वार्षिक प्रतिवेदन

ANNUAL REPORT

2020

भाकृअनुप - केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान

ICAR-Central Research Institute for Jute and Allied Fibres

An ISO 9001 : 2015 Certified Institute

Barrackpore, Kolkata 700121, West Bengal

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ICAR-Central Research Institute for Jute and Allied Fibres

बैरकपुर , कोलकाता - ७००१२१, पश्चिम बंगाल

Barrackpore, Kolkata - 700121, West Bengal

(आईएसओ ९००१:२०१५ प्रमाणित संस्थान)

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Contents

Preface

In the present context of rising environmental pollution and degrading quality of natural resources, the renewed demand of quality biodegradable natural fibres is inevitable. Recent steps taken by the government to discourage and ban on plastics will be boon for the JAF farmers as it will increase the demand and price for the natural fibres. Jute and allied fibre crops are going to play vital role to fill up the gap and meet the diversified demand, besides, these groups of crops have broader scope for by-product utilization and eco-system services in diverse ago-ecosystem.

Plateauing and declining of area under jute cultivation is going to throw new challenges in sustaining the growth of jute productivity to meet the domestic and export requirements. During the last decade the primary challenge was to popularize ICAR-CRIJAF varieties among the farmers. One good indicator is that the varietal replacement with the latest high yielding jute varieties has enhanced during the recent years. It's notable that the potential productivity of these new varieties are not uniformly exploited by the farmers, mainly due to lack of holistic adoption of all the improved technologies for quality and productivity enhancement. It's very important to harness the potential productivity of existing improved jute varieties of ICAR-CRIJAF with integrated scientific agro-management techniques, which needs a strong promotional strategy to reach a wider group of stakeholders. In this context the Institute is transforming its strategies to cater the jute and allied fibre (JAF) farmers and stakeholders with agro-advisory services emphasizing real time information flow on innovative and sustainable technologies, weather and best-practices for JAF crops. This multi-lingual information portal is a robust system of advisory delivery with great potential to facilitate and empower the small and marginal JAF farmers of different states ensuring reduced cost of cultivation, improve productivity and increase income. At this juncture, the convergence of new technologies and the means of its propagation through agro-advisory services of the Institute will perfectly empower the JAF farmers with sustainable farm technologies. I hope that this service is going to increase the visibility of the institute among the farmers, stakeholders and policy makers.

In the backdrop of the onslaught of COVID-19 pandemic it was a difficult year for the institute as peak jute growing season during March-April coincided with nationwide lockdown to contain COVID-19 virus. The institute has done a commendable job by responding positively to the challenges and reached the farmers and stakeholders by using information technology tools like Android based apps (JAF-Safe) and web based form (JAF-Kisan), WhatsApp groups and institute's website. Mandatorily the institute issued agro-advisory and safety measures for farmers and jute mill workers.

In varietal development front, in this pandemic year, a tossa jute genotype, JROB 2 (Purnendu) with high biomass production potential and JRCJ 11, a white jute genotype

with better fibre yield, quality and higher tolerance to major diseases and pests were identified for notification and release for commercial cultivation. Identification of eight heat stress tolerant genotypes will play potential donor in the development of terminal heat stress tolerant fibre flax varieties.

By application of fertilizers as per soil test based targeted yield (ST-TY) equation. In the farmers' field, the targeted yield (40 q/ha jute and 50 q/ha paddy) was achieved in jute-rice cropping. Diversifying jute-rice system through inclusion of green gram and pumpkin (jute fabric soil columns) as inter crop in jute and lowland rice significantly increased the return, nitrogen use efficiency (NUE) and water use efficiency (WUE) of the system. In climate resilient study, two varieties i.e, MTU-1010 of rice and JRO-204 of jute showed very high degree of adaptation to enhanced level and exposure to ozone.

The standardized protocol for bioethanol production from high biomass jute variety JROB 2 and JRO 524 may increase the possibility for diversified use of jute. High capacity fibre flax extractor developed by the institute will certainly increase the scope for commercial production of flax fibre.

Positive outcome of eco-toxicological studies in conjugation with standard UV-protectant will improve the sustainability of *Spilosoma obliqua* nucleopolyhedrosis virus (*Spob*NPV) for management of hairy caterpillar in field condition. Few accessions of native *Trichoderma* strains showed potential as ideal candidate for biocontrol consortium for management of flax wilt complex caused by *Rhizoctonia* sp. and *Sclerotium* sp. Integration of superior jute varieties (JRO 204 and JROG 1) with two foliar sprays of fenpyroximate 5EC@ 1.5ml/l during the peak mite incidence period (40-55 days after sowing) is ideal for reducing the mite incidence and damage grade as well as highest fibre yield. Soil application of sulphur @ 60kg/ha proved effective against yellow mite of jute besides, it enhanced the plant height, dry weight and chlorophyll content. These parameters could compensate the adverse effect of mite damage on fibre yield.

In the process of doubling farmer's income, empowering farmers and self-help groups with latest farm technologies and skill development for value addition were also emphasized. Besides, the challenge is to channelize the resources and inputs from within the farm. In this aspect the institute conceptualized and demonstrated JAF crop retting tank-based farming system approach and also retting in free flowing water. In capacity building programmes this year special trainings were undertaken for farm women, SC farmers, the farmers of NE region.

I am highly grateful to Dr. Trilochan Mohapatra, Hon'ble 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 acknowledge the efforts of the editorial team, scientists and all the staffs of ICAR-CRIJAF, its regional stations and KVKs who have done a commendable job to accomplish the volume of research and extension activities during the pandemic year.

(Gouranga Kar)

Director, ICAR-CRIJAF

Place: Barrackpore

Date: 20.01.2021

Executive Summary

Crop Improvement

- Mitochondrial genomes of the two cultivated species (*C. capsularis* and *C. olitorius*) were assembled, with genome size of ~1.9Mb and ~1.8Mb, respectively. Comparative features of the two mitogenomes was established.
- A complex carbohydrate-enriched pectin biosynthesis salvage pathway and crucial genes involved in the process were characterized in *C. olitorius* and *C. capsularis* through transcriptome and jute genome sequence information.
- Gene structure analysis of Major Intrinsic Protein (MIP) genes in *C. olitorius* indicated a conserved pattern of intron-exon diversities within the sub families of MIPs and supported CoAQP family classification.
- From previously sequenced bast fibre-retting bacterial consortium of 'CRIJAF SONA', a genome-wide analysis of genes encoding Carbohydrate-Active enZYmes (CAZys) were characterized. The *ab initio* models of pectate lyases from the three PJRB strains was deduced to explore the structural divergence and effective ligand binding active site residues.
- Heat stress-induced whole-genome methylation profiles through bi-sulfite sequencing were generated in fibre flax variety JRF 2 and compared to control and a hypo-methylation agent 5-azacitidine-treated plants.
- A total of 64 global flax germplasm lines were assayed for heat-stress induced lipid oxidation damage, eight genotypes showed insignificant changes in the MDA content compared to the control plants, suggesting these genotypes as a potential resource for heat stress tolerance in flax.
- A total of 900 germplasm accessions were regenerated, 187 accessions were distributed to different indenters and 315 germplasm line were characterized and evaluated for fibre yield and associated traits.
- A tossa jute genotype, JROB 2 (Purnendu) with high biomass production potential and JRCJ 11, a white jute genotype with better fibre yield, quality and higher tolerance to major diseases and pests were identified in 31th Annual Workshop of AINPJAF for consideration to Central Sub-Committee on CSN & RV for notification and release for commercial cultivation.
- Three trait specific jute germplasm lines: OIN-154-1 and WCIN-136-1 for stem rot resistance and OIN-456 susceptible to stem rot disease were identified by "Institute Germplasm Identification Committee" and recommended suitable for registration with the ICAR-NBPGR, New Delhi.
- A panel of 341 MAGIC lines namely (ML_4-RI_6) and their 20 founders were evaluated in an α-lattice (19 × 19) at two environmental locations viz., ICAR-CRIJAF, Barrackpore and ICAR-CSRSJAF, Budbud. Summary statistics showed that, mean trait values of 341 MAGIC lines did not differ much from that of their founders. However, there were lines that showed significantly higher values for fibre yield and associated traits.
- Fifty each capsularis and olitorius jute germplasm lines were evaluated for fibre traits, among olitorius accessions, OEX 20, OIM 12, OIJ 204, OEX 32 and OEX 13 were the best with respect to fibre yield and accession CIM 32, CIJ 59, CIN 305, CEX 04 and CIM 57 were best among capsularis genotypes. Further, a 10 x 10 full diallel mating was made in tossa jute and white jute separately involving advanced breeding lines, high yielding varieties as parents.
- A total of 54 advanced breeding lines of kenaf and ten genotypes of roselle were evaluated and selected based on growth parameters. Further, out of 1853 F_4 kenaf progenies 745 single plant selections were made based on plant growth parameters. A 9 x 9 half diallel mating was made among nine roselle genotypes to develop segregating population.
- A panel of 15 jute RIL's evaluated under sick plot conditions found showing stable resistance to stem rot disease. Further, among the jute germplasm lines screened for nematode (*Meladogina incognita*) resistance at UBKV, Coochbehar and ICAR-NBPGR RS, Hyderabad. The genotype WCIN-

183A was categorised as resistant and Nalte as susceptible under artificial inoculated conditions.

- In tossa jute, through screening for stem rot resistance in the two mapping populations, 10 plants from OIJ-272 x RS-6 population and 05 plants form OIN-456 x OIN-154 were found to be moderately resistance.
- In flax, a total of 209 F_3 single plant progenies and five F_2 progenies are under evaluation and selection in Rabi 2020-21.
- A total of 19.0 q breeder seed of 15 varieties of jute, 3 varieties of sunnhemp and one variety of flax were produced. Further, nucleus seeds of the released varieties of jute (1.28 q), mesta (0.35 q) and sunnhemp (0.41 q) were produced.
- Under ICAR seed project, 428.8 q seeds of different crops (jute, mesta, flax, dhaincha, paddy, mung, wheat and mustard) were produced. In addition to this, planting material of sisal (50,000 bulbils and suckers) and ramie (50 q rhizome) were also produced and distributed to the farmers.

Crop Production

- As per ozone study on crops under field condition, day time ozone levels often exceeded 40 ppb (critical level) during boro rice season and main vegetative stage of jute crop. MTU-1010 of rice and JRO-204 of jute cultivar found well adapted to ozone exposure.
- The response of 30 days old jute seedlings with exogenous ascorbic acid (AsA) application was studied under drought and found that the membrane stability, chlorophyll and carotenoid content, plant height and biomass were reduced and significantly higher with exogenous ascorbic acid treatment.
- Energy balance components such as net radiation, latent heat flux, soil heat flux, and sensible heat flux were measured using biomet sensors attached with eddy covariance system at institute's research farm.
- Defoliation delay flowering in jute and upper leaves are more important to perceive the signal for flowering.
- Application of inorganic fertilizers, in presence or absence of FYM significantly increased the crop yields. The effect of zinc application could not found any significant increase in crop yield.
- The effect of tillage systems (conventional tillage and no tillage) with or without crop residue retention on soil organic carbon (SOC) dynamics was evaluated under jute based cropping systems. No tillage with residue retention had significant effect of the capacity of the soil for storing SOC under jute based cropping systems.
- Among the cropping systems, jute-rice-lentil system contributed highest SOC. Under Nitrogen dynamics under rice-flax cropping system, highest nitrogen mineralization was recorded in zero tillage and lowest in fallow-flax. Energy use and economic efficiency for various jute based cropping systems were evaluated under no tillage with residue and conventional tillage. The highest input energy was estimated for jute-rice-wheat system and the lowest was for the jute-rice-lentil cropping system.
- Soil test based targeted yield (ST-TY) equations developed under AICRP-STCR project were validated in the farmers' fields. Application of fertilizers as per ST-TY without and with FYM achieved the target yield of 40 q/ha jute fibre and 50 q/ha paddy.
- Diversifying jute-rice system through inclusion of green gram and pumpkin as inter crop in jute and lowland rice, and lentil as mixed crop in mustard helped to meet 85% of cost of cultivation of all crops. Nitrogen use efficiency (NUE) and water use efficiency (WUE) were significantly increased under this system.
- Low density jute sowing helped in curtailing the labour cost in weeding. Jute and green gram intercropping produced 22.5 quintal jute fibre (JRO BA3) and 2.73 q mung grain and reduced 110 mandays/ha for its major operations over manual weeding process.
- Among the herbicidal and mechanical weed management methods, application of ipfencarbazone and nail weeder produced higher fibre yield (29.07 q/ha).
- In an interactive effect of planting materials and fertilizer levels on sisal production study, number of leaf production and leaf length varied significantly due to different size of planting materials at planting and fertilizer doses in Sisalana sisal. In case of both

Sisalana sisal and hybrid sisal, irrespective of nutrients levels, the highest number of leaves per plant was produced by the large sized sucker at planting, and similarly, irrespective of sucker size, the maximum number of leaves per plant was produced by the highest dose of fertilizer.

- An improved fibre extractor for flax has been designed and developed with throughput capacity of 80-85 kg flax straw/h and material capacity of 40-45 kg dry fibre/h. The manually operated multi-crop seed drill (jute seeder) has been improved with field efficiency of 90-95% and low drudgery effect on farm labour. Man or women can easily pull it for 2-3 hours continuously for seed sowing.
- The protocol for obtaining bioethanol from jute biomass has been standardised in the high biomass jute variety JROB-2 and JRO-524. However, further refinement is essential for enhancing the efficiency of bioethanol production from such jute biomass.
- To characterize the diversity of community-level physiological profiles, BIOLOG ECO microplate were used to analyze the metabolic functions of jute retting water samples collected from jute growing areas in West Bengal. Utilization of different types of carbon sources by the microbes present in retting water samples showed an increasing trend with the prolongation of incubation time and the utilization capability.
- Eleven large scale retting trials of jute and mesta were carried out in different parts of North 24 Parganas and Nadia districts utilizing six to eight months old liquid (spore based) formulation of Crijaf Sona. The resultant fibre of jute and mesta recorded good fibre strength ranging from 23.6 to 27.7 g/tex for jute and 27.0 g/tex for mesta.

Crop Protection

- Eco-toxicological studies on the effect of temperature regulating the virulence of *Spilosoma obliqua* nucleopolyhedrosis virus (*Spob*NPV) in terms of temperature coefficient indicated 28^{0}C to be the optimum incubation temperature for enhancing the virulence of *Spob*NPV on hairy caterpillar larvae. Robbin blue (0.2%) protected the occlusion bodies of *Spob*NPV and maintained the virulence even exposure to UV source continuously for 2 hrs.
- On the basis of colony growth inhibition of flax wilt pathogens by resident isolates of *Trichoderma* accessions, CJMR180, CJMR183 and CJMR192 were found consistently effective against both the pathogens i.e., *Rhizoctonia* sp. and *Sclerotium* sp. CJMR180, CJMR193, CJMR192 accessions of *Trichoderma* exhibited maximum inhibition against *Rhizoctonia* sp. while CJMR182, CJMR183, CJMR180 accessions were most effective on *Sclerotium* sp.
- Out of five isolates of *Trichoderma* collected from Pratapgarh and Amethi districts of U.P., T-1 isolate exhibited maximum antagonistic ability (75.13 %) against *Fusarium udum* f. sp. *crotolariae* causing sunnhemp wilt.
- As the host, WCIN-104; the wild accession of *C. fascicularis* manifested maximum antibiosis on larval development with least larval weight and survival, which may be possible resistance source against indigo caterpillar, *Spodoptera litura.*
- The peroxidase activity varied significantly among the different cultivated and wild jute species. More than 8-fold higher peroxidase activity in the WCIN-179 accession of *Corchorus aeustans* than the cultivated *C. olitorious* may be due to high antibiosis of wild species, particularly *C. aeustans* on hairy caterpillar larvae.
- Bio-ecological studies on cotton mealybug, *Phenacoccus solenopsis* established that with an increase of 18^{0}C temperature, total life cycle duration is reduced by 29 days. At temperature regimes of 16-34^{0}C, optimum temperature for highest survival of mealybug is 28^{0}C. There was an increase in the proportion of males with increase in rearing temperature (28-34^{0}C).
- Selection of superior jute varieties (JRO 204 and JROG 1) for sowing may be integrated with two foliar sprays of fenpyroximate 5EC@ 1.5ml/l during the peak mite incidence period (40-55 days after sowing) for reducing the mite incidence and damage grade as well as highest fibre yield.
- Soil application of sulphur @ 60kg/ha proved effective against yellow mite of jute, it restricted the mite incidence and damage and supported the plant

growth with significantly enhanced plant height, dry weight and chlorophyll content. These parameters could compensate the dverse effect of mite damage on fibre yield. In field condition also with soil application of sulphur@ 60 kg/ha, highest yield and least mite damage was observed in JRO 204 variety.

- Under *in vitro* condition, Carbendazim 50% WP and combination of Propiconazole 13.9 % + Difenoconazole 13.9% EC, completely (100 %) inhibited the growth of pathogen, *Fusarium udum* f.sp. *crotolariae* that causes sunnhemp wilt.
- Seed treatment with insecticide and fungicide for preventive management of insect pests and diseases of jute proved that combined pre-sowing seed treatment with both carbendazim (2g/kg) + imidacloprid (4g/kg) and soil application of bleaching powder @ 25 kg/ha 7 days ahead of sowing to be most effective to reduce the stem rot, yellow mite, stem weevil and highest dry fibre yield.
- Based on the performance, integration of three treatments were identified as the best practices viz., seed treatment (ST) with carboxin + thiram @ 2g/ kg seed + soil application (SA) of neem cake @ 250 kg/ ha and *Trichoderma* sp. @ 2.5 kg/ha + intercropping (IC) with maize (10:1) for integrated management of sunnhemp wilt and maximum fibre yield.

Transfer of Technology

- A total of 177 frontline demonstrations on improved production technologies of jute covering 64.92 ha area were conducted in North 24 Parganas, 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 3.01-4.73 q/ha and reduced the cost of cultivation by approx ₹ 10,463 to ₹15,921/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 ₹ 400-500/q.
- The perception of the agricultural scientists for climate change mitigation and adaptive strategies on which the greater level of consensus was found were as follows: change in agronomic practices, SRI, nitrification inhibitor etc., jute-green gram intercropping, mixed cropping, diversified farming, rain water harvesting, in-situ retting, soil mulching, adding organic matter in soil, green manuring, soil testing, split application of N fertilizers, IPM and INM practices, sowing in furrows, making proper drainage channels, drip irrigation in vegetables, low cost poly-houses and weather-based agro-advisory service.
- Three skill development programmes for entrepreneurship development through making of jute fibre and fabric based products were conducted for farm women. Twenty four farm women from three different villages in North 24 Parganas district was selected and organised in two different Self Help Groups.
- As per the conceptual model developed for the Value chain in jute two Farmers Producer Companies namely Baduria Krishi Bikas FPC and Sapka Apna FPC, Nilgunj were linked with ICAR-CRIJAF and its KVK through various Govt. schemes, programmes and projects.
- During evaluating the impact of proven ICAR-CRIJAF technologies under Jute-ICARE in three districts namely, North-24 Parganas, Murshidabad and Nadia, it was found that the respondents of North 24 Parganas had highest gain of jute fibre yield as well as knowledge score (regarding application of ICAR-CRIJAF technologies) at field level. In general, major consraints in jute cultivation in these ditricts were non- avaiability of retting water followed by labour crisis during harvesting of jute.
- On the basis of crop information received from master trainers (MTs) under Jute-ICARE through Google form, the overall Extension Gap observed in four districts of West Bengal revealed that Technology gap was found maximum at Malda (10.07 q/ha) followed by Uttar Dinajpur (07.67 q/ ha) probably due to AMPHAN cyclone and other climatic variations.
- During the year 2020, Jute-ICARE programme was extended to 1,03, 900 ha area of jute growing states (West Bengal, Assam, Bihar, Odisha, Meghalaya). The programme was supported with HYV seeds

(603 MT), agricultural implements developed by ICAR- CRIJAF (600 CRIJAF-MRSD; and 900 CRIJAF single wheel jute weeder) and CRIJAF-SONA. For timely dissemination of important agro-advisories and operational instructions, online meetings were held. Social media groups (3 nos.) were also formed for regular interaction amongst CRIJAF scientists, JCI officials, NJB officials, Block Supervisors and Master Trainers involved in Jute-ICARE programme.

Krishi Vigyan Kendra

- Five OFTs were conducted by the KVK, Burdwan for evaluation of different recommended technologies like management of late blight of potato, nutrient management of marigold, assessment of different techniques for transplanting of vegetable seedling, seedling mortality and economy, and assessment of different herbicides on weed control of transplanted rice. A total of 211 FLDs were conducted on jute, paddy, lentil, chickpea, onion, brinjal and banana. Altogether, 25 training programmes were organized for practicing farmers and rural youths. A total of 367 trainees were benefited through these training programmes.
- KVK, North 24 Parganas (additional) 68 FLDs on improved production technology of jute, rice and blackgram were conducted by the KVK, North 24 Parganas during the year 2020. Altogether, 16 training programmes were organized for farmers, farm women and extension functionaries. A total of 215 trainees were benefited through these training programmes. Important programmes like webcasting of various programmes addressed by Hon'ble Prime Minister of India, 150th Birth Day Celebration of Mahatma Gandhi, Constitution Day, World Soil Day, Mahila Kisan Diwas etc. were organized.

AINP on Jute and Allied Fibres

- One variety each of *tossa* jute i.e., JROMU 1 and kenaf i.e., JRHC 3 were recommended for release by the Central Sub-Committee on Crop Standard, Notification and Release of Varieties which has been notified vide Gazette notification no. S.O. 99(E) dated 6 January, 2020.
- Intercropping of brinjal on soil columns within jute gunny bags in the transplanted paddy field in 4:1 and 8:1 row ratio recorded higher rice equivalent yield (131.91 and 134.43 q/ha), gross return, net return and B:C ratio at Cooch Behar, West Bengal.
- Integrated nutrient management (75% RDN + 25% N through FYM + 5 kg $MgSO_4$) in seed crop of *tossa* jute recorded maximum seed yield (17.09 q/ha) of the crop along with maximum gross return (₹ 10,2580/ha) and net return (₹ 57,270/ha) at Rahuri, Maharashtra.
- In jute, two hand weedings / mechanical weeding (15-20 and 35-40 DAE) performed best in weed control and yield increase where as quizalofop ethyl 5 EC 60 g + ethoxysulfuron @ 100 g/ha at 15 DAE treatment recorded maximum net return at Kalyani, Coochbehar and Nagaon centres.
- Line sowing (5-6 lakhs/ha) + seed treatment with Carbendazim 50 WP @ 4g/kg seed + spraying of Spiromesifen 240 SC @ 0.7 ml/l at 35 DAS + spraying of Tebucanazole @ 0.15% at 45 DAS + spraying of λ-cyhalothrin 5 EC @ 0.6 ml/l at 55 DAS recorded least pest and disease incidence with maximum yield (28.17 q/ha) of jute at Barrackpore.
- Targeted yield of mesta (roselle) (3.2 t/ha) could be achieved with (-) 5.8% yield deviation at Aduthurai, Tamil Nadu only when FYM was incorporated @ 5 t/ha along with fertilizer application on the basis of soil test and target yield (100% NPK on ST-TY).
- Application of NSKE 5% at 35 DAS + Azadirachtin (1500 ppm) @ 5ml/l at 50 DAS + *Verticillium lecani* @ 6g/l at 65 DAS was found superior for managing the sucking pests of mesta at Katihar.
- Maximum plant height (105.8 cm), basal diameter (0.41 cm), green weight (192.01 q/ha), dry weight (54.43 q/ha) and fibre yield (18.05 q/ha) of flax was recorded with sowing on 1st week of November and it decreased progressively with delay in the sowing time at Coochbehar, West Bengal.
- At Amadalavalasa, Andhra Pradesh, application of fertilizer NPK @ 60:13:50 kg/ha or NPK @ 90:13:50 kg/ha alongwith vermi-compost @ 2.5 t/ha recorded higher value of leaves/plant, green leaf biomass and fibre yield of sisal (19.58 - 19.81 q/ha).

कार्यकारी सारांश

फसल सुधार

- दो कृषित प्रजातियों (सी. कैप्सुलेरिस और सी. ऑलिटोरियस) के माइटोकॉन्ड्रियल जीनोम का पुनर्निर्माण किया गया जो कि क्रमशः 1999602 बी.पी. और 1829341 बी.पी. था और इसी के साथ तुलनात्मक माइटोजेनोमिक्स भी किया गया।
- पटसन के ट्रांसस्क्रिप्टोम और जीनोम अनुक्रम से पेक्टिन जैव- संश्लेषण मार्ग का पता लगाया गया। तीन प्रमुख मार्ग, यूडीपी-सुगर इंटरकॉन्वर्सन, जीडीपी- सुगर इंटरकॉन्वर्सन और सालवेज मार्ग को सी. कैप्सुलेरिस और सी. ऑलिटोरियस दोनों में सक्रिय पाया गया। पेक्टिन जैव- संश्लेषण मार्ग में कुल 624 से 3210 न्यूक्लिओटाइड तक के पूर्वानुमानित कोडिंग क्रम के साथ 805 न्यूक्लिओटाइड से 3638 न्यूक्लिओटाइड तक के आकार वाले 17 जीनों के कुल 27 आइसोफोर्मों की पहचान की गई।
- सी. ऑलिटोरियस में वृहद आंतरिक प्रोटीन (एमआईपी) जीन के जीन संरचना विश्लेषण से एमआईपी की उप-प्रजाति के भीतर इंट्रो-एक्सॉन के संरक्षित पैटर्न का संकेत मिलता है जो कि इसके संरक्षित विकास को दिखाता है और सीओएक्यूपी परिवार के अंदर वर्गीकृत किया गया है।
- बेसिलस में विभिन्न पेक्टिन अपघटन करने वाले एंजाइमों के प्रोटीन-प्रोटीन अंतःक्रिया नेटवर्क का पता करने में फ्लोएम रेशे सड़न बैक्टीरिया कंसोर्टियम के बेसिलस उपभेदों में जीन को एन्कोडिंग करने वाले जीनों का जीनोम- वृहद स्तर पर विश्लेषण किया गया। इसके अलावा, सक्रिय साइट अवशेषों की संरचनात्मक अन्तर और पहचान का के लिए पीजेआरबी उपभेदों से पेक्टेट लायेज के मॉडल का पूर्वानुमान लगाया गया।
- वैश्विक 64 फ़्लेक्स के जननद्रव्यों के वसीय क्षति (जो ऊष्मीय तनाव के कारण उत्प्रेरित होती हैं) की जाँच से केवल 8 जननद्रव्य ऐसे पाये गए जिनके एम.डी.ए. की मात्रा में चेक की तुलना में बहुत कम अंतर पाया गया। ये 8 जननद्रव्य फ़्लेक्स में ऊष्मीय तनाव के अध्ययन के लिए बेहतर स्त्रोत हो सकते हैं।
- कुल 900 जननद्रव्यों को फिर से पुनर्जीवित किया गया, जिसमें से 187 जननद्रव्यों को खोज के लिए वितरित किया गया। रेशे की उपज और उससे संबन्धित लक्षणों के लिए 315 जननद्रव्यों को वर्णित किया गया।
- उच्च जैव-भार उत्पादन क्षमता वाली तोषा पटसन की जेआरओबी-2 (पूर्णेंदु) तथा उच्च रेशा उपज के साथ- साथ कीट और रोग के प्रति प्रतिरोधी सादा पटसन की जेआरसीजे-11 नामक प्रविष्टियां 31 वीं वार्षिक कार्यशाला में अखिल भारतीय नेटवर्क परियोजना के तहत समन्वित परीक्षणों में उत्कृष्ट पायी गयी जिन्हें 'फसल मानक, अधिसूचना एवं अनुमोदन केंद्रीय उपसमिति द्वारा अधिसूचित व जारी कर दिया गया है।
- "संस्थान जनद्रव्य पहचान समिति" द्वारा पटसन की तीन विशिष्ट जननद्रव्य लाइनें: ओआईएन-154-1 और डब्लूसीआईएन-136-1 तना सड़न प्रतिरोधी और ओआईएन-456 तना सड़न के लिए संवेदनशील, चिन्हित किए गए, जिन्हें भाकृअनुप-एनबीपीजीआर, नई दिल्ली में पंजीकरण के लिए उपयुक्त पाया गया।
- सी. ऑलिटोरियस की बहु-पैतकृ उन्नत पीढ़ी अन्तरसंकरण (मेजिक, एम एल 4 – आरआई 6) समुदाय से कुल 341 प्रभेदों और उनके 20 संस्थापकों का मूल्यांकन दो पर्यावरणीय स्थानों, भाकृअनुप – क्रिजेफ, बैरकपुर और केन्द्रीय पटसन एवं समवर्गीय रेशा बीज अनुसंधान केंद्र, बुड्बुद, पश्चिम बंगाल पर अल्फा- लेटिस (19 x 19) बनावट में किया गया। सारांश के आंकड़ों से पता चला कि, 341 मेजिक लाइनों के लक्षण और आंकड़ें उनके संस्थापकों से बहुत ज्यादा अलग नहीं थे। हालांकि, कुछ ऐसी लाइनें थीं जो रेशे की उपज और संबंधित लक्षणों के लिए काफी अच्छी थीं।
- रेशे से संबन्धित लक्षणों के लिए सी. कैप्सुलेरिस और सी. ऑलिटोरियस दोनों की 50-50 जननद्रव्य लाइनों का मूल्यांकन किया गया। इनमें से रेशे की उपज के लिए ओ.ई.एक्स.–20, ओ.आई.एम.–12, ओ.आई.जे.–204, ओ.ई.एक्स.–32 एवं ओ.ई.एक्स.–13 लाइनों ने अच्छा प्रदर्शन किया तथा जिसमें से सभी कैप्सुलेरिस जीनोटाइप्स सी.आई.एम.–32, सी.आई.जे.–59, सी.आई.एन.–305, सी.ई.एक्स.–04 एवं सी.आई.एम.–57 सर्वश्रेष्ठ थे। इसके अलावा, तोषा और सादा पटसन में 10 x 10 पूर्ण डायलील मेटिंग में संकरण कार्यक्रम किया गया जिसमें पितृ एवं मातृ के रूप में उन्नत प्रजनन लाइनें एवं उच्च उपज वाली किस्में शामिल थीं।
- विकास मानकों के आधार पर, केनाफ की कुल 54 उन्नत प्रजनन लाइनों और रोजेल के दस जीनोटाइप का मूल्यांकन और चयन किया गया। इसके अलावा, 1853 एफ-4 केनाफ संततियों में से 745 एकल पौधा चयन विकास मापदंडों के आधार पर किया गया। नए संकर एवं उनकी आगामी संततियां विकसित करने के लिए नौ रोजेल जीनोटाइप के बीच एक 9 x 9 आंशिक डायलील मेटिंग संकरण किया गया।
- पटसन की 15 आर.आई.एल लाइंस का सिक प्लॉट में परीक्षण करने सभी तना गलन रोग प्रतिरोधी पायी गयी। इसके अलावा, यूबीकेवी, कूचबिहार और भाकृअनुप-एनबीपीजीआर, क्षेत्रीय केंद्र, हैदराबाद में निमेटोड (मेलडोगिना इन्निटा) प्रतिरोध के लिए पटसन जननद्रव्य लाइनों की जांच की गई जिनमें से जीनोटाइप डब्लू.सी.आई.एन -183A को कृत्रिम संक्रामक परिस्थितियों में प्रतिरोधी और नल्टे संवेदनशील पाया गया।
- तोषा पटसन की 2 मैपिंग आबादी का जब तना गलन के लिए परीक्षण किया गया तो ओ.आई.जे.–272 x आर.एस – 6 आबादी में से 10 पौधे एवं ओ.आई.एन.–456 x ओ.आई.एन.–154 आबादी में से 5 पौधे तना गलन के लिए मध्यम प्रतिरोधी पाये गए।
- फ़्लेक्स में, कुल 209 F_3 एकल पादप संतति और पाँच F_2 संततियों का मूल्यांकन किया गया और अच्छे पौधों का चयन आगामी पीढ़ी से किया गया।

- पटसन की 15 किस्मों और सनई की 2 किस्मों के कुल 16.2 क्विंटल प्रजनक बीज का उत्पादन किया गया। इसके अलावा, पटसन की 31 किस्मों, मेस्ता की 14 किस्मों, सनई की 5 किस्मों और फ़्लेक्स की 1 किस्म के 2.58 नाभिकीय बीज का उत्पादन किया गया।
- भाकृअनुप की बीज परियोजना के तहत, विभिन्न फसलों (पटसन, मेस्ता, फ़्लेक्स, ढेंचा, धान, मूंग, गेहूं और सरसों) के 428.8 क्विंटल बीज का उत्पादन किया गया। इसके अलावा, सीसल (50,000 बल्ब और सकर्स) और रेमी (50 क्विंटल प्रकंद) की रोपण सामग्री भी उत्पादित एवं किसानों को वितरित की गई।

फसल उत्पादन

- क्षेत्र एवं मौसम की परिस्थितियों में फसलों पर ओजोन के अध्ययन से पता चला कि दिन के समय ओजोन का स्तर बोरो धान और पटसन की फसल के मुख्य वनस्पति अवस्था के दौरान 40 पीपीबी (महत्वपूर्ण स्तर) से अधिक था। चावल की एमटीयू-1010 और पटसन की जेआरओ -204 प्रजाति ओजोन की अधिकता के लिए अनुकूल पायी गयी। अनावृष्टि के समय 30 दिन पुराने पटसन के पौधों पर बाहर से एस्कॉर्बिक एसिड (एएसए) का छिड़काव करने पर देखा गया कि झिल्ली स्थिरता, क्लोरोफिल और कैरोटीनॉयड सामग्री, पौधे की ऊंचाई और बायोमास सूखे कि स्थिति में भी अधिक थी। वातावरण में अधिक तापमान होने से पटसन उत्पादन के स्थानिक और लौकिक परिवर्तनशीलता पर अध्ययन से पता चला कि पश्चिम बंगाल में पटसन उगाने वाले क्षेत्रों में अप्रैल-मई के दौरान अधिकतम और न्यूनतम तापमान, जून-जुलाई के दौरान अधिकतम और न्यूनतम दोनों तापमानों की इष्टतम सीमा पर थी। पिछले 40 साल के जलवायु आंकड़े का विश्लेषण द्वारा पटसन एवं समवर्गीय रेशा फ़सलों जैसे केनेफ़, रोजेल, फ़्लेक्स, सनई, रेमी और सीसल के लिए जलवायु और पानी की आवश्यकता की पहचान निश्चित की गई।
- अजैविक उर्वरक और जैविक खाद के निरंतर उपयोग के दीर्घकालिक (49 वर्ष) प्रभावों को अलग अलग या एक साथ उपयोग करके फसल उत्पादकता और मिट्टी की उर्वरता में होने वाले परिवर्तन का अध्ययन किया गया। जैविक खाद की उपस्थिति या अनुपस्थिति में अजैविक उर्वरकों के प्रयोग से फसल की पैदावार में काफी वृद्धि पायी गयी। मृदा कार्बनिक कार्बन गतिकी पर फसल अवशेषों के साथ या बिना जुताई (बिना जुताई) के पारंपरिक प्रणालियों के प्रभाव का मूल्यांकन पटसन आधारित फसल प्रणालियों के तहत किया गया।
- अवशेषों के प्रतिधारण के साथ किसी भी जुताई पर जूट आधारित फसल प्रणालियों के तहत जैविक कार्बन के भंडारण के लिए मिट्टी की क्षमता का महत्वपूर्ण प्रभाव नहीं था। सभी फसल प्रणालियों में से, पटसन-चावल-मसूर प्रणाली ने सबसे अधिक जैविक कार्बन में योगदान दिया। केवल फ्लैक्स की बजाय धान -फ्लैक्स फसल प्रणाली को एक साथ उपयोग करने से नाइट्रोजन गतिकी अधिक होती है एवं बिना जुताई की स्थिति में भी अधिक नाइट्रोजन का खनिजीकरण होता है। विभिन्न पटसन आधारित फसल प्रणालियों के लिए ऊर्जा उपयोग और आर्थिक दक्षता का मूल्यांकन पारंपरिक जुताई और बिना जुताई (अवशेष के साथ) के तहत किया गया। सबसे अधिक ऊर्जा का निवेश पटसन-चावल-गेहूं प्रणाली मे और सबसे कम पटसन-चावल-मसूर फसल प्रणाली में था। मृदा परीक्षण आधारित लक्षित उपज (एसटी – एसवाई) समीकरण के अनुसार उर्वरकों का उपयोग, जैविक खाद के साथ और इसके बिना भी पटसन रेशे की उपज 40 क्विंटल/ है॰ और धान की उपज 50 क्विंटल/ है॰ प्राप्त हुई। पटसन और चावल में अंतर फसल के रूप में मूंग और कद्दू को शामिल करने से, और सरसों में मिश्रित फसल के रूप में मसूर की बुवाई करने से सभी फसलों की खेती की लागत का 85% प्राप्त करने में मदद मिलती है। इस प्रणाली के तहत नाइट्रोजन उपयोग दक्षता और जल उपयोग दक्षता में काफी वृद्धि हुई।
- कम घनत्व में पटसन की बुवाई करने से निराई की श्रम लागत बहुत कम हो जाती है। पटसन और मूंग की अन्त:फसल के रूप में बुवाई से 22.5 क्विंटल पटसन रेशा (जेआरओबीए-3) और 2.73 क्विंटल मूंग का उत्पादन हुआ और निराई में लगने वाले मजदूरों (110 आदमी प्रति हेक्टेयर) की भी बचत हुई। शाकनाशी और यांत्रिक खरपतवार प्रबंधन विधियों में, इपफेनकारबाजोन और नेल वीडर के प्रयोग से रेशे की उच्च उपज प्राप्त हुई। रोपण सामग्री और उर्वरक के पारस्परिक अन्त:क्रिया में सिसलाना सिसल और हाइब्रिड सिसल दोनों में, पोषक तत्वों के स्तर के बावजूद, प्रति पौधे पत्तों की संख्या उनमें अधिक पायी गई जहां बड़े आकार के सकर्स से बुवाई हुई थी, इसके अलावा सकर्स के बावजूद उनसे प्रति पौधे अधिक पत्तियों की प्राप्ति हुई जहां उर्वरक की अधिक मात्रा उपयोग में ली गयी।
- फ़्लेक्स के लिए एक बेहतर रेशा निष्कर्षण मशीन जिसकी क्षमता 40-45 किलोग्राम सूखा रेशा प्रति घंटे और 80-85 किलोग्राम फ्लैक्स भूसा प्रति घंटे है, इसका डिजाइन और विकास किया गया है। पटसन के बायोमास से बायोइथेनॉल प्राप्त करने के प्रोटोकॉल को उच्च बायोमास उत्पादित करने वाली पटसन की किस्म जेआरओबी-2 और जेआरओ-524 में मानकीकृत किया गया है। हालांकि, इस तरह के बायोमास से बायोइथेनॉल उत्पादन की दक्षता बढ़ाने के लिए आगे और ज्यादा शोध की आवश्यकता है। सड़न के पानी में मौजूद जीवाणुओं द्वारा विभिन्न नमूनों में से कई प्रकार के कार्बन स्रोतों का उपयोग ऊष्मायन समय और लंबे समय तक उपयोग की क्षमता के साथ एक बढ़ती प्रवृत्ति को दर्शाता है। सड़न प्रक्रिया में प्रयोग होने वाले क्रिजेफ सोना के छह से आठ महीने पुराने तरल (बीजाणु) आधारित मिश्रण का उपयोग करते हुए बड़े पैमाने पर पटसन और मेस्ता में ग्यारह ट्रायल उत्तर 24 परगना और नादिया जिलों के विभिन्न हिस्सों में किए गए। इसके बाद प्राप्त पटसन और मेस्ता के रेशे की क्षमता क्रमश: 23.6 से 27.7 ग्राम/टेक्स एवं 27.0 ग्राम/टेक्स दर्ज की गई।

फसल सुरक्षा

- तापमान गुणांक के संदर्भ में स्पीलोसोमा ओब्लिकुया एन.पी.वी. (एस. पी.ओबी एन.पी.वी.) के विषैलेपन को नियंत्रित करने वाले तापमान के प्रभाव का इको-टॉक्सिकोलॉजिकल अध्ययनों से पता चला कि रोमिल सूँडी कैटरपिलर पर एस.पी.ओबी एन.पी.वी. के विषाणु को बढ़ाने के लिए इष्टतम तापमान 280C है। रॉबिन ब्लू (0.2%) ने एस.पी.ओबी

एन.पी.वी. के निकायों की सुरक्षित रखा और 2 घंटे के लिए लगातार यूवी स्रोत के संपर्क में भी इसे बनाए रखा।

- ट्राइकोडर्मा समूह के आइसोलेट्स जैसे सीजेएमआर – 180, सीजेएमआर – 183, सीजेएमआर – 192 के फ़्लेक्स विल्ट रोगजनक कॉलोनी को अवरोध करने के आधार पर यह पता चला कि यह राइजोक्टीनिया एवं स्क्लेरोसियम दोनों के प्रति प्रभावी है। ट्राइकोडर्मा समूह के आइसोलेट्स सीजेएमआर – 180, सीजेएमआर – 193, सीजेएमआर – 192 राइजोक्टीनिया के लिए एवं सीजेएमआर – 182, सीजेएमआर – 183, सीजेएमआर – 180 स्क्लेरोसियम रोगजनक के प्रति प्रभावी पाये गए।
- यूपी के प्रतापगढ़ और अमेठी जिलों से एकत्र किए गए ट्राइकोडर्मा के पांच आइसोलेट्स में से, टी -1 आइसोलेट ने फुसैरियम उडुम प्रजाति क्रोटोलारिया के प्रति अधिकतम प्रतिपक्षी क्षमता (75.13%) का प्रदर्शन किया जो कि सनई में विल्ट बीमारी फैलाता है।
- कोरकोरस फेसिकुलेरिस (डब्लू.सी.आई.एन.-104) इंडिगो कैटरपिलर, स्पोडोप्टेरा लिटुरा के प्रति एक प्रतिरोध स्रोत हो सकता है क्यों कि इसने लार्वा के खिलाफ अधिकतम प्रतिजैवी गुण प्रदर्शित किया जिसके कारण लार्वा का वजन और उसकी जीवित रहने की क्षमता दोनों कम पायी गई।
- जंगली और सामान्य कृषित प्रजातियों में परोक्सीडेज गतिविधि अलग-अलग पायी गई । कोरकोरस एस्टुयन्स के डब्लू.सी.आई.एन.-179 लाइंस में परोक्सीडेज गतिविधि कृषित प्रजातियों की तुलना में 8 गुना अधिक पायी गई। शायद कोरकोरस एस्टुयन्स में रोमिल सूँडी कैटरपिलर के प्रति अधिक प्रतिजैवी गुण होने के कारण यह अंतर पाया गया।
- कॉटन मिलीबग (फेनाकोकस सोलनोप्सिस) पर जैव-पारिस्थितिक अध्ययन से पता चला कि 18°C तापमान में वृद्धि के साथ, कुल जीवन चक्र की अवधि 29 दिनों तक कम हो जाती है। 16-34°C के तापमान में, मिलीबग के अधिकतम जीवित रहने के लिए इष्टतम तापमान 28°C है। रियरिंग तापमान (28-34°C) में वृद्धि के साथ नर के अनुपात में वृद्धि हुई।
- पटसन की उच्च उपज वाली क़िस्मों (जेआरओ–204 एवं जेआरओजी-1) को उगाने के साथ 45 से 55 दिन बाद फेनिप्रोक्सिमेट 5EC (1.5 मि. ली. /ली.) पर्ण छिड़काव करने से पीली मकड़ी के अंडे और घनत्व में कमी के साथ ही रेशे की उपज में भी वृद्धि पायी गयी |
- मृदा में सल्फर @ 60 किग्रा/हेक्टेयर का प्रयोग जूट के पीले घुन के प्रति प्रभावी पाया गया, इसने घुन के संक्रमण और क्षति में कमी के साथ-साथ यह पौधे की वृद्धि, पौधे की ऊंचाई, शुष्क भार और क्लोरोफिल में बढ़ोतरी होती है। इन कारणो से रेशे की उपज, पीली मकड़ी से होने वाली क्षति से संतुलित हो जाती है। इस तरह जेआरओ–204 किस्म को लगाने के बाद सल्फर @ 60 किग्रा / हे. का प्रयोग रेशे की अधिक उपज और घुन से कम क्षति होती है।
- इन विट्रो स्थिति के तहत, कार्बेन्डाजिम 50% डब्लू.पी. और प्रोपिकोनाज़ोल (13.9%) + डेफ़ेन्कोनाज़ोल (13.9% ईसी), का मिश्रण पूरी तरह से (100%) फुसैरियम उडुम प्रजाति क्रोटोलारिया के संक्रमण को रोकता है, जो कि सनई में विल्ट बीमारी फैलाता है।
- कीट एवं रोगों के प्रबंधन के लिए बीज को कीटनाशक और फफूंदनाशक से उपचारित करने पर यह पता चला कि कार्बेन्डाजिम (2 ग्रा./किग्रा) + इमिडाक्लोप्रिड (4 ग्रा./किग्रा) और ब्लीचिंग पाउडर का मृदा प्रयोग @ 25 किग्रा/है. के मिश्रण को बुवाई से 7 दिन पहले बीज के साथ उपचरित करने पर तना सड़न, पीला घुन, तना वेविल का संक्रमण कम हो जाता है जिससे रेशे की उपज भी अधिक होती है।
- प्रदर्शन के आधार पर सनई विल्ट और रेशे की अधिकतम उपज के लिए तीन उपचारों का एक साथ मिश्रण उपयोग करना सर्वोत्तम पाया गया जिसमें बीजोपचार, कार्बोक्सिन + थीरम @ 2 ग्रा./किग्रा बीज + मृदा प्रयोग के साथ नीम केक @ 250 किग्रा/है. और ट्राइकोडर्मा प्रजाति @ 2.5 किग्रा/हे. + मक्का की अंत: फसल (10:1) का उपयोग हुआ था।

तकनीकी हस्तांतरण

- पश्चिम बंगाल के उत्तर 24 परगना, नदिया, हुगली तथा पूर्व वर्धमान जिला के 64.92 है॰ क्षेत्रफल में पटसन के उन्नत उत्पादन तकनीकों का अग्रिम पंक्ति प्रक्षेत्र प्रदर्शन आयोजित किया गया, जिसमें 177 कृषकों की भागीदारी रही | उनत प्रजाति जेआरओ 204 की उत्पादकता सर्वाधिक थी | क्रिजेफ मल्टी रो सिड ड्रिल तथा क्रिजेफ नेल वीडर द्वारा खरपतवार प्रबंधन से मानव श्रम में लगभग 10,643-15,921 रु॰/प्रति है॰ की बचत तथा उत्पादकता में 3.01-4.73 क्विंटल/है॰ की वृद्धि हुई | क्रिजेफ सोना द्वारा पटसन को सड़ाने से रेशा की गुणवत्ता में 1-2 ग्रेड का सुधार हुआ, जिससे कृषकों को लगभग 400-500 रु॰/ क्विंटल की अधिक आमदनी हुई |
- वैज्ञानिकों के अनुभव को पटसन आधारित फसल पद्धति पर जलवायु परिवर्तनशीलता के प्रभाव को व्यक्त करने के लिए एक प्रश्नावली विकसित की गई | इसमें वैज्ञानिकों के जलवायु परिवर्तन के प्रति उनकी अनुभूति, पटसन आधारित फसल पद्धति पर मौसम/जलवायु असमान्यता का प्रभाव, इस प्रभाव को कम करने वाली राहत एवं अनुकूली रणनीति तथा जलवायु के इस असर को कम करने में पटसन आधारित तकनीकों की प्रभावशीलता आदि शामिल हैं |
- कृषक महिलाओं में उद्यमिता विकास हेतु पटसन रेशा एवं पटसन फैब्रिक आधारित तीन कौशल विकास के कार्यक्रम आयोजित किए गए | उत्तर 24 परगना जिला के तीन विभिन्न ग्रामों से चयनित 24 कृषक महिलाओं को दो स्वंय सहाता समूह में गठित किया गया |
- पटसन मूल्य श्रिंखला संकल्पना के आधार पर उत्तर 24 परगना जिला के दो फार्मर प्रोड्यूसर कंपनी, बादुरिया कृषि विकास फार्मर प्रोड्यूसर कंपनी तथा सबका अपना फार्मर प्रोड्यूसर कंपनी, नीलगंज को आई॰ सी॰ ए॰ आर॰- क्रिजेफ तथा इसके कृषि विज्ञान केन्द्र के विभिन्न सरकारी योजना, परियोजना तथा कार्यक्रम से जोड़ा गया |
- आई॰ सी॰ ए॰ आर॰- क्रिजेफ के प्रमाणित तकनीकों के प्रभाव का मूल्यांकन तीन जिलों उत्तर 24 परगना, नदिया तथा मुर्शिदाबाद जिला में किया गया | उत्तर 24 परगना जिला के उत्तरदाताओं द्वारा सर्वाधिक रेशा

उपज में वृद्धि तथा जानकारी प्राप्तांक (आई॰ सी॰ ए॰ आर॰- क्रिजेफ तकनीकों) का प्रदर्शन किया गया | समान्यत: इन सभी पटसन उत्पादक जिलों में सड़न के समय जल की अनुपलब्धता तथा पटसन कटाई के समय श्रम की अनुपलब्धता मुख्य समस्या थी|

- पटसन-आईकेयर परियोजना के अन्तर्गत प्रक्षेत्र से सीधी जानकारी प्राप्त करने के लिए बाह्य विशेषज्ञ की मदद से एक गूगल आधारित प्रपत्र विकसित किया गया | इसे सभी मास्टर ट्रेनर को प्रशिक्षण देने के बाद भरने के लिए उपलब्ध कराया गया | पश्चिम बंगाल के चार जिलों में प्रसार अंतर का अध्ययन में सर्वाधिक मालदा (10.07 क्विंटल/ है॰) के बाद उत्तर दिनाजपुर (7.67 क्विंटल/ है॰) में संभवत: अंफन चक्रवात एवं आँय जलवायु विभिन्नता के कारण देखी गई |
- वर्ष 2020 में, पटसन-आईकेयर परियोजना का विस्तार पटसन उत्पादक राज्यों (पश्चिम बंगाल, असम, बिहार, ओडिशा, मेघालय) के 1,03,900 है॰ में किया गया | इसमे उच्च उपज वाली प्रजातियों के बीज (603 मि॰ टन), आई॰ सी॰ ए॰ आर॰- क्रिजेफ विकसित कृषि यंत्र (600 - क्रिजेफ मल्टी रो सिड ड्रिल, तथा 900- क्रिजेफ सिंगल व्हील जूट वीडर) और क्रिजेफ सोना का प्रयोग किया गया| समय पर महत्वपूर्ण कृषि परामर्श के प्रसार तथा प्रक्रिया से संबद्ध निर्देश हेतु ऑनलाइन बैठक आयोजित की गई | सूचना के नियमित आदान-प्रदान के लिए तीन सोशल मीडिया समूह बनाए गए, जिसमें पटसन-आईकेयर परियोजना में शामिल क्रिजेफ के वैज्ञानिक, जूट कार्पोरेशन के अधिकारी, नेशनल जूट बोर्ड के अधिकारी, ब्लाक सुपरवाइज़र, तथा मास्टर ट्रेनर थे |

अखिल भारतीय पटसन एवं समवर्गीय रेशा नेटवर्क परियोजना

- तोषा पटसन की जेआरओएमयू 1; केनाफ की जेआरएचसी 3 किस्मों का विमोचन भारत सरकार के अधीन फसल मानकों, किस्मों का विमोचन एवं अधिसूचना संबंधी केन्द्रीय उपसमिति के सिफ़ारिश पर की गयी है। जिसे राजपत्र अधिसूचना संख्या एस. ओ. 99 (ई) दिनांक 6 जनवरी, 2020 के तहत अधिसूचित की गयी है ।
- राहुरी, महाराष्ट्र में एकीकृत पोषक तत्व प्रबंधन (75% आरडीएन + 25% नत्रजन जैविक खाद के द्वारा + 5 किलोग्राम $MgSO_4$) द्वारा तोषा पटसन की बीज फसल में अधिकतम सकल रिटर्न (10-25-2580 / हेक्टेयर), शुद्ध वापसी (रु। 57,270 / हे) के साथ फसल की अधिकतम उपज (17.09 क्विंटल/हेक्टेयर) दर्ज की गई।
- कल्याणी, कूचबिहार और नगाँव केन्द्रों में बुवाई के 15-20 और 35-40 दिनों बाद हाथ या यांत्रिक विधि से निराई खरपतवार नियंत्रण और उपज बढ़ाने में सबसे अच्छी पायी गयी इसी के साथ बुवाई के 15 दिनों के बाद क्विज़ालोफ़ॉप इथाईल 5 ईसी 60 ग्रा. + एथोक्सिसल्फ्यूरॉन @ 100 ग्रा./हे. का प्रयोग करने से अधिकतम शुद्ध आय की प्राप्ति हुई।
- बैरकपुर में एकीकृत कीट और रोग प्रबंधन हेतु पंक्तिबद्ध बोई गई पटसन फसल में कार्बेन्डाजिम 50 डब्लू पी @ 4 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 लेम्डा सायहेलोथ्रिन 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।
- अधुतराई, तमिलनाडु में मिट्टी के परीक्षण और लक्ष्य उपज (एसटी - एसवाई पर 100% एनपीके) के आधार पर मेस्ता (रोसेल) की लक्षित उपज 3.2 टन/ हेक्टेयर जैविक खाद (5 टन/ हेक्टेयर) के अनुप्रयोग और उर्वरक उपयोग में लेने से 5.8% उपज विचलन के साथ हासिल की जा सकती है।
- कटिहार में चूषक कीटों के प्रबंधन के लिए बुवाई के 35 दिनों बाद नीम के बीजों का रस (5%) + एजाड़िरेक्टिन (1500 पीपीएम) 5 मिली लीटर/ लीटर की मात्रा से + बुवाई के 65 दिनों बाद वर्टिसीलियम लेकनी 6 ग्राम प्रति लीटर की मात्रा से डालने पर यह प्रभावी पाया गया।
- पश्चिम बंगाल के कूचबिहार में जब फ़्लेक्स की बुवाई नवंबर के प्रथम सप्ताह में की गई तो पौधे की ऊंचाई (105.8 सेमी), बेसल व्यास (0.41 सेमी), हरा वजन (192.01 क्विंटल प्रति हेक्टेयर), सूखा वजन (54.43 क्विंटल प्रति हेक्टेयर) और रेशे की उपज (18.05 क्विंटल प्रति हेक्टेयर) अधिकतम प्राप्त हुई जैसे जैसे बुवाई का समय में देरी हुई वैसे वैसे इन सभी मापदण्डों में कमी देखि गई।
- आंध्र प्रदेश के अमदलावलासा में, एनपीके @ 60:13:50 किग्रा/ हेक्टेयर या एनपीके @ 90:13:50 किग्रा/हेक्टेयर के साथ वर्मी-कम्पोस्ट @ 2.5 टन प्रति हेक्टेयर प्रयोग करने से सिसल में प्रति पौधे पत्तियों की संख्या, हरी पत्तीयों का भार और रेशे की उपज (19.58 - 19.81 क्विंटल प्रति हेक्टेयर) अधिकतम देखी गयी।

कृषि विज्ञान केन्द्र

- कृषि विज्ञान केन्द्र, बर्दवान के द्वारा – आलू में पछेती अंगमारी बीमारी का प्रबंधन, गेंदें में पोषक तत्वों का प्रबंधन, सब्जी की रोपाई के लिए अलग-अलग तकनीकों का आकलन, छोटे पौधों की मृत्यु दर, रोपित धान में उगने वाली खरपतवार पर विभिन्न खरपतवारनाशियों का आकलन इस सभी पर पाँच फार्म परीक्षण किये गए। पटसन, धान, मसूर, काबलु चना, उरद दाल, प्याज, बैंगन, केला की उन्नत उत्पादन तकनीकों पर कुल 348 अग्रिमपंक्ति प्रक्षेत्र प्रदर्शन (एफएलडी) आयोजित किए गए। कुल मिलाकर, किसानों, ग्रामीण युवाओ और विस्तार अधिकारियों के लिए 52 प्रशिक्षण कार्यक्रम आयोजित किए गए। इन प्रशिक्षण कार्यक्रमों के माध्यम से कुल 1454 प्रशिक्षुओ को लाभान्वित किया गया।
- कृषि विज्ञान केन्द्र, उत्तर 24 परगना के द्वारा वर्ष 2020 में पटसन, धान और उर्द की उन्नत उत्पादन तकनीकों पर कुल 68 अग्रिमपंक्ति प्रक्षेत्र प्रदर्शन (एफएलडी) आयोजित किए गए। कुल मिलाकर, किसानों, ग्रामीण महिलाओं और विस्तार अधिकारियों के लिए 16 प्रशिक्षण कार्यक्रम आयोजित किए गए। इन प्रशिक्षण कार्यक्रमों के माध्यम से कुल 215 प्रशिक्षुओ को लाभान्वित किया गया। महत्त्वपूर्ण कार्यक्रम जैसे आदरणीय प्रधानमंत्री द्वारा किसानों के लिए संबोधन, महात्मा गांधी की 125 वीं जयंती का आयोजन, संविधान दिवस, विश्व मृदा दिवस, महिला किसान दिवस आदि आयोजित किए गए।

1. 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.

ICAR-CRIJAF 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.

Sub-stations of ICAR-CRIJAF

Central Seed Research Station for JAF, BudBud

Sunnhemp Research Station, Pratapgarh

Sisal Research Station, Bamra

Ramie Research Station, Sorbhog

1.1. Research Achievements

In the backdrop of the onslaught of COVID-19 pandemic it was a difficult year for the institute as peak jute growing season during March-April coincided with nationwide lockdown to contain COVID-19 virus. The institute has done a commendable job by responding positively to the challenges and reached the farmers and stakeholders by using information technology tools like Android based apps (JAF-Safe) and web based form (JAF-Kisan), WhatsApp groups and institute's website. Mandatorily the institute issued agro-advisory and safety measures for farmers and jute mill workers.

In varietal development front, in this pandemic year, a tossa jute genotype, JROB 2 (Purnendu) with high biomass production potential and JRCJ 11, a white jute genotype with better fibre yield, quality and higher tolerance to major diseases and pests were identified for notification and release for commercial cultivation. Identification of eight heat stress tolerant genotypes will play potential donor in the development of terminal heat stress tolerant fibre flax varieties.

By application of fertilizers as per soil test based targeted yield (ST-TY) equation. In the farmers' field, the targeted yield (40 q/ha jute and 50 q/ha paddy) was achieved in jute-rice cropping. Diversifying jute-rice system through inclusion of green gram and pumpkin (jute fabric soil columns) as inter crop in jute and lowland rice significantly increased the return, nitrogen use efficiency (NUE) and water use efficiency (WUE) of the system. In climate resilient study, two varieties i.e, MTU-1010 of rice and JRO-204 of jute showed very high degree of adaptation to enhanced level and exposure to ozone.

The standardized protocol for bioethanol production from high biomass jute variety JROB 2 and JRO 524 may increase the possibility for diversified use of jute. High capacity fibre flax extractor developed by the institute will certainly increase the scope for commercial production of flax fibre.

Positive outcome of eco-toxicological studies in conjugation with standard UV-protectant will improve the sustainability of Spilosoma obliqua nucleopolyhedrosis virus (SpobNPV) for management of hairy caterpillar in field condition. Few accessions of native Trichoderma strains showed potential as ideal candidate for biocontrol consortium for management of flax wilt complex caused by Rhizoctonia sp. and Sclerotium sp. Integration of superior jute varieties (JRO 204 and JROG 1) with two foliar sprays of fenpyroximate 5EC@ 1.5ml/l during the peak mite incidence period (40-55 days after sowing) is ideal for reducing the mite incidence and damage grade as well as highest fibre yield. Soil application of sulphur @ 60kg/ha proved effective against yellow mite of jute besides, it enhanced the plant height, dry weight and chlorophyll content. These parameters could compensate the adverse effect of mite damage on fibre yield.

In the process of doubling farmer's income, empowering farmers and self-help groups with latest farm technologies and skill development for value addition were also emphasized. Besides, the challenge is to channelize the resources and inputs from within the farm. In this aspect the institute conceptualized and demonstrated JAF crop retting tank-based farming system approach and also retting in free flowing water. In capacity building programmes this year special trainings were undertaken for farm women, SC farmers, the farmers of NE region.

1.2. 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.

1.3. Vision

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

1.4. 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.

1.5. 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.

1.6. 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.

1.7. Krishi Vigyan Kendra

Two Krishi Vigyan Kendras i.e. KVK, Purba Bardhaman and KVK-II, North 24 Parganas 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 was established in 2016 in 10 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.

1.8. 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.

1.9. 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.

1.10. 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.

1.11. 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.

1.12. 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.

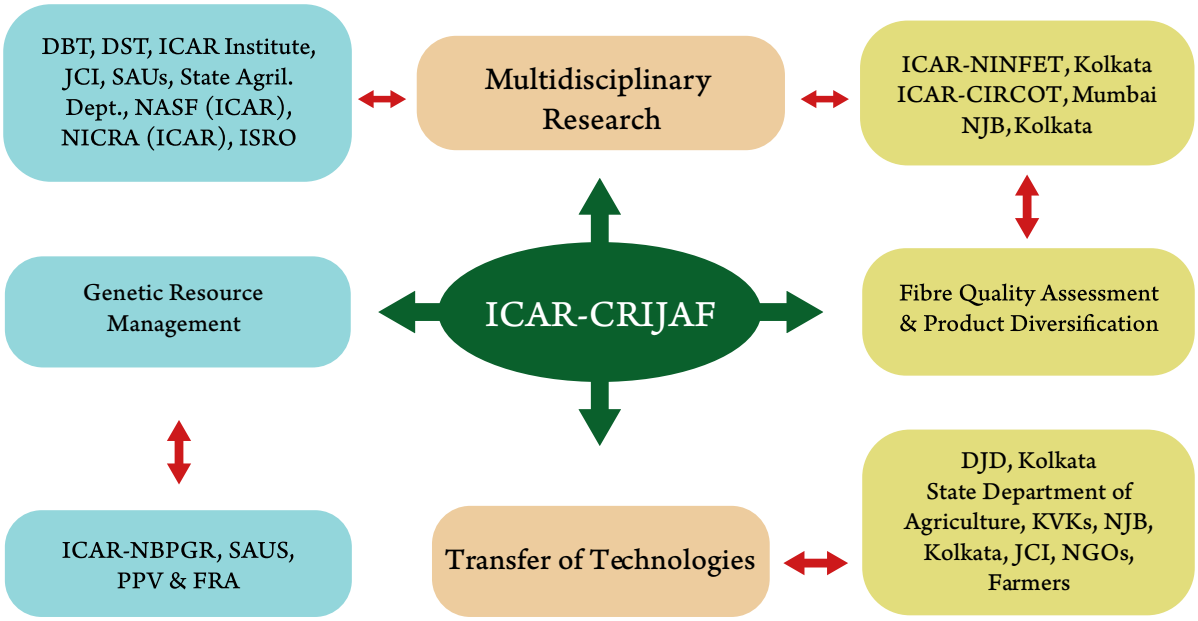
1.13. Regional Centre of National Agricultural Education Accreditation Board

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.

1.14. 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

LINKAGES & COLLABORATION



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, MoAC 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.

1.15. Infrastructural Facilities

1.15.1. 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.

1.15.2. 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, power tiller, 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.

1.15.3. 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.

1.16. Financial Statement

Table 1. Financial Statement of ICAR-CRIJAF, Barrackpore for the year 2020-21 (₹ In Lakh)

Head	Proposed RE (2020-21)	Expenditure up to Dec, 2020
Grant in aid - Capital	20.00	0.00
Grant in aid - Salary	2212.15	1731.21
Grant in aid - General	1275.00	714.74
Total	3507.15	2445.95

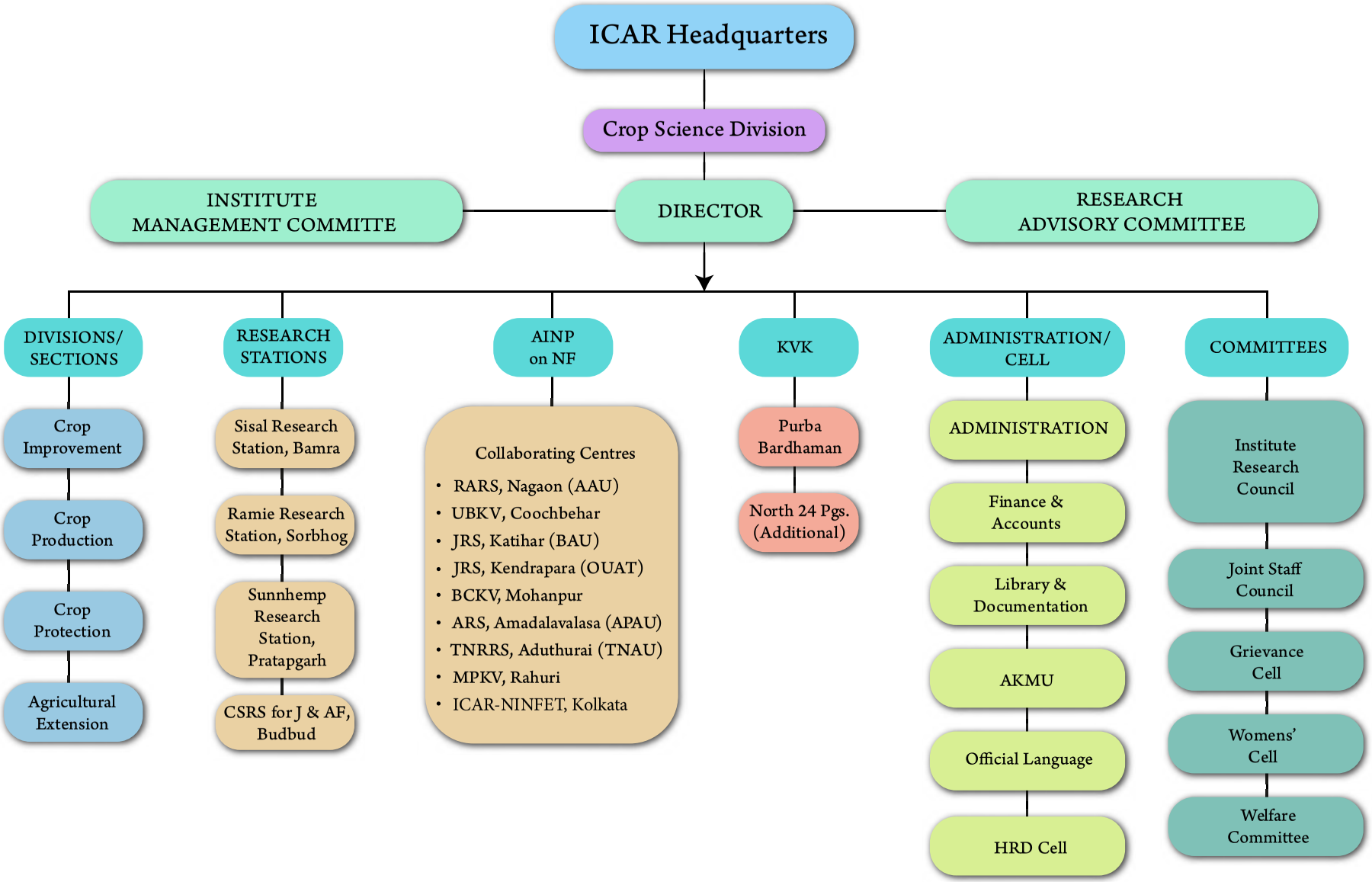
** Detailed financial statement is given in chapter 26*

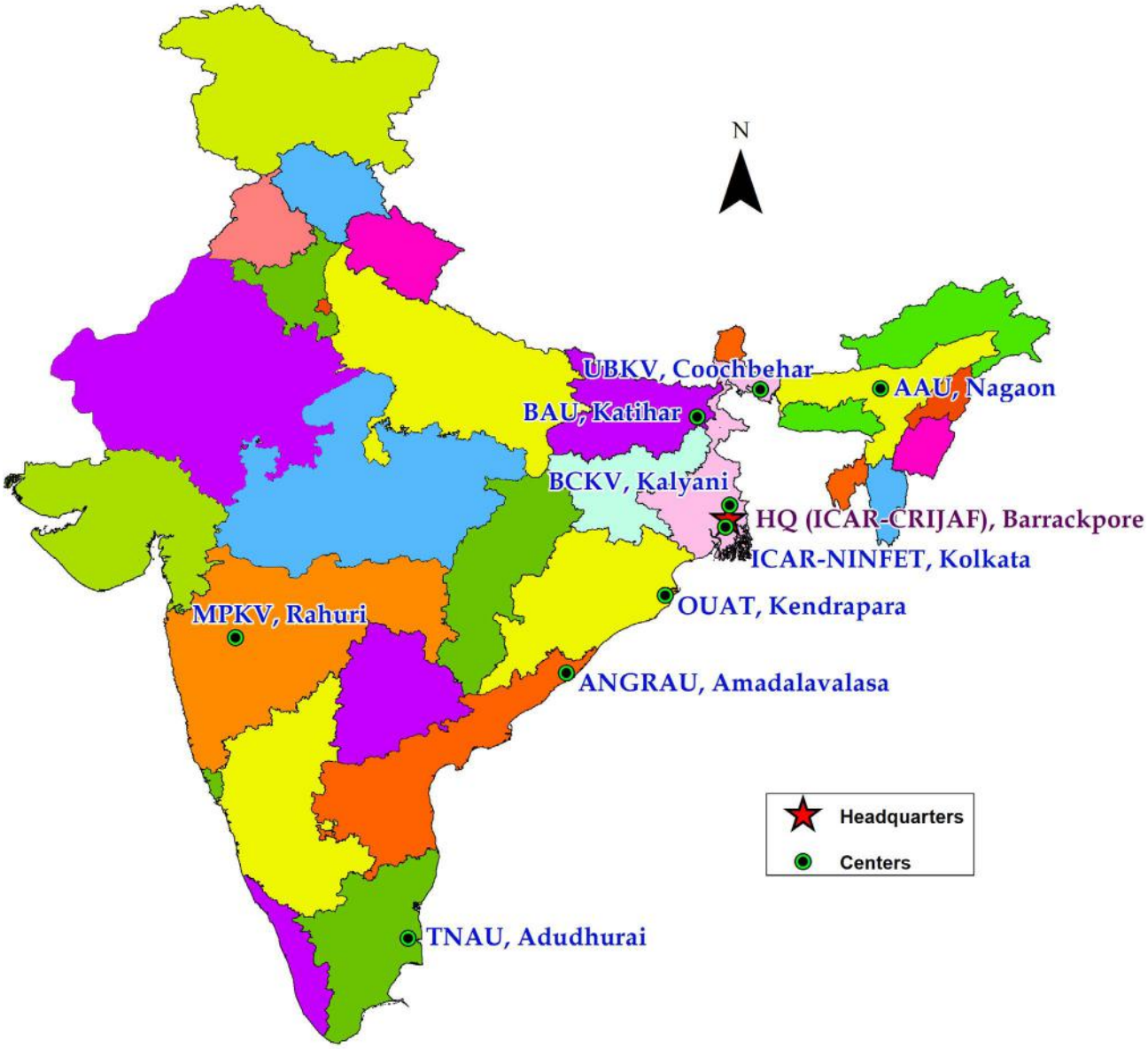
1.17. Staff Position

Table 2. Cadre-wise staff position of ICAR-CRIJAF and its Regional Stations

Cadre	Sanctioned	In position	Vacant
RMP	01	01	-
Scientist	55	44	11
Technical	108	43	65
Administrative	62	35	27
SSS	46	37	09

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
RARS, Nagaon (AAU)
UBKV, Coochbehar
JRS, Katihar (BAU)
JRS, Kendrapara (OUAT)
BCKV, Mohanpur
ARS, Amadalavalasa (APAU)
TNRRS, Aduthurai (TNAU)
MPKV, Rahuri
ICAR-NINFET, Kolkata
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



Location of All India Network Project on Jute and Allied Fibres centres in the country

2. Crop Improvement

2.1. Advanced Breeding in Jute

2.1.1. Comparative mitogenomics of two cultivated jute species

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

Mitochondrial genomes of the two cultivated species (*Corchorus capsularis* and *C. olitorius*) were reconstructed with 1,999,602 bp and 1,829,341 bp, respectively (Table 3).

Table 3. Comparative features of mitochondrial genomes of the two cultivated jute species

Parameter	*C. capsularis*	*C. olitorius*
GC content (%)	43.00	42.85
Protein-coding genes	37	35
Protein-coding sequences (nt)	31,402	30,233
Protein-coding sequences (%)	1.57	1.65
tRNA genes	34	35
rRNA genes	3	3
RNA-coding sequences (nt)	8,135	6,116
RNA-coding sequences (%)	0.41	0.33
ORFs	620	644
ORF sequences (nt)	311,880	287,619
ORF sequences (%)	15.60	15.72
Simple repeats	109	133
Simple repeat sequences (nt)	4,319	5,050
Simple repeat sequences (%)	0.22	0.28
Low-complexity repeats	41	29
Low-complexity repeat sequences (nt)	1,639	1,077
Low-complexity repeat sequences (%)	0.08	0.06
DNA transposon (RC/Helitron)	1	1
LTR retrotransposon	53	29
Non-LTR retrotransposon	71	57
Transposable element sequences (nt)	45,336	35,551
Transposable element sequences (%)	2.27	1.94

For synteny mapping, both the mitogenomes were aligned by LAST which is efficient for circular genomes without requiring repeat masking (Fig. 1).

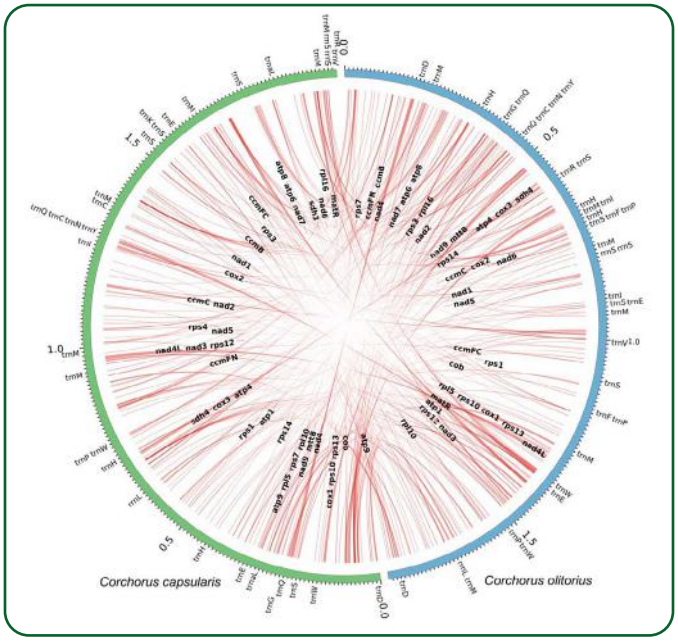


Fig. 1: A mitogenomic synteny map of the two cultivated jute species

2.1.2. Pectin biosynthesis pathways

(Investigators: P. Satya, D. Sarkar, S. Ray, S. Roy, L. Sharma, A. Bera, C.S. Kar, J. Mitra; Project Code: In-house Projects-JBT 4.1, JB 10.4 and Externally Funded Project-ICAR-NPTC-3070)

A rhamnogalacturonan (RG)-rich salvage pathway for pectin biosynthesis in jute: Pectin biosynthesis pathways were identified from transcriptome and genome sequence information of jute. Three major routes, UDP-sugar interconversion, GDP-sugar interconversion and salvage pathways are operational in both *C. olitorius* and *C. capsularis* (Fig. 2). A total of 27 isoforms of 17 genes having size range of 805nt to 3638 nt, with their predicted coding sequences ranging from 624 to 3210 nt, were identified to be involved in these pathways. Many of these genes have multiple isoforms. All these genes were mapped to the genomic locations of *C. capsularis* cv. CVL-1, with a sequence identity of 98.8 to 100%. Corresponding genomic regions were also identified from *C. olitorius* cv. JRO-524 genome with more than 88.8% identity,

suggesting that basic pectin biosynthesis pathways are highly conserved between these two species. Twenty five homologs of these genes were also identified from jute hypocotyl transcriptome, suggesting these genes are active from seed germination to active growth, contributing to pectin biosynthesis in jute. All the proteins contained corresponding functional domains of pectin biosynthesis genes (Fig. 3). It was observed that these genes also have high similarity (67–93%) with corresponding genes from *A. thaliana*, which suggest that pectin biosynthesis pathways are well conserved between Malvaceae and Brassicaceae. Domain analysis also identified mechanistically similar reactions for pectin biosynthesis in these two families.

The UDP-Glc interconversion pathway was characterized by nearly 1.4- (in *C. olitorius*) to 4.1-fold (in *C. capsularis*) upregulation of *CcUGD1* over *CcRHM1*. Jute, like other plant species produces more homogalacturonan (HG) pectin than rhamnogalacturonan (RG) pectin which is due to the metabolic flux favoring the conversion of UDP-Glucose more to UDP-Glucuronic Acid than to UDP-Rhamnose. This metabolic flux was found to be driven towards more RG formatuon in *C. olitorius* than in *C. capsularis,* as *CcRHM1* expression was 38.0-fold higher in *C. olitorius*. On the other hand, upregulation of *CcMIOX3* over *CcUGD1* indicated that salvage pathways are more crucial for UDP-GlcA formation in jute. Comparative expression analysis of *CcUSP1* and *CcGER1* also revealed the relative predominance of the GDP-Fuc salvage pathway.

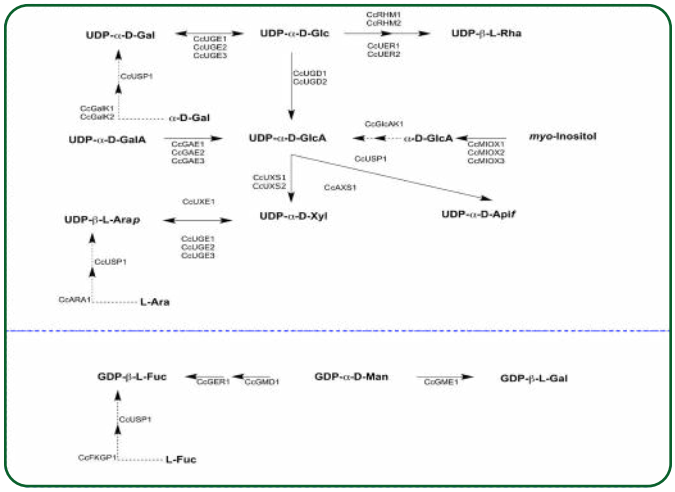


Fig. 2: Pectin biosynthesis pathways in jute. Dotted arrows represent the salvage pathways. Nomenclature of UDP- and GDP-sugars, and genes are according to conventional systems. The pathways were reconstructed by identifying genes that encode enzymes using BLASTx annotation of the KEGG database based on KAAS and BRITE hierarchies followed by cross validation of protein families.

Pectin biosynthesis pathway was found to be more active in *C. olitorius* as all the ten genes were found to be upregulated. Salvage pathways ensure a continuous supply of UDP-Rha in C. olitorius, which results in higher synthesis of RG-rich pectin in *C. olitorius* over *C. capsularis.*

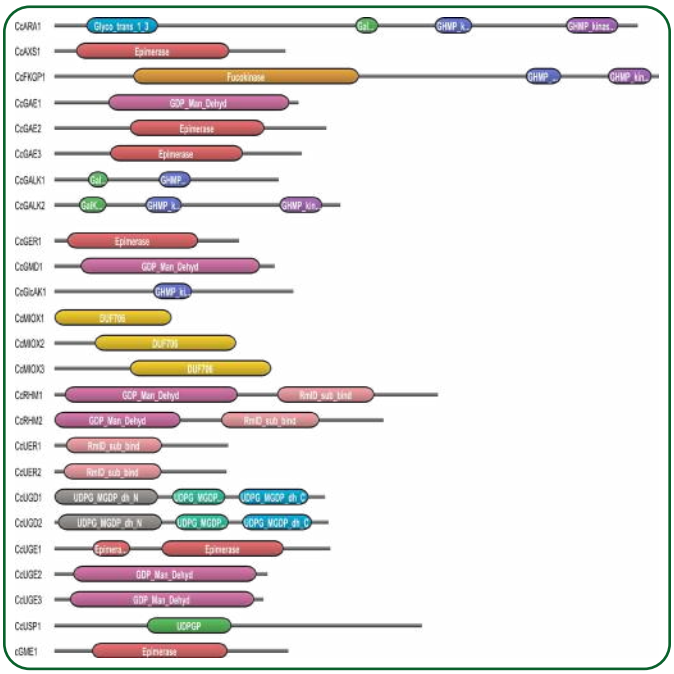


Fig. 3: Protein domains present in pectin biosynthesis genes, domains were identified using DoMosaics software.

Conserved pectin biosynthesis pathways in higher plants: Evolution of pectin biosynthesis pathways progressed in accordance with the evolution of plants. Most of the closely related jute homologs of pectin biosynthesis genes could be identified from other Malvaceous species like *T. cacao*, *D. zibenthinus*, *Gossypium raimondii*, *G. hirsutum*, *G. arboreum*, *G. barbadense* and *Herrania umbratica*, but the rate and pattern of evolution of these genes varied. For example *CcAXS1* (jute *UDP-d-Apif/UDP-d-Xyl synthase*) and *CcUSP1* (jute *UDP-sugar pyrophosphorylase*) (Fig. 4), were phylogenetically more isolated even within the Malvaceae. The study identified genes from species where pectinaceous polymers are known to have specialized functions. Many of jute pectin biosynthesis genes were identified in *Ziziphus jujuba* that produces high mucilage (~7 %). They require high mucilage for osmotic adjustment during drought stress. Thus mucilage might contribute to drought tolerance in jute. Similarly, identification of several homologs in many herbaceous and tree species like *Medicago truncatula*, *Hevea brasiliensis*, *Populus trichocarpa*, *Jatropha curcas* and *Juglans regia* can serve as valuable soure for alteration of pectin profile in these species to improve wood quality.

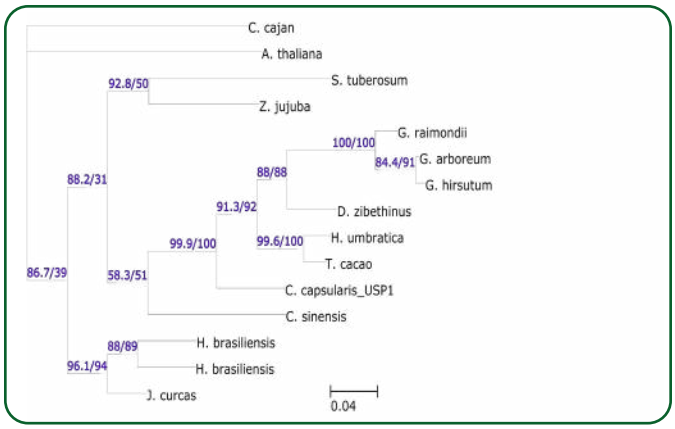


Fig. 4: Phylogeny of UDP-sugar pyrophosphorylase (USP1) constructed using IQ-Tree with maximum likelihood and best-fit model.

Rhamnose biosynthesizing enzyme (RHM) in plant evolved from lower charophycean algae: Phylogenetic relationships among 191 of RHA revealed that RHM homologs, even from the same species, were classified into different clades (Fig. 5), suggesting polyphylectic origins of plant RHMs. Several dicot RHMs were grouped with monocots. Presence of *Klebsormidium nitens* (a charophycean algal species) UDP-L-rhamnose synthase (PFAM: A0A1Y1IHI8_KLENI) indicates existence of a functional rhamnose biosynthesis pathway in this alga. The two-domain structure of plant RHMs originated in lower order Charophyceae leading to its subsequent lateral acquisition by both aquatic and land angiosperms. The Ka/Ks ratios of 66 *CcRHM1* homologs (< 1) across lower to higher plants indicated that plant *RHMs* might have evolved through strong purifying selections maintaining a conserved evolutionary pattern. More than a two-fold higher Ka/Ks ratio of *CoRHM1* (0.44) than that of its corresponding homolog *CcRHM1* (0.17) suggests less stringent selection pressure on *CoRHM1*. Six non-synonymous substitutions between CcRHM1 and CoRHM1 was observed. A tertiary structural model of CcRHM1 was developed. The N-terminal domain (aa: 18–335) matched to that of 2HUN chain B (NAD+ binding protein from *Pyrococcus horikoshii*). Whereas its C-terminal domain (aa: 410–677) was found to align with the 4QQR chain B (*A. thaliana* rhamnose synthase). The jute RHM1 model identified NAD as a ligand for the N-terminal region that physically interacts with the Rosmann fold (Fig. 6). By docking UDP-Glc on this tertiary structure, we further identified the substrate-binding pocket in CcRHM1, which is accessible to several amino acid sequences of both the N- and the C-terminal domains, including the catalytic triads.

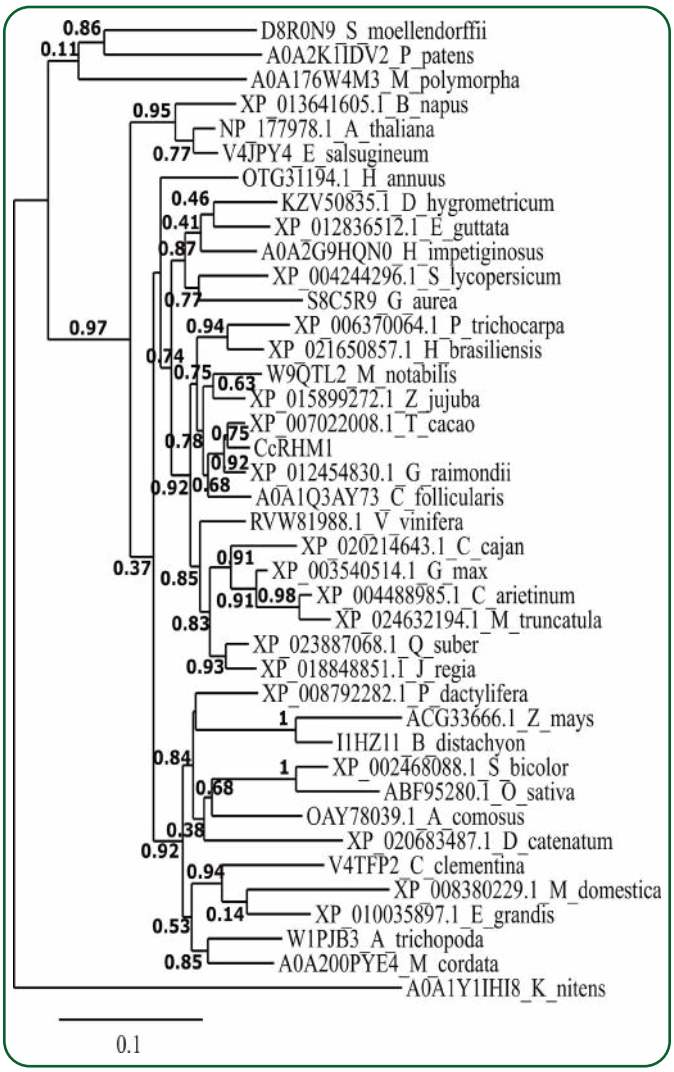


Fig. 5: A phylogeny of RHM with representative species. The tree was built using IQ-Tree with maximum likelihood and best-fit model.

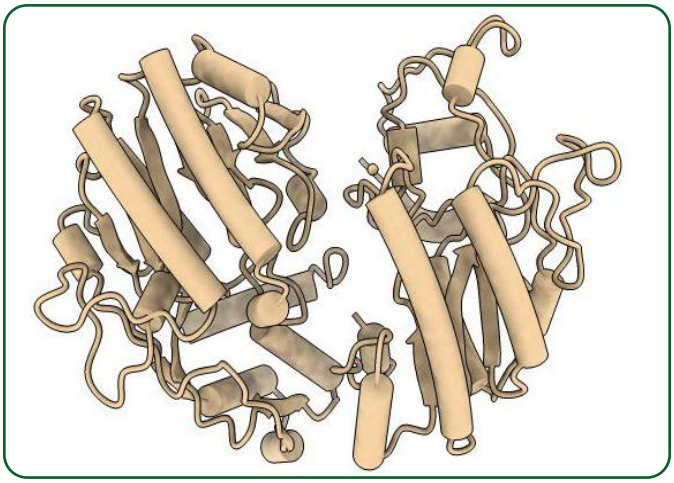


Fig. 6: A protein structural model of jute RHM1

2.2. Novel Biotechnological Approaches in Improvement of JAF Crops

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

(Investigators: *Subhojit Datta, Jiban Mitra, Dipnarayan Saha, Pratik Satya and Anil Kumar. Project Code: In-house Project-JBT 4.7.)*

Gene Structure of Major Intrinsic Protein (MIP) genes in C. olitorius: Distribution of introns and exons in the CoAQP genes are highly variable. A gene for SIP was found to lack any intron, whereas two NIP genes contained four introns each. TIPS had two introns, whereas PIPs contain either two or three introns (Fig. 7). Variation was also observed among different subfamilies in terms of gene size, CDS size and average intron length. Average gene size (2341 bp) and intron sizes (1263 bp) were highest in case of SIPs, perhaps due to the presence of a very long intron in one of the SIPs. The XIP gene had the smallest (64 bp) intron and longest (1275 bp) CDS. Average gene size, CDS size and intron sizes of CoAQPs were 1765, 836 and 280 bp respectively which was in conformity with other plant MIPs. Overall, the gene structure analysis indicated a conserved pattern of intron-exon within the subfamilies of MIPs suggesting the conserved evolution and supporting the CoAQP family classification.

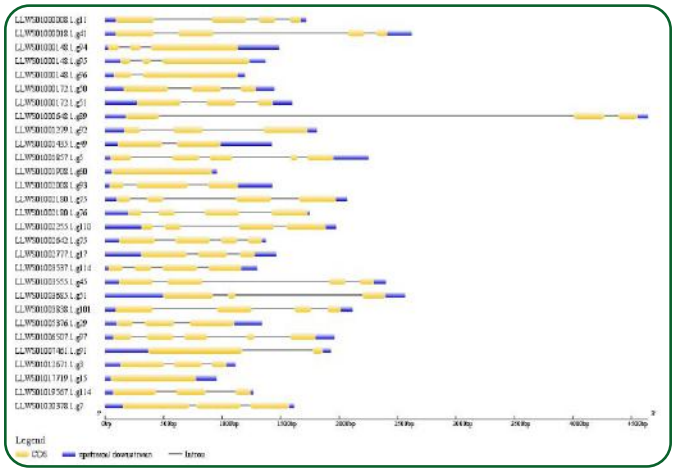


Fig. 7: Distribution of exons, introns upstream/ downstream elements in CoAQP genes.

2.2.2. Molecular insights into pectin degrading genes of bast fibre-retting bacterial consortium

(Investigators: *B Majumdar, Subhojit Datta, Dipnarayan Saha. Project Code: In-house Project-JA 7.7.)*

CAZys in Bacillus and interaction networks: Genome-wide distribution of genes encoding CAZys was studied in the Bacillus strains in the bast fibre-retting bacterial consortium. The major carbohydrate degrading CAZy classes observed are PL1, PL9, GH28, CE8, and CE12. Among the CAZy classes, the glycoside hydrolase family 28 (GH28) was most predominant with their numbers varying between 32-39 among different strains of *B. safensis, B. velezensis* and *B. altitudinis*. Among the three strains in CRIJAF SONA consortium, PJRB2 contained maximum 38 GHs, while PJRB1 and PJRB2 consisted 35 GHs each. With a closer look on the polysaccharide lyase CAZy family, which encodes pectin degrading enzymes like exo-pectate lyase (PL1; EC 4.2.2.9) and exopolygalacturonate lyase (PL9; EC 4.2.2.9), one copy each of PL1 and PL9 were observed in PJRB1 and PJRB3 strains. Whereas, PJRB2 genome consisted two copies of PL1 and single PL9. By incorporating the STRING interaction results with the pectin and xylan degrading enzymes of other Bacillus species, we could predict an enzyme interaction network based on co-occurrence of the respective genes across the genomes (Fig. 8).

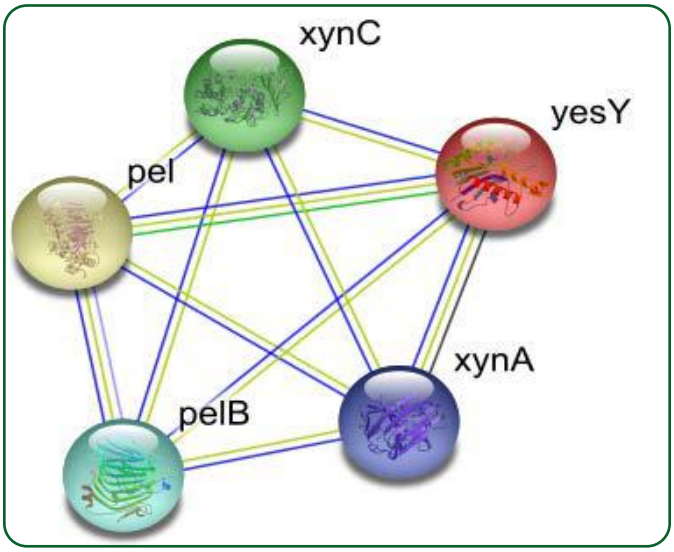


Fig. 8: Protein–protein interaction network of different pectin degrading enzymes in Bacillus.

Coloured nodes indicate query proteins and first shell of interactors. The blue lines indicate interactions based on gene co-occurrence, dark green lines based on gene neighbourhood, and light green lines indicate text mining based interactions.

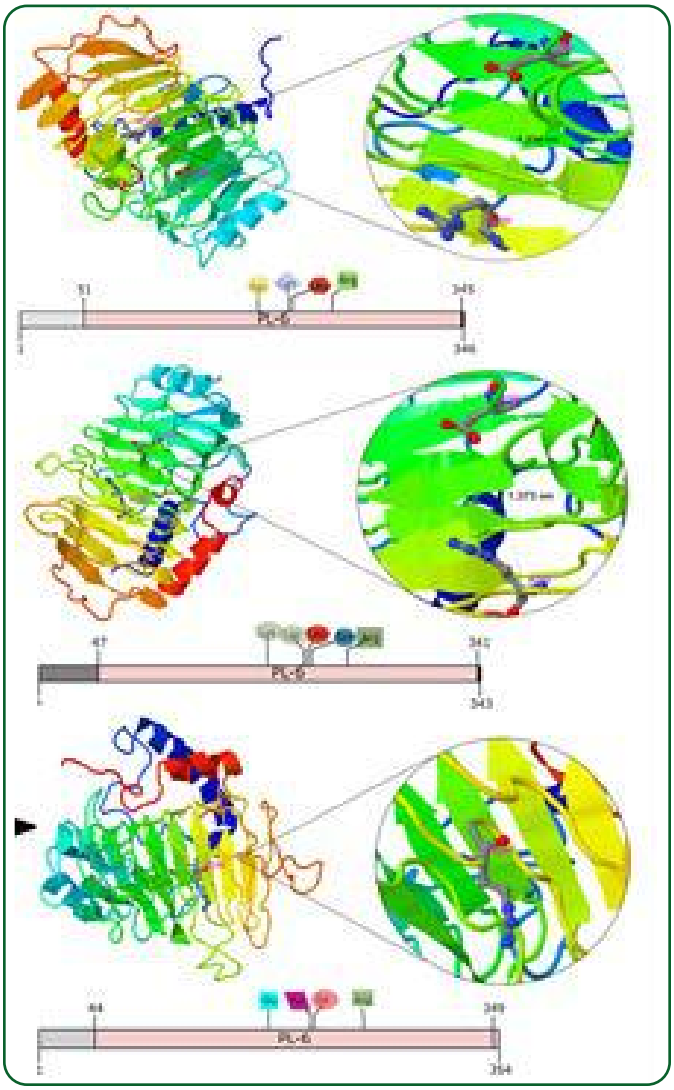
Pectinesterase, derived by automated computational analysis using gene prediction method, was found to interact with arabinoxylan hydrolase. Pectin lyase, catalyzing the depolymerization of methyl-esterified

pectins was found to interact with rhamnogalacturonan acetylesterase, which play a considerable role in the degradation of rhamnogalacturonan derived from plant cell walls. Similarly, pectate lyase was found to interact with glycoside hydrolases (Table 4).

Table 4. Details of protein–protein interaction network of different pectin degrading enzymes in *Bacillus*.

node1	node2	node1_id	node2_id	phylogenetic_cooccurrence	automated_textmining	combined_score
xynA	xynC	224308.BSU18840	224308.BSU18150	0.706	0.971	0.991
pel	yesY	224308.BSU07560	224308.BSU07070	0.709	0.153	0.744
xynC	pel	224308.BSU18150	224308.BSU07560	0.592	0.374	0.733
xynA	pel	224308.BSU18840	224308.BSU07560	0.677	0.185	0.725
xynA	pelB	224308.BSU18840	224308.BSU18650	0.535	0.312	0.666
pelB	xynC	224308.BSU18650	224308.BSU18150	0.504	0.301	0.638
xynA	yesY	224308.BSU18840	224308.BSU07070	0.518	0.127	0.57
pelB	pel	224308.BSU18650	224308.BSU07560	0.764	0.86	0.569
xynC	yesY	224308.BSU18150	224308.BSU07070	0.476	0.108	0.512
pelB	yesY	224308.BSU18650	224308.BSU07070	0.419	0.077	0.44

Homology modelling of PJRB pectate lyases: Three dimensional structures of pectate lyases were also compared. *Ab initio* model prediction of pectate lyases from PJRB strains were performed to explore the structural divergence and identification of ligand binding and active site residues (Fig. 9). As per COACH analyses, the closest structural homologue of PJRB1 and PJRB2 pectate lyases was a hexasaccharide I bound to B. subtilis pectate lyase (PDB model 2NZM), whereas, the pectate lyase from PJRB3 strain found its closest homologue in pectate Lyase C of *Dickeya chrysanthemi* mutant R218K (PDB model 2EWE). In case of PJRB1, the ligand ADA (α-D-galacturonic acid) interacted with four residues of the enzyme- Asp 186, Lys 210, Leu 213 and Arg 244. Similarly, the ligand binding residues of PJRB2 PL2 comprised of Gly 185, Tyr 209, Ile 212 and Arg 250. The pectate lyase enzymes of PJRB strains exhibited considerable divergence in their sequence as evidenced in the ligand binding site residues predicted by ab initio modelling. Pectate lyase of PJRB3 and PL1 of PJRB2 had five residues each in their ADA binding site. In PJRB2 PL1, the binding residues are Asn 203, Asp 246, Lys270, Val 273 and Arg 307; whereas in PJRB3 PL these residues are Lys 178, Lys 206, Leu 209, Ser 212 and Arg 240. Active site residues were predicted by COFACTOR module of COACH, and, except PJRB PL2 which contained a single Arg at position 244, all other contained one Asp and one Arg each in their active sites. The closest active site homologue observed in PJRB1 and PJRB3 pectate lyases was a pectate lyase of *D. chrysanthemi* (PDB model 1pclA), whereas, both the PLs of PJRB2 had highest homology with that of Bacillus sp. TS-47 (PDB model 1vblA).



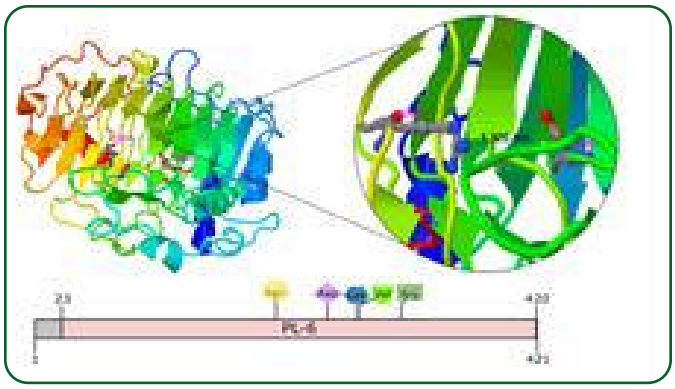


Fig. 9: 3-D homology modelling of PJRB pectate lyases.

Representative models derived from closest PDB homologues using COFACTOR module of COACH server are show in the right side with the active site residues denoted in pink. The respective Polysaccharide lyase-6 (PL-6) domains as identified using SUPERFAMILY 2, and the ligand docking residues are illustrated below the models

2.2.3. Heat stress-induced epigenomic changes in flax

(Investigator: *D. Saha; Project Code: Externally Funded Project- EEQ/2018/000274)*

Screening of heat-stress induced lipid oxidation damage in flax genotypes: The membrane lipid peroxidation is estimated through malondialdehyde (MDA) content in plants. MDA level thus can be used as screening assay to detect oxidative lipid injury caused by environmental stress, such as heat stress in flax. A total of 64 global flax germplasm lines were screened for MDA content due to heat stress treatment (15-day old seedlings, 40±2 °C, treated 5 hours for two consecutive days). As compared to control plants, leaves of heat-stressed plants accumulated significantly high level of MDA (~1.8 to 3.5-fold increase over control), and indicating membrane damage due to heat stress. The level of MDA ranges from ~41 to 99 nmole/gFW (gram/Fresh weight) (Fig. 10). Interestingly, eight genotypes showed little changes in the MDA content due to heat-stress when compared to the control plants. These genotypes may serve as a potential resource for heat stress tolerance studies in flax.

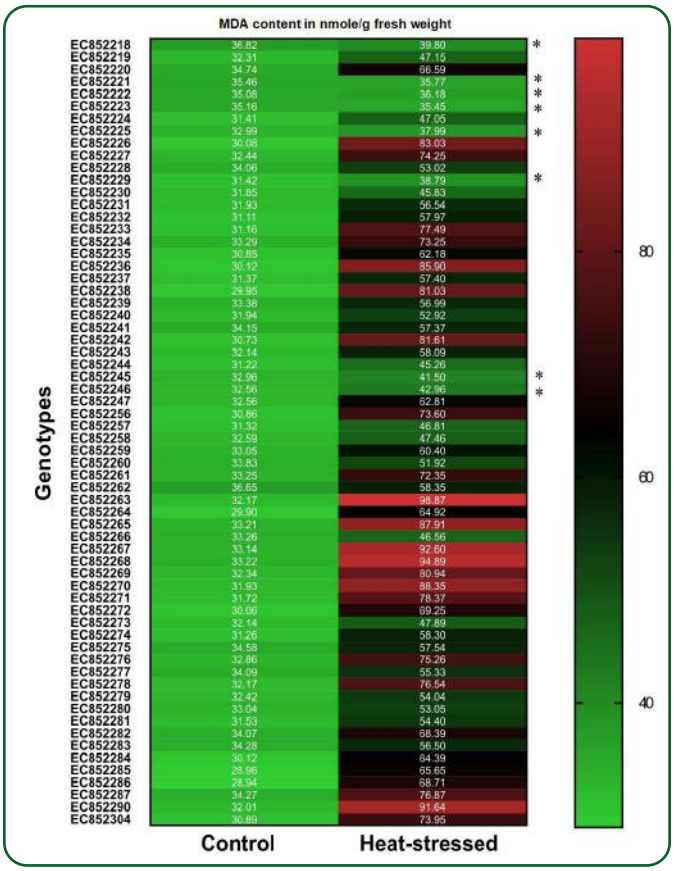


Fig. 10: Heatmap of MDA content estimation in seedlings of fibre flax genotypes under heat-stress.

The scale on the right denotes range of MDA content. The asterisks represent potential tolerant flax genotypes (non-significant MDA variations) for heat stress induced membrane damage.

Whole-genome methylome analysis in flax for heat stress: Whole-genome bisulfite sequencing data of fibre flax variety JRF 2 was generated for heat stress in flax. The Illumina paired-end sequencing data produced 24.5 to 27.2 million (M) reads of which 77.5 - 80.0% were mapped to the reference flax genome (Table 5).

Table 5. Methylome loci statistics in flax

	JRF2-C	JRF2-H	JRF2-Aza-C	JRF2-Aza-H
Reads (Millions)	27.28	26.39	24.58	25.21
Total bases (M)	7330.66	7089.00	6604.94	6774.77
Mapped reads %	77.5	79.7	80.0	79.4
Methylated C's in CpG (M)	49.73	46.79	44.45	44.96
Methylated C's in CHG (M)	21.60	20.42	19.16	19.56
Methylated C's in CHH (M)	27.38	23.32	21.48	21.43

Methylated loci (mCpG) were called in the context of CpG/CHG/CHH (Fig. 11). The mC's in CpG, CHG, and CHH contexts were found highest in control JRF 2 plants (49.7M, 21.6M, and 27.3M) compared to the lowest in 5-azacytidine treated JRF-2 plants grown under control conditions (44.4M, 19.1M, 21.4M). Chromosome-wise the mCpG and mCHH distributions were found highest in flax chromosome number 3, while the mCHG distribution was highest in Chr 2.

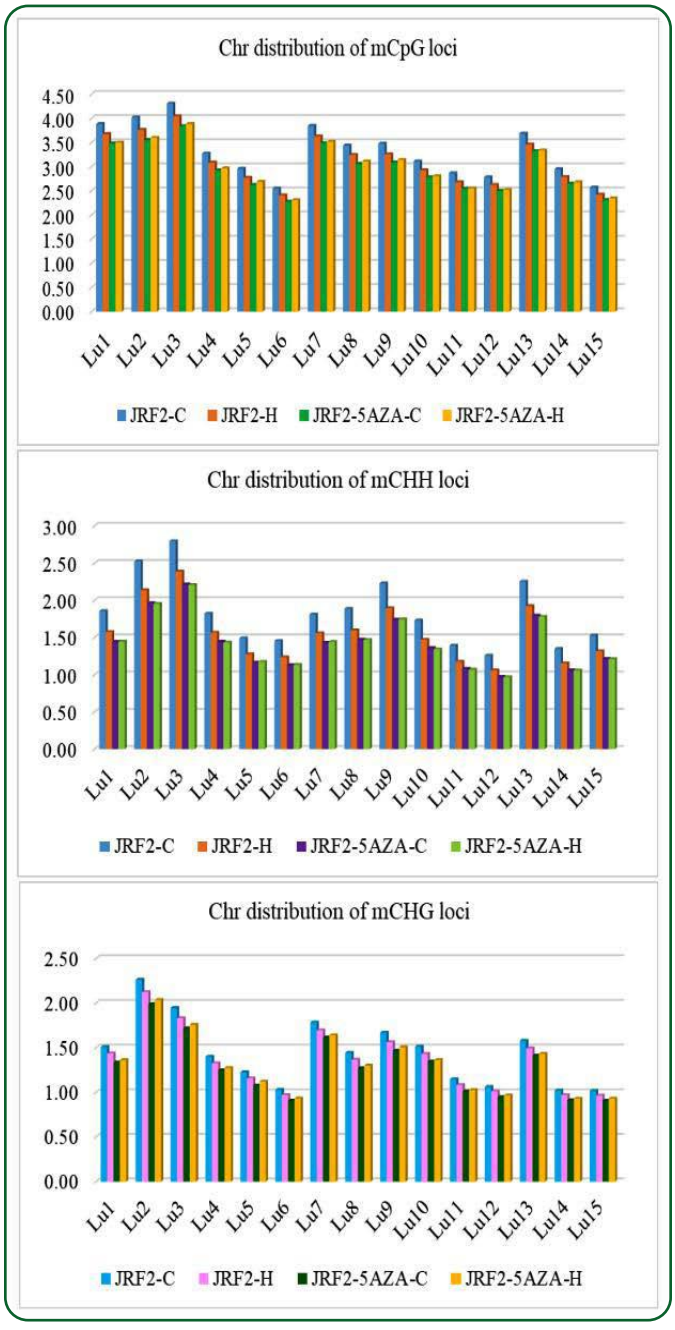


Fig. 11: Distribution of methyl cytosine loci based on mCpG, mCHH, and mCHG context on the 15 chromosomes of flax.

Lu: *Linum usitatissimum*; C: control; H: heat stress at 40±2 °C (4 hours for consecutive 4 days); 5-aza: 5- azacytidine (hypomethylating agent).

2.3. Germplasm Resource Management

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

Acclimatization and conservation: A total of 900 (exotic accessions: 07, exploration material: 98 and roselle accessions: 688) germplasm lines were regenerated.

Characterization and evaluation: A total of seven exotic lines and 98 exploration materials were characterized for 20 agro-morphological traits.

Variation in calyx colour in newly collected roselle lines

Besides, 210 tossa jute germplasm lines of recent exploration were evaluated for fibre yield and yield attributing traits for the second year. The germplasm lines showed significant variability for fibre yield ranged from 3.1 to 25.2g/plant.

Distribution: A total of 187 (*C. olitorius*: 82, *C. capsularis*: 60 and mesta: 45) germplasm accessions of JAF have been distributed to different indenters including scientists of CRIJAF, AINP on Natural Fibres and other institutes.

2.4. Varietal Development

2.4.1. Tossa jute variety: JROB 2 (Purnendu)

(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)*

The variety JROB 2 recorded 59.1 q/ha green biomass which is 7.7 and 10% higher than the check varieties JRO 204 and JRO 524, respectively, in the varietal trials of All India Network Project on Jute and Allied Fibres. In

addition to high biomass production, the variety JROB-2 also recorded 32.1 q/ha fibre yield outperforming both the check varieties in the varietal trials. Till date, there is no tossa jute variety recommended for biomass production, The variety JROB 2 will help in production of value-added diversified products like paper pulp, bioethanol, charcoal, etc. Considering all the merits, the tossa jute variety JROB 2 was identified for submission of proposal to Central Sub-Committee on CSN & RV by Variety identification committee in 31st Annual Workshop of All India Network Project on Jute & Allied Fibres held on 14th February, 2020 at OUAT, Bhubaneswar.

2.4.2. White jute variety: JRCJ 11

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

The capsularis variety recorded 31.45 q/ha fibre yield which is 7.62% and 4.19% higher than check varieties JRC 698 and JRC 517, respectively. The vareity has finer fibre (1.78 tex) which is 3.13% finer than check variety JRC 517 and the fibre strength of JRCJ 11 is 3.12% higher than check variety JRC 698. Moreover, JRCJ 11 exhibited higher tolerance to Bihar hairy caterpillar (49.7-53.8%) and yellow mite (9.5-17.6%) compared to check varieties. Since, variety JRCJ 11 showed yield advantage along with better fibre quality and higher tolerance to major diseases and pests. It was identified by Variety identification committee in 31st Annual Workshop of AINPJAF held on 14th February, 2020 at OUAT, Bhubaneswar.

2.4.3. Development of trait specific genotypes

(Investigators: *A. Anil Kumar, S.B. Choudhary, H.K. Sharma, R.T. Maruthi, K. Mandal, R.K. De and B.S. Gotyal)*

Three trait specific jute germplasm lines: 1. A tossa jute genotype, OIN-154-1 resistant to stem rot disease caused by *Macrophomina phaseolina,* 2. OIN-456 tossa jute genotype, susceptible to stem rot disease, 3. A wild jute (*C. aestuans*) genotype, WCIN-136-1 highly resistant to stem rot disease, found stable in expression after several years of screening were identified by "Institute Germplasm Identification Committee" and recommended suitable for registration with the ICAR-NBPGR, New Delhi.

2.5. Breeding for Fibre Yield and Quality Improvement

2.5.1 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)*

Generation advancement: A total of 341 MAGIC lines were advanced to ML_4-RI_8 generation.

Phenotypic evaluation: With 341 MAGIC lines (ML_4-RI_6) and their 20 founders, field experiments were conducted at two environmental locations (ICAR-CRIJAF, Barrackpore and ICAR-CSRSJAF, Budbud). At each location, the experiment was laid out in an α-lattice (19 × 19) with two replications. After 120 DAS, observations were recorded on plant height (PH), stem base diameter (SBD), fibre yield (FY) and green biomass (BIOM).

Data analyses: Prior to data analyses, all missing values were imputed by additive regression, bootstrapping and predictive mean matching (PMM). Data heteroscedasticity was tested by plotting the histograms of trait values followed by Bartlett's and Levene's tests at $P \leq 0.05$. Prior to parametric mixed-model analyses of variance, BIOM, SBD and FY data were Box-Cox power-transformed for linear models based on vector of values of λ (-6, 6) in steps of 0.1 and the computed profile log-likelihood vector. All statistics were computed and plotted using various R packages.

Models parameterized: For partially balanced incomplete block design (α-lattice), the additive linear model for an experiment at a single location was defined as:

$$Y_{ijk} = \mu + Rep_i + Blk_j(Rep_i) + Gen_k + \varepsilon_{ijk}$$

where, μ is the main effect, Rep_i is the effect of the ith replication, $Blk_j(Rep_i)$ is the effect of the jth incomplete block within the ith replication, Gen_k is the effect of the kth genotype and ε_{ijk} is the error associated with ith replication, jth incomplete block and kth genotype, which is assumed to be normally and independently distributed with zero mean and homoscedastic variance σ^2. The model for combined analysis was defined as:

$$Y_{ijkl} = \mu + Loc_i + Rep_j(Loc_i) + Blk_k(Loc_iRep_j) + Gen_l + Loc_iGen_l + \varepsilon_{ijkl}$$

where, μ is the main effect, Loc_i is the effect of the ith location, $Rep_j(Loc_i)$ is the effect of the jth replication within the ith location, $Blk_k(Loc_iRep_j)$ is the effect of the kth incomplete block within ith location and jth replication, Gen_l is the effect of the lth genotype, Loc_iGen_l is the interaction effect between ith location and lth genotype, and ε_{ijkl} is the error associated with ith location, jth replication, kth incomplete block and lth genotype, which is assumed to be normally and independently distributed with zero mean and homoscedastic variance σ^2.

Mixed-model analyses were performed as implemented in SAS® Enterprise Guide Version 4.3/Site number 0011601388 (SAS Institute Inc., Cary, NC), and the variance components were estimated using PROC MIXED (call method = type3), with all effects as random. Broad sense heritability (*H*) was obtained from variance estimates of the random-effect model. The model was fitted with and without the genotype effect, and the significance of *H* ($P \leq 0.05$) was tested from the difference in -2 log-likelihoods for the two models.

Table 6. Summary statistics for bast fibre yield and yield components in *Corchorus olitorius* MAGIC[a] population in comparison with their founders

Trait	Founders	MAGIC
a) Plant height (cm)[b]		
Mean (±SD)	245.39± 48.61	251.26 ± 49.35
Min	132.40	147.80
Max	337.33	383.33
Skewness	0.01786436	0.2830286
Kurtosis	-1.045463	-0.9673223
b) Fibre yield (g plant^{-1})[b]		
Mean (±SD)	7.01 ± 3.96	7.46 ± 3.87
Min	2.00	2.00
Max	19.60	27.33
Skewness	1.277431	1.491349
Kurtosis	1.209601	2.818867
c) Stem base diameter (mm)[c]		
Mean (±SD)	9.40 ± 2.05	9.96 ± 1.46
Min	5.75	5.93
Max	15.94	16.42
Skewness	1.310592	0.6630635
Kurtosis	2.319416	1.936332
d) Biomass (g plant^{-1})[c]		
Mean (±SD)	26.08 ± 8.69	28.20 ± 10.24
Min	11.28	5.00
Max	45.28	86.92
Skewness	0.2293081	1.10771
Kurtosis	-0.5928843	2.927467

[a]Multiparent Advanced Generation Inter-Cross population comprising 341 lines fixed at RI_6 after four generations of controlled intermating between 20 founder lines

[b]Data in original scale and combined over two locations

[c]Data in original scale from a single location

To determine BLUEs (best linear unbiased estimates) of the trait effect for each genotype, the same mixed model was used considering genotype as a fixed effect and keeping all the other effects as random.

Table 7. Spearman's rank order correlations between bast fibre yield and yield components

Trait	SBD[a]	BIOM	FY
PH	0.313(0.313)***	0.640(0.640)***	0.709(0.709)***
SBD	-	0.086 (0.086)[ns]	0.376(0.375)***
BIOM		-	0.627(0.626)***

[a]Values within parentheses represent adjusted estimates following Fisher's *z* transformation

***Significant at $P \leq 0.0001$, with n -2 = 359 d. f.

[ns]Not significant at $P \leq 0.05$

A comparison of summary statistics showed that, though mean trait values of 341 MAGIC lines did not differ much from that of their founders, there were MLs that showed significantly higher values in terms of plant height (max 383.33 cm), stem base diameter (max 16.42 mm), biomass (max 86.92 g plant^{-1}) and bast fibre yield (max 27.33 g plant^{-1}) as compared to their founders (Table 6). However, these effects were most conspicuous for biomass (2.0-fold) followed by bast fibre yield (1.4-fold).

Spearman's rank order correlation analyses (Fig. 12; Table 7) showed that bast fibre yield (FY) had maximum correlation with plant height followed by biomass (BIOM) and stem base diameter (SBD). SBD did not have any significant ($P \leq 0.05$) correlation with BIOM.

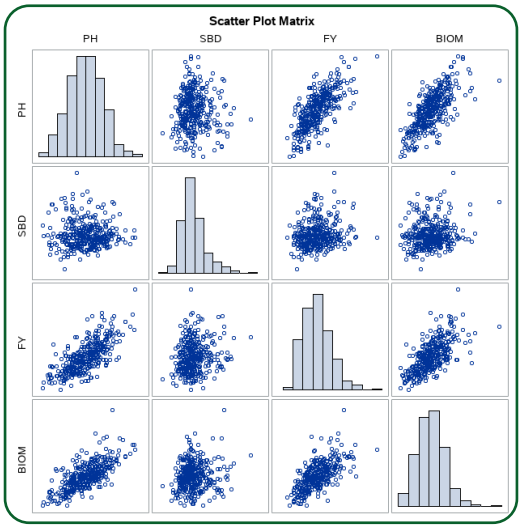


Fig. 12: Scatter plots of Spearman's rank-order correlations (Fisher's z transformation) of the four important agronomic traits in *C. olitorius*

Stem base diameter (SBD) had maximum h^2 (82 %) followed by biomass (78 %), while plant height (PH) the least (66 %). The broad-sense heritability estimate for fibre yield was found to be 70 % (Table 8).

Table 8. Broad-sense heritability estimates (%) of bast fibre yield and yield components in *Corchorus olitorius*

Trait	h^2 (%)
Plant height (PH)[a]	66.32***
Stem base diameter (SBD)[b]	81.95*
Fibre yield (FY)[a]	70.19***
Biomass (BIOM)[b]	76.97***

[a]Data combined over two locations

[c]Data from a single location

***, *Significant at $P \leq 0.0001$ and 0.05, respectively based on χ^2 test for the difference between the -2 log likelihoods of the model fitted with and without the genotype term

2.5.2. Development of improved jute genotypes through hybridization

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

Germplasm lines of capsularis and olitorius jute were evaluated for fibre traits during April-July 2020. Significant differences were observed among genotypes for different traits. Among olitorius accessions, OEX 20, OIM 12, OIJ 204, OEX 32 and OEX 13 were the best with respect to fibre yield (Table 9). Among capsularis accessions, CIM 32, CIJ 59, CIN 305, CEX 04 and CIM 57 were the best (Table 10). Both the groups of accessions revealed low heritability coupled with low genetic advance (as % of mean) depicting non-additive gene action in determination of fibre yield.

Table 9. Genetic parameters for olitorius germplasm

Par ameter	Plant Height (cm)	Basal diameter (mm)	Biomass (g/pl.)	Stick wt (g/pl.)	Fibre wt (g/Pl.)
Mean	312.7	12.2	150.0	20.0	10.0
Max.	356.5	15.3	240.0	30.0	14.0
Heritability (%)	44.1	22.4	14.6	8.6	3.9
GA as % of mean	6.68	5.18	7.10	4.90	2.61

Table 10. Genetic parameters for capsularis germplasm

Parameter	Plant Height (cm)	Basal diameter (mm)	Biomass (g/pl.)	Stick wt (g/pl.)	Fibre wt (g/Pl.)
Mean	303.6	15.6	150.0	20.0	9.0
Max.	338.5	18.7	230.0	30.0	17.0
Heritability (%)	43.4	26.1	39.1	5.18	5.87
GA as % of mean	8.63	6.02	19.91	3.85	4.51

2.5.3. Maximizing fibre productivity in jute through genetic and agronomic approaches

(Investigators: Vikas Mangal, J.K. Meena, J. Mitra, P. Satya. S. Mitra, A.R. Saha, R.K. De; Project Code: In-house Project- new project)

Ten promising lines (advanced breeding lines along with high yielding varieties) of white jute (JRC 517, Padma, JRC 532, JRC 698, JRCJ 11, JRCP-6, JRCP-7, JRCA-3, JRCA-55 and JRCA-2) and tossa jute (JRO 204, JRO 2407, S 19, JBO 1, JROM 1, JROMU 1, JROBA 3, JRO 524 , JRO 8432, JROBA 4) were selected on the basis of their performance in AINPNF fibre yield trials. These lines were crossed in a 10 x 10 full diallel mating design and seeds of resulting 90 F_1 hybrids of white and tossa jute were collected for evaluation.

2.5.4. Evaluation of mesta breeding lines

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

A panel of 54 improved kenaf breeding lines with two check (HC 583 and AMC 108) varieties were evaluated for fibre yielding traits. Plant height of the genotypes varied from 267-399 cm with an average of 325.3±27.4 cm. Average basal diameter was 18.8±0.6 mm and ranged between 14.5-21.0 mm. Seventeen genotypes performed better than both the check varieties for plant height and basal diameter were selected for yield improvement programme (Fig 13).

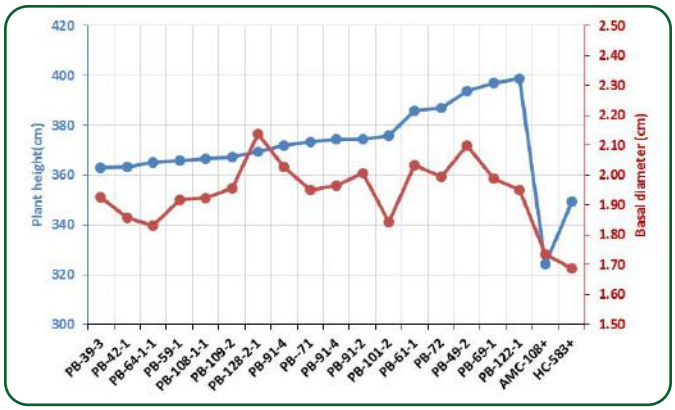


Fig. 13: Performance of superior kenaf genotypes

In station trial, ten roselle genotypes along with check (AMV 05) variety were evaluated for yielding contributing traits. Three genotypes RBL-119, RBL-134 and RBL-206 found promising (Fig. 14) and were selected for contribution to coordinated yield trials.

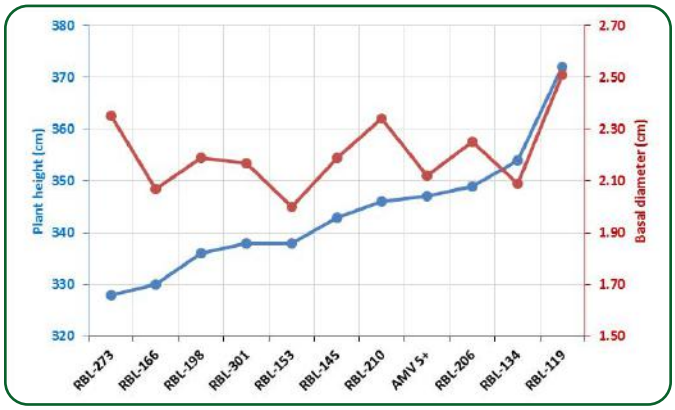


Fig. 14: Performance of roselle genotypes in station trial

2.5.5. Evaluation of F_4 progenies of kenaf and single plant selection

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

A total of 1853 F_4 single plants selected amongst 481 F_3 progenies derived from 12 promising cross combinations during 2019 at Sunhemp Research Station, Pratapgarh were further advanced to their successive F_5 generation though plant to progeny row evaluation. Each plant progeny comprised of a row of 4m length with row to row spacing 30 cm and plants were 5-7 cm apart within the row. The superior individual plants among superior plant progeny rows were selected on the basis of visual observations on plant growth parameter and other agronomic traits i.e. plant height, basal diameter, incidence and reaction to various diseases and pests. However, a total of 745 single plants were selected in F_4 generation which were found to be morphologically better than both the check varieties of kenaf (HC 583 and AMC 108). Seeds of selected plants harvested separately for their further evaluation and selection during the ensuing *Kharif* 2021. Promising F_5 families will be identified and selected on the basis of plant growth parameter i.e. plant height, basal diameter, mid-diameter, top diameter, green biomass, dry stick weight, dry fibre yield, fibre quality and reaction to various diseases and pests.

Hybridization of promising roselle lines and raising F_1 hybrids: Six diverse promising lines (REX-019, REX-066, RIJ-039, RIJ-080, RIN-239 and RIN-469) of roselle selected for fibre yield and other agronomic traits on the basis of consecutive two years screening were hybridized in half diallel mating design. The seed of resulting 15 F_1 hybrids were collected for evaluation and selection of desirable segregates in their successive generations. These hybrids along with their parents will be evaluated in replicated trials with suitable checks for plant growth parameters and other agronomic traits during 2021.

2.5.6. Evaluation of segregating generation in flax

*(*Investigators: *J. Mitra, D. Saha, K. Mandal and K. V. Shivakumar; Project Code: In-house Project-JB 10.3)*

A total of 209 selected F_3 single plant progenies from seven crosses were grown under field condition for evaluation and selection in the current (2020-21) Rabi season. Similarly, five F_2 progenies were also raised for evaluation and single plant selection (Fig. 15). Furthermore, two additional crosses made during last (2019-20) Rabi season were sown under pot condition for harvesting F_2 seeds.

Fig. 15: Segregating generation of flax at Barrackpore

Simple sequence repeat (SSR) markers were screened in parental genotypes and F_2 progenies of one of the cross involving EC 852234 x EC 852264 fibre flax genotypes. One of the SSR marker, p129 showed satisfactory polymorphic patters between the parental genotypes and a segregation pattern in 22 F_2 progenies (Fig. 16).

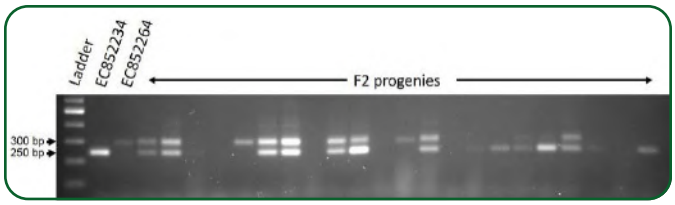


Fig. 16: Agarose gel image showing a polymorphic SSR marker and segregating banding pattern in F_2 flax progenies.

A total of 269 germplasm lines were sown for maintenance breeding (Fig. 17) and 60 promising germplasm selected for *Fusarium* wilt resistance under natural field condition at last Rabi season (2019-20) were sown under sick pot condition (Fig. 18) in current Rabi season to further confirmly screen under actual artificial epiphytotic condition at Sunnhemp Research Station, Pratapgarh, Uttar Pradesh.

Fig. 17: Maintenance of 269 flax germplasm at Pratapgarh

Fig. 18: Sick pot for *Fusarium* wilt disease in flax

2.6. Breeding for Biotic Stresses

2.6.1. Genetic improvement of jute genotypes to biotic stresses

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

Screening for stem rot resistance: A panel of 15 stem rot resistant RILs along with parents, checks and cultivars were evaluated under sick plot conditions for stem rot resistance and fibre yield. RILs were found showing consistent disease reaction over the years and fibre yield ranged from 20.2 to 33.5g/plant (Fig. 19).

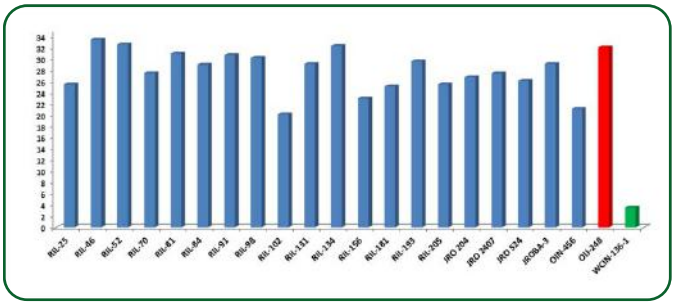


Fig. 19: Fibre yield of RILs along with parents and checks

Screening for nematode resistance: A set of selected jute genotypes were screened for nematode (*Meladogina incognita*) resistance at two different locations viz. UBKV, Cooch behar and ICAR-NBPGR RS, Hyderabad. The genotype WCIN-183A categorised as resistant and Nalte as susceptible at test locations under artificial inoculated conditions (Table 11).

Table 11. Nematode reaction of selected genotypes

	Gall/plant			Egg mass/plant			Root Gall Index		
	UBKV	ICAR-NBPGR	Mean	UBKV	ICAR-NBPGR	Mean	UBKV	ICAR-NBPGR	Mean
OIJ-248	32.3	47.6	**40.0**	16.7	31.0	**23.8**	3.7	4.0	**3.8**
WCIN-17-1	56.0	97.4	**76.7**	36.7	33.0	**34.8**	4.0	4.0	**4.0**
WCIN-183A (R)	7.3	21.4	**14.4**	1.7	10.0	**5.8**	2.0	2.0	**2.0**
CIN-109	14.7	-	**14.7**	4.7	-	**4.7**	3.0	-	**3.0**
WCIN-136-1	25.7	62.4	**44.0**	9.7	22.4	**16.0**	3.3	3.0	**3.2**
OIN-154-1	23.7	48.2	**35.9**	12.3	27.0	**19.7**	3.0	3.0	**3.0**
Nalte (S)	100.7	155.4	**128.0**	89.7	85.6	**87.6**	4.7	5.0	**4.8**

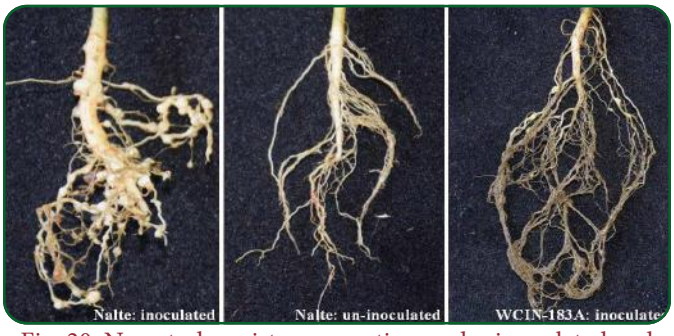


Fig. 20: Nematode resistance reaction under inoculated and un-inoculated conditions

2.6.2. Development of stem rot resistant jute genotypes

(Investigators: J.K. Meena, P. Satya, K. Mandal and K. Das; Project Code: In-house Project- JBT 4.8)

Screening of advanced breeding lines for stem rot resistance using stem inoculation method. Two mapping populations OIJ-272 x RS-6 and OIN-456 x OIN-154 were screened for stem rot resistance at Barrackpore. In population OIJ-272 x RS-6 only 10 plants exhibited moderately resistant symptoms while remaining were found moderate to highly susceptible. While, in case of mapping population OIN-456 x OIN-154 only five plants exhibited moderately resistant and remaining were showed moderate to highly susceptible symptoms.

Jute breeding lines showing stem rot symptoms

2.7. Breeding for Special Traits

2.7.1. Introgression of low pectin fibre trait into high yielding jute varieties

(Investigators: A. Anil Kumar, R.T. Maruthi, B. Majumdar; Project Code: In-house Project-new project)

A total of 34 jute varieties (17 each of olitorius and capsularis varieties) were selected, raised and plants were harvested at 130 DAS. Stem cuttings were prepared and retted under *in-vitro* conditions. The retting duration varied from 15 to 21 days among the jute varieties.

2.7.2. Evaluation of jute MAGIC population for premature flowering tolerance

A MAGIC (multi-parent advanced generation intercross) population consisting of 341 intercross lines along with 20 parents was evaluated at extra-early-sowing (28th February) in 2020.

2.8. Breeder Seed and Nucleus Seed Production of JAF Crops

2.8.1. Breeder seed production of Jute, Mesta and Sunnhemp

(Investigators: C.S. Kar, H.R. Bhandari, A. Bera; Project Code: Externally Funded Project-BSP 1.0)

Breeder seed of 15 varieties of jute and 3 varieties of sunnhemp were produced as per DAC & FW indent. A total of 8.50 q of breeder seeds of jute and 9.0 q of sunnhemp were produced against the DAC indent of 7.31 q and 8.40 q of jute and sunnhemp, respectively (Table 12).

Table 12. Breeder seed production of Jute & Allied Fibres

Crop/ Variety	DAC Indent (q)	Production (q)
Jute		
JRC 321	0.13	0.30
JBO 1	0.05	0.05
JRC 532	0.15	0.30
JRO 2407	0.25	0.40
JROG 1	0.10	0.10
JROM 1	0.10	0.10
JRO 632	0.02	0.02
IRA	0.82	0.82
JRO 204	2.41	2.76
S-19	0.20	0.20
JRO 8432	0.10	0.10
JRO 524	1.35	1.35
JRO 878	0.15	0.20
CO-58	1.46	1.70
JRO 128	0.02	0.10
Sunnhemp		
SUIN 053	3.00	3.00
JRJ 610	0.40	1.00
SUIN 037	5.00	5.00
Flax		
JRF 2	1.50	1.50

Nucleus seed production: Seeds harvested from selected individual true to type plants of a variety were used to raise progeny rows. Progeny rows found to be true-to-type of varieties (jute, mesta and sunnhemp) were bulked to constitute nucleus seed.

Breeder seed crop plot

Nucleus seeds of the released varieties of jute (1.28 q), mesta (0.35 q), sunnhemp (0.41 q) and flax (9.0 kg) were produced (Table 13).

Table 13. Nucleus seed production of jute and allied fibres

Variety	Prod. (kg)	Variety	Prod. (kg)
Jute		**Mesta**	
JRO 524	9.5	MT 150	4.5
JRO 8432	4.5	HC 583	4.0
JBO2003H	4.0	AMC 108	4.0
JRO128	9.5	HS 4288	7.0
JRO 204	9.0	HS 7910	4.0
JRO 878	2.0	Central Kenaf JBMP 2	3.5
JROM 1	1.0	JRKM 9-1	2.5
JROG 1	1.0	CRIJAF R2	2.5
CO 58	6.0	CRIJAF R8	1.5
S 19	6.0	AMV 2	1.0
JRC 321	8.0	Total	34.5
JRCM 2	7.0		
JRC 517	12.5		
JRC 532	8.5	**Sunnhemp**	
JRC 212	8.0	SUIN 053	16.5
JRC 80	10.0	SUIN 037	14.0
JRC 698	7.0	JRJ 610	10.0
Monalisa	4.5	Total	40.5
JRC 9057	7.0	**Flax**	
JRO 2407	3.0	JRF 2 (Tiara)	9.0
Total	128.0	**Grand Total**	**212.0**

2.8.2. Seed production in agricultural crops

(Investigators: C.S. Kar, H.R. Bhandari, A. Bera; Project Code: Externally Funded Project-ICAR Seed Project)

Seeds of different crops were produced under this project for distribution among farmers. Total of approximately 668.13 q of seeds were produced (Table 14).

Table 14. Quality seed production under ICAR Seed Project

Crop	Production (q)
Jute (TL)	5.20
Mesta (breeder)	0.65
Mesta (TL)	2.55
Sunnhemp (TL)	35.00
Dhaincha(TL)	8.70
Paddy (Certified)	370.00
Mung (TL) var. IPM-2-14	2.91
Wheat(TL) var. DBW-187	7.00
Mustard	10.00
Flax (breeder)	1.00
Flax (TL)	1.79
Ramie Rhizome (TL) var. Hazarika	223.33
Grand Total	668.13

2.8.3. Protection of jute varieties and DUS testing

(Investigators: A. Bera and H.R. Bhandari; Project Code: Externally Funded Project-DAC Project)

Thirty reference varieties of tossa jute, *viz.*, JRO 204, IRA, JRO 632, JRO 3690, JRO 66, JRO 524, JRO 7835, JRO 878, JRO 8432, S-19, JRO 128, JRO 620, JRO 36 E, Chinsurah Green, Sudan Green, Tanganyika-1, JRO 2345, KOM 62, TJ 40, CO-58, JRO 2407, Tarun, JBO 1, JROG 1, NJ7010, NJ 7050, NJ 7055, Bidhan Rupali, JROM 1 and NJ 7005 and twenty one 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 at both DUS centres (Barrackpore and Budbud). All essential characters were recorded and database of all reference varieties has been prepared.

Field of reference collection of jute at CRIJAF

3. Crop Production

3.1. Climate Resilient in JAF Crops

3.1.1. Screening of jute and rice cultivars for ambient ozone tolerance

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

Field experiments were conducted at ICAR-CRIJAF Research Farm as well as in Bhabanipur village (Nadia district, W.B.) to establish the resilience of jute and rice crop to high ambient ozone concentration. Day time ozone levels often exceeded 40 ppb (critical level) throughout the boro rice season. During jute crop season, ozone concentrations were above critical limit during main vegetative growth stage. IR-36 and GB-3 cultivars of rice and JRO 524, NJ 7010 and S 19 cultivar of jute under study were found sensitive to ambient ozone concentrations. There was no significant yield difference in MTU 1010 of rice and JRO 204 of jute cultivar in EDU (ethylene diurea) treated and control plots and these varieties may be considered as well adapted to ozone exposure (Fig. 21).

Experimental trial on different cultivars of jute at Bhabanipur

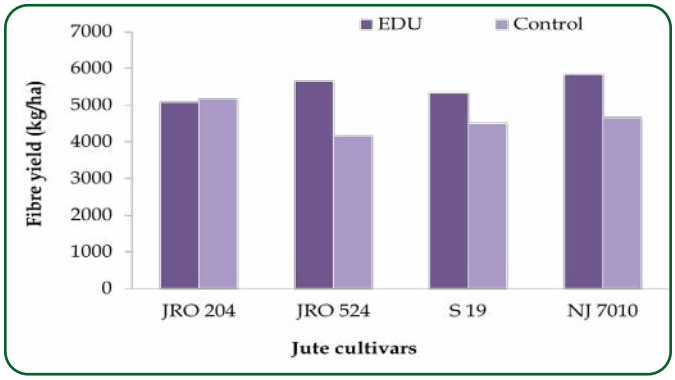


Fig. 21: Impact of ozone on fibre yield of jute cultivars in West Bengal

3.1.2. 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)

The response of 30 day old jute seedlings with exogenous ascorbic acid (AsA) application was studied under drought condition. The seedlings of JRO 204 were grown in pot culture and stress was imposed by withholding the irrigation at 30 days. The membrane stability, chlorophyll content, carotenoid content, plant height and biomass that reduced under drought was found to be significantly higher with exogenous ascorbic acid treatment (Fig. 22). The non-enzymatic antioxidant component was assessed. Flavonoid content was found to be increased under drought which decreased with exogenous ascorbic acid. In contrast, the endogenous ascorbic acid decreased under moisture deficit. The exogenous ascorbic acid treatment further increased the endogenous ascorbic acid content thereby increasing its antioxidant potential under drought.

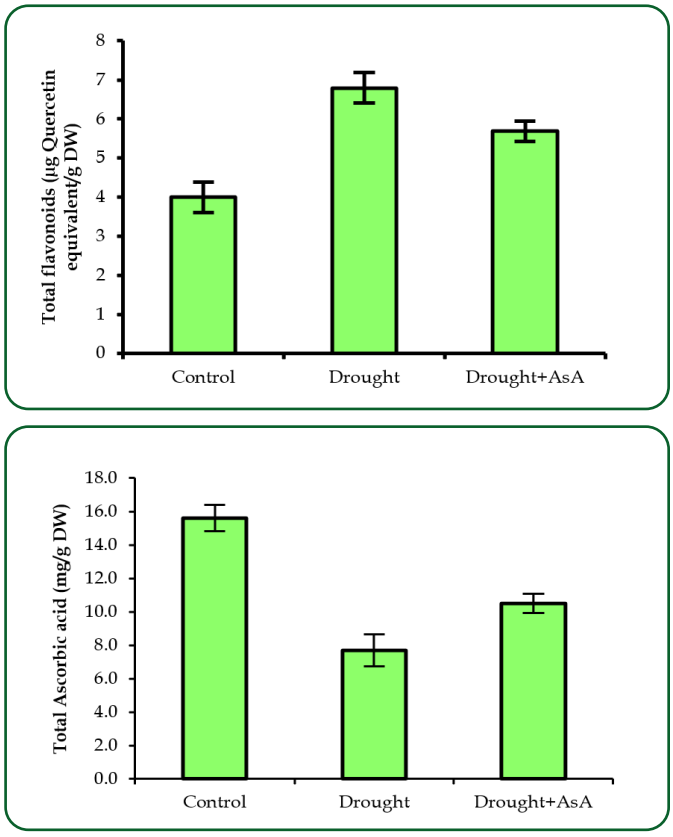


Fig. 22: Flavonoid and ascorbic acid content in jute seedlings (JRO 204) with exogenous AsA application

3.1.3. Spatial and temporal variability of extreme air temperature related to jute production

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

Based on 102-year long-term climatic data (1901-2002), spatial and temporal variabilities analysis was done for maximum and minimum air temperatures during jute growing season. For data analysis, jute season was divided into two periods such as April-May (first-half) and June-July (second-half) due to the prevalence of two distinct climatic conditions during jute growth period. For jute growth in April-May and June-July, the requirement of maximum and minimum air temperatures were 37°C and 24°C, respectively in both the period. The deviations from these climatic optimum values were computed to assess variation in fibre productivity (Fig. 23 & Fig. 24).

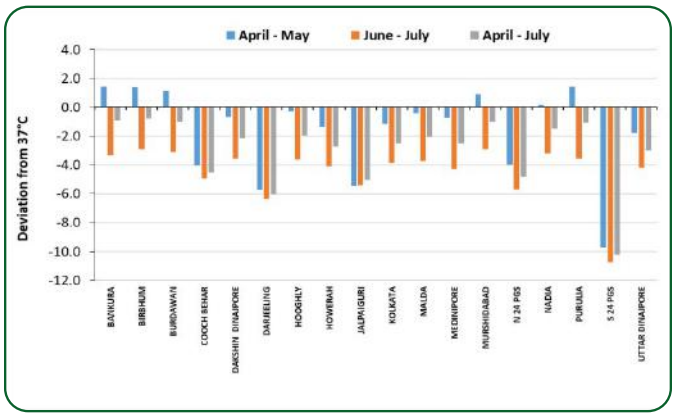


Fig. 23: Deviation from critical maximum temperature (102 yrs, 1901-2002)

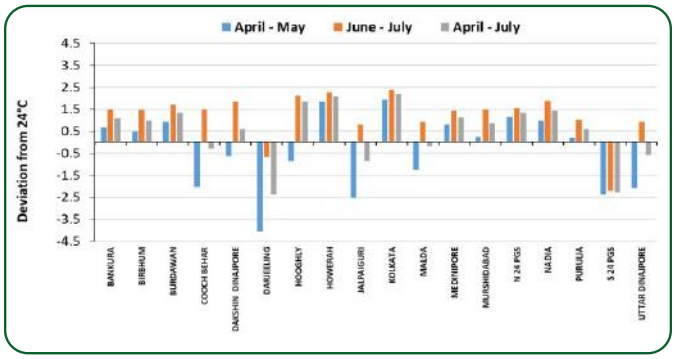


Fig. 24: Deviation from critical minimum temperature (102 yrs, 1901-2002)

During first-half of jute season, higher maximum and lower minimum air temperatures were observed in six districts, and in eight districts, respectively. However, during second-half both the maximum and minimum air temperatures were within the optimum range and congenial to jute growth in all the jute growing districts except in Darjeeling and South 24-Parganas where minimum air temperature was found lower than the optimum that resulted in reduced jute growth.

3.1.4. Climate and water requirements for jute and allied fibre crops

(Investigators: D. Barman, R. Saha and G. Kar; Project Code: In-house Project-JA 7.1)

Climate requirements were identified for jute and allied fibre crops such as kenaf, rossele, flax, sunnhemp, ramie and sisal by analysing climate data of last 40 years. The climate requirements of jute, kenaf, roselle, and sunnhemp are almost similar and therefore they are cultivated in the same season. Flax can sustain as low as 10.9°C and maximum of 32.9°C temperature. Both ramie and sisal are perennial crops and have wide range of adaptive capability of climate. Water requirements of jute and allied fibre crops were estimated using CROPWAT 8.0 simulation model. The model was simulated for each crop by using the input data of weather, crop, soil and water requirements. (Table 15).

Table 15. Climate and water requirements for jute and allied fibre crops

Crop	T_{MAX} (°C)	T_{MIN} (°C)	RH (%)	Rainfall (mm)	Water requirement (mm)
Jute	32.1-35.8	24.0-26.0	50-94	793	450-550
Kenaf	32.2-35.8	24.0-26.1	50-94	1030	425-450
Roselle	32.2-35.8	24.0-26.1	50-94	1030	425-450
Flax	24.3-32.9	10.9-19.8	40-96	80	250-300
Sunnhemp	32.2-35.8	24.0-26.1	55-94	1030	400-450
Ramie	24.9-35.8	10.9-26.6	40-96	1540	700-950
Sisal	24.9-35.8	10.9-26.6	40-96	1540	700-800

3.1.5. Diurnal pattern of net radiation during jute and rice seasons

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

Energy balance components such as net radiation, latent heat flux, soil heat flux, and sensible heat flux were measured using biomet sensors attached with eddy covariance system. Diurnal pattern of net radiation during jute and rice seasons were computed in half-

hourly interval during jute and rice cropping season at ICAR-CRIJAF Research Farm. During jute season (120 days, 9 Apr to 7 Aug, 2020), minimum (-30.6 Wm^{-2}) and maximum (551.8 Wm^{-2}) net radiation were observed at 21.00 h and 11.30 h, respectively. However, during rice season (103 days, 24 Aug to 4 Dec, 2020), minimum (-19.1 Wm^{-2}) and maximum (467.6 Wm^{-2}) net radiation were observed at 18.00 h and 11.00 h, respectively. Net radiation plays an important role in photosynthesis and respiration processes and therefore on crop yields (Fig.25).

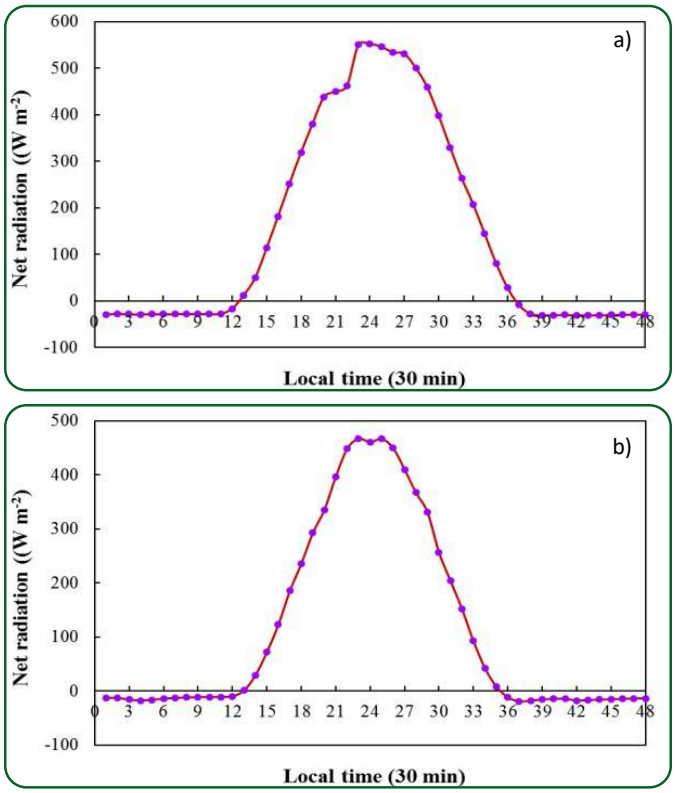


Fig. 25: Diurnal pattern of net radiation during (a) jute season and (b) rice season

3.1.6. Effect of defoliation and biochemical signal of flowering in jute

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

The response of defoliation on the onset of flowering indicated that defoliation delay flowering in jute and upper leaves are more important to perceive the signal for flowering. Increase in percentage defoliated leaves delay the onset of flowering in JRO 204. Non-reducing sugars in leaves are well-known signals of flowering in several crop plants. It has been observed that long night as well as low light (Fig.26) treatment induces the production of non-reducing sugars in leaves of jute plants.

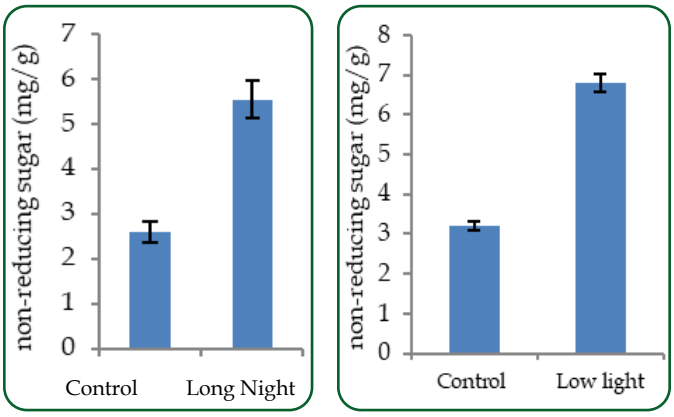


Fig. 26: Non-reducing sugar content under normal and long night/ low light condition

3.2. Soil Health for Sustainable Productivity

3.2.1. Soil fertility status in long-term multiple cropping and fertilization

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

Long-term (49 years) effects of continuous application of inorganic fertilizer and organic manure either alone or in combination was studied to observe the changes in crop productivity under different treatment combinations in a permanent field trial at ICAR-CRIJAF Research Farm, Barrackpore in jute-rice-wheat cropping system. The crops were cultivated with different fertilizer and manurial treatments.

Table 16. Yield of jute, rice and wheat during 2020 in LTFE

Treatments	Yield (q/ha)		
	Jute	Rice	Wheat
50 % NPK	15.8 ^{e}	16.3 ^{d}	15.0 ^{c}
100% NPK	25.6 ^{abc}	23.5 ^{c}	21.0 ^{b}
150% NPK	31.6 ^{a}	29.5 ^{a}	27.5 ^{a}
100% NPK +HW	23.4 ^{bcd}	22.8 ^{c}	20.8 ^{b}
100 % NPK+ Zn	26.0 ^{ab}	24.2 ^{bc}	21.2 ^{b}
100% NP	19.7 ^{cde}	21.0 ^{cd}	19.6 ^{bc}
100% N	18.8 ^{de}	19.5 ^{cd}	18.1 ^{bc}
100% NPK+FYM	31.2 ^{a}	29.1 ^{ab}	27.1 ^{a}
100 % NPK-S	24.9 ^{bc}	22.4 ^{c}	20.3 bc
Control	8.2 ^{f}	10.0 ^{e}	6.4 ^{d}

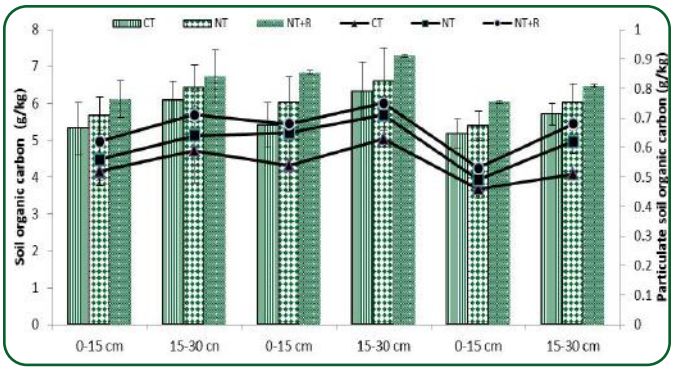
**Mean values followed by a common letter are not significantly different by DMRT at 5% level*

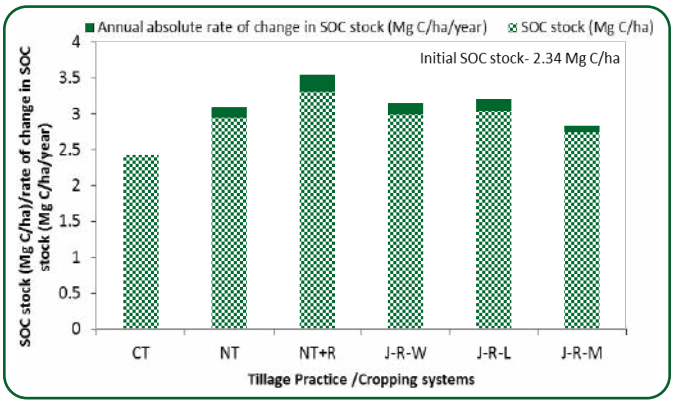
Yield of jute (cv. JRO 204), rice (cv. Khitish) and wheat (cv. SD 2967) ranged from 8.2 to 31.6 q/ha, 10.02 to 29.5 q/ha and 6.4 to 27.5 q/ha, respectively under different treatments (Table 16). Application of inorganic fertilizers, in presence or absence of FYM significantly increased the crop yields over no input control. Highest yield of jute, rice and wheat was recorded in 150% NPK followed by 100% NPK+FYM treatment. Yield obtained in 100% NPK+FYM treatment was found to be at par with the 150% NPK treatment. Application of P and K along with N significantly increased the crop yield over 100%N in jute only. The effect of zinc application on crop yield was non-significant.

3.2.2. Carbon dynamics under tillage and residue retention in jute based cropping systems

(Investigators: *R. Saha, S.P. Mazumdar, D. Barman, B. Majumdar, M.S. Behera, 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 (CT) and no tillage (NT) with or without crop residue retention (+R/-R) on soil organic carbon (SOC) dynamics was evaluated under most predominant jute based cropping systems (jute-rice-wheat; J-R-W, jute-rice-lentil; J-R-L and jute-rice-mustard; J-R-M) after completion of 4th year of experimentation. Study revealed that SOC content in NT+R (7.29 g/kg) was significantly higher compared to NT (6.11 g/kg), and CT (5.32 g/kg). The increase in SOC under NT+R treatment is significantly higher than NT (8.2-10.3%) and CT (21.9-22.1%) across the soil depth. This was more evidenced by the difference in particulate soil organic carbon (PSOC) contents in CT treatments (Fig.27), which was much low (0.46 -0.59 g/kg) compared to the same between NT (0.49-0.71 g/kg) and NT+R plots (0.53-0.75 g/kg). Among the cropping systems, J-R-L contributed highest SOC (mean: 6.33 g/kg) followed by J-R-W (mean: 5.86 g/kg) and J-R-M (mean: 5.78 g/kg). NT+R contributed the highest SOC stock (3.30 Mg C/ha) followed by NT (2.94 Mg C/ha), and CT (2.42 Mg C/ha). No tillage with residue retention (NT+R) had significant effect on the capacity of the soil for storing SOC under jute based cropping systems.





**CT: Conventional tillage; NT: No tillage and NT +R: No tillage + residue# J-R-W: Jute-Rice-Wheat; J-R-L: Jute-Rice-Lentil and J-R-M: Jute-Rice-Mustard*

Fig. 27: Soil organic carbon and particulate soil organic carbon under different tillage practices and cropping systems

3.2.3. 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- JA 7.8*)

Cropping systems had apparent effect on carbon and nitrogen dynamics in soil after completion of 2 experimental years. Greater soil organic carbon and microbial biomass carbon were observed in rice-flax (zero tillage) but there was no significant difference among cropping systems or nitrogen levels (Fig.28). In contrary to carbon, nitrogen status was significantly affected by different cropping systems and nitrogen levels. Nitrogen levels showed significant effect on urease activity in soil. Nitrogen mineralization was also influenced by nitrogen levels and cropping systems. Highest nitrogen mineralization was recorded in rice-flax (zero tillage) and lowest in fallow-flax. Most of the nitrogen mineralized up to 28 days of incubation.

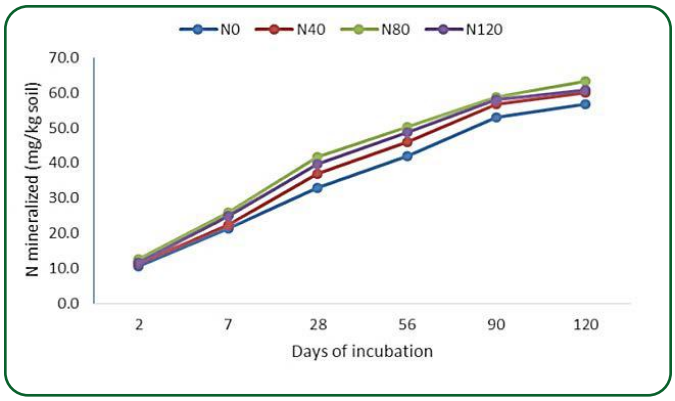


Fig.28: Nitrogen mineralization under different nitrogen levels

3.2.4. Energy use and economic efficiency of jute based cropping systems

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

Energy use and economic efficiency for various jute based cropping systems (jute-rice-wheat; J-R-W, jute-rice-lentil; J-R-L and jute-rice-mustard; J-R-M) were evaluated under no tillage with residue (NT+R) and conventional tillage (CT). The highest input energy (Table 17) was required for J-R-W system (44.1 and 42.2 GJ/ha under CT and NT+R, respectively) and the lowest was for the J-R-L cropping system (35.4 and 33.6 GJ/ha under CT and NT+R, respectively).

Table 17. Energy analysis of different jute based cropping systems under CT and NT+R

Cropping systems	Input energy (GJ/ha)		Output energy (GJ/ha)		Energy use efficiency		Energy productivity (t/GJ)	
	CT	NT+R	CT	NT+R	CT	NT+R	CT	NT+R
J-R-W	40.1	38.2	377	390	9.42	10.23	0.17	0.19
J-R-L	35.4	33.6	369	381	10.43	11.36	0.20	0.22
J-R-M	36.7	34.9	338	344	9.22	9.86	0.18	0.19

CT: Conventional tillage; NT+R:; No tillage with residue; J: Jute; R: Rice; W: Wheat; L: Lentil; M: Mustard

Among the cropping systems, output energy of J-R-W cropping system was marginally higher (377.9 and 390.8 GJ/ha under CT and NT+R, respectively) than J-R-L system (369.3 and 381.8 GJ/ha under CT and NT+R, respectively). The highest energy use efficiency was recorded for J-R-L (10.43 and 11.36 under CT and NT+R, respectively) cropping system. The energy productivity (Table 17) among the jute based cropping system ranged in between 0.17-0.20 and 0.19-0.22 t/GJ, respectively in CT and NT+R, respectively highest being in J-R-L cropping system. B: C ratio was highest for J-R-L system (1.67 and 1.48 under NT+R and CT, respectively). The highest economic efficiency was obtained in NT+R across the cropping systems highest being in J-R-L (₹200.8/ha/day) followed by J-R-W (₹140.4/ha/day) and J-R-M (₹131.3/ha/day) cropping systems.

3.3. Precision Water and Nitrogen Management in JAF crops

3.3.1. 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- JA 5.6)

Field trials on jute (cv. CO 58) and rice (cv. Shatabdi) were undertaken in the farmers' fields at different locations in Nadia and North 24 Parganas districts of West Bengal to validate soil test based targeted yield (ST-TY) equations. It was observed that application of fertilizers as per ST-TY without and with FYM achieved the target yield of 40 q/ha jute fibre and 50 q/ha paddy with (-) 5 and (+) 0.25%, and (-) 8.8 and (-) 6 % deviation, respectively.

Under long term trial on jute-rice-lentil sequence, application of fertilizers as per ST-TY could achieve the target yield of 40 q/ha jute fibre with (-) 7.25% yield deviation. Integration of ST-TY with FYM achieved the targeted yield of jute fibre (35 q/ha) with (+) 2.85% yield deviation. Application of fertilizers as per ST-TY could achieve the target of 50 q/ha and 40 q/ha of rice with (-) 9.0% and (-) 9.75 % yield deviation, respectively.

Jute crop and jute fibre from farmers field in ST-TY experiment

In an another trial, effect of nutrient management on soil properties and available micronutrients using ST-TY equations under long-term jute-rice-lentil cropping system was assessed. Balanced fertilizer application

through mineral fertilizer on the basis of ST-TY approach or its integration with FYM or bio-inoculants resulted in enhanced crop growth and thereby increase in crop residues addition in soil containing high amount of macro and micro-nutrients. Irrespective of treatments, balanced application of FYM, bio-inoculants in combination with inorganic fertilizers based on ST-TY approach resulted in highest micronutrient concentration.

3.4. Integrated Crop Management for Smart Farming

3.4.1 Diversifying jute-rice system to improve total factor productivity

(Investigators: A.K. Singh, A.K. Ghorai, M.S. Behera, R. Saha and M.L. Roy; Project Code: In-house Project- JA7.6)

Field trials were conducted in Belleshakarpur and Galdaha of North 24 Parganas and Bhanbanipur of Nadia district (West Bengal) for crop diversification with integrated land and crop management practices along with inter or mixed crops. The study included two management systems: integrated soil-crop management (ILM_{soil}), and improved management (IM_{soil}). Jute-rice-mustard crop rotation was managed by using appropriate crop varieties and by optimizing plant densities and N fertilization. Inclusion of green gram and pumpkin as inter crop in jute and lowland rice, and lentil as mixed crop in mustard helped to meet 85% of cost of cultivation of all crops. Leguminous crops as inter and mixed crop reduced weeds (~ 50%) and provided nitrogen (N) for subsequent crops. The yield was 9.30%, 27% and 16.15% higher in jute, rice and mustard, respectively under ILM_{soil}. Nitrogen use efficiency (NUE) and water use efficiency (WUE) were significantly increased in ILM_{soil} over other management practices (Fig.29).

Jute-greengram and rice-pumpkin intercropping experiment in villages

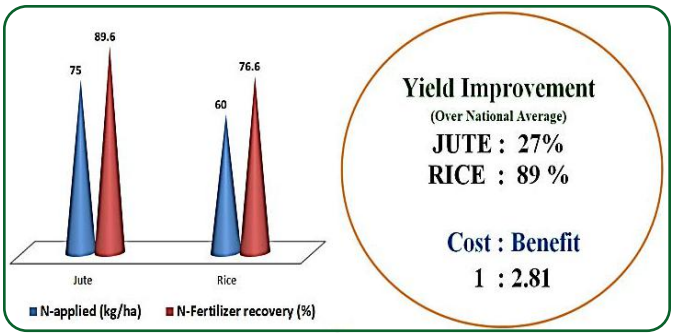


Fig. 29: N-applied and N-recovery under jute-rice-mustard cropping system with inter and mixed cropping

3.4.2. Low density jute sowing to economize weeding

(Investigators: A.K. Ghorai, A.K. Chakraborty, S. Roy and S.P. Mazumdar; Project Code: In-house Project-JA 8.0)

A field experiment was conducted with low density broadcast sowing of jute seeds (cv. NJ 7010) @ 1.20, 1.5, 1.9, 2.25 and, 2.6 kg/ha in double crisscross pattern. Modified CRIJAF nail weeder was used for mechanical weed control. At 48 hours after sowing with irrigation, Pretilachlor 50 EC @ 0.9 kg/ha was applied for pre-emergence weed control (Table 18). This sowing method significantly reduced ultimate plant population (Eqn 1), increased individual plant and fibre weight (Eqn. 3 & 4), plant height without affecting fibre yield and biomass production (Eqn. 2 & 5). Low density sowing methods curtailed 120-152 man days/ha in major operations and reduced cost of cultivation (₹30000-₹38,000/ha @ ₹250/man days) over conventional high density sowing (Eqn. 6 & 7). The relationships with seed rates, crop biometry, mandays requirements and savings in expenditures in major operations are shown below.

$Y\ P_{opn/ha} = 3.66 + 0.404X, \quad R^2 = 0.80$ [1]

$Y\ Fib._{yield/ha} = 37.565 + 0.953\ X \quad R^2 = 0.0.001$ [2]

$Y_{Plnt.wt} = 174.17 - 7.57X, \quad R^2 = 0.51$ [3]

$Y_{Fib.wt} = 14.44 - 1.361X, \quad R^2 = 0.67$ [4]

$Y_{Biomass/ha} = 63.32 + 0.632X, \quad R^2 = 0.0.113$ [5]

$Y_{MDMajopr/ha} = 81.275 + 20.28X, \quad R^2 = 0.70$ [6]

$Y\ S_{avexpdt/ha} = 50143 - 5059X, \quad R^2 = 0.70$ [7]

Where, $Y_{Popn/ha}$, $Y_{Fib.yield/ha}$, $Y_{Plnt.wt}$, $Y_{Fib.wt}$, $Y_{Biomass/ha}$, $Y_{MDMajopr/ha}$ and $Y_{Savexpdt/ha}$ are effective plant population (lakh/ha), fibre yield (q/ha), individual fresh plant weight (g), individual fibre weight (g), fresh biomass/ha, man days reduction in major operations and savings in major operations (₹/ha). X is the different doses of seed rates applied (kg/ha).

Table 18. Yield and plant parameters under low density jute sowing

Treatments	Plant population (Lakh/ha)	Fibre yield (g/plant)	Total fibre yield (q/ha)	Mandays/ha)
T_1-Live seed 1.2 kg /ha (cv. NJ 7010) + inert seed (4.8 kg/ha) + Pretilachlor 50 EC 0.9kg/ha +1 HW	2.71	14.0	37.98	129.67
T_2-Live seed 1.50 Kg/ha (cv.NJ 7010) + inert seed (4.5 kg/ha) + Pretilachlor 50 EC 0.9kg/ha +1 HW	3.65	11.0	38.67	132.00
T_3-Live seed 1.9 kg/ha(cv. NJ 7010) + inert seed (4.1 Kg/ha) + Pretilachlor 50 EC 0.9kg/ha +1 HW	3.91	9.0	34.71	132.00
T_4-Live seed 2.25kg /ha (cv.NJ 7010) + inert seed (3.75Kg/ha)+ Pretilachlor 50 EC 0.9kg/ha + 1 HW	3.97	10.13	39.50	149.33
T_5-Live seed 2.6 kg/ha (cv NJ 7010) + inert seed (3.4 kg/ha)+ Pretilachlor 50 EC 0.9kg/ha + 1 HW	4.15	9.44	37.98	162.33
T_6-Live seed 3.0 kg/ha (cv NJ 7010) + inert seed (3.0 kg/ha) + Pretilachlor 50 EC 0.9kg/ha + 1 HW	3.72	9.81	36.29	142.67
T_7-Live seed 3.75kg/ha (cv NJ 7010) + inert seed (2.25 kg/ha) + Pretilachlor 50 EC 0.9kg/ha + 1 HW	5.26	6.20	32.39	250.00
T_8-Live seed 6.0 kg/ha (cv NJ 7010) + inert seed (0 kg/ha) + 1 HW	5.48	7.95	42.49	282.33
T_9-Jute (JRO BA 3, 2.2 kg/ha) + Green gram (cv. Virat 15 kg/ha) + Pretilachlor 50 EC 0.9kg/ha + 1 HW	3.30	6.87	22.46	172.00
T_{10}-Unweeded control 6.0 kg/ha (cv. NJ 7010)	4.07	5.15	21.29	134.00
T_{11}-Live seed 6.0Kg/ha (cv NJ 7010) + Modified CRIJAF nail weeder used as bida (10 DAS) + 1 HW	5.41	7.13	38.40	201.33
T_{12}-High density sowing (6 kg/ha) + No weeding and thinning	7.64	5.58	37.98	180.00
CD (P=0.05)	1.20	2.53	5.88	29.56

3.4.3. Upgraded mechanical weeder and novel herbicides for efficient weed management in jute

(Investigators: S. Sarkar, A.K. Ghorai, R.K. Naik, B. Majumdar and Debarati Datta; Project Code: In-house Project- JA 8.2)

In this study, two times manual weeding (7 and 21 DAS) produced the lowest weed dry matter at 42 DAS (35.57 g/m^2) and 60 DAS (25.07 g/m^2) in tossa jute (cv. JRO 204). However, at 42 DAS, among the herbicidal and mechanical weed management methods, the lowest weed dry matter was noted either with ipfencarbazone @120 g/ha (PE) + nail weeder at 21 DAS (57.2 g/m^2) or with ipfencarbazone @120 g/ha (PE) + single wheel jute weeder at 21 DAS (57.87 g/m^2) (Table 19).

Table 19. Effect of different weed management methods on weed biomass and fibre yield in *tossa* jute

Treatment details	Dry weight of weeds (g/m^2)		PH (cm)	BD (cm)	Fibre Yield (q/ha)	Yield reduction (%)
	42 DAS	60 DAS				
T_1-Manual weeding (*Nirani*) two times (7 DAS and 21 DAS)	37.57	25.07	335.6^a	1.71	31.37^a	-
T_2-Nail weeder two times (7 DAS and 21 DAS)	64.67	32.67	313.0^{bc}	1.63	27.47^c	12.43
T_3-Single wheel weeder two times (10 DAS and 21 DAS)	65.87	32.80	316.3^{bc}	1.63	27.44^c	12.53
T_4-Nail weeder (7 DAS) + Single wheel jute weeder (21 DAS)	64.53	28.67	318.0^{abc}	1.64	27.63^c	11.92
T_5-Ipfencarbazone @ 90 g ai/ha	80.53	44.40	294.8^d	1.56	24.17^e	22.95
T_6-Ipfencarbazone @ 120 g ai/ha	70.80	43.47	309.7^{bcd}	1.61	26.68^{cd}	14.95
T_7-Ipfencarbazone @ 90 g ai/ha + Nail weeder at 21 DAS	68.93	36.53	314.5^{bc}	1.63	27.22^c	13.23
T_8-Ipfencarbazone @ 120 g ai/ha + Nail weeder 21 DAS	57.20	35.73	327.5^{ab}	1.67	29.07^b	7.33
T_9-Ipfencarbazone @ 90 g ai/ha + Single wheel jute weeder at 21 DAS	73.47	36.13	301.1^{cd}	1.58	25.76^d	17.88
T_{10}-Ipfencarbazone @ 120 g ai/ha + Single wheel jute weeder at 21 DAS	57.87	35.47	318.7^{abc}	1.64	28.72^b	8.45
CD (P=0.05)	5.02	3.80	18.17	0.061	1.02	-

DAS: Days after sowing; PH: Plant height of jute at harvest; BD: Basal diameter of jute at harvest.

The maximum plant height (PH) at harvest was recorded with two manual weeding treatments (335.6 cm). Among the herbicidal and mechanical weed management treatments. Ipfencarbazone @120 g/ha (PE) + nail weeder at 21 DAS produced the tallest jute plants (327.5 cm). Like PH, similar trends were observed in case of plant basal diameter (BD) at harvest. Two manual weeding recorded highest fibre yield (31.37 q/ha). Among the herbicidal and mechanical weed management methods, application of ipfencarbazone @120 g/ha (PE) + nail weeder at 21 DAS produced higher fibre yield (29.07 q/ha) closely followed by and at par fibre yield recorded with ipfencarbazone @120 g/ha (PE) + single wheel jute weeder at 21 DAS (28.72 q/ha). In both the effective combination treatments, the fibre yield reduction, due to competition from surviving weeds, was only 7.33 and 8.45%, respectively, as compared to the fibre yield obtained in manual weeding treatment.

3.4.5. 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)*

In Sisal based IFS, about 47% of total input cost could be met from the by-product of animal waste, sisal waste, vermicomposting and oil cakes. The poultry litters and cow dung was used as feed for fish. The efficient use of available resources helped in generating adequate income up to 150% due to integration of various farm enterprises. About 234-man days employment can be generated through such IFS in sisal based farming. Under jute based IFS experiment, there was significant increase in net income by 70% including employment generation upto 26% (Table 21).

Table 20. Effect of planting material and fertilizers on leaf yield component in sisal

Sucker size at planting	Number of leaves/ plants and Nutrient levels (kg/ha)								Leaf length (cm) and Nutrient levels (kg/ha)							
	Sisalana sisal				Hybrid sisal				Sisalana sisal				Hybrid sisal			
	NPK 60:30:60	NPK 90:45:90	NPK 120:60:120	Mean	NPK 90:45:90	NPK 120:60:60	NPK 150:75:150	Mean	NPK 60:30:60	NPK 90:45:90	NPK 120:60:120	Mean	NPK 90:45:90	NPK 120:60:60	NPK 150:75:150	Mean
Small	19.20	20.87	23.93	21.33	33.67	34.63	36.30	34.87	59.10	62.50	62.80	61.47	56.47	58.23	58.77	57.82
Medium	22.57	23.17	24.43	23.39	35.13	35.43	37.13	35.90	67.20	67.03	71.80	68.68	56.77	58.10	63.57	59.48
Large	24.70	24.80	24.83	24.78	38.10	38.77	41.67	39.51	69.53	72.30	73.17	71.67	63.10	63.40	68.23	64.91
Mean	22.15	22.94	24.40	-	35.63	36.28	38.37	-	65.28	67.28	69.26	-	58.78	59.91	63.52	-
CD-I	0.577				2.220				1.433				2.696			
CD -II	0.993				3.868				2.493				4.663			

CD-I (P=0.05): within a factor; CD-II (P=0.05): interaction

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

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

Interaction effect of planting material (sucker) and fertilizer doses were assessed involving three sized planting material (suckers) of Sisalana sisal and hybrid sisal with three levels of fertilizer. In case of sisalana sisal, it was found that the interaction effect of large sucker at planting x higher fertilizer (NPK @120:60:120 kg/ha) dose produced the maximum number of leaves (24.83) and longest leaf (73.17 cm), which was at par with the medium fertilizer (NPK @ 90:45:90 kg/ha) dose (leaf numer-24.43 cm and leaf length-71.80 cm). The leaf breadth parameter also followed similar pattern of leaf length values. In hybrid sisal, the interaction effect of the large sized planting material with all three levels fertilizer followed similar trends on leaf numbers and leaf length production. (Table 20).

3.4.6. Area expansion strategy under sisal farming in India with modern production technologies

*(*Investigators: *M.S. Behera, A. R. Sha, S. Sarkar, A. K. Jha and D. Datta: Project Code: In-house Project-SLA 1.9)*

Initiatives were taken for expansion of area under sisal plantation to various geographical areas across India and efforts have been made for creating standardized official database for the same. Meetings and discussion were held with different Govt. Departments of Odisha, Andhra Pradesh, West Bengal and Meghalaya associated with sisal plantations, soil conservation, watershed development for area expansion in the respective states. For new plantation, 18,000 suckers has been provided and planted at Khandahata and Badbahal (Sambalpur) and availability of 65,000 planting materials (suckers and bulbils) has also been ensured. Indents has been received from Govt. of Odisha to supply 1,55,000 sisal planting materials.

Poultry, dairy, intercropping, fishery, duckary and rabbitary in jute and sisal based IFS

Table 21. Income and employment generation through IFS in sisal and jute based farming system

Area: 1 hectare	Gross Return (₹)	Cost (₹)	Net Profit (₹)	Employment Generation (Man days)
Sisal based system				
Conventional	108000	64150	43850	115
IFS	194725 (80%)	84680 (32%)	110045 (150%)	234 (103%)
Jute based system				
Conventional	118640	74520	44120	172
IFS	169960 (43%)	94638 (26%)	75322 (70%)	228 (70%)

Values in parentheses indicates %increase in income

3.5. Farm Mechanization

3.5.1. Development of improved fibre extractor for flax

(Investigators: *R.K. Naik and S. Mitra; Project Code: In-house Project-JAE 3.5)*

An improved fibre extractor for flax has been designed and developed. The machine is operated by three phase 5 hp electric motor. The flax straw movement in the machine is horizontal with provision of straw feeding and fibre outlet platform. The machine is having seven scutching points obtained from fourteen longitudinal grooved nylon rollers driven with the help of chain/sprockets and pinions. The conveyor belt at the inlet side facilitates continuous feeding of flax straw into the machine. Two operators are required for feeding the straw and collection of scutched fibre from outlet. The overall dimensions of the machine including conveyor belt attachment are 3.1 m x 0.9 m x 1.3 m (L x W x H). The primary evaluation of the machine showed the throughput capacity of 80-85 kg flax straw/h and material capacity of 40-45 kg dry fibre/h.

Improved fibre extractor for flax

3.5.2. Improvement 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)

The manually operated multi-crop seed drill (jute seeder) has been improved by addition of two sealed ball bearings on the drive/ground shaft to facilitate easy movement of machine in tilled soil and reduce drudgery in operation. The furrow openers present ahead of seed box have been modified to prevent opening of deep furrow. The length and shape of the pegs on the ground wheels of 304.8 mm has been modified for smooth movement of machine. The handle has been attached on a bar in between the drive shaft and furrow opener bar to prevent lifting of ground wheels during operation. The handle can be adjusted according to the height of operator. The evaluation of machine showed effective field capacity (EFC) of 0.18 to 0.20 ha/h at the operational speed of 1.6 -2.0 km/h. The field efficiency of machine is 90-95 % with average draft of operation 85.02 N. The drudgery is less on farm labour, as the average power requirement for operation is 41.93 W.

Manual multi-crop seed drill

3.6. Post- harvest Processing and Retting

3.6.1. Potential of jute biomass for bioethanol production

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

The protocol for obtaining bioethanol from jute biomass was standardised in the high biomass jute variety JROB 2 and traditional variety JRO 524. The pre-treatment method for removal of lignin was standardized with physical, chemical and biological methods and their combinations (Fig. 30). Combination of 2% alkali (NaOH) treatment followed by steam pre-treatment showed better removal of lignin over steam pre-treatment, acid pre-treatment and alkali pre-treatment. Saccharification with commercial cellulase enzyme incubated at 25 °C for 72 hrs yielded maximum glucose. The fermentation was carried out with *Saccharomyces cerevisiae,* the broth was incubated at 30 °C for 5 days at 40 rpm. However, further refinement is essential for enhancing the efficiency of bioethanol production from jute biomass.

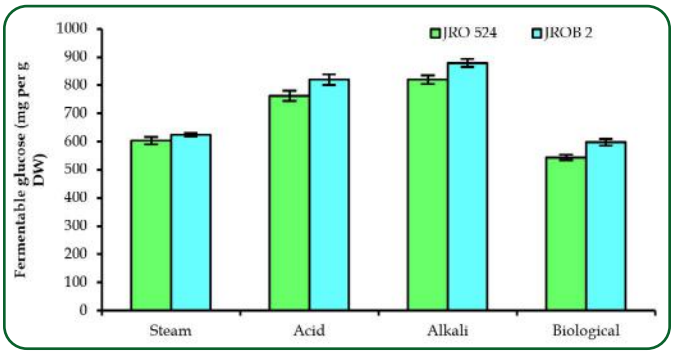


Fig. 30: Fermentable sugar yield from different pretreatment methods

3.6.2. Metagenomics of retting microbiome

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

In this study, the BIOLOG ECO microplate were used to analyze the metabolic functions of jute retting microbes in water samples collected from five most jute growing areas in West Bengal (North 24 Parganas, Murshidabad, Hooghly, Nadia and South Dinajpur). An average well color development (AWCD) showed that there was an apparent lag phase in the first day for most of the retting water samples, microbes present in retting water were capable of utilizing different carbon sources (Fig. 31). The results indicated that the utilization of different types of carbon sources by the microbes present in retting water samples showed an increasing trend with the prolongation of incubation time and the utilization capability order was Nadia > South Dinajpur > Murshidabad >Hooghly >North 24 Parganas.

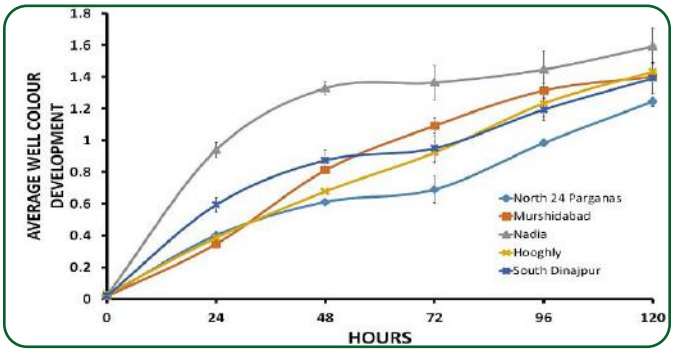


Fig. 31: Changes in AWCD of retting water samples with different time interval

3.6.3. Retting trial of jute and mesta using liquid formulation

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

Eleven large scale retting trials of jute and mesta were carried out in different parts of North 24 Parganas and Nadia districts utilizing six to eight months old liquid (spore based) formulation of "CRIJAF Sona" during the months of August to October, 2020. The retting of jute completed in 10 to 14 days in both the districts while mesta retting was completed in 15 days i.e. at the end of October (Table. 22). Under control, i.e. without liquid microbial formulation, the retting of jute was completed respectively in 17 and 19 days in North 24 Parganas and Nadia districts with fibre strength of 20.5 and 19.4 g/tex only. The resultant fibre of jute and mesta recorded good fibre strength ranging from 23.6 to 27.7 g/tex for jute and 27.0 g/tex for mesta.

Table 22. Performance of liquid formulation of CRIJAF SONA on retting of jute and mesta

Place and Month	Crop	Retting duration (days)	Fibre strength (g/tex)
Sashipur, North 24 Parganas (August)	Jute	10	27.7
		11	25.3
		12	23.6
		10	28.2
		10	24.7
Sashipur (without liquid formulation)	Jute	17	20.5
Haringhata, Nadia (September)	Jute	12	24.2
		13	24.5
		12	24.7
Basudevpur (without liquid formulation)	Jute	19	19.4
ICAR-CRIJAF (October)	Jute	13	27.2
	Mesta	12	27.0
	Jute	14	25.8

4. Crop Protection

4.1. Biological Control of Insect Pests and Diseases

4.1.1. Eco toxicological studies of *Spilosoma obliqua* nucleopolyhedrosis virus (SpobNPV) against hairy caterpillar

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

Effect of incubation temperature on virulence of SpobNPV : Toxicity at three different temperature levels (20°C, 28°C, and 35°C) was studied to assess the efficacy of *Spilosoma obliqua* nucleopolyhedrosis virus (*Spob*NPV). Leaf dip bioassay with second instar larvae of hairy caterpillar was conducted to assess the correlation between temperatures exposed and median lethal concentration deduced. Six viral concentrations of *Spob*NPV (ranging from 10^8 to 10^3) were subjected to each temperature. The median lethal concentration (LC_{50}) deduced for each individual temperature assessed was 3.59 x10^4 OBs/ml (F.L. 2.11x10^4 - 5.63x10^6) at 20°C; 1.17X 10^3 OBs/ml (F.L. 2.84x10^3 - 4.84x10^5) at 28°C and 1.03 × 10^5 OBs/ml (F.L. 2.3x10^4 -1.1x10^5) at 35°C. The bioassay results based on LC_{50} revealed that the temperature coefficient was positively correlated at 28°C by -30.5 folds increase in LC_{50} and was negatively correlated both at 20°C and 35°C by -0.01 folds and -0.35 folds suggesting that 28°C being the ambient temperature for showing potency of the occlusion bodies on the host larvae.

Ultraviolet light protection and prolonging the viral potency : The occlusion bodies (OB's) of the *Spob*NPV solution @2.8 × 10^8 OBs/ml were exposed to UV radiation in a laminar air-flow for five different time intervals viz., 0 min, 30 min, 60 min, 90 min and 120 min. Robbin blue (0.2%) was used as UV protectant. Leaf dip bioassay with second instar larvae of hairy caterpillar was conducted to assess the efficacy of OB's in combination with UV protectant based on percentage larval mortality. The larval mortality with OB's alone was 100%, 79.33%, 53.33%, 13.33% and 0.00% for 0 min, 30 min, 60 min, 90 min and 120 min respectively. The larval mortality with OB's in combination with UV protectant was 100%, 83.33%, 60%, and 53.33% for UV exposure of 30 min, 60 min, 90 min and 120 min respectively (Fig. 32). Thus, from the preliminary studies, robbin blue enables to maintain the virulence of *Spob*NPV on exposure UV radiation to some extent.

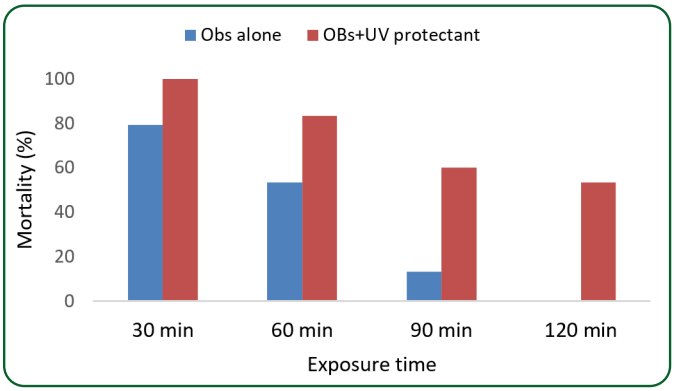


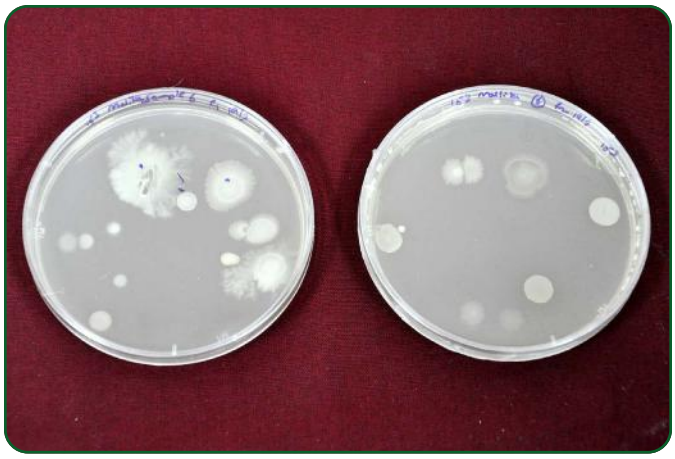
Fig. 32: Effect of UV protectant on SpobNPV potency

4.1.2. Isolation of entomocidal bacteria and their toxicity

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

Soil samples and dead insect cadavers were collected from jute growing villages adjoining ICAR-CRIJAF, Barrackpore for isolation of native microbial bioagents viz. *Bacillus thuringiensis*. Isolation of entomocidal bacterial isolates was carried out using both non selective and selective medium like Nutrient agar, Luria Bertani Agar and T_3 medium. All bacterial colonies grown on media were creamy white coloured mat like irregular colonies. Gram's staining of these bacterial colonies resulted in rod shaped bacteria which belonged to genus *Bacillus*. Purification and isolation of the spore crystal mixture of *cry* toxin from the Bt cultures was carried out.

Bt spore crystal mixture



Creamy white bacterial colonies on the media

4.1.3. Isolation of *Trichoderma* isolates from wild mushroom

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

Collection of new samples of resident *Trichoderma* isolate was greatly affected due to COVID19 restrictions. However, this opened up new opportunities in the form of spotting potential candidates directly under the natural conditions. Cyclonic storm Amphan caused massive destructions of trees. On such substrates wild mushrooms flourished. Naturally occurring *Trichoderma* was spotted infecting such wild mushrooms and on the decaying wood. Successful isolation and purification of the targeted organism was achieved from six such samples (Table. 23).

Colonies of *Trichoderma* on wild mushroom and wood substrates

Table 23. Accession of *Trichoderma* isolated from wild mushrooms

Accession	Location of collection	Substrate
CJMR192	ICAR-CRIJAF, Barrackpore	Wild mushroom on wood
CJMR193	ICAR-CRIJAF, Barrackpore	Dead wood bark
CJMR194	ICAR-CRIJAF, Barrackpore	Wood trunk
CJMR195	ICAR-CRIJAF, Barrackpore	Wild mushroom on wood
CJMR196	Dumdum, Kolkata	Wild mushroom on wood
CJMR197	Dumdum, Kolkata	Wild mushroom on wood

4.1.3. Colony growth inhibition of flax wilt pathogens by *Trichoderma* accessions

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

Thirty one *Trichoderma* accessions including four from commercial sources were tested against two soil borne fungal pathogens i.e., *Rhizoctonia* sp. and *Sclerotium* sp. through dual culture technique (Table. 24). All the accessions suppressed pathogen growth. However, it varied depending on the *Trichoderma* accessions, the target pathogens and experimental conditions. Accordingly, colony growth inhibition of the pathogens by different *Trichoderma* accessions varied between 41.80-69.10 % in case of *Rhizoctonia* sp. while it was 46.00-75.55% against *Sclerotium* sp. CJMR180 (71.20%), CJMR183 (70.78%) and CJMR192 (69.35%) were found consistently effective

against both the pathogens. Among the resident isolates, CJMR180, CJMR193, CJMR191, CJMR192 exhibited maximum inhibition against *Rhizoctonia* sp. in two repetitions. In case of *Sclerotium* sp. CJMR182, CJMR183, CJMR180 were most effective on the basis of two experimentations.

Table 24. Colony growth inhibition (%) by different *Trichoderma* accessions

Trichoderma accessions	Mean inhibition (%)			Trichoderma accessions	Mean inhibition (%)		
	Rhizoctonia sp.	*Sclerotium* sp.	Mean of both the pathogens		*Rhizoctonia* sp.	*Sclerotium* sp.	Mean of both the pathogens
CJMR180	67.75	74.65	71.20	CJMR197	65.1	70.45	67.78
CJMR181	60	72.7	66.35	MTCC-3144	62.65	71.35	67.00
CJMR182	64.65	73.1	68.88	TH-1	63.1	70	66.55
CJMR183	66	75.55	70.78	TH-10	65.1	70	67.55
CJMR184	60	72	66.00	TH-8	63.55	66.85	65.20
CJMR185	56.9	70	63.45	TV-1	60	62.2	61.10
CJMR187	60.65	62.65	61.65	TV-10	50.9	46	48.45
CJMR188	53.3	60	56.65	TVC-4	60	66.55	63.28
CJMR189	66.4	61.35	63.88	TVC-2	59.35	68.25	63.80
CJMR190	56.9	71.55	64.23	TVC-5	60.65	72.7	66.68
CJMR191	65.75	66.9	66.33	TV-H	66.45	69.6	68.03
CJMR192	67.35	71.35	69.35	Comm 1	62	74.7	68.35
CJMR193	67.75	66.45	67.10	Comm 2	69.1	59.55	64.33
CJMR194	59.8	68.45	64.13	Comm 3	64.2	67.3	65.75
CJMR195	41.8	49.8	45.80	Comm 4	51.1	58	54.55
CJMR196	56.45	51.55	54.00				

4.1.4. *In vitro* efficacy of antagonistic organisms against *Fusarium udum f. sp. crotolariae*

(Investigators: K.V. Shivakumar and S. K. Sarkar; Project Code: In-house Project-SNHM 1.1)

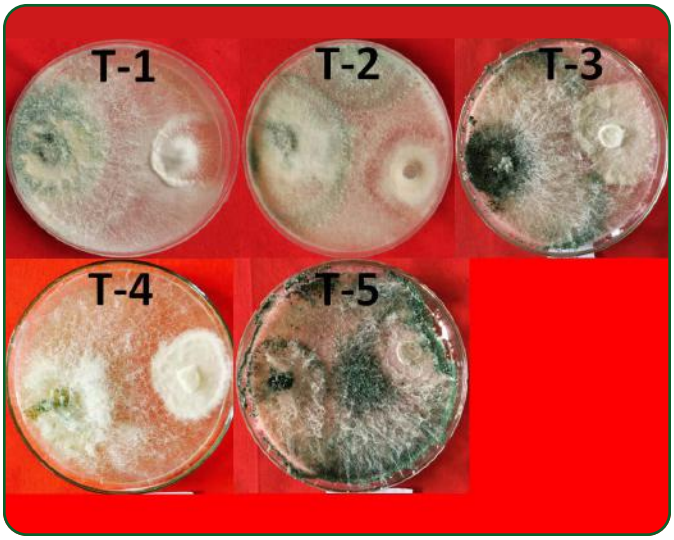
The antagonistic ability of five isolates of *Trichoderma* collected from two districts viz., Pratapgarh and Amethi of U.P. in inhibiting the sunnhemp wilt pathogen was studied by dual culture method. All the *Trichoderma* isolates reduced the growth of *F. udum f. sp. crotolariae*. Maximum reduction which was significantly superior over all the bioagents tested.

Table 25. Effect of *Trichoderma* isolates on the mycelial growth of fungi causing wilt of sunnhemp

Bioagent isolate	Inhibition (%)
T. sp (T-1)	75.13 (60.07)*
T. sp (T-2)	66.50 (54.62)
T. sp (T-3)	52.75 (46.57)
T. sp (T-4)	57.63 (49.38)
T. sp (T-5)	56.46 (48.70)
CD (P=0.01)	**3.16**

Figures in the parentheses are arc sine transformed values

in colony growth was observed in isolate T-1 (75.13%) Another superior isolate in inhibiting the mycelia growth of fungus was T-2 (66.50%). Least mycelial growth inhibition was observed in T-3 (52.75%) (Table. 25).



Inhibition zones created by different *Trichoderma* isolates

4.2. Host Plant Resistance

4.2.1. Comparative larval development of indigo caterpillar, *Spodoptera litura* on cultivated and wild species of jute an indicative of antibiosis

(Investigators: B. S. Gotyal, S. Satpathy and V. Ramesh Babu; Project Code: In-house Project- JE 2.1)

Indigo caterpillar is one of the early season lepidopteran pests of jute, the infestation of which adversely affect the plant population. Scope of insecticide use is very much restricted, alternatively preliminary experiment was conducted to find out the source of resistance against indigo caterpillar. There was significant variation in the weight and survival of the larvae reared on varieties and accessions of cultivated and wild species (Fig. 33). The larval weight, 20 days after feeding (DAF) on different host species varied from 150.25 mg (*C. fascicularis,* WCIN-104) to 164.74 (*C. aestuans*, WCIN-136). Cultivated varieties supported the larval growth to maximum extent and recorded highest larval weight i.e., 307.11 mg and 242.49 mg in JRC 212 and JRO 204 respectively. The survival of larvae on JRO 204 was 70% compared to 56.57% in WCIN-104. With least larval weight and survival, the wild accession WCIN-104 of *C. fascicularis* showed maximum antibiosis on larval development which may be the possible resistance source against indigo caterpillar.

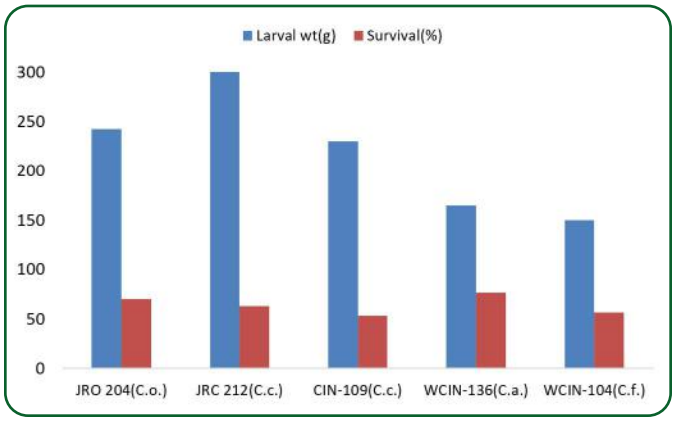


Fig. 33: Weight and survival of larvae in different wild and cultivated jute species

4.2.2. Role of peroxidase activity in regulating antibiosis of *Corchorus aestuans* against hairy caterpillar

(Investigators: B. S. Gotyal, S. Satpathy and V. Ramesh Babu; Project Code: In-house Project- JE-2.1)

The peroxidase activity varied significantly among the different cultivated and wild jute species(Fig. 34). Varieties of cultivated jute species, JRO 632 and JRC 80 have recorded less peroxidase activity with 0.43 and 0.21 mM tetra-guaiacol/min/g respectively. Whereas, wild jute species, *C. aestuans* (WCIN-179) had higher peroxidase activity of 2.04 mM tetra-guaiacol/min/g. Enhanced peroxidase activity triggers oxidation of phenolics that can directly deter feeding by insect herbivores and/or produce toxins that has adverse effect on biology. Previous studies which confirms high antibiosis of wild species, particularly *C. aeustans* on hairy caterpillar larvae is due to higher peroxidase activity.

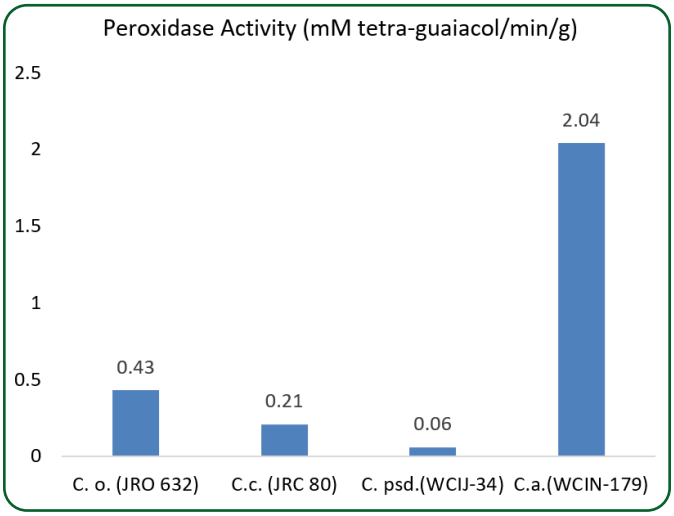


Fig. 34: Peroxidase activity in wild and cultivated species of jute

4.2.3. Evaluation of jute entries against stem rot in sick plot

(Investigators: R. K. De, Ramesh Babu and Shamna, A.; Project Code: In-house Project- JM 9.0)

Twenty two genotypes from both *C. olitorius* and *C. capsularis* were evaluated in the sick plot. To maintain the disease pressure, inoculum of *Macrophomina phaseolina* multiplied in laboratory was incorporated in the soil before and during sowing. Among the entries, PDI of stem rot was highest (5.66) in the susceptible check JRC 412. It was followed by JRO 524 with 2.33 and JRO 204 with 1.76. All other genotypes from both the species showed low stem rot PDI (0.6 – 1.21) (Table. 26).

Table 26. Evaluation of jute entries against stem rot in sick plot

Genotype	Mean PDI	Genotype	Mean PDI
CIN 010	0.60	OIN 125	0.86
CIN 262	0.88	OIN 154	1.21
CIN 371	0.82	OIN 154G	0.89
CIN 386	0.86	OIN 154R	1.12
CIN 439	0.97	OIN 252	0.89
JRO 204	1.76	OIN 270	0.99
JRO 524	2.33	OIN 392	0.69
OEX 027	0.72	OIN 651G	1.00
OEX 15R	1.06	OIN 853	1.10
OIJ 052R	0.89	OIN 932	0.91
OIN 110	0.90	JRC 412	5.66

4.2.4. Evaluation of sunnhemp genotypes against *Fusarium* wilt in field condition

(Investigators: K.V. Shivakumar and S. K. Sarkar; Project Code: In-house Project-SNHM 1.1)

Fifty germplam of sunnhemp were screened for wilt resistance in field condition along with resistant check variety SH-4. The wilt incidence ranged between 1.79 - 38.09 % among the germplasm. Out of 50 germplasm screened 22 showed less than 10 % wilt incidence and rated as resistant (R), 24 showed wilt incidence between 10-30 % rated as moderately resistant (MR) and 4 showed susceptible reaction which recorded more than 30 % wilt incidence (Table. 27). The resistant and susceptible check, SH-4 and Ankur recorded 9.12% and 34.34% disease incidence respectively.

Table 27. Field evaluation of sunnhemp germplasm against *Fusarium* wilt

Disease reaction	No. of germplasm	Name of germplasm
R (0-10 %)	22	SUIN-1, SUIN-2, SUIN-3, SUIN-5, SUIN-6, SUIN-7, SUIN-8, SUIN-9, SUIN-10, SUIN-14, SUIN-16, SUIN-17, SUIN-19, SUIN-20, SUIN-22, SUIN-24, SUIN-25, SUIN-26, SUIN-27, SUIN-29, SUIN-35, SUIN-41
MR (10-30 %)	24	SUIN-4, SUIN-11, SUIN-12, SUIN-13, SUIN-15, SUIN-21, SUIN-28, SUIN-30, SUIN-31, SUIN-32, SUIN-33, SUIN-34, SUIN-36, SUIN-37, SUIN-38, SUIN-40, SUIN-43, SUIN-44, SUIN-45, SUIN-46, SUIN-47, SUIN-48, SUIN-49, SUIN-51
S (>30 %)	4	SUIN-18, SUIN-23, SUIN-39, SUIN-42

4.3. Bio-ecology and Management of Insect Pests and Diseases

4.3.1. Effect of temperature on life cycle duration and mortality of mealybug

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

Cotton mealybug, *Phenacoccus solenopsis* has established as new pest on jute and enhanced its pest status on mesta mainly due to the changing temperature and rainfall pattern during the crop establishment phase. In a laboratory experiment, the impact of variable temperature regimes (16^{0}C to 34^{0}C) on the development and survival of mealybug was assessed.

Table 28. Durations (days) of nymphal instars of mealy bug at different temperatures

Host	Temp.(±1°C)				
	16	22	26	34	Mean
Stage-Crawler					
Mesta	14.00	10.85	8.93	7.89	10.41^b
Jute	16.68	18.78	13.30	9.72	14.61^a
Mean	15.34^a	14.81^a	11.11^b	8.80c	
C (P=0.05)	Temp.- 0.93	Host- 0.66	Temp. x Host- 1.32		
Stage- II instar					
Mesta	6.9	8.74	6.05	3.94	6.40^b
Jute	12.76	11.31	5.43	3.59	8.27^a
Mean	10.02^a	9.83^a	5.74^b	3.76^c	
C (P=0.05)	Temp.- 0.59	Host- 0.42	Temp. x Host- 0.83		
Stage- III instar					
Mesta	23.89	23.33	11.12	8.33	16.66^a
Jute	23.12	14.18	7.48	6.44	12.80^b
Mean	23.50^a	18.75^b	9.30^c	7.38^d	
C (P=0.05)	Temp.- 0.80	Host- 0.56	Temp. x Host- 1.12		
Total life cycle					
Mesta	44.79	42.92	26.1	20.16	33.49^b
Jute	52.56	44.26	26.21	19.74	35.69^a
Mean	48.67^a	43.59^b	26.11^c	19.95^d	
C (P=0.05)	Temp.- 1.56	Host- 1.11	Temp. x Host- 2.21		

Four temperature regimes (16^{0}C, 22^{0}C, 28^{0}C and 34^{0}C) significantly influenced the duration of different stages of *P. solenopsis* and the survival during the developmental period. The duration of each stage was longest at 16^{0}C and shortest at 34^{0}C. The duration of crawlers varied from

8.80 days at 34^{0}C to 15.34 days at the lowest temperature which was significantly least when reared at 34^{0}C (Table. 28). Similarly, the duration of II stage was significantly reduced to 3.7 days at 34^{0}C compared to 10.20 days at 16^{0}C. Irrespective of hosts, the developmental period of III instar mealy bug was 3 times longer longer at 16^{0}C compared to the duration recorded at 34^{0}C (7.38 days). Significant effect of rearing temperature was observed on total life cycle duration also. Significantly shortest and longest duration was recorded at 34^{0}C and 16^{0}C respectively. Total life cycle duration was reduced by 29 days with an increase of 18^{0}C temperature. The main effect of host plant showed significant prolongation of total life cycle in jute compared to mesta.

The extent of survival of mealybug when reared separately on jute and mesta was non-significant whereas temperature greatly influenced the survival (Fig. 35).

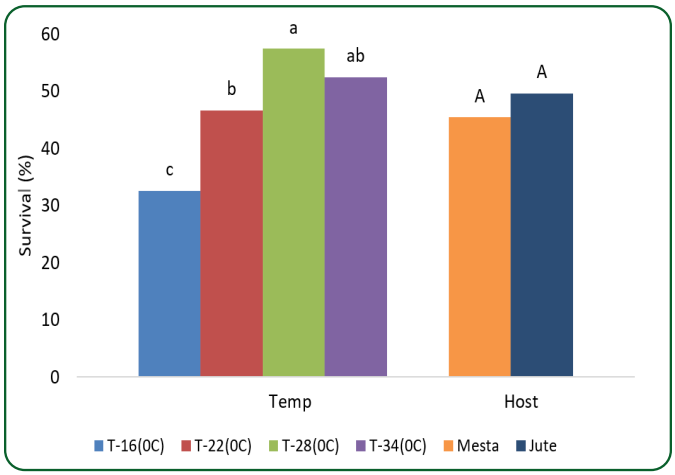


Fig. 35: Effect of temperature on survival of mealy bug on jute and mesta

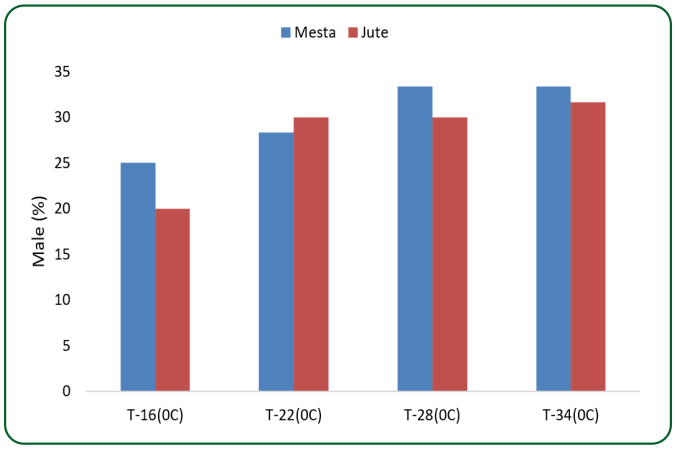


Fig. 36: Proportion of male (%) mealy bug reared on jute and mesta at variable temperature

The survival of mealy bug was highest at 28^{0}C (57.50%) and lowest (32.50%) at 16^{0}C. The sex ratio of mealy bug altered under different temperature regimes. There was an increase in the proportion of males with increase in rearing temperature. Highest proportion of males i.e., 33.33% and 31.33% was recorded when the mealy bugs were reared on mesta and jute respectively (Fig. 36).

4.3.2. Integration of varieties and acaricides for yellow mite management in jute

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

Superior jute varieties and acaricides in terms of resistance and toxicity against yellow mite were integrated together for management of this pest under field condition. The mite density showed significant variation among the jute varieties (Table. 29). During both the observations, mite count was significantly lowest in JRO 204 (29.18 and 24.18/cm^2) followed by JROG 1 (32.29/cm^2). On the other hand it was significantly highest in JRO 2407 (36.07 and 33.55/cm^2).

Table 29. Effect of varieties and acaricides on mite infestation in jute

Mite/cm^2 (I-post treatment)				
Acaricide	**JRO 2407**	**JRO 204**	**JROG 1**	**Mean**
Fenpyroximate 5 EC @1.5ml/l	27.22	24.77	31.99	27.99^b
Spiromesifen 240 SC@0.8ml/l	32.21	25.66	29.55	29.14^b
Control	48.77	37.10	35.33	40.40^a
Mean	36.07^a	29.18^b	32.29^b	
C (P=0.05)	Variety- 3.16	Acaricide- 3.16	Variety x Acaricide- 5.51	
Mite/cm^2 (II-post treatment)				
Fenpyroximate 5 EC @1.5ml/l	26.55	20.66	26.55	24.58^b
Spiromesifen 240 SC@0.8ml/l	31.55	21.77	26.98	26.77^b
Control	42.55	30.10	36.34	36.66^a
Mean	33.55^a	24.18^c	29.99^b	
C (P=0.05)	Variety- 3.05	Acaricide-3.05	Variety x Acaricide- NS	

The acaricide, fenpyroximate 5EC@1.5 ml/lit was most effective in reducing the mite infestation in jute. During

both the post application observations the acaricide treated plots had significantly lowest population (27.99 and 24.58/cm^2) compared to untreated control (40.40 and 36.66/cm^2).

The varietal effect was prominent on damage grade due to mite infestation. The damage grade was significantly high (3.22) in JRO 2407 and low (2.17) in JRO 204. Due to acaricide treatment the damage grade was significantly reduced (2.34 to 2.48) compared to control (3.06) (Fig. 37).

JRO 204 jute variety was most superior with least infestation and highest yield (40.55 q/ha) followed by JROG 1 (39.84 q/ha). Irrespective of varieties the acaricide application could improve the yield by reducing the mite infestation and damage (Fig. 38). Fenpyroximate 5EC treatment recorded highest fibre yield (40.93q/ha).

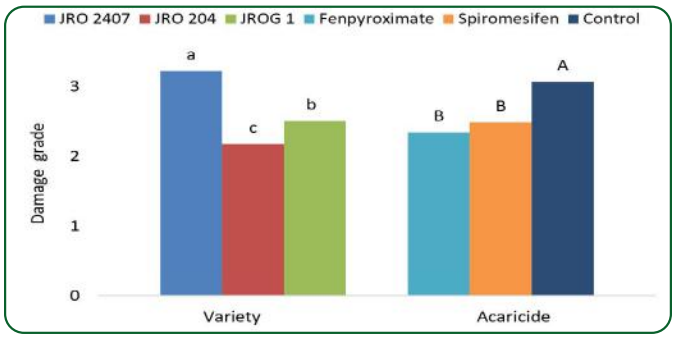


Fig. 37: Damage grade in different variety and acaricide treatments

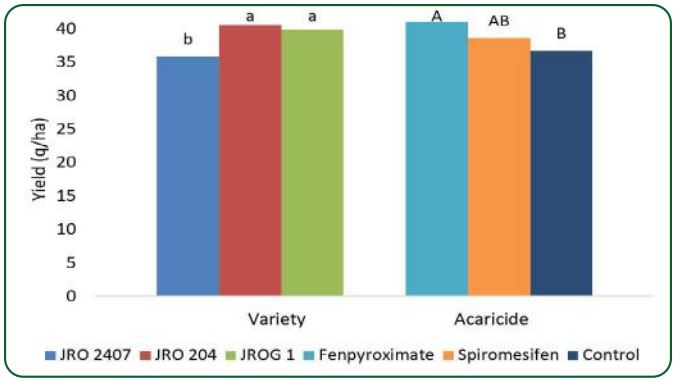


Fig. 38: Fibre yield in different variety and acaricide treatments

4.3.3. Effect of sulphur on yellow mite infestation' damage and other growth parameters of jute

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

Pot experiment: The role of soil application of sulphur on yellow mite infestation in jute was studied in a pot experiment. The effect of sulphur applied at two doses (30 and 60 kg/ha) in the pot soil on mite population density, infestation and plant growth characteristics of jute (Cv JRO 8432) indicated that higher dose of soil applied sulphur could reduce the mite population build up. The jute plants grown in soil applied with 60 kg s/ha recorded 24.11 eggs and 22.33 adults/cm^2 eggs and adults respectively (Table. 30). Whereas the untreated plants harboured significantly higher population (34.39 and 27.89/cm^2). Sulphur applied at higher dose significantly restricted the damage to 47.76%.

Table 30. Mite population and infestation at different levels of sulphur application on jute

S-Dose	Mite population/cm^2		Plant damage (%)	Plant ht (m)
	Egg	Adult		
S @ 60 kg/ha	24.11^c	22.33^b	47.76(43.68)^b	2.14^a
S @ 30 kg/ha	29.61^b	26.16^{ab}	61.09(51.63)^{ab}	2.07^a
Control	34.39^a	27.89^a	64.00(55.77)^a	1.91^b
CD (P=0.05)	3.96	4.63	10.23	0.16

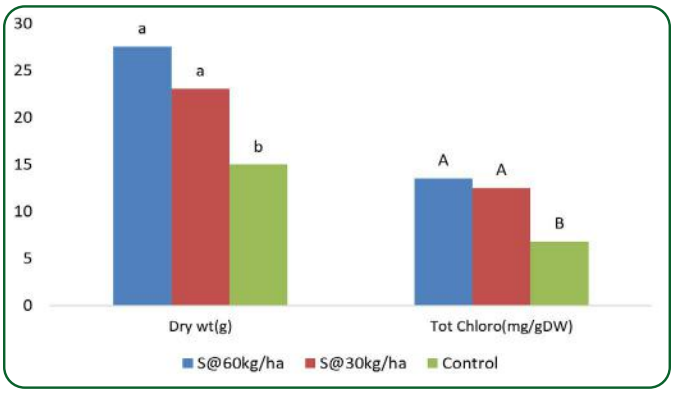


Fig. 39: Dry weight and chlorophyll content of plants grown under different sulphur regimes

Jute plants under different soil sulphur regimes

Besides reducing the population and mite infestation, sulphur significantly enhanced the plant height, dry weight and chlorophyll content (Fig. 39). The dry weight (27.54 g) and chlorophyll content (13.53 mg/gDW) of the plants grown in higher level of sulphur was almost double compared to the control plants. These parameters could compensate the adverse effect of mite damage on fibre yield.

Field experiment: Effect of soil applied sulphur was evaluated on three jute varieties (JRO 204, JROG 1 and JRO 2407) under field condition. Sulphur was applied @ 30 and 60 kg/ha in the soil just before sowing. The preliminary result showed that although numerically sulphur application reduced the mite population, was not significant across the treatments. The tolerant varieties suffered significantly less damage (1.8-2.20 damage grade) compared to JRO 2407 (3.04). The plants from sulphur treated plot sustained significantly less damage (2.10-2.56 grade). The damage grade of control plot was very high (3.22) (Fig. 40a). Highest yield was obtained in JRO 204 variety from the plot treated with 60 kg/ha sulphur (Fig. 40b).

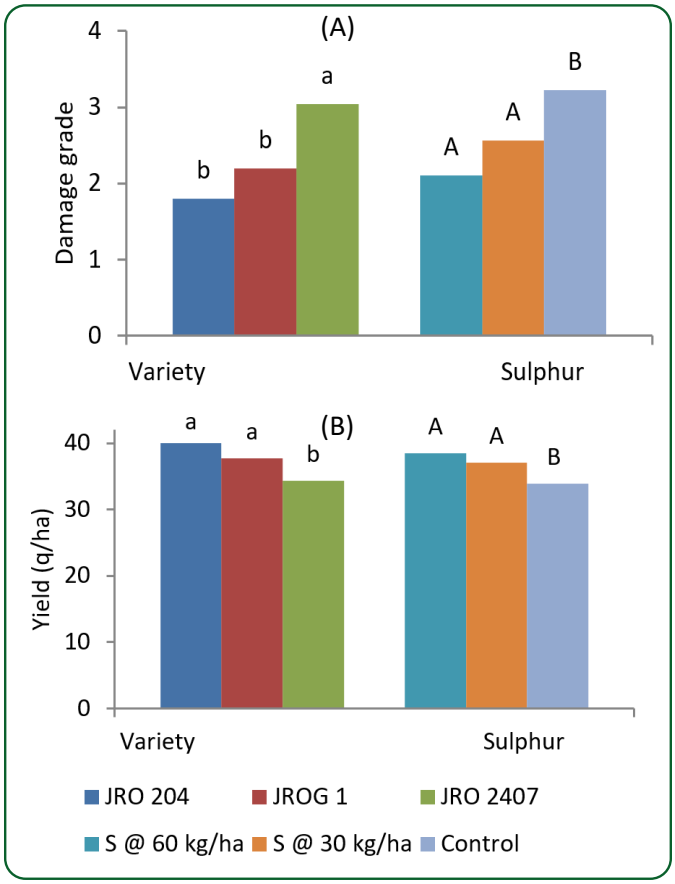


Fig. 40: Effect of varieties and sulphur application on fibre damage grades (A) and yield (B) of jute

4.3.4. Standardization of seed treatment for sustainable IPM of jute

*(*Investigators: *Rajib Kumar De, S. Satpathy, V. Ramesh Babu and Shamna. A; Project Code: In-house Project- JM 9.4)*

To develop a robust seed treatment strategy in jute, a field experiment was conducted with variety JRO 204 (Suren) using fungicide, insecticide or biocontrol agent either alone or in combination against stem rot disease and different sucking and leaf eating insect pests of jute. The incidence of stem rot and damages caused by different sucking and leaf eating insect pests was recorded to be minimum (9.4%) in pre-sowing seed treatment using both carbendazim and imidacloprid. It was better than any other treatment using either of the two components or *Trichoderma* with fungicide. Soil application of bleaching powder @ 25 kg/ha 7 days ahead of sowing was also very promising as it reduced the incidence of stem rot (15.1%). Combined pre-sowing seed treatment with both carbendazim + imidacloprid and soil application of bleaching powder was the best of all treatments tested to reduce the stem rot to 8.45% from 29.7% in check and yellow mite to 10.4 from 20.2 % in check and achieved the highest dry fibre yield of 34.2 q/ha.

4.3.5. Efficacy of fungicides against wilt of sunnhemp caused by *Fusarium udum* f.sp. *crotolariae*

*(*Investigators: *K.V. Shivakumar and S. K. Sarkar; Project Code: In-house Project-SNHM 1.1)*

Efficacy of six fungicides were tested at 3 different concentrations by poison food technique. There was significant difference among the fungicides in inhibiting the growth of *Fusarium udum* f.sp. *crotolariae*. Carbendazim 50% WP, Propiconazole 13.9 % + Difenoconazole 13.9% EC, Carboxin 37.5 % + Thiram 37.5 % WS and Tebuconazole 25.9 % EC completely (100 %) inhibited the growth of the pathogen. Least inhibition of mycelial growth (67.38%) was observed in Propineb 54.2% + Tricyclazole 15% WP followed by Hexaconazole 5% SC (76.90) even at 0.1 % compared other tested fungicides (Table. 31).

4.3.6. Integrated management of sunnhemp wilt

*(*Investigators: *K.V. Shivakumar and S. K. Sarkar; Project Code: In-house Project-SNHM 1.1)*

Based on the performance, three treatments were identified as best practices viz., seed treatment (ST) with

Table 31. *In vitro* efficacy of fungicides against mycelial growth and inhibition of *Fusarium udum* f.sp. *crotolariae*

Fungicides (F)	Inhibition (%) at different concentrations (C)			
	0.025 %	0.05 %	0.1 %	Mean
Carbendazim 50 % WP	100 (89.96)*	100 (89.96)	100 (89.96)	100 (89.96)
Propiconazole 13.9 % + Difenoconazole 13.9% EC	100 (89.96)*	100 (89.96)	100 (89.96)	100 (89.96)
Propineb 54.2% + Tricyclazole 15% WP	41.19 (39.92)	48.69 (44.24)	67.38 (55.16)	52.42 (46.38)
Carboxin 37.5 % + Thiram 37.5 % WS	100 (89.96)	100 (89.96)	100 (89.96)	100 (89.96)
Hexaconazole 5% SC	24.52 (29.67)	33.37 (35.28)	76.90 (61.26)	44.93 (42.08)
Tebuconazole 25.9 % EC	100 (89.96)	100 (89.96)	100 (89.96)	100 (89.96)
Mean	77.61 (61.75)	80.33 (63.66)	90.71 (72.24)	82.89 (65.55)
CD (P=0.01)	F	C	F x C	
	1.05	0.74	1.83	

Figures in the parenthesis are arc sine transformed values

carboxin + thiram @ 2g/ kg seed + soil application (SA) of neem cake @ 250 kg/ha and *Trichoderma* sp. @ 2.5 kg/ ha + intercropping (IC) with maize (10:1) recorded lowest mean wilt incidence of 9.03 per cent with highest mean fibre yield of 8.97 q/ha followed by ST with *Trichoderma* sp @ 5g/ kg seed + SA of neem cake @ 250 kg/ha and *Trichoderma* sp. @ 2.5 kg/ha + IC with maize (10:1) + SA of organic liquid formulation (OLF) @ 500 lit/ ha at 40 DAS which recorded mean wilt incidence of 10.63 per cent with mean fibre yield 8.20 q/ha. However, SA of organic liquid formulation (OLF) @ 500 lit/ha + ST with *Trichoderma* sp @ 5g/ kg seed + intercropping with maize (10:1) which recorded mean wilt incidence of 11.87 per cent with mean fibre yield 7.97 q/ha was also found effective in controlling wilt incidence and increasing fibre yield compared to control. (Table. 32).

Table 32. Integrated management of sunnhemp wilt with bio-agent, fungicide, intercropping and organic liquid formulation.

Treatments	Plant Height (cm)	Basal Diameter (cm)	Wilt incidence (%)	Fibre yield (q/ha)
SA of OLF @ 500 lit/ha + *Trichoderma* sp ST @ 5g/ Kg seed + IC with Maize (10:1)	212	11.56	11.87	7.97
SA of OLF @ 500 lit/ha + *Trichoderma* sp seed treatment @ 5g/ Kg seed + IC with Sorghum (10:1)	221	10.77	14.80	6.92
ST with Carboxin + Thiram @ 2g/ Kg seed + S.A. of Neem cake @ 250 Kg/ha and *Trichoderma* sp. @ 2.5 kg/ha + IC with Maize (10:1)	210	11.24	9.03	8.97
ST with Carboxin + Thiram @ 2g/ Kg seed + SA of Neem cake @ 250 Kg/ha and *Trichoderma* sp. @ 2.5 kg/ha + IC with Sorghum (10:1)	215	10.44	12.79	7.13
ST with Tebuconazole @1ml/ Kg seed + SA of Neem cake @ 250 Kg/ha and Trichoderma sp. @ 2.5 kg/ha + IC with Maize (10:1)	196	8.74	19.50	5.87
ST with Tebuconazole @1ml/ Kg seed + SA of Neem cake @ 250 Kg/ha and *Trichoderma* sp. @ 2.5 kg/ha + IC with Sorghum (10:1)	199	9.13	21.17	5.27
ST with Carbendazim @ 2g/ Kg seed + SA of Neem cake @ 250 Kg/ha and *Trichoderma* sp. @ 2.5 kg/ha (Positive check)	214	9.98	15.53	6.88
ST with *Trichoderma* sp @ 5g/ Kg seed + SA of Neem cake @ 250 Kg/ha and *Trichoderma* sp. @ 2.5 kg/ha + IC with Sorghum (10:1) + SA of OLF @ 500 lit/ ha @ 40 DAS	234	10.61	10.63	8.20
Control (Negative check)	194	8.46	43.33	4.40
CD (p=0.05)	11.55	1.19	2.65	0.73

ST-Seed treatment, SA-Soil application, IC-Intercropping, OLF-Organic liquid formulation

4.3.7. 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 70 days after sowing by mycelial bits of *Macrophomina phaseolina* culture. Based on the length of the lesion developed (recorded at 15 and 130 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). The least susceptible germplasms were OIN 113 (2.1 cm), OIJ 61 (2.19 cm), OIN 161 (2.30 cm) and OIN 154 (2.40 cm) whereas the most susceptible gemplasms were OIN 112 84 (5.07 cm), OIJ 75 (5.13 cm), OIN 145 (5,90 cm), OIJ 78 (7.17 cm), OIN 150 (6.80), OIJ 66(7.50), OIJ 83 (7.67 cm), OIJ 84 (9.10 cm), OIN 162 (9.33 cm) and OIJ 34 (18.03cm).

4.4. Informatics for Pest Prediction and Management

4.4.1. Decision Support System for IPM in jute

(Investigators: V. Ramesh Babu, N.M. Alam, S. K. Sarkar and S.K. Pandey; Project Code: In-house Project-J.E 2.1)

Development of Decision Support System (DSS) for pest management in jute with the aim of identifying and integrating weather parameters vis-à-vis with crop phenology and developing pest forewarning models in North 24 North Parganas district of West Bengal has been attempted. Data encompassing weather related issues (rainfall, humidity, temperature, day-light hours), abiotic stress factors (critical stage of irrigation, drought periods) biotic stress factors (critical stages of disease infestation, pest outbreaks, management issues) and crop related factors (varieties, crop phenology) in conjunction with management practices has been collected. With the collected information, database has been developed and linked with management strategies to be provided. The database will be developed in SQL Software (2008 or 12.0). Appropriate statistical approach (Analytical Hierarchy Process) will be used for ranking the compared scenarios with aim of getting best management practices. The flow chart of the DSS Software displaying the major decision flow-logics has been prepared.

4.5. Use of Nano Particles for Stress Management in Jute

4.5.1. Effect of carbon nanotubes on soil salinity tolerance in jute (*Corchorus olitorius*)

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

Carbon Nanotubes (CNTs) were synthesized which have a zeta potential of -9.06 mV indicating the presence of carboxyl (-COOH) and hydroxyl (-OH) surface groups. Jute seeds (JRO 204) treated with CNT @ 10 ppm were grown on saline soil in earthen pots. Greater tolerance to salinity than the untreated check. Three cDNA libraries were prepared from CNT treated; active carbon treated and untreated plants which generated more than 1.5 million reads (Table. 33). Transcriptome analysis revealed that a significant number of salinity stress tolerant genes involved in the saline stress -response viz. SLT1, GDSL esterase, WRKY TF, ABA responsive pathways. The most frequent molecular functions of the identified salinity stress tolerance

Table 33. Results of RNA seq data

Reads			Assembly V1				
library	#454 plates	#454 reads	# of bp	AV. of reads	# contigs	AV. of contigs	% of reads of contigs
CNT treated	3	43,718	7626589	257	43,245	545	69.4%
Active carbon treated	3	40,248	7021659	328	39,249	524	68.4%
Untreated	3	41,274	6921547	429	38,458	379	65.47%

genes were sodium- and lithium-tolerant gene, ABA- and DICER-DUF-Dead Box helicase protein, GDSL esterase/ lipase, putative WRKY transcription factor 16, L-ascorbate peroxidase 2, and DELLA protein GAI as revealed by GO annotation distribution. Several annotation categories including "metabolic process", "WRKY-like salt-induced family protein", were significantly over-represented in salt tolerant CNT treated sample not expressed in untreated and other activated carbon samples. A statistical analysis using the GOstat program [GO: http://www.geneontology.org] confirmed the enrichment of inoculated non-infected lines transcritpome in these functional categories (p-value <0.01). On the other hand, several functional categories including mainly house-keeping genes such "structural constituent of the ribosome", "translation", "ribosome biogenesis and assembly", and "protein metabolic process" were over-represented in healthy check and other treated samples (p-value < 0.01).

5. Transfer of Technology

5.1 Awareness on Climate Resilience, Value Chain and Impact Assessment

5.1.1 Scientists' perception about effect of climate variability on jute-based cropping system

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

Jute based cropping is one of the predominant traditional cropping systems in West Bengal, Bihar and Assam. In the present context of climate change, like other cropping systems, this system is also being affected due to weather vagaries and climatic aberrations. To address this issue, an attempt has been taken to study the perception of the agricultural scientists about the mitigation and adaptive strategies to minimize the effect of climate variability on jute based cropping system. A comprehensive list of mitigation and adaptive strategies was prepared through review of relevant literatures and consultation with experts. Then the scientists of ICAR-CRIJAF, Barrackpore were requested to give their responses about these strategies on a five point continuum ranging from 'strongly agree' to 'strongly disagree'. The mitigation and adaptive strategies on which majority of the learned and experienced scientists were in 'strongly agree' and 'agree' categories (Table 34) could be the potential advisories for the farmers struggling against adverse effect of climate change and adoption of these strategies by them could pave the way towards climate smart jute based cropping system.

Table 34. Scientists' perception on general mitigation and adaptive strategies for climate change

Sl. No.	Mitigation and adaptive strategy	SA+A (%)	Sl. No.	Mitigation and adaptive strategy	SA+A (%)
1	Change in agro-practices		13	Community nursery bed	77.78
	a) sowing time	100	14	Dense sowing of crops	55.55
	b) row spacing	77.78	15	Split application of N fertilizers	100
	c) crop rotation	94.45	16	IPM and INM practices	100
	d) tillage practices	88.89	17	Low cost poly-houses	94.44
	e) crop cultivars	100	18	Less water requiring crops	77.78
2	SRI , nitrification inhibitor etc.	100	19	Crop insurance	88.89
3	Use of bio-product of jute	83.33	20	Sowing in furrows	100
4	Use of bio-ethanol	66.67	21	Use of green manure	100
5	Rainwater harvesting	100	22	Soil testing	94.44
6	Soil mulching	94.44	23	S application in soil in drought	66.67
7	Jute-moong intercropping	100	24	Profitable cropping system	72.22
8	Adding organic matter in soil	94.44	25	Retting by CRIJAF Sona	88.89
9	Drip irrigation in vegetables	100	26	In-situ jute retting	94.44
10	Mixed cropping	100	27	Weather based agro-advisory	94.44
11	Diversified farming	94.44	28	Re-sowing in crop damage	83.33
12	Proper drainage channels	94.45	*SA= Strongly agree, A= Agree*		

system was studied. Mitigation and adaptive strategies on which the greater level of consensus was found amongst scientists to minimize the effect of climate variability on jute based cropping system were as follows: change in agronomic practices (sowing time, crop rotation and crop cultivars), adoption of technologies like SRI, nitrification inhibitor etc., jute-green gram intercropping, mixed cropping, diversified farming, rainwater harvesting, in-situ retting, soil mulching, application of organic matter in soil, use of green manure, soil test based fertilizer application, split application of nitrogenous fertilizers, adoption of IPM and INM practices, sowing in furrows to maximize

soil moisture use, making of proper drainage channels, use of drip irrigation in vegetables and construction of low cost poly-houses to raise nursery and vegetable during unfavourable weather condition. Majority of the scientists also perceived that weather-based agro-advisory service of the institute is a very useful tool for good farming practices and contingency planning.

5.1.2 Scope of value chain development in jute and role of farmers producers 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)

The attitude of farmers towards the development of value chain in jute was studied by following Likerts Scale considering 100 farmers from two registered Farmers Producer Company (FPC) namely Badhuria Krishi Bikas FPC, Badhuria and Sabka Apna FPC, Nilgunj. Majority of the farmers (95%) had strong favorable attitude towards value chain development in jute. The maximum attitude scored was 24 and minimum was 12. The profile of the respondents revealed that the mean age of respondents was 51 years and the average area of jute cultivated by farmers registered in FPO was 0.5 ha. As part of value chain development in jute, these two FPCs were linked with ICAR-CRIJAF and its KVK through various Govt. schemes, programmes and projects as per the conceptual model developed for the value chain in jute (Fig. 41) . Capacity building of farmers was done to the extent possible through Institute's beneficiary oriented programmes.

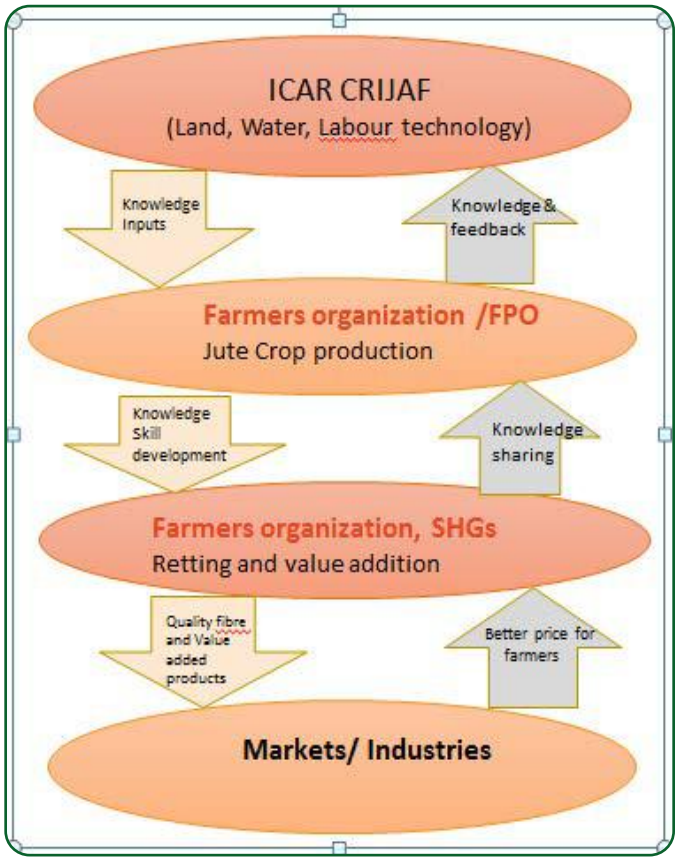


Fig. 41: Conceptual model of value chain in jute

5.1.3 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 major jute growing districts of West Bengal namely, Murshidabad, Nadia and North 24 Parganas. The socio-psychological profile of the respondents viz, age, literacy, land holding size and income was very diverse. Majority 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 ICAR-CRIJAF technologies like high yielding varieties of jute, multi row seed drill, CRIJAF nail weeder/ single wheel jute weeder and CRIJAF Sona (Fig. 42) .

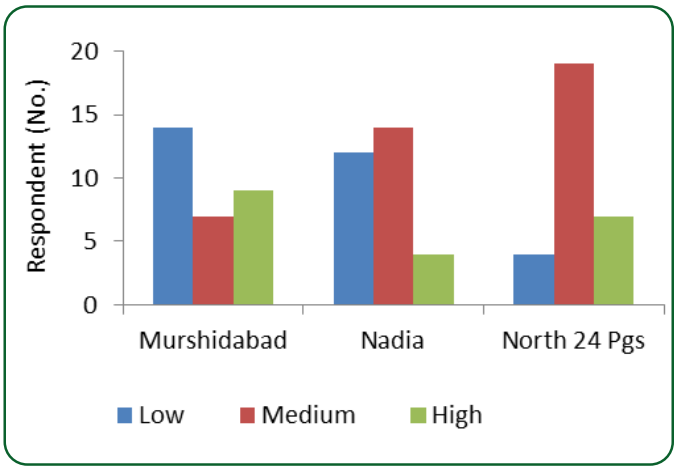


Fig. 42: Distribution of the respondents based on adoption level

The respondents of North 24 Parganas had highest gain of jute fibre yield as well as knowledge score (regarding application of ICAR-CRIJAF technologies) at field level. In general, major consraints in jute cultivation in these ditricts were non-avaiability of retting water (66.6%)

followed by labour crisis during harvesting of jute (44.5%).

5.1.4 Enhancing farm income through up-scaling of jute based diversified products as an alternative to plastics

(Investigators: Shamna. A, S.K. Jha, S. Kumar and M.L. Roy; Project Code: In house-Project -JEXA 6.2)

Three skill development programmes for entrepreneurship development through making of jute fibre and fabric based products were conducted for farm women. Twenty four farm women from three different villages in North 24 Parganas district was selected and organised in two different Self-Help Groups (SHGs). It was observed that the average age of Group 1 was 38.8 yrs and group 2 was 34.4 yrs (Fig. 43). More than 75% of the women in both the groups had education up to high school level. The major contribution of household income of group 1 was from small scale business (30.7%) followed by agriculture (21.48%) where as in case of group 2 the major contribution to total house hold income was from non-agricultural wage labour (28.84%) followed by service (24.58%) and agriculture (20.77 %) (Table 35).

Table 35. Distribution of household income of the members from different livelihood sources

Source of income	SHG-1		SHG -2	
	Income (₹)	Percent contribution	Income (₹)	Percent contribution
Crop	282500	21.48	345500	20.77
Livestock	70000	5.32	13600	0.82
Land rented out	-	-	22160	1.33
Agriculture Wages	106000	8.06	242500	14.57
Small scale business	404000	30.72	53600	3.22
Service	218400	16.61	409000	24.58
Foreign remittance	-	-	48000	2.88
Non-agricultural wage labour	192000	14.6	479816	28.84
Pension	-	-	43200	2.59
Others	42000	3.19	6000	0.36
Total	1314900	100	1663376	100

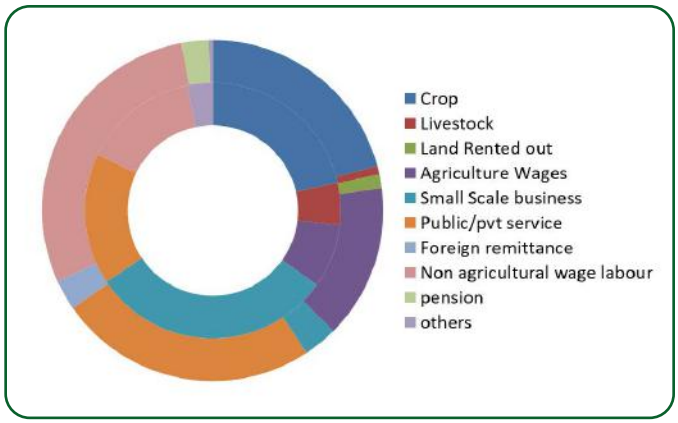


Fig. 43: Contribution of different livelihood income sources to total income of two different SHGs

5.1.5 Analysis of Yield Gap and Contribution of Production Factors in Cultivation of Jute

(Investigators: S.K. Jha, M.L. Roy, A.K. Ghorai, S. Mitra, R. Saha, S. P. Mazumdar, R. K. Naik and A.K. Chakraborty; Project Code: In house-Project -JEXA 6.1)

The study area involved the area of operation under Jute-ICARE program viz. West Bengal, Assam, Bihar, Odisha & Meghalaya. The on-field information from the programme's location was collected through a google based form-JAF Kisan. The link of this google form was provided to all the master trainers (MTs) under Jute-ICARE and they were trained to fill it up accordingly. The pre-harvest information was received from the majority of the MT. However, post-harvest information was difficult through google based JAF Kisan, hence information was received through hard copy from respondents. The overall Technology Gap as well as Extension Gap observed in four districts of West Bengal are presented in Fig. 44.

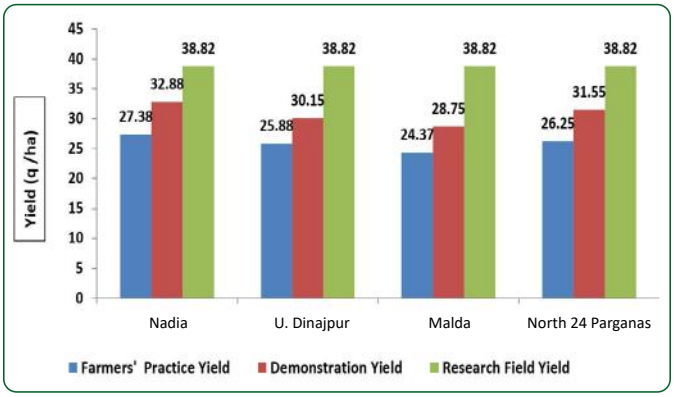


Fig. 44: Technology and extension gap in four districts of West Bengal

Technology gap was found maximum at Malda (10.07 q/ha) and Uttar Dinajpur (7.67 q/ha) which may be due to AMPHAN and other climatic variations; while the maximum Extension gap was observed in Nadia (5.38 q/ha) and Malda (4.38 q/ha) districts respectively. The plant height and vigour didn't translate into bumper yield due to very high and erratic rainfall as well as "Amphan" cyclone. As a part of the strategy to mitigate the yield gap, farmers were also advised, through agro-advisory, to make drainage channels in the field and reduce the impact of water stagnation on crop growth. A perusal of the data revealed better yield, net return, better fibre quality and less cost of cultivation for the ICARE beneficiaries than the non-ICARE farmers.

5.2. Frontline Demonstrations (FLDS)

(Investigators: C.S. Kar, S.K. Jha, S. Kumar, Shamna A. and M.L. Roy; Project code: NFSM (Commercial Crops) Jute & In-house sub-project-JEXA 4.7)

Frontline demonstrations on latest high yielding varieties and other improved production technologies of jute were conducted in various blocks of North 24 Parganas, Hooghly and Purba Bardhaman districts of West Bengal through the extension centres of the institute and Krishi Vigyan Kendra, Burdwan under National Food Security Mission (NFSM) for Commercial Crops (Jute) sponsored by Ministry of Agriculture and Farmers' Welfare, Govt. of India. Altogether, 177 demonstrations on improved production technologies of jute were conducted in 64.92 ha area covering three districts (Table 36).

Table 36. Area ('ha) under FLDs on improved production technologies of jute

District	Block/Village	No. of farmers	Varieties (ha)	Mechanical weed control (ha)	Line sowing with MRSD⁺ (ha)
North 24 Parganas	Habra-I/ Kumra	54	28.87	8.20	20.67
	Barrackpore-I/Belley Sankarpur	29	13.12	3.00	10.12
Hooghly	Singur/ Madhusudanpur	69	12.93	2.20	10.73
Purba Bardhaman	Ausgram II/Gopalpur Colony	25	10.00	-	-
Total		177	64.92	13.4	41.52

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

⁺Multi-row seed drill

Weed management through mechanical method : In order to reduce the cost of weeding and increase profitability of jute cultivation, the demonstrations on mechanical weeding by nail weeder (NW) or single wheel jute weeder (SWJW) were conducted in the farmer's field (13.40 ha) in two districts of West Bengal (Table 37). Demonstrations on mechanical weed management resulted in 3.01-4.73 q/ha fibre yield gain over farmers' practice (22.18-29.05 q/ha). Saving on cost of labour was ₹ 10,463 to 15,921/ha.

Table 37. Economics of jute cultivation through mechanical method of weeding

Locations / Particulars	IC (₹/ha)	LC (₹/ha)	CC (₹/ha)	Yield (q/ha)	GR (₹/ha)	NR (₹/ha)	B:C ratio
Belley Sankarpur							
NW/SWJW	8618	65214	73832	30.16	150800	76968	2.04
FP	11015	75677	86692	27.15	135750	49058	1.57
Kumra							
NW/SWJW	7986	60516	68502	33.78	168900	100398	2.47
FP	10108	74315	84423	29.05	145250	60827	1.72
Madhusudanpur							
NW/SWJW	7818	66978	74796	25.75	128750	53954	1.72
FP	11245	76835	88080	22.18	110900	22820	1.26

IC- Input Cost, LC- Labour Cost, CC- Cost of Cultivation, GR-Gross Return, NR-Net Return, B:C-Benefit Cost Ratio, FP-Farmers' Practice, NW- Nail Weeder, SWJW-Single Wheel Jute Weeder, Prices of jute fibre and jute stick were ₹ 5,000/q and ₹400/q, respectively.

Mechanical weed control in Kumra village

Line sown jute crop at Madhusudanpur

Line sowing: Demonstrations on manual 4 (four) row seed drill were conducted in 41.52 ha area in two districts of West Bengal (Table 38). It helped in increasing the fibre yield by 3.06-4.30 q/ha. It also saved the cost of human labour in jute cultivation by ₹ 8,226-13,284/ha over farmers' practice.

Table 38. Economics of jute cultivation under line sowing using multi-row seed drill

Location/ Particulars	IC (₹/ha)	LC (₹/ha)	CC (₹/ha)	Yield (q/ha)	GR (₹/ha)	NR (₹/ha)	B:C ratio
Kumra							
Multi-row seed drill	7418	63128	70546	32.11	160550	90004	2.28
FP	10108	74315	84423	29.05	145250	60827	1.72
Belley Sankarpur							
Multi-row seed drill	8152	70314	78466	31.45	157250	78784	2.00
FP	11015	75677	86692	27.15	135750	49058	1.57
Madhusudanpur							
Multi-row seed drill	7581	65817	73398	25.75	128750	55352	1.75
FP	11245	76835	88080	22.18	110900	22820	1.26

IC- Input Cost, LC- Labour Cost, CC- Cost of Cultivation, GR-Gross Return, NR-Net Return, B:C-Benefit Cost Ratio, FP-Farmers' Practice, NW- Nail Weeder, SWJW-Single Wheel Jute Weeder, Prices of jute fibre and jute stick were ₹ 5,000/q and ₹400/q, respectively.

***Improved retting through CRIJAF SONA*:** Improved retting demonstrations were also conducted. 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, growers could earn additional income of ₹ 300 - 450/q (Table 39). 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).

Improved retting of jute with CRIJAF Sona

Table 39. Qualitative evaluation of improved jute retting

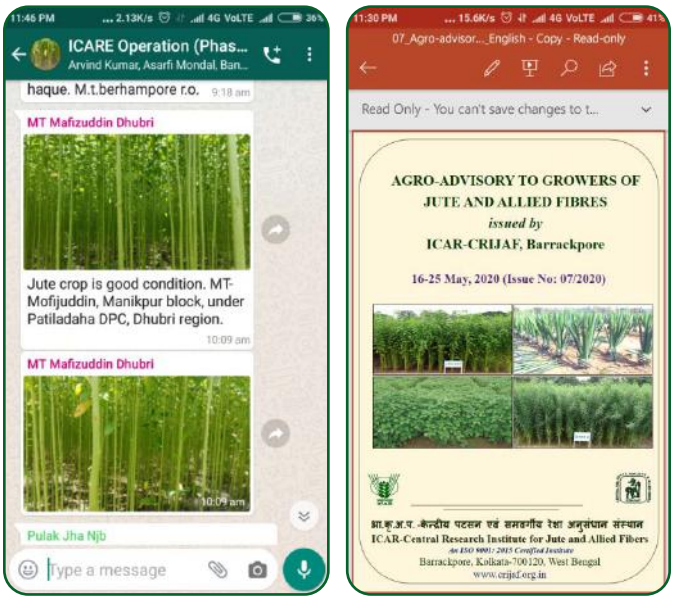
Extension Centre	Fibre Quality		Retting Duration(days)		Additional Income (₹/q)
	Improved	Conventional	Improved	Conventional	
Belley Sankarpur	TD 3- 4	TD 5 - 6	12 - 14	18 - 21	450
Kumra	TD 4- 5	TD 5 - 6	11 - 12	17 -20	500
Madhusudanpur	TD 4- 5	TD 5 - 6	13 -15	18 -20	350

Golden fibre produced out of CRIJAF Sona mediated retting

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

(Investigators: B. Majumdar, S. Sarkar, S. K. Jha, R. K. Naik, and S. Satpathy; Project code: JUTE-ICARE)

Amid COVID-19 pandemic, the Jute-ICARE project was carried out in 130 blocks under WB, Bihar, Assam, Odisha, Meghalaya and Andhra Pradesh covering 110893 ha area involving 258324 farmers during 2020-21. About 604 t of certified seed of cv. JRO 204 and JBO 2003H, 600 nos. of CRIJAF multi row seed drill and 900 nos. of single wheel jute weeder were distributed among the farming community. During retting season, 500 t of CRIJAF Sona were distributed among the farming communities for improved retting of jute and mesta. Altogether 300 demonstrations of sowing, weeding and improved retting were conducted by the master trainers and block supervisors across the country under the technical supervision of scientists of ICAR-CRIJAF. The regular agro-advisory issued by ICAR-CRIJAF were disseminated directly to the farming community under Jute-ICARE in different languages. The scientists of ICAR-CRIJAF along with Director, ICAR-CRIJAF attended several video conferences for benefit of farming community, to train the block supervisors & master trainers, scientists of ARS Amadalavalasa during sowing to retting organized by National Jute Board. Not only this,ICAR-CRIJAF provided guidance to the farmers through whatsapp messages as well as agro-advisory bulletins. The quality check of samples of CRIJAF SONA received from Bengal Biotech and Research, Panskura and Next to Nature, Guwahati were carried out at ICAR-CRIJAF on time maintaining COVID 19 protocol. The fibre yield of jute in Jute-ICARE area increased by more than 10% compared to non-Jute-ICARE area and fibre quality ranged between TDN2 and TDN3. On an average the farming community got higher market price for their quality jute fibre by ₹400 to 500 /q than the conventional retting.



Jute-ICARE farmers were guided through WhatsApp messages and agro-advisory of ICAR-CRIJAF

5.4. Other Extension Activities Organized

Table 40. Exposure visit, interface meeting, seed distribution and sensitization program

Particulars	Place	Date
Exposure visit of trainees at Mushroom Farm	Chandpara, Bongaon	18 January, 2020
Exposure visit of trainees at Fish Farm	Kamdenu, Kharibari	01 February, 2020
Exposure visit of trainees at SHG and Voluntary Organization	Atghara, Baduria	26 February, 2020
Research-Extension-Farmer interface meeting	Haripal, Hooghly	4 March, 2020
FET village seminar by the newly recruited ARS scientists	Mathurapur	11 March, 2020
Exposure visit of newly recruited ARS scientists to jute mill	Agarpara Jute Mill	12 March, 2020
Research-Extension-Farmer interface meeting	Beraberia, North 24 Parganas	19 March, 2020
Research-Extension-Farmer interface meeting	Madhusudanpur and Haripal, Hooghly	21 March, 2020
Jute seed distribution to farmers	Kumra, Beraberi, Belley Sankarpur (North 24 Parganas), Madhusudanpur (Hooghly)	April, 2020
Scientist-farmer interactions over mobile /whatsapp	Online	April-October, 2020
Research-Extension-Farmer interface meeting	Baduria FPO and SHG	15 December, 2020
Off-campus awareness / sensitization programmes and campaigns under Swachhta Pakhwada	Kharermath, Ariala, Dakshin Hansia, Sewli Telenipara villages of North 24 Parganas	18, 23, 24, 28 December, 2020

Exposure visit of farmers, farm women and rural youth at Mushroom Farm, Chandpara, Bongaon

Exposure visit of trainees at SHG and Voluntary Organization, Atghara, Baduria

Exposure visit of trainees at Fish Farm, Kharibari

6. AINP on Jute and Allied Fibres

In 2020, a total of 65 projects comprising of 252 trials were conducted on jute, mesta, sunnhemp, ramie, flax and sisal during 2019-20 under crop improvement, crop production and crop protection programme.

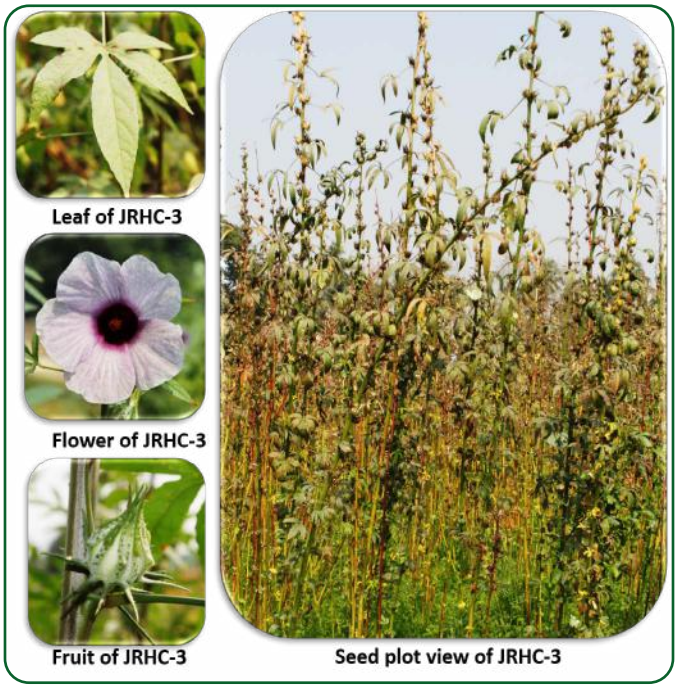
Under crop improvement programme, 34 projects comprising of 152 trials were conducted on jute and allied fibre crops in different centres. Similarly, under crop production programme, 23 projects comprising of 60 trials were conducted and under crop protection programme, 13 projects comprising of 41 trials were conducted in 2020 cropping season.

6.1. Release and Notification of JAF Varieties

One variety each of *tossa* jute i.e., JROMU 1 and kenaf i.e., JRHC 3 were recommended for release by the Central Sub-Committee on Crop Standard, Notification and Release of Varieties which has been notified vide Gazette notification no. S.O. 99(E) dated 6th January, 2020.

Field view of JROMU 1

JROMU 1: A high yielding *tossa* jute variety developed through Gamma ray mutation of popular variety JRO 204 with an average fibre yield of 32.89 q/ha. The potential yield of this variety is 35-40 q/ha. It is tolerant to stem rot disease and insect pests like semilooper and Bihar hairy caterpillar. The fibre quality is also comparable to that of JRO 204.



Field view of JRHC 3

JRHC 3: A high yielding kenaf variety with average fibre yield of 28.56 q/ha and adapted to rainfed mesta growing belt of India for mid-April to mid-May sowing. It has superior fibre quality in terms of fibre fineness (3.30 tex) and 7-11% less defects and root content. It is 25-30% more tolerant to foot and stem rot and yellow vein mosaic disease of mesta.

Besides, one more variety of tossa jute i.e. NJ-7005 (Rani) has also been recommended for release and notification by the Central Sub-Committee on Crop Standard, Notification and Release of Varieties vide its minutes of 84th meeting held on 29.07.2020.

6.2. Identification of JAF Varieties for Release

Three varieties of jute and allied fibre crops namely, JROB-2 of *tossa* jute, JRCJ-11 of white jute and AMV-10 of roselle were identified in 31st Annual Workshop of AINPJAF held at OUAT, Bhubaneshwar, Odisha during

14-15 February, 2020 had also been recommended for central release by the Central Sub-Committee on Crop Standard, Notification and Release of Varieties vide its minutes of 85th meeting held on 09th of November, 2020.

6.3 Jute (*Corchorus olitorius and C. capsularis*)

In tossa jute, F_7, F_6 , F_5 , F_4, F_3, and F_1 progenies of different cross combinations were evaluated at Kalyani, Kendrapara, Katihar, Coochbehar, Rahuri and Nagaon centre and promising line have been identified and selected for further evaluation.

Trial of National Hybridization Programme at BCKV, Kalyani

The targeted yield of jute under acid soil situation (4.0 t/ha) could not be achieved even by increasing the fertilizer dose from 100% to 150% NPK on ST-TY approach with or without application of FYM and lime but the targeted yield of rice (5.0 t/ha) was achieved.

Maximum plant height (371.6 cm), green biomass (513.37 q/ha) and fibre yield (31.04 q/ha) of *tossa* jute were recorded with two hand weeding / mechanical weeding (15-20 & 35-40 DAE) treatment closely followed quizalofop ethyl 5 EC 60 g + ethoxysulfuron @ 100 g/ha at 15 DAE treatment (30.23 q/ha) while maximum net return (Rs. 48976/ha) was recorded with nail weeder + quizalofop ethyl (5% EC @ 60 g/ha) treatment at Kalyani, West Bengal. At Coochbehar, West Bengal, maximum fibre yield of jute (26.85 q/ha), minimum weed dry matter, maximum net return (Rs. 59174/ha) and B:C ratio (2.47) was recorded with quizalofop ethyl 5 % EC 60 g + ethoxysulfuron @50 g/ha at 15 DAE + one hand weeding (HW) at 30 DAE treatment. At Nagaon, Assam, maximum fibre yield (23.86 q/ha) was recorded with

In white jute, F_5, F_4 and F_1 progenies of different cross combinations were evaluated at Kalyani, Coochbehar, Katihar, Nagaon and Kendrapara. Promising cross combinations at different centres have been identified for further evaluation.

A total of 6 F_1 hybrids of roselle were evaluated at Amadalavalasa centres. New crossing in roselle has also been attempted at Amadalavalasa and Barrackpore centres using performing roselle germplasm. In kenaf, a total 38 F_4 progenies were evaluated with 2 check varieties at Barrackpore and Aduthurai centres.

Yield evaluation trial of jute at MPKV, Rahuri

quizalofop ethyl 5% EC @ 60 g/ha + ethoxysulfuron @ 100 g/ha at 15 DAE treatment which was statistically at par with fibre yield recorded with pretilachlor 50% EC @ 900 g/ha + one HW at 15 DAE (22.44 q/ha) and quizalofop ethyl 10% EC @ 38 g/ha + one HW at 15 DAE (22.81 q/ha) treatments.

Weed management trial of jute at Coochbehar

Maximum fibre yield (29.72 q/ha) and weed control efficiency (WCE) (78.3%) were recorded with pretilachlor 50% EC @ 900 ml/ + one HW at 15 DAE treatment at Kendrapara, Odisha. The treatment also recorded higher net return. At Rahuri, Maharashtra, maximum seed yield (16.70 q/ha) of tossa jute was recorded with application of quizalofop ethyl 5 EC 60 g + ethoxysulfuron @ 50 g/ha at 15 DAE + one HW at 30 DAE treatment which was at par with quizalofop ethyl 5 EC 60 g + ethoxysulfuron @ 100g/ha at 15 DAE (16.22 q/ha) and propaquizafop 10 EC @ 90 g/ha at 15 DAE + one HW at 30 DAE (15.16 q/ha) treatments, respectively. Maximum gross return (Rs. 100191/ha) and net return (Rs. 56821/ha) was also recorded with application of quizalofop ethyl 5 EC 60 g + ethoxysulfuron @ 50 g/ha at 15 DAE + one HW treatment.

Intercropping of brinjal on soil columns within jute gunny bags in the transplanted paddy field in 4:1 and 8:1 row ratio recorded higher rice equivalent yield (131.91 & 134.43 q/ha), gross return (Rs. 145105 & 147870/ha), net return (Rs. 87955 & 91920/ha) and B:C ratio (2.54 & 2.64) at Cooch Behar, West Bengal.

Integrated nutrient management (75% RDN + 25% N through FYM + 5 kg $MgSO_4$) in seed crop of *tossa* jute recorded maximum seed yield (17.09 q/ha) of the crop along with maximum gross return (Rs. 102580/ha) and net return (Rs. 57270/ha) at Rahuri, Maharashtra.

Survey and surveillance of insect pests and diseases of jute were conducted at different AINP centers. The yellow mite infestation was maximum during last week of May to end-June at Nagaon, Kendrapara, and Coochbehar. Maximum infestation of Bihar hairy caterpillar was noticed at Nagaon, Coochbehar and Kendrapara at 65-85 DAS during June-August. Infestation of mealy bug was specific to Nagaon. Stem rot, root rot, anthracnose and mosaic diseases were common in jute. The infestation of leaf mosaic of white jute was very specific to Kendrapara centre. The maximum incidence of stem rot was observed from mid-June to September at Nagaon, Coochbehar and Kendrapara respectively during 85 to 120 DAS. The incidence of root rot disease was maximum at Nagaon, Coochbehar and Kendrapara. At Nagaon, 4 entries showed lower plant damage by Bihar hairy caterpillar; 5 entries showed lower infestation by semilooper and 6 entries showed lower infestation by mite. At Coochbehar, 2 germplasm (OIN-149 and OIN-181) were found to be completely immune against yellow mite infestation while among the *capsularis* accessions, significantly lower mite population was noticed in CIN-149, CIN-167 & CIN-148. At Kendrapara, minimum infestation of mite was found in OIN-138. At Katihar, lowest infestation of yellow mite was observed in 04 entries (OIN-152, OIN-162, OIN-159, OIN-143).

In Nagaon, entry OIN-141 was free from root rot infestation while 7 *olitorius* entries showed lower root rot infestation and 6 *olitorius* entries showed lower stem rot infestation. At Coochbehar, 08 *olitorius* entries showed lower root rot infestation; 6 *olitorius* entries showed lower stem rot infestation; 7 *capsularis* entries showed lower root rot infestation. In Katihar, 38 olitorius lines showed immune reaction to stem rot and 41 lines to stem rot disease incidence under field condition. In Kendrapara, the germplasm free from stem rot disease are OIN-158, OIN-160 and OIN-168.

At Barrackpore, at 30 DAS and 50 DAS line sowing recorded less mite population (14.41 mites/cm^2 and 13.08 mites/cm^2). Line sowing (5-6 lakhs/ha) + seed treatment with Carbendazim 50 WP @ 4g/kg seed + spraying of Spiromesifen 240 SC @ 0.7 ml/lit at 35 DAS + spraying of Tebucanazole @ 0.15% at 45 DAS + spraying of λ-cyhalothrin 5 EC @ 0.6 ml/L at 55 DAS recorded maximum yield (28.17 q/ha) of jute.

Seed treatment with Carbendazim 50WP @ 4g/kg seed + spraying of Spiromesifen 240 SC @ 0.7 ml/lit at 35 DAS + spraying of Tebucanazole @ 0.15% at 45 DAS + spraying of λ-cyhalothrin 5 EC @ 0.6 ml/L at 55 DAS or seed treatment with *Trichoderma* @ 10 g/kg seed + soil drenching of *Pseudomonas fluorescence* @ 100 g/l at 15 DAS + spraying of Azadirachtin (10000 ppm) @ 3 ml/l at 35 and 55 DAS (PDI 3.27) showed significantly lower stem rot incidence in jute at Barrackpore, West Bengal.

At Coochbehar, out of 16 genotypes of jute screened none were found immune or resistant against M. incognita (Pundibari isolate race-5). Five genotypes (OIN-05, OIN-13, OIN-154 & OIN-853) were found as moderately resistant with few galls and eggs in the root system. Five entries (JRC-321, OIN-651 & OIN-125) were highly susceptible and six were susceptible in reaction.

6.4 Roselle (*Hibiscus sabdariffa*)

Targeted yield of mesta (roselle) (3.2 t/ha) could be achieved (-) 5.8% yield deviation at Aduthurai, Tamil Nadu only when FYM was incorporated @ 5 t/ha along with fertilizer application on the basis of soil test and target yield (100% NPK on ST-TY) and this INM treatment also recorded significantly higher uptake of nitrogen (61.67 kg/ha), phosphorus (36.62 kg/ha) and potassium (56.97 kg/ha) by the crop.

Yield evaluation trial of roselle at Rahuri

Yield evaluation trial of kenaf at Rahuri

At Amadalavalasa, Andhra Pradesh, the yield target of mesta (kenaf) (2.8 t/ha) could be achieved through application of fertilizer on soil test and targeted yield basis (100% NPK on ST-TY) in combination with either organic manure or lime. Maximum plant height (350 cm), plant population (3.01 lakh/ha), green weight (697.51 q/ha) and dry fibre yield (41.86 q/ha) of kenaf were recorded with 100% NPK on ST-TY + lime @ 25% LR + FYM @ 5 t/ha treatment at Amadalavalasa, Andhra Pradesh.

At Amadalavalasa, Andhra Pradesh, application of quizalofopethyl 5EC 60g + ethoxysulfuron @ 50g/ha at 15 DAE + one HW at 30 DAE recorded highest fibre yield (13.83 q/ha) of mesta along with lower weed dry biomass and higher weed control efficiency (74.7%). At Aduthurai, Tamil Nadu, application of pretilachlor @ 900 g/ha at 45-48 hrs of sowing with irrigation + one HW at 15 DAE recorded highest fibre yield (27.32 q/ha), minimum weed dry matter (0.28 - 0.76 q/ha), maximum weed control efficiency (50.09 – 76.34%) along with highest gross return (Rs. 109280/ha), net return (Rs. 77830/ha) and B:C ratio (3.47) in mesta.

At Amadalavalasa, Andhra Pradesh, highest mesta equivalent yield (48.34 q/ha) was recorded with sole maize closely followed by mesta + maize (2:1) intercropping system (47.36 q/ha) and mesta + sunnhemp (3:4) (32.82 q/ha). Among the intercropping systems tested, maximum gross return (Rs. 132740/ha) and net return (Rs. 80624/ha) was recorded with mesta + maize (2:1) intercropping followed by mesta + sunnhemp (3:4) (Rs. 91976/ha & Rs. 70310/ha) at Amadalavalasa. At Aduthurai, Tamil Nadu, highest mesta equivalent yield (45.96 q/ha), gross return (Rs. 128412/ha) and net return (Rs. 98212/ha) was recorded with mesta + rice (3:4) intercropping system followed by mesta + groundnut (3:4) intercropping system (41.02 q/ha, Rs. 105511/ha & Rs. 77711/ha).

At Amadalavalasa, the infestation of semilooper and mealybug in mesta was 51.33 % and 77.00% at 45 DAS and 77 at 55 DAS, respectively. At Katihar, Bihar, the number of leafhopper/plant observed at different growth stage ranged from 1.32 to 4.68 at 45 DAS, 2.49 – 7.58 at 52 DAS and 3.25 – 8.12 at 59 DAS while in case of white flies, the population ranged from 0.46 to 4.86, 1.34 to 8.34 and 2.85 to 9.16 at 45 DAS, 52 DAS and 59 DAS, respectively. In Amadalavalasa, the aphid incidence was low in all the *Hibiscus sabdariffa* (roselle) germplasm entries, ranging from 0.00 to 10.56 aphids per plant with highest incidence being recorded in RIN-64. Incidence of whitefly was completely absent in RIN-66 and RIN-100. Leafhopper population was completely absent in RIN-71 entry as against higher population leafhoppers in RIN-

96 entry. At Katihar, the incidence of foot and stem rot was very low and varied from nil to 4.62%. The highest percentage of diseases was recorded in germplasm line KIN-185 followed by KIN-208. Total 26 lines were not infected with foot and stem rot.

In Katihar, application of NSKE 5% at 35 DAS + Azadirachtin (1500 ppm) @ 5ml/L at 50 DAS + *Verticillium lecani* @ 6g/L at 65 DAS was found superior followed by application of Profenophos @ 2 ml/L at 35, 50 and 65 DAS in managing the sucking pests of mesta.

6.5. Sunnhemp (*Crotalaria juncea*)

Yield evaluation trial of sunnhemp at Rahuri

At Rahuri, Maharashtra, sowing of seed crop of sunnhemp at 15th June recorded maximum seed yield (16.32 q/ha) of the crop along with highest gross (Rs. 81622/ha) and net return (Rs. 49212/ha)The new sunnhemp variety JRJ 610 also recorded higher seed yield (13.95 q/ha) at Rahuri.

6.6. Ramie (*Boehmeria nivea*)

At Barrackpore, West Bengal, ridge and furrow method of planting recorded significantly higher fibre yield of ramie (13.95 q/ha) of the crop over other planting methods. The total fibre yield of ramie recorded with the INM treatments, i.e., application of 125% N from RDF (inorganic) + 25% N from FYM (14.34 q/ha) and / or application of 125% N from RDF (inorganic) + 25% N from ramie compost (14.58 q/ha) were statistically at par and were significantly higher than fibre yield obtained with 150% recommended dose of nitrogen (RDN) (13.84 q/ha) at Barrackpore, West Bengal. At Coochbehar, West Bengal, total fibre yield of ramie recorded with ridge and furrow sowing (6.42 q/ha) and raised bed systems (6.11 q/ha) were statistically at par and both the planting methods recorded significantly higher fibre yield of the crop over flatbed planting method. The total fibre yield (total of 3 cuttings) of ramie recorded with 150% recommended dose of N (RDN) (6.50 q/ha) was statistically at par with the yield recorded with INM treatments comprising of 25% of the N from FYM / ramie compost (6.88 & 7.12 q/ha) at Coochbehar, West Bengal. At Sorbhog, Assam, maximum value of total fibre yield (16.14 q/ha) of ramie was recorded with 100% RDN. The interaction effect of nitrogen and potassium on fibre yield of ramie at Barrackpore, West Bengal revealed that combination of N @ 75 kg/ha/cut and K @ 50 kg/ha/cut recorded significantly higher fibre yield of ramie (16.40 q/ha) at Barrackpore.

6.7. Flax (*Linum usitatissimum*)

Maximum plant height (105.8 cm), basal diameter (0.41 cm), green weight (192.01 q/ha), dry weight (54.43 q/ha) and fibre yield (18.05 q/ha) of flax was recorded with sowing on 1st week of November and it decreased progressively with delay in the sowing time at Coochbehar, West Bengal.

Flax intercropping trial at ICAR-CRIJAF, Barrackpore

At Barrackpore, West Bengal, intercropping of flax + spinach (2:1) recorded highest system flax fibre equivalent yield (25.31 q/ha) followed by sole flax crop (19.70 q/ha) while at Coochbehar, West Bengal, maximum fibre equivalent yield of flax was recorded with flax + garden pea (2:1) (16.45 q/ha) followed by flax + grass pea (2:1) (15.90 q/ha) and flax + lentil (2:1) (15.23 q/ha). At Nagaon, Assam, seed yield of flax was maximum with sole flax crop (12.91 q/ha) which was statistically at par with flax + lentil (12.20 q/ha).

In Nagaon, the seed treatment with carbendazim 50 WP and azoxystrobin 25% SC recorded lower wilt incidence. Plant height and green weight for the two treatments

were significantly higher than the control treatment. In Pratapgarh, the seed treatment with thiram 80 WP @ and carbendazim 50 WP @ 2 g/ kg seed recorded highest fibre yield (11.55 q/ha) and lowest wilt incidence (5.33 %) over control (10.28 q/ha).

6.8. Sisal (*Agave sisalana*)

Application of fertilizer NPK @ 60:13:50 kg/ha or NPK @ 90:13:50 kg/ha along with vermi-compost @ 2.5 t/ha recorded higher value of leaves/plant (37.6 - 38.0), green leaf biomass (590.16 - 597.16 q/ha) and fibre yield of sisal (19.58 - 19.81 q/ha) over application of inorganic NPK @ 120:13:50 kg/ha at Amadalavalasa, Andhra Pradesh.

6.9. Tribal Sub Plan

The Tribal Sub Plan programme during 2020 crop season had been taken up by AINPJAF units of BCKV, Kalyani; UBKV, Coochbehar and RARS, Nagaon. The TSP programme had been conducted in six (06) villages belonging to three (03) districts (24 Paraganas North and Coochbehar districts of West Bengal and Nagaon district of Assam) covering 19.12 ha area and involving 89 tribal farmers. Under this programme filed demonstrations were conducted on farmers' participatory mode on new varieties of jute (JRO 204 & JBO-2003-H), line sowing using CRIJAF Multi Row Seed Drill, integrated weed management using CRIJAF Nail Weeder, IPM and improved retting using CRIJAF SONA in farmers' fields.

6.10. 31st Annual Workshop of AINPJAF

The 31st Annual Workshop of AINPJAF was conducted at OUAT, Bhubaneswar during 14-15 February, 2020. About 70 scientists participated in the Workshop. During the two days, the achievements of the AINPJAF centres during 2019-20 crop season was presented, discussed in three concurrent sessions on Crop Improvement & Fibre Quality, Crop Production and Crop Protection and the Technical Programme of Work for 2020-21 was finalized. In the Variety Identification Committee (VIC) meeting chaired by Dr. R. K. Singh, ADG (CC), ICAR three varieties – JROB 2 and JRCJ 11 of tossa and white jute and AMV 10 of roselle were identified.

Dignitaries during the inaugural session of 31st Annual Workshop of AINPJAF held at OUAT, Bhubaneshwar

Dr. R.K. Singh ADG (CC), ICAR lightening the lamp

Scientists and participants of 31st Annual Workshop

Dr. R.K. Singh ADG (CC), ICAR addressing the scientists in 31st Annual Workshop

7. On Farm Trials (OFTs), Frontline 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.

7.1. KVK, Burdwan

7.1.1. On Farm Trials (OFTs)

Five OFTs were conducted by the KVK, Burdwan for evaluation of different recommended technologies like management of late blight of potato, nutrient management of marigold, assessment of different techniques for transplanting of vegetable seedling, seedling mortality and economy, and assessment of different herbicides on weed control of transplanted rice. In marigold, application of chelated zinc was found effective for improvement of quality of flowers as well as yield. In potato, foliar application of new generation fungicides like Mancozeb 60%+Cymoxanil 80%WP, Mancozeb 60% + Dimethomorph 9% WP and Famoxadone 16.6% + Cymoxanil 22.1% SC was found most efficient method of controlling late blight disease.

7.1.2. Frontline Demonstrations (FLDs)

A total of 211 FLDs were conducted during the year 2020 on jute, paddy, lentil, chickpea, onion, brinjal and banana. The salient findings of the FLDs are given in Table 41. With improved production technology of jute there was 9.75% increase in fibre productivity. Adoption of Integrated Pest Management in brinjal can increase the yield by 19%. In case of onion, Agrifound Dark Red variety increased the benefit-cost ratio to 2.55%. Besides, the local variety of brinjal showed about 15.5% improvement in yield (254q/ha) than the existing open pollinated varieties (220 q/ha). There was 14.82% increase in yield of paddy in improved practice (60.67 q/ha) over local check (52.84 q/ha). Cost-benefit ratio in improved practice was 1.78 as against local check of 1.58.

Table 41. Details of FLDs conducted by KVK, Burdwan during the year 2020

Crop/ No. of FLDs	Technology demonstrated	Results
Jute (25)	Improved production technology with JRO 204	There was 9.75% increase in yield of jute in improved practices (33.11 q/ha) over local check (30.17 q/ha; JRO 524). Cost-benefit ratio in improved practice was 1.52 as against local check of 1.30
Paddy (25)	Seed production with SRI principles	There was 14.82% increase in yield of paddy in improved practice (60.67 q/ha) over local check (52.84 q/ha). Cost-benefit ratio in improved practice was 1.78 as against local check of 1.58
Brinjal (25)	Improved variety (Bhangar Selection)	New variety of brinjal showed about 15.5% improvement in yield (254q/ha) than the existing open pollinated varieties (220 q/ha).
Brinjal (20)	IPM for brinjal shoot & fruit borer	About 19% improvement in yield was observed.
kharif Onion (20)	Agrifound Dark Red	Introduction of new onion variety in kharif season increased the benefit-cost ratio to 2.65.
Banana (17)	Grand Naine (TC)	Introduction of Grand Naine (TC) cultivar yielded 25% more fruits over local check.
Fruit ripening (6)	ICAR-IIHR-Ripening Chamber	ICAR-IIHR-Ripening Chamber (an airtight plastic chamber) successfully demonstrated for ripening of banana, mango using ethylene gas by replacing poisonous calcium carbide.

7.1.3. Demonstration units

To disseminate the integrated farming system (IFS) technology, KVK-Burdwan has developed new demonstration units of vermicomposting, azolla farming, mushroom farming, poultry and duckery rearing, goatary, apiary, etc. during 2020 as given below:

Table 42. Details of demonstration unit at KVK, Burdwan

Name of demonstration unit	Variety	Quantity available
Vermicompost	*Eisenia fetida*	10,000 worms, 10 q vermicompost
Mushroom	Oyster	40 mushroom beds
Poultry	RIR	37 nos.
Poultry	Kadaknath	49 nos.
Duckery	Khaki Campbell	86 nos.
Goatary	Black Bengal	04 nos.
Apiary	*Apis mellifera*	02 bee hives
Azolla	-	5 Kgs

Demonstration unit on Azolla, at KVK, Burdwan

Field day on Improved Technology of jute at Gopalpur

Field day on SRI of paddy at Kasba, Burdwan

7.2. KVK, North 24 Parganas

7.2.1. Frontline Demonstrations (FLDs)

Altogether 68 FLDs on improved production technology of jute, rice and blackgram were conducted by the KVK, North 24 Parganas during the year 2020.

Table 43. Details of FLDs conducted by KVK, North 24 Parganas during the year 2020

Crop	Technology	Results
Jute (10)	Improved retting of jute by 'CRIJAF Sona'	Yield (q/ha) = 24.82, Quality (TD) = 3, Retting Time (Days) = 17.5 and Fibre strength (g/tex)= 25.15
Rice (36)	Variety: Shatabdi	No of panicle per sq. mt. = 265.13, Panicle length (cm) = 22.57, Filled grain per panicle = 140.18, 1000 grains weight (g) = 22.1 and Yield (q/ha) = 41.08
Blackgram (22)	Variety: IPU 2-43)	No of branches per plant = 4.86, No of pod per plant = 23.40, No of seeds per pod = 8.1, 1000 seed weight (g) = 38.65 and Yield (q/ha) = 10.38

Demonstration on CRIJAF Sona for retting by KVK, North 24 Parganas

8. Major Weather Parameters of ICAR-CRIJAF Research Farms

ICAR-CRIJAF, Barrackpore and all its regional stations have meteorological observatory in the respective research farms. Vital meteorological parameters are recorded regularly and shared with the scientists and IMD for the benefit of farmers and other stakeholders.

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

At ICAR-CRIJAF, Barrackpore, in the year 2020, the annual mean maximum and minimum air temperatures were 31.0°C and 21.5°C, respectively. The lowest mean minimum air temperature was observed in the month of January (12.3°C), and the highest maximum air temperature was observed in April (34.6°C). Annual total rainfall of 2051.8 mm was recorded with highest in the month of August (440.7 mm) and lowest in February (3.3 mm). There was no rainfall only in the month of December.

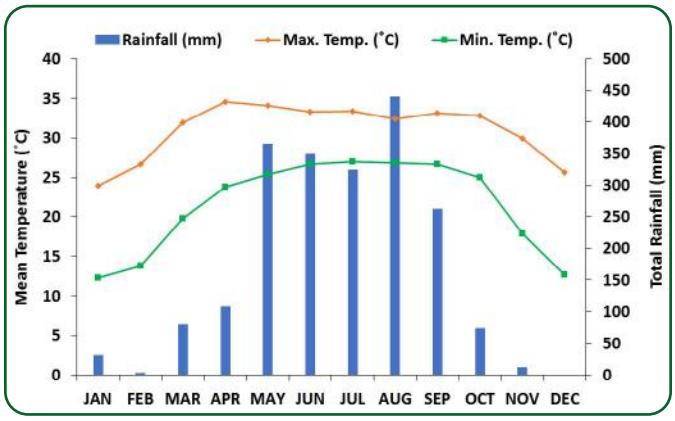


Fig. 45: Rainfall and temperature at CRIJAF, Barrackpore

8.2. Central Seed Research Station for Jute and Allied Fibres (CSRSJAF), Budubud, West Bengal

At CSRSJAF, Budbud, in the year 2020, the annual mean maximum and minimum air temperatures were 30.9°C and 19.6°C, respectively. The lowest mean minimum air temperature was observed in the month of December (9.8°C), and the highest maximum air temperature was observed in April (34.7°C). Annual total rainfall of 1357.5 mm was recorded with highest in the month of August (343.3 mm) and lowest in November (3.8 mm). There was no rainfall only in the month of December.

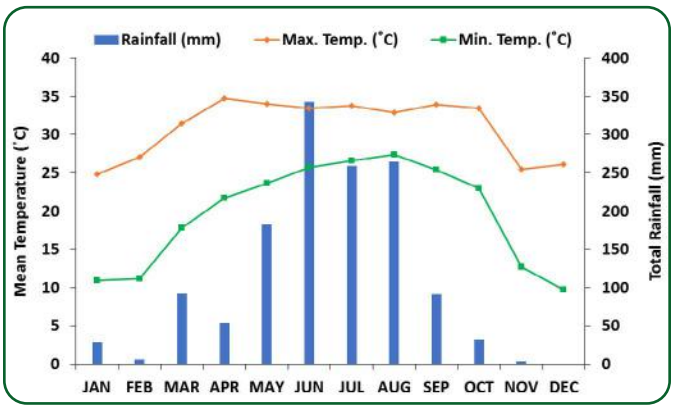


Fig. 46: Rainfall and temperature at CSRSJAF, Budbud

8.3. Ramie Research Station (RRS), Sorbhog, Assam

At RRS, Sorbhog, in the year 2020, the annual mean maximum and minimum air temperatures were 32.2°C and 17.7°C, respectively. The lowest mean minimum air temperature was observed in the month of January (11.1°C), and the highest mean maximum air temperature was observed in June (36.4°C). Annual total rainfall of 4764.0 mm was recorded with highest in the month of June (1218.9 mm) and lowest in December (2.0).

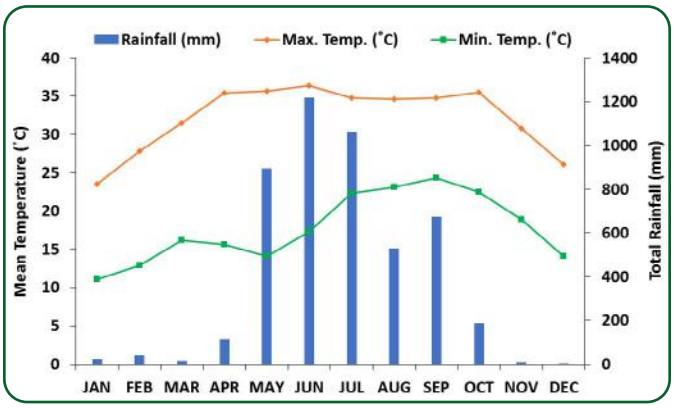


Fig. 47: Rainfall and temperature at RRS, Sorbhog

8.4. Sisal Research Station (SRS), Bamra, Odisha

At SRS, Bamra, in the year 2020, the annual mean maximum and minimum air temperatures were 32.4°C and 20.1°C, respectively. The lowest mean minimum air temperature was observed in the month of January (9.5°C), and the highest mean maximum air temperature

was observed in May (40.8°C). Annual total rainfall of 1344.2 mm was recorded with highest in the month of June (413.3 mm). There was no rainfall in the months of February and December.

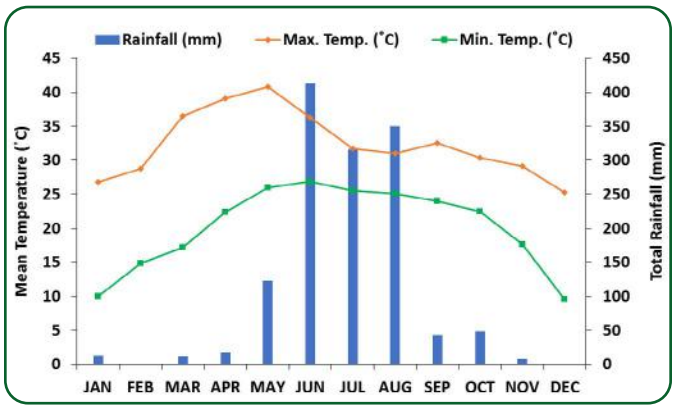


Fig. 48: Rainfall and temperature at SRS, Bamra

8.5. Sunnhemp Research Station (ShRS), Pratapgarh, Uttar Pradesh

At ShRS, Pratapgarh, in the year 2020, the annual mean maximum and minimum air temperature were 31.2°C and 19.5°C respectively. The lowest mean minimum air temperature was observed in the month of January (8.4^0c), and the highest maximum air temperature recorded in May (40.0°C). Annual total rainfall of 1048.8 mm was recorded with highest in the month of August (337.2 mm) and lowest in February (2.4 mm). There was no rainfall in three consecutive months of October, November, and December.

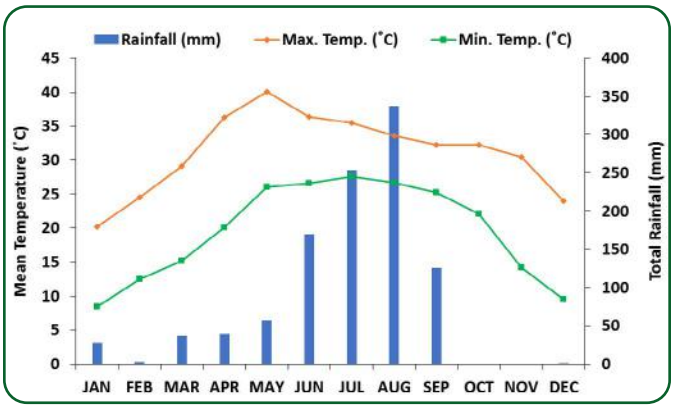


Fig. 49: Rainfall and temperature at ShRS, Pratapgarh

9. Human Resource Development

9.1. Annual Training Plan

The HRD Nodal officer of ICAR-CRIJAF attended a training on 'Training management information system (TMIS) for HRD Nodal Officers of ICAR' and developed the annual training plan (ATP) using the TMIS software. The ATP (2020-21) contains plan for training of 25 employees. Care was taken to give priority to the manpower who did not receive any training during 2014-19. The training plan included training proposals for scientific (5), technical (5), administrative (6) and skilled supporting (9) staff. Due to pandemic situation, most of the trainees attended training online. Till December, 2020, a total of ten scientific staffs have received training on different aspects including 'IP Valuation and Technology Management', 'Geo-spatial analysis using QGIS and R', 'Sustainable Management of Small Scale Seed Enterprises', 'Good Governance for Effective Implementation of Development Programmes', 'Genome Editing in Agriculture - Innovations for Sustainable Production and Food Systems', 'Cyber Security for Central Government Ministries', 'Access Benefit and Sharing in Agriculture' and 'Stress Management'. Administrative and technical staff received training on 'Noting and Drafting' and 'Capacity Building for CJSC members'.

9.2. Training Imparted

Dr. Sougata Bhattacharjee, ARS scientist, ICAR-VPKAS, Almora attended his professional attachment training (PAT) during 15.06.2020 to 14.09.2020 on 'Molecular Breeding of Crops' at ICAR-CRIJAF. He was trained on various techniques including DNA and RNA isolation from target species, DNA marker systems (SSR, ISSR, SCoT), molecular breeding, direct PCR, cross-species transferability of markers and bioinformatics software for analysis of marker data.

9.3. Training Feedback

A feedback on training implemented during 2018-19 of 10 scientific, 15 technical, 14 administrative and five skilled supporting staff was prepared and submitted to ICAR-HRM unit. The average rating of impact was 3.93 (self-assessment) and 3.88 (reporting officer's assessment) on a scale of 1 (least extent) to 5 (greatest extent). The trainees expressed that after receiving the training, improvement has been observed in job efficiency, knowledge development, confidence development and attitude. The reporting officers certified the progress and suggested measures for better application of training knowledge and skill.

Annual Training Plan of ICAR-CRIJAF prepared in TMIS

9.4. Trainings, Seminars, Conferences, Workshops, Webinars Attended by CRIJAF Staff other than ATP

Apart from Annual Training Plan (ATP), staff members of ICAR-CRIJAF including scientists, participated in various training programmes mostly in online mode due to COVID-19 restrictions (Table 44 & 45).

Table 44. Training undergone by scientific/ technical staff members

Name of the Participant	Organized by/ Date	Name of the programme/training
Scientists		
Dr. Anil Kumar	ICAR-CPRI, Shimla 10-19 February, 2020.	Training on 'Flow cytogenetics and molecular techniques for improvement of horticulture crops'
Dr. H. R. Bhandari Dr. Maruthi R.T. Dr. Laxmi Sharma	ICAR-CRIJAF, Barrackpore 25 February-05 March, 2020.	Training on 'Advances in molecular breeding of industrial crops'
Mr. Kajal Das	ICAR-CIFE, Mumbai 26 May-08 June, 2020	Online Training on 'Science communication for smart scholars'
Dr. Ritesh Saha	ICAR-NAARM, Hyderabad 07-10 July, 2020	Online Training Programme on 'Management development program (MDP) on orientation-cum- awareness and implementation of ABS guidelines'
Mr. Kajal Das	V.V. Giri National Labour Institute, Noida 24-28 August, 2020	Online Training on 'Good governance for effective implementation of development programmes'
Dr. H. R. Bhandari	V.V. Giri National Labour Research Institute, Noida 26-28 August, 2020	Online Training on 'Good governance for effective implementation of development programmes'
Dr. C. S. Kar Dr. Ritesh Saha	ICAR-NAARM, Hyderabad 01-05 September, 2020	Online Training Programme on 'IP valuation and technology management'
Dr. Sitangshu Sarkar	FOSSAg Forum, Bengaluru 11 September, 2020	Online Short Training on 'Artificial intelligence for agriculture'
Dr. D. Barman	ICAR-IISS, Bhopal and World Agroforestry (ICRAF), Kenya 10 October, 2020	International Webinar on 'Soil spectroscopy: An emerging technique for rapid soil health Assessment'
Dr. D. Barman	School of Agriculture & Allied Science, The Neotia University (TNU), Kolkata and ICAR-CSSRI, Karnal, Haryana 15 October, 2020	National Webinar on 'Advanced strategies for the management of coastal agriculture'
Dr. A.K. Singh	ICAR-DKMA, New Delhi 08 November, 2020	J-Gate@CeRA Online National Ambassador and users orientation programme
Dr. H. R. Bhandari	NAARM, Hyderabad 05-09 October, 2020	Online Training on 'Sustainable management of small scale seed enterprises'
Dr. S. Mitra	NAARM, Hyderabad 07-10 July, 2020	Online Training on 'Stress management'
Technical Personnel		
Mr. Ankan Singha Roy Mr. Sudip Nandy Mr. Kallol Sarkar	ICAR-CRIJAF, Barrackpore 12-14 March, 2020	Training on 'Improved production technology of jute & allied fibres'

Table 45. Seminar/ Symposium/ Conference/ Meeting/Workshop/ Webinar attended by the Scientists

Name of the Participant	Organized by/ Date	Programme
Dr. R.K. Naik	Hyatt Regency, Pune 07-09 January, 2020	International symposium on "Artificial Intelligence based future technologies in agriculture".
Dr. S. K. Jha	ICAR-CCARI, Old Goa 05-07 February, 2020	Biennial Conference on "Weed Management for Enhancing Farmers Income and Food Security"
Dr. P. Satya	HRD Cell, ICAR, New Delhi 08 May, 2020	Online Workshop on "Training management information System (TMIS) for HRD nodal officers of ICAR"
Dr. A.K. Singh	NRM Division, ICAR, New Delhi 21 May, 2020	Video Conference on 'Review of NICRA project by Deputy Director General (NRM)'
Dr. S. K. Jha	Asian Productivity Organisation, Tokyo, 27 May, 2020	Managing food logistics in a pandemic – Actions taken in face of COVID-19
Dr. S. K. Jha	BRDPG College, Deoria 10-11 July, 2020	Online International Conference on 'Challenges and Innovative Solutions in Development Management During and Post Covid-19'
Dr. D. Barman	IASWC & ICAR-IISWC, Dehradun 22-24 July, 2020	International Webinar on 'Land degradation neutrality'
Dr. A.K. Singh Dr. D. Barman	ICAR-NIASM, Baramati and SARAS, Pune 10 August, 2020	Webinar on 'Under-utilized crops for augmenting farmers' income in abiotic stress regions'
Dr. A.K. Singh	BCKV, Kalyani 29 August, 2020	Webinar on 'Agro-chemicals for up keeping environment'
Dr. S. Satpathy Dr. S. Mitra Dr. S. K. Jha Dr. Ritesh Saha Dr. D. Barman Dr. B.S Gotyal Dr. Anil Kumar Dr. Maruthi R.T.	IARI, New Delhi, 09 September, 2020	Webinar on 'Drone remote sensing in agriculture'
Dr. Ritesh Saha	NAHEP and IP&TM Unit, New Delhi 12-28 September, 2020	Webinar Series on 'Intellectual property rights in agriculture research and education in India'
Dr. Subhojit Datta	CGIAR Global Webinar Series 22 September-20 October, 2020	Webinar on 'Genome editing in agriculture - innovations for sustainable production and food systems'
Dr. Sonali Paul Mazumdar Mr. Kajal Das	Dr. RPCAU, Samastipur 24-26 September, 2020	International Webinar on 'Impact of water stress on crop productivity: its mitigation and adaptation strategies'
Dr. Sitangshu Sarkar	IDUAI Online by UNESCO, 30 September, 2020	Webinar on 'Open science for building resilience in the face of COVID-19'
Dr. Sonali Paul Mazumdar Dr. D. Barman	ICAR-IISS, Bhopal 01 October, 2020	International Webinar on 'Soil Spectroscopy'
Dr. Laxmi Sharma	ICAR-NIASM, Baramati 09 October, 2020	Webinar on 'Translating physiology into techniques for abiotic stress tolerance'
Dr. Anil Kumar	NIT, Rourkela 16-18 November, 2020	Webinar on 'Omics of plant pathogen interaction with their implication'
Dr. S. K. Jha	MANAGE, Hyderabad 18 – 20 November, 2020	MANAGE Dialogue 2020 – Future of Agricultural Extension and Advisory Services
Dr. Sitangshu Sarkar Dr. R.K. Naik	TINFS, Kolkata 27-28 November, 2020	Webinar on 'Role of natural fibres for Atma Nirvar Bharat'
Dr. Shamna, A.	Kazi Nazrul University, Kolkata, 12-13 December, 2020	1st Global Conference on 'Emerging agricultural research to endure the predicament of COVID-19 pandemic (GCEAREPCP-2020)'
Dr. Sonali Paul Mazumdar	20 December, 2020 EWASH, Kolkata	International Conference on 'Environment, water, agriculture, sustainability and health (EWASH – 2020): Expanding our vision post COVID-19'
Dr. Shamna, A.	BHU, Varanasi 27-30 December, 2020	International Extension Education Conference on 'Role of NGOs in extension services: opportunities & challenges'

Name of the Participant	Organized by/ Date	Programme
Dr. R.K. Naik	The Institution of Engineers, Kolkata 18-20 December, 2020	35th Indian Engineering Congress 'Engineering for self-reliance and sustainable goals'
KVK Personnel		
Dr. Sk. Md. Azizur Rahman	Deen Dayal Research Institute, Delhi 05 March, 2020	Webinar on 'Strategies for FPO Formation and Migrant Labour Policies'
Dr. S. Sarkar	SAMETI, Narendrapur 18 May, 2020	Online workshop on 'DAESI course'
Dr. S. Sarkar	PIB, Kolkata 14 June, 2020	Webinar on 'Recent cabinet decision to encourage rural agriculture-Enables farmers to harness economy and attract FDI in agriculture'
Dr. Sk. Md. Azizur Rahman Mr. S. Garai	BAU, Sabour, Bhagalpur 29 June, 2020	Webinar on 'Managing wetlands for aquatic crops: opportunities and challenges'
Dr. Sk. Md. Azizur Rahman	ICAR-ATARI, Kolkata 1 to 2 July, 2020	Webinar on 'Zonal workshop of KVKs of Zone V'
Dr. S. Sarkar	SAMETI, Narendrapur 06 July, 2020	Online review workshop on 'DAESI course '
Dr. Sk. Md. Azizur Rahman	WBUAFS, Kolkata 10 June, 2020	Webinar on 'Strategies of small scale aqua-farming during COVID-19 and beyond'
Mr. S. Garai	ICAR-RCER, Ranchi 21 August, 2020	Webinar on 'Achieving agrarian prosperity through agri-entrepreneurship'
Dr. Sk. Md. Azizur Rahman Mr. S. Garai	ICAR-ATARI, Kolkata 18 September, 2020	Webinar on 'Farmers Producers Organisations (FPOs)-the road ahead'
All KVK staff	ICAR-ATARI, Kolkata 29 October, 2020	Webinar on 'New Farm Act, 2020'
Dr. Sk. Md. Azizur Rahman Mr. S. Garai	ICAR-ATARI, Kolkata 11 November, 2020	Webinar on 'National nutrition Mission-the way forward'
Dr. Sk. Md. Azizur Rahman	ICAR-ATARI, Pune 28 November, 2020	Webinar on 'Sensitization workshop on animal husbandry'

10. Women Empowerment

ICAR-CRIJAF, Barrackpore has focused programmes on skill and entrepreneurship development and technological empowerment of farm women for improving the income and drudgery reduction. The institute emphasised on capacity building and facilitating the women farmers for formation of Farmers Producers Organization (FPOs) and Self-help Groups (SHGs). Such initiatives could improve the participation of women farmers in jute cultivation and value chain establishment.

10.1. Enhancing Nutritional Security of Farm Women

Malnutrition among the farm women and children is very common which is more serious particularly in case of scheduled castes and tribes who rely on very marginal diets. Crop diversification through pulses, vegetables and integration of fishery, poultry and duckery can provide base for balanced food for these farm women. Intercropping and strip cropping of short duration green gram with jute, vegetable cultivation in jute based soil column, practising backyard poultry and scientific fish rearing are some of the interventions introduced in the adopted villages to enhance the nutritional security of the farm women. Vegetable seed kits were distributed to farm families in order to help the farm women to establish small scale kitchen gardens. Exposure visits were organised for the farm women to give first-hand information on jute based integrated farming system.

Farm women are being explained about importance of IFS in balanced nutrition

10.2. Entrepreneurship Development among Farm Women through FPOs

The institute facilitates farm women for formation of SHGs and FPOs through very structured projects. Technical support was extended to three FPOs in North 24 Parganas covering 60 farm women. Two women SHGs were formed and linked with Sabka Apna Farmers Producer Company Limited, North 24 Parganas. The groups were trained in value addition of jute fibre and fabrics in order to empower the farm women. In addition to this, necessary linkages were created with FPOs through ICAR-CRIJAF and its KVK for need based technical support to the SHGs and farmers interest groups registered with FPOs.

Display of jute handicrafts for women trainees on entrepreneurship development

10.3. Skill Enhancement and Capacity Building

ICAR-CRIJAF organised several capacity building programs for farm women enabling them to be more proactive in adoption of new technologies, awareness on Government scheme related to agriculture and making of jute diversified products

10.3.1. Creating awareness among women regarding Government Schemes

Training was imparted to farm women to enable them to aware and take advantage of Govt. Schemes. In this context special sessions were organised in the institute to sensitise the farm women to become beneficiary of agricultural loans, Kisan Credit Cards, Kisan Samman Nidhi, Crop Insurance etc.

Interaction of bank officers regarding Govt. schemes with members of SHGs

10.3.2. Skill Enhancement of SC farm women in making of jute bag and handicrafts

The capacity building programme of SC farm women were undertaken through various training programmes on making of jute bags, handicrafts, shopping bags, office bag, file, folders etc. More than 50 farm women and members of woman SHGs participated in such trainings. The Women groups were immensely benefitted for becoming self-reliance in value added product making from jute fabrics and fibre for better earning opportunities.

Hands on training in making of jute handicrafts and bags

A women trainee receiving the certificate from Director, ICAR-CRIJAF

10.3.3. Technologial empowerment of farm women

Training on "Technological empowerment of farm women" was organised by ICAR-CRIJAF, Barrackpore from 5 to 7th March 2020. Fifty five women farmers from five different villages under North 24 Parganas and Nadia Districts had participated in the programme. In the training, major emphasis was given on new and improved women-friendly agricultural technologies, various women empowerment schemes.

Inaugural address of Director, ICAR-CRIJAF on technological

Trainees attending a training on empowerment of farm women

10.4. Other Activities for Farm Women

10.4.1. International Women's Day

ICAR-CRIJAF along with KVK, North 24 Parganas (additional) and Socio Legal Aid Research and Training Centre (SLARTC), Barrackpore celebrated International Women's Day on 08 March, 2020. On this occasion lecture cum interaction session was organised on nutri-smart agriculture, women empowerment programmes,

nutrition garden, bio-fortified varieties and millets as well as '*Poshan Thali*' in which 61 farm women from Giddha village and surrounding areas were participated. On this occasion coconut saplings were distributed to the farm women by KVK, ICAR CRIJAF.

Participants of International womens day celebration at Giddha village

Distribution of coconut saplings to farm women

10.4.2 Mahila Kisan Diwas

ICAR-CRIJAF celebrated Mahila Kisan Diwas on 15.10.2020 for recognizing the contribution of rural women in enhancing agricultural and rural development. Fourteen women from different villages of North 24 Parganas district participated in the programme. During the deliberations, special attention was given to the topics on women empowerment, SHGs, drudgery reduction,

Winners of drawing competition being felicitated by Director, ICAR-CRIJAF

mushroom cultivation, different aspects of COVID management in farm operation, nutrition, health and hygiene. A drawing competition was conducted as a part of programme and the winners were given prizes. An exhibition of value added products from different entrepreneurs was arranged on the occasion.

11.Documentation, Online Resource Management, Project Management, IPR and Commercialization

11.1. CRIJAF Library: Information and Documentation Unit

Library continued its support for research activities of the Institute by subscribing to electronic resources and providing scientific and technical information on jute and allied fibre crops like mesta, ramie, sisal, sunnhemp and flax.

Display of journals in the library

Virtual library through CeRA platform: The library pro-actively provided this service to enable the users to access subscribed journals from a single portal, irrespective of place and time. This facility was very much useful for the scientists and others users especially during Covid pandemic lockdown period.

Scientific books: Presently, the library holds about 9861 books under various themes of agriculture and allied sectors like agronomy, soil science, genetics and plant breeding, plant pathology, agricultural entomology, agricultural extension, plant physiology, bio-technology, agricultural engineering, etc. from National and International publishers. Besides, library also procured general books like stories, economics and politics in Hindi, English and Bengali languages.

Scientific journals: The library is enriched with 39 International and 102 Indian journals and digital version of International Bibliographic Information System for the Agricultural Sciences and Technology (AGRIS). The library has about 9230 bound volumes of journals and scientific literatures since 1947.

Institute Publications: 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 other policy making and developmental departments of the States. Library also holds the annual reports/newsletters/ technical bulletins of various ICAR Institutes and SAU's, Commission/Committee reports etc.

Software Support for Library Information: An open source library management software (KOHA) has been installed and database management of library books started during 2020-21.

Digitization of Documents: Library started digitization of all kinds of scientific and technical information of the institute during 2020-21. About 164 old publications as listed below have already been digitized during the reporting period.

Table 46. Digitization of Institute publication

Publication	Number
Technical Books	8
Technical Bulletins	106
Annual Report of ICAR-CRIJAF (1939-1979)	34
Hindi books	2
Indian Central Jute Committee proceedings (1937 & 1938)	2
Catalogue	2
Pamphlets	8
ICAR-CRIJAF Vision document	2
Total	164

Reprographic and photographic facility: All type of photography, photocopying and printing requirements of the Institute for the research and administrative purposes of the Institute is facilitated by library.

11.2. Online Resource Management

Agricultural Knowledge Management Unit (AKMU) is 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. During COVID pandemic situation AKMU has arranged more than 100 online programme such as IRC, DRC, various meeting, workshop, training, monitoring of AINP trials, celebration of independence day, weekly seminars etc. in which all the employees of the institute participated through online mode. AKMU have also uploaded agro-advisories and media coverages in institute website regularly. All the Conventional cyber security norms defined by ADG (Information Communication Technology), ICAR *viz*., only use of genuine software, installation of latest Operating System, antivirus, use of firewall etc. are being followed by AKMU of the Institute. Recently, AKMU has developed its new website (https://crijaf.icar.gov.in) as per ICAR guidelines and hosted the website on ICAR Data Centre on 19th December, 2020. The backbone for operating the e-extension, mobile advisory, agro-advisory services, media coverage and other related activities are also supported by AKMU.

Newly launched updated institute website

11.3. IPR and Commercialization

11.3.1. IPR protection of JuteMet and JAF-Safe

JuteMet, an agrometeorological database management system-cum-agro-advisory system was registered under trademark application in class 44, under no. 4288584, dated 10.09.2019 for a period of ten years.

JAF-*Safe*, an android based mobile application used to disseminate scientific information on jute and allied fibre crops pest and disease management was registered under trademark application of in class 42, under no. 4383288, dated 19.12.2019 for a period of ten years.

JAF-Safe logo trade mark certificate

Jute Met trademark certificate

11.3.2. Processing of patent application

An Agreement between ICAR-CRIJAF and National Biodiversity Authority (NBA) done on 20th August, 2020 as per the IPR guidelines for Patent Application entitled 'An improved process of large scale degumming of ramie fibre' (Application No. 1036/KOL/2008, Filed on 16.06.2008) for further processing of the patent grant.

11.3.3. Commercialization

Royalty from commercialization of the technologies: During 2020, total Rs. 35,72,625/- received as royalty payment of various commercialized technologies (CRIJAF SONA, CRIJAF Single Wheel Jute Weeder, Nail Weeder and Multi Row Seed Drill) from authorized firms. Ex-factory rate of CRIJAF SONA was fixed at Rs. 55/- per packet of 1 kg w.e.f. 01.04.2020

11.4. 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 47. Linkage 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

12. Scheduled Caste Sub-Plan and North Eastern Hill Programme

Scheduled Caste Sub-Plan (SCSP) programmes 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 equipment, improved seed and appliances for improving the farm income in jute and allied fibre-based cropping programme were promoted among the SC farmers with adequate resource support to increase the farm income and reduce the cost of cultivation. The institute through its SCSP and NEH initiatives conducted demonstration, capacity building and input distribution programmes to empower the farmers belonging to SC and NEH region with technology and basic inputs for agriculture and allied activities for better livelihood and farm income.

12.1. Scheduled Caste Sub-Plan

12.1.1. Demonstration of water conservation for in-situ jute retting and self-reliance eco-farming

To cope up the erratic rainfall and scarcity of retting water during retting season, ICAR-CRIJAF has designed four different models of rainwater conservation structures for improved retting of jute allied fibre crops using CRIJAF Sona(Fig-50). By contributing only 3-5% of land, farmer can save about ₹4000-6000/acre as the cost of transport of jute bundles from jute field to nearest retting spot. In addition, farmer can utilize *in situ* retting pond for fish culture, dyke-based horticultural crops including banana, papaya, vegetables, apiary, duck rearing, mushroom cultivation etc. and can earn ₹ 25000-30000/acre/year as additional income. Ten batches of training have been conducted and 212 numbers of SC farmers have got benefited through field demonstration of the technology.

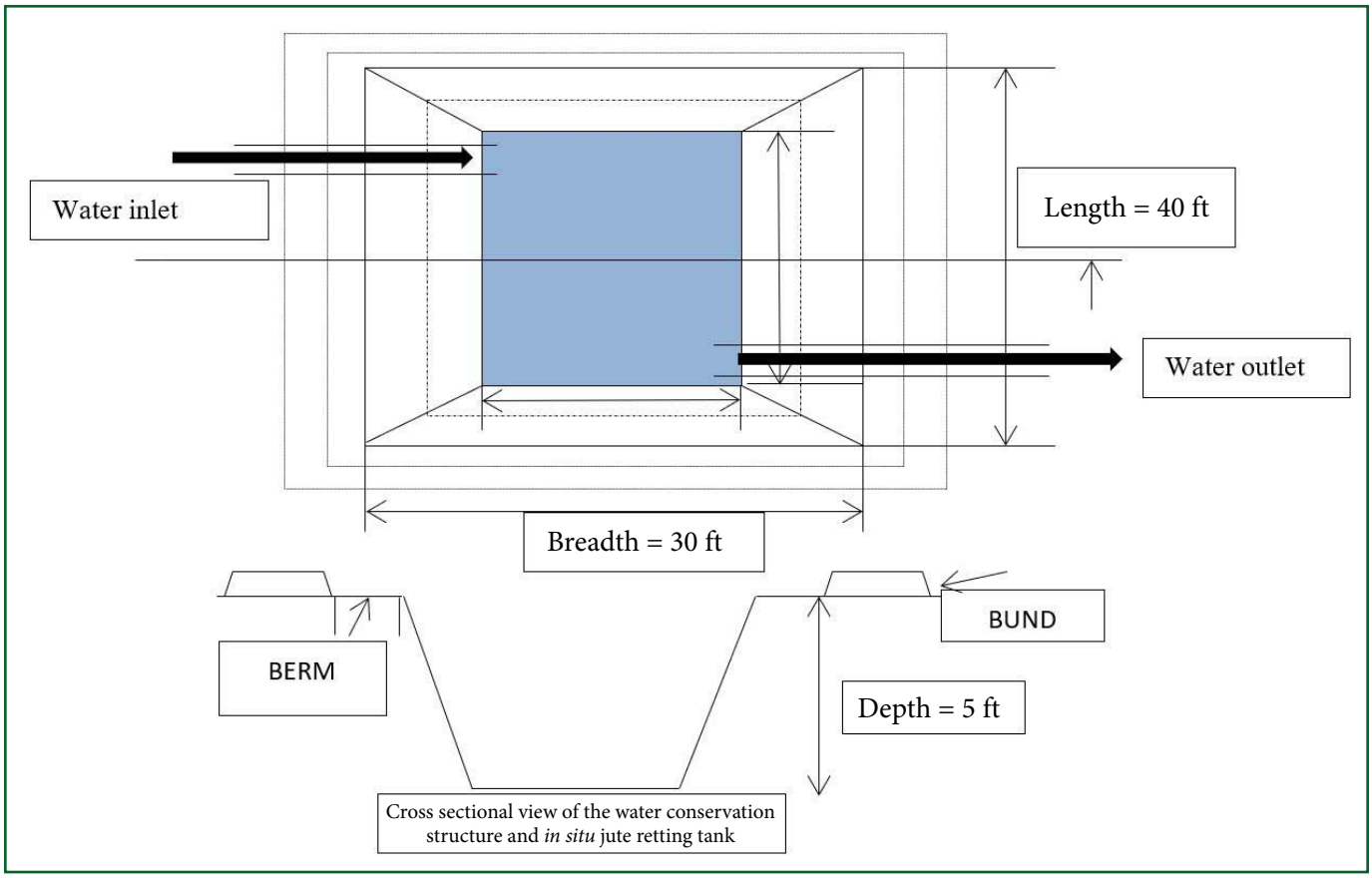


Fig. 50: Design of in-situ retting pond (40 ft x 30 ft x 5 ft with silpaulin lining)

In situ retting pond with dyke based horticultural crops

12.1.2. Capacity building programmes

In order to develop knowledge and skill of SC farmers by identifying and addressing the issues related to low farm income in the field of agriculture and allied field, ICAR-CRIAF has conducted various capacity building activities like trainings and exposure visit in several states like West Bengal, Odisha, Assam and Uttar Pradesh. During 2020, altogether 46 programmes were conducted and about 3500 SC farmers were trained under the programme.

Table 48. Capacity building programmes undertaken in SCSP

Capacity building programme	Date/Place	No of Participants
Soil health management under IFS for sustainable agriculture and enhancing farm income	3-4 January, 2020 Gopalpur and Akhuna, Bankura	50
CRIJAF technologies with special reference to plant protection	10 January, 2020 Khareermath, West Bengal	60
Scientific cultivation of mushroom	16-18 January, 2020 ICAR-CRIJAF, Barrackpore	39
Improved seed production technology of major crops cultivated in West Bengal	27-29 January, 2020 ICAR-CRIJAF, Barrackpore	50
Feed management for improved fish cultivation	31 Jan - 2 Feb, 2020 ICAR-CRIJAF, Barrackpore	43
Integrated pests and diseases management in jute based cropping system	3-5 February, 2020 11 March, 2020 ICAR-CRIJAF, Barrackpore	120
Integrated management of weeds in jute based cropping system	5-7 February, 2020 ICAR-CRIJAF, Barrackpore	44

Capacity building programme	Date/Place	No of Participants
Use of improved farm machinery & role of CHC in farm mechanization	10-12 February, 2020 ICAR-CRIJAF, Barrackpore	46
Soil testing and INM for increasing farm productivity and enhancing farm income	24-26 February, 2020 ICAR-CRIJAF, Barrackpore	55
Various Govt. schemes, loans, insurances etc. and development & strengthening of SHGs	24-26 February, 2020 ICAR-CRIJAF, Barrackpore	40
Improved package and practices of sunnhemp cultivation for enhancing fibre productivity	26 February, 2020 ShRS, Pratapgarh	64
Entrepreneurship development for diversification of jute product	2-7 March, 2020 ICAR-CRIJAF, Barrackpore	21
Integrated pest and disease management in jute	13 March, 2020 Baduria, West Bengal	60
Scope of Jute based cropping system for enhancing farm income and sustainable agriculture	13 March, 2020 ICAR-CRIJAF, Barrackpore	47
Enhancing farm income in jute-based cropping system	16-18 March, 2020 Bhaganai, Keonjhar, Odisha Bhuban, Dhenkanal, Odisha	110
Rearing of RIR poultry chicks	17 March, 2020, KVK Burdwan	150
Vermicompost preparation	21 March, 2020, KVK Burdwan	50
Improved retting of jute with CRIJAF Sona for quality fibres	5 & 10August, 2020, RRS Sorbhog	80
Integrated pest and disease management in jute-based cropping system	11-22 Aug, 2020 21-25 Dec, 2020 ICAR-CRIJAF, Barrackpore	110
Use of CRIJAF Sona for enhancing yield and fibre quality in jute	25 August, 24 November, 2020 ICAR-CRIJAF, Barrackpore	20
Scope of jute-based cropping system for enhancing farm income and sustainable agriculture	25-27 November, 2020 ICAR-CRIJAF, Barrackpore	11
Skill development in jute bag making for SC farm women	2-7 December, 2020 29 Dec, 2020 - 8 Jan, 2021 ICAR-CRIJAF, Barrackpore	10
Scope of sunnhemp and flax based cropping systems for enhancing yield and farm income	21 December, 2020 ShRS, Pratapgarh	40
Fibre quality improvement and doubling farmers' income through eco-friendly in-situ jute retting pond based farming system	31 December, 2020 ICAR-CRIJAF, Barrackpore	31

Training, and awareness programmes under SCSP

Training, and awareness programmes under SCSP

12.1.3. Input distribution for field demonstration

In order to augment crop yield, productivity, farm income and to reduce drudgery, critical agriculture inputs like improved variety of seeds (jute, paddy), vegetable kits, fruit planting materials, herbicides, vermicompost units, mushroom spawns and farm implements/tools (CRIJAF Nail Weeder, Cycle Weeder and Sprayers) were provided to more than 2100 farmers of West Bengal, Assam, Odisha, Uttar Pardesh.

Director, ICAR-CRIJAF handing over sprayer to a farmer

Demonstration of farm implements to SC farmers at ICAR-CRIJAF

Distribution of paddy seeds to SC farmers by Director, ICAR-CRIJAF

Distribution of chicks to SC farm women

Distribution of fruit saplings to SC farmers of Odisha

Distribution of paddy seeds to SC farmers of Burdwan, WB

12.2. Programme Conducted under NEH Scheme

To promote multi-enterprise based integrated agriculture and Jute and allied fibre based cropping system to meet the diverse requirements of the farm households of NEH Region, ICAR-CRIJAF has organized the training and input distribution programmes in joint collaboration with College of Agriculture, Kyrdemkulai, Umiam, Meghalaya and ICAR-ATARI Zone VI, Guwahati. Approximately 950 farmers of NEH region were benefitted from these programmes. Promotion of IFS, rural bio-entrepreneurship, backyard poultry farming, dairy farming, orchid cultivation, vermicomposting specific for NEH region was emphasized for doubling farmer's income of small holders. Specific training programme as well as inputs were provided to the NEH beneficiaries through different collaborators of that region.

Different collaborative programmes and input distribution under NEH scheme of the Institute

13. Swachh Bharat Mission

ICAR-CRIJAF is dedicated to implement the Government missions on Swachha Bharat. In this context, the Institute, its regional stations and KVKs are making all round efforts in realizing the dream of clean India. Various activities and programmes related to Swachhata are implemented and promoted among the stakeholders, general public, farmers and students.

13.1. Swachha Bharat Mission- Special Drive at CRIJAF during the Pandemic Year

Considering greater importance of cleanliness and sanitation at the onset of COVID-19, special cleaning drives were undertaken at ICAR-CRIJAF, Barrackpore to keep the campus and the residential areas clean throughout the year. During the COVID-19 lockdown, the scientists and other staff of the institute followed social distancing, wearing of face masks, and other protocols as suggested by the Ministry of Health and Family Welfare, Government of India in order to prevent spread of COVID-19 virus. Removal of weeds, leaf litters from backyards of the office buildings, residential areas and roads was regularly done. Mosquito repelling treatment has also been carried out. The office building and different divisions and sections were being disinfected at frequent intervals to keep the work place germ-free during the pandemic time.

Sanitization in the main lobby of Institute

Monitoring with thermal scanner for containing COVID

13. 2. Swachhata Pakhwada at ICAR-CRIJAF

As part of the year round activities, the institute observed *Swachhta Pakhwada* (16-31 December, 2020), the main theme of which was "Jan andolan for appropriate COVID-19 behaviour". In this continuum, ICAR-CRIJAF and CRIJAF-KVK, North 24 Pgs (Additional) organized cleanliness campaign, awareness and sensitization porgramme, Kisan Diwas, quiz and painting competitions to propagate the message of cleanliness, sustainable agriculture and COVID-19 prevention among the students, farmers and general public.The swachhata activities with special reference to waste management for organic farming, water conservation and recycling, eco-farming, vermicomposting, organic agriculture, by product utilization in jute and allied fibre crops-based agriculture and replacement of plastic were organized in villages involving jute growers. Being a natural fibre institute, ICAR-CRIJAF has taken many initiatives on swachhata particularly in disseminating the knowledge to make wealth from the waste which will fulfil the dream of clean environment vis-a vis higher income for farmers.

13.2.1. Swachhata pledge and inaugural function of Swachhta Pakhwada

The inaugural programme and pledge taking ceremony of Swachhta Pakhwada (16th Dec. to 31st Dec., 2020) was held on 16.12.2020 in which Dr. Gouranga Kar, Director, ICAR-

CRIJAF administered Swachhata pledge to all the employees of the Institute and urged that cleanliness is very important in workplaces for which individual action is needed. Dr. Narendra Kumar, Director, Directorate of Jute Development, GoI, Kolkata graced the occasion as chief guest. Tree plantation programme was also organized in which Director and other dignitaries planted fruit trees in the T. Ghosh Farm.

Swachhata pledge administered by Directior, ICAR-CRIJAF

Tree palntation by Directior, ICAR-CRIJAF during Swachhata

13.2.2. Awareness and sensitization programme on Swachhata

With the objective of disseminating the message of Swachhata, ICAR-CRIJAF organized awareness and sensitization programme in the institute, residential area, Gidhha village (North 24 Pgs), Sishu Bhawan Orphanage, Barrackpore, South Hansia village (North 24 Pgs) and Matharangi market place, The issues related to cleanliness, waste recycling, water conservation, organic farming and vermicomposting were focused in such sensitization programmes. Awareness were also created among the participants to follow appropriate COVID 19 behaviour.

Inmates of Sishu Bhawan Orphanage, Barrackpore being sensitized regarding COVID-19

Swachhata awareness camp at South Hansia village (North 24 Pgs)

13.2.3. Cleanliness and sanitation drive

Periodical cleanliness and sanitation drives were organized in the Institute, nearby villages, schools and market places involving the employees, students, farmers and shopkeepers to maintain cleanliness in the surrounding areas.

Laboratory cleaning by scientists

Directior, ICAR-CRIJAF participating in cleaning drive in the campus

13.2.4. Kisan Diwas

Kisan Diwas was organized on 23.12.2020 at Ariala village, North 24 Parganas. The scientists briefed the farmers about the use of jute mulch in horticultural crops and vermicomposting as a method of conversion of waste into wealth.

Kisan Diwas at Ariala village, North 24 Parganas

13.2.5. Vermicomposting demonstration

Low cost HDPE vermicomposting unit was demonstrated to farmers and students regarding different substrates to be used in vermicomposting and its management. The farmers were convinced to produce vermicompost from crop residues to generate good quality manure for farming.

Demonstration of vermicomposting to farmers

13.2.6. Painting and quiz competition

Quiz and painting competitions were also organized at ICAR-CRIJAF to foster healthy competition and rewarding the practice of cleanliness. The theme of painting was "Swachhata awareness and social behaviour during COVID-19 pandemic situation".

13.2.7. Press Conference and media coverage on Swachhata

In the concluding day of Swachhata Pakhwada, a press conference and training was organised for the scheduled caste farmers on the topic "Jute retting tank based eco-farming and wealth from waste to make clean and green India". The *Swachhata Vahini* and winners of quiz and painting competition were felicitated by Director, Dr. Gouranga Kar. In his remark, the Director highlighted about the initiatives taken by the institute on implementation of Swachhata mission. Panel discussion was organised on conversion of agricultural waste to wealth, jute retting tank based eco-farming, replacement of plastic with natural fibre. Total of 25 farmers and 10 correspondents from press media were present in this training cum press conference.

Director, ICAR-CRIJAF addressing the farmers and media persons on Swachhata

Director is felicitating the winner of quiz competition on Swachhata

13.3. Swachhata Pakhwada in Regional Stations

Regional stations of ICAR-CRIJAF also organised programmes and activities to disseminate the message of cleanliness and sanitation. Swachhata pledge and day-wise activities were taken up by the staff members in the surrounding areas and villages.

Cleaning activity at ShRS, Pratapgarh

RRS, Sorbhog staffs participating in Swachhata drive

14. Mera Gaon Mera Gaurav (MGMG) Programme

A total of 52 villages have been identified under MGMG programme. The scientists of the institute have been grouped into 11 teams, each team with 3-4 scientists. During this COVID-19 pandemic situation also each multi-disciplinary team contacted the farmers of adapted villages for the critical input distribution as well as agro-advisory for better self-monitoring of the critical growth stages of jute as well as other crop of jute based cropping system. After the lockdown, farmers from these villages have been called for training / critical input distribution, albeit on a limited basis.

Table 49. 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 Dr. Suman Roy Dr. Jitendra Kumar Meena	Bagnabar, Barisha+ 3 Villages (Paschim Medinipur)	Sanjay Manna, Ashis Patra	• Awareness generation of farmers on IFS, IPM, INM, organic farming *etc.* • Awareness generation of farmers regarding Govt. schemes like PMFBY, KCC, SHC etc. • Demonstration of improved production technologies of jute and distribution of critical inputs • Cleanliness drive • Distribution of extension literatures
2.	Dr. Jiban Mitra Dr. R. K. De Dr. Manik Lal Roy	Madhusudanpur, Beraberi Khagragachi, Bajemelia Kinkarkati, Jampukur (Hooghly)	Nimami Pal	
3.	Dr. Chinmay Biswas Dr. Subhojit Datta Dr. Shailesh Kumar	Kumra, Kashipur Rudrapur, Bijoynagar, Nikerati Panchpota (North 24 Parganas)	Narahari Mandal	
4.	Dr. B. Majumdar Dr. A. Anil Kumar Dr. Laxmi Sharma Mr. Vikas Mangal	Athghara, Kirtipur, Rajapur, Kanupur, Bena (North 24 Parganas)	Abdur Rahaman	
5.	Dr. S. Satpathy Dr. S. K. Sarkar Dr. S. Sarkar Dr. V. Ramesh Babu	Goaldaha, Gokulpur, Bhaduria, Bankra, Koijhury (North 24 Parganas)	Asit Sarkar	
6.	Dr. S. K. Jha Dr. Dipnarayan Saha Dr. R. K. Naik	Paschim Simla, Dighirpar, Chandanpur, Durgapur, Saiadpur, Dakshin Simla (North 24 Parganas)	Abdur Rahaman	
7.	Dr. M. S. Behera Dr. A. K. Chakraborty Dr. Shamna. A Dr. B. S. Gotyal	Makaltala, Farmania, Sonakenia, Abad, Kharo-rudrapur, Beliakhali (North 24 Parganas)	Rounaqul Haque	
8.	Dr. A.K. Singh Dr. Amit Bera Dr. D. Barman	Ghidah, Selampur, Gustia, Telenipara, Chapuria (North 24 Parganas)	Yakub Ali Tarafdar	
9.	Dr. Kunal Mandal Dr. Ritesh Saha Dr. Pratik Satya Dr. N. M. Alam	Teghoria, Kadambagachi, Raigram, Bonkanda, Baidyapur, Bharpara (North 24 Parganas)	Sachindra Nath Roy Md. Shah Alam	

Group	Group Members	Villages/[District]	Local contact person/farmer	Broad areas of activities
10.	Dr. S. Mitra Dr. D. Sarkar Dr. C.S. Kar Dr. S.K. Pandey	Bargachia, Baichhigachi, Ratanpur, Kushdanga, Tapanpur, Shrirampur (North 24 Parganas)	Md. Huzzatalla Mohidul Islam	• Solving farmers' crop related queries through direct communication with the contact farmers by mobile phone
11.	Dr. A. R. Saha Dr. S. Paul Mazumdar Dr. Maruthi , R.T	Brahmapur, Panchkahania, Satyapole, Bhabanipur, Bansbona, Dhopagachi, Bamanpara (Nadia)	Kenaram Ghosh	

Farm women getting trained in mushroom cultivation

Distribution of inputs to the contact persons of the MGMG villages at ICAR-CRIJAF

14.1. Activities in MGMG villages

Interface meetings/*Gosthies* have been organized at some 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. 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 areas like improved production practices of jute, improved retting technology of jute, integrated pest management, soil fertility management, farm mechanization, entrepreneurship development through diversification of jute fibre products, scientific mushroom cultivation and scientific fish feed management practices.

Distribution of paddy seeds to farmers of MGMG villages

Exposure visit of MGMG farmers to NGO at Baduria, North 24 Parganas

15. National Food Security Mission (Commercial Crops)-Jute

The programmes under National Food Security Mission (Commercial Crops-Jute), is sponsored by Department of Agriculture and Cooperation of MoA and FW and monitored by Directorate of Jute Development (DJD), Kolkata.

15.1. Frontline Demonstration (FLD)

15.1.1. Jute

In 2020, the institute conducted 177 FLDs in North 24 Parganas, Hooghly and Purba Bardhaman districts of West Bengal through its three extension centres and KVK, Burdwan.

The technologies demonstrated under FLDs were improved varieties of jute, mechanical weed control through CRIJAF Nail Weeder and line sowing by CRIJAF Multi-row seed drill. FLDs on growing improved varieties of jute were conducted in 64.92 ha covering 177 farmers. FLDs on mechanical weed control by CRIJAF Nail Weeder were conducted in 13.40 ha while line sowing of jute by CRIJAF Multi-row seed drills were conducted in 41.52 ha area. Besides, critical inputs for improved retting of jute, CRIJAF SONA were also provided to the farmers of West Bengal.

JRO 204 in farmers' field at North 24 Parganas

15.1.2. Ramie

For area expansion of ramie, FLD on "Ramie fibre production and extraction technology" was undertaken and new ramie plantation has been done at RRS, Sorbhog (8 ha) and farmers field at village Uttar Burikhamar, Assam (2 ha). Initiative to expand area under ramie in farming system mode involving different stakeholders was taken for successful ramie cultivation.

New plantation of ramie at RRS, Sorbhog

Ramie plantation in Uttar Burikhamar, Chirang district, Assam

15.2. Trainings cum Demonstrations

Four training-cum-demonstrations on "Degumming of ramie fibre" at Tura and Ampati districts of Meghalaya and Barpeta and Kamrup (M) districts of Assam were conducted by RRS, Sorbhog. A total 213 participants including progressive farmers, field inspectors, agriculture officers, NGOs etc. attended the training programmes.

Ramie degumming training at RRS, Sorbhog

Leaflets published on ramie degumming technology in Assamese

15.3. Seed Production

Foundation seed production of targeted varieties were done by SAUs/State Dept./KVKs/Farmers Group under guidance of ICAR-CRIJAF. A total of 24.90 q foundation seed of jute, mesta and sunnhemp was produced and Rs. 2.99 lakh financial assistance was provided to the growers.

15.3.1. Skill development among seed producers

Three training programmes for quality maintenance of new jute, mesta and sunnhemp varieties were conducted on 19th, 24th and 27th Feb 2020 respectively in Andhra Pradesh, West Bengal and Assam, in which altogether 210 seed growers, officers and technical persons were benefitted.

Skill development training at RRS, Sorbhog, Assam

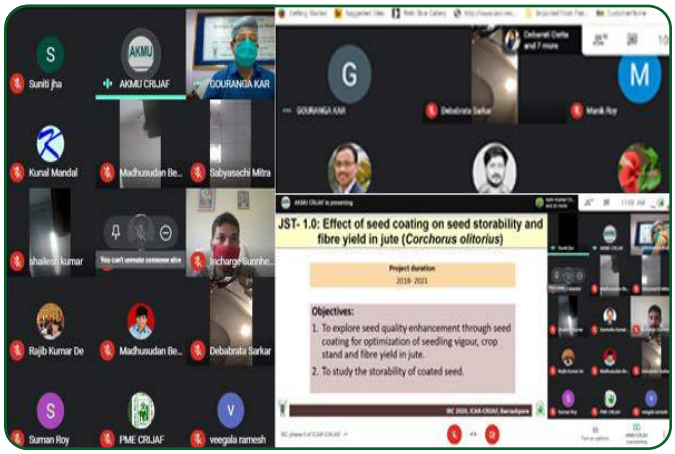
Jute seed production training at Bundwan, Purulia Distt., WB

16. Institute Research Council Meeting and Other Review Meetings

16.1. IRC Meeting

The Institute Research Council - 2020 meeting of ICAR- CRIJAF was held in two phases (8-9 June and 20-22 July) under the chairmanship of Dr. Gouranga Kar, Director, ICAR-CRIJAF. In order to contain the spread of COVID 19, the meeting was conducted through both online and offline modes as per the Govt. guidelines and by maintaining health protocols of the MoHFW, GoI. The meeting was attended by HoDs & In-Charges of sections, Regional Stations and all the scientists of the institute both in offline and online mode. Dr. Subhojit Datta, Principal Scientist & Member Secretary, IRC, welcomed Dr. Gouranga Kar, the Chairman, IRC & Director, ICAR-CRIJAF, Barrackpore, HoDs & In-Charges and all the scientists of the institute. The scientists presented 14 new research project proposals in RPP I. Most of the projects were conceptualized with objectives of improving the return from JAF crop through byproduct utilization, ecosystem services and bridging the yield gap.

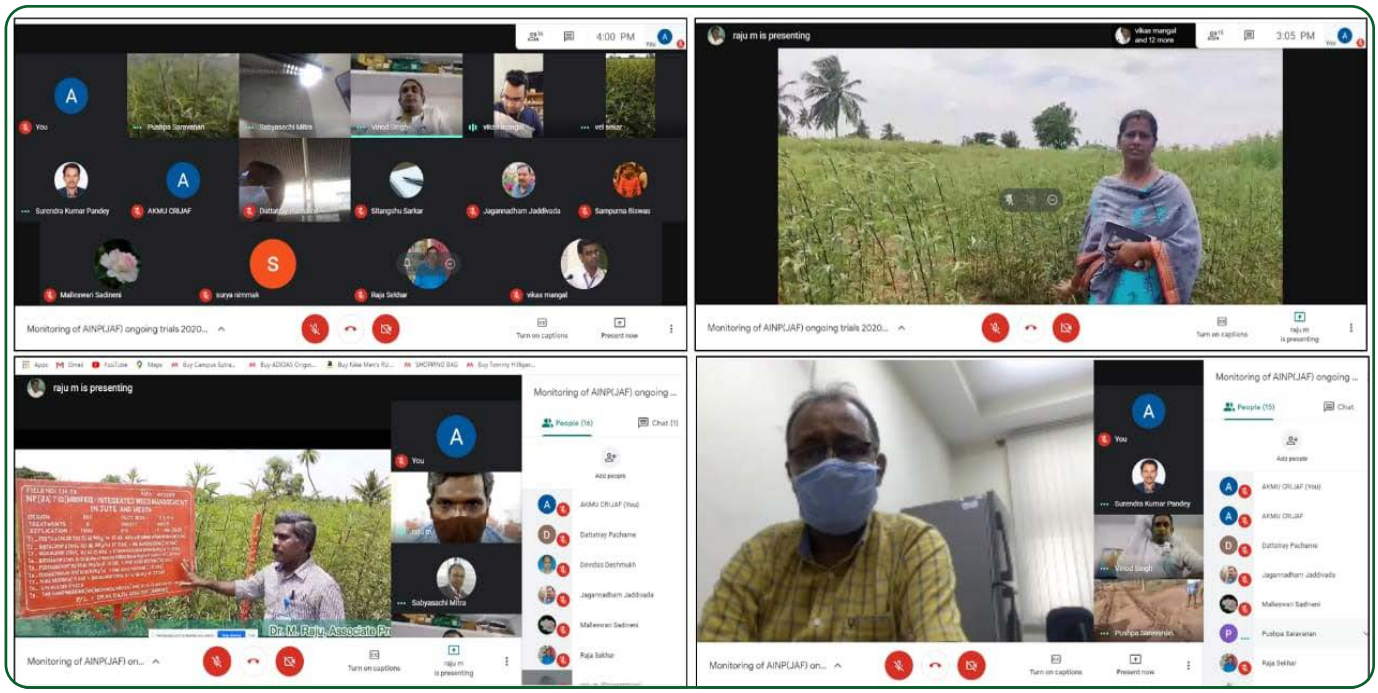
The second meeting of the Institute Research Council (2020) of ICAR- CRIJAF was held during 20-22 July 2020. In this meeting, ongoing projects (RPP II and RPP III, and externally funded projects) were discussed. In his introductory remarks, Dr. Gouranga Kar, Chairman, IRC congratulated the scientists about the important achievement made during 2019-20 and suggested the Scientists to strengthen the institutional projects, and be proactive in obtaining externally funded research projects. The chairman requested all the scientists to put sincere efforts on need-based and demand-driven technology-oriented research for the stakeholders of jute and allied fibre sector commensuration with RAC/QRT recommendations, national/sustainable development goal, so that derived technology will reach to stakeholders after completion of the project. He also emphasized that publication of the Institute's research output needs to be improved and scientists should publish their research output in peer-reviewed scientific journals with high impact factors and also submit their innovative products/ concepts for granting patents.



Director, HoDs, In-charges (AINP and PME Cell), Member Secretary (IRC) and scientists (online) during IRC meeting

16.2. Monitoring and Review Meeting of AINPJAF Centres

Due to the pandemic situation the monitoring of eight AINPJAF Centres was done through online Google meet from July to September, 2020. The monitoring team of each center led by the group leaders monitored the crop directly from the field through live video of standing crop. Each trial was explained by the scientists and the matters related to the crop condition, any specific problem and financial matters related to the centres were specifically discussed during the review.



Online monitoring and review meeting of AINP JAF centers

17. Trainings and Events

17.1. Trainings Organized by ICAR-CRIJAF, Barrackpore and its Regional Stations

Table 50. Details of training programmes conducted by ICAR-CRIJAF, Barrackpore

Name of the programme/training	Date and place	No. of participants
Advances in molecular breeding of industrial crops	25 Feb - 5 Mar, 2020 ICAR-CRIJAF, Barrackpore	15
Improved package and practices of sunnhemp cultivation for enhancing fiber productivity	26 February, 2020 ShRS, Pratapgarh	64
Improved production technology of jute and allied fibres under NFSM-CC (Jute)	12-14 March, 2020 ICAR-CRIJAF, Barrackpore	20
Farmer's training-cum-Scientist interaction (SCSP- NICRA)	12 March, 2020 ICAR-CRIJAF, Barrackpore	57
Integrated insect pests and disease management in sunnhemp and flax	13 March, 2020 ShRS, Pratapgarh	60
Improved retting of jute with CRIJAF Sona for quality fibres	10 August, 2020 RRS, Sorbhog	30
Importance of soil testing and judicious fertilizer application for increased crop productivity	19 - 21 November, 2020 ICAR-CRIJAF, Barrackpore	20

Soil Health card distribution by Director, ICAR-CRIJAF

Farmers receiving certificate from Director, ICAR-CRIJAF

Participants of the training on "Advances in molecular breeding of industrial crop"

Participants of training with Director and Scientists of ICAR-CRIJAF, Barrackpore

A farmer is receiving sprayers from the guest during the training at Pratapgarh

17.2. Trainings Organized by ICAR-CRIJAF KVKs

17.2.1. Trainings organized by KVK, Burdwan

Table 51. Details of training programmes conducted by KVK, Burdwan

Target group	No. of Training	N0. of Participants								
		SC/ST			Others			Total		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
PF	22	170	58	228	94	15	109	264	73	337
RY	3	17	13	30	0	0	0	17	13	30
Total	**25**	**187**	**71**	**258**	**94**	**15**	**109**	**281**	**86**	**367**

PF= Practicing farmers, RY= Rural youths

Hands on training on beekeeping

Training on Kadaknath poultry rearing

Women being trained on mushroom production

Training on Jute based Integrated Farming System

17.2.2. Details of Trainings Organized by KVK, North 24 Parganas

Table 52. Details of trainings conducted by KVK, North 24 Parganas (Additional)

Target group	No. of Trainings	General			SC/ST			Trainee Days
		Male	Female	Total	Male	Female	Total	
Farmers and Farm Women	14	9	54	63	32	181	213	276
Extension Functionaries	2	4	15	19	0	2	2	43
Total	16	13	69	82	32	183	285	319

Hon'ble Director, ICAR-CRIJAF, Dr. Gouranga Kar interacting and distributing inputs to the trainees

Off-Campus training and awareness programmes

On-Campus training programmes maintaining social distancing

17.3. Events Organized by ICAR-CRIJAF, Barrackpore and its Regional Stations

17.3.1. Republic Day Celebration

Republic Day, 2020 was celebrated on 26 January, 2020 at ICAR-CRIJAF, Barrackpore and its sub-stations. Dr. Jiban Mitra, Director (I/c) hoisted the National Flag followed by recitation of National Anthem. Director, Head of the Divisions, Scientists, Officers of Administration and Finance, etc. conveyed message of Republic Day on this occasion. All the staffs of CRIJAF, their family members and children participated in the programme.

Republic Day Celebration of the Institute

17.3.2. 67th Foundation Day Celebration

67th Foundation Day of the Institute was celebrated on 9 February, 2020 at its headquarters, Barrackpore. Plantation of tree saplings and sports events were organized for staff and family to mark the occasion. Scientists and other officials of ICAR-CRIJAF, ICAR-NBSSLUP, ICAR-NINFET and ICAR-IVRI graced the celebration. Director, ICAR-CRIJAF welcomed all the invitees and cited the significant contributions of the institute in terms of technology development and release of several JAF varieties. Best administration and technical personnel were awarded for their outstanding performance during the year.

Guests planting saplings during Foundation Day

Best employees being honoured by Director (I/c)

17.3.3. International Day of Yoga-2020

Yoga Day – 2020 was celebrated in the Institute on 21 June, 2020 through an online programme chaired by Director, ICAR-CRIJAF. On this occasion Dr. Gourang Kar, Director told that Yoga plays a crucial role in promoting health in a holistic manner by improving physical, mental and spiritual health which ultimately helps in fighting stresses and also alleviate other ailments including depression and anxiety. All the staffs of the Institute along with their family members participated online and performed yoga as per the theme "Yoga at Home and Yoga with Family".

Director's address during International Yoga Day

17.3.4 Celebration of World Environment Day

World Environment Day was celebrated on 5 June, 2020 by organising discussion on COVID-19 pandemic and measures to prevent spread of virus followed by plantation programme. Besides explaining the messages to be followed to stop the spread of pandemic, Director, Dr. Gouranga Kar also told the importance of natural fibres in sustaining clean environment. The HoDs, In-charges, Scientist, CAO, FAO, Medical Officer and staffs of institute were present for tree plantation.

Tree plantation by Director, ICAR-CRIJAF on the occasion of World Environment Day

17.3.5. Independence Day

Amidst COVID-19 crisis, ICAR-CRIJAF celebrated 74th year of Indian Independence in the campus in the presence of limited gathering. But all other Scientists and staffs were connected to celebrate this day virtually. Dr. Gouranga Kar, Director of the Institute hoisted national flag by remembering great freedom fighters of India who scarified to make India an independent nation. He appealed all the staffs of the institute to work hard to make India 'Atma Nirvar' through research and development of natural fibres in 'new normal' way during present and post-COVID situation. Progressive farmers and farm workers were also facilitated on the occasion.

Director hoisted National Flag on the occasion of 74th Independence Day at ICAR-CRIJAF, Barrackpore

17.3.6. Observance of Constitution Day

ICAR-CRIJAF, Barrackpore observed Constitution Day on 26th November, 2020 to commemorate the adoption of Indian Constitution by our country. The objective was to make awareness about the importance of Indian Constitution among the employees of the Institute. The programme started with the reading of the Preamble by Director and all the employees which was led on line by Hon'ble President of India.

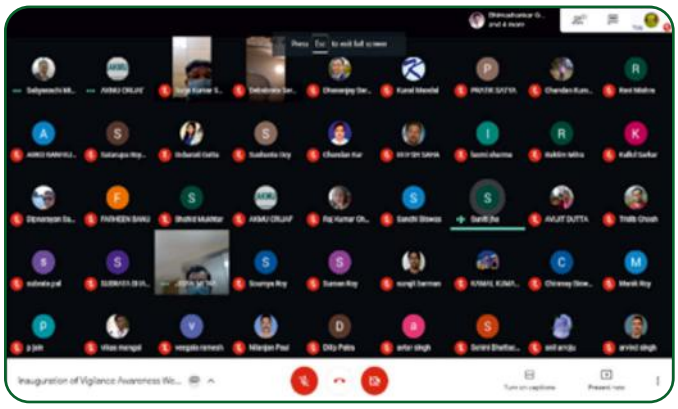
Reading of Preamble of Indian Constitution

Lecture on Constitutional provisions for women empowerment

Two lectures on Indian Constitution were delivered by Dr. J.K. Meena and Dr. Debarati Datta. Director, Dr Gouranga Kar highlighted the importance of Indian Constitution and the significance of Constitution Day. Dr. Kar also told that in every organization it is very important to give liberty and equal opportunity to the employees to think and act that enhances the organizational output. Constitution provides equal opportunity to every person to perform for the organization in transparent manner and earn credit for the institute. All the staff of the institute participated in this programme in offline and on line mode.

17.3.7. Vigilance Awareness Week

With the framed theme of '***Vigilant India, Prosperous India*** - **सतर्क भारत, समृद्ध भारत**' the Vigilance Awareness Week-2020 was observed by ICAR-CRIJAF, Barrackpore during October 27 to November 02, 2020, which started with the Integrity Pledge administered by Dr. Gouranga Kar, Director, ICAR-CRIJAF to all the staffs of the institute in online mode. In his remark, Director appealed to all the officers and staffs to follow the GoI, CCS Rules, financial rules in the working place. He also articulated to follow integrity, transparency and discipline in the work-place and in all other spheres of life. During the week long programme, the institute organized different associated activities including sensitization lecture, different competitions namely debate, drawing, quiz etc. where employees and their family members participated ardently.



All employees of ICAR-CRIJAF taking integrity pledge with Director, ICAR-CRIJAF

17.3.8. World Soil Day

To promote the pivotal role of soil as a major component of natural ecosystem, ICAR-CRIJAF celebrated the World Soil Day on 05.12.2020 with the theme "Keep soil alive, protect soil biodiversity". Dr. A. R. Saha, Incharge, Crop Production Division briefed about the importance of the day. Dr. Gouranga Kar, Director, ICAR-CRIJAF underlined the significance of soil health restoration and urged to maintain the soil health in all possible ways. He also emphasized the importance of soil testing and balanced fertilization in preserving the quality of soil, water and food. He urged the farmers to use fertilizers as per the soil test recommendation so as to reduce unnecessary expenditure and for obtaining better production. 150 soil health cards were prepared for distribution among the farmers of Dakshin Brahmapur, Haringhata, Nadia. In an interaction with farmers the scientists of Crop Production Division conveyed the message of importance of soil health.

Celebration of World Soil Day with farmers

17.3.9. Celebrations culminating in 150th Birth day Anniversary Celebration of the Father of Nation-Mahatma Gandhi

During week-long celebrations before culminating in 150th Birth day on 2nd October, 2020 of Father of Nation Mahatma Gandhi, several activities including tree plantation, speech competition, swachhata campaign, painting competition and special guest lectures on Gandhian philosophy of Gram Swaraj and its essence for Sustainable Agriculture, women empowerment, non-violence, Swadeshi and Atmanirbhar Bharat were organized by ICAR-CRIJAF, Barrackpore. The week-long programme was inaugurated by Director, Dr. Gouraga Kar on 25.09.2020 by paying homage and tribute to Mahatma ji and threw light on the life of Mahatma, his principle, and his contribution to the country and the humanity. He also emphasized that proper technology

development and extrapolation of the usefulness of natural fibres can fulfil Gandhiji's dream of clean and green India. Dr. S. Satpathy, Coordinator of the week-long activities briefed about the day-wise activities to be organized during the week. Guest lecture on 'Gram Swaraj and Rural Development' and 'Yoga in Modern Life'; debate and painting competition on Gandhiji's life and principle were also organized online.

Pleadge taking ceramony during 150th birth annivarsary of the Father of Nation

Director, ICAR-CRIJAF is visualising the paintings on Gandhiji

17.3.10. Webcasting of PM-Kisan Samman Nidhi Yojana on 25.12.2020

The webcasting of PM-Kisan Samman Nidhi Fund release and address to the farmers by Hon'ble Prime Minister was organized in the Institute, its Regional Stations and KVKs (Burdwan and North 24 Parganas (Additional). All the staff of the Institute attended the programme physically and virtually. In this occasion, scientist-farmers interaction was also arranged in the Institute and KVKs in which the farmers viewed the live webcast of Hon'ble Prime Minister's address during the occasion of release of Kisan Samman Nidhi Funds for the farmers. Numbers of farmers (registered-763 and viewed-203) staff members (registered-190 and viewed-179) attended the webcast of Hon'ble Prime Minister's address during the release of Samman Nidhi Funds both physically and virtually.

Address of Hon'ble Prime Minister and Union Minister of Agriculture and Farmers Welfare during PM-Kisan Samman Nidhi Fund release

During this occasion Director, ICAR-CRIJAF, Dr. Gouranga Kar addressed the farmers and elaborated about the frontline Govt. Schemes implemented by Govt. of India. He appealed the farmers to avail benefit of these schemes especially Kisan Samman Nidhi for improved technology-based farming. He also informed the farmers that ICAR-CRIJAF will facilitate the farmers in taking full benefit of these schemes. In the farmers-scientists interaction programme, Dr. Tanmay Samajdar, Head, KVK, North-24 Parganas welcomed the farmers and appealed that the farmers to be aware of different Govt. schemes for betterment of their farming. The HoDs, I/c. of sections and other senior officials also addressed the farmers. In this occasion, a training programme on "IPM in jute based cropping system" was also organized.

ICAR-CRIJAF staff & farmers viewing the programme

Director & Scientists, ICAR-CRIJAF, Barrackpore, interacting with a farmer

17.4. Events organized by ICAR-CRIJAF KVKs

17.4.1. Events organized by ICAR-CRIJAF KVK, Burdwan

Table 53. Lists of events organized by KVK, Burdwan

Extension Activity	Date/duration	No. of participants
Webcast of Global Potato Conclave	28 January, 2020	40
ICAR 92nd Foundation Day	16 July, 2020	16
Webcasting programme of 'Inauguration of Rani Lakhmi Bai CAU, Jhansi by our Hon'ble PM	29 August, 2020	27
Parthenium Awareness Week	16-22 August, 2020	7
Farmers Group Meeting	1 February, 2020 15 February, 2020	25
Mahila Kisan Diwas	15 October, 2020	21
Birth Day Celebration of Gandhi	02 October, 2020	23
Vigilance Awareness Week	27 October to 02 November, 2020	45
Celebration of "Constitution Day" on 26.11.20	26 November, 2020	8
World Soil Day	15 December, 2020	31

Mahila Kisan Diwas

International Women Day

Webcast of Global Potato Conclave

Live Telecast of 92nd Foundation Day of ICAR

Training of Anganwadi Worker during Poshan Abhiyan

Program on Poshan Abhiyan

17.4.2 Events Organized by ICAR-CRIJAF KVK, North 24 Parganas (Additional)

Table 54. Lists of events organized by KVK, North 24 Parganas

Event Name	Date/duration	No of participants
Farmers Sensitization Programme on NADCP for FMD & Brucellosis and National Artificial Insemination Programme	17 March, 2020	50
Post Amphan Management of Jute" and "Swacchhata Activities during Covid-19 Pandemic"	18 June, 2020	19
Live telecast of 92nd Foundation Day of ICAR	16 July, 2020	
Mahila Kisan Diwas-2020	15 October, 2020	20
World Soil Day	5 December, 2020	28
Awareness Programme on Swachha Bharat Abhiyan-2020	20 October, 2020	20
Awareness Programme on Swachha Bharat Abhiyan-2020	24 September, 2020	12
Cleanliness Drive under Swachha Bharat Abhiyan-2020	29 September, 2020	15

World Soil Health Day

Mahila Kisan Diwas celebration

18. Research Projects

In-house Research Projects

Project code	Project title	Investigators	Duration
Crop Improvement			
JB 10.1	Genetic improvement of jute genotypes against biotic stresses	*A. Anil Kumar, Maruthi R.T., K. Mandal and B.S. Gotyal*	2015-20
JB 1.1	Introduction, maintenance, characterization and conservation of jute, mesta and flax germplasm	*J. Mitra, A. Bera, A. Anil Kumar, Maruthi R.T., S.K. Sarkar and K. Das*	1977-Long Term
JB 10.3	Genetic improvement of flax (*Linum usitatissimum*) for higher fibre productivity and fibre quality	*J. Mitra, D. Saha, K. Mandal and Shiva Kumar K.V.*	2016-22
JB 10.4	Genetic improvement of jute and mesta for diversified end use	*P. Satya, D. Sarkar, S.K. Pandey, S. Roy and S. Ray*	2017-21
JB 10.0	Genetic enhancement of kenaf using conventional and molecular approaches for fibre yield and quality improvement	*S.K. Pandey and P. Satya*	2015-20
JB 10.2	Genetics of self-compatibility and development of improved fibre yielding populations in Sunnhemp (*Crotalaria juncea* L.)	*Maruthi R.T. and S. Datta*	2015-20
JB 10.5	Maximizing fibre productivity in jute through genetic and agronomical approaches	*V. Mangal, J.K. Meena, P. Satya, J. Mitra, D. Sarkar, A.R. Saha, R.K. De and S. Mitra*	2020-25
JB 10.6	Introgression of low pectin content into high yielding jute varieties	*A. Anil Kumar, Maruthi, R.T, B. Majumdar and Veda Krishnan*	2020-25
JST 6.2	Jute-Mungbean Intercropping: A statistical perspective	*A.K. Chakraborty, N.M. Alam and A.K. Ghorai*	2019-21
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
JB 9.3	Towards harnessing cell technological approaches for enhancement of jute and allied fibres	*A.B. Mandal and Kanti Meena*	2013-20
JBT 4.6	Fixation of a multiparent advanced generation inter-cross (MAGIC) population of *Corchorus olitorius*	*D. Sarkar, P. Satya, S. Ray*	2017-20
JBT 4.7	Mining novel alleles for genome engineering applications for herbicide and stress tolerance in jute and allied fibres	*S. Datta., J. Mitra, D. Saha, P. Satya and A. Anil Kumar*	2017-22
JBT 4.8	Identification of host genes related to stem rot disease resistance in jute and development of segregating population for resistance gene mapping	*S. Ray, P.Satya, K. Mandal and K. Das*	2018-21
Crop Production			
JA 7.3	Development of low-cost and eco-friendly integrated weed management technologies for jute	*A.K. Ghorai, S. Roy and B. Majumdar*	2017-20
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, A.K. Chakraborty and S. Roy*	2019-21
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. Sarkar and S.K. Jha*	2018-21
JA 7.6	Improvement of soil carbon stocks and farm productivity through integrated cropland management practices in jute cultivation areas (A farmer's participatory research)	*A.K. Singh, A.K. Ghorai, R. Saha and M.L. Roy*	2018-23

Project code	Project title	Investigators	Duration
JA 7.1	Climate change risk assessment in jute production and related advisory services through Decision Support System (DSS)	*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
JA 7.2	Soil health characterization and carbon sequestration potential in ramie based cropping system in North Eastern India	*S.P. Mazumdar, S. Mitra, A.R. Saha, B. Majumdar and K. Das*	2016-20
JA 7.8	Studies on nitrogen dynamics under rice-flax cropping system	*S.P. Mazumdar, D. Barman and M.S. Behera*	2018-21
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 5.7	Conservation agricultural practices of jute based cropping systems under climate change scenario	*R. Saha, M.S. Bahera, A.R. Saha, B. Majumdar, S.P. Mazumdar, D. Barman, R.K. Naik and L. Sharma*	2015-20
JAE 3.4	Development of multi-crop manual seed drill and dry land weeder for Gangetic Alluvial soil	*R.K. Naik, A.K. Ghorai, S. Sarkar and S.K. Jha*	2014-21
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 productionin jute and mesta	*R.K. Naik, B. Majumdar, S.P. Mazumdar and M.S. Behera*	2015-20
JA 6.9	Prospects of growing spices, medicinal and aromatic plants in jute and sisal based cropping systems	*M.S. Behera, A.K. Jha, S. Satpathy and R.K. Naik*	2014-20
JA 7.5	Physiology of flowering behaviour of jute under different photoperiod regimes	*S. Roy, P. Satya, D. Sarkar, L. Sharma, A.K. Jha and H.R. Bhandari*	2017-20
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
JA8.4	Expansion of flax area in pilot scale with improved technologies	*S. Mitra, J. Mitra, S. Sarkar, C.S. Kar, S.K. Pandey, S.K. Jha, R.K. Naik, K. Das, Shiva Kumar K.V. and M.S. Behera*	2020-23
JA 8.1	Leaf litter management: Decomposition and nutrient dynamics of leaf litter composts and its effects on JAF crops	*A.K. Singh, A.K. Ghorai, B. Majumdar, S. Mitra, M.S. Behera, S.K. Sarkar and S. Satpathy, V. Mangal and M.L. Roy*	2020-23
JA 8.2	Upgraded mechanical weeder and novel herbicides for efficient weed management in jute	*S. Sarkar, A.K. Ghorai, R.K. Naik, B. Majumdar and D. Datta*	2020-23
JA 8.3	Quantification of emission of green-house gases in conventional and improved jute retting	*B. Majumdar, S.P. Mazumdar and P. Bhattacharya, Rachna Dubey, (Scientists from AINP-Kathihar and AINP-Kendrapara)*	2020-25
Crop Protection			
JE 1.9	Bio-ecology and management of sucking pests of jute	*S. Satpathy, B.S. Gotyal and V. Ramesh Babu*	2016-21
JM 9.1	Investigation on diseases of flax and their management	*S. K. Sarkar and K. Mandal*	2017-21
JM 9.2	Isolation, characterisation and application of *Trichoderma* for disease management	*K. Mandal, S.K. Sarkar, R. Saha*	2018-21
JM 9.0	Development of IPM module for jute	*R.K. De, V. Ramesh Babu and Shamna A.*	2015-21
JM 9.3	Use of nanoparticles for managing pests and diseases in jute	*C. Biswas and V. Ramesh Babu*	2018-23
JM 9.4	Development of IPM module for jute and mesta	*R. K. De, S. Satpthay, V. Ramesh Babu and Shamna A.*	2020-25
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 and V. Ramesh Babu*	2019-23

Project code	Project title	Investigators	Duration
JE 2.0	Identification of microbial entomo-pathogens for management of major lepidopteran pests of jute	*V. Ramesh Babu, G. Siva Kumar K.V. and S. Satpathy*	2018-23
JE 2.2	Risk assessment through modelling 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
JE 2.3	Decision support system for pest management in jute	*V. Ramesh Babu, S.K. Sarkar, S.K. Pandey and N.M. Alam*	2020-23
Agricultural Extension			
JEXA 6	Impact assessment of CRIJAF technologies in Jute-ICARE areas of West Bengal	*S. Kumar, S.K. Jha, Shamna A., M.L. Roy and N.M. Alam*	2019-21
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, S. Satpathy and A.K. Chakraborty*	2017-20
JEXA 5.9	Scope of value chain development in jute and role of farmer-producers' organizations	*Shamna. A, S.K. Jha, T. Samajdar, R.K. Naik, A. Bera, S.P Mazumdar, B.S. Gotyal and N.M. Alam*	2019-22
JEXA 6.1	Analysis of yield gap and contribution of production factors in cultivation of jute	*S.K. Jha, M.L. Roy, A.K. Ghorai, S. Mitra, Ritesh Saha, S.P. Mazumdar, R.K. Naik and A. Chakraborty, (AINP Centre In-charges)*	2020-25
JEXA 6.2	Enhancing farm income through up-scaling of jute based bio diversified products as an alternative to plastics	*Shamna. A, S.K. Jha, S. Kumar and M.L. Roy*	2020-24
Sisal Research Station			
SLM 1.2	Management of Alternaria leaf spot of sisal *Agave sisalana*) through eco-friendly approach	*A.K. Jha*	2019-22
SLA 1.6	Use of drip irrigation for improving productivity of sisal-based fruit fibre system in the central plateau region of India	*M.S. Behera and A.K. Jha*	2015-20
SLA 1.7	Effect of planting materials and fertilizer levels on growth and yield of sisal Agave sisalana) and hybrid sisal	*S. Sarkar, M.S. Behera, A.K. Jha, B. Majumdar and R.K. Naik*	2018-23
SLA 1.8	Integrated farming system in sisal plantation under organic management package	*M.S. Behera, R Saha, S. Sarkar and A.K. Jha*	2018-23
SLA 1.9	Area expansion strategy under sisal farming in India with modern production technologies	*M.S. Behera, S. Sarkar, A.K. Jha, A.R. Saha and D. Datta*	2020-23
Sunnhemp Research Station			
SNHM 1.1	Management of sunnhemp wilt	*Shivakumar K.V. and S.K. Sarkar*	2019-22
Ramie Research Station			
RA 1.1	Development of improved weed management strategies to enhance fibre and rhizome productivity of ramie in north-eastern India	*K. Das, S. Sarkar, B. Majumdar and R.K. De*	2019-23
RA 1.2	Expansion of ramie-based farming system with improved genotypes and technology	*Kajal Das, C.S. Kar, M.S. Behera, S. Sarkar, S. Mitra, R.K. De and R.K. Naik*	2020-23
Central Seed Research Station for JAF			
CSRSJAF 1.0	Investigations on crossing barriers in inter-specific crosses in the genus *Crotalaria*	*H.R. Bhandari and Maruthi R.T*	2017-20
CSRSJAF 1.1	Development of high fibre yielding jute genotypes through hybridization	*H.R. Bhandari, C.S. Kar, Vikas Mangal and J.K. Meena*	2019-21

Externally Funded Projects

Project Title	Principal Investigator	Funding agency	Duration
ICAR Seed Project	*C.S. Kar*	ICAR-New Delhi	Long term
NFSM- Commercial Crops Jute	*C.S. Kar*	MoAFW, New Delhi	Long term
AICRP- National Seed Project Crops	*C.S. Kar*	ICAR-New Delhi	Long term
Protection of jute varieties and DUS testing project	*A Bera*	DAC	Long-term
National Carbon Project: Quantitative assessment of carbon and moisture fluxes over Jute based agro-ecosystem: Integrating ground observations, satellite data and modelling	*D. Barman*	ISRO-NRSC	*2018-20*
ICAR-NPTC- sub-project 3070: Functional genomics: Jute	*D. Sarkar*	ICAR-NPTC	*2015-19*
Impact of tropospheric ozone on crop production under jute-rice cropping system	*A.K. Singh*	NICRA	2018-20
To study changes in soil quality, crop productivity and sustainability under jute-rice-wheat cropping system (LTFE)	*A.R. Saha*	JC 5.2 AICRP-LTFE	Long-term
Soil test and resource based integrated plant nutrient supply system for sustainable agriculture	*A.R. Saha*	JC 5.6 AICRP-STCR	Long-term
Long term effect of ST-TY equation based INM on yield, value addition, nutrient budgeting and quality of soil under jute-rice-lentil sequence	*A.R. Saha*	JC 5.6a AICRP-STCR	Long-term
Assessment of vulnerability of jute production to climate change and its mitigation strategies development using remote sensing GIS in West Bengal	*D. Barman*	DST, WB	2018-21
The impact of Heat Shock Factors in regulating heat stress-induced epigenomic changes: a case study in flax (*Linum* spp.)	*D. Saha*	SERB, DST	2019-22
Frontline demonstration on jute under NFSM (CC) Jute	*S.K. Jha*	NFSM Sub project	2014 -Long term

19. Publications

19.1. Research Papers

Barai, S., Chattopadhyay, L. and Majumdar, B. (2020). Studies on delignification in jute (*Corchorus spp* L.) fibre with promising lignin degrading bacterial isolates. *Journal of Environmental Biology*, 41: 703-710.

Datta, D., Chandra, S., Chaturvedi, S., Bhatnagar, A., Singh, G. and Singh, V. (2020). Spring sweet corn (*Zea mays*) response to irrigation levels, sowing methods and moisture conservation practices. *Indian Journal of Agricultural Sciences*, 90(5): 150-154.

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Sivakumar, G., Kannan, M., Ramesh Babu, V., Mohan, M., Kumari, S., Rangeshwaran, R., Venkatesan T. and Ballal, C. (2020). Characterization of nucleopolyhedrosis virus of *Spilosoma obliqua* (SpobNPV) strain NBAIR 1 against jute hairy caterpillar. *Eygptian Journal of Biological Pest Control*. doi.org/10.1186/s41938-020-00282-5.

Ghorai, A.K and Mazumdar, S.P. (2020). Jute and mesta stick charcoal production by using smokeless fire in kon-tiki-kiln, an open earth pyrolysis process. DOI:10.13140/RG 2.2.3309.94889

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GIS. *Journal of Agricultural Physics,* 19(2): 176-184

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Kharbikar, H.L., Roy, M.L., Joshi, P., Mukherjee, A., G.A. Atheequlla and Chandra, N. (2020). Economic empowerment of small, marginal and landless farmers through value addition in button mushroom (*Agaricus bisporus*): A success story from Almora district of Uttarakhand. *International Journal of Advanced Research and Review*, 5(3):123-130.

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Rahman, F.H., Ghorai, D., Sarkar, S., Kundu, S.S. and Das, S. (2020). Doubling farmers' income through integrated farming system approach in Purba Barddhaman district of West Bengal. *Current Journal of Applied Science and Technology*, 39(24): 133-141.

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19.2. Review Papers

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19.3. Technical Bulletins

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19.4. Book Chapters

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Gotyal, B.S., Satpathy, S. and V. Ramesh Babu (2020). Bio-Intensive integrated pest management of spice crops. In: Anil Kumar, Swati Saha and Jaipal Singh Choudhary (Eds.) Bio- Intensive Integrated Pest Management for Horticultural Crops. New India Publishing Agency, New Delhi-110034. ISBN no: 978-93-86546-00-0. pp. 303-318.

19.5. Training Manuals

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Mazumdar, S.P., Shamna, A., Sharma, L., Gotyal, B.S. and Alam, N.M. (2020). Training manual on "Technological empowerment of farm women." ICAR-CRIJAF, Barrackporel, pp.39.

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19.6. Popular Articles

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19.7. Leaflets/Folders

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20. Awards and Recognitions

20.1. Awards

- Dr. B. S. Gotyal, Senior Scientist was awarded with "Young Scientist Award' for the biennium 2018-19 conferred by the Prof. T. N. Ananthkrishnan Foundation, Chennai, India for his contribution and achievement in the field of Agricultural Entomology on 15 December, 2020.

Dr. B. S. Gotyal receiving 'Young Scientist Award' at Chennai

- Dr. S. Satpathy, Head, Crop Protection Division was conferred with AZRA-Fellowship Award-2019 for his research contribution in biology and bionomics of major insect pests of jute and their management during the International Conference on "Frontier Research in Applied Zoology and Insect Pest Management Strategies : A way Forward for Food and Nutritional Security" held at UAS, Raichur, 12-14 February, 2020.
- Dr. R.K. Naik, Senior Scientist has been awarded as Fellow (F-1271462) of Agricultural Engineering Division of the Institution of Engineers (India), Kolkata on 05 November, 2020.
- Dr. Sonali Paul Majumdar awarded with STE Women Excellence Award conferred by Save the Environment (STE) - A Society for Research, Awareness and Social Development, Kolkata, West Bengal in the International Conference on Environment, Water, Agriculture, Sustainability and Health (EWASH – 2020): Expanding our vision post COVID-19 on 20 December, 2020.
- Alam, N.M., Gotyal, B.S., Barman, D., Satpathy, S., Mitra, S. and Sarkar, S.K. (2020) received Best Poster Award in National Seminar on "Agrometeorological intervention for enhancing farmers' income (AGMET-2020) during 20-22 January, 2020 at Kerala Agricultural University.
- Dr. Shamna A., Senior Scientist was conferred Best Oral Presentation Award for the paper entitled "Farmers Producers Organization: A Means to Empower Farmers and Farm Women Groups" at International Extension Education Conference on "Role of NGOs in Extension services: opportunities and challenges" organised by Institute of Agricultural Sciences, Banarus Hindu University , Varanasi, U.P during 27 to 30th December 2020.

20.2. Recognitions

- Dr. B. Majumdar participated as an expert in the "*Aajker Chas Bas*" programme for farming community of West Bengal on a topic "*Sathik Paddotite Pat Jag Deoyar Upay*" broadcasted by Akashbani Kolkata (Gitanjali) on 29 August, 2020 at 07.10 pm.
- Dr. B.S. Gotyal acted as Panelist and delivered a lecture on "An overview on the production of jute and allied fibres in India" in the Webinar on "Role of natural fibres for atma nirbhar bharat" organized by The Institute of Natural Fibre Society (TINFS), NINFET, Kolkata during 27-28 November, 2020.
- Dr. Anil Kumar delivered an invited lecture on "Pre-breeding and its implications in crop improvement" in NAHEP-CAAST training programme on "Pre-breeding and molecular breeding approaches: two main pillars for the vegetable and crop improvement" at ICAR-NIPB, New Delhi on 20 February, 2020.
- Dr. Manik Lal Roy was invited as Convener for the Technical Session on the Theme "NGO in basic Rural Development Issues" held on 29 December, 2020 during International Extension Education Conference during 27-30 December, 2020 at BHU, Varanasi.
- Dr. R.K. Naik, Senior Scientist was nominated as Expert for evaluation and assessment of proposals for NRDC National Meritorious Invention Award by National Research Development Corporation (Awards Division), Ministry of Science & Technology, Govt. of India, New Delhi.
- ICAR-CRIJAF and KVK, Burdwan Exhibition Stall was awarded "Consolation Prize" at Livestock-cum-Agricultural Mela organized by ICAR-NDRI ERS, Kalyani at Raipur-Supur, Bolpur, on 6 February, 2020.

21. Activities during COVID-19 using ICT and Media Coverage

In the backdrop of the onslaught of COVID-19 pandemic, it was a difficult year for ICAR-CRIJAF as peak jute growing season during March-April coincided with nationwide lockdown. The institute has done a commendable job by responding positively to the challenges and reached the farmers and stakeholders by using information technology tools like Android based apps (JAF-Safe) and web based form (JAF-Kisan), WhatsApp groups and institute's website. Mandatorily the institute issued agro-advisory and safety measures for farmers and jute mill workers. Several leading regional and national media also highlighted the agro-advisories and contingency measures to be followed by the farmers.

21.1. Development and use of mobile Apps for technology outreach

The institute has developed two android based Apps i.e., JAF-Safe and JAF-Kisan. By using JAF-Kisan App, the field functionaries can upload the data, photos and videos related to the field operations and crop condition directly from the farmers' field and can get solution from experts. JAF-Safe app is useful for farmers in diagnosis and management of major pests and diseases of JAF crops. Under Jute I-CARE programme, 65 master trainers engaged in all the jute growing states were coordinated through JAF-KISAN App. Scientists and field functionaries, after assessing the situation at field level and interaction with the farmers updated the essential agricultural operations like seed availability, jute sowing operation, management of drought and waterlogging situation using different digital which proved very much useful for farmers especially during the COVID-19 pandemic.

JAF Safe and Web-based form used under Jute I-CARE

21.2. Technology backstopping for jute growers to mitigate effects of COVID-19

Jute sowing and peak growing season was coincided with COVID-19 pandemic lockdown period across the jute growing states and it was a great challenge for the Institute to execute the crop sowing in experimental fields and implementation of various projects in farmer's field. Farm inputs availability and technology backstopping to the farming community and beneficiary of different government schemes like ICARE, NFSM, SCSP, NICRA etc in West Bengal, Bihar, Assam and Odisha was ensured. The institute has facilitated all possible farming operations to famers so that they can sow the crop at right time; even seeds of improved varieties were supplied to needy farmers.

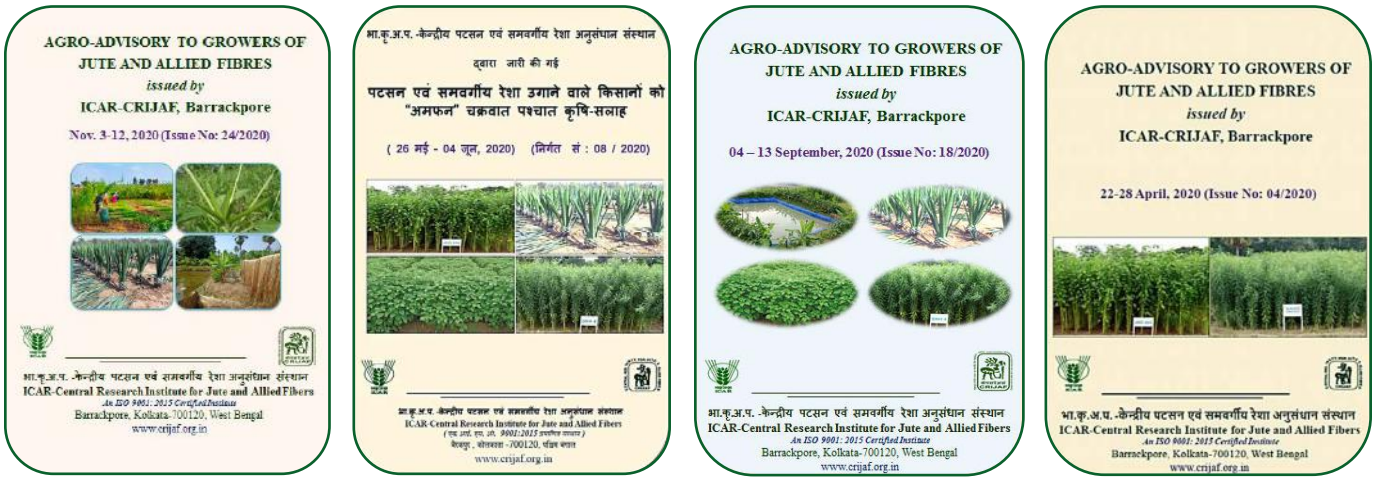
The scientists were also in contact with individual farmers, progressive farmers, farmer's club, FPOs and closely monitored the progress of jute sowing in all jute growing states through WhatsApp, SMS, Mobile App, Website and local media. The organizations like, Jute Corporation of India, National Jute Board and the State Agriculture Department of concerned states were sensitized through video conferencing and coordinated for the availability of improved seed, other inputs and progress of jute sowing in the respective states. Under Jute I-CARE programme, 603 MT seeds of JRO 204, 600 seed drill, and 900 cycle weeders developed by the Institute were provided to the farmers.

Seven technologies of the institute pertaining to jute and allied fibre crops have so far been given wide coverage through different digital platforms. This technological backstopping done during the lockdown period could reach more than 8 lakh beneficiaries through different channels. Constant efforts of the Institute helped the farmers to adopt frontline technologies like use the high yielding variety of jute (JRO 204), line sowing, and proper use of fertilizers, pesticides, herbicides and mechanical weeding. Under the SCSP and NFSM programme seeds of improved jute varieties were provided to the farmers and jute-green gram inter-cropping was implemented in 20 ha area in North 24 Pgs.

Jute – Green gram intercropping in Research Farm and Farmer's field during COVID-19 lockdown

21.3 Agro-advisory for jute and allied fibres through Institute's website

The farmers' problems related to jute and allied fibre farming were addressed with proper technology backstopping in time. Agro-advisory was released regularly (at every 10 days interval) to assist the farmers with pictorial farming tips as per phonological stage of the jute and allied fibre crops in English, Hindi and Bengali. This service has helped the farmers, extension officers, field functionaries to solve the jute farming related problems. Through the agro-advisory, ICAR-CRIJAF also suggested famers and jute mill workers to follow social distancing, safety measures and to maintain personal hygiene to prevent spread of COVID-19 virus. Several leading regional and national media also highlighted the agro-advisories and contingency measures to be followed by the farmers. These advisories have also been e-mailed to State Governments in local language and have enriched knowledge of about 5 lakh farmers.



Agro-Advisory released during COVID-19 lockdown for farmers and extension personnel

During the COVID-19 crisis, a very severe cyclone 'Amphan' made landfall on 20th May 2020, lashing with maximum wind speed of about 155 kmph and 200 to 230 mm rainfall devastated the jute crop in some parts of North 24-Parganas, Hooghly, Nadia, Murshidabad, East Midnapur and Howrah districts which are main jute growing belt of West Bengal. The effect of cyclone was also observed in some districts of Assam and Odisha. The cyclone severely affected the standing jute crop by lodging and waterlogging. Institute released the cyclone forecast and possible impact on crops advisory to tackle the post-AMPHAN cyclone scenario. The advisory mainly emphasized on adequate drainage by making the ditches in the field, tying together of plants for straightening the plants and spraying of protective fungicides to younger seedlings to protect the crop from diseases like blight and damping off.

Impact of AMPHAN cyclone on jute crop

Agro-advisory released by ICAR-CRIJAF to revive the damaged crop

21.4. Extensive media coverage through print media

Besides the agro advisory portal and use of other digital platforms, the institute also concentrated to highlight the issues related to input availability, impact of major changes of weather and its effect on crop, timely awareness regarding insect-pests problems, availability of farm machineries etc. for jute cultivation through print and electronic media. The institute prepared timely news articles for press release through national and regional newspapers in English, Hindi and Bengali. During the lockdown period CRIJAF has published more than 50 press news through newspapers and broadcasted one AIR news for farmers and other stakeholders in jute sector.

News articles published in different news papers

21.5. Video conferencing for conducting important meetings

Director and scientists of ICAR-CRIJAF used Google Meet / Zoom app for conducting and participating in important meetings of Council and Ministry of Agriculture and Farmers Welfare, Govt. of India, other ICAR Institutes, National Innovations in Climate Resilient Agriculture (NICRA),

National Jute Board (NJB), Jute Corporation of India (JCI), Ministry of Textiles, State Government officials to ensure timely and proper execution of Institute and project activities. During the lockdown period, many important meetings including the Divisional Research Council (DRCs) and Institute Research Council (IRC) were conducted through video conferencing. More than 45 meetings/programmes were conducted online during the year.

Divisional Research Council meeting through video conferencing

21.6. Social-economic Empowerment

To tackle the post COVID and AMPHAN, the institute has started working for social and technological empowerment for different social groups through value added diversified products from jute and allied fibre crops. The *in-situ* jute retting tank based farming system model developed by the institute during lockdown period created employment opportunities for migrant workers after converging with MNREGA schemes.

21.7. Complete e-governance through use of e-file system

About 750 e-files processed during lockdown, highest number of e-file handling among crop science institutes and second among all ICAR institutes. Complete replacement of physical file movement has been made through e-file system.

22. 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 कक्ष है, इसमें एक वैज्ञानिक हिन्दी प्रभारी के रूप में तथा एक सहायक कार्यरत हैं।

22.1. राजभाषा गतिविधियाँ

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.अ.सं. में हुई इन उपलब्धियों का संक्षिप्त विवरण प्रस्तुत हैं:-

22.2. प्रशासनिक उपलब्धियाँ

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

1. अधिकांश विहित फार्मों एवं सभी मानक मसौदे द्विभाषी हैं।
2. अधिकांश रजिस्टरों के शीर्षक द्विभाषी हैं। इसके अलावा 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।
3. 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।
4. अन्य भाषा-भाषी लोगों के हिन्दी शब्द ज्ञान हेतु प्रतिदिन हिन्दी का एक शब्द 'आज का शब्द' लिखा जाता है।
5. 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।
6. संस्थान के सभी कम्प्यूटरों में द्विभाषी रूप में काम करने के लिए यूनीकोड की सुविधा उपलब्ध है तथा कुछ कम्प्यूटरों पर कृतिदेव पर भी काम किए जा रहें हैं।
7. 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 हैं।
8. नगर राजभाषा कार्यान्वयन समिति, कोलकाता (कार्यालय-2) (सीएसआईआर-केन्द्रीय काँच एवं सिरामिक अनुसंधान संस्थान, कोलकाता-700032) की छमाही बैठकों में संस्थान के ओर से अधिकारी/कर्मचारी भाग लेते रहते हैं।
9. हिन्दी अनुभाग में प्रविष्टियाँ, टिप्पणी, मसौदा लेखन व अन्य कार्य हिन्दी में होते हैं।
10. संस्थान में ई ऑफिस के माध्यम से भी हिन्दी में कार्य करने की सुविधा उपलब्ध है।
11. संस्थान के अन्य अनुभागों/प्रभागों में प्रविष्टियाँ, टिप्पणी, मसौदा लेखन व अन्य कार्य हिन्दी में किए जा रहें हैं।
12. हिन्दी में प्राप्त पत्रों के शत-प्रतिशत उत्तर हिन्दी में ही दिए जाते हैं।
13. 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।
14. 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। इस वित्तीय वर्ष 2020-21 में संस्थान के प्रशासनिक वर्ग के अधिकारियों /कर्मचारियों को कार्यालय में प्रयोग में आने वाली टिप्पणियाँ एवं प्रारूप-लेखन की पुस्तकों को क्रय कर वितरित की गई।
15. 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 2019-20 में संस्थान के सात कर्मचारियों को पुरुस्कृत किया गया।
16. भारतीय कृषि अनुसंधान परिषद के दिनांक 31.03.1991 के परिपत्र के अनुसार संस्थान की राजभाषा कार्यान्वयन समिति की बैठकें क्रमश: दिनांक 02.03.2020, 29.06.2020, 29.09.2020 एवं 23.12.2020 को आयोजित की गई।
17. राजभाषा विभाग द्वारा आयोजित (केन्द्रीय हिन्दी प्रशिक्षण उप संस्थान, 1 कौंसिल हाउस स्ट्रीट, कमरा नं. 423, तीसरा तल कोलकाता-700001) पाँच पूर्ण कार्य दिवसीय कंप्यूटर पर हिंदी में काम करने के लिए बेसिक प्रशिक्षण कार्यक्रम दिनांक 10.02.2020 से 14.02.2020 तक संस्थान के दो अधिकारियों/कर्मचारियों ने प्रशिक्षण प्राप्त किया।

22.3. 7 मार्च, 2020 को एक दिवसीय हिन्दी कार्यशाला का आयोजन

भाकृअनुप-केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान, बैरकपुर, कोलकाता में दिनांक 07.03.2020 को पूर्वाह्न 11.00 बजे से 01.00 बजे तक एवं अपराह्न 02.00 बजे से 04.00 बजे तक संस्थान के डॉ. जीबन मित्र, प्रभागाध्यक्ष, फसल सुधार प्रभाग की अध्यक्षता में "राजभाषा का कार्यालय में प्रयोग, राजभाषा नीति, नियम तथा हिन्दी टिप्पण/मसौदा लेखन" एवं यूनिकोड विषय पर एक दिवसीय हिन्दी कियार्यशाला का आयोजन किया गया। कार्यशाला में तकनीकी एवं प्रशासनिक वर्ग के लगभग 65 प्रतिभागियों (29 अधिकारी और 36 कर्मचारी) ने भाग लिया।

सर्वप्रथम सत्राध्यक्ष डॉ. जीबन मित्र जी ने सभी प्रतिभागियों तथा हिन्दी विशेषज्ञ, श्री लखन कुमार सिंह, हिन्दी प्राध्यापक, राजभाषा विभाग, गृह मंत्रालय, भारत सरकार, कोलकाता का स्वागत करते हुए सत्र आरम्भ करने का अनुरोध किया। इस दौरान संस्थान के प्रधान वैज्ञानिक, डॉ. चन्दन सौरभ कर, डॉ. एस. के. झा, डॉ. सुरेन्द्र कुमार पाण्डेय, डॉ. ए. के. घोराई, मुख्य प्रशासनिक अधिकारी, श्री पी. के. जैन तथा वित्त एवं लेखा अधिकारी, श्री गौरांग घोष ने भी इस कार्यशाला के आयोजन की आवश्यकता पर प्रकाश डाला तथा इस कार्यशाला का कुशल संचालन श्री विकास मंगल, वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष एवं श्री मनोज कुमार राय, सहायक के द्वारा किया गया।

डॉ. जीबन मित्र, प्रभागाध्यक्ष, फसल सुधार संस्थान के अधिकारियों/कर्मचारियों को सम्बोधित करते हुए

परिचयात्मक सत्र में श्री सिंह ने सर्वप्रथम सत्राध्यक्ष, डॉ. जीबन मित्र, प्रभागाध्यक्ष, फसल सुधार प्रभाग का विशेष आभार व्यक्त करते हुए आयोजन समिति के अधिकारियों/कर्मचारियों और प्रतिभागियों को धन्यवाद दिया तथा राजभाषा कार्यान्वयन पर विस्तार से चर्चा की। उन्होंने विषय संबंधी सत्र शुरू करने से पहले सभी कर्मचारियों का हिन्दी संबंधी ज्ञान का जायजा लिया तत्पश्चात इन्होंने राजभाषा हिन्दी के कार्यान्वयन एवं सरकारी कार्यालयों में हिन्दी की उपयोगिता एवं अनिवार्यता पर विस्तार पूर्वक चर्चा करते हुए विभिन्न प्रकार के टिप्पणी (नोटिंग) एवं मसौदा (ड्राफ्टिंग) के बारे में विस्तार से चर्चा की। इसके साथ ही साथ उन्होंने अंग्रेजी से हिन्दी में अनुवाद करते समय उसकी बारीकियों को सोदाहरण समझाया तथा अनुरोध किया कि धारा 3(3) के सभी दस्तावेज़ अवश्य द्विभाषी रूप में ही जारी किए जाए। इस दौरान इन्होंने राजभाषा अधिनियम, संकल्प एवं राजभाषा संबंधी प्रमुख निदेशों को विस्तार से बतलाया।

द्वितीय सत्र में भाकृअनुप-प्राकृतिक रेशा अभियांत्रिकी एवं प्रौद्योगिकी संस्थान के सहायक निदेशक (राजभाषा), श्री आर. डी. शर्मा द्वारा पावर प्वाइंट प्रेजेंटेशन के माध्यम से "यूनिकोड" पर एक व्याख्यान भी प्रस्तुत किया। अंत में कार्यशाला में उपस्थित सभी प्रतिभागियों के प्रति एवं श्री मनोज कुमार राय, सहायक के धन्यवाद ज्ञापन के साथ कार्यशाला सम्पन्न हुआ।

श्री लखन सिंह, हिन्दी विशेषज्ञ, संस्थान के अधिकारियों/कर्मचारियों को हिन्दी कार्यशाला में प्रशिक्षण प्रदान करते हुए।

22.4. 26 जून, 2020 को एक दिवसीय हिन्दी कार्यशाला का आयोजन

भाकृअनुप-केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान, बैरकपुर, कोलकाता में दिनांक 26.06.2020 को पूर्वाह्न 11.30 बजे से 01.30 बजे तक एवं अपराह्न 02.30 बजे से 04.30 बजे तक संस्थान के निदेशक, डॉ. गौरांग कर जी की अध्यक्षता में सामाजिक दूरी का पालन करते हुए "राजभाषा कार्यान्वयन" एवं "भारतीय संविधान" विषय पर एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया। कार्यशाला में कुल 10 प्रतिभागियों ने प्रत्यक्ष रूप से भाग लिया तथा बाकी सभी अधिकारियों ने ऑनलाइन माध्यम से इसमें भाग लिया।

तदोपरांत सत्राध्यक्ष डॉ. गौरांग कर, निदेशक ने सभी प्रतिभागियों तथा मुख्य वक्ता, श्री राम दयाल शर्मा, सहायक निदेशक (राजभाषा), भाकृअनुप-राष्ट्रीय प्राकृतिक रेशा अभियांत्रिकी एवं प्रौद्योगिकी संस्थान, कोलकाता का स्वागत

करते हुये अपने सम्बोधन में कहा कि इस तरह के कार्यशाला के आयोजन से अधिकारियों एवं कर्मचारियों को न सिर्फ राजभाषा नीति-नियम की जानकारी होगी बल्कि इसके अनुपालन में उनकी भूमिकाओं से भी उन्हें अवगत कराया जा सकेगा। इस दौरान उन्होंने समस्त प्रतिभागियों से अनुरोध किया कि वे इस कार्यशाला के माध्यम से जो भी सीखे हैं उसे अमल में लाएं एवं धारा 3(3) के सभी दस्तावेजों को द्विभाषी रूप में ही जारी करना सुनिश्चित करें, पत्राचार को अधिक से अधिक हिन्दी में करें, ई- ऑफिस में भी टिप्पण एवं मसौदा हिन्दी में करें तथा अधिकाधिक अपना सरकारी कार्य हिन्दी में करने पर बल दिया।

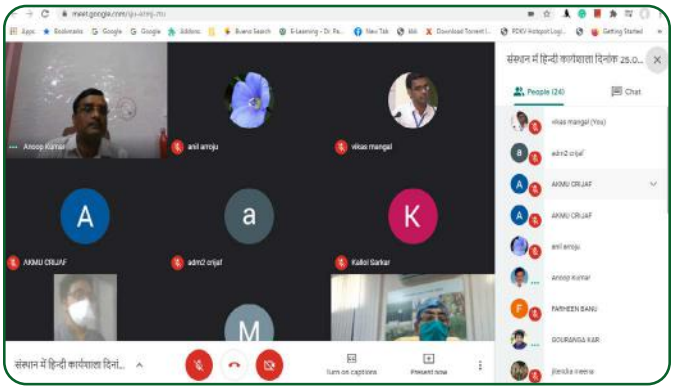
डॉ. गौरांग कर, निदेशक द्वारा संस्थान के अधिकारियों/कर्मचारियों को सम्बोधित करते हुए।

22.5. 25 सितम्बर, 2020 को एक दिवसीय हिन्दी कार्यशाला का आयोजन

भाकृअनुप-केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान, नीलगंज, बैरकपुर, कोलकाता की राजभाषा कार्यान्वयन समिति के तत्वावधान में दिनांक 25 सितम्बर, 2020 को ऑनलाइन माध्यम से एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया। इस कार्यशाला की अध्यक्षता संस्थान के माननीय निदेशक, डॉ. गौरांग कर जी ने की। सर्वप्रथम निदेशक महोदय ने कार्यशाला के मुख्य वक्ता, श्री अनुप कुमार, सहायक निदेशक (आशुलिपिक एवं टंकण) तथा कार्यशाला में ऑनलाइन माध्यम से भाग लेने वाले समस्त अधिकारियों एवं कर्मचारियों का स्वागत करते हुये अपने अभिभाषण में संस्थान के अधिकारियों एवं कर्मचारियों से कार्यालयीन कार्यों में राजभाषा हिन्दी का ज्यादा से ज्यादा प्रयोग करने पर बल दिया।

हिन्दी कार्यशाला में मुख्य वक्ता श्री अनुप कुमार, सहायक निदेशक (आशुलिपिक एवं टंकण) हिन्दी शिक्षण योजना, भारत सरकार, गृह मंत्रालय, राजभाषा विभाग, कोलकाता ने प्रतिभागियों को कम्प्यूटर पर हिंदी में कार्य करने के संबंध में विस्तार पूर्वक जानकारी दी। उन्होंने पावर प्वांट के माध्यम से कम्प्यूटर पर आसानी से हिन्दी में कार्य करने के बारे में बताया। साथ ही ऑनलाइन माध्यम से अनुवाद कैसे किया जाए उसके बारे में भी विस्तृत जानकारी दी। कार्यशाला में कुल 39 प्रतिभागियों (17 अधिकारी और 22 कर्मचारी) ने ऑनलाइन माध्यम से भाग लिया। हिन्दी कार्यशाला के आयोजन में कोविड-19 दिशा-निर्देश का पूर्णतः पालन किया गया।

सहायक निदेशक (राजभाषा), श्री आर.डी. शर्मा ने पावर प्वाइंट के माध्यम से भारतीय संविधान पर चर्चा की। इस दौरान इन्होंने 12 अनुसूचियों, 22 भागों व 5 परिशिष्टों पर चर्चा करते हुए भारत के संविधान सभा के गठन की समयावली पर विस्तार से चर्चा की। इस कार्यशाला का कुशल संचालन श्री विकास मंगल, वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने किया। कार्यशाला के अंत में धन्यवाद ज्ञापन प्रस्तुत करते हुए श्री मनोज कुमार राय, सहायक ने इस कार्यशाला को सफल बनाने के लिए संस्थान के डॉ. गौरांग कर, निदेशक महोदय को विशेष धन्यवाद दिया और कहा कि उन्होंने इस कार्यशाला में जो भी सुझाव दिए हैं उनका अनुपालन निश्चित तौर पर हम सब अपने दैनिक कार्यालयीन कार्यों में करेंगे। हिन्दी कार्यशाला (ऑनलाइन माध्यम द्वारा) का सफल आयोजन श्री विकास मंगल, वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष तथा श्री मनोज कुमार राय, सहायक के द्वारा किया गया। कार्यशाला का समापन श्री मनोज कुमार राय, सहायक के धन्यवाद ज्ञापन के साथ सम्पन्न हुआ।



संस्थान में एक दिवसीय हिन्दी कार्यशाला (ऑनलाइन माध्यम द्वारा) **का आयोजन**

22.6. 22 दिसम्बर, 2020 को एक दिवसीय हिन्दी कार्यशाला का आयोजन

संस्थान में दिनांक 22, दिसम्बर 2020 को संस्थान के अधिकारियों/कर्मचारियों की हिन्दी में कार्य करने की झिझक को दूर करने के उद्देश्य से एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया। कार्यशाला की अध्यक्षता संस्थान के प्रभागाध्यक्ष, फसल सुरक्षा, डॉ. एस. सत्पथी ने की। इस अवसर पर श्रीमती रीता भट्टाचार्य, पूर्व मुख्य प्रबन्धक (राजभाषा), पंजाब नेशनल बैंक (पूर्व यूनाइटेड बैंक ऑफ इंडिया, प्रधान कार्यालय, कोलकाता ने संघ की राजभाषा नीति, नियम, राजभाषा का महत्व एवं राजभाषा अधिनियम/नियम आदि विषयों पर ऑनलाइन माध्यम के द्वारा व्याख्यान दिए तथा अधिकारियों/कर्मचारियों के शंका का समाधान किया।

इस अवसर पर डॉ. एस. सतपथी, प्रभागाध्यक्ष, फसल सुरक्षा ने अपने अध्यक्षीय संबोधन में सभी अधिकारियों/कर्मचारियों का स्वागत करते हुए कहा कि हम सभी का दायित्व है कि कार्यालय का अधिकाधिक कार्य हिन्दी में करने का प्रयास करें। उन्होंने आगे कहा कि कार्यालयीन कामकाज में सरल और सहज हिंदी के प्रयोग पर बल देते हुए यह विचार व्यक्त किया कि राजभाषा का प्रयोग एवं उसका उचित प्रचार-प्रसार हमारा संवैधानिक उत्तरदायित्व है।

संस्थान में हिन्दी कार्यशाला का आयोजन

प्रत्येक अधिकारी/कर्मचारी अपने अन्य कार्यालयीन कर्तव्यों के समान ही इस कर्तव्य को भी पूरी निष्ठा से करें। डॉ. जीबन मित्र, प्रभागाध्यक्ष, फसल सुधार, डॉ. अमित रंजन साहा, प्रधान वैज्ञानिक, फसल उत्पादन, डॉ. सब्यसाची मित्र, प्रधान वैज्ञानिक एवं प्रभारी ए.आई.एन.पी., डॉ. सुनीति कुमार झा, प्रधान वैज्ञानिक एवं प्रभारी, कृषि प्रसार अनुभाग एवं श्री आर. आर. देबानाथ, प्रभारी, वित्त एवं लेखा अधिकारी ऑफलाइन में मौजूद थे। इस कार्यशाला में कुल 08 अधिकारियों/कर्मचारियों ने ऑफलाइन माध्यम से तथा 44 अधिकारियों/कर्मचारियों ने ऑनलाइन माध्यम से भाग लिए। इस हिन्दी कार्यशाला में सरकार द्वारा जारी कोविड-19 के दिशा-निर्देश का पूर्णतः पालन किया गया। हिन्दी कार्यशाला का संचालन विकास मंगल वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने श्री मनोज कुमार राय, सहायक के सहयोग से किया।

श्री मनोज कुमार राय, सहायक के धन्यवाद ज्ञापन के साथ कार्यशाला का समापन हुआ।

22.7. संस्थान में हिन्दी पखवाड़ा समारोह का आयोजन

भाकृअनुप-केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान, नीलगंज, बैरकपुर, कोलकाता में सरकारी काम-काज में राजभाषा के रुप में हिन्दी के प्रति जागरूकता पैदा करने तथा उसके प्रभावों में गति लाने के लिए दिनांक 14 से 28 सितम्बर, 2020 के दौरान हिन्दी पखवाड़ा का आयोजन किया गया, जिसका विधिवत उद्घाटन संस्थान के माननीय निदेशक, डॉ. गौरांग कर जी के द्वारा किया गया। उद्घाटन समारोह ऑनलाइन तथा ऑफलाइन माध्यम से आयोजित किया गया था तथा भारत सरकार द्वारा जारी कोविड-19 दिशा-निर्देश का पूर्णरूपेण पालन किया गया। निदेशक महोदय ने अपने अभिभाषण में हिंदीत्तर भाषी अधिकारियों/कर्मचारियों को हिन्दी पखवाड़ा के कार्यक्रमों/प्रतियोगिताओं में बढ़-चढ़कर भाग लेने की अपील की। उन्होंने, पखवाड़ा के दौरान सभी अधिकारियों एवं कर्मचारियों को प्रत्येक दिवस को हिंदी कार्य दिवस के रूप में मनाने और तदनुसार टिप्पण/आलेखन में ज्यादा से ज्यादा हिंदी का प्रयोग कर हिंदी कार्य की प्रगति को बढ़ाने के लिए प्रेरित किया। इस दौरान संस्थान द्वारा प्रकाशित 'रेशा किरण' पत्रिका का विमोचन भी किया गया। उदघाटन सत्र में 'तात्कालिक भाषण' प्रतियोगिता का आयोजन किया गया था।

उद्घाटन सत्र में अतिथि वक्ता के रूप में श्री विकास कुमार साह, सहायक अधिकारी, एयर इंडिया लिमिटेड को आमंत्रित किया गया था। जिन्होंने राजभाषा के महत्व तथा विकास पर प्रकाश डाला साथ ही संस्थान में हिन्दी कार्यान्वयन की सभी तरह के कार्य एवं प्रोत्साहन योजनाएं लागू करने के लिए भी संस्थान को हार्दिक बधाई दी।

संस्थान के अधिकारियों/कर्मचारियों को संबोधित करते हुए संस्थान के निदेशक महोदय, डॉ. गौरांग कर

डॉ. एस. सतपथी, प्रभागाध्यक्ष, फसल सुरक्षा प्रभाग एवं डॉ. सब्यसाची मित्र, प्रधान वैज्ञानिक एवं प्रभारी, ए.आई.एन.पी. ने ऑनलाइन माध्यम से जुड़ते हुए संस्थान में राजभाषा हिन्दी की प्रगति पर खुशी जाहिर करते हुए सभी अधिकारियों एवं कर्मचारियों को विभिन्न प्रतियोगिताओं में बढ़-चढ़कर भाग लेने की अपील की। डॉ. सुनीति कुमार झा, प्रधान वैज्ञानिक एवं प्रभारी, कृषि प्रसार अनुभाग ने बताया कि हिन्दी भाषा साधारण जनता, किसान भाइयों के साथ संपर्क बनाने का बेहतर माध्यम है क्योंकि इस भाषा को लगभग हर भारतीय समझता या बोलता है। डॉ. सुरेन्द्र कुमार पाण्डेय, प्रधान वैज्ञानिक एवं पूर्व प्रभारी, हिन्दी कक्ष ने संस्थान के समस्त अधिकारियों/कर्मचारियों को कार्यालय में हिन्दी के अधिकाधिक प्रयोग करने पर बल दिया। श्री गौरांग घोष, वित्त एवं लेखा अधिकारी ने भी प्रत्येक अधिकारी/कर्मचारी को अपने शासकीय कार्यों में सीधी व सरल हिन्दी का प्रयोग करने की अपील की।

कार्यक्रम का संचालन करते हुए श्री विकास मंगल, वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने इस सुअवसर पर पावर प्वांइट के माध्यम से हिन्दी कक्ष की ओर से हो रहे गतिविधियों को विस्तार पूर्वक बताया साथ ही 'हिन्दी पखवाड़ा' के अतंर्गत आयोजित किए जाने वाली विभिन्न प्रतियोगिताओं जैसे-तात्कालिक भाषण, हिन्दी निबंध लेखन, वाद-विवाद, कविता-पाठ, हिन्दी अनुवाद, हिन्दी टिप्पण तथा प्रारूप लेखन, हिन्दी श्रुतलेखन, पठन एवं शब्द पर्याय लेखन आदि की जानकारी देते हुए आग्रह किया कि वे प्रतियोगिताओं में अधिकाधिक संख्या में भाग लेकर इस आयोजन को सफल बनाएं। संस्थान

के निदेशक, डॉ. गौरांग कर जी को हिंदी प्रयोग के प्रति उनके प्रयत्न, प्रेरणा और मार्गदर्शन के लिए सभी वक्ताओं ने हार्दिक बधाई और शुभकामनायें दी। कार्यक्रम का समापन श्री मनोज कुमार राय, सहायक के धन्यवाद ज्ञापन के साथ सम्पन्न हुआ।

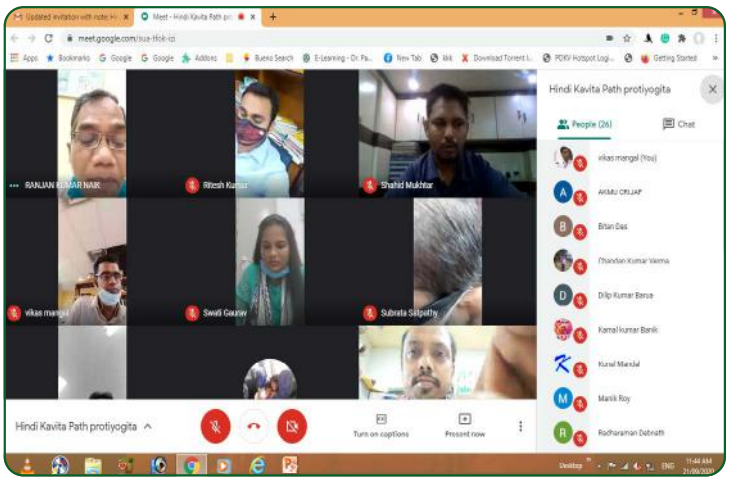
संस्थान की राजभाषा पत्रिका रेशा किरण का विमोचन

संस्थान में बड़े ही उत्साह पूर्ण वातावरण में 'हिन्दी पखवाड़ा' समापन समारोह का आयोजन ऑनलाइन माध्यम से दिनांक 28 सितम्बर, 2020 को किया गया। इस कार्यक्रम की अध्यक्षता कर रहे संस्थान के निदेशक, डॉ. गौरांग कर, ने अपने अध्यक्षीय भाषण में कहा कि हमारा देश परम्पराओं व संस्कृति प्रधान देश है। यद्यपि देश में अनेक भाषाएं बोली जाती हैं मगर राजभाषा का अपना अलग ही स्थान है तथा अब समय आ गया है कि उसे उचित स्थान व सम्मान मिलना चाहिए। उन्होंने संस्थान में राजभाषा कार्यान्वयन की दिशा में अच्छी प्रगति की भी प्रशंसा की। इस अवसर पर उन्होंने कहा कि हिंदी राजभाषा होने के साथ-साथ सरल और सहज भाषा भी है। इसके प्रचार में तीव्र विकास अति आवश्यक है, हिन्दी भाषा साधारण जनता, किसान भाइयों के साथ संपर्क बनाने का बेहतर माध्यम है क्योंकि इस भाषा को लगभग हर भारतीय समझता या बोलता है। डॉ. एस. सतपथी, प्रभागाध्यक्ष, फसल सुरक्षा ने अपने वक्तव्य में भारत सरकार की राजभाषा नीति तथा वार्षिक कार्यक्रम को ध्यान में रखते हुए सरकारी कार्यालयों में ज्यादा से ज्यादा कार्य हिन्दी में करने पर बल दिया।

डॉ. बिजन मजुमदार, प्रधान वैज्ञानिक एवं प्रभारी प्रभागाध्यक्ष, फसल उत्पादन ने कहा कि हिन्दी को कार्यालयीन कार्यों में अधिक से अधिक प्रयोग

संस्थान की हिन्दी गतिविधियों को प्रस्तुत करते हुए श्री विकास मंगल, प्रभारी, हिन्दी कक्ष

करने पर बल दिया। श्री विकास मंगल, वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने कार्यक्रम का संचालन करते हुए विजेता प्रतियोगियों के नाम ऑनलाइन माध्यम से घोषित किए। सात विभिन्न प्रतियोगिताओं में 24 विजेताओं को क्रमशः प्रथम, द्वितीय एवं तृतीय पुरस्कार देकर सम्मानित किया गया व अन्य प्रतियोगियों को भी प्रोत्साहन पुरस्कार देकर उनका मानवर्धन किया गया। हिन्दी प्रोत्साहन योजना के अन्तर्गत वित्तीय वर्ष 2019-20 के दौरान, हिन्दी में कार्यालीन कार्य करने पर 07 अधिकारियों/कर्मचारियों को भी ऑनलाइन माध्यम से पुरस्कृत किया गया। जिनमें दो कर्मचारियों को प्रथम पुरस्कार, तीन कर्मचारियों को द्वितीय पुरस्कार एवं दो कर्मचारियों को तृतीय पुरस्कार से सम्मानित किया गया।



हिन्दी पखवाड़ा के विभिन्न प्रतियोगिताओं में भाग लेते हुए संस्थान के अधिकारी/कर्मचारी

निदेशक महोदय ने 'हिन्दी पखवाड़ा' के दौरान आयोजित विभिन्न हिन्दी प्रतियोगिताओं के सफल आयोजन पर अपनी खुशी व्यक्त की तथा पखवाड़ा के सफल आयोजन के लिये हिन्दी कक्ष को धन्यवाद दिया। साथ ही पुरस्कृत अधिकारियों एवं कर्मचारियों को बधाई देते हुए आशा व्यक्त की कि भविष्य में भी इसी तरह इस संस्थान में हिन्दी के प्रयोग में उत्तरोत्तर प्रगति हो। कार्यक्रम के समापन पर श्री मनोज कुमार राय, सहायक ने निदेशक महोदय को उनके सारगर्मित संबोधन तथा हिन्दी के उत्थान के प्रति दृढसंकल्प, सुयोग्य मार्गदर्शन के लिए हार्दिक धन्यवाद दिया। साथ ही हिन्दी पखवाड़ा कार्यक्रम के आयोजन को संतुलित, सुगम और सुचारू ढंग से संचालन में सहयोग देने के लिए समस्त निर्णायक, परीक्षक, निरीक्षक, अधिकारियों एवं कर्मचारियों के प्रति अपना आभार व्यक्त किया। 'हिन्दी पखवाड़ा' में भारत सरकार द्वारा जारी कोविड-19 दिशा-निर्देश का पूर्णतः पालन किया गया।

23. Distinguished Visitors

Name of the visitor	Affiliation	Date
Shri Arjun Singh	Member of Parliament, Barrackpore	9 September, 2020
Dr. B. K. Das	Director, ICAR-CIFRI, Barrackpore	7 November, 2020
Dr. D.B. Shakyawar	Director, ICAR-NINFET, Kolkata	28 November, 2020
Dr. Narendra Kumar	Director, DJD, Kolkata	16 December, 2020
Shri Debasish Roy	Director General, IJMA, Kolkata	29 December, 2020

Shri Arjun Singh, Hon'ble MP addressing the ICAR-CRIJAF staff

Shri Arjun Singh, Hon'ble MP observing the natural fibre and products

Dr. Narendra Kumar is visiting the research farm with Director, ICAR-CRIJAF

Shri Debasish Roy, DG, IJMA visiting the in situ retting pond

Dr. D.B. Shakyawar, Director, ICAR-NINFET at ICAR-CRIJAF

Dr. B.Das, Director, ICAR-CIFRI, visiting the in situ retting pond at ICAR-CRIJAF

24. Personnel

Staff in Position

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Sri Raktim Mitra	Technical Assistant (Lib. Asstt.)	Raktim.Mitra@icar.gov.in
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Sri Sudip Nandy	Technical Assistant (Lab Tech)	Sudip.Nandy@icar.gov.in
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Smt. Laxmi Bansfore	Sri Jhulan Gupta	Smt. Fulmani	Sri Nandeswar Barman
Sri R.B. Thapa	Sri Chandra Mondal	Sri Nelson	Sri Dinesh Das
Sri Anup Das	Shri Trinath Shaw	Sri Jawahar	Sri Pabitra Das
Sri Shyamal Bhanja	Smt Parbati Bauri	Sri Ram Raj Pal	Sri Puren Choudhury
Sri Lochindra	Sri Prabin Boro	Sri Jokhu	Sri Uddhab Gayari
Sri Abdul Merej	Smt. Khira	Sri Jagdish Singh	Sri Bishu Chhetri
Sri Ram Asre Yadav	Kum. Koushalya	Sri Mahesh Singh Verma	Sri Dulal Chandra Dey
Sri Kartick Ch. Mitra	Sri Narottam	Sri Bhuwal Pal	Sri Kishore Das
Sri Ashok Ghosh	Sri Narendra	Sri Ram Bhajan Saroj	Sri Fakir

Note: This is not purported to be a seniority list.

25. Joining, Promotion, Transfer and Superannuation

Joining

Name	Designation	Date	Place of Posting
Dr. Gouranga Kar	Director	04.03.2020	CRIJAF, Barrackpore
Dr. Debarati Datta	Scientist	04.04.2020	CRIJAF, Barrackpore

Promotion

Name	Designation	Promoted to	Date of promotion
Dr. Sonali Paul Mazumdar	Scientist	Sr. Scientist	15.12.2018
Dr. Manik Lal Roy	Scientist	Sr. Scientist	04.11.2018
Dr. N. M. Alam	Scientist	Sr. Scientist	23.06.2018
Dr. Mukesh Kumar	Scientist	Sr. Scientist	15.12.2018
Mrs. Kanti Meena	Scientist (RGP 7000/-)	Scientist (RGP 8000/-)	07.01.2019
Dr. Laxmi Sharma	Scientist (RGP 6000/-)	Scientist (RGP 7000/-)	01.07.2018
Dr. Suman Roy	Scientist (RGP 6000/-)	Scientist (RGP 7000/-)	01.07.2018
Mr. Bitan Das	Sr. Technical Assistant	Technical Officer	29.05.2019
Mr. Uma Sankar Das	Senior Technician	Technical Assistant	01.01.2020
Mr. Gopal Chandra Dey	Assistant	Assistant Administrative Officer	09.10.2020
Mr. Pankaj Kr. Das	Assistant	Assistant Administrative Officer	01.12.2020

Superannuation

Name	Designation	Date of Retirement	Place of Posting
Dr. A. B. Mandal	Pr. Scientist	30.09.2020	CRIJAF, Barrackpore
Mr. Baul Sarkar	Technical Officer	30.06.2020	CRIJAF, Barrackpore
Sk. Phirose	Technical Officer	31.07.2020	CRIJAF, Barrackpore
Mr. Prahlad Singh	Administrative Officer	31.05.2020	CRIJAF, Barrackpore
Mr. Samar Kumar Ghosh	Assist. Adm/ Officer/ DDO	30.09.2020	CRIJAF, Barrackpore
Mr. Subrata Bhattacharyya	Assistant Administrative Officer	30.11.2020	CRIJAF, Barrackpore
Mr. Fakir	SSS	31.01.2020	SRS, Bamra
Mr. Kishore Das	SSS	31.01.2020	CSRSJAF, Bud Bud
Mr. Dulal Ch. Dey	SSS	29.02.2020	CRIJAF, Barrackpore
Mr. Bishu Chhetri	SSS	30.04.2020	KVK 24 Pgs.(North), Nilgunj
Mr. Dinesh Das	SSS	31.07.2020	RRS, Sorbhog
Mr. Abdul Merej	SSS	30.11.2020	RRS, Sorbhog
Mr. Nandeswar Barman	SSS	30.11.2020	RRS, Sorbhog

SSS= Skilled Supporting Staff

Transfer

Name	Designation	Transferred to
Mr. Monu Kumar	Scientist (Plant Breeding)	ICAR-IARI, Hazaribagh w.e.f. 02.06.2020
Dr. Soham Ray	Scientist (Biotechnology)	ICAR-IARI, New Delhi w.e.f. 07.08.2020
Dr. A. K. Jha	Sr. Scientist (Plant Pathology)	ICAR-RCER, Patna w.e.f. 30.09.2020
Mr. S. P. Prajapati	Sr. Technical Assistant	ICAR-IISR, Lucknow w.e.f. 11.11.2020
Mr. Gauranga Ghosh	Finance & Accounts Officer	ICAR-NEH Region, Barapani w.e.f. 24.10.2020

26. Financial Statement

Financial Statement of ICAR-CRIJAF, Barrackpore for the year 2020-21

(₹ in Lakhs)

Sub-Head	Grants B.E. 2020-21	Grants R.E.2020-21	Grants Expenditure upto 31-12-2020
Establishment Charges	2290.00	2200.00	1722.92
Wages	11.30	12.00	8.21
O.TA.	0.18	0.15	0.07
Retirement Benefit	410.00	511.00	341.079
T.A.	45.00	15.00	9.02
Other Charges (NEH & SCSP incd.)	615.00	614.00	312.18
Works-Maintenance			
a) Residential	20.00	20.00	0.00
b) Non Residential	70.00	70.00	35.11
c) Equipment & others	20.00	20.00	11.23
d) Minor Works	10.00	10.00	0.95
Major Works (Capital)	0.00	0.00	0.00
Minor Works (Capital)	26.00	16.00	0.00
H.R.D	15.00	5.00	1.61
Publicity & Exhibition	15.00	10.00	2.86
Equipment	14.00	4.00	0.00
Vehicle	6.00	0.00	0.00
Information Technology	2.00	0.00	0.00
Furniture	2.00	0.00	0.00
Library Books & Journals	0.00	0.00	0.00
Total	**3571.48**	**3507.15**	**2445.95**
Loans and Advance	00.00	38.00	0.00

Financial Statement for AINP on Jute & Allied Fibres and KVKs (Burdwan and North 24 Parganas) for the year 2020-21

(₹ in Lakhs)

Head	Target (B.E.)	Achievement (Upto 31-12-2020)
AINPJAF	423.47	298.45
K.V.K - Burdwan	169.60	113.55
K.V.K- 24 Parganas (N)-II	158.20	36.19

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

(₹ in Lakhs)

Institute/ Sub-stations	Total Revenue (31-12-2020)
CRIJAF (H.Q.), Barrackpore	22.08
CSRSJAF, Bud Bud	1.13
Ramie Research Station, Sorbhog	1.07
Sisal Research Station, Bamra	2.98
Sunhemp Research Station, Pratapgarh	1.38
Total	**28.64**
Target	**32.47**

NOTES

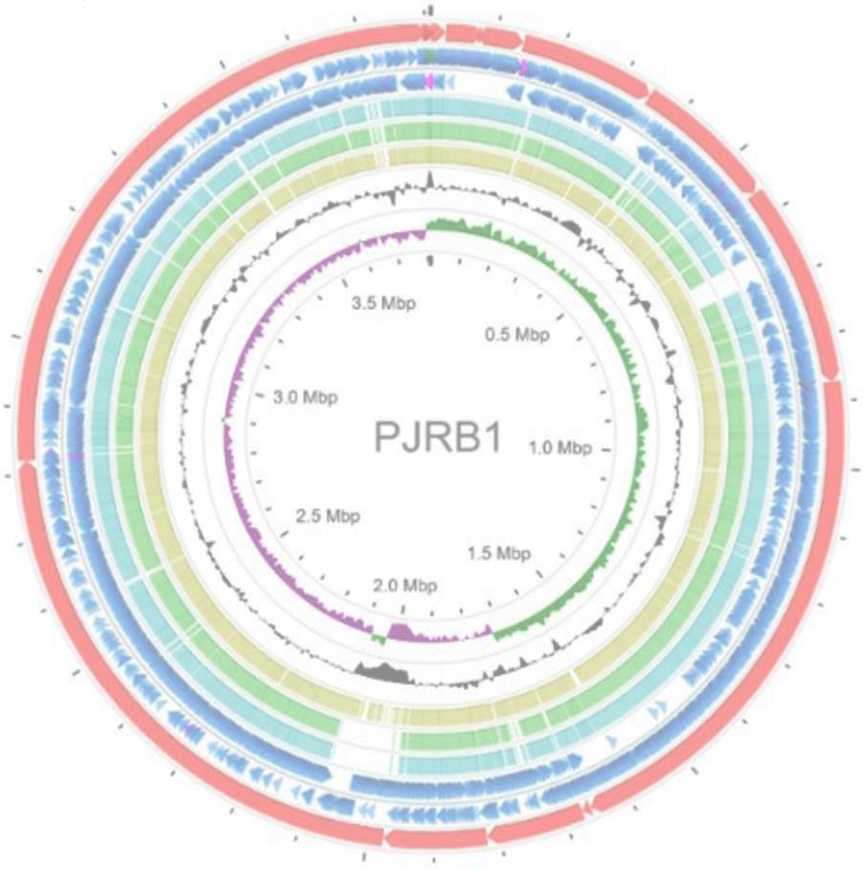
SCIENTIFIC REPORTS
nature research

OPEN

Genome Comparison Identifies Different *Bacillus* Species in a Bast Fibre-Retting Bacterial Consortium and Provides Insights into Pectin Degrading Genes

Subhojit Datta[1,3] ✉, Dipnarayan Saha[1,3], Lipi Chattopadhyay[2] & Bijan Majumdar[2] ✉

Retting of bast fibres requires removal of pectin, hemicellulose and other non-cellulosic materials from plant stem tissues by a complex microbial community. A microbial retting consortium with high-efficiency pectinolytic bacterial strains is effective in reducing retting-time and enhancing fibre quality. We report comprehensive genomic analyses of three bacterial strains (PJRB 1, 2 and 3) of the consortium and resolve their taxonomic status, genomic features, variations, and pan-genome dynamics. The genome sizes of the strains are ~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 to 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. These have preponderant implications in plant biomass research and food industry, and also posit application in the reclamation of water pollution from plant materials.



Circular representation of draft genomes and features of the PJRB strains

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

भाकृअनुप
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ICAR - Central Research Institute for Jute and Allied Fibres

(आईएसओ ९००१:२०१५ प्रमाणित संस्थान)
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