*

It was observed that the maximum numbers of leaves were produced in large size (532 g) sucker at planting with highest dose (120:60:120 kg/ha) of fertilizer (34.5/plants) which was at par with the number of leaf produced with large sized sucker at planting with medium dose (90:45:90 kg/ha) of fertilizer (34.3/plant) in sisalana sisal. In case of hybrid sisal, the maximum numbers of leaves were produced at different combinations of sucker size at planting and fertilizer dose (Table 12). The maximum number of leaves were produced in large size x higher dose (35/plant) ≅medium size × higher dose (33.6/plant) ≅small size × higher dose (33.2/plant) ≅large size × medium dose (32.8/plant) combinations. In Sisalana sisal, interaction effect of large sucker at planting × higher fertilizer dose produced the longest leaf (68.6 cm) which was at par with the leaf length obtained from large sucker × medium fertilizer dose (66.9 cm). The leaf breadth measurement also followed similar pattern of leaf length data. In hybrid sisal, the interaction effect of the large sized planting material × higher dose of fertilizer (55.1 cm), large sized × medium dose (54.9 cm) and large size × lower dose (53.3 cm) produced at par leaf lengths. Similar observations were also recorded in case of leaf breadth for hybrid sisal.

Interactive effect of planting materials and fertilizer levels on sisal production

Table 12: Biometric data of sisal leaves as affected by planting material and fertilizer levels

| Parameter | NPK fertilization in Sisalana (kg/ha) | | | |
|---|---|---|---|---|
| | 60:30:60 | 90:45:90 | 120:60:120 | Mean |
| **Small** | | | | |
| Leaves/plant (nos.) | 24.80 | 25.37 | 30.83 | 27.00 |
| Leaf length (cm) | 53.82 | 57.37 | 58.25 | 56.48 |
| Leaf breadth (cm) | 5.33 | 5.66 | 5.72 | 5.57 |
| **Medium** | | | | |
| Leaves/plant (nos.) | 30.27 | 30.60 | 31.47 | 30.78 |
| Leaf length (cm) | 59.57 | 61.40 | 63.20 | 61.39 |
| Leaf breadth (cm) | 5.94 | 6.12 | 6.29 | 6.12 |
| **Large** | | | | |
| Leaves/plant (nos.) | 31.13 | 34.33 | 34.47 | 33.31 |
| Leaf length (cm) | 64.04 | 66.92 | 68.61 | 66.52 |
| Leaf breadth (cm) | 6.37 | 6.55 | 6.76 | 6.56 |

### 2.4.5. Potential of medicinal and aromatic plants in jute and allied fibre based cropping system

(Investigator: *M.S. Behera, S Satpathy, A .K Jha and R K Naik; Project Code: In-house Project-JA 6.9)*

In sisal-MAPs (medicinal and aromatic plants) cropping system, aloe vera recorded maximum yield followed by vetiver. Among spices, fennel registered yield of 30.27 q/ha. Safed musili and fennel recorded maximum return (Table 13). Under jute-rice-spices cropping system, the jute equivalent yield of 58.54 q/ha was recorded in jute-kharif rice system as seed spices in the cropping system have not been harvested.

**Table 13: Sisal equivalent yield and system economics in medicinal and aromatic plants sequence**

| Treatments | | Sisal equivalent yield (q/ha) | Net return (₹/ha) | B:C ratio |
|---|---|---|---|---|
| Medicinal and Aromatic Plants | Aloe vera | 30.59 | 153774 | 2.38 |
| | Asalio | 17.47 | 80942 | 2.14 |
| | Isabgol | 17.22 | 83649 | 2.28 |
| | Vetiver | 30.03 | 163081 | 2.58 |
| | Lemon grass | 22.32 | 113433 | 2.36 |
| | Palmorosa | 16.39 | 76549 | 2.18 |
| | Citronella | 14.85 | 69852 | 2.14 |
| | Kalmegh | 18.73 | 89197 | 2.12 |
| | Muskdana | 15.64 | 69028 | 2.00 |
| | Senna | 15.09 | 72019 | 2.16 |
| | Ashwagandha | 18.45 | 100358 | 2.54 |
| | Safed musili | 29.46 | 173797 | 2.96 |
| | Menthol mint | | 84032 | 2.26 |
| Spice | Fennel | 30.27 | 145366 | 2.17 |
| | Chilli | 20.80 | 74734 | 1.68 |
| Traditional Crop | Horse gram | 14.25 | 61120 | 1.94 |
| | Ground Nut | 14.48 | 69311 | 2.15 |
| | Okra | 20.45 | 99185 | 2.24 |
| | Maize | 17.82 | 77803 | 1.96 |
| | Ragi | 13.81 | 67536 | 2.22 |
| Interaction (Fertilizer x crop) CD (p=0.05) | | 1.62 | 10606 | 0.087 |


Jute and sisal based medicinal and aromatic plants and spices crop

### 2.4.6. Sisal based Integrated Farming System (IFS)

(Investigators: *M.S. Behera, R. Saha, S. Sarkar and A.K. Jha; Project Code: In-house Project- SLA 1.8)*

Integrated farming system was started in sisal and jute based farm management system with aims to double farmers income. Livestock and fishery components like milch cow, rabbit, poultry, bees, and pisciculture were integrated along with mushroom, vermicomposting, azolla, inter crops etc. for increasing farm income (Table 14).

**Table 14: Sisal based IFS module**

| Farming system | Farm economics (in ₹) | | | Employment Generation (Man days) |
|---|---|---|---|---|
| | Gross Return | Cost | Net Profit | |
| Conventional | 89400 | 54520 | 34880 | 108 |
| IFS Model | 169286 | 79686 | 89600 | 218 |
| % Change | 89 | 46 | 156 | 101 |

Components of IFS model at SRS, Bamara

RAC members visiting IFS model at SRS, Bamara

## 2.5. Farm Mechanization

### 2.5.1. Mechanical weed control through CRIJAF Weeder

(Investigators: *A.K. Ghorai and Asim Kumar Chakraborty; Project Code: In-house Project- JA 8.0)*

In broadcast jute, CRIJAF nail weeder (at field capacity 6-7 DAE) and CRIJAF herbicide applicator using glyphosate @ 2.15 Kg spray liquid/ha (urea 200g/15 lit water) was

used for simultaneous weeding, thinning and making line arrangement. Modified nail weeder could reduce the weed population by 66% and herbicide applicator by 80% over control with jute fibre yield of 38 q/ha and 33 q/ha, respectively. In another study, rotor and boat were attached with CRIJAF nail weeder for its wide range of application from field capacity to waterlogged rice field. After rice transplantation (10-15 DAT), this rotor and boat attached nail weeder works in the principle of to and fro movement in between rice rows (20-25 cm) at 1-2 cm standing water. It saves about 60 man days/ha for weed control in rice and produced rice yield up to 6.0 t/ha and reduces dependence on herbicides.

Agricultural weeder with cone and nail assembly

### 2.5.2. Development of multi-crop seed drill (MCSD)

(Investigators: *R.K. Naik, A.K. Ghorai, S. Sarkar and S.K. Jha Project Code: In-house Project-JAE 3.4)*

A manually pulled seeder (4 rows) has been designed and developed for jute seed sowing. The seed box is fabricated with light weight, durable and transparent material for visibility of seed. The bigger size ground wheels with pegs are used for easy movement of machine without slippage on tilled soil. Instead of four chains a single chain is used as for covering the drilled seeds on the furrow. The handle of machine is made compacted and adjustable to reduce drudgery. The overall dimension of the machine is 1046 mm × 1000 mm × 1000 mm (L × W × H) and weight is 14 kg. Laboratory calibrated seed rate is 2.5-3.0 kg/ha. The uniformity of seed dropping and spacing along the row is 60-70% and 30-50 mm, respectively. The field capacity is 0.19 ha/h with depth of seed placement at 10 to 15 mm. The draft requirement is 12.6 kg. The design of the machine (Design No. 320658-001 dated 13/08/2019) is registered in class 15-03 as Jute Seeder in the Patent Office, Kolkata.

Manually operated seed drill

## 2.6. Post-harvest Processing and Retting

### 2.6.1. Potential of jute biomass for bioethanol production

(Investigators: *L. Sharma, B. Majumdar, P. Satya and S. Roy; Project Code: DSTB-WB Project*)

Biochemical composition of two jute genotypes, viz, JRO 524 and JROB 2 were studied at three stages of growth (45, 90, 120 DAS). The biomass and plant height of JROB 2 were found higher throughout the growth stages. Cellulose content of JROB 2 was higher across all the growth stages in both leaf and stem as compared to JRO 524 (Fig. 16). Cellulose content in stem of JROB 2 was highest at 90 DAS with 664.9 mg glucose equivalent per g DW of biomass. The pectin content was lower in the stem and leaf of JROB 2 as compared to JRO 524. The lignin content in JROB 2 was also lower than JRO 524. Higher quality biomass of JROB 2 therefore ensures better bioethanol production potential.

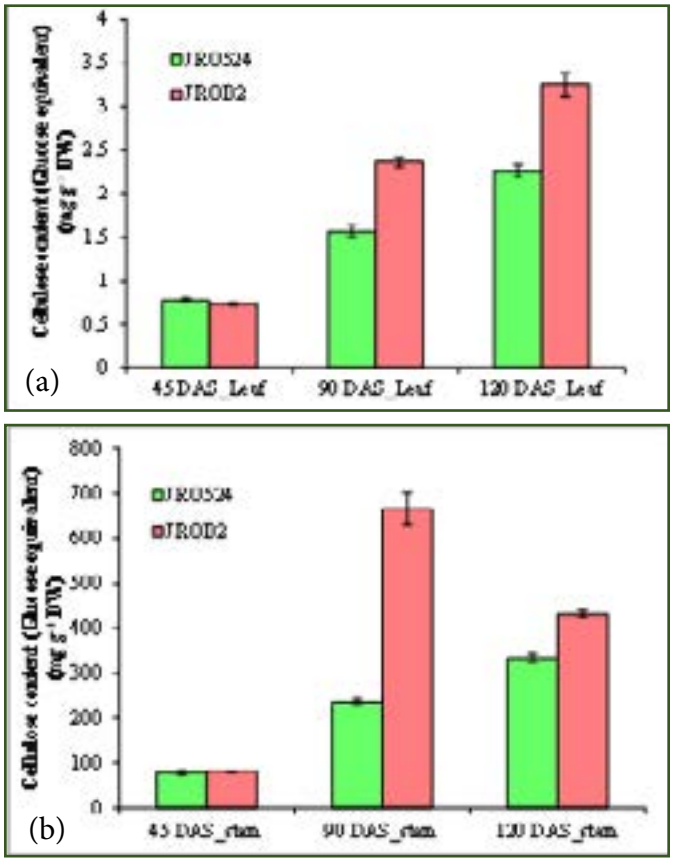



Fig. 16: Cellulose content in (a) leaf and (b) stem of two jute genotypes at three stages of growth

JROB 2 is a high biomass genotype suitable for cellulose derived by-products like paper, cellulose nanocrystals etc. as well as other diversified products like biogas, biochar, lignocellulosic biomass derived metabolites like xylitol, succinates, vanillin, bio-composites etc.

### 2.6.2. Metagenomics of retting microbiome

(Investigators: *B. Majumdar, S.P. Mazumdar, D. Saha, S. Datta, S. Sarkar and S.K. Jha; Project code: In-house Project-JA 7.7)*

A comprehensive genomic analysis of three bacterial strains (PJRB 1, 2 and 3) of the microbial retting consortium indicates the strain's genomes sizes of ~3.8 Mb with 3729 to 4002 protein-coding genes. Detailed annotations of the protein-coding genes revealed different carbohydrate-degrading CAZy classes viz. PL1, PL9, GH28, CE8, and CE12. Phylogeny and structural features of pectate lyase proteins of PJRB strains divulge their functional uniqueness and evolutionary convergence with closely related Bacillus strains. Genome-wide prediction of genomic variations revealed 12461 to 67381 SNPs, and notably many unique SNPs were localized within the important pectin metabolism genes. The variations in the pectate lyase genes possibly contribute in their specialized pectinolytic function during the retting process. These findings encompass a strong foundation for fundamental and evolutionary studies on this unique microbial degradation of decaying plant material with immense industrial significance.

### 2.6.3. Bacterial community analysis of retting water

(Investigators: *B. Majumdar, S.P. Mazumdar, D. Saha, S. Datta, S. Sarkar and S.K. Jha; Project Code: In-house Project- JA 7.7)*

The bacterial community analysis of retting water samples collected from different location of West Bengal indicated that pectin degraders (Fig. 17) are the major part of total bacterial load on the basis of degradation of D-galacturonic acid (major component of pectin) followed by hemicellulose (D-xylose) and cellulose (D-cellobiose) degraders. A substantial bacterial load utilizing lipid and wax components on the basis of biochemical degradation of tween 40 and tween 80 were also found in the retting water. An initial lag-phase was observed for the first 24 hrs of incubation. In most of the location, utilization of D-galacturonic acid and D-xylose was maximum at 48 hrs of incubation. The maximum activities of cellulose degraders were recorded in between 48 and 72 hrs of incubation. Utilization of tween 40 and tween 80 (lipid and wax component) increased stridently after the lag phase and continued up to 96 hrs of incubation.

Retting trials of jute and mesta were carried out at different locations of North 24 Parganas district (W.B.) utilizing six to eight months old liquid (spore based) formulation of 'CRIJAF SONA' during the months of August to November, 2019. The retting of jute completed in 11 to 16 days while mesta retting took 12 to 18 days (October and November). The value of fibre strength ranged from 23 to 24.5 g/tex for jute and 22.86 to 24.03 g/tex for mesta (Table 15).

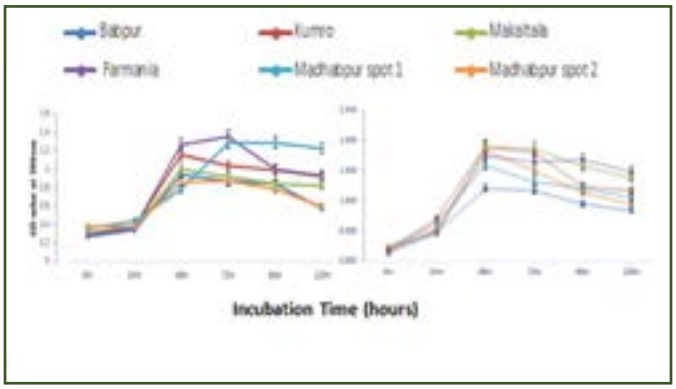



Fig. 17: Utilization pattern of D-galacturonic acid and D-xylose

Table 15: Performance of liquid formulation on retting of jute and mesta

| Location of trial | Crop | Month of retting | Retting duration (days) | Fibre strength (g/tex) |
|---|---|---|---|---|
| ICAR-CRIJAF | Jute | August | 11 | 24.50 |
| Goaldah, Swarupnagar | | -do- | 16 | 23.20 |
| Goaldah, Swarupnagar | | -do- | 13 | 24.13 |
| Bongaon | | October | 15 | 23.00 |
| ICAR-CRIJAF | Mesta | -do- | 12 | 24.03 |
| ICAR-CRIJAF | | November | 18 | 22.86 |

### 2.6.4. Ribbon retting for quality fibre production

(Investigators: *R.K. Naik, B. Majumdar, S.P. Mazumdar and M.S. Behera; Project Code: In-house Project-JA-5.8)*

An experimental model of power operated jute ribboner machine powered by 3 hp electric motor/5 hp Diesel engine has been developed. It extracts ribbons from the freshly harvested jute plants without breaking the sticks. It consists of two sets of stick breaking-cum-ribbon pulling units made of toothed nylon rollers placed one above the other. Two operators can work simultaneously with two units at a time for extraction of ribbon. Five to six jute plants can be fed in one unit, there by 10-12 plants can be extracted at a time by two operators. The machine is being demonstrated in few farmers field for further modifications.

# 3. Crop Protection

## 3.1. Biological Control of Insect Pests and Diseases

### 3.1.1. Isolation of nucleopolyhedrosis virus of semilooper, *Anomis sabulifera* Guenee

(Investigators: *V. Ramesh Babu, G. Siva Kumar and S. Satpathy; Project Code: In-house Project-J.E 2.0)*

The nucleopolyhedrosis virus was isolated from dead *A. sabulifera* larvae found hanging on jute leaves with characteristic viral infection symptoms at farmer's field in Panji, 24 North Paragnas, West Bengal while surveying

*A. sabulifera* larva with signs of NPV infection

the jute fields with heavy infestation of semilooper. From single dead larval cadaver, crude homogenate of the virus was extracted by grinding it in sterile distilled water, centrifuged and stored at -20°C.

***Molecular characterization of AsNPV***: The molecular characterization of occlusion bodies (polyhedra) from the infected larvae was done after extraction and purification of the viral DNA using 0.1M sodium carbonate solution. The extracted DNA was visualized in 0.9% agarose gel. Primer set for the amplification of

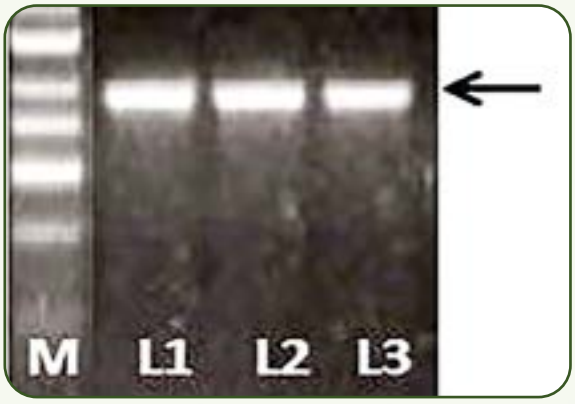



Fig. 18: PCR detection based on *polh* gene at 700 bp (M = Marker (M):100 bp ladder, lane 1-3 = *A. sabulifera polh* NPV gene (Replication 1-3)

*polh* gene was designed as universal primers according to the *As*NPV sequences in the Genbank database of National Centre for Biotechnology Information. The primer sequence consisted of forward primer 5'-ATGCCAGACTTCTCGTACCG-3' and reverse primer 5'-TAATACGCGGGACCGGTGAAT-3'. The PCR conditions consisted of an initial denaturation step of 95°C for 3 min and 35 cycles of 95°C for 30 sec, 70°C for 1min, 55°C for 1 min, and a final extension step 72°C for 10 mins. The PCR product was of 700 bp. (Fig. 18). SEM and TEM studies conducted on the OBs revealed that the size ranged from 1.14-1.82 µm with an average size of about 1.60 µm.

**AsNPV multiplication:** For multiplication of *As*NPV, fifth instar larvae were starved for 2 h and then were fed on jute leaves smeared with 1 ml of viral suspension containing $2.8 \times 10^6$ OBs/ml. Third instar larvae were allowed to feed on the virus inoculated leaf for 24 h in a

Larval mortality after infection with AsNPV at 24 HAT

plastic petri plate and later on were transferred to fresh cleaned jute leaves and maintained at 28° C till death.

***Larval Bioassay*:**The number of occlusion bodies (OBs) obtained from single NPV infected dead larvae was adjusted to $2.8 \times 10^6$ OBs/ml in aqueous solution of 0.05% Triton X-100 (v/v). Preliminary mortality studies using leaf dip bioassay with second instar semilooper larvae and serial dilution of the OBs revealed the median lethal concentration ($LC_{50}$) of AsNPV as $1.03 \times 10^5$ OBs/ml (F.L. $1.1x10^5$-$2.3x10^4$) (Table 16).

Table 16: Leaf dip bioassay with AsNPV against second instar larvae of jute semilooper, *A. sabulifera*

| POBs | No. of larvae treated | Mortality (%) |
|---|---|---|
| $2.8x10^6$ | 30 | 83.33 |
| $5.6x10^5$ | 30 | 76.33 |
| $1.12x10^5$ | 30 | 53.33 |
| $2.24x10^4$ | 30 | 43.33 |
| $4.48x10^3$ | 30 | 26.66 |
| $0.89x10^3$ | 30 | 13.33 |

### 3.1.2. Isolation and characterisation of *Trichoderma* for disease management

(Investigators: *K. Mandal, S. K. Sarkar and R. Saha; Project Code: In-house Project- JM 9.2)*

Twenty four isolates of *Trichoderma* spp. isolated from resident soil samples collected from varying ecological and edaphic conditions, mushroom bed, cultures of commercial products and previously collected superior isolates were characterised for production of inhibition zone, colonization behaviour, and speed of growth over pathogen and lysis of pathogen.

Maximum inhibition of 1 mm was produced by isolates Com1 and Com2. Among the resident isolates, TVC-4 with 0.7 mm inhibition zone was most superior. Some of

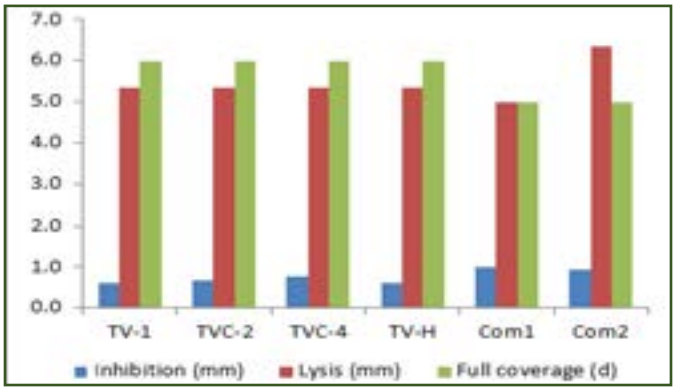



Fig. 19: Antagonistic parameters of some selected *Trichoderma* cultures

the samples produced very limited (0-0.1 mm) inhibition (Fig. 19). Majority of the isolates established contact with the pathogen colony after 72 h of incubation. However, Com1 and Com2 grew very fast and registered contact within 48 h.

In dual culture Com1 and Com2 fully covered the pathogen at the shortest period of 5 days of incubation. TV-1, TVC-2, TVC-4 and TV-H took six days to fully overtake the pathogen. *Trichoderma* induced lysis of the pathogen mycelium indicating the antagonistic capacity in terms of lysis zone on *M. phaseolina* after 24 h varied from 5–6 mm while four isolates were inferior and could produce only 0–3 mm lysis. The isolates collected from resident soil which were most superior with maximum lysis zone (5.5 mm) were TV-1, TVC-2, TVC-4 and TV-H.

## 3.2. Host Plant Resistance

### 3.2.1. Identification of sources and mechanism of resistance in jute against lepidopteron pest complex

(Investigators: *B.S.Gotyal and S Satpathy; Project Code: In-house Project-JE-2.1)*

The biological parameters of hairy caterpillar larvae reared on different accessions of cultivated and wild jute species manifested significant variation. The different jute species significantly affected larval survival from neonate to pupation and adult emergence (Table 17).

The larval survival after 5 days feeding on respective accessions varied from 46.60% in WCIN-179 (*C. aestuans*) to 100% in all the accessions of *C. capsularis* and JRO 204. The larvae failed to survive at 10 DAF in *C. aestuans* (WCIN -128, WCIN-135, WCIN -179) and *C. pseudo-olitorius* (WCIJ-034, WCIN-114). The survival of the larvae was drastically low (0-6.66%) in wild accessions except WCIJ-080 of *C. pseudo-olitorius,* while the survival was 90-100% in cultivated species.

Table 17: Comparative biological parameters of hairy caterpillar on wild and cultivated jute

| *Species/ Accession* | Larval survival (%) | | Pupation (%) | Adult Emergence (%) | Growth Index |
|---|---|---|---|---|---|
| | 5 DAF* | 10 DAF | | | |
| *C. aestuans* | | | | | |
| WCIN- 09 | 56.60 | 6.66 | 0.00 | 0.00 | 0.00 |
| WCIJ-123 | 53.30 | 3.33 | 0.00 | 0.00 | 0.00 |
| WCIN-179 | 46.60 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mean | 52.17 | 3.33 | 0.00 | 0.00 | 0.00 |
| *C. Pseudo-olitorius* | | | | | |
| WCIJ-034 | 100 | 0.00 | 0.00 | 0.00 | 0.00 |
| WCIN-114 | 73.3 | 0.00 | 0.00 | 0.00 | 0.00 |
| WCIJ-080 | 100.00 | 100.00 | 23.33 | 10.60 | 0.97 |
| Mean | 91.10 | 33.33 | 7.78 | 3.53 | 0.32 |
| *C . olitorius* | | | | | |
| OIN-125 | 93.30 | 93.30 | 76.66 | 58.30 | 3.01 |
| OIN-154 | 93.30 | 90.00 | 56.66 | 39.65 | 2.91 |
| JRO 204 | 100.00 | 100.00 | 76.66 | 72.55 | 3.89 |
| Mean | 95.53 | 94.43 | 69.99 | 56.83 | 3.27 |
| *C. capsularis* | | | | | |
| CIJ-12 | 100.00 | 100.00 | 56.66 | 43.20 | 2.51 |
| CIJ-42 | 100.00 | 100.00 | 73.33 | 48.33 | 3.17 |
| JRC 412 | 100.00 | 100.00 | 83.33 | 56.50 | 4.12 |
| Mean | 100.00 | 100.00 | 71.11 | 49.34 | 3.27 |

* days after feeding

None of the wild species except *C. pseudo-olitorius* (WCIJ-080) supported the pupation and adult emergence. The pupation, adult emergence, and growth index was highest in JRC 412 indicating the most susceptible accession. Among the accession of cultivated species, OIN-154 recorded least growth index of 2.91 compared to the most susceptible JRC 412 (4.12). This indicates high degree of antibiosis in WCIN-19, WCIJ-123, WCIN-179 (*C. aestuans);* WCIJ-34 and WCIN-114 (*C. pseudo-olitorius)* because of which the insect failed to complete the larval stage in these five accessions.

### 3.2.2. Tolerance of elite jute varieties against yellow mite

(Investigators: *S. Satpathy. B.S. Gotyal and V. Ramesh Babu; Project Code: In-house Project-JE 1.9)*

The tolerance level of the eight elite varieties of jute was determined on the basis of relative population density, damage grade and yield reduction due to mite infestation. The mite population density among the varieties varied from 42.89/cm$^2$ in JRO 2407 to 22.89 in JRO 204. JRO 524 also recorded significantly less mite population than other varieties being at par with JRO 2407 (Table 18).

Table 18: Effect of mite infestation on fibre weight reduction of different elite jute varieties

| Variety | Mite/cm$^2$ | Damage grade | | Weight reduction (%) |
|---|---|---|---|---|
| | | I | II | |
| JRO 524 | 25.22$^{d}$ | 2.13$^{bc}$ | 2.47$^{cd}$ | 21.95$^{cd}$ |
| JROM1 | 37.00$^{abc}$ | 2.60$^{abc}$ | 2.90$^{cd}$ | 28.29$^{bc}$ |
| JROG1 | 33.00$^{bc}$ | 2.53$^{abc}$ | 3.23$^{bc}$ | 23.59$^{bcd}$ |
| JBO1 | 39.22$^{ab}$ | 3.20$^{ab}$ | 3.93$^{ab}$ | 29.84$^{ab}$ |
| JRO 2407 | 42.89$^{a}$ | 4.00$^{a}$ | 4.20$^{a}$ | 35.53$^{a}$ |
| S 19 | 30.11$^{cd}$ | 2.80$^{abc}$ | 3.10$^{bc}$ | 29.93$^{ab}$ |
| JRO 8432 | 39.00$^{ab}$ | 2.27$^{bc}$ | 2.63$^{cd}$ | 22.74$^{cd}$ |
| JRO 204 | 22.89$^{d}$ | 1.33$^{c}$ | 2.03$^{d}$ | 20.88$^{d}$ |
| CD (P=0.05) | 7.43 | 1.42 | 0.89 | 6.75 |

During the first observation the damage grade was 1.33 in the most resistant variety JRO 204 which was at par with JRO 524 (2.13). Further the damage symptom was more prominent which recorded 2.03 grades in JRO 204 to 4.20 in JRO 2407. Consequent to the mite damage the yield reduction was 35.53% in JRO 2407 followed by JBO 1(29.84%) and S 19 (29.93%). On the other hand the mite infestation had least effect on fibre weight reduction (20.88%) in JRO 204 indicating most tolerant among the test varieties.

Typical mite damage in *tossa* jute variety JRO 2407

### 3.2.3. Evaluation of elite jute varieties against mealybug on the basis of establishment, fecundity and population growth parameters

Being a newer host, eight *tossa* jute varieties were evaluated for resistance against cotton mealybug. Relative host suitability and resistance of the varieties was assessed on the basis of colonization, multiplication and growth in terms of establishment, fecundity and instantaneous growth rate (IGR). Significantly lowest female establishment rate was recorded in the variety JROM 1(0.20) followed by S 19 and JRO 524 (0.23). On the other hand the crawlers showed highest establishment (0.65) in JBO 1. The crawlers produced by the established females varied from 297.25 per plant in JROM 1 to 1086.25 per plant in JBO 1. Although the fecundity of the mealybug was least (119.25 per plant) in the variety JROG 1, on the basis of instantaneous growth rate JROM 1, S 19, JRO 524 and JRO 204 (0.15-0.16) were noted to supress the population growth to maximum extent. With highest IGR (0.21), JBO 1 was identified as the most favourable variety for population growth and registered to be most susceptible to mealybug.

### 3.2.4. Screening of tossa jute germplasms against stem rot

(Investigators: *S.K. Sarkar; Project Code: In-house Project-JB1.1)*

Jute plants were artificially inoculated at 68 days after sowing by mycelial bits of freshly isolated stem rot pathogen, *Macrophomina phaseolina*. Based on the length of the lesion developed (recorded at 7 and 14 days after inoculation), the germplasms were grouped in to five groups viz. Gr. 1 (<2.5 cm), Gr. 2 (>2.5 to 3.0 cm) Gr. 3 (>3.0-4.0), Gr. 4 (> 4.0-5.0cm) and Gr 5 (>5.0 cm) (Table 19). The least susceptible germplasms were OIN 112 (1.6 cm), OIJ 74 (1.70 cm), OIN 140 (1.83 cm) and OIJ 43 (1.93 cm) whereas the most susceptible gemplasms were

OIJ 84 (15.6 cm), OIJ 83 (12.96 cm), OIJ 64 (12.03 cm) and OIJ 76 (10.7 cm). In case of least affected germplasms the rate of lesion development was very slow and after 3-4 days these lesions were healed up whereas the lesion size of most affected germplasm gradually increased and girdle the whole stem .

Accession OIN 112 and OIJ 83 showing stem rot symptoms

Table 19: Size of lesion length (cm) at 14 days after inoculation (DAI) with stem rot pathogen in *tossa* jute

| Group 1. Lesion length <2.5 cm | | Group 2. Lesion length 2.5-3 cm | | Group 3. Lesion length 3-4 cm | | Group 4. Lesion length 4-5 cm | |
|---|---|---|---|---|---|---|---|
| Germ-plasm | Lesion length | Germ-plasm | Lesion length | Germ-plasm | Lesion length | Germ-plasm | Lesion length |
| OIJ-31 | 2.06 | OIJ-34 | 2.63 | OIJ-33 | 3.40 | OIJ-36 | 4.66 |
| OIJ-32 | 2.10 | OIJ-35 | 2.53 | OIJ-39 | 3.33 | OIJ-67 | 4.10 |
| OIJ-37 | 2.26 | OIJ-41 | 2.93 | OIJ-40 | 3.30 | OIJ-79 | 4.83 |
| OIJ-38 | 2.36 | OIJ-45 | 2.70 | OIJ-46 | 3.46 | OIN-143 | 4.80 |
| OIJ-43 | 1.96 | OIJ-48 | 2.90 | OIJ-47 | 3.00 | OIN-144 | 4.63 |
| OIJ-51 | 2.40 | OIJ-50 | 2.96 | OIJ-49 | 3.50 | OIN-146 | 4.33 |
| OIJ-60 | 2.30 | OIJ-53 | 2.53 | OIJ-56 | 3.06 | OIN-147 | 4.76 |
| OIJ-62 | 2.26 | OIJ-54 | 2.66 | OIJ-58 | 3.16 | OIN-150 | 4.03 |
| OIJ-69 | 2.36 | OIJ-55 | 2.66 | OIJ-59 | 3.26 | OIN-153 | 4.60 |
| OIJ-71 | 1.43 | OIJ-57 | 2.56 | OIJ-66 | 3.76 | OIN-158 | 4.33 |
| OIJ-72 | 2.03 | OIJ-61 | 2.66 | OIJ-77 | 3.16 | Group 5. Lesion length > 5.0 cm | |
| OIJ-74 | 1.70 | OIJ-63 | 2.63 | OIJ-82 | 3.76 | OIJ-64 | 12.03 |
| OIN-112 | 1.60 | OIJ-73 | 2.66 | OIN-111 | 3.40 | OIJ-65 | 5.43 |
| OIN-115 | 1.86 | OIJ-75 | 2.53 | OIN-113 | 3.36 | OIJ-68 | 7.26 |
| OIN-117 | 2.03 | OIJ-80 | 2.76 | OIN-114 | 3.06 | OIJ-76 | 10.76 |
| OIN-118 | 2.20 | OIN-121 | 2.53 | OIN-116 | 3.16 | OIJ-78 | 5.23 |
| OIN-119 | 2.30 | OIN-123 | 2.90 | OIN-120 | 3.33 | OIJ-81 | 6.50 |
| OIN-122 | 2.43 | OIN-128 | 2.83 | OIN-127 | 3.20 | OIJ-83 | 12.96 |
| OIN-125 | 2.43 | OIN-129 | 2.53 | OIN-135 | 3.03 | OIJ-84 | 15.66 |
| OIN-126 | 2.06 | OIN-131 | 2.63 | OIN-139 | 3.36 | OIN-151 | 5.40 |
| OIN-130 | 2.33 | OIN-134 | 2.80 | OIN-142 | 3.06 | | |
| OIN-132 | 2.10 | OIN-136 | 2.73 | OIN-145 | 3.20 | | |
| OIN-133 | 2.36 | OIN-154 | 2.93 | OIN-148 | 3.53 | | |
| OIN-137 | 2.20 | OIN-156 | 2.73 | OIN-152 | 3.63 | | |
| OIN-138 | 2.23 | OIN-162 | 2.80 | OIN-155 | 3.83 | | |
| OIN-140 | 1.83 | | | OIN-157 | 3.70 | | |
| OIN-141 | 2.16 | | | OIN-160 | 3.93 | | |
| OIN-159 | 2.33 | | | OIN-161 | 3.13 | | |

## 3.3. Bio-ecology and Management of Insect Pests and Diseases

### 3.3.1. Evaluation of acaricides against yellow mite of jute in farmers' field

*(Investigators: S. Satpathy. B.S. Gotyal and V. Ramesh Babu ; Project Code: In-house Project JE 1.9)*

Bioefficay of acaricides on suppressing the population of yellow mite under farmers' field condition at Mallikapur, North 24 Parganas indicated significant effect of the acaricides in regulating the mite population. During the first post treatment observation on egg density at 3 days after first spray on 45 DAS, the egg density among the treatments varied from 1.33 to 17.67 mite/cm$^2$ leaf area being significantly less than the control (34.55/cm$^2$) (Table 20). Foliar application of fenpyroximate 5EC (0.005%) was superior among the tested acaricides which recorded significantly less egg deposition (1.33/cm$^2$) followed by flonicamid 50 WG (4.67/cm$^2$), spiromesifen 22.9 EC (4.78/cm$^2$) and dinotefuran 20SG (6.56/cm$^2$). The pre-treatment observation at 55 DAS also indicated the superiority of fenpyroximate 5EC (0.005%) with 5.56 mites/cm$^2$ being at par with spiromesifen 22.9 EC (7.67/cm$^2$), flonicamid 50WG (9.21/cm$^2$) compared to 18.22 egg/cm$^2$ in the control. The post treatment egg density at 58 DAS among different acaricide treatments varied from 1.11 egg/cm$^2$ in fenpyroximate 5EC (0.005%) to 27.56/cm$^2$ in control. The egg deposition in spiromesifen (2.33/cm$^2$) and difenthiuron was at par with the best treatment *i.e.*, fenpyroximate.

The effect of the treatments on mite population at 45 DAS, indicated lowest mite population (2.67/cm$^2$) in fenpyroximate being at par with spiromesifen 22.9 EC (4.28/cm$^2$) followed by flonicanid (6.67/cm$^2$) and dinotefuran (7.67/cm$^2$). The relative efficacy of the acaricides in terms of mite infestation was manifested even at 55 DAS. Fenpyroximate 5EC and spiromesifen 22.9 EC (10.44 and 12.35/cm$^2$) recorded significantly lowest population density compared to control (42.22/cm$^2$). At 3 days after second acaricide application the mite population in the treatments varied from 4.33 to 20.44/cm$^2$ significantly less than control (34.89/cm$^2$). Lowest mite infestation was noted in fenpyroximate 5EC treatment (4.33/cm$^2$) being at par with spiromesifen (6.11/cm$^2$).

The management of egg and adult mite population density had significant effect on fibre yield of jute. Fenpyroximate

treatment besides suppressing the mite population, recorded highest fibre yield (35.83q/ha) followed by spiromesifen 22.9 EC (34.89 q/ha) (Fig.20). The fibre yield in control plot was lowest (29.72 q/ha). Among the seven acaricides, fenpyroximate was most effective against both the stages of yellow mite with significantly highest fibre yield as well.

Table 20: Effect of acaricides on egg density of yellow mite in jute

| Treatments | Egg density per cm² leaf area | | | |
|---|---|---|---|---|
| | Pre-treat.-I (45DAS) | Post treat.-I (48DAS) | Pre-treat.-II (55DAS) | Post treat.-II (58DAS) |
| Flonicamid 50WG (0.025%) | 22.00 | $4.67^{E}$ | $9.21^{CD}$ | $6.22^{CD}$ |
| Spiromesifen 22.9EC (0.016%) | 20.11 | $4.78^{E}$ | $7.67^{D}$ | $2.33^{DE}$ |
| Diafenthiuron 50WP (0.05%) | 21.34 | $8.22^{D}$ | $9.78^{CD}$ | $3.33^{CDE}$ |
| Dinotefuran 20SG (0.025%) | 20.78 | $6.56^{DE}$ | $13.44^{BC}$ | $7.78^{C}$ |
| Propargite 57EC (0.15%) | 21.89 | $12.78^{C}$ | $14.78^{AB}$ | $6.22^{CD}$ |
| Fenpyroximate 5EC (0.005%) | 24.89 | $1.33^{F}$ | $5.56^{D}$ | $1.11^{E}$ |
| Wettable S 80% (0.12%) | 22.11 | $17.67^{B}$ | $15.89^{AB}$ | $14.11^{B}$ |
| Control | 25.22 | $34.55^{A}$ | $18.22^{A}$ | $27.56^{A}$ |
| CD (P=0.05) | NS | 2.62 | 4.73 | 4.46 |

Table 21: Effect of acaricides on adult density of yellow mite in jute

| Treatments | Adult density per cm² leaf area | | | |
|---|---|---|---|---|
| | Pre-treat-ment-I (45DAS) | Post treat-ment-I (48DAS) | Pre treat-ment-II (55DAS) | Post treat-ment-III (58DAS) |
| Flonicamid 50WG (0.025%) | 37.67 | $6.67^{C}$ | $16.33^{D}$ | $9.55^{D}$ |
| Spiromesifen 22.9EC (0.016%) | 33.00 | $4.28^{C}$ | $12.34^{E}$ | $6.11^{DE}$ |
| Diafenthiuron 50WP (0.05%) | 33.44 | $7.78^{C}$ | $19.89^{C}$ | $8.22^{DE}$ |
| Dinotefuran 20SG (0.025%) | 34.67 | $7.67^{C}$ | $16.56^{D}$ | $14.78^{C}$ |
| Propargite 57EC (0.15%) | 34.33 | $16.89^{B}$ | $21.67^{BC}$ | $14.89^{C}$ |
| Fenpyroximate 5EC (0.005%) | 35.33 | $2.67^{C}$ | $10.44^{E}$ | $4.33^{E}$ |
| Wettable S 80% (0.12%) | 37.11 | $20.88^{B}$ | $24.22^{B}$ | $20.44^{B}$ |
| Control | 35.55 | $47.00^{A}$ | $42.22^{A}$ | $34.89^{A}$ |
| CD (P=0.05) | NS | 5.88 | 3.29 | 4.93 |

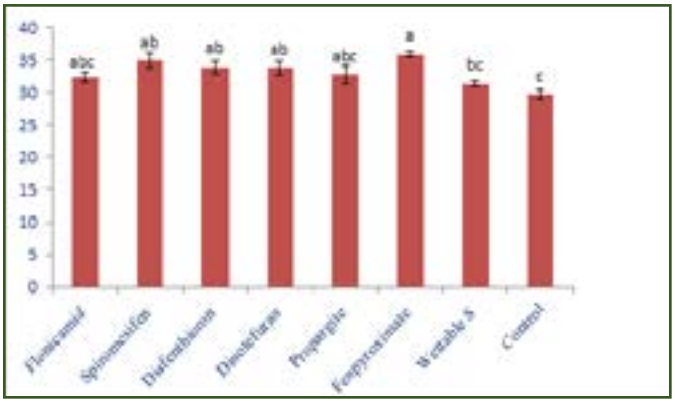



Fig. 20: Effect of acaricide treatments on fibre yield (q/ha) of jute in farmers' fields at Mallikapur

In another experiment the efficacy of fenpyroximate for yellow mite management was evaluated in different farmers' fields compared to untreated farmers practice. Fenpyroximate, a METI acaricide has toxic effect on both immature (egg) and adult stages of mites (Fig. 21). Previously standardized dose of fenpyroximate with significant toxic and persistent effect on yellow mite was evaluated under farmer's field at Mallikapur village, North 24 Pgs. Fenpyroximate 5 EC @ 1.5 ml/lit applied at 40 and 55 DAS in jute (Cv. JRO 204) significantly reduced the egg and adult mite population, damage grade and plant damage (%). Besides the treated fields have significantly higher fibre yield (31.98 q/ha) than the untreated field (27.48 q/ha).

Monitoring of mite damage in jute in farmers' field at Mallikapur

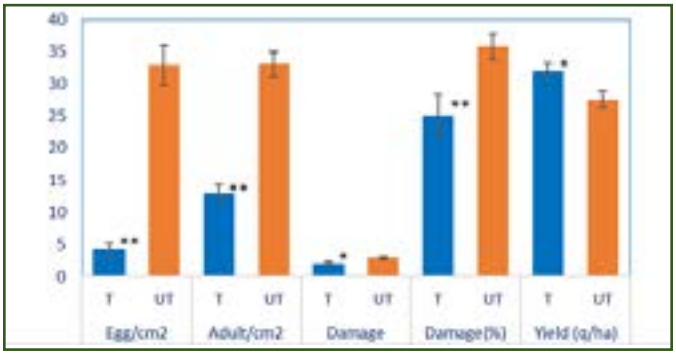



Fig. 21: Effect of fenpyroximate on mite infestation and jute fibre yield at Mallikapur village

### 3.3.2. Evaluation of IPM module in farmers' fields

(Investigators: *Rajib Kumar De, V. Ramesh Babu and Shamna. A; Project Code: In-house Project-JM 9.0)*

IPM module consisting of variety JRO 204 (Suren), application of $Ca(OCl)_2$ @ 30 kg/ha at 7 days before line sowing with 6 lakh plants/ha, seed treatment with carbendazim @ 2g/kg + imidacloprid @ 4g/kg, NPK: 60:30:30, application of pretilachlor @ 3 ml/l within 48 hr of sowing in moist soil, hand weeding at 21 DAS, spraying of spiromecifen @ 1 ml/litre, carbendazim @ 2g/litre and profenophos @ 2 ml/litre was tested in farmers' fields in Mallikapur village in North 24 Pgs. District of West Bengal.

It was observed that, stem rot was major problem with incidence of 26.6 %. The fibre yield of 33 q/ha was obtained in IPM module with highest BC ratio (1.77) in IPM module compared to 1.32 in farmers' practice.

### 3.3.3. Management of Alternaria leaf spot disease of sisal (*Agave sisalana*) through eco- friendly approach

(Investigator: *A.K. Jha; Project Code: In-house Project- SLM 1.2)*

In recent years Alternaria leaf spot of sisal (*Agave sisalana*) caused heavy losses. Disease symptoms on the leaves appeared as circular to ovoid and dark brown spots initially. Tissue necrosis within these spots was observed which ultimately dry up and blighted the leaves. All the six fungicides tested were effective in reducing the *Alternaria* leaf spot disease at bulbil stage and one year suckers. However, Mancozeb M 45@ 3.0g/l gave the best control followed by Propiconazole @ 2.0 ml/l and Chlorothalonil @ 2.0g/l as compared to check. (Table 22).

Table 22: Efficacy of fungicides against *Alternaria* leaf spot disease at bulbil stage and one year suckers (*A. sisalana)*

| Fungicide | PDI(bulbil stage) | PDI (one year suckers) |
|---|---|---|
| Mancozeb M 45@3.0g/l | 12.9 (20.9) | 9.8 (18.1) |
| Propiconazole @2.0 ml/l | 13.2 (21.1) | 11.0 (19.3) |
| Chlorothalonil @2.5g/l | 17.3 (24.5) | 17.3 (24.5) |
| Carbendazim@2.0g/l | 22.9 (28.6) | 20.0 (26.5) |
| Carbendazim 12% + Mancozeb 63% WP @2.5g/l | 19.6 (26.2) | 18.5 (25.4) |
| Copper oxychloride @3.0g/l | 27.0 (31.3) | 27.0 (31.3) |
| Check | 33.6 (35.4) | 28.0 (31.9) |
| CD (P= 0.05) | 3.9 | 2.7 |

All the oil-cakes/dusts tested were effective in reducing the *Alternaria* leaf spot disease of sisal in both bulbil and sucker stage. However, neem cake @10.0 q/ha gave the best control followed by karanj and mahua cake as compared to check (Table 23).

Disease symptoms caused by *Alternaria alternata* in Sisal

Table 23: Efficacy of oil-cakes against *Alternaria* leaf spot disease at bulbil stage and one year suckers (*A. sisalana)*

| Oil-cakes/dust @ 10.0 q/ha | PDI at bulbil stage | PDI at Sucker stage |
|---|---|---|
| Neem | 17.8 (24.9) | 15.5(23.1) |
| Karanj | 19.5 (26.2) | 18.8(25.1) |
| Mahua | 22.5 (28.3) | 24.3(29.5) |
| Linseed | 23.4 (28.9) | 25.0(29.9) |
| Mustard | 24.4 (29.5) | 25.8(30.5) |
| Saw Dust | 26.7 (31.1) | 27.5(31.6) |
| Check | 32.5 (34.7) | 31.0(33.8) |
| CD (P= 0.05) | 2.8 | 3.1 |

Table 24: Integrated Disease Management in sisal against *Alternaria* leaf spot at bulbil stage, one year old suckers (*A. sisalana)* and 5-6 year old hybrid sisal and *A. sisalana*

| Treatment | PDI | | | |
|---|---|---|---|---|
| | Bulbil Stage | Sucker Stage | Hybrid sisal | *A. sisalana* |
| Neem cake@ 10.0 q/ha + Mancozeb M 45@3.0g/l | 9.1 (17.5) | 7.8(16.1) | 20.8 (27.1) | 16.0(23.6) |
| Neem cake@ 10.0 q/ha + Propiconazole @2.0 ml/l | 11.3(19.6) | 8.5(16.8) | 25.7(30.4) | 17.5(24.7) |
| Mancozeb M 45@3.0g/l | 16.9(24.2) | 13.3(21.3) | 28.5(32.3) | 21.8(27.8) |
| Propiconazole @2.0 ml/l | 18.2(25.2) | 14.0(21.9) | 36.0(36.9) | 27.3(31.4) |
| Neem cake@ 10.0 q/ha | 20.9(27.2) | 18.5(25.5) | 38.3(38.2) | 30.8(33.7) |
| Check | 32.7(34.8) | 28.5(32.2) | 49.8(44.9) | 37.0(37.5) |
| CD (P=0.05) | 3.0 | 2.6 | 2.9 | 2.4 |

Neem cake @10.0q/ha + Mancozeb M 45@3.0g/l reduced the disease significantly (9.1 PDI), followed by Neem cake @ 10.0 q/ha + Propiconazole @2.0 ml/l water as compared to check (Table 24). All the treatments were effective in reducing the *Alternaria* leaf spot disease of sisal in both 5-6 years old plantation of hybrid sisal and *A. sisalana*. However, Neem cake @10.0q/ha + Mancozeb M 45@ 3.0g/l water gave the best control followed by Neem@ 10.0 q/ha + Propiconazole @ 2.0 ml/l water as compared to check.

### 3.3.4. Effect of date of sowing, fertilizer and seed treatment on wilt of flax

(Investigator: *S.K.Sarkar and K. Mandal ; Project Code: In-house Project- JM 9.1)*

Date of sowing has significant effect on flax wilt with least incidence of vascular wilt (1.8%) in third date of sowing i.e. 30th November than first date of sowing 30th October (Table 25). Similarly significant reduction in disease incidence (2.3%) was recorded in seed treatment with carbendazim @ 0.1% than the control plot. Application of fertilizer registered no significant effect on vascular wilt. The interaction between date of sowing and seed treatment was significant with least incidence of vascular wilt (1.2 %) with *Trichoderma* closely followed 1.6 % with carbendazim in 30th Nov. sown crop.

Flax plants showing wilt symptoms in the field

Table 25: Effect of date of sowing, fertilizer and seed treatment on wilt incidence (%) of flax

| Fungicides | 30 October (D1) | | | | 15 November (D2) | | | | 30 November (D3) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NPK 40:40:40 | NPK 60:40:60 | NPK 60:40:80 | Mean | NPK 40:40:40 | NPK 60:40:60 | NPK 60:40:80 | Mean | NPK 40:40:40 | NPK 60:40:60 | NPK 60:40:80 | Mean |
| Carbendazim | 2.70 | 2.87 | 2.98 | 2.85 | 4.21 | 4.79 | 4.43 | 4.48 | 1.66 | 1.68 | 1.54 | 1.62 |
| Trichoderma | 2.76 | 2.35 | 2.87 | 2.66 | 2.71 | 3.04 | 3.17 | 2.97 | 1.21 | 1.13 | 1.26 | 1.20 |
| Control | 6.41 | 7.05 | 6.08 | 6.52 | 7.01 | 7.03 | 6.66 | 6.90 | 2.39 | 2.59 | 2.57 | 2.52 |
| Mean | 3.96 | 4.09 | 3.98 | 4.01 | 4.64 | 4.95 | 4.75 | 4.78 | 1.75 | 1.80 | 1.79 | 1.78 |
| Mean | D1 | D2 | D3 | F1 | F2 | F3 | S1 | S2 | S3 | | | |
| | 4.0 | 4.8 | 1.8 | 3.4 | 3.6 | 3.5 | 2.9 | 2.3 | 5.3 | | | |
| CD (P= 0.05) | Main plot effect=1.6 | | | Sub plot effect= NS | | | Sub-sub plot effect= 0.3 | | DxS= 1.7 Other Interactions =NS | | | |

*F1=NPK:: 40: 40:40, F2= NPK:: 60:40: 60, F3= NPK:: 60:40: 80; S1= Carbendazim, S2= Trichoderma, S3= Control*

## 3.4. Development of Nano Formulations for Pest Management

### 3.4.1. Action mechanism of nanosilica against hairy caterpillar

(Investigators: *C. Biswas and V. Ramesh Babu; Project Code: In-house Project- JM 9.3)*

Spraying of nano-silica (diameter 98 nm) @ 10 ppm caused 75% mortality of hairy caterpillar (HC), (*Spilosoma obliqua*). To find out the molecular basis of action mechanism of nanosilica on hairy caterpillar two cDNA libraries using mRNA from nanosilica treated and untreated larval samples were prepared. Transcriptome analysis revealed that a significant number of apoptosis related genes involved in nanosilica stress response *viz.* mitogen-activated protein kinase (MAPK), SRC oncogene and apoptosis inducing pathway. MicroRNA analysis reveals that 22-nt miR-1 regulate the target transcripts and pre-miR-1: DCL complex: miR-196: miR-7 has key role in cleavage of Nedd2-like caspase / (MAPK) with the help of AGO1 protein. Highly abundant 22-nt miRNA families that target conserved domains of Nedd2-like caspase precursors and trigger the production of trans-acting siRNAs were identified.

***Transcriptome assembly of HC:*** Two cDNA libraries (nanosilica treated and untreated HC tissue) were constructed. The 454 sequence reads were assembled into contigs (Table 26). Full-length contigs were identified by running a BLASTX search against the *Drosophila sp.* proteome and compared the lengths of the aligned portion of each contig and the putative proteins.Comparison of Gene Ontology (GO annotation) distribution between species was conducted using the GOstat program (Fig. 22). In total more than 5.6 million (56,26,589) reads

were generated from HC, which was assembled into 1.0 million nucleotides of cDNA sequences. A total of 33,018 contigs were assembled from both treated and untreated cDNA libraries. BLASTX alignments to model system proteomes showed that ~ 70% of the transcript contig sequences from both cDNA libraries have strong similarity to predicted proteins of *Drosophila sp*. The merged transcriptome of 33,018 contigs consisted a total of 18,501 and 14,517 contigs (>800 nts) from treated and untreated HC, respectively.

Table 26: Results of mass assembly of sequence reads from cDNA libraries

| Assembly V1 | | | Assembly V2 | | | |
|---|---|---|---|---|---|---|
| #454 reads | # of bp | Average read | # contigs | Average read | % of reads of contigs | % reads in contigs |
| 33,018 | 11235679 | 200 | 33,018 | 345 | 59.4% | 80.9% |

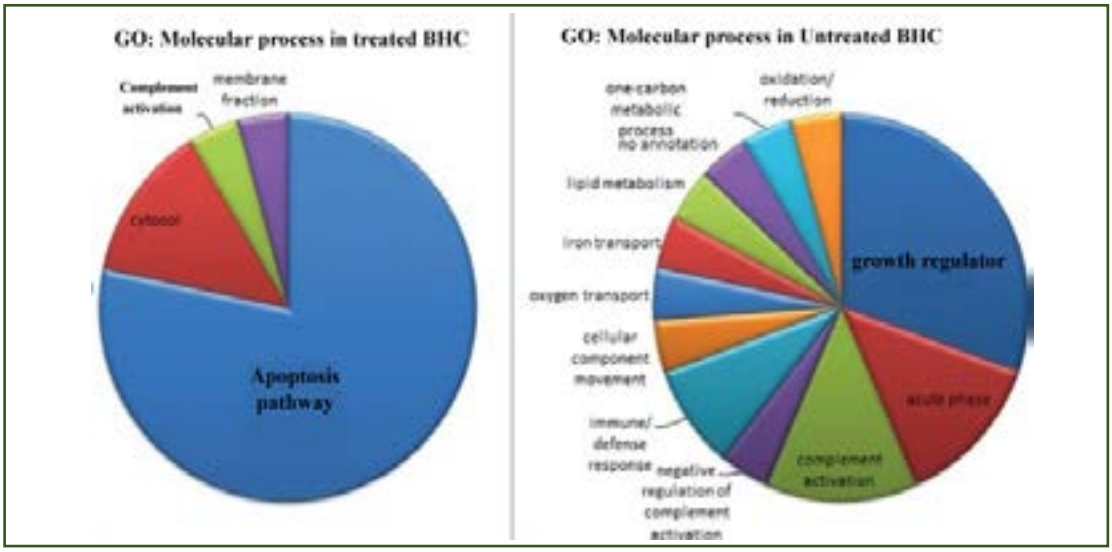



Fig. 22: GO (Gene ontology) study of nano silica treated and untreated HC

***Identification of apoptosis gene in nanosilica treated HC****: In silico* analysis of transcript abundance using the DEGseq approach identified 1204 contigs in nanosilica treated HC. Several annotation categories including "lysine demethylase 4C", "mitogen-activated protein kinase 8", "NAD (P) H quinone dehydrogenase", "pterin-4 alpha-carbinolamine dehydratase 1" and "Death-associated inhibitor of apoptosis" were significantly over-represented in treated HC compared to untreated HC.

***Identification of transcription factors*:** In this study, 458 genes from TF gene families were differentially expressed in treated samples in response to apoptosis signal. The number of TF genes differentially expressed under nanosilica treatment was greater than untreated one. Thirteen TF genes from AP2-EREBP, bHLH, C2H2, GRAS, HB, LOB, MYB-related and OFP families were found activated, and eight gene members from ARR-B, CCAAT, FAR1, MADS, Orphans, SNF2, and Trihelix families were repressed.

***Predicted novel microRNAs secondary structure****:* Micro-RNA was isolated using micro-RNA isolation kit from nanosilica treated and untreated HC and small RNA libraries were constructed and sequenced at Illumina HiSeq. Approximately, 54 million small RNA sequences were obtained after removing adapters and low-quality reads. miRNA named miR-1, miR-196, miR-10, miR-5658, miR-4502, miR-488f, miR-482c, miR-392d, miR-771, miR-166b, miR-2916, miR-3613b, miR-7086, miR-157d, miR- 5083 and miR-6646 passed the MFE criteria and their secondary structure were predicted.

***miRNAs as master regulators of MAPK and SRC pathway precursor-encoding genes and generators of secondary siRNAs :*** A stringent filter retained all matches with scores ≤5; scoring was assigned using the CleaveL and pipeline. The parallel analysis of RNA ends (PARE) data were integrated and phasing analysis was performed. Secondary structure of novel miRNAs were predicted using mFold server with default optimized parameters. A feature of the miR-1 loci was the preponderance of MAPK and SRC domain encoding genes, in nanosilica treated BHC samples. Twenty-two nucleotide miRNA miR-1 with high expression values were found responsible for the initiation of the secondary siRNAs.

***Identification and validation of apoptotic miRNA in HC****:* We confirmed 155 cleavage sites from 19 genes and 18 intergenic regions, targeted by 16 different miRNAs (Table

27).These miRNA targets were not known previously (Table 28). While most target genes were cleaved by only one miRNA at a single recognition site, we identified target sites for miR-1 in PARE library; this is significant because it triggers the MAPK and SRC domain protein synthesis pathway.

Table 27: Target numbers of known miRNAs

| mi-RNA Id | miRNA Expression Value | No. of targets |
|---|---|---|
| MIR1 | 145 | 16 |
| MIR482c | 130 | 12 |
| MIR771 | 127 | 10 |

Table 28: Summary of micro RNA sequence library

| | | Genome assembly V3 | | |
|---|---|---|---|---|
| Code | Total Sequences | Genome Matched Reads | Distinct Genome-Matched Reads | t/rRNA-Matched Reads |
| NS_T | 32,62,563 | 21,48,804 | 7,95,063 | 2,08,533 |
| NS_NT | 27,11,830 | 14,81,446 | 8,16,934 | 3,35,326 |

NS_T= nano silica treated sample; NS_NT= untreated sample

## 3.5. Informatics for Pest Prediction and Pest Management Outreach

### 3.5.1. Life cycle modelling of Indigo caterpillar, *Spodoptera litura as* basis for population prediction

(Investigators: *N.M. Alam, B.S. Gotyal, D. Barman, S. Satpathy, S. Mitra and S.K. Sarkar; Project Code: In-house Project- JE 2.2)*

For developing basic information for insect population prediction, non-linear functions were fitted to model development and mortality rate of *S. litura* using the Insect Life Cycle Modelling (ILCYM) software. The temperature-dependent development rate of the insect was best described by the Brière model for all temperature regimes which resulted in maximum R-square and lowest AIC value among other models. The model is given by the expression:

$$r(T) = aT(T - T_{min}) \times \sqrt{T_{max} - T}$$

Where, 'r' is the developmental time at temperature T, and 'a' is parameter of the model.

Development rate of egg, larvae, pupae and adult has been presented in Table 29. It has been observed that development rate of egg, larvae, pupae and adult gradually increased with increase in temperature. The observed mean development times for all the immature life stages were fastest at 30-33°C (Table 29).

Table 29: Average development time (days ± SE) of indigo caterpillar, *S. litura*, at six constant temperatures.

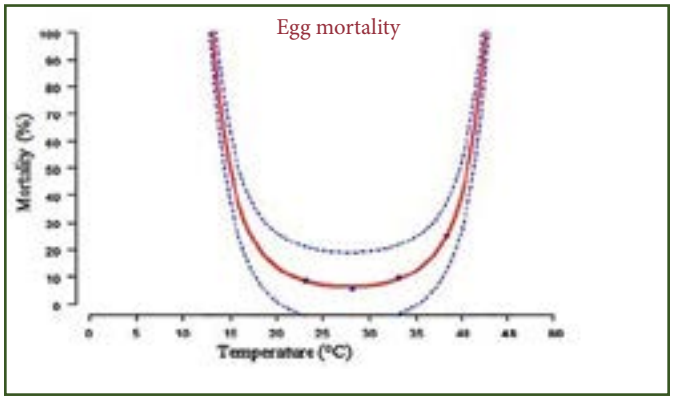
| Temp. (°C) | Egg | | Larva | | Pupa | | Adult | |
|---|---|---|---|---|---|---|---|---|
| | Predicted | Observed | Predicted | Observed | Predicted | Observed | Predicted | Observed |
| 18 | 10.23±0.21 | 11.0±0.15 | 27.76±1.50 | 26.0±0.25 | 18.98±2.05 | 16.0±0.32 | 15.08±2.05 | 17.0±0.35 |
| 21 | 7.67±0.79 | 6.0±0.12 | 26.01±2.76 | 24.0±0.09 | 14.09±1.21 | 14.0±0.12 | 10.20±1.54 | 12.0±0.18 |
| 24 | 6.74±0.38 | 5.0±0.10 | 23.19±2.09 | 22.0±0.05 | 11.89±1.39 | 10.0±0.21 | 8.43±1.98 | 9.0±0.23 |
| 27 | 5.09±0.36 | 3.0±0.07 | 19.04±1.43 | 19.0±0.10 | 9.87±1.05 | 8.0±0.95 | 6.71±0.99 | 6.0±0.29 |
| 30 | 3.98±0.75 | 3.0±0.05 | 15.43±2.05 | 15.0±0.08 | 7.54±0.98 | 6.0±0.07 | 5.37±0.82 | 6.0±0.21 |
| 33 | 3.01±0.12 | 2.0±0.03 | 12.98±1.93 | 13.0±0.02 | 6.55±0.73 | 6.0±0.02 | 4.29±0.76 | 5.0±0.32 |

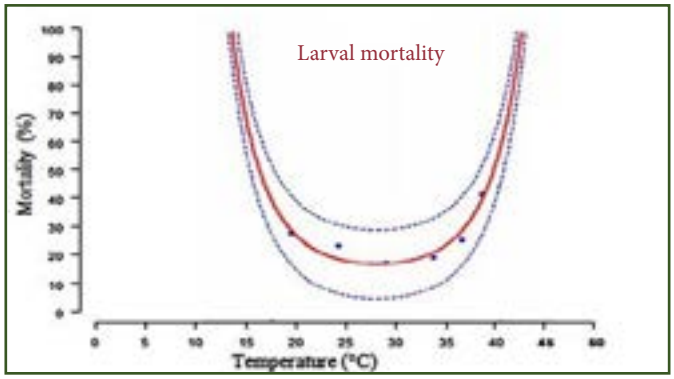
Exponential polynomial equation was fitted to describe the relationship between the mortality rate and the temperature for each life stage. The equation is as follows:

$$M(T) = e^{b_1 + b_2 x + b_3 x^2}$$

Where, M (T) is the mortality rate at temperature T; $b_1$, $b_2$ and $b_3$ are parameters of the equation.

Mortality of *S. litura* was influenced by temperature and the least mortality in immature life stages was observed in 26-28°C (Fig. 23).





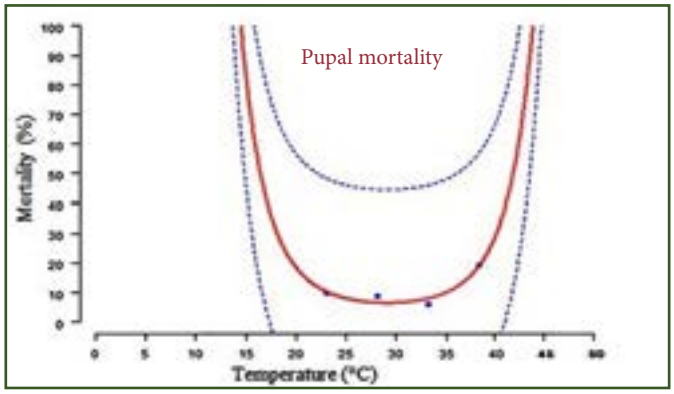
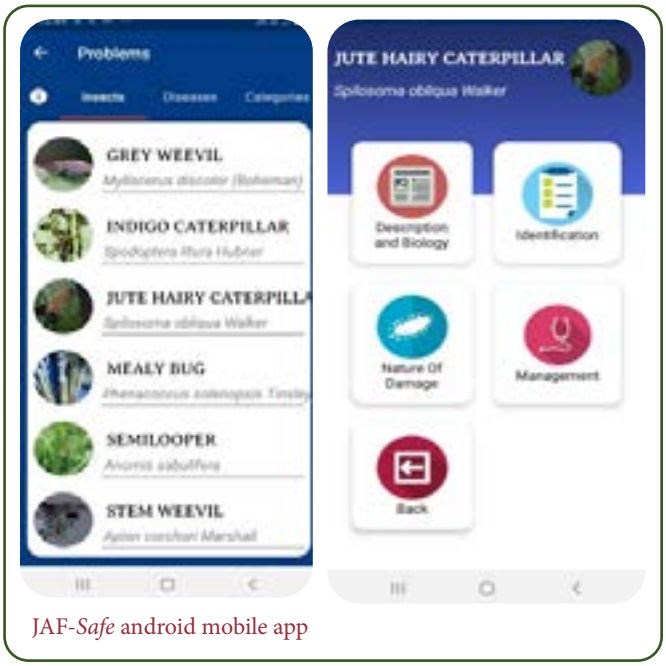




Fig. 23: Temperature dependent mortality rate of *S. litura*. Dotted line represents upper and lower 95% confidence interval of the fitted polynomial regression

### 3.5.2. JAF-*Safe:* Mobile App for Insect Pest Management in Jute and Allied Fibre Crops

(Investigators: *B.S. Gotyal and S. Satpathy)*

ICAR-CRIJAF has developed JAF-*Safe,* an android based mobile app to disseminate scientific information for management of insect pests and diseases in jute and allied fiber crops. This mobile app guides the user to diagnose the pest problem based on crop phenology, nature of damage, biology, life cycle and the image of the pest and disease, the knowledge of which is very much essential for proper decision making in initiating the pest management activities. Choice is also given for Integrated Pest and Disease Management module directly. This app can be accessed by downloading the JAF-*Safe* from Google Play store in any android mobile device. The installation process of the app which is only 4.3 MB in size takes only 30-40 seconds by searching through the key word JAF-*Safe*. To access the contents of JAF-*Safe* app, touch the JAF-*Safe* icon stored in mobile device. This app will comprehensively make the farmers aware of the pest problems in jute and allied fibre crops *vis-vis* their proper, economic management practices. This app will certainly be useful for jute growers, students, extension workers, teachers and other stakeholders.




JAF-*Safe* android mobile app

# 4. Transfer of Technology

## 4.1. Awareness on Climate Resilience, Value Chain and Impact Assessment

### 4.1.1. Awareness of the farmers about adaptive measures for climate variability

(Investigators: *M.L. Roy, S.K. Jha, S. Sarkar, A.K. Ghorai, A.K. Singh, S. Satpathy and A. Chakraborty; Project Code: In-house Project- JEXA 5.8)*

A study was conducted on 60 jute growers of North 24 Parganas, Hooghly and Nadia. The respondents were asked to report their level of awareness on a 3-point continuum (most aware-2, somewhat aware-1 and not aware-0).

Table 30: Farmers' awareness about adaptive measures for climate variability (N=60)

| Adaptive measures | Mean awareness score |
|---|---|
| Growing short duration varieties to increase cropping intensity | 1.47 |
| Rainwater harvesting to cope with prolonged drought situation | 1.22 |
| Application of organic matter to improve water holding capacity of soil | 1.33 |
| Mixed and intercropping for resource use efficiency and weed suppression | 1.50 |
| Diversified farming for additional income and less dependency on crop | 1.52 |
| Making drainage channels to avoid waterlogging during heavy rains | 1.52 |
| Adopting drought resistant/tolerant varieties | 1.00 |
| Sowing and harvesting based on weather forecast | 1.52 |
| Preparing community nursery bed during adverse and scarce situation | 1.33 |
| Dense sowing to recover plant mortality for weather vagaries | 1.32 |
| Split application of nitrogenous fertilizers for efficient use and minimizing loss | 1.33 |
| IPM and INM for better sustainability | 1.27 |
| Construction of low cost poly-houses to raise nursery and vegetables | 1.08 |
| Growing less water consuming crops | 1.12 |
| Crop insurance | 1.35 |
| Adopting SRI method to save water and fertilizer and increase yield | 1.40 |
| Sulphur application in soil to withstand jute against drought situation | 1.20 |
| Creating soil mulch by nail weeder to conserve soil moisture | 1.30 |
| Adopting profitable cropping system | 1.18 |
| Using CRIJAF SONA to reduce retting duration and water requirement | 1.67 |
| *In-situ* retting in micro-pond | 1.08 |

Mean awareness score for each adaptive measure was calculated after adding the respondents' total awareness score on that divided by total number of respondents.

It can be inferred that the farmers are more or less aware of climate resilient measures like improved retting, diversified farming, improved crop husbandry, mechanization, rainwater harvesting, IPM *etc*. Mean awareness score of the respondents ranges from 1.67 to 1.00 (Table 30).

### 4.1.2. Scope of value chain development in jute and role of Farmer Producer Organization (FPO)

(Investigators: *Shamna. A, S.K. Jha, T. Samajdar, R.K. Naik and N.M. Alam; Project Code: In-house Project- JEXA 5.9)*

A baseline study was conducted at two FPOs from North 24 Parganas- Sabka Apna Farmer Producer Company (SAFPC) and Baduria Krishi Bikas Farmer Producer Company (BKBFPC). The average jute yield obtained by the farmers of SAFPC was 35.06 q/ha in 2019. The cost of cultivation of jute (₹ 94500/ha) was found on a higher side and B:C ratio was 1.44. In case of the farmers of BKBFPC, the average jute yield was 30 q/ha, cost of cultivation was ₹ 65000 /ha and B:C ratio was 2.06.

Thirty farmers from SAFPC were selected randomly for pre-testing the attitude of farmers towards value chain development in jute. A set of statements regarding the attitude of farmers towards value chain in jute was developed. Each statement was scored in a continuum of 2, 1 and 0. The cumulative score of 30 participants is given in Table 31. The result showed that the farmers had favorable attitude towards the value chain development in jute.

As a part of building rapport with the farmers as well as FPO, several farmer- scientist interaction meetings, training programmes for farmers on various improved jute cultivation practices and awareness camps were organised. Problems reported by the farmers for the effective functioning of the FPOs with special reference to jute farming were lack of knowledge on jute grading, lack of complete awareness among the members about the functioning of Farmer Producer Company, lack of capital to provide sufficient services, lack of storage and warehouse facility, and backward and forward linkages.

Table 31: Attitude scores of farmers towards value chain development in jute (N=30)

| Particular | FPO SAFPC | |
|---|---|---|
| | Score | Rank |
| I will become a part of jute value chain through Farmer Producer Organisation (FPO) | 37 | 8 |
| Value chain concept will improve the small holder's production | 32 | 10 |
| Value chain will help to improve the post -harvest skills of farmers | 31 | 11 |
| One can develop the attitude of producing what he can sell more profitably | 36 | 9 |
| One can gain skill to adapt to the future through the activities of FPO in value chain | 31 | 11 |
| Value chain members need to understand the specific needs of the customers | 41 | 5 |
| Developing value chain in jute would help to sustain jute cultivation | 40 | 7 |
| Value chain of jute will ensure the market of the jute | 41 | 5 |
| Value chain concept will lead to confidence in farming | 44 | 1 |
| Value chain will improve the mutual interest and commitment | 44 | 1 |
| Better price for production can be ensured through value chain | 42 | 4 |
| Institutional support is required for the success of Farmer Producer Company | 43 | 3 |

### 4.1.3. Impact evaluation of proven ICAR-CRIJAF technologies under Jute-ICARE

(Investigators: *Shailesh Kumar, S.K. Jha, Shamna A., M.L. Roy and N.M. Alam; Project Code: In-house Project- JEXA 6.0)*

The study was carried out in Uttar Dinajpur district of West Bengal. The socio-psychological profile of the respondents *viz*., age, literacy, holding size and income was very diverse. More than half of them were in medium category of sources of information utilization, innovative proneness, scientific orientation and risk bearing ability. These factors had significant influence upon adoption of

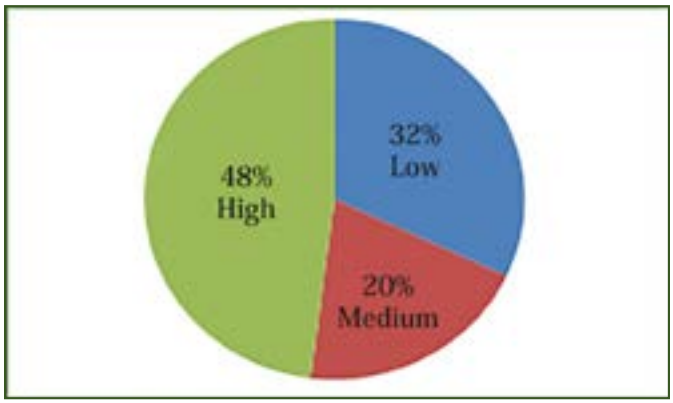



Fig. 24: Distribution of respondents based on adoption level (n=25)

CRIJAF technologies (Fig. 24 & 25). Around one third of them (36%) had increased the area of jute cultivation. Respondents further told that the frequent training - cum- demonstration programmes conducted by ICAR-CRIJAF improved their awareness level about the CRIJAF technologies and simultaneously increased their confidence to adopt the same.

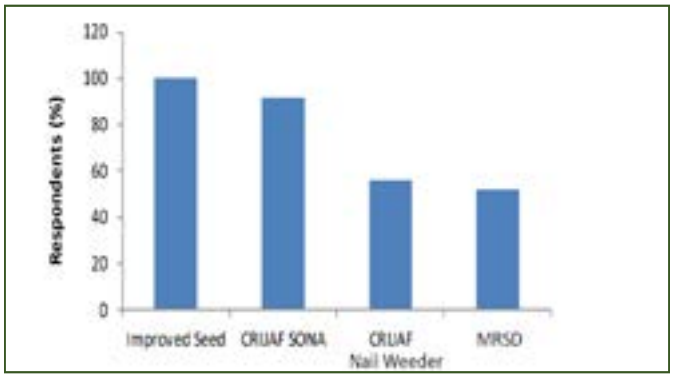



Fig. 25: Degree of adoption of CRIJAF technology

The beneficiaries harvested 23% more fibre yield in comparison to non-beneficiaries. The knowledge score of beneficiaries in terms of source of seed, varietal features, seed rate, operations of Multi row Seed Drill (MRSD), CRIJAF Nail weeder and its attachment and precautions for using CRIJAF SONA was higher than non-beneficiaries.

Table 32: Comparison of selected parameters of the respondents

| Parameter | Adopted | Control | Statistical test | Test statistic | p |
|---|---|---|---|---|---|
| Jute yield (q/ha) | 29.20±0.26 | 23.64±0.29 | t-test | 13.63** | <0.01 |
| Knowledge score | 9.08 | 3.5 | Mann–Whitney U | 0 | <0.01 |

** Significant at 1%

Majority of respondents agreed upon that working condition of farmer has been improved (84%) followed by closer interpersonal relation with fellow farmers (76%) and reduction in workload for farm women/family members (72%). In general, major constraints found in jute cultivation were lack of assured marketing (72%), labour crisis during harvesting and weeding (64%), and availability of retting water (42%).

## 4.2. Frontline Demonstrations (FLDs)

(Investigators: *C.S. Kar, S.K. Jha, S. Kumar, Shamna A., and M.L. Roy, Project: NFSM (CC) Jute)*

### 4.2.1. FLD under National Food Security Mission (NFSM)

Frontline demonstrations on newly released HYV seeds and other improved production technologies of jute were

conducted in various blocks of North 24 Parganas, Nadia, Hooghly and Purba Bardhaman districts of West Bengal through the extension centres of the institute and Krishi Vigyan Kendra (Burdwan) under NFSM for Commercial Crops (Jute) sponsored by Ministry of Agriculture and Farmers' Welfare, Govt. of India. Altogether, 681 demonstrations on improved production technologies of jute were conducted in 245.60 ha area covering four districts (Table 33).

Table 33: Area ('ha) under FLDs on improved production technologies of jute

| District | Block/Village | No. of farmers | Varieties (ha) | Mechanical weed control (ha) | Line sowing MRSD+ (ha) |
|---|---|---|---|---|---|
| North 24 Parganas | Habra-I/ Kumra | 78 | 28.57 | 16.14 | 12.43 |
| | Deganga/ Mangalnagar | 10 | 3.50 | -- | -- |
| | Amdanga/ Govt. Colony & Ratanpur | 20 | 5.12 | -- | -- |
| | Barasat-I/ Ula | 14 | 4.12 | -- | -- |
| Nadia | Haringhata/ Brahmapur | 72 | 26.88 | 15.14 | 11.74 |
| | Krishnanagar-I | 04 | 1.38 | -- | -- |
| | Krishnaganj | 21 | 6.18 | -- | -- |
| | Shantipur | 08 | 2.35 | -- | -- |
| | Karimpur-I/ Gopalpur | 111 | 38.22 | -- | -- |
| | Hanskhali/ Bagula | 33 | 30.00 | -- | -- |
| | Nakashipara | 05 | 1.97 | -- | -- |
| Hooghly | Singur/ Madhusudanpur | 101 | 39.71 | 21.12 | 18.59 |
| | Bolagarh | 159 | 47.60 | - | - |
| Purba Bardha-man | Ausgram II | 45 | 10.00 | - | - |
| **Total** | | **681** | **245.60** | **52.40** | **42.76** |

** All the farmers followed CRIJAF SONA –mediated improved retting*

+ Multi-row seed drill

### 4.2.2. Weed management through mechanical method

In order to reduce the cost of weeding and increase profitability of jute cultivation, the field demonstrations on mechanical weeding by CRIJAF nail weeder (NW) were conducted in the farmer's field (52.40 ha) in three districts of West Bengal (Table 34). Demonstrations on weed management through nail weeder resulted in 2.99-3.83 q/ha fibre yield gain over farmers' practice (28.72-29.07 q/ha). Saving on cost of labour was ₹13,560 to ₹ 14,875/ha. Net return by the farmers of North 24 Parganas was ₹ 36,604/ha followed by Hooghly (₹ 32, 348/ha) and Nadia (₹32,129/ha).

Farmer opareting CRIJAF nail weeder

Jute field after mechanical weed control

Table 34: Economics of jute cultivation through mechanical method of weeding

| Locations/ Particulars | IC (₹/ha) | LC (₹/ha) | CC (₹/ha) | Yield (q/ha) | NR (₹/ha) | B:C ratio |
|---|---|---|---|---|---|---|
| Brahmapur | | | | | | |
| NW | 9854 | 67829 | 77683 | 32.06 | 78791 | 2.01 |
| FP | 12810 | 81389 | 94199 | 29.07 | 46663 | 1.50 |
| Kumra | | | | | | |
| NW | 9213 | 60706 | 69918 | 32.74 | 89968 | 2.29 |
| FP | 12246 | 75581 | 87824 | 28.91 | 53365 | 1.61 |
| Madhusudanpur | | | | | | |
| NW | 7748 | 67659 | 75407 | 31.76 | 79691 | 2.06 |
| FP | 11193 | 81725 | 92918 | 28.72 | 47343 | 1.51 |

*IC- Input Cost, LC- Labour Cost, CC- Cost of Cultivation, NR-Net Return, B:C- Benefit Cost Ratio, FP-Farmers' Practice, NW- Nail Weeder, Prices of jute fibre and jute stick were ₹ 4,000/q and ₹400/q, respectively.*

### 4.2.3. Line sowing

Demonstrations on line sowing through CRIJAF Multi row seed drill were conducted in an area of 42.76 ha in three districts of West Bengal (Table 35). It helped in increasing the fibre yield by 2.16-2.38 q/ha. It also saved the cost of farm labour in jute cultivation by

₹ 8,806- 10,331/ha over farmers' practice. The net return was maximum in Nadia district (₹ 25,169/ha) followed by North 24 Parganas (₹ 23,678/ha) and Hooghly districts (₹ 23,375/ha).

Table 35: Economics of jute cultivation by line sowing using Multi-row seed drill

| Location/ Particulars | IC (₹/ha) | LC (₹/ha) | CC (₹/ha) | Yield (q/ha) | NR (₹/ha) | B:C ratio |
|---|---|---|---|---|---|---|
| North 24 Parganas | | | | | | |
| Multi-row seed drill | 9453 | 65250 | 74703 | 31.07 | 77043 | 2.03 |
| FP | 12243 | 75581 | 87824 | 28.91 | 53365 | 1.61 |
| Nadia | | | | | | |
| Multi-row seed drill | 9519 | 71064 | 80583 | 31.45 | 72948 | 1.91 |
| FP | 12810 | 81389 | 94199 | 29.07 | 47779 | 1.51 |
| Hooghly | | | | | | |
| Multi-row seed drill | 7844 | 72918 | 80762 | 31.01 | 70719 | 1.88 |
| FP | 11193 | 81725 | 92918 | 28.72 | 47343 | 1.51 |

*IC- Input Cost, LC- Labour Cost, CC- Cost of Cultivation, NR-Net Return, B:C-Benefit Cost Ratio, FP-Farmers' Practice, Prices of jute fibre and jute stick were ₹ 4,000/q and ₹400/q, respectively.*

Line sown jute crop at Kumra, North 24 Parganas

Mr. Narendra Kumar, Director, DJD visiting a line sown jute field at Kumra, North 24 Parganas

### 4.2.4. Improved retting through CRIJAF SONA

Improved retting demonstrations were conducted at Kanchiara and Govt. colony villages of North 24 Parganas and Ghoshkamalpur, Karkaria and Gopalpur villages of Nadia district in West Bengal. These were in addition to the demonstrations in Kumra, Brahmapur and Madhusudanpur Extension Centres. Alternate retting demonstrations were also conducted at Jamadarbari and Khudnabari Pathar villages of Barpeta district, Assam and Katihar, Purnea, Madhepura and Supaul Districts in Bihar. At every place Scientist-farmer interaction meetings were also conducted during the demonstrations.

In comparison to conventional method of jute retting, application of CRIJAF SONA (@30 kg/ha) reduced the retting period by 6-9 days at all places. There was an improvement (1-2 grade) in fibre quality and colour *i.e.* yellowish to bright golden. Due to improvement in quality of jute fibre, farmers could earn additional income of ₹ 300 - 450/q (Table 36). This method also reduced the fibre : water ratio (v/v) to only 1:5 which is four times less than the conventional method of retting (1:20).

CRIJAF SONA application during retting

Improved retting demonstrations at Gopalpur, Nadia

Table 37: Qualitative evaluation of fibre using CRIJAF Sona

| Extension Centre | Fibre Quality | | Retting Duration( days) | | Additional Income (₹/q) |
|---|---|---|---|---|---|
| | Improved | Conventional | Improved | Conventional | |
| Nadia | TD 3- 4 | TD 5 - 6 | 13 - 16 | 22 - 24 | 450 |
| North 24 Parganas | TD 4- 5 | TD 5 - 6 | 17 - 20 | 25 -27 | 300 |
| Hooghly | TD 4- 5 | TD 5 - 6 | 14 -18 | 23 -26 | 300 |

Golden fibre produced out of CRIJAF SONA mediated retting

## 4.3. Technology Assessment and Refinement in Farmers' Field

### 4.3.1. Field demonstration on jute and green gram intercropping

(Investigators: *A.K. Ghorai, Suman Roy and Bijan Majumdar; Project Code: In-house Project- JA 7.3)*

Jute and green gram intercropping was done in collaboration with Department of Agriculture, Govt. of West Bengal in different districts like North 24 Parganas, Murshidabad, Dakhsin Dinajpur and West Midnapur. Jute fibre yield varied from 22 to 32 q/ha and the green gram yield ranged from 2.6 - 4.5q/ha. In mixed cropping, maximum green gram yield was up to 660 kg/ha along with jute fibre yield of 30 q/ha under low rainfall in Swarupnagar, North 24 Parganas.

### 4.3.2. Jute-Improved Cultivation and Advanced Retting Exercise (Jute-ICARE)

*(Investigators: B. Majumdar, S. Sarkar, S.K. Jha, R.K. Naik, A.R. Saha, R. Saha and S. Satpathy; Project: Jute-ICARE)*

Jute-ICARE project was initiated in the year 2015 by National Jute Board (NJB) in technical collaboration with ICAR-CRIJAF and The Jute Corporation of India Ltd. (JCI) with an objective to support the small and marginal jute growers with certified seed, mechanization in seed sowing and weed control and to accelerate retting by using microbial consortium. During the year 2019, the project was extended in 72 blocks of West Bengal, Assam, Bihar, Odisha, Meghalaya and Andhra Pradesh covering an area of 1,06,934 ha and 2,43,549 farmers. About 535 MT of certified seed of jute, 600 CRIJAF-Multi row seed drill, 900 CRIJAF-Single Wheel Jute Weeder and 612 MT of CRIJAF SONA were distributed among the jute growers. Scientists of ICAR-CRIJAF have participated in this technology transfer project by imparting training and demonstrations on use of farm inputs and farm implements developed by the institute. Two trainings for master trainers were also conducted at ICAR-CRIJAF campus of Barrackpore for better transfer of technology to jute growers. Altogether 87 training-cum-demonstrations on line sowing, mechanical weeding and improved retting were organized in association with JCI and NJB under farmer's field condition. Scientists also helped in preparation of printed leaflets about the technologies for jute and mesta growers. The quality of CRIJAF SONA produced by various firms was cross checked in ICAR-CRIJAF laboratory before their disbursal to the farming community.

Line sowing of jute crop and improved retting demonstration with CRIJAF SONA under Jute-ICARE programme

Table 37: List of trainings - cum - demonstrations conducted under Jute-ICARE during 2019

| Place | Date | No. of Trainings | Farmers |
|---|---|---|---|
| **Topic: General jute production technology, use of seed drill, nail weeder and single wheel jute weeder** | | | |
| Haripal and Tarakeshwar, Hooghly, West Bengal | 3-4 April, 2019 | 4 | 187 |
| Shantipur, Chapra, Nakashipara, Kaliaganj, Karimpur-I &II, Nadia, West Bengal | 4-10 April, 2019 | 6 | 259 |
| Maynaguri, Jalpaiguri, West Bengal | 4-5 April, 2019 | 3 | 169 |
| Debitala and Golokganj , Dhubri, Assam | 4-5 April, 2019 | 2 | 148 |
| Sitai and Dinhata-II, Coochbehar, West Bengal | 5 April, 2019 | 2 | 105 |
| Purbasthali-I&II, Purba Bardhaman, West Bengal | 5 April, 2019 | 2 | 63 |
| Bhagabangola-II, Jiaganj, Raninagar-I, Domkal and Hariharpara, Murshidabad | 9-11 April, 2019 | 5 | 226 |
| Ratua-I, Malda, West Bengal | 11 April, 2019 | 2 | 179 |
| Gangarampur and Kaliyaganj, North Dinajpur, West Bengal | 12 April, 2019 | 2 | 158 |
| Bhargana and Forbesganj, Araria; Bihariganj and Muraliganj, Madhepura and Chattapur & Pratapganj, Supaul, Bihar | 30 April-2 May, 2019 | 8 | 352 |
| Keonjhar and Jaipur, Odisha | 27-28 May, 2019 | 4 | 155 |
| **Topic: Improved retting of jute with CRIJAF SONA** | | | |
| Maynaguri and Dhupguri , Jalpaiguri, West Bengal | 18 July, 2019 | 3 | 172 |
| Mekhliganj, Coochbehar, West Bengal | 19 July, 2019 | 1 | 61 |
| Shantipur and Chapra, Nadia, West Bengal | 26 July, 2019 | 2 | 131 |
| Katwa- I &II, Purba Bardhaman, West Bengal | 27 July, 2019 | 2 | 105 |
| Balagarh, Hooghly, West Bengal | 30 July, 2019 | 1 | 62 |
| Dinhata-II and Sitai, Coochbehar, West Bengal | 30 July, 2019 | 3 | 183 |
| Golokganj and Agomani, Dhubri, Assam | 31 July, 2019 | 2 | 104 |
| Mathabhanga-I, Coochbehar, West Bengal | 1 August, 2019 | 2 | 121 |
| Baduria, North 24 Parganas, West Bengal | 1 August, 2019 | 2 | 125 |
| Chattapur, Pratapganj, Raghopur- Supaul, Muraliganj- Madhepura, Bihar | 1-3 August, 2019 | 4 | 208 |
| Karimpur-I & II, Nakashipara and Kaliganj, Nadia, West Bengal | 2-3 August, 2019 | 4 | 236 |
| Raninagar-I, Domkal, Jalangi, Jiaganj and Hariharpara, Murshidabad, WB | 2-3 August, 2019 | 5 | 305 |
| Morigaon, Nagaon and Darrang, Assam | 4-5 August, 2019 | 5 | 309 |
| Ratua-I, Malda, West Bengal | 6 August, 2019 | 2 | 167 |
| Kusmandi, Dakshin Dinajpur, West Bengal | 7 August, 2019 | 1 | 65 |
| Kaliganj, Uttar Dinajpur, West Bengal | 7 August, 2019 | 1 | 66 |
| Jajpur, Cuttack and Keonjhar, Odisha | 11-13 Sep, 2019 | 4 | 219 |
| **Total** | | **87** | **4670** |

## 4.4. Other Extension Activities Organized

Table 38: Awareness/sensitization programmes, demonstrations, community mobilization campaign

| Particulars | Place | Date |
|---|---|---|
| Research-Extension-Farmer interface meeting | Kumra, North 24 Parganas and Brahmapur , Nadia | 13 June, 2019 |
| Kisan Gosthi on ramie production technology with special emphasis to planting materials of improved variety Hazarika (under ICAR Seed Project) | RRS, Sorbhog | 20 June, 2019 |
| Farmers Day-2019 | Madhusudanpur, Hooghly | 14 August, 2019 |
| Demonstrations on improved retting method with special emphasis on CRIJAF SONA and power operated jute ribboner | Madhusudanpur, Hooghly | 14 August, 2019 |
| | Kumra, North 24 Parganas | 17 August, 2019 |
| | Kanchiara Village, North 24 Parganas | 20 August, 2019 |
| Parthenium Awareness Campaign | Kanchiara Village, North 24 Parganas | 20 August, 2019 |

| Particulars | Place | Date |
|---|---|---|
| Demonstrations on improved retting method with special emphasis on CRIJAF SONA and Bast fibre extractor | Beraberi Govt. colony, North 24 Parganas | 23 August, 2019 |
| Training-cum-demonstrations of CRIJAF SONA | Nakashipara, Nadia | 26 August, 2019 |
| | Bridhakulla, North 24 Parganas | 2 September, 2019 |
| Interface between Farmers – Scientists – RAC members | ICAR-CRIJAF, Barrackpore | 23 September, 2019 |
| Awareness campaign on ill effects of plastic and MGMG activity | Panchkahaniya village, Nadia | 28 September, 2019 |
| Vigilance awareness programme | Mallickapur Village, North 24 Parganas | 1 November, 2019 |
| World Soil Day celebration and Soil Health Card distribution | Bongaon, North 24 Parganas | 5 December, 2019 |
| Sanitation and cleanliness drive under Swachh Bharat Mission | Kharer Math, North 24 Parganas | 18 December, 2019 |
| Interview with AIR Akashvani Personal about ICAR-CRIJAF technologies and jute as an alternative to minimise use of plastic | Sundarban Kristi Mela-O-Loko Sanskriti Utsab, Kultali, South 24 Parganas | 24 December, 2019 |
| Celebration of Kisan Diwas under Swachh Bharat Mission | Bodai, North 24 Parganas | 23 December, 2019 |
| Swachhta Awareness under Swachh Bharat Mission | Bodai, North 24 Parganas | 24 December, 2019 |
| Awareness on waste management | Kharer Math, North 24 Parganas | 27 December, 2019 |

Demonstration of power operated jute ribboner

Parthenium awareness at Kanchiara village

Field training-cum-demonstration at Kanchiara village

Celebration of Kisan Diwas at Bodai village

# 5. All India Network Project on Natural Fibres (AINPNF)

In 2019-20, a total of 61 projects (jute - 35, mesta - 16, sunnhemp – 02, ramie - 02, sisal - 02 and flax - 04) comprising of trials on germplasm evaluation, hybridization programme and multi-location yield evaluation trials (IETs, AVT-Is and AVT-IIs) under Crop Improvement; soil test based fertilizer prescription, INM, weed management, soil hydro-physical characterization, improved seed production under Crop Production and trials on survey and surveillance of pest and diseases, germplasm screening against biotic stresses, testing of new plant protection molecules and development of location specific IPM modules were taken up under Crop Protection, at different centres of AINPNF. Besides the TSP programme had been taken up at AINP units of BCKV, Kalyani; UBKV, Coochbehar; JRS, Kendrapara and RARS, Nagaon to demonstrate the improved technologies for JAF crops on farmers' participatory mode.

## 5.1 Release and Notification of JAF Varieties

A total of seven (07) jute and allied fibre crop varieties namely, JROMU 1 of *tossa* jute; AMV 8, AMV 9 and JRHS 1 of roselle; JBMP 4 (Utkarsh) and JRHC 3 of kenaf; and SUIN 3 (Kavita) of sunnhemp had been released and notified by the Central Sub-Committee on Crop Standard Notification and Release of Varieties, MoAFW, Govt. of India, New Delhi.

## 5.2 Jute

Out of fifty germplasm accessions of *Corchorus capsularis* screened for fibre yield and yield components at 05 locations, 07 accessions outperformed better check JRC-517 (12.4 g/plant) for fibre yield with CIN-172 recording highest fibre yield (27.7 g/plant) at Coochbehar.

In *Corchorus olitorius,* 50 accessions were screened at 06 locations and 03 accessions OIN-142 (13.0 g/plant), OIN-178 (13.0 g/plant) and OIN-181 (12.8 g/plant) surpassed best check JRO-204 (12.5 g/plant) with accession OIN-147 recording highest fibre yield (25.1 g/plant) at Coochbehar.

In tossa jute, $F_6$, $F_5$,$F_4$, $F_3$ and $F_2$ progenies of different cross combinations were evaluated in Kalyani, Kendrapara, Katihar, Coochbehar, Rahuri and Nagaon centre and promising lines have been identified and selected for further evaluation.

In white jute, $F_4$ and $F_3$ progenies of different cross combinations were evaluated in Katihar and Nagaon. Promising cross combinations at different centres have been identified for further evaluation.

A new crossing program was initiated in Coochbehar and Kalyani centres using superior performing *capsularis* and *olitorius* jute germplasm lines.

In IET of *tossa* jute, the test entry NJ-7020 recorded significantly higher fibre yield (29.13 q/ha) than the best check JRO 524 (26.86 q/ha) while in case of AVT-II trials, test entry JROBA-3 recorded high fibre yield (31.13 q/ha) followed by best check JRO 204 (31.40 q/ha).

In IET of *white* jute, test entry JRCP-7 (31.30 q/ha) recorded high fibre yield followed by JRCP-6 (31.05 q/ha) and both entries were statistically at par with best check JRC 698 (30.82 q/ha) while in case of AVT-I trials, entry JRCP-5 was found to be the high fibre yielder (28.05 q/ha).

In case of AVT-I trials conducted for special traits, entries JROV-5 (132.73 q/ha) and JROV-3 (132.55 q/ha) were found promising with respect to higher biomass production while lowest pre-mature flowering was recorded with test entry JROAF-2 (3.08%) followed by check NJ 7005 (3.27%) at 90 days after sowing

In *olitorius* jute, test entry JROB-2 recorded significantly higher green biomass and fibre yield over both the check varieties (JRO 524 & JRO 204) at Kalyani, West Bengal and over JRO 204 at Katihar, Bihar, respectively. The capsularis entry JRJ-11 recorded significantly higher fibre yield over the checks JRC 517 and JRC 698 at Kendrapara, Odisha and over the check variety JRC 698 at Kalyani, West Bengal and Nagaon, Assam, respectively.

INM trial on jute seed production at Rahuri

In acid soils of Coochbehar, West Bengal, application of fertilizer (100% NPK on ST-TY basis) along with lime (25% LR) in presence or absence of organic manure (5 t/ha) achieved the targeted yield of tossa jute (4.0 t /ha).

Application of quizalofop ethyl 5 EC 60 g + ethoxysulfuron @100 g/ha at 15 DAE recorded higher fibre yield (31.00 q/ha),weed control efficiency, net return (Rs. 91742/ha) and B:C ratio (1.57) at Kalyani.

Application of quizalofop ethyl 5 EC 60 g + ethoxysulfuron @ 50 g/ha at 15 DAE + one hand weeding at 30 DAE recorded higher fibre yield of jute along with better weed control efficiency at Coochbehar, West Bengal and Nagaon, Assam.

Pre-emergence application of pretilachlor 50% EC 900 ml/ha at 45-48 hours of sowing with irrigation + one hand weeding at 15 DAE was found better at Kendrapara, Odisha while post emergence application of quizalofop ethyl (10 EC @ 38 g/ha or 5 EC @ 60 g/ha) alone or with ethoxysulfuron @ 50 g/ha at 15 DAE followed by one hand weeding at 30 DAE recorded higher fibre yield at Katihar, Bihar and seed yield of tossa jute at Rahuri, Maharashtra along with better weed control and higher return.

IWM trial of jute at Kalyani

Application of FYM @ 5.0 t/ha along with fertilizer dose of 80: 17.5: 33.3 kg NPK/ha has recorded maximum seed yield of *olitorius* jute (13.91 - 15.47 q/ha) at Rahuri , Maharashtra and is recommended for the region. In *capsularis* jute, sowing with at 60 cm x 15 cm spacing along with topping at 30 DAS recorded significantly higher seed yield (5.85 q/ha) at Coochbehar.

The bulk SOC content in Purnea, Saharsa and Katihar districts of Bihar were found low to medium (0.49 - 0.62 %) while the SOC content was medium in Jalgaon district, Rahuri (0.69-0.78%). The soils of Nadia district were comparatively low in SOC content (0.48-0.53 %) as compared to soils of Murshidabad district (0.68-0.75 %). The SOC content in Nagaon district ranged between 0.89 to 1.17%.

Among the major insects, yellow mite infestation was more consistent across the centres Barrackpore, Katihar, Kendrapara and Coochbehar) coinciding at 45 DAS to 55 DAS during second fortnight of May to end of June. Maximum infestation of Bihar hairy caterpillar was noticed at Barrackpore, West Bengal while jute semilooper infestation was observed at Nagaon, Katihar, Kendrapara and Coochbehar centres respectively. Maximum incidence of stem rot and root rot diseases were observed from mid-June to September at Barrackpore, Nagaon, Katihar, Kendrapara and Coochbehar

In *tossa* jute, a total of 16 germplasm relatively tolerant to yellow mite were identified at Nagaon (10) and Kendrapara (06), respectively while in *capsularis* jute, 11 germplasm were found to be tolerant to the insects of which 05 were identified at Katihar and 6 germplasm were identified at Kendrapara centre respectively.

Similarly 12 *capsularis* germplasm were found to show considerable resistance against stem rot of which three (CIN-85, CIN-100 and CIN-117) showed no stem rot infection at Katihar, Bihar.

The IPM module comprising of seed treatment with carbendazim 50 WP @ 2g/kg seed + spraying of spiromesifen 240 SC@ 0.7 ml/l water at 35 DAS + spraying of tebuconazole @ 0.15% at 45 DAS + spraying of lamdacyhalothrin 5 EC @ 0.6 ml/l at 55 DAS gave better result in managing the insect pests and disease in jute along with higher fibre yield of line sown jute crop at Barrackpore and Coochbehar, West Bengal (26.18 q/ha & 25.08 q/ha); Katihar, Bihar (24.53 q/ha) and at Kendrapara, Odisha (28.83q/ha), respectively.

IPM trial at Nagaon

## 5.3 Mesta

Out of fifty accessions of *Hibiscus sabdariffa* screened for fibre yield and yield components at 04 locations, 03 genotypes outperformed better check AMV-5 (14.1 g/ plant).

Similarly in *Hibiscus cannabinus,* 50 accessions were evaluated at 03 locations and KIN-221 (14.9 g/plant) and KIN-184 (14.5 g/plant) outperformed better check AMC 108 (14.4 g/plant) for fibre yield.

A total of 23 $F_1$ hybrids of roselle were evaluated at Barrackpore centre. The cross combination REX-4 x NSS 9516 recorded highest fibre yield (30.4 g/plant). A new crossing program was initiated in Amadalavalasa centre using superior performing roselle germplasm lines.

The kenaf test entry, JRK-2018-4 (30.32 q/ha) and JRK_2018-3 (28.49 q/ha) turned out to be the better performing entries over best check HC 583 (25.89 q/ha) in IET trials.

In AVT-I trials, test entry HSLC-2 recorded highest calyx yield (42.29 q/ha) followed by HSLC-1 (42.09 q/ ha), AHC-2 (38.63 q/ha) and AHC-1 (35.42 q/ha) and all entries were significantly superior to the best check HS 4288 (26.54 q/ha).

The test entry AHS 286 recorded significantly higher fibre yield over both the check varieties (AMV 5 & HS 4288) at Rahuri, Maharashtra (23.77 q/ha); at Aduthurai, Tamil Nadu (26.95 q/ha) and at Amadalavalasa, Andhra Pradesh (23.77 q/ha). At Rahuri, maximum fibre yield was recorded with entry AHS-286 receiving fertilizer dose of 60:13.2:25 kg NPK/ha (29.84 q/ha) while at Aduthurai, fibre yield increased significantly up to the maximum fertilizer dose of 80: 17.5: 33.3 kg NPK/ha.

Fertilizer trial of roselle at Rahuri

At Aduthurai, ST-TY based fertilizer application in presence or absence of organic manure at 5 t/ ha could achieve the target yield of mesta (3.2 t/ha) with (+4.6%) and (-5.9%) yield deviation respectively.

At Amadalavalasa, the target of mesta (3.2 t/ha) was achieved with application of 100% of the inorganic fertilizer based on soil test (100% NPK on SY-TY) in combination with either organic manure (5.0 t/ha) or lime (25% LR).

AVT trial of roselle at Amadalavalasa

In mesta, pre-emergence application of pretilachor @ 900 g/ha at 45-48 hrs of sowing with irrigation + one hand weeding at 15 DAE recorded highest fibre yield (27.5 q/ ha), net return (₹ 78000/ha) and weed control efficiency at Aduthurai and also recorded higher fibre yield (23.30 q/ ha) and higher net return (₹ 46,200/ha) at Amadalavalasa.

Maximum seed yield of kenaf was recorded when crop was sown on 15$^{th}$ July at 60 cm x 10 cm spacing, and topping at 45 DAS (8.08 - 14.02 q/ha) at Rahuri, Maharashtra and is recommended for the region.

Maximum fibre equivalent yield (60.86 q/ha) and net return (₹ 127766/ha) was recorded with mesta – sunnhemp cropping sequence followed by mesta – maize and mesta - groundnut sequences at Amadalavalasa. Maximum fibre equivalent yield along with higher returns were recorded when mesta was intercropped with rice (3:4) at Aduthurai, Tamil Nadu and with groundnut (3:4) at Kendrapara, Odisha, respectively.

At Amadalavalasa, maximum infestation of aphids, whiteflies and leafhoppers in mesta were 6.76, 0.64 and 1.67/ plant. The infestation of semilooper and mealybug was 36.33% and 83.00% at 65 DAS and 55 DAS, respectively.

Foliar application of NSKE 5% at 35 DAS followed by azadirachtin (1500ppm) @ 5ml/l at 50 DAS and *V. lecanii* @ 6g/l at 65 DAS or profenophos @ 2 ml/L at 35, 50 and 65 DAS was found effective for management of sucking pests in mesta and also recorded highest fibre yield of mesta (30.06 - 33.28 q/ha) at Katihar, Bihar.

Seed treatment with metalaxyl @ 2.5g/kg seed and foliar spray at 45 and 60 days or seed treatment with cymoxanil + mancozeb @ 3g/kg seed and foliar spray at 45 and 60

DAS significantly reduced foot and stem rot disease in mesta at Katihar centre (25.82 - 25.86 q/ha).

Foot and stem rot infected plants at Katihar

### 5.4 Sunnhemp

Maximum seed yield, net return and B:C ratio in sunnhemp crop was recorded with variety JRJ 610 (17.40 q/ha, ₹ 53890/ha and 2.62) and when the crop was sown on 1st July (18.19 q/ha, ₹ 56920/ha and 2.67) at Rahuri, Maharashtra.

### 5.5 Ramie

At Barrackpore, ridge and furrow method of planting recorded significantly higher fibre yield (8.49 q/ha) of ramie over other planting methods while at Sorbhog, Assam, fibre yield recorded with ridge and furrow method (4.23 q/ha) and raised bed (4.42 q/ha) were statistically at par but significantly higher than fibre yield in flat bed system (2.94 q/ha).

The total fibre yield of ramie recorded with INM treatments (125% of RDN from inorganic + 25% N from FYM/ramie compost) (9.04 – 9.33 q/ha) were statistically at par and both the treatments recorded significantly higher fibre yield over 150% RDN treatment (8.47 q/ha) at Barrackpore, West Bengal. Similar trend was observed at Coochbehar, West Bengal where the ramie yield recorded with INM treatments (10.33 & 9.30 q/ha) were statistically at par with 150% RDN treatment (9.92 q/ha).

At Barrackpore, the annual fibre yield of ramie increased significantly up to 50 kg N/ha/cut dose (9.73 q/ha) while application of potassium increased fibre yield of ramie significantly up to 25 kg K/ha/cut dose as observed in the total fibre yield (8.70 q/ha) of the crop.

### 5.6 Sisal

Application of sisal waste @ 20 t/ha along with inorganic fertilizer @ 60:30:60 or 90:30:60 kg/ha (N: $P_2O_5$ : $K_2O$) recorded 28.2 to 30.2 q/ha fibre yield which was statistically at par with fibre yield obtained from RDF (N: $P_2O_5$: $K_2O$ @ 120:30:60 kg/ha) (24.6 q/ha) at Bamra, Odisha. Similar trend was recorded at Amadalavalasa, Andhra Pradesh when vermicompost @ 2.5 t/ha or sisal waste @ 20 t/ha was applied along with NPK @ 60:13:50 or 90:13:50 kg/ha thereby indicating a savings of 30-60 kg fertilizer N/ha through the use of organic manure at both the locations.

Sisal intercropping trial at Amadalavalasa

The intercropping of sisal with pulses (pigeon pea, cowpea, greengram, blackgram and horsegram) recorded significantly higher sisal fibre equivalent yield (24.4 – 34.7 q/ha) over sole sisal crop (15.1 q/ha) at Bamra, Odisha. Similarly, intercropping of sisal with pulse and oilseed crops significantly increased sisal fibre equivalent yield (24.43 – 43.54 q/ha) at Amadalavalasa, Andhra Pradesh also.

### 5.7 Flax

In IET trials, the test entry JRFJ-4 performed better than check variety JRF 2 while in AVT-I trials, entries JRFJ-2 (12.42 q/ha) and JRFJ-1(12.07 q/ha) out yielded check variety JRF 2 (11.45 q/ha).

Flax intercropping trial at Nagaon

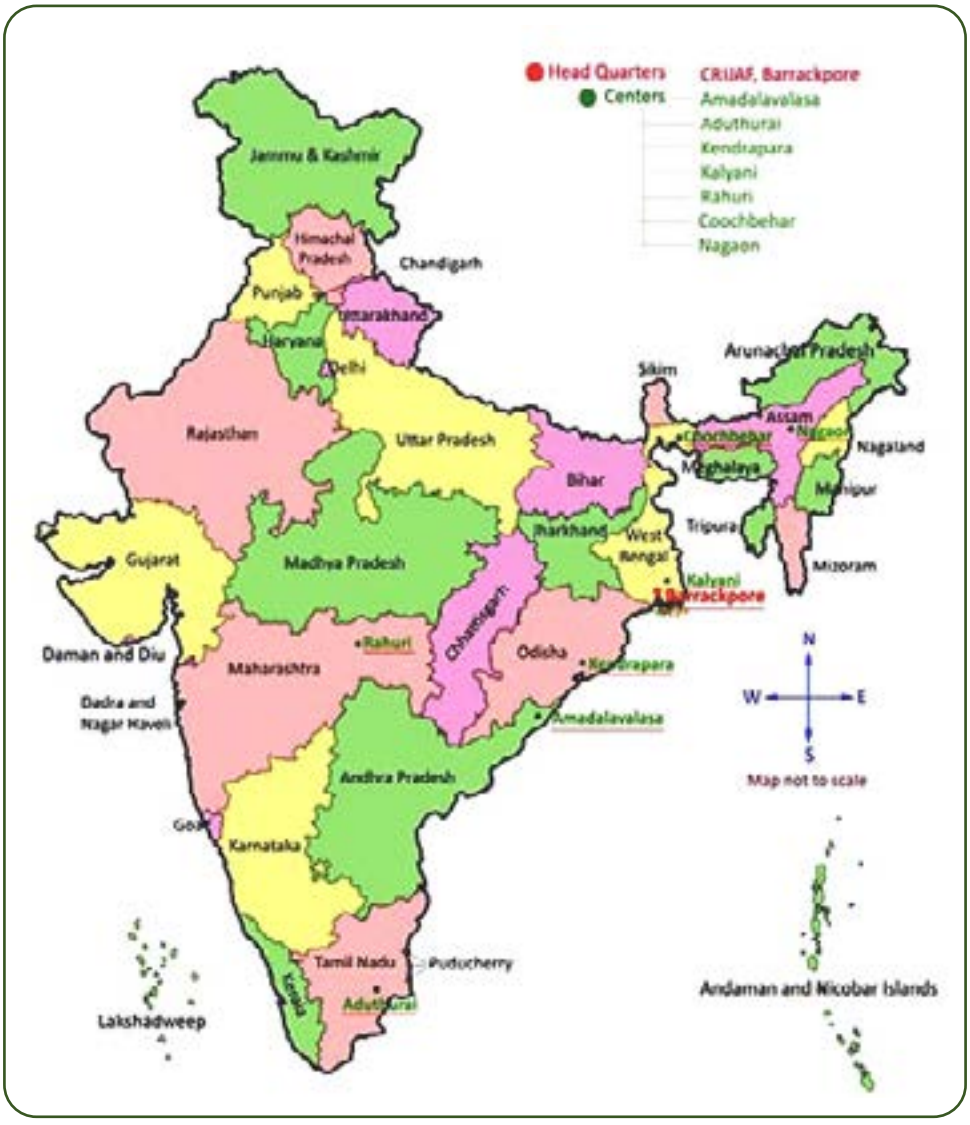
At Coochbehar, flax + coriander (2:1) intercropping system was most profitable and recorded maximum system fibre equivalent yield (32.00 q/ha), net return (₹ 83200/ha) and

B:C ratio (3.31) while at Katihar, Bihar, maximum fibre equivalent yield (14.49 q/ha) was recorded with flax : spinach (2:1) intercropping system.

The incidence of flax wilt caused by *Fusarium oxysporum* sp. *Lini* could be successfully controlled at Nagaon, Assam by spraying of carbendazim 50 WP and azoxystrobin 25% SC at 30 and 60 days old crop.

### 5.8 Tribal Sub Plan (TSP)

In 2019-20, the TSP programme had been taken up by AINP units of BCKV, Kalyani; UBKV, Coochbehar; JRS, Kendrapara and RARS, Nagaon. The programme was conducted in 09 villages belonging to 04 districts of West Bengal, Assam and Odisha covering 35.89 ha area and 251 tribal farmers participated in the programme this year. The demonstration of improved varieties like JRO 204, BCCO 6, line sowing with CRIJAF Seed Drill and improved microbial retting recorded 2.0 – 3.02 q/ha additional fibre yield of jute with additional return of Rs. 4770/ha to Rs. 10895/ha in South Bengal. In North Bengal, the demonstration of improved varieties (JRO 204 and JBO 2003-H), line sowing and integrated weed management in jute recorded 3.0 – 5.0 q/ha additional fibre yield of jute with additional return of ₹ 11100/ha to ₹ 26200/ha over farmers' practices. At Beusahi of Odisha, demonstration of improved microbial retting recorded 2.7 q/ha additional fibre yield with ₹ 15381/ha additional return over farmers' practice. At Nagaon, spraying of neem oil@ 2.5 ml/l or soil application of *Trichoderma viride* reduced the infestation of yellow mite, semilooper, BHC, stem and root rot in jute considerably over farmers' practice.




Location of AINP on NF Centres

# 6. On Farm Trials (OFTs), Front Line Demonstrations (FLDs) through Krishi Vigyan Kendra

Two KVKs, Burdwan and North 24 Parganas (Additional) working under ICAR-CRIJAF implemented various On Farm Trials (OFTs), Front Line Demonstrations (FLDs), and trainings/vocational trainings for disseminating new agricultural technologies and improving skills for farmers, farm women, rural youths and extension workers. Other extension activities like exposure visits, field day, method demonstration, technology week and many other important activities of ICAR-CRIJAF and ICAR-ATARI were also conducted. KVK, Burdwan is presently serving two districts of Purba and Paschim Bardhaman after bifurcation of the erstwhile district of Burdwan. The accomplishments of these KVKs are depicted below in brief.

## 6.1. KVK, Burdwan

### 6.1.1. On Farm Trials (OFTs)

Five OFTs were conducted by the KVK for evaluation of different recommended technologies like remediation measures for cold stress of rice seedling, effect of zinc and boron on productivity and oil content of mustard, late blight management in potato, nutrient management in marigold and mango.

In mango, low yield as well as jelly seed is the common problem. Soil application of calcium nitrate was found suitable in reduction of jelly seeds incidence than other treatments. This treatment increased the mango yield by 25%.

### 6.1.2 Front Line Demonstrations (FLDs)

A total of 348 FLDs were conducted on jute, paddy, mustard, chickpea, onion, banana, brinjal and marigold. The salient findings of the some FLDs are given in Table 39

Table 39: Details of FLDs conducted by KVK, Burdwan

| Crop/ No. of FLDs | Technology demonstrated | Results |
|---|---|---|
| Jute (25) | Variety JRO 204 with improved production technology | Cultivation of improved variety (31.24 q/ha) of jute increased the productivity by 13.5% over farmers practice of JRO 524 (27.52 q/ha). |
| *Kharif* Paddy (60) | Improved seed production technology | An increase of 17% over farmers practice (48.91 q/ha) was obtained in use of improved seed production technology with paddy variety of MTU 7029 (57.24 q/ha). |
| Mustard (47) | Nutrient (sulfur and boron) management with improved variety of Keshari | Introduction of improved cultivar of Keshari with sulfur and boron nutrition resulted in increase of 12 % (15.25 q/ha) over local check (B 9) (13.61 q/ha). |
| Chickpea (117) | INM on improved variety | INM on improved chickpea cultivar, JAKI 9218 resulted in almost 12.1 % increase in productivity over local check Mahamaya. |
| Banana (8) | Grand Naine (TC) | Introduction of Grand Naine (TC) resulted in 26.4% increase in productivity (720 q/ha) over local check (530 q/ha). |
| Onion (25) | Introduction of *kharif* onion, (cv. Agrifound Dark Red) | Introduction of Agrifound Dark Red variety in *kharif* season increased the benefit cost ratio to 3.26, though yield (130 q/ha) was low due to natural calamities. |

OFT on mustard for improving oil content

Farmers visiting low cost vermi-compost unit

FLD on tissue culture (TC) banana, Grand Naine

Demonstration plot of jute (*cv.* JRO 204)

Pheromone trap demonstration for brinjal fruit borer management

Demonstration field of blackgram (cv. IPU 2-43)

Demonstration on polymulching in brinjal

## 6.2 KVK, North 24 Parganas (Additional)

### 6.2.1. Front Line Demonstrations (FLDs)

Thirty four FLDs were conducted on improved production technologies of jute and black gram.

Table 40: Details of FLDs conducted by KVK, North 24 Parganas (Additional) in 2019

| Crop/ No. of FLDs | Technology demonstrated | Results |
|---|---|---|
| Jute (25) | Improved variety of jute (*cv.* JRO 204) and Improved retting of jute with 'CRIJAF SONA' | Yield (q/ha) = 33.86, Quality (TD) =3-4, Retting time (Days) =16-18, Fibre strength (g/tex) =19.03 |
| Black gram (9) | Improved variety of black gram ( *cv.* IPU 2-43) | No of pods per plant = 26.33, No of seeds per pod = 5.26, Pod length = 3.89 cm, Yield (q/ha) = 9.36 |

### 6.2.2 Seed Production by KVK, North 24 Parganas (Additional)

Truthfully labelled seed of rice and black gram was produced in *Kharif* season.

Table 41: Crop-wise seed production at KVK, North 24 Parganas (Additional)

| Crop | Variety | Seed produced (in kg) |
|---|---|---|
| Rice | MTU 1010 | 945 |
| | Luna Sampad | 1307 |
| | Swarna Sub 1 | 2198 |
| | Pusa 1612 | 595 |
| Black gram | IPU 2-43 | 660 |

Seed Production of Rice

# 7. Major Weather Parameters of ICAR-CRIJAF Research Farms

## 7.1. ICAR-CRIJAF, Barrackpore, West Bengal (H.Q.)

At ICAR-CRIJAF, Barrackpore, in the year 2019, the annual mean maximum and minimum air temperatures were 31.1°C and 21.5°C, respectively. The lowest minimum air temperature was recorded in the month of January (10.0°C), and the highest maximum air temperature recorded in May (36.3°C). Annual rainfall of 1589.5 mm was recorded with highest in the month of August (349.1 mm) and lowest in December (mm).

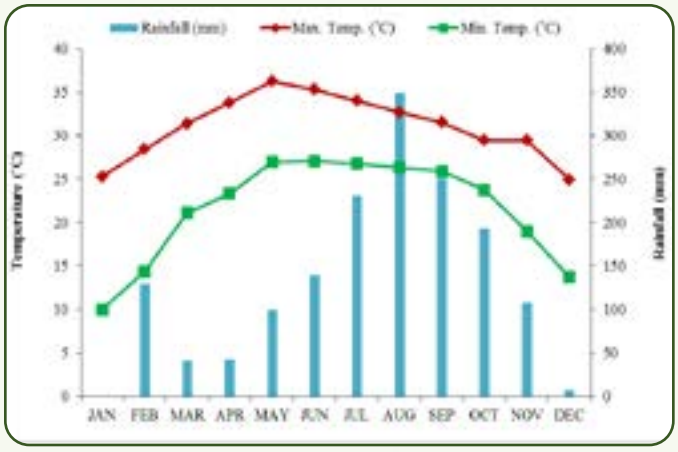



Fig. 26: Rainfall and temperature at CRIJAF, Barrackpore

## 7.2. Central Seed Research Station for Jute and Allied Fibres (CSRSJAF), Budbud, West Bengal

At CSRSJAF, Budbud, in the year 2019, the annual mean maximum and minimum air temperatures were 32.3°C and 20.3°C, respectively. The lowest minimum air temperature was recorded in the month of January (8.4°C), and the highest maximum air temperature recorded in June (37.2°C). Annual rainfall of 1180.2 mm was recorded with highest in the month of August (223.4 mm). There was no rainfall in the month of January.

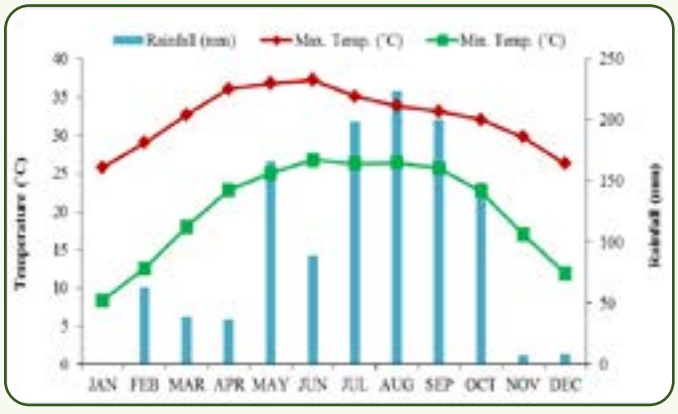



Fig. 27: Rainfall and temperature at CSRSJAF, Budbud

## 7.3. Ramie Research Station (RRS), Sorbhog, Assam

At RRS, Sorbhog, in the year 2019, the annual mean maximum and minimum air temperatures were 29.3°C and 18.3°C, respectively. The lowest minimum air temperature was recorded in the month of January (7.7°C), and the highest maximum air temperature recorded in August (33.5°C). Annual rainfall of 3661.8 mm was recorded with highest in the month of July (1512.0 mm). There was no rainfall in January and December.

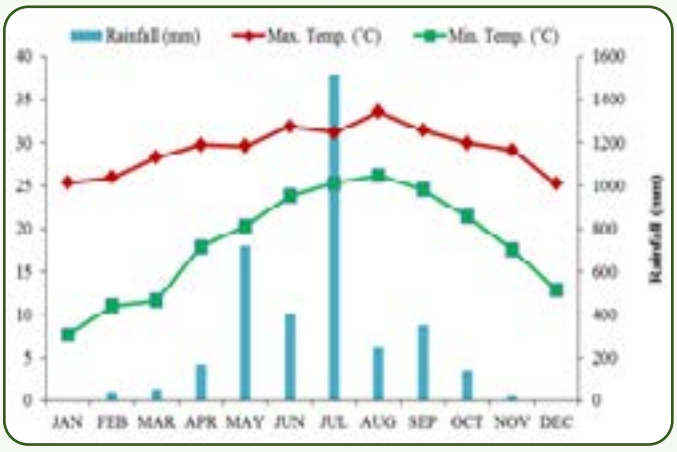



Fig. 28: Rainfall and temperature at RRS, Sorbhog

## 7.4. Sisal Research Station (SRS), Bamra, Odisha

At SRS, Bamra, in the year 2019, the annual mean maximum and minimum air temperatures were 33.6°C and 20.1°C, respectively. The lowest minimum air temperature was recorded in the month of January (9.0°C), and the highest maximum air temperature recorded in May (41.0°C). Annual rainfall of 784 mm was recorded with highest in the month of August (329 mm). There was no rainfall in the months of February, March and December.

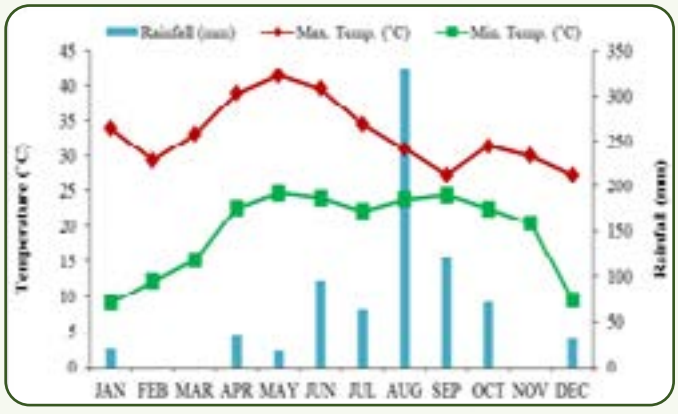



Fig. 29: Rainfall and temperature at SRS, Bamra

### 7.5. Sunnhemp Research Station (ShRS), Pratapgarh, Uttar Pradesh

At ShRS, Pratapgarh, in the year 2019, the annual mean maximum and minimum air temperatures were 31.0°C and 19.8°C, respectively. The lowest minimum air temperature was recorded in the month of January (7.9°C), and the highest maximum air temperature recorded in May (41.6°C). Annual rainfall of 1141.2 mm was recorded with highest in the month of September (398.6 mm). There was no rainfall in the months of November.

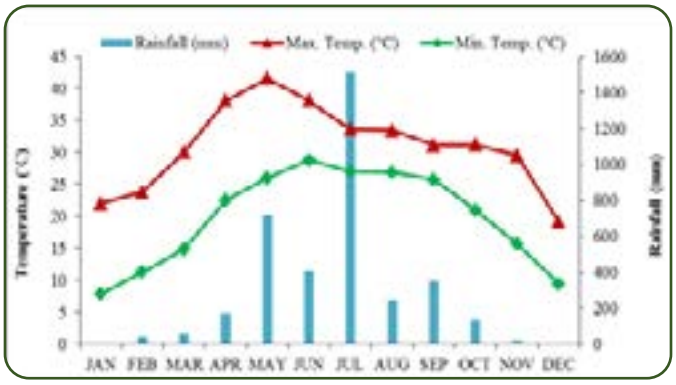



Fig. 30: Rainfall and temperature at ShRS, Pratapgarh

Meteorological observatory at ICAR-CRIJAF, Barrackpore

# 8. Human Resource Development, Seminar/Symposium Attended

## 8.1. Annual Training Plan

An annual training plan for 42 employees of ICAR-CRIJAF was prepared for the year 2019-20. The training need and area were decided by the Director in consultation with Head of the divisions, In-charges of sections and sub-stations, administrative officers and staffs. A total number of 18 scientists, 13 technical personnel and 11 administrative staffs were selected for training. The training plan was submitted through online portal of Human Resource Management (HRM) of ICAR. A six-monthly progress report was also submitted to the ICAR-HRM unit. The financial expenditure up to September-2019 for the training under HRD budget was 3.58 lakh.

## 8.2. Training Conducted

Under HRD programme, a seven-day national level training program sponsored by ICAR entitled "Hands-on training in laboratory instrument handling for technical personnel" was conducted during 19 to 26 September, 2019. The training was intended to impart laboratory machinery handling and techniques for technical personnel of ICAR, SAUs and CAUs. Ten scientists from various ICAR institutes viz., ICAR-NRRI, Cuttack, ICAR-VPKAS, Almora and ICAR-CRIJAF, Barrackpore, participated in this training program. The training program was divided into ten modules with theory and practical sessions. The contents of training included analysis of N:P:K and soil sampling techniques; isolation of DNA, RNA and protein quantification using electrophoresis in molecular techniques; staining of bacteria, fungus and plant tissues; pest and disease management in crops with special emphasis to use of bio-control agents; retting techniques of jute and farm machinery used in jute cultivation, etc.

Participants of instrument handling training programme

## 8.3. Training Imparted

A total 6 scientists, 10 technical personnel and 5 administrative staffs were trained during the year 2019-20. Three newly recruited scientists, namely, Dr. Jitendra Kumar Meena and Mr. Vikas Mangal were sent for professional attachment training. Nine technical personnel were trained on laboratory instrument handling through an in-house training programme. One senior technician (Driver) was trained on "automobile maintenance, road safety and behavioral skill" at ICAR-CIAE, Bhopal. Four newly recruited administrative staffs were trained at ICAR-CIFRI, Barrackpore; and two staffs at ICAR-IASRI, New Delhi on e-office management.

Table 42: Training Undergone by the Scientists/ Staff Members

| Name of the Participants | Place and Date | Name of the programme/training |
|---|---|---|
| **Scientists** | | |
| Dr. A.K. Jha,<br>Dr.Maruti, R.T.<br>Dr. P.N. Meena<br>Mr. Kajal Das | ICAR- CRIJAF, Barrackpore<br>14-23 November, 2019 | ICAR-Sponsored Short Course on 'Recent advances in resource conservation technologies ( RCTS) under aberrant climate change scenario' |
| Dr. J.K. Meena<br>Mr. Vikas Mangal | ICAR-NBPGR, New Delhi<br>03 June-03 September, 2019 | PAT Training |
| **Technical Personnel** | | |
| Shri Sandip Roy<br>Mrs. Pallavi Mandal<br>Shri Biswajit Biswas<br>Shri Ashish M. Pitre<br>Ms. Sharmila Sarkar<br>Shri Paritosh Roy<br>Shri Sudip Nandy<br>Shri A. Sinha Roy<br>Shri Akshay Mondal | ICAR-CRIJAF, Barrackpore 19-26 September, 2019 | Hands-on training in 'Laboratory instrument handling for technical personnel' |
| **Administrative Personnel** | | |
| Shri Surajit Barman<br>Ms. Farheen Banu | ICAR-IASRI, New Delhi<br>03-04 May, 2019 | Training on 'How to create the EMD and how to use e-office (e-file) and maintain the e-office as local admin' |

Table 43: Seminar/ Symposium/ Conference/Meeting/ Workshop attended by the Scientists

| Name of the Participant | Institute and Date | Program |
|---|---|---|
| Dr. Amit Bera | CCSHAU, Hisar, Haryana<br>07-09 April, 2019 | Joint Annual Group Meeting of AICRP - National Seed Project (Crops) and ICAR Seed Project |
| Dr. Subhojit Datta | Hotel West Inn, Kolkata<br>20 June, 2019 | Workshop on Single Cell Genomics by Illumina Inc. |
| Dr. S. Satpathy<br>Dr. Subhojit Datta<br>Dr. S.K. Jha<br>Dr. Manik Lal Roy<br>Dr. S.P. Mazumder<br>Dr. Shamna, A.<br>Dr. Ranjan Kr. Naik<br>Dr. Suman Roy<br>Dr. Laxmi Sharma | BBCC, Kolkata<br>05-08 November, 2019 | Agricultural Scientists Meet at India International Science Festival |
| Dr. S. P. Mazumder<br>Dr. Ranjan Kr. Naik<br>Dr. N.M. Alam<br>Dr. Shamna, A.<br>Dr. S. Sarkar<br>Dr. A.K. Chakraborty | BCKV, Kalyani<br>28 Nov - 01 Dec, 2019 | International Seminar on 'Agriskills for Convergence in Research, Industry and Livelihood' |
| Dr. J. Mitra<br>Dr. B. Majumdar<br>Dr. S. Sarkar<br>Dr. A.K. Ghorai<br>Dr. C.S. Kar | Science City, Kolkata<br>25 July, 2019 | National Workshop on 'Jute- Strategies for Development' |
| Dr. Ajit Kumar Jha | BAU, Ranchi<br>10-11 August, 2019 | National Conference on 'Doubling Farmers Income for Sustainable & Harmonious Agriculture' |
| Dr. A.R. Saha<br>Dr. S. Mitra<br>Dr. B. Majumdar<br>Dr. Ritesh Saha<br>Dr. S. Sarkar<br>Dr. S. K. Jha<br>Dr. M.S. Behera | NAAS Complex, New Delhi<br>5-9 November, 2019 | International Conference on 'Soil and Water Resource Management for Climate Smart Agriculture, Global Food and Livelihood Security' |
| Dr. S. Satpathy<br>Dr. R.K. De<br>Dr. S.K. Sarkar<br>Dr. B.S. Gotyal<br>Dr. V. Ramesh Babu | ICRISAT, Hyderabad<br>10-14 November 2019 | XIX International Plant Protection Congress (IPPC) 2019 on 'Crop Protection to Outsmart Climate Change for Food Security and Environmental Conservation' |
| Dr. R.K. De<br>Dr. S.K. Pandey | TNAU, Coimbatore<br>14-15 December, 2019 | National Symposium on 'Potential Crops for Food and Nutritional Security' |

# 9. Women Empowerment

ICAR-CRIJAF, Barrackpore has implemented many programmes and activities during 2019 by involving farm women for improving livelihood security, drudgery reduction, skill and entrepreneurship development. The institute has also taken initiatives to improve the farm women's participation in agriculture and to reduce the drudgery. Small farm implements like jute seed drill, nail weeder, single row jute weeder, knapsack sprayer were distributed among 100 farm women to reduce drudgery during the farm operations. Skill development programme was organised on mushroom production, maintenance of backyard poultry, jute bag making etc. for economic empowerment of farm women.

Women farmer sowing jute seeds with CRIJAF MRSD

## 9.1. Demonstration of Women Friendly Farm Implements for Drudgery Reduction Among Farm Women

### *Improved CRIJAF Multi-row seed drill (Jute Seeder)*

The broadcast method of sowing is mostly followed in jute growing areas that increases man days for various intercultural operations. The introduction of manual CRIJAF Multi-row seed drill (MRSD) encouraged the farmers to adopt line sowing method in jute cultivation. CRIJAF scientists have modified this implement to make it lighter and more women friendly. The modified machine is lighter in weight with transparent and weather resistant seed box. The other parts of the earlier seed drill also have been modified to make it women friendly. Due to reduced weight, the drudgery in operation is reduced. The farm women had expressed their wish to involve in jute seed sowing operation after the successful field trials in various locations.

### *Weed control tool for women*

Manual weeding in jute involves lots of drudgery in farm women as the critical period for weeding coincides with extreme hot and humid weather. ICAR-CRIJAF took initiative to introduce drudgery reducing implements *i.e.* single wheel jute weeder for weeding in jute crop.

Demonstration-cum-training on use of nail weeder and single wheel jute weeder was organised in various villages of North 24 Parganas and Nadia district. The improved weeder is reported to be more comfortable with less drudgery for farm women. These low cost, simple implements are very easy to handle and the mechanical weeding can be done in a standing posture. Introduction of such implements had a positive impact on the working condition of farm women.

A women farmer operating CRIJAF single wheel jute weeder

## 9.2. Skill Development for Economic Empowerment of Farm Women

For empowering farm women various initiatives were taken by ICAR-CRIJAF like skill development on making of jute bags, jute ornaments and introduction of poultry and duckery in jute based integrated farming system. Awareness on importance of soil test based fertilizer application was created among the farm women. They were also imparted training on knowledge and skill. During 2019-20 eleven young women were trained in the training programme of rural youths for the role of agriculture extension service providers under the Skill India Programme of Agriculture Skill Council of India.

Participants of ASCI training programme of rural youths

The women SHG members attending an interaction meeting

### 9.3. Entrepreneurship Development

For developing entrepreneurial activities among farm women, trainings were imparted to women Self Help Groups (SHG) on preparation of jute bag and other handicraft. The "Paat Rani" Self Help Group which was formed by a group of trainees under entrepreneurship development programme of ICAR-CRIJAF have played a lead role in convincing and inspiring other farm women in entrepreneurship development through imparting training and sharing their success story. The "Paat Rani" SHG members acted as master trainers for several training programmes across the jute growing area of West Bengal. ICAR CRIJAF have taken keen interest in mobilising farm women under the newly registered "Sabka Apna Farmers Producers Company", Nilgunj. The farm women registered under the FPO were given training on mushroom production and jute bag making. Trainings were also organised for the farm women on rearing of improved breeds of poultry (Vanaraja) and duck (Khaki Campbell) under various institute projects and SCSP schemes. Time to time the women groups of the villages were updated about the ways to sustain the women self-help groups by linking them with other related institutions.

Exposer visit of women trainees to mushroom farm

Women members of FPO attending jute bag making training

# 10. Documentation, Online Resource Management, IPR & Commercialization

## 10.1 Documentation Unit

The library facility of the ICAR-Central Research Institute for Jute and Allied Fibres functions as a documentation unit of all kinds of scientific and technical information on jute and allied fibre crops like mesta, ramie, sisal, sunnhemp and flax. The library is full-fledged with resources from Indian and International publishers. ICAR-CRIJAF library is playing an important role in meeting the information needs of scientists, research scholars, extension personals, and farmers.

*Books:* Presently, it holds about 9776 books under various subjects of agriculture and allied discipline like-agronomy and soil science, genetics and plant breeding, plant pathology and entomology, plant physiology and bio-technology, agricultural engineering and extension, statistics and economics, basic science and information technology, hindi and bengali literatures, etc.

*Journals:* The library is enriched with 39 international and 106 indian journals and digital version of international bibiliographic information system for the agricultural science and technology (AGRIS). The library has about 9230 bound volumes of journals and scientific literature since 1947.

CERA (Journals): the link for CERA journals is https://jgateplus.com/home/.

Glimpse of Institute Library

Library holds the annual reports/newsletters/ technical bulletins of various ICAR institutes and sau's, commission/committee reports, research reports, and other general books like stories, economics and politics in hindi, english and bengali languages. to keep abreast of the activities of the institute, the library sends the annual reports, newsletters (JAF news) and technical bulletins of ICAR-CRIJAF to various research organizations including universities and developmental departments of the states.

## 10.2 Online Resource Management

Agricultural Knowledge Management Unit (AKMU) is devoted to online resource management of the institute and assigned with responsibility of developing ICT in agricultural research, maintaining the Institute's network; web server administration; designing, developing and maintenance of institute website and video conferencing systems etc. The online applications of ICAR viz., personnel management information system network (PERMISNET), project information and management system of ICAR (PIMS-ICAR), half yearly progress monitoring system of scientists (HYPM), ICAR KRISHI portal are also updated. ICAR-ERP system is also maintained by MIS-FMS unit of the institute. All the conventional cyber security norms defined by ICAR are being followed by AKMU. AKMU manages audio / video presentations at lecture hall, conference hall, auditorium and committee room for various lectures, training, workshop, seminars, symposia etc.

AKMU, ICAR-CRIJAF has redesigned and developed Institute website (http://www.crijaf.org.in/) as per the ICAR Guidelines. The institute website provides overall research, training and extension activities and achievements of the institute and its research centres. The contents of the institute website are being regularly updated.

The Institute has set up a LAN consisting of more than 100 nodes with a 100 mbps internet connectivity, provided by Ministry of Science and Technology under National Knowledge Network (NKN) in coordination with National Informatics Centre (NIC) since 2014. The internet and email services are available round the clock for the employees of the institute. The internet services are spread over more than 100 users of all categories of staff of the institute who are regularly using the internet and email services in the institute.

Maintenance of LAN infrastructure in the institute done through CISCO gigabit switches and the whole LAN is distributed through a SONICWALL firewall installed at AKMU with fibre optic backbone connectivity to all buildings. Server centric antivirus and antispam, web and application filter and intrusion detection and prevention (IDP) to support the virus protection for the end users.

## 10.3 IPR and Commercialization

### 10.3.1. IPR protection of CRIJAF seed and farm implements

Three designs were registered for ten years namely CRIJAF-Single Wheel Jute Weeder (Design Application No. 289424 in Class 15-03, dated 19.12.2016), Agricultural Weeder with Nail Assembly (Design Application No. 289754 in Class 15-03, dated 02.01.2017) and CRIJAF Jute Seeder (Design Application No. 320658-001 in Class 15-03, dated 13.08.2019). Trademark for CRIJAF Seed (Trade Mark No 1893231) was renewed for ten years w.e.f. 08.12.2019.

Design registration certificate of CRIJAF-Single Wheel Jute Weeder


Design registration certificate of Agricultural Weeder with Nail Assembly


Design registration certificate of CRIJAF Jute Seeder

Trade mark certificate for CRIJAF Seed

### 10.3.2. Royalty from commercialization of the technologies

During 2019-20, total Rs. 35,72,405/-lakhs was received as royalty payment of various commercialized technologies (CRIJAF-Nail Weeder, CRIJAF Multi-Row Seed Drill and CRIJAF SONA, CRIJAF Flax Fibre Extractor and CRIJAF Single Wheel Jute Weeder.

## 10.4. Project Management and Research Networking

The PME Cell of the institute is working as "Single Window" system for priority setting, research monitoring and evaluation, maintenance of database related to projects, achievements, technologies developed, publication etc. Important activities performed by the Cell are conducting Departmental Research Council (DRC), Institute Research Council (IRC) meeting, maintaining Research Project Proforma (RPP), processing of externally funded projects. The PME cell also facilitates in providing the research information of the institute to other departments and stakeholders.

ICAR-CRIJAF is executing a number of collaborative research programmes with several national institutes and other organizations to improve the quality of research programmes on jute and allied fibres and to strengthen linkages among the stakeholders.

Table 44: Networking with other organizations for collaborative research

| S. No | Collaborating organization | Type of activity undertaken |
|---|---|---|
| 1. | National Remote Sensing Centre (ISRO), Hyderabad | Assessment of carbon and moisture flux in jute based cropping system |
| 2. | ICAR-National Institute of Natural Fibre Engineering and Technology, Kolkata | Fibre quality testing, training and technology dissemination |
| 3. | National Jute Board and Jute Corporation of India, Ministry of Textiles, Govt. of India, Kolkata | Dissemination of CRIJAF varieties and technologies, training, survey and knowledge exchange through Jute-ICARE |
| 4. | Agriculture Department, Govt. of W. Bengal | Dissemination of CRIJAF varieties and technologies, training, survey and knowledge exchange |
| 5. | Directorate of Jute Development, Govt. of India, Kolkata | Sharing of expertise for transfer of technologies as well as implementation of NFSM programme |
| 6. | Science and Engineering Research Board, Govt. of India | Research collaboration on basic and strategic aspect of JAF crops. |
| 7. | Science and Technology and Biotechnology, Govt. of West Bengal | Research funding on by-product utilization for bio-ethanol production in jute |
| 8. | National Innovations on Climate Resilient Agriculture (NICRA), ICAR | Research funding on studying the impact of climate change on jute based cropping system. |
| 9. | Department of Higher Education, Science & Technology and Biotechnology, Govt. of West Bengal | Collaborative research funding for assessment of vulnerability of jute production to climate change and its mitigation strategies |
| 10. | ICAR-NBPGR, New Delhi | Collaboration on germplasm exploration and exchange of JAF crops |

# 11. Scheduled Caste Sub- Plan (SCSP)

SCSP focused primarily on promotion of R&D based proven technologies for skill and livelihood improvement to facilitate scheduled caste farmers community in their developmental aspirations programmes backed up by the supply of adequate resources. Successful technology models, farm equipments, improved seed and appliances for improving the farm income in jute-based cropping programme were promoted among the SC farmers with adequate resource support to increase the farm income and reduce the cost of cultivation.

Training programme at ICAR-CRIJAF, Barrackpore

Training programme at Sankha, Jajpur, Odisha

### ICAR-CRIJAF Initiatives

In 2019, the institute has conducted several training and input distribution programmes on improved production technologies of jute and allied fibre crops through its HQ and Regional Research Stations for technological awareness and empowerment of SC farming communities of different districts of West Bengal, Odisha and Assam. The details of the programmes conducted under SCSP are briefed in the following tables.

Table 45: Training programmes and input distribution under SCSP in 2019

| Sl. No. | Programme | Date | Venue | No. of Beneficiaries |
|---|---|---|---|---|
| **Training** | | | | |
| 1. | Mid-season crop management Practices in jute | 26 June, 2019 | ICAR-CRIJAF, Barrackpore | 103 |
| 2. | Mid-season crop management Practices in jute | 27 June, 2019 | ICAR-CRIJAF, Barrackpore | 50 |
| 3. | Mid-season crop management Practices in jute | 28 June, 2019 | ICAR-CRIJAF, Barrackpore | 60 |
| 4. | Enhancing farm income in jute based cropping system | 26 Oct, 2019 | Village: Fasilpur, District: Jajpur, Odisha | 50 |
| 5. | Enhancing farm income in jute based cropping system | 28 Oct, 2019 | Village: Sankha, District: Jajpur, Odisha | 40 |
| 6. | Enhancing farm income in jute based cropping system | 29 Oct, 2019 | Village: Badamalisahi, Fakhirpur, District: Keonjhar, Odisha | 50 |
| 7. | IFS in sisal for doubling farmers income | 18-20 Dec, 2019 | SRS, Bamra, Odisha | 28 |
| **Input Distribution** | | | | |
| 8. | Input Distribution in Assam (4000 Chicks) | 20 June, 2019 | RRS, Sorbhog, Assam | 95 |
| 9. | Input Distribution Programme in Odisha | 7 December, 2019 | Village: Fasilpur, Dist. Jajpur, Odisha | 45 |

Training programme at SRS, Bamra, Odisha

Chicks distribution at RRS Sorbhog

# 12. Swachh Bharat Mission

The institute, its Regional Stations and KVKs under administrative control of ICAR-CRIJAF, Barrackpore actively observed *Swachhta hi Seva* Campaign (11 September-27 October, 2019) and *Swachhta Pakhwada* (16-31 December, 2019) through various cleanliness oriented activities and awareness programmes. The main theme of the programmme was to discourage use of single use plastics.

## 12.1. *Swachhta Hi Seva* Activities

As per the directives of ICAR during the *Swachhta Hi Seva* campaign from 11 Sep to 02 Oct, 2019 the institute organized several drives for cleanliness, collection and disposal of plastics, create awareness about the ill effect of single use plastics. It started with the Swachhata pledge administered by the Director to all the employees of ICAR-CRIJAF.

Public meetings in market place, schools and villages were organized to convey the message to say *'no to plastics'* and use alternatively jute bags which are biodegradable and environment friendly. The shopkeepers in the local market were urged to ask the customers not to carry plastic bags. Drawing competition was also organized among the children in the campus to depict the theme of the campaign through innovative paintings. A cleanliness drive in Matharangi Park attended by all the employees of ICAR-CRIJAF, local people and the public representatives followed by campaign in the local market to ban plastics on 02 October, 2019 marked the end of the 22 days long programme.

In the second part of the *Swachhta Hi Seva* activities from 03-28 October, 2019, *Swachhata* Campaign was initiated on recycling of plastics. During the first period of cleaning of various places inside and outside the campus more than 20 kg collected plastic wastes were disposed to local plastic recycler. In the whole process of recycling, 450 hrs *Shramdan* was extended by the staff of the Institute as well as 50 farmers, local public and students from the nearby schools. In the concluding function the winners of different competitions were awarded. More importantly the main workforce i.e. the *Swacchata Vahini* of the institute were duly felicitated for their dedicated service in keeping the campus clean.


*Swachhta* Pledge taken by the institute personnel

Cleaning activity in institute

Awareness campaign for no use of plastics

Cleanliness campaign at School

Display of *Swachhta* related drawings and paintings

Felicitation of the *Swacchata Vahini* members

KVK, Budbud also arranged massive tree plantation programme and sapling distribution in Uchchagram, Baromuria villages and in KVK campus. Awareness camp on cleanliness, sanitation was organized to sensitize the people on cleanliness. The local people and staff of KVK provided *shramdhan* for plastic waste collection and recycling.

### 12.2. Celebration of *Swachhata Pakhwada* (16-31 December, 2019)

The activities started with *Swachhta* Pledge administered by Director, ICAR-CRIJAF followed by his briefing about the comprehensive activities to be undertaken during the *Pakhwada*.

- Saplings were planted in the CRIJAF farm, institute campus, divisions, guest house, and main office as the symbol of clean environment. During planned cleaning drive, all the divisions, sections, residential area, guest house and the record room of administrative block were cleaned and some obsolete, unserviceable items were discarded.
- Cleanliness drive and awareness program in the MGMG villages Kharermath, Amdanga Block of North 24 Pgs was undertaken. About 40-45 of the villagers with their children enthusiastically participated in this program. Sanitary kits were distributed among the participants. Scientists, technical persons, students, research fellows and young professionals actively participated in this program.

*Shramdhan* for plastic waste collection organised by KVK, Burdwan

Drawing competition at KVK Burdwan

# 13. Mera Gaon Mera Gaurav (MGMG) Programme

A total of 52 villages could be covered under MGMG programme. The scientists are grouped into 11 teams each with 3-4 scientists. Each multi-disciplinary team visited the villages for monitoring of critical growth stages of jute crop and advisory services for improved production and retting practices of jute were given by multi-disciplinary team.

Table 46: Groups of scientists and the allotted villages under MGMG program of ICAR-CRIJAF

| Group | Group Members | Villages/[District] | Local contact person/farmer | Broad areas of activities |
|---|---|---|---|---|
| 1. | Dr. A. K. Ghorai<br>Dr. Suman Roy<br>Dr. Soham Ray<br>Dr. Jitendra Kumar Meena | Bagnabar, Barisha+ 3 Villages (Paschim Medinipur) | Sanjay Manna,<br>Ashis Patra | • Awareness generation of farmers on IFS, IPM, INM, organic farming *etc.*<br>• Awareness generation of farmers regarding Govt. schemes like PMFBY, KCC, SHC etc.<br>• Demonstration of improved production technologies of jute and distribution of critical inputs<br>• Cleanliness drive<br>• Distribution of extension literatures<br>• Solving farmers' crop related queries through direct communication with the contact farmers by mobile phone |
| 2. | Dr. Jiban Mitra<br>Dr. R. K. De<br>Dr. Manik Lal Roy | Madhusudanpur, Beraberi Khagragachi, Bajemelia Kinkarkati, Jampukur (Hooghly) | Nimami Pal | |
| 3. | Dr. Chinmay Biswas<br>Dr. Subhojit Datta<br>Dr. Shailesh Kumar | Kumra, Kashipur Rudrapur, Bijoynagar, Nikerati Panchpota (North 24 Parganas) | Narahari Mandal | |
| 4. | Dr. B. Majumdar<br>Dr. A. Anil Kumar<br>Dr. Laxmi Sharma<br>Mr. Vikas Mangal | Athghara, Kirtipur, Rajapur, Kanupur, Bena (North 24 Parganas) | Abdur Rahaman | |
| 5. | Dr. S. Satpathy<br>Dr. S. K. Sarkar<br>Dr. S. Sarkar<br>Dr. V. Ramesh Babu | Goaldaha, Gokulpur, Bhaduria, Bankra, Koijhury (North 24 Parganas) | Asit Sarkar | |
| 6. | Dr. A. B. Mandal<br>Dr. S. K. Jha<br>Dr. Dipnarayan Saha<br>Dr. R. K. Naik | Paschim Simla, Dighirpar, Chandanpur, Durgapur, Saiadpur, Dakshin Simla (North 24 Parganas) | Abdur Rahaman | |
| 7. | Dr. M. S. Behera<br>Dr. A. K. Chakraborty<br>Dr. Shamna. A<br>Dr. B. S. Gotyal | Makaltala, Farmania, Sonakenia, Abad, Kharo-rudrapur, Beliakhali (North 24 Parganas) | Rounaqul Haque | |
| 8. | Dr. A.K. Singh<br>Dr. Amit Bera<br>Dr. D. Barman<br>Dr. Kanti Meena | Ghidah, Selampur, Gustia, Telenipara, Chapuria (North 24 Parganas) | Yakub Ali Tarafdar | |
| 9. | Dr. Kunal Mandal<br>Dr. Ritesh Saha<br>Dr. Pratik Satya<br>Dr. N. M. Alam | Teghoria, Kadambagachi, Raigram, Bonkanda, Baidyapur, Bharpara (North 24 Parganas) | Sachindra Nath Roy<br>Md. Shah Alam | |
| 10. | Dr. S. Mitra<br>Dr. D. Sarkar<br>Dr. C.S. Kar<br>Dr. S.K. Pandey | Bargachia, Baichhigachi, Ratanpur, Kushdanga, Tapanpur, Shrirampur (North 24 Parganas) | Md. Huzzatalla<br>Moidul Islam | |
| 11. | Dr. A. R. Saha<br>Dr. S. Paul Mazumdar<br>Dr. Maruthi , R.T | Brahmapur, Panchkahania, Satyapole, Bhabanipur, Bansbona, Dhopagachi, Bamanpara (Nadia) | Kenaram Ghosh | |


Distribution of CRIJAF SONA packets at MGMG village of Hooghly

Farmer-Scientist interaction at MGMG village of Nadia

## 13.1 Activities in MGMG villages

Interface meetings/*Gosthies* were organized at villages on soil health management, IPM and CRIJAF technologies. Farmers of MGMG villages were invited to attend on-campus training programmes organized at ICAR-CRIJAF, Barrackpore. Demonstrations were conducted on improved production technologies of jute at some of the MGMG villages. Extension literatures and inputs like CRIJAF SONA were also provided to the farmers. Awareness was created among farmers on use of soil health cards, vigilance, *Swachh Bharat Abhiyan* and other government programmes. The farmers in the selected MGMG villages were trained on major ares like Improved Production Practices of Jute, Improved Retting Technology of Jute, Integrated Pest Management, Soil Fertility Management, Farm Mechanization and Scientific Goat Farming.

Distribution of farm and plant protection implements to farmers of MGMG villages

Vigilance awareness programme at MGMG village

# 14. National Food Security Mission (Commercial Crops) Jute

The programmes under National Food Security Mission (Commercial Crops) Jute, are sponsored by Department of Agriculture and Cooperation of Ministry of Agricultural and Farmers Welfare and monitored by Directorate of Jute Development (DJD), Kolkata. In 2019, the institute conducted 681 FLDs through its three Extension Centres and KVK, Burdwan. These FLDs were conducted in North 24 Parganas, Nadia, Hooghly and Purba Bardhaman districts of West Bengal. The number of FLD beneficiaries in these four districts were 122, 254, 260 and 45, respectively.

## 14.1 Demostration

The technologies demonstrated under FLDs were improved varieties of jute, mechanical weed control by CRIJAF Nail Weeder and line sowing by CRIJAF Multi-row seed drill. FLDs on growing improved varieties of jute were conducted in 245.60 ha covering 681 farmers. FLDs on mechanical weed control by CRIJAF Nail Weeder were conducted in 52.40 ha area covering 251 farmers. FLDs on line sowing of jute by CRIJAF Multi-row seed drills were conducted in 42.46 ha area covering 251 farmers. Besides, field demonstrations on improved retting of jute by CRIJAF SONA were also conducted in the states of West Bengal, Bihar and Assam. In West Bengal, seven field demonstrations on improved retting of jute by CRIJAF SONA were conducted in North 24 Parganas, Nadia and Hooghly districts; in Bihar four field demonstrations were conducted at Katihar, Purnea, Madhepura and Supaul districts. In Assam, one field demonstration on improved retting of jute with CRIJAF SONA was conducted at Barpeta district.

Improved retting demonstration at Khudnabari Pathar, Barpeta

Demonstration programme on 'Degumming Technology of Ramie Fibre' at RRS, Sorbhog

Besides, a demonstration programme on 'Degumming Technology of Ramie Fibre' under "NFSM (Commercial Crops) Jute 2019-20" was held at Ramie Research Station, Sorbhog, Assam on 10th December, 2019. A total of 51 farmers from Uttar Burikhamar, Dakhin Burikhamar, Dekerbori, Sukanjani, Sorbhog, Manikpur, Guwahati, Puthimari, Uttar Ganakgari, Dakhin Ganakgari, Ketekibari and Madulijer participated in this programme.

FLDs were conducted in Mallikapur village, North 24 Parganas to create awareness about the new technologies for management of major pests and diseases in jute crop. Ten farmers participated in this programme in which different pest and diseases management tools were applied in approx. one ha area. Farmers were acquainted with the identification of major insect pests of jute and the damage symptoms under field condition. Besides, the farmers were made aware of the safe handling of chemical insecticides and other precautions to be taken while applying the insecticides in the field.

FLD on new plant protection technology in jute at Mallikapur.

Seed production plot of sunnhemp at Amadalavalasa

## 14.2 Seed production activities

Total 26.30q foundation seed of JAF crops was produced against the target of 30q. Foundation seed produced in West Bengal was 23.20 q [KRO 4 (17.54), JRO 2407 (1.50q), CO 58 (4.16q)]. Foundation seed produced in Andhra Pradesh was 3.10q (Sunnhemp JRJ 610 -2.5 q; Roselle AMV 7 - 0.6q).

Six (6) trainings were conducted for skill development among the seed producers for quality maintenance of new jute, mesta and sunnhemp varieties as per programme in Andhra Pradesh, Tamil Nadu, West Bengal and Assam. A total of 420 seed growers were benefitted through these training programmes.

Under community seed production, demonstrations of seed production technologies of jute and; allied fibres were conducted in 6 ha area in Purulia District of West Bengal with improved mesta variety AMV-5. Six (6) trainings were also conducted in this district and 150 kg of mesta seed was distributed among 50 farmers in Bundwan and Arsha block.

# 15. Research Advisory, Institute Research Council and other Important Meetings

## 15.1. Research Advisory Committee (RAC) Meeting

The Research Advisory Committee (RAC) meeting was held during 24-25 November, 2019 under the Chairmanship of Dr. S.A. Patil, Ex-Director, IARI, New Delhi. The RAC discussed in detail the research activities with the scientists for the period of July 2018 to November 2019. The committee also visited the Sisal Research Station of the institute at Bamra, Odisha on 25th November and reviewed research on different sisal based farming. The Committee interacted with sisal growers during the visit. The committee was satisfied with the research achievements of the scientists under the broad mandate of the institute. The RAC made nine specific recommendations for further strengthening of the research activities of the institute.

RAC meeting at ICAR- CRIJAF

RAC members at SRS, Bamra

## 15.2. Institute Research Council (IRC) Meeting

The Institute Research Council (IRC) meeting (2019-20) was held during 08-09 May, 2019 under the chairmanship of Dr. Jiban Mitra, Director, ICAR-CRIJAF and Co-Chaired by Dr. N. C. Pan, Director, ICAR-NINFET to review the proposal of new research projects as well as the progress and achievements of the on-going in-house and externally funded research projects. A total of 58 research projects were reviewed in the IRC. Dr. S.K. Sarkar, Pr. Scientist and In-charge PME Cell coordinated the meeting.

Dr. J. Mitra, Director, CRIJAF addressing scientists in IRC meeting

Scientist presenting research findings in IRC meeting

### 15.3. Scientific Advisory Committee (SAC) Meeting of KVKs

First Scientific Advisory Committee (SAC) meeting of ICAR-CRIJAF-KVK, North 24 Parganas (Additional) was held on 30.05.2019. Dr. Jiban Mitra, Director, ICAR-CRIJAF chaired the meeting and Dr. S. S. Singh, Director, ICAR-ATARI, Zone V, Kolkata graced the occasion as the Chief Guest. The officers from the State Agriculture Department, Lead Bank Manager, all the Heads, In-charges of the Divisions/Sections, representatives from AIR and press along with the farmer members attended the

SAC meeting of ICAR-CRIJAF-KVK, North 24 Parganas (Additional)

meeting. The committee reviewed the existing programmes and suggested Action Plan for the year 2019-20.

The 15th meeting of the SAC of KVK, Burdwan was held at Bud Bud on 1 June, 2019. The meeting was chaired by Dr. S. Satpathy, Head, Crop Protection Division, ICAR-CRIJAF. Dr. Sk. Md. Azizur Rahman, Head, KVK and a Member Secretary, appraised the committee regarding actions taken on the previous recommendations and the progress of activities under different programmes of KVK. The proposed activities were thoroughly discussed prior to its finalization.

### 15.4. Meeting of Bangladesh delegates with ICAR-CRIJAF Scientists

A team of 27 Bangladesh delegates led by Begum Sabina Yasmin, Joint Secretary, Ministry of Textiles and Jute, Govt. of Bangladesh visited ICAR-CRIJAF, Barrackpore, on 18 July, 2019. Dr. S. Satpathy, Head, Crop Protection Division, ICAR-CRIJAF welcomed the delegates. The discussion was mainly focused around (i) issues related to production, availability and export-import of quality jute seed of high yielding varieties, (ii) issues related

Begum Sabina Yasmin, Joint Secy, MoT, Bangladesh interacting with ICAR-CRIJAF scientists

to jute retting for quality fibre production especially regarding use, benefits, availability and import-export possibility of 'CRIJAF SONA' to Bangladesh, and (iii) mechanization of jute cultivation especially for line sowing by multi-row seed drill, weeding by CRIJAF Nail Weeder and Single Wheel Jute Weeder (popularly known as cycle weeder among the farmers). Begum Sabina Yasmin, profusely thanked the Director and all the Scientists of ICAR-CRIJAF for organizing such a fruitful interaction meet.

# 16. Trainings and Events

## 16.1 Trainings organized by ICAR-CRIJAF, Barrackpore and its Regional Stations

Table 47. Details of training programmes conducted by ICAR-CRIJAF, Barrackpore

| Name of the programme/training | Place and date | No. of participants |
|---|---|---|
| One day training programme for farmers and extension functionaries on "Advanced jute production technology" | ICAR-CRIJAF, Barrackpore<br>12 April, 2019 | 30 |
| Capacity building programme for field staffs under ICAR Seed Project | CSRSJAF, Budbud<br>18-20 June, 2019 | 8 |
| Training programme on 'Ramie Production Technology with special emphasis to planting Mmaterials of improved variety hazarika' under ICAR Seed Project | RRS, Sorbhog<br>20 Jun, 2019 | 50 |
| Trainers' training on "Improved jute retting technology" under Jute-ICARE | ICAR-CRIJAF, Barrackpore<br>3 July, 2019 | 43 |
| "Improved crop management and jute retting practices for enhancing farm income" under DST-NRDMS | ICAR-CRIJAF, Barrackpore<br>16 July, 2019 | 30 |
| One day training programme on"Seed production techniques in jute and allied fibres" under ICAR-Seed Project | SRS, Bamra<br>21 August, 2019 | 41 |
| One day training programme for Farmers and extension functionaries on "Advanced jute production technology" (DJD sponsored) | ICAR-CRIJAF, Barrackpore<br>28 August, 2019 | 80 |
| ICAR sponsored Short Course Training on "Recent Advances in Resource Conservation Technologies (RCTs) under Aberrant Climate Change Scenario" | ICAR-CRIJAF, Barrackpore<br>14-23 November, 2019 | 23 |
| Farmers' training-cum-demonstration on "Quality seed production of rabi crops-towards doubling farmers income" | CSRSJAF, Budbud<br>13 December, 2019 | 75 |
| Training programme on " Integrated Farming System in sisal for doubling farmers Income " under ICAR- SCSP Programme | SRS, Bamra<br>18-20 December, 2019 | 27 |

Inauguration of DJD-sponsored training

Participants of jute production technology training

Inaugural Session of ICAR-Short Course Training

Seed Production training at SRS, Bamra

## 16.2 Trainings organized by ICAR-CRIJAF KVKs

### 16.2.1 Trainings organized by KVK, Burdwan

Table 48. Details of training programmes conducted by KVK, Burdwan

| Target group | No. of Trainings | No. of Participants | | | | | | Trainee days |
|---|---|---|---|---|---|---|---|---|
| | | General | | | SC/ST | | | |
| | | Male | Female | Total | Male | Female | Total | |
| PF | 45 | 28 | 16 | 44 | 724 | 565 | 1289 | 1333 |
| RY | 5 | 36 | 3 | 39 | 23 | 14 | 37 | 76 |
| EF | 2 | 24 | 0 | 24 | 11 | 10 | 21 | 45 |
| Total | 52 | 88 | 19 | 107 | 758 | 589 | 1347 | 1454 |

*PF=Practicing farmer, RY= Rural youth, EF= Extension functionary*

FTP on Mushroom Production


Visit of DAESI trainees to KVK, Howrah

### 16.2.2 Trainings organized by KVK, North 24 Parganas (Additional)

Table 49. Details of trainings conducted by KVK, North 24 Pgs (Addl.)

| Target group | No. of Trainings | No. of Participants | | | | | | Trainee day |
|---|---|---|---|---|---|---|---|---|
| | | General | | | SC/ST | | | |
| | | Male | Female | Total | Male | Female | Total | |
| PF | 12 | 56 | 112 | 168 | 190 | 42 | 232 | 400 |
| RY | 1 | 15 | 0 | 15 | 8 | 0 | 8 | 69 |
| **Total** | **13** | **71** | **112** | **183** | **198** | **42** | **240** | **469** |

Training on Clean Milk Production

Training on weed control in Boro Rice

## 16.3 Events organized by ICAR-CRIJAF, Barrackpore and its Regional Stations

### 16.3.1 International Day of Yoga-2019

ICAR-CRIJAF celebrated 5th International Day of Yoga on 21st June, 2019 at Barrackpore Campus. Dr. Pranab Roy, District President, Patanjali Yoga Samiti, North 24 Parganas, Barasat delivered a talk on Yoga and demonstrated some of the physical *asanas* including *Pranayams*. About 67 participants of the Institute comprising Scientists, Administrative, Technical and Supporting staff attended the programme.


Felicitation of Yoga Guru by Director, CRIJAF

### 16.3.2 World Environmental Day at RRS, Sorbhog

"World Environmental Day" was organised on 5th June, 2019 at RRS, Sorbhog by planting trees in the campus.

Plantation of saplings at RRS, Sorbhog

Dr. Kajal Das, Scientist In-charge (RRS, Sorbhog, ICAR - CRIJAF), FAO (ICAR - CRIJAF) and other staffs of the station participated in this programme.

### 16.3.3 Independence Day Celebration

Independence Day, 2019 was celebrated on 15th August, 2019 at ICAR-CRIJAF in presence of CRIJAF staff and their family members. Dr. Jiban Mitra, Director hoisted the National Flag followed by recitation of National Anthem. Director, Head of the Divisions, In-charges of the sections, Administrative officer, FAO and other senior officers conveyed the message of Independence Day in this occasion.

Independence Day celebration at CRIJAF

### 16.3.4 Celebration of National Unity Day

National Unity Day (Rashtriya Ekta Diwas) was observed on 31st October, 2019 at ICAR-CRIJAF, Barrackpore and its regional stations to remember the great contribution of Sardar Vallabhbhai Patel, the IRON MAN and first Central Home Minister of Independent India, for unification and building of India as a nation.

Pledge taking on National Unity Day

### 16.3.5 Celebration of Constitution Day

'Constitution Day' celebration started on 26th November, 2019 with reading of Preamble of Constitution by all the staffs of ICAR-CRIJAF (HQ) and its Regional Research Stations. Various lectures by experts and eminent

Awareness Campaign on citizen duties on the occasion of Constitution Day

personalities on 'Constitution amendments and their Significance' 'Agriculture Act and Agriculture Legislation and its significance' were organised. At CRIJAF (HQ), Barrackpore a talk on 'Constitution and Citizen Duties, Land Legislation and Reforms' were also organised. To create awareness about the different aspects of Indian Constitution, 'Quiz Competition' was also organised.

### 16.3.6 World Soil Day and distribution of Soil Health Card

The World Soil Day was celebrated on 5th December, 2019 by ICAR-CRIJAF, Barrackpore at Briddhapalla, Bongaon, North 24 Parganas, in the presence of more than 400 farmers, who are direct beneficiaries of soil health card programme. Dr. Jiban Mitra, Director, ICAR-CRIJAF and other senior scientists of the institute were present in this occasion. Director explained about the usefulness of soil health card. The dignitaries distributed 430 soil health cards among the farmers.

Soil Health Cards Distribution on World Soil Day-2019

Vigilance quiz competition awardee being felicitated at WBSU, Barasat

### 16.3.7 Vigilance Awareness Week

Vigilance Awareness Week (VAW)-2019 was observed during 28.10.2019 to 02.11.2019, which started with the Integrity Pledge administrated by the Director, ICAR-CRIJAF to all the staffs of the institute on 28.10.2019. After that human chain was formed in front of the Institute to commemorate the beginning of VAW-2019. Essay writing competition was held on the theme topic, "Integrity-A way of life" on 30th October, 2019. An interface meeting with the suppliers/vendors/service providers of the institute was conducted on 31.10.2019 to sensitize them about the relevance of VAW and also to respond if they have any genuine grievances. A spot quiz competition related with vigilance was conducted during the valedictory function on 02.11.2019 for all participants. All the sub-stations of the institute also celebrated the week to create awareness among the staff on vigilance. Apart from various activities at the institute, vigilance awareness quiz competition cum sensitization programme was conducted at West Bengal State University, Barasat on 01.11.2019 and farmers' awareness programme was organized at Mallickapur village of Barasat-I block in North 24 Parganas district on 01.11.2019.

### 16.3.8 Farmers' Day-2019

Farmers' Day-2019 was organized at village Madhusudanpur, Hooghly. The major objective of this programme was the dissemination of improved jute production technologies and interaction with the farmers about their practical farming problems and the ways to solve these problems with proper technological intervention. Around 120 persons including progressive farmers from surrounding villages, scientists and technical personnel, DJD officials, press and media personnel participated in this programme. The programme was conducted by the Agricultural Extension Section of this Institute. Mr. Jintu Das, Joint Director, DJD, Kolkata was present as the Chief Guest in this programme. Before the start of the programme, two demonstrations on improved retting of jute using CRIJAF SONA and mechanical extraction of fibre by Bast Fibre Extractor were conducted. In the farmer-scientist interaction, the views and knowledge on practical problems and remedies related to new varieties, retting, nutrient management, plant protection practices of jute were exchanged. In this programme, CRIJAF SONA packets and extension literatures were distributed. The progressive farmers were felicitated with Certificates of Appreciation.


Integrity Pledge during Vigilance Awareness Week

Dr. Jiban Mitra, Director, CRIJAF addressing the farmers

### 16.3.9 Kisan Gosthi at RRS, Sorbhog

Kisan Gosthi was organized on 20.06.2019 at RRS, Sorbhog under NFSM (Commercial crop). About 50 ramie farmers from village – Duramari, Ahompothan, Sukanjani participated in the programme. In addition to discussion on scientific ramie cultivation, farmers were also told about the marketing linkage.

Dr. S. Mitra, I/c AINPNF addressing the ramie farmers

### 16.3.10 Exposure visit organized at ICAR-CRIJAF, Barrackpore

Table 50. List of exposure visit of farmers and students organized at ICAR - CRIJAF, Barrackpore

| Particulars | Date | No. of participants |
|---|---|---|
| Exposure visit of farmers from Pakur under Mobile Agriculture School and Services, Ranchi | 21 August, 2019 | 25 |
| Exposure visit of students from UBKV | 2 November, 2019 | 30 |

Exposure visit of UBKV students

### 16.3.11 Kisan Diwas at SRS, Bamra

Kisan Diwas was organized at SRS, Bamra on 23rd September, 2019 to disseminate the latest technologies in sisal farming and general agricultural technologies among the local farmers. Fifty farmers from nearby villages expressed the problems faced by them and suitable technologies were advocated.

### 16.3.12 Participation in agri-fairs, exhibition etc. by ICAR-CRIJAF, Barrackpore

Table 51. List of agri-fairs exhibitions participated by ICAR-CRIJAF, Barrackpore

| Particulars | Place | Date |
|---|---|---|
| 34th Annual Titumeer Fair | Vikas Kendra, Atghara, North 24 Parganas | 17-19 Nov, 2019 |
| Agri-Exhibition | ICAR-NRRI, Cuttack | 6 Dec, 2019 |
| 35th Monomohan Mela o Lokosanskriti Utsav | Chhoto Jagulia, North 24 Parganas | 15-22 Dec, 2019 |
| Sundarban Kristi Mela-o-Loko Sanskriti Utsab | Kultali, P.O. Basanti, South 24 Parganas | 20-29 Dec, 2019 |

Hon'ble DG, ICAR visits CRIJAF stall at ICAR-NRRI, Cuttack

## 16.4 Events organized by ICAR-CRIJAF KVKs

Table 52. List of events organized at KVK, Burdwan

| Sl. No. | Event Name | Duration /Date | No. of Participants |
|---|---|---|---|
| 1 | Celebration of Partheniuam Awareness Week | 16-22 August, 2019 | 25 |
| 2 | Jal Shakti Abhiyan | 27 August, 3 September, 17 September, 2 October, 2019 | 150 |
| 3 | Webcasting of National Animal Disease Control Programme (NADCP) for FMD and Brucellosis | 11 September, 2019 | 58 |
| 4 | Artificial Insemination (AI)Programme | 11 September, 2019 | 10 |
| 5 | Anti-Counterfeit Programme | 12 September, 2019 | 40 |
| 6 | Massive Plantation Programme including Kisan Gosthi | 17 September, 2019 | 100 |
| 7 | 150th Birth Day Celebration of Mahatma Gandhi | 2 October, 2019 | 45 |
| 8 | Distribution of Saplings under *Swachhta he Seva* Programme | 26 September, 2019 | 50 |
| 9 | *Swachhta hi Seva* Programme | 1 September - 2 October, 2019 | 160 |
| 10 | Vigilance Awareness Week | 2 October - 2 November, 2019 | 80 |
| 11 | Awareness programme on Fertilizer Application | 22 October, 2019 | 220 |
| 12 | World Soil Day | 5 December, 2019 | 61 |

Parthenium Awareness Week

Jal Shakti Abhiyan

Webcasting of FMD Programme

Tree Plantation Programme

### 16.4.2 Events organized by KVK, North 24 Parganas (Addl.)

Table 53. List of events organized at KVK, North 24 Parganas (Addl.)

| Sl. No. | Event Name | Duration /Date | No. of Participants |
|---|---|---|---|
| 1 | Webcasting of NADCP for FMD and Brucellosis and National AI Launching Programme | 11 September, 2019 | 105 |
| 2 | World Soil Day | 5 December, 2019 | 28 |
| 3 | Large scale tree plantation programme | 17 September, 2019 | 302 |
| 4 | Fertilizer Awareness Programme | 22 October, 2019 | 65 |

Webcasting of Hon'ble PM's Address

Vaccination Programme

Distribution of planting materials to school children

Hon'ble VC, WBSU planting sapling at KVK farm

# 17. Research Projects

## 17.1 In-house Research Projects

| Project Code | Project title | Investigators | Duration | Results cited in page no. |
|---|---|---|---|---|
| **Crop Improvement** | | | | |
| JB 1.1 | Introduction, maintenance, characterization and conservation of jute, mesta, flax and ramie germplasm | *J. Mitra, A. Bera, A. Anil Kumar, Maruthi R.T., S.K. Sarkar* and *K. Das* | 1997-Long term | 6 |
| JB 10.1 | Genetic improvement of jute genotypes to biotic stresses | *A. Anil Kumar, K. Mondal* and *B.S. Gotyal* | 2015-20 | 10 |
| JB 10.4 | Genetic improvement of jute and mesta for diversified end use | *P. Satya, S. K. Pandey, S. Roy* and *Soham Ray* | 2017-21 | 2, 7, 8 |
| JB 9.6 | Evaluation and selection for high fibre yield and other diversified uses in roselle (*H. sabdariffa*) | *Maruthi R.T., A. Anil Kumar* and *A.R. Saha* | 2014-20 | 11 |
| JB 10.0 | Genetic enhancement of mesta using conventional and molecular approaches for fibre yield and quality improvement | *S.K. Pandey and P. Satya* | 2015-20 | 9 |
| JB 10.2 | Genetics of self-incompatibility and development of improved fibre yielding populations in sunnhemp (*Crotalaria juncea* L.) | *Maruthi, R.T.* and *S. Datta* | 2015-20 | 11 |
| JB10.3 | Genetic improvement of flax (*Linum usitatissimum*) for higher fibre productivity and fibre quality | *J. Mitra, D.N. Saha, Kunal Mandal* and *K.V. Sivakumar* | 2016-22 | 9 |
| JB 9.3 | Towards harnessing cell technological approaches for the enhancement of jute and allied fibre | *A.B. Mandal and Kanti Meena* | 2013-20 | 5 |
| JBT 4.6 | Fixation of a multiparent advanced generation inter-Cross (MAGIC) population of *Corchorus olitorius*) | *D. Sarkar* and *P. Satya and Soham Ray* | 2017-20 | 2 |
| JBT 4.7 | Mining novel alleles for genome engineering applications for herbicide and stress tolerance in jute and allied fibers | *S. Datta, J. Mitra, D.N. Saha, P. Satya* and *A. Anil Kumar* | 2017-20 | 3 |
| JBT 4.8 | Identification of host genes related to stem rot disease resistance in jute and development of segregating population for resistance gene mapping | *Soham Ray, P. Satya, K. Mandal and K. Das* | 2018-21 | 11 |
| JST 6.2 | Jute-Mungbean Intercropping: A statistical perspective | *A.K. Chakraborty, N.M. Alam and A. K. Ghorai* | 2019-21 | 19 |
| JST 1.0: | Effect of seed coating on seed storability and fibre yield in jute (*Corchorus olitorius*) | *A. Bera, C.S. Kar, M. Kumar and B.S. Gotyal* | 2018-21 | - |
| **Crop Production** | | | | |
| JA 7.3 | Development of low-cost and eco-friendly integrated weed management technologies for jute | *A.K. Ghorai, M. Kumar* and *S. Roy* | 2017-20 | 37 |
| JA 8.0 | Integrated weed management and low density jute sowing to increase its net return minimizing manpower requirements in different major operations | *A.K. Ghorai and A. K. Chakraborty* | 2019-2021 | 18, 20 |
| JA 6.9 | Prospect of growing medicinal and aromatic plants in jute and sisal based cropping system | *M.S. Behera, S. Satpathy, A.K. Jha* and *R.K. Naik* | 2014-20 | 20 |
| SLA 1.6 | Use of drip irrigation for improving productivity of sisal based fruit-fibre system in central plateau region of India | *M.S. Behera* and *A.K. Jha* | 2015-20 | 16, 20 |

| Project Code | Project title | Investigators | Duration | Results cited in page no. |
|---|---|---|---|---|
| JA 5.7 | Conservation agricultural practices of jute based cropping systems under climate change scenario | *R. Saha, M.S. Behera, Mukesh Kumar, A.R. Saha, B. Majumdar, S. Paul Mazumdar, D. Barman, R.K. Naik* and *L. Sharma* | 2015-20 | 15 |
| JA 7.4 | Physiological basis of drought tolerance at early growth stage in jute (*C. olitorius*) | *L. Sharma, J. Mitra, S. Mitra, P. Satya, D. Barman* and *S. Roy* | 2017-20 | 12 |
| JA 7.5 | Physiology of flowering behaviour of jute under different photoperiod regimes | *S. Roy, D. Sarkar, P. Satya, L. Sharma, H.R. Bhandari* and *A. K. Jha* | 2017-20 | 8 |
| JA 7.6 | Improvement of soil carbon stocks and farm productivity through integrated cropland management practices in jute cultivation areas (A Farmer's participatory R0esearch) | *A.K. Singh, A.K. Ghorai, R. Saha and M. L. Roy* | 2018-23 | 15 |
| JA 7.9 | Yield and quality of jute seed as influenced by method of application and dose of fertilizer nutrients in southern Bengal condition | *S. Sarkar, M.S. Behera, A. Bera and S.K. Sarkar* | 2018-20 | - |
| JA 7.2 | Soil health characterization and carbon sequestration potential in ramie based cropping system in Eastern India | *S.P. Mazumdar, S. Mitra, B. Majumdar , A.R. Saha* and *K. Das* | 2016-20 | 15 |
| JA 7.8 | Studies on nitrogen dynamics under rice-flax cropping system | *S. P. Mazumdar, D. Barman and M.S. Behera* | 2018-2021 | 16 |
| JAE 3.4 | Development of manual multi-crop seed drill and dry land weeder for Gangetic alluvial soil | *R.K. Naik, A.K. Ghorai, S. Sarkar* and *S.K. Jha* | 2014-20 | 21 |
| JA 7.1 (DSS) | Climate change risk assessment in jute production and related advisory services through Decision Support System | *D. Barman, P. Satya, B.S. Gotyal, A.K. Singh, A.K. Chakraborty, R. Saha, S. P. Mazumdar, Shamna A., S. Mitra and L. Sharma* | 2016-21 | 13 |
| JAE 3.5 | Development of prototype model flax fibre extractor with higher capacity | *R.K. Naik and S. Mitra* | 2018-21 | - |
| JA 5.8 | Studies on ribbon retting methods for quality fibre production in jute and mesta | *R.K. Naik, B. Majumdar, S.P. Mazumdar and M.S. Behera* | 2015-20 | 22 |
| JA 7.7 | Environment friendly low cost retting technology for jute and metagenomics of retting microbiome | *B. Majumdar, S.P. Mazumdar, D. Saha, S. Datta, S. Sarka and S.K. Jha* | 2018-21 | 22 |
| **Crop Protection** | | | | |
| JE 1.9 | Bio-ecology and management of sucking pests in jute | *S. Satpathy, B.S. Gotyal* and *V. Ramesh Babu* | 2016-21 | 25, 26 |
| JM 9.3 | Use of nanoparticles for managing pests and diseases in jute | *C. Biswas and V. Ramesh Babu* | 2018-23 | 29 |
| JE 2.0 | Identification of microbial entomopathogens for management of major lepidopteran pests of jute | *V. Ramesh Babu, G. Siva Kumar and S. Satpathy* | 2018-23 | 23 |
| JE 2.1 | Identification of sources and mechanism of resistance among wild and cultivated accessions of jute against lepidopteran pest complex | *B.S. Gotyal S. Satpathy, V. Ramesh Babu and S. Ray* | 2019-23 | 24 |
| JM 9.2 | Isolation, characteristion and application of *trichoderma* for disease management | *K. Mandal, S.K. Sarkar and Ritesh Saha* | 2018-21 | 24 |
| JM 9.1 | Investigation on diseases of flax and their management | *S.K. Sarkar* and *K. Mandal* | 2017-20 | 29 |

| Project Code | Project title | Investigators | Duration | Results cited in page no. |
|---|---|---|---|---|
| JE 2.2 | Risk Assessment through modeling of major pests and diseases of jute under climate change scenario in India | *N.M. Alam, B.S. Gotyal, D. Barman, S. Satpathy, S. Mitra and S.K. Sarkar* | 2019-22 | 31 |
| JM 9.0 | Development of IPM module for jute | *R.K. De, V. Ramesh Babu* and *Shamna A.* | 2015-21 | 28 |
| **Agricultural Extension** | | | | |
| JEXA 5.8 | Climate variability vis-à-vis jute-based cropping system in West Bengal-an appraisal based on farmers' perspective | *M.L. Roy, S.K. Jha, S. Sarkar, A.K. Ghorai, A.K. Singh and A.K. Chakraborty* | 2017-20 | 33 |
| JEXA 6.0 | Impact assessment of CRIJAF technologies in Jute-ICARE areas of West Bengal | *Shailesh Kumar, S.K. Jha, Shamna A., M.L. Roy and N. M. Alam* | 2019-21 | 34 |
| JEXA 5.9 | Scope of value chain development in jute and role of farmer's producer's organization | *Shamna. A, S.K. Jha, T. Samajdar, R.K. Naik, A. Bera, S.P Mazumdar, B.S. Gotyal and N.M. Alam* | 2019-22 | 33 |
| **Sisal Research Station, Bamra** | | | | |
| SLA 1.7 | Effect of planting materials and fertilizer levels on growth and yield of sisal (*Agave sisalana*) and hybrid sisal | *S. Sarkar, A.K. Jha, D.K. Kundu, M.S. Behera, B. Majumdar and R.K. Naik.* | 2018-23 | 19 |
| SLA 1.8 | Integrated farming system in sisal plantation under organic management package | *M.S. Behera, S. Sarkar and A.K. Jha* | 2018-23 | 20 |
| SLM 1.2 | Management of *Alternaria* leaf spot of sisal (*Agave sisalana*) through eco-friendly approach | *A.K. Jha* | 2019-21 | 28 |
| **Sunnhemp Research Station, Pratapgarh** | | | | |
| SNHM 1.1 | Management of sunnhemp wilt | *Shivakumar K. V. and S.K. Sarkar* | 2019-21 | - |
| **Ramie Research Station, Sorbhog** | | | | |
| RA 1.1 | Development of improved weed management strategies to enhance fibre and rhizome productivity of ramie for North-Eastern India | *K. Das, S. Sarkar, B. Majumdar and R.K. De* | 2019-23 | - |
| **Central Seed Research Station for JAF, Bud bud** | | | | |
| CSRSJAF 1.0 | Investigations on crossing barriers in inter-specific crosses in the genus *Crotalaria* | *H.R. Bhandari* and *Maruthi R.T.* | 2017-20 | 9 |
| CSRSJAF 1.1 | Development of high fibre yielding jute genotypes through hybridization | *H.R. Bhandari, C.S. Kar, Vikash Mangal and J.K. Meena* | 2019-21 | 8 |

## 17.2 Externally Funded Projects

| Sl. No. | Project Title | Principal Investigator | Funding agency | Amount (lakhs) | Duration | Results cited in page no. |
|---|---|---|---|---|---|---|
| 1. | Mega Seed Project (MSP) Seed production in agricultural crops and fisheries | *C.S. Kar* | ICAR, New Delhi | 9.25 | Long-term | - |
| 2. | National Seed Project (NSP) - Crops (BSP) | *C.S. Kar* | ICAR, New Delhi | 5.00 | Long-term | - |
| 3. | Protection of jute varieties and DUS testing project | *Amit Bera* | PPV&FR Authority, New Delhi | 10.00 | Long-term | 9 |

| Sl. No. | Project Title | Principal Investigator | Funding agency | Amount (lakhs) | Duration | Results cited in page no. |
|---|---|---|---|---|---|---|
| 4. | AICRP-LTFE-Project to study changes in soil quality, crop productivity and sustainability under jute-rice-wheat cropping system (LTFE) | *A.R. Saha* | ICAR, New Delhi | 3.00 | Long-term | 14 |
| 5. | AICRP-STCR-Project on soil test and resource based integrated plant nutrient supply system for sustainable agriculture | *A.R. Saha* | ICAR, New Delhi | 2.75 | Long-term | 16 |
| 6. | NFSM: Commercial Crop-Jute | *C.S. Kar* | MoAFW, New Delhi | 60.00 | 2014-19 | 34, 61 |
| 7. | ICAR-NPTC Subproject 3070 Genome sequencing and functional genomics of bast fibre quality | *D. Sarkar* | ICAR | 6.80 | 2015-19 | 1, 2 |
| 8. | Natural resource management for climate smart jute farming through capacity building of scheduled caste farmers in West Bengal | *A.K. Singh* | DST-NRDMS | 17.95 | 2016-19 | 65 |
| 9. | Development of an efficient in vitro micro-propagation protocol for production of healthy propagules in ramie (*Boehmeria nivea* L. Gaud) as planting material for enhanced productivity in sustainable scale | *A.B. Mandal* | DST, West Bengal. | 20.00 | 2016-19 | 5 |
| 10. | Quantitative assessment of carbon and moisture fluxes over Jute based agro-ecosystem: Integrating ground observations, satellite data and modelling | *D Barman* | ISRO, DoS | 38.39 | 2017-20 | 13 |
| 11. | Impact of tropospheric ozone on crop production under jute-rice cropping system | *A.K. Singh* | NICRA, ICAR | 33.75 | 2018-21 | 12 |
| 12. | Assessment of vulnerability of jute production to climate change and its mitigation strategies development using remote sensing GIS in West Bengal | *D. Barman* | DST, West Bengal | 13.94 | 2018-21 | 13 |
| 13. | The impact of Heat Shock Factors in regulating heat stress-induced epigenomic changes: a case study in flax (*Linus spp.*) | *D. Saha* | SERB, DST, GoI | 37.09 | 2019-22 | 4 |
| 14. | Utilizing the potential of jute biomass for bioethanol production | *L. Sharma* | DST, West Bengal | 25.295 | 2019-22 | 21 |
| 15. | Intellectual Property Facilitation Centre (IPFC) for MSME | *Chinmay Biswas* | MoMSME, GoI | 65.00 | 2017-22 | - |

# 18. Publications

## Research Papers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# 19. Awards and Recognitions

## Awards

- Dr. B.S. Gotyal, Senior Scientist received National Academy for Agricultural Science (NAAS) Associateship - 2019 for the outstanding research contribution in the discipline of Agricultural Entomology on June 5, 2019.
- Dr. B.S. Gotyal, Senior Scientist was conferred with 'Dr. B. Vasanthraj David Young Scientist Award' for research contribution in Jute Entomology on November 17, 2019.
- Dr. D. Barman, Senior Scientist was awarded with 'Outstanding Scientist Award' for the year 2019 conferred by Venus International Foundation, Chennai, India for his contribution and achievements in the field of Agricultural Physics on August 03, 2019.
- Dr. D. Barman was also awarded with 'Best Poster Award' presented in: International Seminar on Agriskills for Convergence in Research, Industry and Livelihood organized by Crop and Weed Science Society, BCKV, Kalyani, Nadia, West Bengal, 28 Nov to 1 Dec, 2019.
- Dr. S. Satpathy, Head, Crop Protection Division was awarded with 'Scientist Award – 2019" conferred by Dr. B. Vasanthraj David Foundation, Chennai for his contribution to Agricultural Entomology, Plant Health Management, Biological Control and IPM at Chennai on November 17, 2019.
- Dr. S.P. Mazumdar, Senior Scientist was awarded with 'Best Oral Presentation Award' for the paper "Influence of organic and inorganic source of nutrients on the functional diversity of microbial communities in jute based cropping system in the Eastern region of the Indo-Gangetic plains" presented in: International Seminar on Agriskills for Convergence in Research, Industry and Livelihood organized by Crop and Weed Science Society, BCKV, Kalyani, Nadia, West Bengal, 28 Nov to 1 Dec, 2019.
- Dr. Ranjan Naik, Senior Scientist was awarded with 'Best Researcher Award' conferred by VD Good International Society, Chennai in the 2nd International Award Ceremony at Visakhapatnam, on November 16, 2019

Dr. B.S. Gotyal receiving the NAAS Associateship

Dr. R. K. Naik conferred with Best Researcher Award

- Dr. Shamna A., Senior Scientist was awarded with 'Best Poster Award' for the poster presentation on 'Farm women empowerment through Research and Extension convergence approach'. presented in: International Seminar on Agriskills for Convergence in Research, Industry and Livelihood organized by Crop and Weed Science Society, BCKV, Kalyani, Nadia, West Bengal, 28 Nov to 1 Dec, 2019.
- Dr. M.S. Behera, Principal Scientist was awarded with 'Best Poster Award' for research paper entitled 'Integrated Farming System in sisal plantation for sustainable production' presented in: International Conference jointly organized by Soil Conservation Society of India, World Association of Soil and Water Conservation and International Soil Conservation Organization, November 5-9, 2019, New Delhi.

## Recognitions

- Dr. S. Sarkar, Principal Scientist was nominated as Academic Editor of *World Research Journal of Agronomy*, ISSN: 2320-3404; published by Bioinfo Publication, www.bioinfopublication.org. He was also nominated as Editorial Board Member, *Indian Journal of Science and Technology*, http://indjst.org and as Editorial Board Member, *ARPN Journal of Science and Technology*, http://www.ejournalofscience.org

- Dr. S. Sarkar, Principal Scientist was elected as Councilor of Indian Society of Coastal Agricultural Research (ISCAR) for West Bengal.
- Dr. S.K. Sarkar, Principal Scientist, ICAR-CRIJAF was nominated as a member of Peer Review Team of NAEAB (ICAR) for evaluating UAS, Raichur and its various colleges for Accreditation.
- Dr. S.K. Sarkar, Principal Scientist was nominated by ASRB as a member of DPC for selection of press and editorial and workshop staff (Cat III) at ICAR-CIFRI, Barrackpore.
- Dr. S.K. Sarkar, Principal Scientist was appointed as a Member of Advisory Committee, Neotia University, Kolkata.
- B. Majumdar, Principal Scientist participated as an expert in the "Aajker Chas Bas" programme for farming community of West Bengal on a topic "Paat Chase Pusti Byabasthapana" broadcasted by Akashbani Kolkata (Gitanjali) on 05 April, 2019 at 06.30 AM.

CRIJAF Scientists addressing a radio talk in AIR, Kolkata

- B. Majumdar, Principal Scientist participated as an expert in the "*Khet khamarer Katha*" programme for farming community of India and Bangladesh on a topic "*Paat Chase Pusti Byabasthapana*" broadcasted by the Maitree Channel of All India Radio, Kolkata on 06 April, 2019 at 4.30 PM.
- B. Majumdar, Principal Scientist participated as an expert in the "*Khet khamarer Katha*" programme for farming community of India and Bangladesh on a topic "*Paat Chaser Katha*" broadcasted by the Maitree Channel of All India Radio, Kolkata on 17 April, 2019 at 04.30 PM.
- Sitangshu Sarkar was invited by Prasar Bharati to deliver radio talks on "*Ei samaye pāṭ chāṣe karaṇiya*" which was telecasted by Maitreī Channel for listeners of India and Bangladesh on 05.04.2019 at 04:30 PM and on 12.4.2019 at 04:30 PM.
- Sitangshu Sarkar was invited by Prasar Bharati to deliver a radio talk on "*Ei samaye pāṭ chāṣer prastuti*" telecasted by Gītānjalī Channel on 06.4.2019 at 06:30 AM.
- Sitangshu Sarkar was invited by Prasar Bharati to deliver a radio talk on "*Pāṭer atīt, bartamān o bhabiṣyat*" telecasted by Gitanjali Channel on 10.4.2019 at 06:40 PM.
- Director, Dr. Jiban Mitra participated as country representative nominated by DG, ICAR in the "Joint Meeting of the 40th Session of the Intergovernmental Group on Hard Fibres; the 42nd Session of the Intergovernmental Group on Jute, Kenaf and Allied Fibres and the 21st Session of the Sub-group of Sisal and Henequen Producing Countries" organized by FAO at Beijing, China on October 22-24, 2019.

Delegates of Joint Meeting of the 40th Session of the Intergovernmental Group on Hard Fibres

## Sports Contingent of ICAR-CRIJAF

The sports contingent of ICAR-CRIJAF participated in ICAR Zonal Sports-2019 held at ICAR – NRRI, Cuttack

Victorious sports team of ICAR-CRIJAF

from 18 -22 November, 2019 and won many individual and team events. The institute was the winner in volley ball smashing team event and won gold in 1500 metre race, 800 metre race, 200 metre race, high jump and long jump and chess men events. Altogether the institute bagged 7 golds and 3 bronze medals.

# 20. Official Language Implementation (राजभाषा गतिविधियाँ)

भाकृअनुप-केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान में भारत सरकार की राजभाषा नीति का अनुपालन सुनिश्चित करने के लिए संस्थान में एक राजभाषा प्रकोष्ठ है, इसमें एक वैज्ञानिक हिन्दी प्रभारी के रूप में तथा एक सहायक कार्यरत हैं।

## राजभाषा गतिविधियाँ -

इस संस्थान के वैज्ञानिकों द्वारा कृषकों के जीवन यापन में गुणात्मक सुधार हेतु पटसन एवं समवर्गीय रेशे वाली फसलों के महत्वपूर्ण कृषि तथ्यों से अवगत कराया जाता है। कृषि के क्षेत्र में इस संस्थान की सकारात्मक भूमिका रही है। विकासात्मक गतिविधियों एवं जानकारियों को अन्य भाषाओं के साथ-साथ हिन्दी में भी किसानों तक पहुंचाने में यह संस्थान प्रयासरत है। भाकृअनुप-के.प.स.रे.अनु.सं. में हुई इन उपलब्धियों का संक्षिप्त विवरण प्रस्तुत हैः-

## प्रशासनिक उपलब्धियाँ

संस्थान ने प्रशासन के क्षेत्र में भी काफी महत्पूर्ण उपलब्धियाँ प्राप्त की हैः-

1. अधिकांश विहित फार्मों एवं सभी मानक मसौदे द्विभाषी हैं।
2. अधिकांश रजिस्टरों के शीर्षक द्विभाषी हैं। बाकी रजिस्टरों के शीर्षक द्विभाषी रूप में जल्द से जल्द कर लिए जाएंगे।
3. संस्थान में सभी रबर की मोहरें, नाम पट्ट, शीर्षक-पत्र इत्यादि द्विभाषी हैं। समय-समय पर आवश्कतानुसार मोहरें एवं नाम पट्ट द्विभाषी रूप में बनवाये जाते हैं।
4. संस्थान की राजभाषा कार्यान्वयन समिति की बैठकों में होने वाली चर्चायें सिर्फ और सिर्फ हिन्दी में होती हैं तथा उसे अमल में लाया जाता है।
5. अन्य भाषा-भाषी लोगों के हिन्दी शब्द ज्ञान हेतु प्रतिदिन हिन्दी का एक शब्द 'आज का शब्द' लिखा जाता है।
6. हिन्दी अनुभाग में प्रविष्टियाँ, टिप्पणी एवं मसौदा लेखन व अन्य कार्य हिन्दी में ही होते हैं तथा अन्य अनुभागों में भी अधिकांश प्रविष्टियाँ, टिप्पणी एवं मसौदा लेखन हिन्दी में किए जा रहे हैं।
7. संस्थान के सभी कम्प्यूटरों में द्विभाषी रूप में काम करने के लिए यूनीकोड की सुविधा उपलब्ध है तथा कुछ कम्प्यूटरों पर कुर्तिदेव पर भी काम किए जा रहें हैं।
8. संस्थान के अन्य भाषा-भाषी अधिकारियों/कर्मचारियों को हिन्दी में प्रशिक्षण देने के लिए हिन्दी शिक्षण योजना के अन्तर्गत राजभाषा कक्ष द्वारा संस्थान में ही हिन्दी कक्षायें चलायी जाती है। संस्थान में नवम्बर, 2019 के दौरान 12 अधिकारियों एवं कर्मचारियों ने प्रवीण परिक्षायें उत्तीर्ण कीं तथा मई, 2019 के दौरान इस संस्थान के क्षेत्रीय केन्द्र के.प.स.रे.बी.अ.के., बुदबुद एवं कृषि विज्ञान केंद्र, बुदबुद, बर्दवान के कुल 13 अधिकारियों एवं कर्मचारियों ने प्राज्ञ परीक्षा उत्तीर्ण किए।
9. नगर राजभाषा कार्यान्वयन समिति, कोलकाता कार्यालय–2 (सीएसआईआरकेन्द्रीय कांच एवं सिरामिक अनुसंधान संस्थान, कोलकाता-700032) की छमाही बैठकों में संस्थान के ओर से अधिकारी/कर्मचारी भाग लेते रहते हैं।
10. हिन्दी अनुभाग में प्रविष्टियाँ, टिप्पणी, मसौदा लेखन व अन्य कार्य हिन्दी में होते हैं।
11. हिन्दी में प्राप्त पत्रों के शत-प्रतिशत उत्तर हिन्दी में ही दिए जाते हैं।
12. संस्थान में धारा 3(3) के अन्तर्गत आने वाले संस्थान के सभी दर आमंत्रण, निविदा-प्रपत्र, निविदा सूचनाएं एवं बिक्री सूचनायें आदि द्विभाषी रूप में जारी किए जाते हैं।
13. संस्थान में राजभाषा विभाग के आदेशों के अनुसार संस्थान के स्वीकृत बजट में पुस्तकालयों के लिए निर्धारित कुल अनुदान राशि का 50 प्रतिशत हिन्दी पुस्तकों की खरीद पर व्यय के लक्ष्य को ध्यान में रखते हुए संस्थान में प्रयोग किए जाने वाले विज्ञान, शब्दकोश, सरकारी टिप्पणियाँ एवं कार्यालय उपयोगी संदर्भ पुस्तकें मँगवाई जाती हैं।
14. संस्थान में मूल रूप से हिन्दी में काम करने पर दी जाने वाली प्रोत्साहन योजना को वर्ष 2001 से लागू किया गया है। जिसमें वित्तीय वर्ष 2018-19 में संस्थान के पाँच कर्मचारियों को पुरुस्कृत किया गया।
15. भारतीय कृषि अनुसंधान परिषद के दिनांक 31.03.1991 के परिपत्र के अनुसार संस्थान की राजभाषा कार्यान्वयन समिति की बैठकें नियमित रूप से आयोजित की जाती हैं।
16. राजभाषा विभाग द्वारा आयोजित (केन्द्रीय हिन्दी प्रशिक्षण उप संस्थान, 1 कौंसिल हाउस स्ट्रीट, कमरा नं. 423, तीसरा तल कोलकाता-700001) दिनांक 16.12.2019 से 20.12.2019 के दौरान कंप्यूटर पर हिंदी में काम करने के लिए पंच दिवसीय प्रशिक्षण कार्यक्रम में संस्थान के दो कर्मचारियों ने प्रशिक्षण प्राप्त किया।

## 29 जून, 2019 को एक दिवसीय हिन्दी कार्यशाला का आयोजन

भाकृअनुप-केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान, बैरकपुर, कोलकाता की राजभाषा कार्यान्वयन समिति के तत्वावधान में दिनांक 29 जून, 2019 को एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया। इस कार्यशाला की अध्यक्षता संस्थान के निदेशक, डा. जीबन मित्र जी ने की। निदेशक महोदय ने अपने अध्यक्षीय संबोधन में कहा कि हिन्दी कार्यशालाओं का आयोजन कार्यालय में संघ की राजभाषा नीति के अनुपालन का परिचायक है। इनके माध्यम से ही हम कर्मचारियों को राजभाषा में कार्य करने के दौरान उत्पन्न होने वाली आम कठिनाईयों का निराकरण करने का प्रयास करते हैं।

निदेशक महोदय संस्थान के अधिकारियों/कर्मचारियों को सम्बोधित करते हुए

प्रथम सत्र में हिन्दी कार्यशाला के दौरान मुख्य अतिथि एवं वक्ता श्री अनुप कुमार, सहायक निदेशक (आशुलिपिक एवं टंकक) हिन्दी शिक्षण योजना, भारत सरकार, गृह मंत्रालय, राजभाषा विभाग, कोलकाता ने प्रतिभागियों को हिन्दी पत्राचार तथा टिप्पण आलेखन के बारे में विस्तृत जानकारी दी। उन्होंने आगे पावर प्वाइंट के माध्यम से कम्प्यूटर पर आसानी से टाइप करने के संबंध में बताया तथा अभ्यास भी करवाया।


संस्थान के अधिकारी/कर्मचारी हिन्दी कार्यशाला में भाग लेते हुए

द्वितीय सत्र में श्री रामदयाल शर्मा, सहायक निदेशक (रा.भा.) ने राजभाषा नीति, नियम तथा हिंदी भाषा के मानकीकरण पर विस्तार से चर्चा करते हुए शुद्ध व मानक वर्तनी से प्रतिभागियों को अवगत कराया। इस हिन्दी कार्यशाला में कुल 70 प्रतिभागियों ने हिस्सा लिया। हिन्दी कार्यशाला का सफल संचालन श्री रामदयाल शर्मा, सहायक निदेशक (रा.भा.) ने श्री मनोज कुमार राय, सहायक के सहयोग से किया।

## 11 सितम्बर, 2019 को एक दिवसीय हिन्दी कार्यशाला का आयोजन

संस्थान की राजभाषा कार्यान्वयन समिति के तत्वावधान में दिनांक 11 सितम्बर, 2019 को हिन्दी का कार्यसाधक ज्ञान रखने वाले संस्थान के अधिकारियों/कर्मचारियों की हिन्दी में काम करने की झिझक को दूर करने के उद्देश्य से एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया। इस कार्यशाला की अध्यक्षता संस्थान के निदेशक, डॉ. जीबन मित्र ने की। निदेशक महोदय ने अपने अभिभाषण में कहा कि संघ की राजभाषा नीति का मूल उद्देश्य हिंदी को जनमानस की भाषा के रूप में विकसित करना है ताकि सरकारी गतिविधियों व उपलब्धियों को आमजन तक आसानी से उपलब्ध कराई जा सके। उन्होंने संस्थान के अधिकारियों एवं कर्मचारियों से आग्रह किया कि वे कार्यशाला में प्राप्त व्यावहारिक ज्ञान का पूरा-पूरा लाभ उठाएं एवं कार्यालयीन कार्यों में उनका ज्यादा से ज्यादा प्रयोग करें। डॉ. ए.के. घोराई, प्रभागाध्यक्ष, फसल उत्पादन ने अपने वक्तव्य में कहा कि हिन्दी कार्यशाला के आयोजन से अधिकारियों और कर्मचारियों को हिंदी में काम करते समय आने वाली कठिनाइयों को दूर करने में मदद मिलती है। श्री प्रहलाद सिंह, प्रशासनिक अधिकारी ने अपने वक्तव्य में राजभाषा हिंदी में कार्य करने पर बल दिया।

निदेशक महोदय संस्थान के अधिकारियों/कर्मचारियों को सम्बोधित करते हुए

कार्यशाला में व्याख्यान हेतु श्रीमती रजनी पोद्दार, हिन्दी प्राध्यापक, हिन्दी शिक्षण योजना, भारत सरकार, गृह मंत्रालय, राजभाषा विभाग, निजाम पैलेस, कोलकाता को आमंत्रित किया गया था। उन्होंने राजभाषा नीति, नियम तथा हिन्दी में टिप्पणी, पत्र लेखन एवं मसौदा लेखन आदि विषयों पर विस्तृत जानकारी प्रदान करायी तथा कार्यालयीन कार्यों में हिंदी में आम तौर पर प्रयोग में आने वाले शब्दों के लिंग तथा उनकी पहचान के मूल नियमों की जानकारी दी। डॉ. सुरेन्द्र कुमार पाण्डेय, प्रधान वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने कहा कि हिंदी केवल कागजों की भाषा बनकर

न रहे, इसे हमें अपने चिन्तन की भाषा बनाने की आवश्यकता है। इस कार्यशाला में 53 अधिकारियों एवं कर्मचारियों ने भाग लिया। हिंदी कार्यशाला का संचालन डॉ. सुरेन्द्र कुमार पाण्डेय, प्रधान वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने श्री मनोज कुमार राय, सहायक के सहयोग से किया।

संस्थान के अधिकारी/कर्मचारी हिन्दी कार्यशाला में भाग लेते हुए

## 20 दिसम्बर 2019 को में हिन्दी कार्यशाला का आयोजन

भाकृअनुप-केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान, बैरकपुर, कोलकाता में दिनांक 20.12.2019 को संस्थान के निदेशक, डॉ. जीबन मित्र जी की अध्यक्षता में "राजभाषा कार्यान्वयन" एवं "संविधान दिवस" विषय पर एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया। निदेशक महोदय ने सभी प्रतिभागियों का स्वागत करते हुये कहा कि राजभाषा हिन्दी में कार्य करना बहुत आसान है और इसे सभी कर्मियों को करना चाहिए। इस दौरान संस्थान के मुख्य प्रशासनिक अधिकारी, श्री पी. के. जैन तथा श्री गौरंग घोष, वित्त एवं लेखा अधिकारी ने कार्यशाला के आयोजन की आवश्यकता पर प्रकाश डाला। श्री राम दयाल शर्मा, सहायक निदेशक (राजभाषा) ने राजभाषा नियम, अधिनियम, अनुच्छेद 343 तथा अनुच्छेद 351 इत्यादि को सविस्तार बताया। सभी प्रतिभागियों (21 अधिकारी और 40 कर्मचारी) ने पूरे सत्र में उत्साहपूर्वक ने भाग लिया। हिंदी कार्यशाला का संचालन श्री विकास मंगल, वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने किया तथा कार्यशाला का समापन श्री राम दयाल शर्मा, सहायक निदेशक (राजभाषा) के धन्यवाद ज्ञापन के साथ सम्पन्न हुआ।

संस्थान के अधिकारियों/कर्मचारियों को निदेशक महोदय का संबोधन

## संस्थान में हिन्दी पखवाड़ा समारोह का आयोजन

संस्थान में दिनांक 13 – 27 सितम्बर, 2019 तक हिन्दी पखवाड़ा समारोह का आयोजन किया गया। दिनांक 13 सितम्बर, 2019 को हिन्दी पखवाड़ा उद्घाटन समारोह का आयोजन किया गया। जिसमें मुख्य अतिथि के रूप


संस्थान के अधिकारी/कर्मचारी हिन्दी कार्यशाला में भाग लेते हुए

में श्री नवीन कुमार प्रजापति, पूर्व वरिष्ठ हिन्दी अधिकारी, दामोदर घाटी निगम, कोलकाता को आमंत्रित किया गया था। कार्यक्रम की अध्यक्षता संस्थान के निदेशक, डॉ. जीबन मित्र जी ने की तथा कार्यक्रम का कुशल संचालन डॉ. सुरेन्द्र कुमार पाण्डेय, प्रधान वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने श्री मनोज कुमार राय, सहायक के सहयोग से किया। सर्वप्रथम डॉ. सुरेन्द्र कुमार पाण्डेय, प्रधान वैज्ञानिक ने सभी का स्वागत किया तदुपरांत डॉ. सुब्रत सतपथी, प्रभागाध्यक्ष, फसल सुरक्षा प्रभाग ने सभी का पुन: स्वागत करते हुए कार्यक्रम में इतनी अधिक उपस्थिति को देखते हुए प्रसन्नता जाहिर की और बताया कि सरकारी काम-काज में हिन्दी की प्रगति हुई है जिसे और बढ़ाने की आवश्यकता है। प्रशासनिक अधिकारी, श्री प्रहलाद सिंह ने राजभाषा हिन्दी के अधिकाधिक प्रयोग हेतु प्रशासनिक वर्ग की भूमिका को बतलाते हुए सभी से अधिक से अधिक हिन्दी में काम करने का अनुरोध किया। संस्थान के निदेशक, ने कहा कि हिन्दी अभी उस स्थान पर नहीं पहुँची है जिसकी वह अधिकारिणी है। हमें और बेहतर तरीके से काम करने की आवश्यकता है। इस कार्यक्रम के मुख्य अतिथि एवं वक्ता श्री नवीन कुमार प्रजापति ने हिन्दी की विकास यात्रा पर प्रकाश डालते हुए राजभाषा हिन्दी में कम्प्यूटर के उपयोग की तकनीकी पहलुओं को सविस्तार बताया।

हिन्दी पखवाड़ा के उपलक्ष्य में स्वागत भाषण प्रस्तुत करते प्रभारी, हिन्दी कक्ष, डॉ. एस. के. पाण्डेय

इस दौरान राजभाषा हिन्दी से संबंधित विभिन्न प्रकार की प्रतियोगितायें आयोजित की गईं जैसे दिनांक 13 सितम्बर, 2019 को तत्कालिक भाषण (एक्सटेम्पोर), दिनांक 16 सितम्बर, 2019 को हिन्दी निबंध लेखन प्रतियोगिता, दिनांक 19 सितम्बर, 2019 को वाद-विवाद प्रतियोगिता, दिनांक 21 सितम्बर, 2019 को कम्प्यूटर पर हिन्दी टंकण प्रतियोगिता, दिनांक 23 सितम्बर, 2019 को हिन्दी अनुवाद प्रतियोगिता, दिनांक 25 सितम्बर, 2019 को हिन्दी टिप्पणी एवं प्रारूप लेखन प्रतियोगिता एवं


संस्थान के निदेशक डॉ. जीबन मित्र अधिकारियों/कर्मचारियों को संबोधन करते हुये

26 सितम्बर, 2019 को हिन्दी श्रुतलेखन, पठन एवं शब्द पर्याय लेखन प्रतियोगिता का आयोजन किया गया जिसमें वैज्ञानिक, प्रशासनिक एवं तकनीकी वर्ग के अधिकारियों एवं कर्मचारियों ने उत्साहपूर्वक भाग लिया।

संस्थान में हिन्दी पखवाड़ा समापन समारोह का आयोजन दिनांक 27 सितम्बर, 2019 को बड़े ही हर्षोल्लास वातावरण में सम्पन्न हुआ। इस अवसर पर डॉ. विनोद कुमार सिंह, प्रधान वैज्ञानिक एवं प्रभागाध्यक्ष, सस्य विज्ञान, भाकृअनुप-भारतीय कृषि अनुसंधान संस्थान, नई दिल्ली, मुख्य अतिथि, डॉ. महादेव प्रमाणिक, प्रोफेसर एवं प्रमुख, कृषि विज्ञान विभाग, विधान चन्द्र कृषि विश्वविद्यालय, नदिया, सम्मानित अतिथि, डॉ. एस.एन. सिंह, प्रधान वैज्ञानिक (सस्य विज्ञान), भाकृअनुप-भारतीय


हिन्दी प्रतियोगिताओं मे सफल अधिकारी/ कर्मचारीयों कों पुरस्कार वितरण

गन्ना अनुसंधान संस्थान, लखनऊ, विशिष्ठ अतिथि एवं सुश्री रागिनी तिवारी, हिन्दी प्राध्यापक, हिन्दी शिक्षण योजना, राजभाषा विभाग, निजाम पैलेस, कोलकाता मुख्य वक्ता के रूप में सादर आमंत्रित थे। इस कार्यक्रम की अध्यक्षता संस्थान के निदेशक डॉ. जीबन मित्र जी ने की। सर्वप्रथम डॉ. सुरेन्द्र कुमार पाण्डेय, प्रधान वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने इस अवसर पर उपस्थित संस्थान के वैज्ञानिकों, तकनीकी एवं प्रशासनिक अधिकारियों, कर्मचारियों तथा मंचासीन मुख्य अतिथियों का संस्थान की ओर से हार्दिक स्वागत किया। उसके पश्चात हिन्दी वार्षिक पत्रिका 'रेशा किरण' द्वितीय संस्करण का विमोचन किया गया। तदुपरान्त संस्थान की ओर से सादर आमंत्रित माननीय मुख्य अतिथि, सम्मानित अतिथि, विशेष अतिथि तथा मंचासीन महानुभावों एवं संस्थान के निदेशक महोदय ने अपने वक्तव्य रखे। तत्पश्चात सुश्री रागिनी तिवारी, हिन्दी प्राध्यापक ने राजभाषा हिन्दी के बारे में विस्तार से चर्चा की। हिन्दी पखवाड़ा समारोह के दौरान आयोजित विभिन्न प्रतियोगिताओं में प्रथम, द्वितीय एवं तृतीय स्थान पाने वाले विजयी प्रतिभागियों को मुख्य अतिथि, सम्मानित अतिथि, विशेष अतिथि एवं निदेशक महोदय के कर कमलों द्वारा पुरस्कृत किया गया और अन्य प्रतिभागियों को भी सांत्वना पुरस्कार प्रदान किया गया।

डॉ. विनोद कुमार सिंह ने अपने व्याख्यान में संस्थान के मुख्य अतिथि के रूप में आमंत्रित करने हेतु संस्थान के निदेशक के प्रति कृतज्ञता प्रकट करते हुए सभी से अधिक से अधिक काम हिन्दी में करने का अनुरोध किया। संस्थान के मुख्य प्रशासनिक अधिकारी, श्री प्रद्युम्न कुमार जैन ने कहा कि हिन्दी आम जन की भाषा है जो भारतवर्ष के कण-कण में विराजमान है जिसे और व्यापक बनाने की जरूरत है। मंचासीन सभी अतिथियों ने हिन्दी वार्षिक पत्रिका 'रेशा किरण' द्वितीय संस्करण के सफल प्रकाशन के लिए हिन्दी कक्ष के साथ-साथ सभी संपादकीय मण्डल को भी बधाई दी।

अपने अध्यक्षीय सम्बोधन में संस्थान के निदेशक महोदय ने अतिथियों एवं हिन्दी पखवाड़ा समारोह समिति के सदस्यों, हिन्दी कक्ष और उपस्थित समस्त अधिकारियों एवं कर्मचारियों को इस समारोह को सुव्यवस्थित ढ़ंग से सम्पन्न कराने के लिए धन्यवाद दिया। निदेशक महोदय ने संस्थान में लागू राजभाषा प्रोत्साहन योजना के अंतर्गत पाँच सफल प्रतिभागियों को पुरस्कार प्रदान किए तथा उन्होंने अपेक्षा की कि सभी प्रतिभागी हिन्दी

संस्थान के अधिकारी/कर्मचारी गण हिन्दी प्रतिभागिता में भाग लेते हुए

के प्रचार-प्रसार को अपना हर संभव समर्थन देंगे। उन्होंने सभी पुरस्कार विजेताओं को बधाई दी एवं हिन्दी पखवाड़ा के सफल आयोजन पर हिन्दी कक्ष के साथ-साथ सभी पुरस्कार विजेताओं को धन्यवाद दिया। इस कार्यक्रम का कुशल संचालन डॉ. सुरेन्द्र पाण्डेय, प्रधान वैज्ञानिक एवं प्रभारी, हिन्दी ने श्री मनोज कुमार राय, सहायक के सहयोग से किया।

# 21. Distinguished Visitors

| Name of the Visitor | Affiliation | Date |
|---|---|---|
| Dr. N.C. Pan | Director, ICAR-NINFET, Kolkata | 8 May, 2019<br>24 November, 2019 |
| Dr. S.S. Singh | Director, ICAR-ATARI, Kolkata | 30 June, 2019 |
| Begum Sabina Yasmin | Joint Secretary, Ministry of Textiles and Jute, Govt. of Bangladesh | 18 July, 2019 |
| Dr. K.K. Satpathy | Ex- Director, ICAR-NINFET, Kolkata | 17 September, 2019 |
| Dr. Basab Chowdhury | Hon'ble V C, WBSU, Barasat | 17 September, 2019 |
| Dr. S.A. Patil | Former Director, IARI, New Delhi | 24 November, 2019 |
| Dr. R.K. Singh | Assistant Director General (CC), ICAR, New Delhi | 24 November, 2019 |
| Prof. Tapas Dasgupta | Ex-Professor (Genetics & Plant Breeding), Calcutta University | 24 November, 2019 |
| Dr. S.K. Panda | Ex-Head, OUAT, Bhubaneswar | 24 November, 2019 |

Dr. S.A. Patil, Chairman RAC releasing CRIJAF publications

Dr. B. Chowdhury, VC, WBSU distributing sapling to a woman farmer

Begum Sabina Yasmin and Bangladesh delegates with ICAR-CRIJAF Scientists

# 22. Personnel

## Staff in Position

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**Supporting Staff**

| | | |
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| Sri S.B. Rajbansi | Shri Trinath Shaw | Sri Jagdish Singh |
| Smt. Laxmi Bansfore | Smt Parbati Bauri | Sri Mahesh Singh Verma |
| Sri R.B. Thapa | Sri Prabin Boro | Sri Bhuwal Pal |
| Sri Anup Das | Smt. Khira | Sri Ram Bhajan Saroj |
| Sri Shyamal Bhanja | Kum. Koushalya | Sri Radhey Shyam Yadav |
| Sri Lochindra | Sri Narottam | Sri Ram Baran Yadav |
| Sri Abdul Merej | Sri Narendra | Sri Nandeswar Barman |
| Sri Ram Asre Yadav | Sri Sugriva | Sri Dinesh Das |
| Sri Kartich Ch. Mitra | Sri Minaketan | Sri Pabitra Das |
| Sri Ashok Ghosh | Smt. Fulmani | Sri Puren Choudhury |
| Sri Naba Kumar Dutta | Sri Nelson | Sri Uddhab Gayari |
| Sri Sunil Patra | Sri Jawahar | *Note: This is not purported to be a seniority list.* |
| Sri Jhulan Gupta | Sri Ram Raj Pal | |

# 23. Joining, Promotion, Transfer and Superannuation

## Joining

| Name | Designation | Date | Place of Posting |
|---|---|---|---|
| Dr. J. K. Meena | Scientist | 16.04.2019 | CRIJAF, Barrackpore |
| Dr. Vikas Mangal | Scientist | 16.04.2019 | CRIJAF, Barrackpore |

## Promotion

| Name | Designation | Promoted to | Date of promotion |
|---|---|---|---|
| Dr. Asim Kr. Chakraborty | Scientist | Scientist (SS) | 29.08.2001 |
| Mr. Ranjan Das | Lower Division Clerk | Upper Division Clerk | 23.10.2019 |

## Superannuation

| Name | Designation | Date of Retirement | Place of Posting |
|---|---|---|---|
| Dr. D.K.Kundu | Pr. Scientist | 31.07.2019 | CRIJAF, Barrackpore |
| Mr. B. Ghosh | Technical Officer | 30.11.2019 | CRIJAF, Barrackpore |
| Mr. O.P. Choudhrury | Technical Officer | 31.08.2019 | CRIJAF, Barrackpore |
| Mr. A.N. Dey | T-5 | 31.08.2019 | CRIJAF, Barrackpore |
| Mr. Sankar Shome | Assistant | 30.11.2019 | CRIJAF, Barrackpore |
| Mr. D.N. Kundu | SSS | 30.06.2019 | CSRSJAF, Budbud |
| Mr. Anukul Poddar | SSS | 31.12.2019 | CRIJAF, Barrackpore |
| Mr. Sanat Bagdi | SSS | 30.04.2019 | CSRSJAF, Budbud |
| Mr. Chinta Haran Das | SSS | 31.07.2019 | RRS, Sorbhog |
| Mr. Sadhu | SSS | 31.12.2019 | SRS, Bamra |
| Mr. Charan Mandal | SSS | 31.12.2019 | CRIJAF, Barrackpore |
| Mr. Pradip Mandal | SSS | 31.12.2019 | CRIJAF, Barrackpore |

SSS= Skilled Supporting Staff

## Transfer

| Name | Designation | Transferred to |
|---|---|---|
| Dr. P.N. Meena | Scientist (Plant Pathology) | ICAR-NCIPM w.e.f. 23.11.2019 |
| Mr. M. Ramesh Naik | Scientist (Agronomy) | ICAR-NAARM w.e.f. 02.12.2019 |

# 24. Financial Statement

## Financial Statement of ICAR-CRIJAF, Barrackpore for the year 2019-20

(₹ in Lakhs)

| Sub-Head | Grants B.E. 2019-20 | Grants R.E.2019-20 | Grants Expenditure upto 31-12-2019 |
|---|---|---|---|
| Establishment Charges | 1742.40 | 2025.00 | 1652.54 |
| **Wages** | 260.00 | 160.00 | 155.51 |
| **O.TA.** | 0.15 | 0.00 | 0.00 |
| **Retirement Benefit** | 344.00 | 550.81 | 478.24 |
| **T.A.** | 35.00 | 45.00 | 31.04 |
| **Other Charges** | 634.25 | 510.00 | 313.71 |
| Works-Maintenance | | | |
| a) Residential | 30.00 | 62.00 | 30.31 |
| b) Non Residential | 60.00 | 95.00 | 43.70 |
| c) Equipment & others | 20.00 | 17.00 | 8.95 |
| d) Minor Works | 20.00 | 38.00 | 8.17 |
| Major Works | 0.00 | 0.00 | 0.00 |
| **H.R.D** | 14.50 | 8.00 | 6.16 |
| **Equipment** | 26.00 | 25.08 | 13.32 |
| **Vehicle** | 0.00 | 0.00 | 0.00 |
| **Information Technology** | 9.50 | 9.50 | 3.71 |
| **Furniture** | 0.00 | 0.00 | 0.00 |
| **Library Books & Journals** | 0.50 | 0.50 | 0.05 |
| Total | **3196.30** | **3545.89** | **2745.41** |
| *Loans and Advance* | *62.00* | *62.00* | *26.40* |

## Financial Statement for AINP on Natural Fibres, and KVKs (Burdwan and 24 Parganas(N) for the year 2019-20

(₹ in Lakhs)

| Head | Target | Achievement (Upto 31-12-2019) |
|---|---|---|
| AINPNF | 414.45 | 285.62 |
| K.V.K - Burdwan | 163.85 | 124.59 |
| K.V.K- 24 Parganas(N)-II | 79.70 | 47.66 |

## Classification of revenue generated at ICAR-CRIJAF and its sub-stations

(₹ in Lakhs)

| Institute/ Sub-stations | Total Revenue (31-12-2019) |
|---|---|
| CRIJAF (H.Q.), Barrackpore | 26.80 |
| CSRSJAF, Bud Bud | 6.86 |
| Ramie Research Station, Sorbhoog | 6.24 |
| Sisal Research Station, Bamra | 0.28 |
| Sunnhemp Research Station, Pratapgarh | 2.14 |
| **Total** | **42.32** |
| **Target** | **32.47** |

# NOTES

भाकृअनुप
ICAR

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

*Agrisearch with a human touch*


CENTRAL RES. INSTT. FOR JUTE & ALLIED FIBRES
CRIJAF

# भाकृअनुप - केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान
# ICAR - Central Research Institute for Jute and Allied Fibres

*(आईएसओ ९००१:२०१५ प्रमाणित संस्थान)*
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