



वार्षिक प्रतिवेदन ANNUAL REPORT 2017-18



ICAR - Central Research Institute for Jute and Allied Fibres

Barrackpore, Kolkata - 700 120, West Bengal
(An ISO 9001 : 2008 Certified Institute)

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Preface



Environmental and economic sustainability are the major challenging issues in developing a profitable agricultural system, more so in recent changing climatic condition. In this context, jute and allied fibre cultivation provide unique opportunities to harness economic profitability as well as environmental sustenance.

However, under constraints of marginal agricultural systems in which jute and allied fibres are grown and market instability of the produce, the primary researchable issues are to devise systems and technologies to maintain the growth in productivity.

Technological breakthrough coupled with strong policy backup is highly needed at this juncture to sustain the productivity and profitability in jute cultivation. Genetic improvement and technological interventions in crop management is a long term research target in fibre crops, with fine tuning and up-scaling of existing technologies based on end user feedback. Under this backdrop, new varieties of kenaf (JBMP 3 - Priya) and roselle (JRR 17-Ayush) have been released. Jute and allied fibre breeding have been further strengthened by genomic research supports by determining genome and transcriptome sequences, mining new genes and alleles for important traits associated with self-incompatibility, secondary metabolites, drought tolerance and disease resistance. The jute genome sequence of *Corchorus olitorius* cv. JRO-524 is being further refined which will allow for better prediction of genes and development of markers.

For increasing profitability of the JAF farming system under variable climatic condition, new programmes have been initiated to assess carbon flux in jute based cropping system and to develop vulnerability maps and models. Simultaneously, technologies for intercropping of jute with mungbean, baby corn and garden pea under early-sowing have been standardized during the last few years to ensure profitability even under

early drought. Small farm implements have been quite successful at farmers' field with demands for further mechanization. Accordingly, power tiller driven seed drill system has been designed and tested successfully.

Integrated, eco-friendly and cost-effective management of pests, diseases and weeds are integral components of sustainable agro-system. To strengthen protection against these biotic stresses, IPM modules in participatory mode were quite effective in the management of major insect pests and diseases. Sex pheromones and volatiles reveal the clue for monitoring of insect pests and identifying plant resistance. Pheromone compounds have been identified for jute semilooper. Besides, the novelty of WCIN-179 accession of *C. aestuans* was confirmed on the basis of unique biochemical and VOC profile which makes it resistant against hairy caterpillar.

ICAR-CRIJAF has played a pivotal role in dissemination of four of its important technologies, viz., improved variety (JRO 204), retting consortium (CRIJAF SONA), Nail Weeder and Multi-row seed drill in implementing Jute-ICARE, a Ministry of Textile programme among 75,000 farmers during 2017-18. Further, for commercialization of technologies MOUs have been signed with new firms for easier availability of implements and retting consortium. In addition, android based App "JuteAgri" has been developed to guide the farmers from seed selection to sale of the produce.

I acknowledge the efforts of the scientists of ICAR-CRIJAF who have done a commendable job to accomplish the volume of research and documentation work successfully. The support from administrative and other staff in implementing the overall activities of the institute is also appreciable. I am grateful to Hon'ble Dr. Trilochan Mohapatra, Secretary, DARE and Director General, ICAR for his leadership and direction. I express my sincere gratitude and thanks to Dr. A.K. Singh, Deputy Director General (Crop Science) and Dr. R.K. Singh, Assistant Director General (Commercial Crops), ICAR, New Delhi for their constant encouragement and support.



(Jiban Mitra)

Director, ICAR-CRIJAF

Place: Barrackpore

Date: 26.06.2018

Executive Summary

Crop Improvement

- A total of 84 germplasm lines of *Corchorus* and *Hibiscus* species have been collected through exploration from six districts of Maharashtra. A total of 1265 accessions have been regenerated. A total of 1169 germplasm accessions (*C. olitorius*: 394, *C. capsularis*: 139, wild *Corchorus* spp: 254, *H. cannabinus*: 164, *H. sabdariffa*: 157, *C. juncea*: 31, wild *Crotalaria* spp.: 30) of JAFs were distributed to different indenters.
- F₁ generation of crosses JRC 212 x CIN 109, CMU 49 x JRC 212, CMU 14 x JRC 212 and JRO 2407 x WCII 141-2 were advanced to F₂ generation to study for stem rot and hairy caterpillar resistance and RIL population of OIJ 248-1 x WCIN-136-1 was advanced to F₄ generation. The germplasm line OIN 154-1 was found to be resistant to stem rot disease followed by RS 6, CIN 109 and cv. JRO 204.
- JRORS-6, an inter-specific early flowering resistant line has been developed from a biparental cross between JRO 632 and WCII 037.
- A total of 1023 multi-parent advanced generation inter-cross (MAGIC) lines of *C. olitorius* have been constructed from 20 parental lines for fine-mapping of QTL for major agronomic traits including early (premature) flowering resistance and complex bast fibre yield, yield components and quality traits (tensile strength and fibre fineness) in jute.
- Assessment of biomass production pattern under long day and short day conditions using five genotypes of *C. olitorius* and one *C. capsularis* line revealed that the ratio of bark biomass to total biomass decreased and the ratio of stick biomass to total biomass increased under short day, indicating reduced fibre production under short day condition.
- Through mutation breeding in jute, two mutant lines (Pfr-59 & Pfr-65) were identified showing stable tolerance to early (premature) flowering under short day conditions when sown in the first week of February for last 3 years. Further, three novel mutants i.e., super dwarf (*sdf*) mutant (INGR17072), low lignin phloem fibre (*llpf*) mutant (INGR17073), premature flowering (*pfr-59*) mutant (INGR17074) were registered with ICAR-NBPGR, New Delhi.
- During 2017-18, one white jute variety, i.e., JRCM 2 and five *tossa* jute varieties, i.e., JROM 1, NJ 7005, NJ 7010, NJ 7050 and NJ 7055 were tested under DUS testing. The candidate varieties NJ 7005, NJ 7010, NJ 7055 were not found to be distinct from two reference varieties except for seed colour. While the variety NJ 7050 was not found distinct from reference varieties with respect to any of the claimed characters.
- For DNA fingerprint of 25 *C. olitorius* jute varieties, 45 EST-SSRs and 36 SCoT markers were screened. EST markers, EST 14 and EST 65 were able to differentiate cv. JRO 7835 and JRO 878, respectively. While the SCoT markers SCoT 5, SCoT 19 and SCoT 27 were able to differentiate leading cultivars with green stem pigmentation (JRO 204, JRO 524) and red stem pigmentation (JRO 2407 and S 19).
- In roselle, three lines suitable for leafy vegetable purpose and three for calyx purpose were selected and nominated for IET of AINPJAF for 2018-19.
- In kenaf, considerable average heterosis was observed in F₁ hybrids for almost all the fibre yield and attributing traits. Further, a total of 395 single plants were selected on the basis of plant height and base diameter from 20 M₂ population derived from γ irradiation of kenaf varieties JBM 2004D, AMC 108 and HC 583.
- Agglomerative hierarchical cluster analysis grouped selected sunnhemp accessions into well-defined phenotypes with four distinct seed producing clusters. Accessions from cluster-I and II recorded outstanding trait values for the majority of vegetative and reproductive traits.

Seed Production

- During *kharif* 2017-18, a total of 15.97 q breeder seed of 16 varieties of jute and 2 varieties of sunnhemp were produced. Furthermore, about 1.90 q of nucleus seeds of released varieties of jute (26 varieties), mesta (7 varieties) and sunnhemp (4 varieties) were produced.
- Under ICAR seed project, 472.21 q seeds of different crops (jute, mesta, sunnhemp, dhaincha, paddy, wheat and mustard) were produced. In addition to this, planting material of sisal (50,000 bulbils and suckers) and ramie (5 q rhizome and 1.5 lakh plantlet) were also produced and distributed to the farmers.

- In seed production programme under NFSM commercial crops, 3 q breeder seed of mesta and 18.36 q foundation seed of jute (CO 58, JRO 204 and S 19) were produced. Besides, 17.69 q quality jute seed of new varieties like JRO 204, S 19, JBO 2003 H were produced under seed village programme.

Biotechnology

- Whole genome sequence of leading Indian *C. olitorius* variety, JRO-524 has been decoded resolving into 377.3 Mbp, with a *K*-mer-estimated genome size of 415 Mbp and 57,087 protein-coding genes. Reannotation using evidence from RNA-seq alignments as intron hints predicted a total of 47,434 protein-coding genes. Blast2GO prediction identified 47,035 protein-coding genes from the unmasked genome (377.3 Mbp) of *C. olitorius* cv. JRO 524 that covered 25,108 sequence regions, with a total length of 209.4 Mbp.
- A total of 12,772 SSRs (37.3%) were identified to be distributed in 10,041 unigenes of the Transcriptome Shotgun Assembly (TSA) accession GBS000000000 of *C. capsularis* cv. JRC 212. A total of 2163 SSR sequences in 1,624 TF-unigenes belonging to 65 TF families were identified. A total of 39 phenylpropanoid biosynthesis gene specific SSR markers were designed from 39 isoforms of 20 different enzymes. A total of 440 RG-specific SSR primers were designed from 54 TF gene classes. Further, 600 SSR primers from another 1500 randomly selected SSR motifs were also designed. One hundred and twenty markers were validated in *C. capsularis*, of which 105 produced 1–6 amplicons.
- From the genome sequence of *C. olitorius* cv. O4, total 39 aquaporin (AQP) genes were identified including nine NOD26-like intrinsic proteins (NIPs), 8 tonoplast intrinsic proteins (TIPs), 12 plasma membrane intrinsic proteins (PIPs), and 8 small basic intrinsic proteins (SIPs). In *C. capsularis* cv. CVL 1, total 35 AQP genes were identified including 11 PIPs, 10 NIPs, 8 TIPS, and 3 SIPS. Conserved domains within the jute AQP protein sequences were identified using NCBI's Conserved Domain Database. A total of 17 heat shock factors (Hsfs) each were identified from *C. olitorius* and *C. capsularis*. Thirty four (34) heat shock factor (HSF) genes with typical DNA-binding domain (DBD) and hydrophobic heptad repeat A/B domains (HR-A/B) were identified from the flax genome. Comparative homology analysis classified them into three broad groups A, B and C. Regulatory role of *LuHsf* genes in abiotic stress response was predicted from the localization of diverse *cis*-acting elements in the promoters of *LuHsf* genes.
- From transcriptome analysis, sunnhemp transcripts were matched against the 1,009 plant self-incompatibility related proteins, 20 S-locus receptor kinases, 215 G-type lectin S-receptor-like serine/threonine-protein kinase (from *Glycine max*, *M. truncatula*, and *A. thaliana*), and 393 S-locus cysteine-rich proteins. BLASTP analysis was also performed to identify Restorer of fertility (Rf-like) associated transcripts using 72 plant Rf proteins. A set of genes were selected based on the output and expression validation was performed in four different tissues (shoot, developing seed, anthers and pistils) of *C. juncea* cv. Sun 053 and two different tissues (anthers and pistils) of a self-compatible wild species *C. retusa*, revealing differential gene expression.
- An *in vitro* plantlet production system in flax has been developed. Callus maintaining medium containing MS with 0.5 mg/l 2,4-D, 0.5 mg/l Kin and 0.05 mg/l IAA showed best results (97.2%) for profuse callus proliferation. Maximum shootlet (94.6%) regeneration was observed on MS medium containing 1.5 mg/l Kin with average of 15.65 shootlets per explants. MS with 2 mg/l Kin showed superior performance. Rooting medium fortified with 1.5 mg/l IBA produced profuse long robust rooting.
- *Agrobacterium*-mediated genetic transformation has been optimized for transgenic development in proliferating calli derived from 12d old hypocotyl of flax cv. JRF 2. In 77.5% GUS expression of reporter gene at transient level was observed. A floral-dip transformation in olitorius jute (JRO 524 & S 19) using Cry 1A(b) was developed using an infiltration medium (5.0% sucrose + 01% tween-20). In ramie, nodal explants from variety RS 67-34, when cultured on MS medium supplemented with 2.0 mg/l N6-BA and 2.0 mg/l AgNO₃ produced maximum shootlets (46) per explant. About 90% *in vitro* micropropagated plantlets survived.
- Ten roselle and nine kenaf varieties were screened with RAPD primers for DNA fingerprinting. Among roselle varieties presence of unique band was observed in cv. AMV-2, AMV-4, HS4288 & HS 7210, whereas among kenaf variation was observed in cv. MT-150, HC-583, JBM-G-4, JBM81, JRM 3 and JRKM. Two markers (jute intron linked marker and kenaf EST-SSR-11) showed polymorphism among the fertile and sterile bulk of kenaf.

Soil and Nutrient Management

- Long term effect of fertilizers indicated that

application of fertilizers alone or in combination with FYM significantly increased the yield of jute, rice and wheat. The highest yield of rice and wheat was achieved in 100% NPK+ FYM treatment, whereas highest yield in jute was recorded in 150% NPK treatment. Integrated use of organic manure and chemical fertilizers resulted in a positive influx of nutrients thereby increased OC, available nitrogen, available phosphorus and available potassium in the soil.

- Modelling of soil organic carbon sequestration in response to long term fertilizer management practices under jute-rice-wheat agro-ecosystem in alluvial soils revealed that 100% NPK fertilizer applied with FYM and stubble and roots retention of all crops would act as a net C sink. Average SOC density kept increasing from 18.18 Mg/ha during 1972 to the current average of ~22 Mg/ha during 2065. The critical C input was estimated to be 5.30 Mg C/ ha/yr, depending on local soil and climatic conditions.
- Application of fertilizers as per ST-TY equation could achieve the target of 40 q/ha of jute fibre with (-) 4.5 %. Integration of ST-TY with FYM achieved the targeted yield of jute fibre (35 q/ha) with (+) 2.68 % yield deviation. Under farmers field trials application of fertilizers as per ST-TY without and with FYM achieved the target of 40 q/ha jute fibre yield and 30 t/ha tuber yield of potato.
- Soil organic carbon sequestration studied in various ramie based cropping systems revealed that very labile and non-labile carbon pool constituted 32-41% and 24-31% of total organic carbon, respectively, on surface soils.
- Under conservation tillage practiced of different jute based cropping system, soil organic carbon (SOC) was significantly and positively correlated with clay content. Available-N, P, K and EC was negatively correlated with bulk density. Soil quality index values were significantly higher in jute-rice-lentil as compared to other cropping systems, and in no tillage with residue.

Crop Husbandry

- Among different cropping systems, the highest system productivity and sustainability yield index was recorded in jute-rice-baby corn and jute-rice-garden pea whereas jute-rice-mustard and mungbean cropping system had highest carbon management index. Application of 100 % NPK with crop residues recorded the highest system productivity,

sustainability index and carbon management among different nutrient management practices.

- Maximum jute equivalent yield was recorded with jute-*kharif* rice-potato cropping system while maximum benefit-cost ratio was obtained from jute-rice-ashwagandha cropping sequence. Among different medicinal and aromatic plants under jute seed crop, jute-stevia-autumn rice cropping sequence recorded the highest jute equivalent yield.
- Under jute-mung bean intercropping system, higher jute fibre was recorded at 35 cm row spacing and higher mung bean yield was recorded at 40 cm spacing of jute.
- Among medicinal and aromatic plants, intercrops in sisal, *safed* musli and among spices fennel recorded maximum yield and net return. Among sisal-fruit intercropping, the highest sisal yield was recorded with intercrop of custard apple. Irrigating the fruit plant at 80% PE resulted in maximum plant and fruit yield compared to irrigation at 60% and 100% PE.

Biotic and Abiotic Stresses

- Isolation and identification of female sex pheromone of jute semilooper, *Anomis sabulifera* using Gas Chromatography coupled with Electroantennogram Detector (GC-EAD) and Gas Chromatography coupled with Mass Spectrometry (GC-MS) revealed the presence of heneicosadiene as the active compound in pheromone gland of the female moths for enticing the male moths of *A. sabulifera*.
- The uniqueness and novelty of WCIN-179 accession of *C. aestuans* was confirmed on the basis of very unique biochemical and VOC profile which makes it resistant against hairy caterpillar through multiple mechanisms. As *C. aestuans* is crossable with the cultivated species, *C. olitorius*, hence, it is quite practical that this accession can further be used for insect resistance breeding program in *tossa* jute. The germplasm accession has been submitted to NBPGR, New Delhi for registration.
- On the basis of infestation of adult stages, mite days, and tolerance index and over all susceptibility against the pest the varieties JRO 524, JRO 8432, JRO 204 were most superior against yellow mite. The population build up and symptom development due to mite feeding was significantly less in these varieties. Susceptibility index (SI) of the elite varieties varied from 179.43 to 708.58 being least in JRO 524.

- Fenpyroximate 5EC (0.005%) and spiromesifen 22.9EC (0.016%) proved to be most effective in terms of toxicity and persistency against yellow mite under glass house condition. These two acaricides had very good residual toxicity, persistent toxicity, high translaminar activity and efficacy against both immature and mobile stages of yellow mite of jute.
- Individually, the endophytic entomopathogen, *L. lecanii* was more effective than *B. bassiana* against mealy bug and *B. bassiana* performed better against BHC. However, combined application of endophytic *L. lecanii* (VL8, VL15) and *B. bassiana* (BbM-isolated from dead mealybug) was most effective against mealy bug whereas combined application of endophytic *L. lecanii* (VL8, VL15) and *B. bassiana* (ITCC 5408) caused maximum mortality of BHC.
- Pathogen associated with the lesions due to stem rot disease of jute belongs to 6 morpho-groups and four ITS-RFLP categories. To establish their identities molecular phylogeny of two representative isolates from each six groups were selected. Both maximum likelihood (ML) and maximum parsimony (MP) methods were used to construct the phylogenetic tree. Accordingly, the pathogens infecting jute belonged to three families viz. Diaporthaceae (*Diaporthe* spp.), Glomerellaceae (*Colletotrichum* spp.) and Botryosphaeriaceae (*Lasiodiplodia* spp., *Macrophomina phaseolina*) of Ascomycota.
- IPM module consisting of cultural (sowing in line with 5 - 6 lakh plants /ha, NPK: 60:30:30), chemical (soil application of $\text{Ca}(\text{OCl})_2$ @ 30 kg/ha at 7 days before sowing (DBS), seed treatment with (a) carbendazim @ 2g/kg + (b) imidacloprid @ 4g/kg, application of pesticides: spiromecifen @ 1 ml/litre, profenophos @ 2 ml/litre); biological (*Trichoderma viride* @ 10g/kg seed) before sowing and spraying of neem oil @ 3 - 4 ml/litre) components was effective against major insect pests and diseases of jute with higher C:B ratio in CRIJAF Research Farm as well as farmers' field.
- In Sambalpur, Sundargarh and Jharsugda districts of Odisha the zebra disease incidence in sisal was 13.3 to 34.7% in *Agave sisalana* and 17.0 to 48.3 % in Bamra Hybrid-1. Temperature showed significantly negative correlation with disease severity in both the varieties, *Agave sisalana* and Bamra Hybrid-1 under both nursery stages and 2-3 years old suckers. Rainfall was significantly positive correlation with disease severity in sisal.
- The date of sowing has significant effect on the incidence of wilt in flax. In the early sown crop in the last week of October, the incidence of wilt was significantly higher (18.1%) than the November (10 November and 25 November) sown crop.
- Fosetyl – Al @2.0g/l was the most effective fungicide in reducing the zebra disease of sisal both in nursery and sucker stage. Among the oil cakes, neem cake @10.0q/ha provided the best control of the disease followed by karanj, mahua and linseed cakes.
- Weed density varied with N and P status in soil. Higher weed density was observed in higher N and P status in soil and vice versa. Under different crop residue management practices, rice, wheat and corn residue @ 4 t/ha each significantly reduced the weed density compared to pea and mung bean residue @ 2 t/ha.
- Application of Ipfencazone @68.43 and 91.24 g/ha as pre-emergence weedicide in jute reduced the grass weed up to 90%, broad leaved weed by 52% and sedges by 40% without harming the jute emergence. Haloxofop-R-R methyl 10.5 EC @42-157 g/ha as post emergence reduced the grass weeds up to 98% in jute seed crop and resulted in significantly higher jute seed yield than two hand weeding.
- Application of plant growth regulators, ascorbic acid showed the best stress recovery performance with respect to plant height and leaf rolling under drought stress.
- The jute plants raised from seeds treated with endophytic Bb (ITCC 5408) could survive under 6-day interval watering without any wilting. The proline level in response to water stress was elevated in ITCC 5408 treated plants (1.78mg/g) followed by ITCC 5562 (1.46 mg/g) and ITCC 4563 (0.85 mg/g) which was as low as 0.21 mg/g in untreated plants.

Farm Mechanization and Post-Harvest Technology

- A simple light weight manual operated seed drill has been developed to reduce the drudgery of operator. The reduction in cost is quite affordable to marginal and small farmers.
- Experimental model of six-row power operated seed drill has been tested for its field efficiency and adaptability in the farmers' field. The field capacity was measured to be 0.35-0.4 ha/h with 25-30 mm depth of seed placement.
- At average speed of operation of 28.08 m/min, the field capacity of CRIJAF Single wheel jute weeder

was found to be 0.026-0.28 ha/h and field efficiency of 76.7 per cent with draft of 29.7 kg.

- Ribbon retting improved fibre production in terms of quantity and quality with reduced retting duration of about 12-13 days against conventional retting. The average fibre fineness of 2.4 to 3.2 tex was obtained with ribbon retting.

Jute and Allied Fibre Informatics

- An android App named "Jute Agri" has been developed for easy access and dissemination of information about new varieties, improved production and protection technologies, MSP, grading, marketing and export of jute.
- A web-based Agrometeorological Database Management System (ADBMS)-cum-Agro-advisory System named, JuteMet[®] has been developed for storing, updating, retrieving, and analysing the long-term temporal and spatial climatic data for agricultural advisory services to the farmers with an embedded agro-advisory module.
- JuteMarkerdb is a database of SSR markers derived from published jute unigene sequences that uses SQL queries to provide SSR primer data. With the advancement and availability of jute genome sequences, the upgraded version of JuteMarkerdb will consist of BLASTn or BLASTn-alike tool

Technology Assessment & Transfer

- The FLDs on improved production technologies of jute were conducted in Nadia, North 24 Parganas, Murshidabad and Hooghly districts of West Bengal. A total of 345 demonstrations covering 87.75 ha area were conducted in these districts. The results showed the highest fibre yield of jute in the variety JRO 204 (31.42 q/ha) irrespective of the locations. Demonstrations on mechanical weed management by CRIJAF Nail Weeder resulted in 2.35-3.24 q/ha yield increase over farmers' practice (27.90-28.97 q/ha) and reduced human labour cost by Rs.8094 - Rs.14304/ha. Demonstrations on line sowing by CRIJAF Multi-row Seed Drill improved the fibre yield by 2.28-2.81 q/ha and saved the human labour cost in thinning, harvesting etc. by Rs.5258 - Rs.5998/ha over conventional practice of broadcasting. Application of CRIJAF Sona improved the fibre quality by 1-2 grade in all locations which enabled the jute farmers to earn an additional income of Rs.250 - Rs.400/q. This method also reduced the fibre: water ratio (v/v) to 1:5 which is four times less than conventional retting

(1:20). Majority of the farmers were satisfied with the performance of the technological interventions implemented by ICAR-CRIJAF at their fields.

- In a study to assess the farmers' perception about plant protection management practices (PPMPs) in jute-based cropping system, it was found that all the respondents had high level of positive attitude towards PPMPs and were aware of pesticide hazards and banned/restricted pesticides. In jute-rice-mustard/lentil cropping sequence, expenditure for pesticides was found maximum in rice (Rs.8000/ha) followed by jute (Rs.5500/ha) and mustard/lentil (Rs.2500/ha).
- Another study on effects of climate variability in jute-based cropping system revealed that ninety percent of the farmers have perceived that climatic components and its occurrences have varied from last 10-15 years. The farmers perceived that heavy rainfall during harvesting has been causing huge yield losses, jute is being affected due to prolonged drought and incidences of heavy rainfall during its early growth stages, insect and disease infestation has become more virulent and frequent due to prolonged hot and humid weather.

AINP on J&AF

- Four varieties of jute and allied fibre crops namely, NJ 7010 (Rani) of *tossa* jute, BCCC 1 (Shweta) of white jute, JBMP 3 (Priya) of kenaf and JRR 17 (Ayush) of roselle have been released and notified by the Central Sub-Committee on Crop Standard, Notification and Release of Varieties for their commercial cultivation. Brside, one variety each in kenaf (JBMP-4), roselle (JRHS-1) and sunnhemp (SUIN-3) have been identified for central release during the 13th Group Meeting of AINPJAF held at BCKV, Kalyani on 10-11th March, 2018.
- Fifty accessions each of *tossa* jute, white jute, roselle and kenaf were evaluated with their respective check varieties at various locations of JAF growing states. Hybridization programme at different centres was also attempted and evaluation of crosses, selection of individual plants in various segregating generation and their seeds were collection for further evaluation. Elite entries of jute and allied fibre crops were also evaluated under multi-location experiments comprising of IETs, AVTs, and adaptive trials.
- Application of fertilizer on ST-TY basis, in presence and absence of organic manure achieved the targeted yield of jute and rice in UP and Bihar.

Application of pretilachlor 50 EC 900g/ha with one hand weeding effectively reduced the weeds biomass and recorded the highest fibre yield at West Bengal and Assam. Application of FYM @ 5 t/ha recorded significantly higher seed yield (14.25 q/ha) of jute. Highest fibre yield of flax was recorded with pre-emergence application of pendimethalin 30% EC @ 750g/ha while pendimethalin 1.0 kg a.i./ha recorded significant reduction in weed growth

- Pre-sowing seed treatment with carbendazim + spraying of carbendazim at 45 DAS was the best treatment in managing stem rot of jute in West Bengal whereas seed treatments with tebuconazole @1.5ml/kg of seed +spraying of tebuconazole @ 0.15% at 40-45 days of crop age was found to be Odisha and Bihar. Foliar application of agricultural grade mineral oil @ 3 ml/litre + neem oil @ 3 ml/litre at 35 DAS and 50 DAS was found most effective for management of yellow mite in jute.
- The Tribal Sub Plan programme had also been taken up by AINPJAF units of BCKV, Kalyani, UBKV, Coochbagar, JRS, Kendrapara and RARS, Nagaon. The programme was conducted in 11 villages

belonging to 5 districts of West Bengal, Assam and Odisha covering 57.8 ha area and 265 tribal farmers participated in the programme.

Krishi Vigyan Kendra

- OFTs on recommended production technologies of jute, paddy, oilseeds, vegetables and fish were conducted. A total of 1111 FLDs were conducted on improved production technologies of crops like jute, rice, groundnut, sesame, greengram, mustard, lentil, chickpea, onion, annual moringa, brinjal, and fodders (sorghum, maize, berseem, oat and rice bean). In fishery sciences, FLD was conducted on monosex *tilapia*. Altogether, 111 training programmes were organised for practicing farmers, rural youths and extension functionaries including two vocational trainings. A total of 2819 trainees were benefited through these training programmes. Important programmes like *New India Manthan-Sankalp se Siddhi*, awareness programme on *Pradhan Mantri Fasal Bima Yojana (PMFBY)*, *Mahila Kisan Diwas*, *Swachhta hi Seva* campaign, World Soil Day and webcasting of Hon'ble PM's speeches were also successfully organized.

कार्यकारी सारांश

फसल सुधार

महाराष्ट्र के छह जिलों से पटसन तथा मेस्ता के कुल 84 जननद्रव्यों का संग्रहण किया गया है तथा कुल 1265 जननद्रव्यों का पुनर्उद्भवण भी किया गया है। पटसन तथा समवर्गीय रेशा फसलों के कुल 1169 जननद्रव्यों, जिनमें तोषा पटसन के 394, सादा पटसन के 139, जंगली पटसन के 254, केनॉफ के 164, रोजेल के 157, सनई के 31 तथा जंगली सनई के 30 जननद्रव्य शामिल हैं, का वितरण भी किया गया है।

तना सड़न रोग तथा बिहार रोमिल सूड़ी के प्रति प्रतिरोधिता के अनुवांशिकी अध्ययन के उद्देश्य से सादा पटसन के चार एफ₁ संकरों को एफ₂ संतति में तथा तोषा पटसन के एक रिल' समुदाय को एफ₄ संततियों में अग्रेसित किया गया है। तोषा पटसन के ओ.आई.एन.-154-1 नामक जननद्रव्य को तना सड़न रोग के प्रति अवरोधी पाया गया जिसके बाद क्रमशः आर.एस.-6, सी.ओ.आई.एन.-109 तथा प्रचलित प्रजाति जे.आर.ओ.-204 का स्थान था। जननद्रव्य ओ.आई.एन.-272-1 को इस रोग के प्रति अत्यन्त संवेदनशिल पाया गया जिसके बाद क्रमशः जे.आर.सी.-412 तथा ओ.आई.एन.-456 का स्थान था।

जे.आर.ओ.-632 तथा डब्ल्यू.सी.आई.जे.-037 के अन्तरप्रजातिय संकरण से उद्भवित प्रभेद जे.आर.ओ.एस.-6 को विकसित किया गया है जो कि पूर्वपक्वण पुष्पन के प्रति सहिष्णु है।

तोषा पटसन के 20 पित्रों के संकरण से निर्मित "मैजिक समुदाय" से कुल 1023 प्रभेदों का उद्भवण किया गया है जिसका उद्देश्य पटसन के शस्य लक्षणों जैसे पूर्वपक्वण पुष्पन प्रतिरोधिता, रेशा उपज तथा इसके जटिल उपलक्षणों सहित रेशा गुणवत्ता से संबंधित गुणों का क्यू.टी.एल. मैप तैयार करना है।

तोषा पटसन के पाँच तथा सादा पटसन के एक प्रभेदों की सहायता से लघु तथा दीर्घ दिवसीय दशा में जैवभार उत्पादन क्षमता का आकलन किया गया। लघु दिवसीय फसल में कुल जैवभार के सापेक्ष रेशा जैवभार का अनुपात घटते क्रम में जबकि, उसी फसल अवधि में कुल जैवभार की तुलना में डंठल जैवभार के अनुपात में वृद्धि दर्ज की गयी। इससे यह सिद्ध होता है कि लघु दिवसीय पटसन फसल में रेशा उत्पादकता कम होती है।

पटसन में उत्परिवर्तन प्रजनन के द्वारा दो उत्परिवर्ती प्रभेदों की पहचान की गयी है जिसे वर्ष 2013 से 2017 के मध्य लगातार फरवरी के प्रथम सप्ताह में बुआई के दौरान भी स्थायीरूप से पूर्वपक्वण पुष्पन के प्रति सहिष्णु पाया गया है। इस प्रकार पटसन के तीन नवीनतम उत्परिवर्ती जो कि अत्यन्त छोटे कद, अल्प लिगनीन तथा पूर्व पक्वण पुष्पन प्रतिरोधी गुणों के लिए ज्ञात है, का पंजीकरण नई दिल्ली स्थित एन.बी.पी.जी.आर. से कराया गया है।

वर्ष 2017-18 के दौरान सादा पटसन के एक तथा तोषा पटसन के पाँच प्रजातियों का डि.यू.एस. परीक्षण किया गया है जिनमें एन.जे.-7005, एन.जे.-7010 तथा एन.जे.-7055 नामक प्रजातियाँ बीज रंग के अतिरिक्त संदर्भ प्रजातियों के किसी भी गुणों में भिन्न नहीं पायी गयी। जबकि एन.जे.-7050 नामक प्रजाति को दावा किये गये किसी भी लक्षणों के लिए संदर्भ प्रजातियों से भिन्न नहीं पाया गया है।

तोषा पटसन के 25 प्रजातियों के फिंगर प्रिंट हेतु ई.एस.टी.-एस. एस.आर. तथा "स्कॉट" से संबन्धित क्रमशः 45 तथा 36 मार्कर्स का चयन किया गया। ई.एस.टी. तथा स्कॉट मार्कर्स की सहायता से तोषा पटसन के क्रमशः 2 तथा 4 प्रचलित प्रजातियों को चिन्हित करने में सफलता प्राप्त हुई।

सब्जी उत्पादन तथा कैलिक्स उत्पादन हेतु उपयुक्त रोजेल के तीन-तीन प्रभेदों को ए.आई.एन.पी. के आई.ई.टी. परीक्षण 2018-19 हेतु नामित किया गया है।

केनॉफ में रेशा उत्पादन तथा इससे संबंधित सभी गुणों के लिए इनके एफ₁ संकर में पर्याप्त औसत संकर ओज पाया गया है। केनॉफ के तीन प्रजातियों को गामा रेंज से उपचारित 20 एम₂ समुदाय से पौध उँचाई तथा तने की मोटाई के आधार पर कुल 395 एकल पौध का चयन किया गया है।

पलैक्स में उच्च रेशा उपज क्षमता तथा उकटा रोग से सहिष्णु प्रजातियों के विकास हेतु एकल तथा पारस्परिक अन्तः संकरण कराया गया है।

एग्लोमेरेटिव हाईरेरकियल कलस्टर विश्लेषण के द्वारा सनई के चयनित प्रभेदों को परिभाषित बीज उत्पादन लक्षणों हेतु कुल चार भिन्न समूहों में वर्गीकृत किया गया है। समूह-I तथा समूह-II

के सभी प्रभेदों को वानस्पतिक वृद्धि तथा बीज उत्पादन लक्षणों से संबंधित लगभग सभी गुणों के लिए श्रेष्ठ पाया है।

बीज विज्ञान एवं प्रौद्योगिकी

खरीफ 2017-18 के दौरान पटसन के 16, मेस्ता के 5 तथा सनई के 2 प्रजातियों के कुल 15.97 कुन्टल जनक बीज का उत्पादक किया गया है। इसके अतिरिक्त पटसन, मेस्ता तथा सनई के क्रमशः 26, 7 तथा 4 प्रजातियों की कुल 1.90 कुन्टल केन्द्रक बीज का उत्पादन भी किया गया है।

आई.सी.ए.आर. बीज परियोजना के अन्तर्गत विभिन्न फसलों जैसे पटसन, मेस्ता, सनई, ढैंचा, धान, गेहूँ तथा सरसों के उन्नत प्रजातियों का कुल 477.21 कुन्टल बीज उत्पादन किया गया है। इसके अतिरिक्त सीसल (50,000 बुलबिल्स तथा सकर्स) तथा रेमी (5 कु. राइजोम तथा 1.5 लाख पौध) के रोपण सामग्री का उत्पादन तथा कृषकों में वितरण भी किया गया है।

राष्ट्रीय खाद्य सुरक्षा मिशन के व्यावसायिक फसलों के बीज उत्पादन कार्यक्रम के अन्तर्गत पटसन का कुल 18.36 कुन्टल आधारीय बीज तथा मेस्ता के विभिन्न प्रजातियों का कुल 3 कुन्टल जनक बीज तैयार किया गया है। इसके अतिरिक्त ग्राम बीज कार्यक्रम के अन्तर्गत पटसन के नवीन प्रजातियों जैसे सी.ओ.-58, जे.आर.ओ.-204 तथा एस.-19 से संबंधित कुल 17.69 कुन्टल गुणवत्ता बीज का उत्पादन भी किया गया है।

जैव प्रौद्योगिकी

पटसन की प्रचलित प्रजाति जे.आर.ओ.-524 के पूर्ण जिनोम अनुक्रमण के दौरान कुल 377.3 मिलियन बेस पेयर के साथ-साथ लगभग 57087 प्रोटीन कोडिंग जिन्स पाये गये। आर.एन.ए. अनुक्रम के माध्यम से पुनः व्याख्या करने पर कुल 47434 प्रोटीन कोडिंग जिन्स ज्ञात हुए जिनका कुल जिनोम आकार लगभग 209.4 मिलियन बेस पेयर पाया गया।

सादा पटसन की प्रजाति जे.आर.सी.-212 में कुल 12772 एस.एस.आर. मार्कर्स को चिन्हित किया गया है। 20 विभिन्न किण्डवक की मदद से फिनाईलप्रोपेनायड जैवसंश्लेषण विशिष्ट जीन्स से संबंधित कुल 39 एस.एस.आर. मार्कर्स को भी डिजाइन किया गया है। इसके अतिरिक्त 1500 यादृच्छिक ढंग से चयनित एस.एस.आर. मोटिफ्स से कुल 600 एस. एस. आर. प्राइमर्स बनाये गये हैं। सादा पटसन

में 120 मार्कर्स की पुष्टि भी की गयी है जिनमें से 105 मार्कर्स 1-6 एमप्लीकॉन को प्रस्तुत करने में सफल रहे।

तोषा पटसन के जे.आर.ओ.-204 नामक प्रजाति के माध्यम से कुल 39 एक्वापोरिन जीन्स की पहचान की गयी। जबकि सादा पटसन की प्रभेद सी.वी.एल.-1 में कुल 35 एक्वापोरिन जीन्स को चिन्हित किया गया है। तोषा तथा सादा पटसन के माध्यम से कुल 17 उष्ण आघात कारकों की पहचान की गयी है। इसके अतिरिक्त फ्लैक्स में भी कुल 34 उष्ण आघात कारकों को चिन्हित किया गया है।

ट्रान्सक्रिप्टोम विश्लेषण के माध्यम से सनई के 1009 पौधों के ट्रान्सक्रिप्ट को अनिषेच्यता संबंधित प्रोटीन से मेल कराया गया है। 72 पौधों के आर.एफ. प्रोटीन से संबंधित स्वनिषेच्यता बहाली जीन्स के पहचान हेतु भी "ब्लास्ट" विश्लेषण किया गया है। सनई की कृषित प्रजाति एस.यू.आई.एन.-053 तथा स्वनिषेच्य सनई के जंगली प्रजाति सी. रेटुसा के पुष्प के विभिन्न उत्तकों में अभिव्यक्ति के आधार पर जीन्स के एक समुच्च का चयन किया गया है।

फ्लैक्स की कृत्रिम परिवेश में पौध उगाने की एक पद्धति का विकास किया गया है। उत्तक संवर्धक एम.एस. मीडियम में 0.5 मि.ग्रा./ली. 2, 4-डी, 0.5 मि.ग्रा./ली. कार्बोनेटिन तथा 0.5 मि.ग्रा./ली. आई.ए.ए. मिलाने से कैल्स निर्माण में उत्साहवर्धक परिणाम प्राप्त हुए। एम.एस. मीडियम में 1.5 मि.ग्रा./ली. कार्बोनेटिन मिलाने पर सर्वाधिक पौध उद्भवन (औसत 15.65 पौध/एक्सप्लांट) पाया गया जबकि एम.एस. मीडिया में 2.0 मि.ग्रा./लीटर कार्बोनेटिन के प्रयोग से पौध की उँचाई में सर्वाधिक (7.46 से.मी.) वृद्धि दर्ज की गयी। पौध के मूल उद्भवन हेतु संवर्धन मीडिया में 1.5 मि.ग्रा./ली. आई.बी.ए. का प्रयोग उपयुक्त पाया जिसके फलस्वरूप लगभग 43.7 प्रतिशत तक परिपक्व पौधों की प्राप्ति तथा उनसे गुणवत्ता बीज भी प्राप्त हुए।

ट्रांसजेनिक विकास के क्रम में फ्लैक्स की प्रजाति जे.आर.एफ. 2 के 12 दिन पुराने पौध के हाइपोकोटार्डल से एग्राओ-वैक्टेरियम आधारित आनुवांशिक रूपांतरण पद्धति को स्थापित किया गया है। जिससे 77.5 प्रतिशत रूपांतरित पौधों में जी.यू.एस. की अभिव्यक्ति दर्ज की गयी है। तोषा पटसन की दो प्रजातियों के पुष्पकली के माध्यम से क्राई 1 ए.(बी.) जीन के द्वारा सफलतापूर्वक आनुवांशिक रूपांतरण किया गया है। रेमी की प्रजाति आर.एस. 67-34 का भी उत्तक संवर्धन किया गया है जिसके फलस्वरूप प्रति एक्सप्लांट लगभग 46 पौध प्राप्त हुए तथा लगभग 90 प्रतिशत पौध अपना जीवन

चक्र पूर्ण करने में सफल रहे।

रोजेल तथा केनॉफ की क्रमशः 10 एवं 9 प्रजातियों की पहिचान हेतु आर.ए.पी.डी. मार्कर्स की सहायता से उनका डी.एन.ए. फिंगर प्रिंट तैयार किया गया है। रोजेल की प्रजाति ए.एम.वी.-2, ए.एम.वी.-4, एच.एस.-4288 तथा एच.एस.-7910 में विशिष्ट बैंड पाया गया जबकि केनॉफ की एम.टी.-150, एच.एस.-583, जे.बी.एम.जी.-4, जे.बी.एम.-81, जे.आर.एम.-3 तथा जे.आर.के.एम.-9-1 प्रजातियों में विशिष्ट बैंड पाया गया। दो मार्कर्स की सहायता से केनॉफ में नर बन्ध तथा प्रजनन क्षम नर की अभिरूपता स्थापित की गयी है।

मृदा एवं पोषकतत्व प्रबंधन

उर्वरकों के दीर्घकालिक प्रभाव के अध्ययन से ज्ञात हुआ कि केवल उर्वरकों का अनुप्रयोग या गोबर की खाद के साथ उर्वरकों के अनुप्रयोग से पटसन, धान और गेहूँ की उपज में उल्लेखनीय वृद्धि हुई है। धान एवं गेहूँ की अधिकतम उपज 100% एन.पी.के.+ गोबर की खाद के उपयोग से प्राप्त की गई जबकि अधिकतम पटसन की उपज 150% एन.पी.के. के उपचार से प्राप्त हुई। जैविक खाद तथा रसायनिक उर्वरकों के समेकित उपयोग से पोषक तत्वों के सकारात्मक अंतःप्रवाह हुई जिससे मृदा में ओ.सी., उपलब्ध नाइट्रोजन, उपलब्ध फास्फोरस तथा उपलब्ध पोटेशियम में वृद्धि दर्ज की गयी।

जलोढ मृदा में पटसन-धान-गेहूँ कृषि प्रणाली के अंतर्गत लम्बी अवधि की उर्वरक प्रबंधन पद्धति की प्रतिक्रिया स्वरूप मृदा जैविक कार्बन सीक्वेस्ट्रेशन के मॉडलिंग से स्पष्ट हुआ है कि सभी फसलों में गोबर की खाद के साथ 100 प्रतिशत एन.पी.के. के अनुप्रयोग तथा सभी फसलों की टुंठियों एवं जड़ अवशेष कार्बन धारक के रूप में कार्य करते हैं। औसत मृदा कार्बन घनत्व 1972 के दौरान 18.18 मि.ग्रा./हे. से बढ़ते वर्तमान औसत 22 मि.ग्रा./हे. 2065 हो जायेगा। योगदान का आकलन 5.30 मि.ग्रा. कार्बन/हे./वर्ष किया गया है जो कि स्थानीय मृदा तथा जलवायुविय स्थितियों पर निर्भर करेगा।

एसटी-टीवाई के अनुसार उर्वरकों के अनुप्रयोग से पटसन रेशे के लक्षित उपज - 4.5% के साथ 40 कु./हे. प्राप्त किया गया। गोबर की खाद के साथ एसटी-टीवाई के साथ एकीकरण से पटसन रेशे के लक्षित उपज + 2.68% विचलन के साथ 35 कु./हे. प्राप्त किया गया। किसानों के खेत में परीक्षणों के अंतर्गत एसटी-टीवाई के साथ तथा एसटी-टीवाई के बिना उर्वरकों के अनुप्रयोग से पटसन रेशे की 40 कु./हे. लक्षित उपज तथा आलू की 30 टन/हे. कंद उपज प्राप्त किया गया।

रेमी आधारित विभिन्न फसल प्रणालियों में मृदा जैविक कार्बन सेक्वेस्ट्रेशन के अध्ययन से स्पष्ट हुआ है कि सतही मृदा में अत्यंत परिवर्ती तथा गैर-परिवर्ती कार्बन पूल कुल जैविक कार्बन का क्रमशः 32-41% तथा 24-31% होता है।

संरक्षित जुताई वाले पटसन आधारित विभिन्न फसल प्रणालियों में मृदा जैविक कार्बन का चिक्की मिट्टी से सहसंबंध उल्लेखनीय एवं सकारात्मक रहा है। उपलब्ध एन.पी.के. तथा ईसी का स्थूल घनत्व से नकारात्मक सहसंबंध पाया गया। अन्य फसल प्रणालियों और जुताई बिना अवशेषों की तुलना में पटसन-धान-मसूर फसल प्रणाली में मृदा गुणवत्ता सूचकांक काफी अधिक पाया गया है।

फसल प्रबंधन

विभिन्न प्रकार की फसल प्रणालियों में से पटसन-धान-बेबी कॉर्न तथा पटसन-धान-मटर प्रणाली में उच्चतम प्रणाली उत्पादकता एवं सतत उपज सूचकांक दर्ज किया गया, जबकि पटसन-धान-सरसों तथा मूंगबीन फसल प्रणाली में उच्चतम कार्बन प्रबंधन सूचकांक दर्ज हुआ है। विभिन्न प्रकार की पोषक तत्व प्रबंधन पद्धतियों में से फसल अवशेषों के साथ 100% एन.पी.के. के अनुप्रयोग से उच्चतम प्रणाली उत्पादकता, सतत सूचकांक तथा कार्बन प्रबंधन दर्ज किया गया।

परंपरागत पटसन-धान-आलू फसल प्रणाली में अधिकतम पटसन समकक्ष उपज की प्राप्ति हुई जबकि पटसन-धान-अश्वगंधा फसल क्रम में अधिकतम लाभ-लागत अनुपात दर्ज किया गया। पटसन बीज फसल के अंतर्गत विभिन्न प्रकार के औषधीय एवं सुगंध पौधों में से पटसन-स्टीविया धान फसल क्रम में उच्चतम पटसन समकक्ष उपज दर्ज की गई।

पटसन-मूंग की अंतःफसलीय कृषि प्रणाली के अंतर्गत पटसन के पंक्तियों के बीच 35 से.मी. के अंतराल से उच्चतर पटसन रेशा तथा 40 से.मी. अंतराल से उच्चतर मूंग की उपज दर्ज की गई।

औषधीय एवं सुगंध पौधों को सीसल के अंतः फसल में सफेद मुसली के अंतः-फसल तथा मसालों में सौंफ के अंतःफसल में अधिकतम उपज तथा शुद्ध आय दर्ज की गई। सीसल-फल अंतः-फसल प्रणाली में सीताफल के साथ अंतः-फसल में उच्चतम सीसल उपज दर्ज की गई। फल के पौधे की 60% तथा 100% पी.ई. पर सिंचाई करने की अपेक्षा 80% पी.ई. पर सिंचाई करने से अधिकतम पौध एवं फल उपज प्राप्त हुई।

जैविक एवं अजैविक तनाव

इलेक्ट्रॉएंटोनोग्राम डिटेक्टर के साथ गैस क्रोमोटोग्राफी (जीसी-ईएडी) तथा मास स्पेक्ट्रोमेट्री के साथ गैस क्रोमोटोग्राफी (जीसी-एमएस) के उपयोग से पटसन के सेमिलूपर, एनोमिस सबुलिफेरा के मादा सेक्स फेरोमोन का पृथकीकरण तथा पहचान से स्पष्ट हुआ है कि ए. सबुलिफेरा के नर कीटों को आकर्षित करने हेतु मादा कीटों के फेरोमोन ग्रंथी में सक्रिय यौगिक के रूप में हेनेयोकोसाडियन की मौजूदगी है।

अत्यंत विशिष्ट जैव-रसायन तथा वीओसी प्रोफाइल के आधार पर सी. एस्टॉन्स के डब्ल्यूसीआईएन-179 वंशक्रम की विशिष्टता एवं नवीनता की पुष्टि हुई जो इसे एकाधिक तंत्रों के माध्यम से रोंयेदार सूड़ी के प्रति प्रतिरोधी बनाता है। अतः सी. एस्टॉन्स का संकरण पटसन के कृषित प्रजाति सी. ओलिटोरियस से किया जा सकता है अतः यह अत्यंत व्यवहार्य है कि इस वंशक्रम को तोषा पटसन में कीट प्रतिरोधी प्रजनन कार्यक्रम हेतु उपयोग किया जा सकता है। उक्त जननद्रव्य वंशक्रम के पंजीकरण हेतु नई दिल्ली में स्थित एन.बी.पी.जी.आर. को प्रस्तुत किया गया है।

वयस्क अवस्थाओं के संक्रमण, मकड़ी प्रकोप काल सहिष्णुता सूचकांक तथा नाशीजीव के प्रति समग्र संवेदनशीलता के आधार पर जे.आर.ओ.-524, जे.आर.ओ.-8432 तथा जे.आर.ओ.-204 किस्में पीली मकड़ी के विरुद्ध प्रतिरोधी पाए गए हैं। मकड़ी के संक्रमण काल में भी मकड़ी की संख्या इनकी वृद्धि तथा इनके लक्षणों का विकास भी इन प्रजातियों में कम देखा गया। विभिन्न उन्नत किस्मों में संवेदनशीलता सूचकांक 179.43 से 708.58 के बीच पाया गया और जे.आर.ओ.-524 में न्यूनतम स्तर दर्ज किया गया।

ग्लास हाउस स्थितियों के अंतर्गत पीली मकड़ी के विरुद्ध विषाक्तता तथा अटलता के संदर्भ में फेनपायरॉक्सिमेट 5 ईसी (0.005%) तथा स्पायरोमेसिफाइन 22.9 ईसी (0.016%) अत्यंत प्रभावकारी प्रमाणित हुए हैं। पटसन के पीली मकड़ी के अपरिपक्व एवं मोबाइल अवस्थाओं के विरुद्ध इन दोनों अकारिसाइड्स की अवशेष विषाक्तता, अटल विषाक्तता, उच्च ट्रांसलेमिनार गतिविधि एवं प्रभावकारिता उच्चतर पायी गयी।

मिलिबग के विरुद्ध एकल रूप में एंडोफाइटिक एंटमोपेथोजेन, एल. लेकानी, बी. बेसियाना की अपेक्षा अधिक प्रभावकारी है तथा बिहार रोमिल सूड़ी के विरुद्ध बी. बेसियाना का प्रदर्शन बेहतर

पाया गया। तथापि, एंडोफाइटिक एल. लेकानी (वीएल8, वीएल15) तथा बी. बेसियाना (मृत मिलिबग से पृथक किए गए (बी.वी.एम.) के मिश्रित अनुप्रयोग मिलिबग के विरुद्ध अत्यंत प्रभावकारी पाया गया जबकि एंडोफाइटिक एल. लेकानी (वीएल8, वीएल15) तथा बी. बेसियाना (आईटीसीसी 5408) के मिश्रित अनुप्रयोग से बिहार रोमिल सूड़ी में अधिकतम मृत्युदर देखी गई।

पटसन के तना सड़न रोग से उत्पन्न घावों से जुड़े रोगाणु 6 मॉर्फो-समूहों तथा 4 आईटीएस-आरएफएलपी वर्गों से संबंधित हैं। इनकी पहचान करने हेतु 6 समूहों में से प्रत्येक के दो प्रतिनिधि आइसोलेट्स की मॉलिक्यूलर फाइलोजेनी का चयन किया गया। पॉलीजेनेटिक ट्री के निर्माण हेतु अधिकतम लाइक्लिहुड (एमएल) तथा अधिकतम पार्सिमोनी (एमपी), दोनों ही पद्धतियों का उपयोग किया गया। तदनुसार पटसन को संक्रमित करने वाले रोगाणु एस्कोमाइकोटा के तीन परिवारों नामतः, डायपोर्थेसी (डायपोर्थे स्पेसीज), ग्लोमेरेल्लेसी (कोल्लेटोट्राइकम स्पेसीज) तथा बोट्रायोस्फेरेसी (लासियोडिप्लोडिया स्पेसीज, मेक्रोफोमिना फेसियोलीना) से सं. बंधित पाये गये हैं।

केंद्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान के अनुसंधान प्रक्षेत्र के साथ-साथ किसानों के खेत में पटसन के प्रमुख कीट एवं व्याधियों के विरुद्ध आईपीएम मॉड्यूल अत्यन्त प्रभावकारी होने के साथ-साथ इससे उच्चतर लाभ:लागत अनुपात भी दर्ज किया गया, जिसमें सस्य क्रियाएं (5-6 लाख पौधे/हे. की पंक्ति रोपाई, एनपीके : 60:30:30), रसायन (रोपाई से 7 दिन पूर्व 30 कि.ग्रा./ हे. की दर से Ca(OCl)₂ का मृदा अनुप्रयोग, (क) कार्बोडाजिम 2 ग्रा./कि.ग्रा. + (ख) इमिडाक्लोप्रिड 4 ग्रा./कि.ग्रा की दर से बीजों का उपचार, कीटनाशकों का अनुप्रयोग : स्पाइरोमेसिफेन 1 मि.ली./ली. की दर से, प्रोफेनोफोस 2 मि.ली./ली. की दर से); जैविक (रोपाई से पूर्व ट्राइकोडर्मा विरिडी 10 ग्रा./कि.ग्रा. बीज की दर से तथा नीम तेल का छिड़काव 3-4 मि.ली./ली. की दर से) घटक सम्मिलित हैं।

ओडिशा के संबलपुर, सुंदरगढ़ तथा झारसुगंडा जिलों में सीसल की खेती में जेबरा रोग प्रकोप, एगव सिसालाना में 13.3 से 34.7% तथा बामरा हाइब्रिड-1 में 17.0 से 48.3% पाया गया। एगव सिसालाना तथा बामरा हाइब्रिड-1, दोनों ही किस्मों पर नर्सरी अवस्था तथा 2-3 वर्षों की आयु वाले सकरों की रोग तीव्रता पर तापमान का उल्लेखनीय नकारात्मक सहसंबंध देखा गया। सीसल में रोग तीव्रता

पर वर्षापात का उल्लेखनीय सकारात्मक सहसंबंध रहा है।

पलैक्स के उकठा रोग प्रकोप पर बुआई की तिथि का उल्लेखनीय प्रभाव देखा गया है। अक्टूबर के अंतिम सप्ताह की अगेती बुआई में उकठा रोग का प्रकोप नवंबर (10 नवंबर तथा 25 नवंबर) में बोई गयी फसल की तुलना में उल्लेखनीय रूप से अधिक (18.1%) रहा है।

सीसल की नर्सरी तथा सकर अवस्थाओं में जेबरा रोग को कम करने में कवकनाशकी फोस्टाइल ए.आई.-2.0 ग्रा./ली. की दर से उपयोग करने पर अत्यंत प्रभावकारी पाया गया। विभिन्न प्रकार के खलियों में से नीम खली का 10.0 क्विंटल/हे. की दर से उपयोग से रोग का प्रभावी नियंत्रण हुआ जिसके बाद करंज, महुआ और अलसी खल्ली का स्थान रहा।

मृदा में नाइट्रोजन एवं फास्फोरस मान के अनुसार खरपतवारों के घनत्व में भिन्नता देखी गई। मृदा में नाइट्रोजन एवं फास्फोरस के उच्चतर मान होने पर खरपतवारों का घनत्व अधिक देखा गया। विभिन्न प्रकार के फसल अवशेष प्रबंधन पद्धतियों के अंतर्गत मटर तथा मूंग अवशेष 2 टन/हे. की दर की तुलना में चावल, गेहूं तथा मक्का अवशेष प्रत्येक 4 टन/हे. की दर से अनुप्रयोग करने पर उल्लेखनीय रूप से खरपतवार घनत्व में कमी देखी गयी।

पटसन की खेती में खरपतवार उभरने से पूर्व खरपतवारनाशी आइफेनकार्बाजोन 68.43 तथा 91.24 ग्रा./हे. की दर से उपयोग करने पर पटसन को क्षति पहुंचाए बिना घास कुल के खरपतवारों में 90% चौड़ी पत्तियों वाले खरपतवार 52% तथा सेज कुल के खरपतवार 40% तक कम हुए। पटसन की बीज फसल में खरपतवार उभरने के पश्चात हेलॉक्सोफोप-आर-आर मेथाइल 10.5 ई.सी. 42-157 ग्रा./हे. की दर से उपयोग के परिणामस्वरूप हाथों से दो बार निराई की तुलना में उच्चतर पटसन बीज की उपज दर्ज की गई।

पादप वृद्धि विनियामक एस्कोर्बिक एसिड का उपयोग सूखे की स्थिति के अंतर्गत पौधे की ऊंचाई तथा पत्तियों के मुड़न के संदर्भ में शुष्क तनाव दूर करने में अत्यंत कारगर पाया गया।

एंडोफाइटिक Bb (आईटीसीसी 5408) से उपचारित बीजों से उगाए गए पटसन के पौधे मुरझाए बिना जल देने के 6 दिनों के अंतराल में भी जीवित पाए गए। आईटीसीसी 5408 से उपचारित पौधों में जल की कमी के संदर्भ में प्रोलीन स्तर अधिक (1.78 मि.ग्रा./ग्रा.)

पाया गया जिसके बाद क्रमशः आईटीसीसी 5562 (1.46 मि.ग्रा./ग्रा.) तथा आईटीसीसी 4563 (0.85 मि.ग्रा./ग्रा.) का स्थान रहा है जबकि अनुपचारित पौधों में निम्न स्तर 0.21 मि.ग्रा./ग्रा. पाया गया है।

प्रक्षेत्र यंत्रीकरण एवं कटाई उपरांत तकनीकी

एक सामान्य हल्के भार वाले हस्तचालित सीड ड्रिल का विकास किया गया है ताकि ऑपरेटर के परिश्रम को कम किया जा सके। इसकीकीमत कम होने के कारण यहलघु सीमांत कृषकों के लिए अत्यन्त उपयोगी है।

छह पंक्तियों वाले पावर चालित सीड ड्रिल के प्रयोगात्मक मॉडल का इसकी दक्षता एवं अनुकूलनशीलता के लिए किसानों के खेत में परीक्षण किया गया। इस सीड ड्रिल की 0.35-0.4 हे./घंटा क्षमता के साथ-साथ यह 25-30 मि.मी. की गहराई तक बीज डालने में सक्षम है।

परिचालन की औसत गति 28.08 मी./मिनट होने पर क्राइजाफ सिंगल व्हील जूट वीडर की औसत प्रक्षेत्र क्षमता 0.026-0.28 हे./घंटा तथा 29.7 कि.ग्रा. ड्रॉपट के साथ 76.7 प्रतिशत प्रक्षेत्र क्षमता पाई गई।

परंपरागत रूप से पटसन सड़न की तुलना में पटसन रीबन सड़न की विधि रेशा के उत्पादन एवं इसकी गुणवत्ता, दोनों में सुधार के साथ इसकी सड़न अपनाने से अवधि (5-7) में भी कमी दर्ज की गयी।

पटसन एवं समवर्गीय रेशा सूचना विज्ञान

पटसन के नए किस्मों, उन्नत उत्पादन एवं संरक्षण तकनीकों, एमएसपी, ग्रेडिंग, विपणन तथा निर्यात संबंधी सूचनाओं की सरल उपलब्धता एवं प्रचार के लिए "जूट एग्री" नामक एंड्रायड एप विकसित किया गया है।

कृषि-सलाहकार मॉड्यूल के तहत किसानों को कृषि सलाहकार सेवाओं के लिए लम्बी अवधि के टेम्पोरल एवं स्पेशियल क्लाइमेटिक डाटा के भंडारण, अद्यतन, पुनर्प्राप्ति हेतु "जूटमेट" नामक वेब-आधारित एग्रोमिटयोरोलॉजिकल डाटाबेस मैनेजमेंट सिस्टम-सह-कृषि-सला. हकार प्रणाली विकसित की गई है।

'जूटमार्करडीबी', प्रकाशित जूट यूनिजीन सीक्वेंसेस से व्युत्पत्ति की गई एक डाटाबेस है, जो एसएसआर प्राइमर डाटा उपलब्ध कराने

हेतु 'एस.क्यू.एल.' क्वोरीज का उपयोग करता है। जूट जिनोम सी. क्वेंसेस में हुई प्रगति एवं उपलब्धता के कारण 'जूटमार्करडीबी' के उन्नत संस्करण में BLASTn अथवा BLASTn-alike टूल होंगे।

तकनीकी आकलन एवं हस्तान्तरण

पश्चिम बंगाल राज्य के नदिया, उत्तर 24 परगना, मुर्शिदाबाद तथा हुगली जिलों में पटसन की उन्नत उत्पादन तकनीकों का अग्रपंक्ति प्रदर्शनों का आयोजन किया गया इन जिलों के 87.75 हे. क्षेत्रफल में कुल 345 परिणामों में देखा गया कि स्थान प्रभाव से मुक्त, पटसन की सर्वाधिक उपज जे.आर.ओ.-204 (31.42 क्विंटल/हे.) प्रजाति से प्राप्त हुई। क्राइजैफ 'नेल वीडर' द्वारा यांत्रिक विधि से खर-पतवार प्रबंधन परिणामस्वरूप किसानों की पद्धति (27.90-28.97 क्विंटल/हे.) की तुलना में 2.35-3.24 क्विंटल/हे. की उपज वृद्धि हुई तथा मजदूरी लागत में भी 8094-14304 रु./हे. की कमी आई है। छिटकवाँ विधि की तुलना में क्राइजैफ बहु पंक्ति सीड ड्रिल द्वारा पंक्तिबद्ध बुआई से रेशा उपज में 2.28-2.81 क्विंटल/हे. की वृद्धि हुई इसके अलावा विरलीकरण (थिनिंग) और फसल कटाई आदि में भी श्रम लागत में 5258-5998 रु./हे. तक की बचत हुई। 'क्राइजैफ सोना' के उपयोग से सभी स्थानों पर रेशे की गुणवत्ता में 1-2 ग्रेड का सुधार हुआ है जिससे पटसन उत्पादकों को 250-400 रु./क्विंटल की अतिरिक्त आय प्राप्त हुई है। परंपरागत सड़न की तुलना में इस नवीन तकनीक से जल की खपत काफी कम हुई है। अधिकांश किसान उनके खेतों में आईसीएआर-क्राइजैफ द्वारा किए गए प्रदर्शित तकनीकों के परिणाम से संतुष्ट दिखे।

पटसन आधारित फसल प्रणाली में पादप संरक्षण प्रबंधन पद्धतियों (पीपीएमपी) के संदर्भ में किसानों की धारणा के मूल्यांकन संबंधी अध्ययन में पाया गया कि सभी संबंधित किसानों में पीपीएमपी के प्रति सकारात्मक धारणा है और वे कीटनाशकों के खतरों तथा प्रतिबंधित कीटनाशकों के प्रति जागरुक हैं। पटसन-धान-सरसों/मसूर फसल चक्र में कीटनाशकों पर अधिकतम खर्च (8000 रु./हे.) धान के बाद पटसन में (5500 रु./हे.) तथा सरसों/मसूर में (2500 रु./हे.) में था।

पटसन आधारित फसल प्रणाली में जलवायु भिन्नता के प्रभावों पर एक अन्य अध्ययन से स्पष्ट हुआ है कि 90 प्रतिशत किसानों में यह धारणा है कि 10-15 वर्षों के दौरान जलवायुवीय घटकों में भिन्नता आई है। अति वृष्टि (फसल कटाई के समय), दीर्घ अवधि

तक सूखा या अति वृष्टि (पौध प्रारंभिक अवस्था) फसल उपज पर प्रतिकूल प्रभाव डालता है। इसके अलावा दीर्घ अवधि तक गर्म एवं आर्द्र मौसम के कारण कीट व रोग के बारंबारता व व्यापकता में वृद्धि भी उत्पादकता में कमी लाते हैं।

अखिल भारतीय पटसन एवं समवर्गीय रेशा नेटवर्क परियोजना

क्रॉप स्टैन्डर्ड, नोटिफिकेशन एण्ड रिलीज ऑफ वेरैटीज सब-कमे. टी द्वारा पटसन एवं समवर्गीय रेशा फसलों के चार किस्मों नामतः तोषा पटसन के एन.जे.-7010 (रानी), सादा पटसन के बी.सी.सी. सी.-1, केनॉफ के जे.बी.एम.पी.-3 (प्रिया) तथा रोजेल के जे.आर. आर.-17 को व्यवसायिक खेती के लिए विमोचित एवं अधिसूचित किया गया। इसके अलावा 10-11 मार्च, 2018 के दौरान बिधान चन्द्र कृषि विश्व विद्यालय, कल्याणी में आयोजित अखिल भारतीय नेटवर्क पटसन एवं समवर्गीय रेशा परियोजनाकी 13वीं वार्षिक समूह बैठक में केन्द्रीय विमोचित हेतु केनॉफ (जे.बी.एम.पी.-4), रोजेल (जे.आर.एच.एस.-1) तथा सनई (एस.यू.आई.एन.-3) प्रत्येक के एक एक किस्म की पहचान की गई है।

पटसन एवं समवर्गीय रेशा फसल उगाए जाने वाले राज्यों में तोषा पटसन, सादा पटसन, रोजेल तथा केनॉफ प्रत्येक के 50 जननद्रव्यों को उनसे संबंधित प्रचलित किस्मों के साथ मूल्यांकन किया गया। संकरण कार्यक्रम के अंतर्गत विभिन्न केन्द्रों में संकरों, भिन्न-भिन्न सेग्रीगोटिंग संततियों के चयनित एकल पौधों का मूल्यांकन किया गया है और उनके बीजों को आगे के मूल्यांकन हेतु एकत्रित भी किया गया। बहुस्थानीय प्रयोगों के अंतर्गत पटसन एवं समवर्गीय रेशा फसलों के उन्नत प्रविष्टियों का मूल्यांकन किया गया जिनमें आईईटी, एवीटी तथा अनुकूली परीक्षण शामिल हैं।

उत्तर प्रदेश और बिहार में जैविक खाद की मौजूदगी तथा गैर-मौजूदगी में एसटी-टीवाई आधारित उर्वरक के अनुप्रयोग से पटसन एवं चावल की लक्षित उपज प्राप्त की गई। हाथों से एक बार निराई के साथ साथ प्रेटिलाक्लोर 50 ईसी 900 ग्रा./हे. की दर से उपयोग करने पर पश्चिम बंगाल और असममें खरपतवारों का प्रकोप काफी कम पाया गया और उच्चतम रेशा उपज की प्राप्ति हुई। गोबर की खाद 5 टन/हे. की दर से प्रयोग करने पर पटसन की उच्चतर बीज उपज (14.25 क्वि/हे.) प्राप्त हुई। खरपतवार उगने से पूर्व पेंडीमेथालिन 30% ईसी 750 ग्रा./हे. की दर से उपयोग करने पर फ्लाक्स की उच्चतम रेशा उपज प्राप्त हुई जब

कि पेंडीमेथालिन 1.0 कि.ग्रा एआई/हे. की दर से उपयोग करने पर खरपतवारों की वृद्धि उल्लेखनीय रूप से घट गई।

बुवाई से पूर्व कार्बेन्डाजिम से बीजोपचार + बुवाई के 45 दिनों पर कार्बेन्डाजिम का छिड़काव, पश्चिम बंगाल में पटसन के तना सड़न रोग प्रबंधन के लिए सर्वोत्तम उपचार पाया गया जबकि ओडिशा और बिहार में टेबुकोनाजोल 1.5 मि.ली./कि.ग्रा. बीज की दर से बीजोपचार + फसल की 40-45 दिनों की आयु पर टेबुकोनाजोल का छिड़काव उपयुक्त पाया गया है। पटसन में पीली मकड़ी के प्रबंधन के लिए बुवाई के 35 और 50 दिनों पर कृषि ग्रेड के मिनरल आयल 3 मि.ली./ली. की दर से + नीम का तेल 3 मि.ली./ली. की दर से पर्णिय छिड़काव अत्यंत प्रभावकारी पाया गया।

बीसीकेवी, कल्याणी, यूबीकेवी, कूचबिहार, जेआरएस, केन्द्रापाड़ा तथा आरएआरएस, नगांव केन्द्रों के माध्यम से जनजातीय उपयोजना कार्यक्रम का क्रियान्वयन भी किया गया। पश्चिम बंगाल, असम और ओडिशा के 5 जिलों के अंतर्गत 11 गांवों के कुल 57.8 हे. क्षेत्रफल में कार्यक्रम का आयोजन किया गया जिसमें 265 जनजातीय किसानों ने भाग लिया।

कृषि विज्ञान केन्द्र

कृषि विज्ञान केन्द्र द्वारा पटसन, धान, तिलहन, सब्जियों तथा मत्स्य पालन उत्पादन हेतु अनुशंसित की गई तकनीकों पर प्रक्षेत्र परीक्षणों का आयोजन किया गया। पटसन, धान, मूंगफली, तिल, मूंग, सरसों, मसूर, चना, प्याज, वार्षिक सहजन, बैंगन तथा चारा फसल (ज्वार, मक्का, बरसीम, जई तथा राइस बीन) की उन्नत उत्पादन तकनीकों से संबंधित कुल 1111 अग्रिम पंक्ति प्रदर्शनों का आयोजन किया गया। मात्स्यकी विज्ञान के क्षेत्र में एकलिंगी *तिलापिया* पर अग्रिम पंक्ति प्रदर्शन किया गया। किसानों, ग्रामीण युवाओं तथा विस्तार कार्यकर्ताओं के लिए दो व्यवसायिक प्रशिक्षणों सहित कुल 111 प्रशिक्षण कार्यक्रमों का आयोजन किया गया। इन प्रशिक्षण कार्यक्रमों से कुल 2819 प्रशिक्षणार्थी लाभान्वित हुए। महत्वपूर्ण कार्यक्रमों, जैसे न्यू इंडिया मंथन-संकल्प से सिद्धि, प्रधान मंत्री फसल बीमा योजना के प्रति जागरुकता कार्यक्रम, महिला किसान दिवस, स्वच्छता ही सेवा अभियान, विश्व मृदा दिवस तथा प्रधानमंत्री के भाषणों का प्रसार आदि का सफलतापूर्वक आयोजन किया गया।

Introduction

ICAR-Central Research Institute for Jute and Allied Fibres is one of the oldest premier research institutes of NARS conducting basic, strategic, anticipatory and applied research on all aspects of jute and allied fibre crops. The institute popularly known as ICAR-CRIJAF 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. To carry out research on jute and allied fibres and seed production, four research stations i.e., Ramie Research Station, Sorbhog, Assam (in 1959), Sisal Research Station, Bamra, Odisha (in 1962), Sunnhemp Research Station, Pratapgarh, Uttar Pradesh (in 1963) and Central Seed Research Station for Jute and Allied Fibres, Budbud, West Bengal (in 1956) were established.

The institute has played major role in developing and popularizing more than 50 varieties of jute and allied fibre crops which has doubled the productivity with considerable reduction in harvest period which enabled this crop to establish in the cropping sequence of different jute and allied fibres growing states. Besides, the institute has developed important technologies related to crop production & protection, improved retting, improved machineries for fibre extraction and intercultural operation and seed production. CRIJAF is also leading in jute genomic research, maintenance of related database and germplasm of jute and allied fibre crops.

Location

Geographically it is located at 88°26E longitude and 22°45N latitude at an altitude of 9 m above mean sea level. The institute is situated at 5 km east of Barrackpore Railway Station and is well connected with NSCB International Airport, Kolkata (18 km) and Howrah Railway Station (35 km).

Mission

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

Vision

Provide leadership in research and technology

development to make jute and allied fibre farming profitable and sustainable.

Mandate

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

Organizational set up

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 & plant protection. The regional stations with sufficient manpower, farm and laboratory facilities work on specific mandate crops and seed production. The research management is supported by different sections cells like PME cell, ALMU 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.

Ramie Research Station, Sorbhog, Assam

Ramie Research Station of ICAR-CRIJAF was established at Sorbhog, Assam in 1959 in 56 ha area. This station is engaged in the development of improved technology for ramie crop cultivation which is very specific to NE states. Since its inception, Ramie Research Station is playing important role in development and promotion of technology, generation and distribution of planting materials for area expansion and profitable ramie cultivation.

Sisal Research Station, Bamra, Odisha

Sisal Research Station was established at Bamra, Odisha

in 1962. Sisal germplasm block, model nursery and plantations are maintained in this station. Continuous effort by the station in the production and distribution of planting materials enhanced the area under sisal. This station has 103.60 ha area for conducting research and field trials on sisal crop.

Sunnhemp Research Station, Pratapgarh, U.P

In 1963, on the recommendation of Indian Central Jute Committee (ICJC) the Sunnhemp Research Station was established at Pratapgarh, UP. For a short period it was under the control of Director, Directorate of Jute Development. Later on from 1966 it was under the control of Jute Agricultural Research Institute, JARI (presently ICAR-CRIJAF). The Station moved over to its present campus in 1974. The research on crop improvement, seed and fibre production technology of sunnhemp is exclusively done at this station. It has a research farm, laboratories, office and staff quarters in 9.18 ha campus.

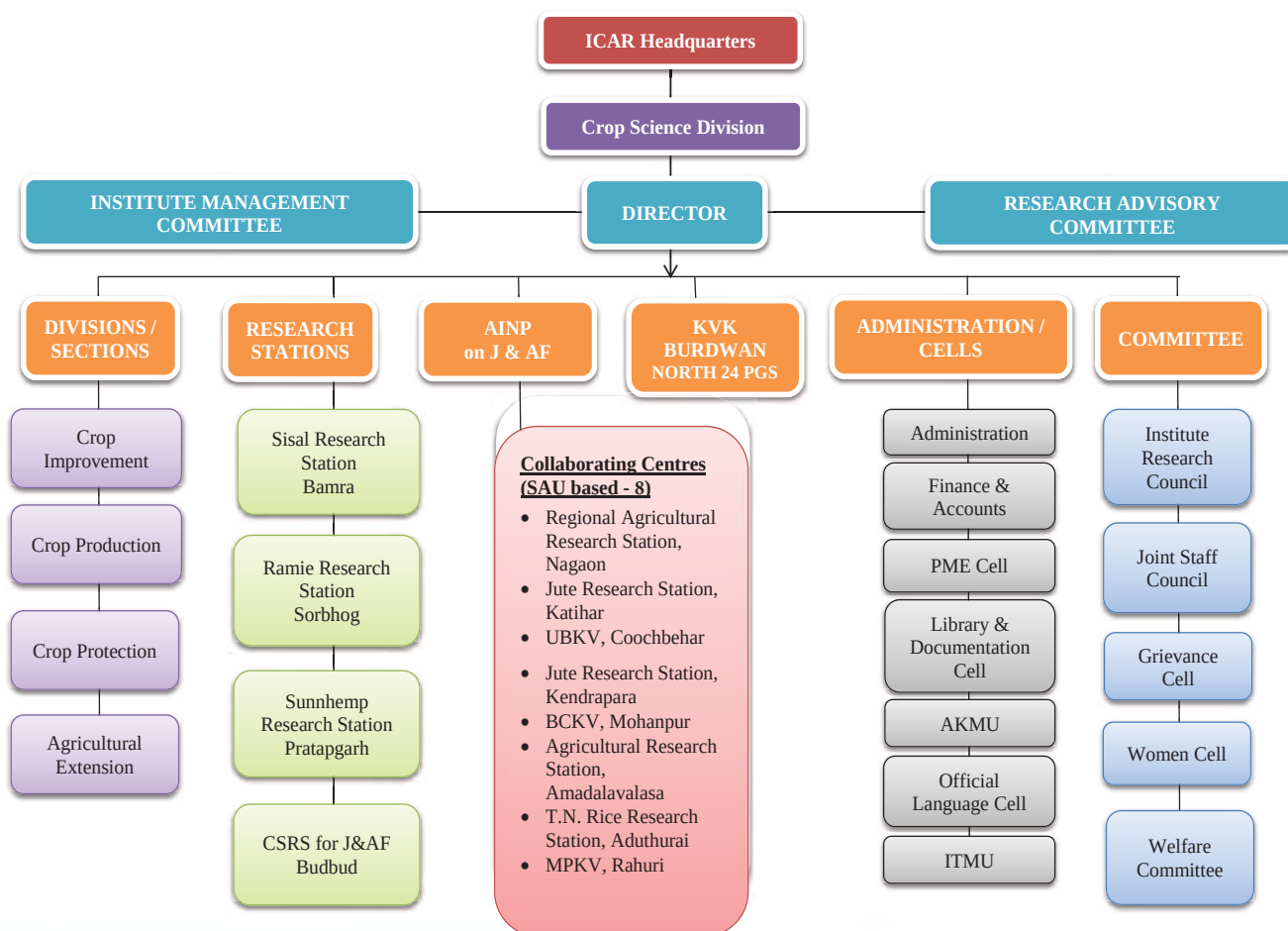
Central Seed Research Station for Jute and Allied Fibres, Budbud, West Bengal

Central Seed Research Station for Jute and Allied Fibres (CSRSJAF) previously known as Central Nucleus Jute Seed Multiplication Farm, was established in the year 1956 at Budbud, Burdwan, West Bengal. The station has 65 ha research farm, seed processing and storage unit, mobile seed processing unit, combined harvester to support the quality seed production technology. This regional station mainly deals with the production of nucleus seed of jute and allied fibres through maintenance breeding, production of breeder seed of jute, mesta and sunnhemp and production of quality seed (foundation, certified & TL) of jute and other field crops.

All India Network Projects on Jute and Allied Fibres (AINPJAF)

The coordinating cell of All India Network Projects on

Organogram





Jute and Allied Fibres (AINP JAF) is headquartered in the institute. At present, this project has 14 centres including 8 SAU-based and 6 ICAR-institute based collaborative centres for multilocational evaluation of the varieties, validation of production and protection technologies and quality evaluation of the fibres.

Krishi Vigyan Kendra (KVK), Purba Bardhaman, West Bengal

KVK, 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 under the administrative control of ICAR-CRIJAF. The KVK is actively involved in the transfer of technology through on-farm Trials (OFTs), frontline demonstrations, capacity building through hand-on training and other promotional extension activities in agriculture and other allied fields of horticultural crops, animal husbandry, fishery and home science. The KVK is well equipped with facilities like trainees 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.

Krishi Vigyan Kendra (KVK-II), North 24 Parganas (Nilgunj), West Bengal

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), frontline demonstrations, capacity building through hand-on training and other promotional extension activities in jute based farming system in the 11 Southern blocks of the District. Foundation stone of Administrative Building and the Trainee's hostel was laid by Hon'ble Union Minister of Agriculture and Farmers' Welfare Sri Radha Mohan Singh on 13th February 2017. Presently, this KVK is functioning from its temporary office at Extension Section of ICAR-CRIJAF.

Agricultural Knowledge Management Unit (AKMU)

Agricultural Knowledge Management Unit (AKMU) facilitates the e-governance and manages research information on jute and allied fibres. It provides stable, secured and uninterrupted internet facility to the whole campus. In order to implement the online ICAR-ERP solution the facility of high speed internet connectivity along with secured Wi-Fi systems has been created. The unit is also responsible for maintenance and updation

of institute website. The backbone for operating the e-extension, mobile advisory services and other related activities is also supported by AKMU.

Institute Technology Management Unit (ITMU)

Institute Technology Management Unit (ITMU) deals with protection of intellectual properties (IPs), their maintenance and commercialization of the technologies developed by the institute. ITMC chaired by the Director is the apex decision making body of the institute regarding IP management and their commercialization. It also looks after consultancy, contract research, patents, technology protection protocols, licensing etc.

Prioritization, Monitoring and Evaluation (PME) Cell

The PME cell of ICAR-CRIJAF was established as per guidelines of the Council. 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 assists the Director of the institute in evaluation, assessment, monitoring, management and co-ordination of all the on-going in-house as well as externally funded projects.

Library

The institute library, information and documentation unit has rich collection of books and journals of agro – biodiversity especially on jute and other fibre crops such as sisal, ramie, flax, sunnhemp, mesta, etc. It serves the research community with the information at their desks. The library has rich collection of books and journals (current and back volumes). The activity of the library has been digitized and the services are being provided electronically. AGRIS CD is available from 1971 to 2005 for easy access of abstracts of different publications. Library also provided the internet and reprography service to the readers along with Document Delivery Services (DDS) system by Consortium for e-Resources in Agriculture (CeRA) to access different journals on line.

Human Resource Development

The institute has been recognized for research work for M.Sc and Ph.D programmes by the Presidency University, Calcutta University and R.K.M. Vivekananda University. Beside the institute also conducts short term summer training for M.Sc students of SAUs and general universities (Govt. or private) on payment of appropriate fees. The extension section of the institute also conducts training to farmers and the other stakeholders of jute and allied fibre sectors.

Women Cell

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

Regional Centre of National Agricultural Education Accreditation Board

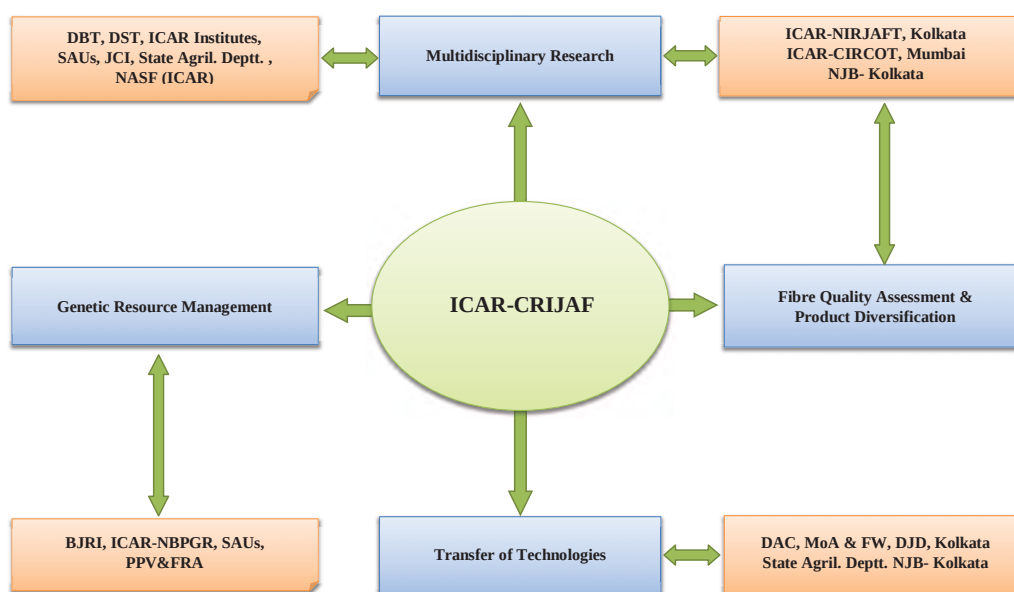
On recommendation of the accreditation board of ICAR, this institute (ICAR-CRIJAF) has been selected as the nodal centre for eastern and north-eastern region for facilitating the, submission of self-study reports of the

agricultural universities and other modalities required for accreditation.

Linkages

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

Linkages



1. Crop Improvement

1.1. Genetic Resources Management

1.1.1. Collection of germplasm

An exploration programme for collection of *Corchorus* spp. and *Hibiscus* spp. was carried out from Buldana, Jalgaon, Dhule, Nandurbar and adjoining districts of Maharashtra in collaboration with ICAR-NBPGR Regional Station, Akola. In total, 84 accessions were collected (Fig. 1.1) from six districts which includes, *C. aestuans* (07), *C. olitorius* (23), *C. tridens* (01), *C. trilocularis* (09), *C. fascicularis* (06), *C. pseudo-olitorius* (02), *C. depressus* (02), *H. sabdariffa* (22), *H. cannabinus* (07), *Hibiscus* spp. (02). Among the collected species *C. depressus*, *C. pseudo-olitorius* and *C. tridens* were of very rare occurrence and *C. pseudo-olitorius* was collected for the first time from Maharashtra. The seed material is being processed for accessioning and conservation as voucher specimen. (Source: JB 1.1. Contributors: J. Mitra, A. Bera, A. Anil Kumar and R.T. Maruthi).



Fig. 1.1. Jute and allied fibre crop species collected from farmer's field

1.1.2. Acclimatization, conservation and characterization

A total of 765 *C. olitorius* accessions and 145 JAF germplasm collected from previous exploration programme (Odisha, Telangana and Andhra Pradesh) were successfully regenerated at ICAR-CRIJAF, Barrackpore, West Bengal and SRS, Bamra, Odisha. Besides, 355 accessions of *H. sabdariffa* were also characterized and regenerated during this year. (Source: JB 1.1. Contributors: J. Mitra, A. Bera, A. Anil Kumar and R.T. Maruthi).

1.1.3. Distribution

A total of 1169 germplasm accessions (*C. olitorius*: 394, *C. capsularis*: 139, wild *Corchorus* spp.: 254, *H. cannabinus*: 164, *H. sabdariffa*: 157, *Crotalaria juncea*: 31, wild *Crotalaria* spp.: 30) of JAFs were distributed to different indenters including scientists of CRIJAF, AINP on Jute and Allied Fibres and other institutes. (Source: JB 1.1. Contributors: J. Mitra, A. Bera, A. Anil Kumar and R.T. Maruthi).

1.2. Jute (*C. olitorius* and *C. capsularis*)

1.2.1. Breeding for resistance to biotic stresses in *tossa* jute

F₁ generation of crosses JRC-212 x CIN-109, CMU-49 x JRC-212, CMU-14 x JRC-212 and JRO 2407 x WCJ-141-2 were advanced to F₂ generation to study for stem rot and hairy caterpillar genetics and RIL population of OIJ-248-1 x WCIN-136-1 was advanced to F₄ generation. Selected germplasm lines were screened for stem rot disease at ICAR-CRIJAF, Barrackpore. Based on mean PDI values (Fig. 1.2) germplasm line OIN 154-1 was found resistant followed by RS-6, CIN 109 and Cv. JRO 204. Germplasm line OIJ-272-1 was highly susceptible followed by JRC 412 and OIM 456. (Source: JB 10.1. Contributors: A. Anil Kumar, R.T. Maruthi, K. Mandal and B.S. Gotyal).

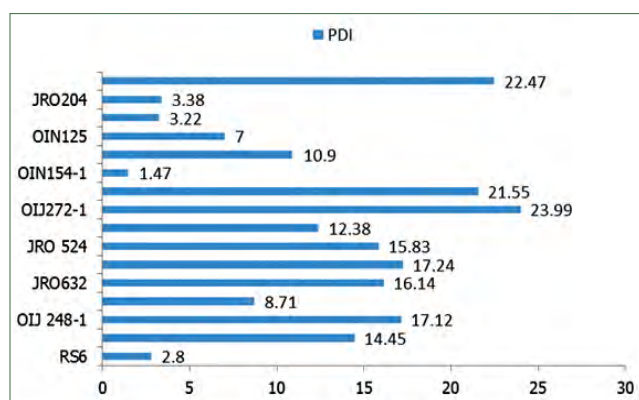


Fig. 1.2. Screening of selected germplasm lines against stem rot of jute

1.2.2. JRORS-6, an interspecific early flowering resistant line of *C. olitorius*

From an inter-specific biparental cross between *C. olitorius* cv. JRO-632 (female) and *C. aestuans* accession WCJ-037 (male), an early flowering resistant (in early sowing) line, designated as JRORS-6, has been developed.

This early (premature) flowering resistant line is distinguished by its dark red stem color due to the accumulation of cauline anthocyanins, which is inherited from *C. aestuans* (Fig. 1.3). Over the last consecutive three years, it has been tested for early (premature) flowering resistance in early to very early sowing during the last week of February to the first week of March under long-day conditions at the experimental field of ICAR-CRIJAF, Barrackpore (Table 1.1). Overall, it showed high resistance to early (premature) flowering in early to very early sowing under long-day conditions. In comparison, cent percent

flowering occurred in *C. olitorius* cv. JRO-632, the female parent of JRORS-6, under very early February sowing (Fig. 1.3). Overall, it showed high resistance to early (premature) flowering in early to very early sowing under long-day conditions.

Table 1.1. Incidence of flowering in JRORS-6 in early to very early sowing under long-day conditions over the three consecutive years at Barrackpore.

Year	Date of sowing	% flowering*
2016	04 March	0.0±0.0
2017	04 March	0.0±0.0
2018	24 February	11.8±2.1

*recorded at 60 days after sowing



Fig. 1.3. JRORS-6 and check JRO 632 at 100 d after very early sowing (24 February 2018) under long-day conditions

Yield and fibre quality attributes [tensile strength (18.1 ± 2.1 g/tex) and fibre fineness (2.1 ± 0.03 tex)] of JRORS-6 have been found to be at par with its female parent JRO-632. In 2017, this line was assessed to be highly resistant to stem rot disease caused by *Macrophomina phaseolina* and jute hairy caterpillar, *Spilosoma obliqua*. (Source: JBT 4.1, NPTC project 3052. Contributor: D. Sarkar).

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

A multiparent advanced generation inter-cross (MAGIC) population of *C. olitorius* has been constructed from 20 parental lines by intermating for four generations followed by selfing for five generations (Table 1.2). In all, 341 ML_4 - RI_5 families have been generated, with three MAGIC lines (MLs) retained for each family. These 1023 MLs represent a unique genomic resource for fine-mapping of QTL for major agronomic traits including early (premature) flowering resistance and complex bast fibre yield, yield components and quality traits (tensile strength and fibre fineness) in jute. (Source: JBT 4.6. Contributor: D. Sarkar).

Table 1.2. Parental lines used to construct the MAGIC population of *C. olitorius*

BioSample accession	Sample name	Cultivar name
SAMN03097961	CoAM-224	JRO-620
SAMN03097962	CoAM-225	Chinsurah Green
SAMN03097749	CoAM-012	Sudan Green
SAMN03097738	CoAM-001	Tanganyika-1
SAMN03097746	CoAM-009	Australia via Brazil
SAMN03097750	CoAM-013	Russian Green
SAMN03097794	CoAM-057	BRA NONSOONG
SAMN03097747	CoAM-010	Germany
SAMN03097742	CoAM-005	Peaking
SAMN03097741	CoAM-004	Bangkok
SAMN03097748	CoAM-011	Nigeria Ibaden
SAMN03097744	CoAM-007	Olit-3 Burma
SAMN03097751	CoAM-014	KEN/DS/015C
SAMN03097775	CoAM-038	IDN/SU/053C
SAMN03097780	CoAM-043	NPL/JRC/550
SAMN03097807	CoAM-070	Golden
SAMN03097808	CoAM-071	Vandarpur (Binpur)-1
SAMN03097811	CoAM-074	Olit. Deep Red
SAMN03097812	CoAM-075	Wild Olit. Dwarf
-	-	Bidhan Rupali

1.2.4. Biomass partitioning in jute varieties under long and short day

Five genotypes of *C. olitorius* including JRO 524, JRO 632, *bast fibre shy* (*bfs*, mutant) and two advanced breeding lines D-55-6 and Dwarf-2 along with one *C. capsularis* line CAP-14-NBR (non-branching) were tested for biomass production under long day and short day conditions. Observations were recorded on biomass produced at 120 days after sowing. Under long day, JRO 632 produced highest biomass of 149.2 g/plant, while Dwarf-2 produced lowest biomass of 76.8 g/plant. Under short day, *bfs* produced lowest biomass of 6.7 g/plant, while JRO 524 produced highest biomass (excluding branches) of 19.2 g/plant. Two distinct groups, one low biomass producing (Dwarf-2, *bfs* and CAP-14-NBR) and another high biomass producing (JRO 524, JRO 632 and D-55-6) were identified through DMRT test. When stem biomass excluding leaf was considered, JRO 524 produced highest biomass under both long day (115.9 g/plant) and short day (17.2 g/plant). The ratio of bark biomass to total biomass decreased under short day (Fig. 1.4a), while the ratio of stick biomass to total biomass increased under short day (Fig. 1.4b), indicating

fibre production is reduced under short day condition. However, decrease in accumulation of stick biomass under short day was observed in *bfs*. (Source: JB 10.4. Contributors: P. Satya, D. Sarkar, S.K. Pandey, S. Roy and S. Ray).

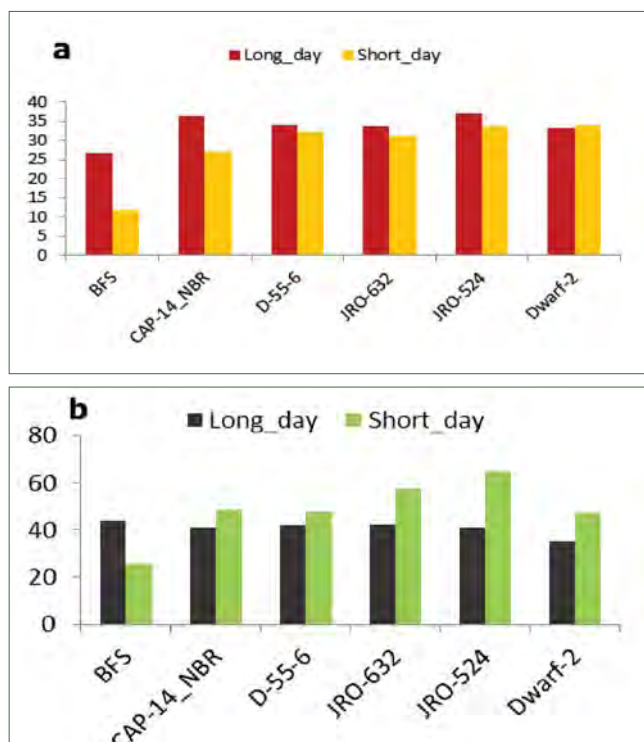


Fig. 1.4. Biomass partitioning in jute. (a) Ratio of bark biomass to total biomass (%), (b) Ratio of stick biomass to total biomass (%).

1.2.5. Flowering behaviour of jute

The flowering behaviour of two jute varieties JRC 212 (*C. capsularis*) and JRO 524 (*C. olitorius*) had been studied. The plants were sown on 15th September, 2017. JRC 212 showed an early flowering as compared to JRO 524. JRC 212 followed a normal curve of flowering pattern whereas JRO 524 did not follow any pattern. The flowering period of JRC 212 was shorter (20 days) as compared to 25 days in JRO 524 (Fig. 1.1). (Source: JA 7.5. Contributors: S. Roy, D. Sarkar, P. Satya, L. Sharma, A.K. Jha and H. Bhandari).



Fig. 1.5. Flowering behaviour of jute under different photoperiod regimes

1.2.6. Mutation breeding in jute

Among selected mutants Pfr-59 and Pfr-65 were showing stable tolerance to short day conditions when sown in first week of February from 2013 to 2017 (Table 1.3). Under this project three novel mutants i.e., super dwarf mutant (*sdf*) (INGR17072), low lignin phloem fibre (*llpf*) mutant (INGR17073), premature flowering (*pfr-59*) mutant (INGR17074) were registered with ICAR-NBPGR, New Delhi.

Table 1.3. Screening of selected mutants for flowering under short day conditions from 2013-2018

Genotypes	% flowering (60 DAS)				Mean
	2013	2014	2015	2017	
Pfr-20	3.6	4.2	8.1	4.2	5.03± 1.03
Pfr-32	0	0	7.7	0	1.93±1.93
Pfr-59	0	0	0	0	0
Pfr-65	0	0	2.6	2.9	1.38±0.80
Pfr-66	8.2	3.2	2.3	0	3.43±1.73
Pfr-69	2.9	7.9	7.2	0	4.50±1.86
Pfr-71	1.4	1.3	5	0	1.93±1.07
Pfr-73	7.1	8	2.1	0	4.30±1.93
Tanganayika	29.6	26	25.7	-	27.10± 6.83
Sudan green	25.9	24.3	25	-	25.07±6.28
JRO 204	38.8	30.7	20.3	14.1	25.98± 5.48
JRO 8432	64.6	52.5	31.7	50	49.70±6.79

1.2.7. Protection of jute varieties and DUS testing

One new white jute (*C. capsularis*) variety, i.e., JRCM 2 and five new *tossa* jute (*C. olitorius*) varieties, viz., JROM 1, NJ 7005, NJ 7010, NJ 7050 and NJ 7055 were tested for second year growing cycle at CRIJAF, Barrackpore and at

CSRSJAF, Bud Bud to observe distinctiveness, uniformity and stability. The candidate variety, JRCM 2 was found to be distinct from both the reference varieties (JRC 321 and JRC 212) with respect to stem colour (green with light red pigmentation). New *tossa* jute variety, JROM 1 was tested against reference variety JRO 524 and JRO 8432. The candidate variety was found to be distinct with respect to leaf shape (lanceolate). *Tossa* jute variety, NJ 7005 was tested against reference variety JRO 204 and JRO 524 for second year growing cycle at both the centre. The candidate variety was not distinct with respect to any of the claimed characters like leaf vein colour, petiole colour, stipule colour and stem colour. However, NJ 7005 was found to be distinct with respect to the seed colour (steel grey) from both the reference varieties JRO 204 and JRO 524 (black seed colour).

Tossa jute variety NJ 7010 was tested against reference variety JRO 204 and JRO 8432. In NJ-7010 seed colour (chocolate brown) was distinct from the reference varieties (black seed colour). However, the candidate variety was not distinct with respect to the other claimed characters (leaf shape and time of flowering). Another *tossa* jute variety NJ 7055 was tested against reference variety JRO 8432 and JRO 204. The candidate variety was not distinct with respect to the claimed characters like leaf shape and plant height at both the centre. However, the candidate variety NJ-7055 was found to be distinct with respect to the seed colour (steel grey) from the reference varieties JRO 8432 and JRO 204 (black seed colour). The candidate variety NJ 7050 was grown for the second year growing cycle and tested against reference variety S 19 and JRO 878 at both the centre. The candidate variety NJ 7050 was not distinct from reference varieties with respect to any of the characters. (Source: DA&FW (DUS Testing). Contributor: A. Bera).



Fig. 1.6. Monitoring of DUS testing plots at ICAR-CRIJAF

1.2.8. DNA fingerprint of jute varieties

A total of 25 released varieties of *C. olerorius* were screened with 45 EST-SSRs and 36 SCoT markers for development

of DNA finger prints. EST markers EST 14 and EST 65 were able to differentiate cultivars JRO 7835 and JRO 878, respectively. SCoT markers SCoT 5, SCoT 19 and SCoT 27 were able to differentiate leading cultivars with green stem pigmentation (JRO 204, JRO 524) and red stem pigmentation (JRO 2407 and S-19) (Fig. 1.7). (Source: JB 9.5. Contributors: J. Mitra, C.S. Kar and A. Anil Kumar).

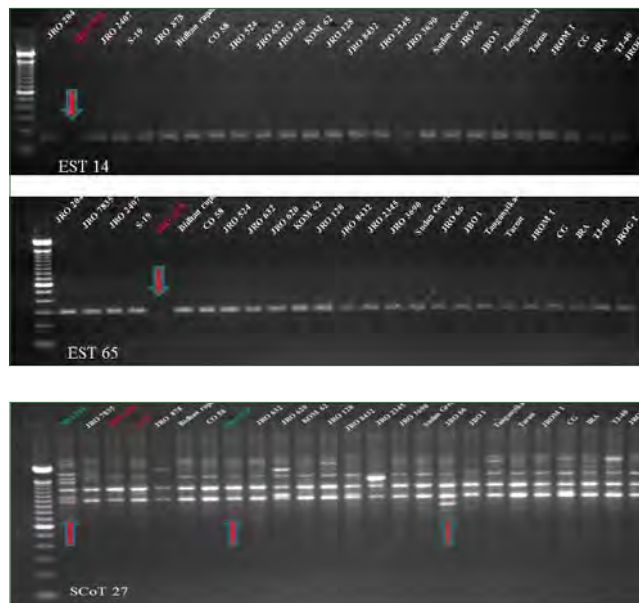


Fig. 1.7. DNA profiles of 25 varieties with EST 14, EST 65 and SCoT 27

1.2.9. Varietal development

New crosses developed: Forty five new crosses were attempted during 2017 kharif involving ten parents namely, JRO 632, JRO 524, JRO 878, JRO 7835, JRO 66, CO 58, Sudan Green, Tanganyika 1, S 19 and NJ 7010 and 10 successful cross pods from each crosses were harvested for growing F_1 generation for identification of true hybrid during kharif 2018.

Growing of F_2 populations: Ninety F_2 populations, developed from a 10×10 diallel involving ten parents namely, Sudan Green, Tarun, JRO 878, Tanganyika 1, JRO 8432, JRO 7835, JRO 3690, JRO 620, JRO 524 and JRO 632 were grown along with parents. For each F_2 300-400 plant population were maintained. Plant height and base diameter data were taken at 60 DAS, 90 DAS and 120 DAS. Based on plant height and basal diameter 15 F_2 population were selected for advancement to F_3 generation following modified mass selection method.

Selection of high yielding and quality fibre genotypes from F_4 population: A total of 103 progenies of 8 populations of F_4 were grown during kharif 2017 for selection of high yielding and better fibre quality genotypes. Based on the plant height and base diameter 22 selections were bulked for advancement to F_5 generation.

Micro plot trial: A microplot trial from entries of different F_1 bulks (6) and one local collection including two checks (JRO 524 and JRO 204) were conducted with plot size: 3m×1.5m, rows-5, 4 replications in simple lattice design. Out of seven entries, only one namely JR-2013-137 (32.9 q/ha) surpassed the best check JRO 524 (31.6q/ha) in fibre yield. The entry has been nominated as new entry in AINP on JAF during 2018. (Source: JB 9.9. Contributor: C.S. Kar).

1.3. Mesta (*H. cannabinus* and *H. sabdariffa*)

1.3.1. Varietal development

Based on station trials two kenaf lines (JRHC-11, JRHC-12) and two roselle lines (JRHS-11, JRHS-12) were contributed to IET trials-2018-19 under AINPJAF for fibre purpose. Out of 50 roselle lines evaluated in station trials a set of 20 promising lines suitable for the calyx and the leafy vegetable purpose was selected. From those lines three lines suitable for the leafy vegetable purpose and three for calyx purpose were contributed to IET trials- 2018-19 under AINPJAF. (Source: JB 9.6. Contributors: H.K. Sharma, A. Anil Kumar, R.T. Maruthi and A.R. Saha).

1.3.2. Genetic improvement of mesta

1.3.2.1. Evaluation of 45 F_1 hybrids in kenaf

45 F_1 hybrids were evaluated with their parents in randomized block design with three replications during 2017. Each replication was designated as a single row of 4 m length with row to row spacing 30 cm and plants within the row were 5-7 cm apart. Observation on plant growth parameters namely, plant height, base diameter, mid-diameter, top diameter, green biomass, dry stick weight, dry fibre yield and fibre % were recorded. Observations were recorded on 10 randomly selected plants and their mean value was calculated. Average performance of F_1 hybrids in general, was higher than parental lines for almost all characters under study. The highest mean heterosis of F_1 s over parents was recorded for green biomass (40.15%) followed by dry stick weight (33.33%), fibre yield (27.78%), base diameter (20.17%), plant height (20.00%), mid-diameter (15.77%), fibre % (12.99%) and top diameter (12.52%) (Table 1.4).

Data has also been presented graphically (Fig. 1.8) which also showed considerable average heterosis of F_1 hybrids for almost all the traits under study over the mean performance of parents. However, the present finding indicates the scope for exploitation of hybrid vigour in kenaf if, an economically feasible hybrid seed production technique is devised.

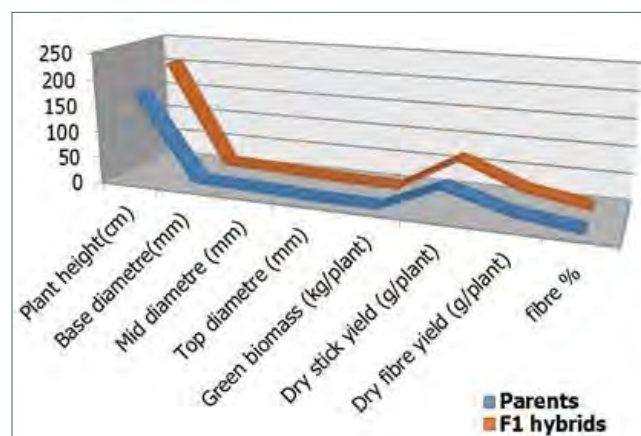


Fig. 1.8. Average performance of parents and their F_1 hybrids in kenaf

F_2 seed of all 45 cross combinations was collected and stored for further evaluation and selection of individual plants among selected superior F_2 population. Selection of the single plants will be made on the basis of plant growth parameter i.e. plant height, base diameter, mid-diameter, top diameter, green biomass, dry stick weight, dry fibre yield, fibre quality and reaction to various diseases and pests. (Source: JB 10.0. Contributors: S.K. Pandey, P. Satya and P.N. Meena).

1.3.2.2 Mutation breeding in mesta

Twenty M_2 population derived from γ irradiation of kenaf varieties JBM 2004D, AMC 108 and HC 583 with higher doses of 60Co (25 kRAD, 35 kRAD, 45 kRAD, 55 kRAD, 65 kRAD, 75 kRAD and 85 kRAD) were sown with check varieties to assess their morphological variations in plant growth parameters and qualitative traits. No morphological aberrations was observed in any of the

Table 1.4. Mean performance of parents and F_1 hybrids for metric traits in kenaf

Characters	Parents			F_1 hybrids			Mean heterosis (%)
	Mean	Range	SD	Mean	Range	SD	
Plant height (cm)	173	133-192	18.12	208.0	133-237	15.28	20.00
BD (mm)	10.7	8.4-11.8	0.94	12.8	10.4-16.3	1.19	20.17
MD (mm)	7.6	6.1-8.6	0.70	8.8	6.8-10.4	0.70	15.77
TD (mm)	3.4	2.7-4.2	0.45	3.8	3.1-4.4	0.31	12.52
Biomass (g/plant)	680.0	387-833	133.00	953.0	555-1500	172	40.15
Stick yield (g/plant)	51.0	25-74	14.00	68.0	41-136	16.00	33.33
Fibre yield (g/plant)	18.0	9-25	4.00	23.0	11-41	5.00	27.78
fibre %	2.6	2.4-3.1	0.23	3.0	2.5-3.4	0.28	12.99

treated M_2 population except height and base diameter. However, a total of 395 single plant were selected on the basis of plant height and base diameter and seeds thus collected were stored separately for further evaluation as plant to progeny rows in next generation. (Source: JB 10.0. Contributors: S.K. Pandey, P. Satya and P.N. Meena).

1.4. Flax (*L. usitatissimum*)

1.4.1. Genetic improvement

Fibre flax genotypes which were previously evaluated for different agro-morphological traits were used as a resource to select parental genotypes differing for plant height, petal color, flowering time and resistance to fungal disease Fusarium wilt. The objective is to develop fibre flax varieties with high-fibre yielding capacity, more sturdy plant with enhanced capacity to tolerate Fusarium wilt disease. Three paternal genotypes were crossed to each maternal genotype (one-way cross) to develop F_1 seeds (Table 1.5). In another crossing experiment, four reciprocal crosses were made among global fibre flax genotypes including one Indian line (Table 1.6). All the above F_1 seeds will be advanced to F_2 generation in the coming flax growing season. (Source: JBT 10.3. Contributors: J. Mitra and D.N. Saha).

Table 1.5. Inter-varietal one-way hybridization in fibre flax lines

Accession Name	Petal colour	Role in F_1 seed	Plant height*	Susceptible to Fungal infection **	Flowering
FT-1001	Blue	Paternal Source	Medium	Less	40-45 days
NFT-1	White	Paternal Source	Tall	Less	40-45 days
H-31	white	Maternal Source	Short	Moderate	Early flowering
H-43	Blue	Maternal Source	Short	Less	40-45 days
HIM-ALSI-2	white	Maternal Source	Tall	High	Late flowering
NATASJA	Blue	Paternal Source	Medium	High	Late flowering

*Height, less= <70 cm; medium = 71-110 cm; tall = >110 cm.

** Susceptible to fungal infection, less= 0-25%; Moderate = 25-45%; high = > 45%.

Table 1.6. Inter-varietal reciprocal hybridization in global fibre flax lines

Female parent	Male parent	No. of pods/seeds
VNII-17 (EC852226) RUS	G 2063-5-10 (EC852292) RUS	7/61
G 2063-5-10 (EC852292) RUS	VNII-17 (EC852226) RUS	4/38
Dolguentz (EC852252) USA	JRF-1 IND	4/33
JRF-1 IND	Dolguentz (EC852252) USA	3/25

Female parent	Male parent	No. of pods/seeds
De metcha (EC852234) FRA	Svetoch mutation (EC852264) RUS	4/36
Svetoch mutation (EC852264) RUS	De metcha (EC852234) FRA	2/17 yellow color
De metcha (EC852234) FRA	China 2 (EC852300) CHN	4/27
China 2 (EC852300) CHN	De metcha (EC852234) FRA	Nil

1.5. Sunnhemp (*Crotalaria juncea*)

1.5.1. Genetic improvement in sunnhemp

Self-incompatibility needs to be overcome in order to allow self-fertilization, we used six chemicals with three different concentrations (Table 1.7) for stigma treatment. The stigma of the emasculated flower was dipped into the chemical solution for 3-5 seconds and flowers were pollinated with self-pollen 30 min after chemical treatment. However, none of the chemicals were found effective in overcoming self-incompatibility in sunnhemp.

Table 1.7. Concentrations of chemicals used to attenuate SI.

Chemical	Level 1	Level 2	Level 3	Pod setting
Urea ($\text{CO}(\text{NH})_2$)	10%	15%	20%	Nil
Ammonium sulphate ($(\text{NH})_4\text{SO}_4$)	15%	20%	25%	Nil
Gibberellin (GA_3)	60 mg/l	80 mg/l	100 mg/l	Nil
Indole acetic acid (IAA)	60 mg/l	80 mg/l	100 mg/l	Nil
Salt (NaCl)	3%	6%	9%	Nil
Potassium chloride (KCl)	3%	6%	9%	Nil

Phenotypic characterization of selected sunnhemp genetic accessions revealed a wider spectrum of diversity for all the 11 agro-morphological traits [DFF: days to 50% flowering; PH: plant height (cm), NPBP: number of primary branches/plant; NSBP: number of secondary branches/plant; NIP: number of internodes/plant; IL: internode length (cm); NPP: number of pods/plant; NSP: number of seeds/pod; SYP: seed yield/plant (g/plant); HSW: hundred seed weight (g)]. Agglomerative hierarchical cluster analysis grouped 44 accessions of sunnhemp into well-defined phenotypes with four distinct seed producing clusters (Fig. 1.8). Cluster-I and cluster-III harbored 11, 13 accessions respectively producing medium seed yield. Cluster-II consisted of 13 high seed producing accessions, while cluster-I consisted of 3 low seed producing accessions. Superior accessions were identified based on their promising performance for different agro-morphological traits (Table 1.8).

Table 1.8. Accessions identified for superior agro-morphological traits.

Characters*	Best performing accession
DFF	Early-SIN-30, SIN-01, SIN-26 (33.44); Late-SIN-18, SIN-22, SIN-27 (53.67)
PH	SIN-09 (173.17 cm)
NLP	SIN-29 (162.33)
NPBP	SIN-38 (15.17)
NSBP	SIN-38, SIN-41 (17.50)
NIP	SIN-27, SIN-28, SIN-23 (46.00)
IL	SIN-01 (3.33 cm)
NPP	SIN-47 (143.00)
NSP	SIN-44 (15.17)
SYP	SIN-28 (29.43 g/plant)
HSW	SIN-07 (4.89 g)

* Details provided in text.

Table 1.9. Cluster mean values for different traits of sunnhemp accessions.

Characters*	Cluster mean±SD			
	I	II	III	IV
DFF	49.39±1.81	46.23±3.30	44.82±3.18	33.44±0.51
PH	129.94±7.63	150.45±12.53	147.21±11.53	122.28±10.84
NLP	126.67±26.61	113.36±22.44	95.45±15.68	39.67±6.89
NPBP	9.08±3.15	9.21±2.28	6.75±1.49	3.83±0.50
NSBP	9.86±4.92	11.23±2.47	9.30±4.25	3.78±1.78
NIP	32.73±3.59	36.33±5.24	36.15±4.41	22.83±1.36
IL	2.43±0.29	2.31±0.35	2.62±0.25	3.16±0.21
NPP	69.45±13.3	97.09±26.18	68.02±18.67	47.89±1.71
NSP	10.41±1.35	11.13±2.11	9.00±1.53	7.50±1.37
SYP	14.38±2.72	22.06±4.42	14.55±3.23	9.21±0.85
HSW	3.11±0.33	3.42±0.29	4.01±0.38	4.41±0.32

* Details provided in text.

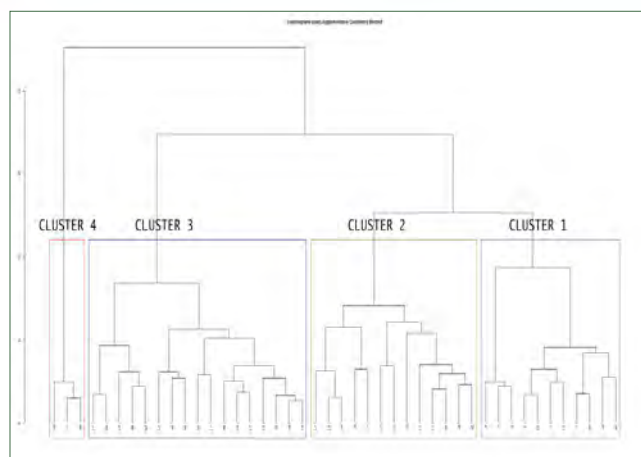


Fig. 1.9. AHC dendrogram based on Euclidian's coefficient showing clustering of 44 sunnhemp accessions into four major groups.

Cluster wise mean values of 11 traits (Table 1.9) suggested that cluster-II was the best with outstanding trait values for the majority of vegetative and reproductive traits like PH, NPBP, PSBP, NPP, NSP and SYP. It is closely followed by cluster-I which has highest mean value for NLP and average performance of other traits. The two commercial cultivars of sunnhemp (K 12 yellow and K 12 black) were grouped in cluster-III, which comprises accessions with erect growth habit, fewer branches, less number of leaves, larger internode length and medium seed yielding. Therefore, accessions from cluster-I and II can be exploited in sunnhemp breeding program to develop a high seed yielding variety while maintaining all the beneficial qualities of a cover crop for enhanced biomass yield. (Source: JB 10.2. Contributors: R.T. Maruthi, A. Anil Kumar and S. Datta).

2. Seed Production

2.1. National Seed Project

2.1.1. Breeder seed production

Breeder seed of 16 varieties of jute, and one variety of sunnhemp were produced as per DAC & FW indent (Table 2.1). A total of 10.77q of breeder seeds of jute and 3.00 q of sunnhemp were produced against the DAC indent of 9.29 q and 3.00 q of jute, and sunnhemp, respectively. The variety wise details are given below. (Source: NSP. Contributors: C.S. Kar, A. Bera and H.R. Bhandari).

Table 2.1. Breeder seed production of jute & allied fibres during 2017-18

Variety	DAC/Other indent (q)	Actual production (q)
Jute		
JRC 517	0.04	0.25
JRC 321	0.30	0.60
JRC 212	0.10	0.38
JRC 532	0.24	0.24
JRO 2407	0.36	0.22
JROG 1	0.22	0.50
JROM 1	0.20	0.20
JRCM 2	0.10	0.20
JBO-2003-H (IRA)	0.95	0.66
JRO 204	2.32	2.32
S-19 (Subala)	0.21	0.50
JRO 8432	0.04	0.11
JRO 524	2.45	2.50
JRO 878	0.04	0.06
CO-58	0.66	0.53
JRO 128	1.06	1.50
Total	9.29	10.77
Sunnhemp		
SUIN 053	1.50	1.50
JRJ 610	1.50	1.50
Total	3.00	3.00

2.1.2. Production and maintenance of nucleus seeds

Seeds from selected true to type individual plants of a variety harvested during kharif 2016 were used to raise progeny rows during kharif 2017. True to the type progeny rows with Off types plants were discarded obtain nucleus seedy with highest genetic purity confirming (jute, mesta and sunnhemp) were bulked to constitute nucleus seed. About 1.9 q of nucleus seeds of the released varieties of jute (26 varieties), mesta (7 varieties) and sunnhemp (4 varieties) were produced and kept under proper storage for utilization during breeder seed production in kharif 2018-19 (Table 2.2). (Source: NSP. Contributors: C.S. Kar, A. Bera and H.R. Bhandari).

Table 2.2. Nucleus seed production of jute, mesta, sunnhemp and flax

Variety	Production (kg)	Variety	Production (kg)
Jute		JRC 9057	2.0
JRO 524	13.5	JRC 4444	2.0
JRO 8432	5.5	Padma	3.0
JBO 2003H	6.0	Bidhan Pat 3	4.0
JRO 128	9.0	Total	123.9
JRO 204	13	Mesta	
JRO 878	3.8	MT 150	6.0
JROM 1	1.5	HC 583	7.5
JROG 1	1.5	AMC 108	1.0
CO 58	4.5	HS 4288	4.0
JRO 2407	3.5	HS 7910	3.0
S 19	4.5	JBMP 2	5.0
JRO 66	3.5	JRKM 9-1	3.0
Bidhan Rupali	1.0	Total	29.5
JBO 1	3.0	Sunnhemp	

Variety	Production (kg)	Variety	Production (kg)
JRC 321	6.0	K 12 yellow	15.0
JRCM 2	5.0	SUIN 053	16.0
JRC 517	6.5	SUIN 037	5.0
JBC 5	4.0	JRJ 610	2.5
JRC 212	6.5	Total	38.5
JRC 80	5.8	Flax	
JRC 698	3.5	JRF 2	5.0
Monalisa	2.0	Grand Total	196.9

A Monitoring team comprising representative from State Seed Certification Agency, National Seed Corporation (NSC) Kolkata, visited the breeder seed plots and nucleus seed plot to examine the crop condition, maintenance of proper isolation distance, and pest incidence if any during Kharif 2017 to ensure seed quality.



Fig. 2.1. Monitoring team in front of nucleus seed plot at CSRSJAF, Budbud

2.1.3. Monitoring of foundation and certified seed production

Two teams comprising scientists from CRIJAF and NSC visited Guntur and Sriprakasham districts, Andhra Pradesh to monitor the Foundation seed production plots by different agencies using CRIJAF supplied breeder seed of jute varieties during 23-28 Oct. 2017 and 19-20 Dec. 2017. It was observed that jute seed production plots of contract farmers of Ongole under NSC at Koppulu, Prakashm District were mostly of early sown (July-Aug) variety JRO 204 for certified seed production with wide spacing Roguing operations were not followed properly at

same places. Percentage of mixture of other jute varieties in some plots more than permissible limits. In Enamadala, Yeddnapudi, Martur certified seed plots were maintained. Foundation seed plots around Pedanandipadu, Pusuluru and Kakumanu were well managed and genetic purity was maintained as per recommendation.

A team comprising Dr. K Madhusudan, (UAS Bangalore), Dr. P Bhattacharyay (BCKVV), Dr. Govind Pal (IISS, Mau) and Dr. C. S Kar (CRIJAF) visited the North Eastern Zone (2017-18) comprising ICAR Res. Complex for NEH Region, (Barapani and Tripura); Central Agricultural University, Imphal, Manipur; AAU, Jorhat and UBKV, Pundibari, Cooch Behar, West Bengal during 8-15th Oct. 2017, to monitor the progress of Breeder Seed Production under AICRP-NSP (Crops) and Tribal Sub Plan. (Source: NSP. Contributors: C. S. Kar, A. Bera and H.R. Bhandari).



Fig. 2.2. Certified jute seed production field at Koppulu, Sriprakasham AP



Fig. 2.3. Certified seed production plot of JRO 524 at Koppulu, Ongole, AP



Fig. 2.4. Foundation seed plot harvesting of JRO 204 at Pamidipadu, Guntur, AP



Fig. 2.5. Certified seed production plot of JRO 524 at Koppulu, Ongole, AP

2.2. AICRP on ICAR Seed Project

Quality seeds of different crops were produced under this project for distribution or sale among farmers. A total of 472.21 q seeds of different crops were produced. Under this programme 0.5 q of breeder seed and 17.69 q TL seeds of jute along with mesta (0.4 q breeder, 2.30 q TL), sunhemp (25 q TL), dhaincha (19.63 q TL) paddy (335 q including 103q certified), wheat (45q TL) and mustard (26.0 q TL) were produced. Planting material of sisal (50,000 bulbils and suckers) and ramie (5 q rhizome and 1.5 lakh plantlet) were also produced under this project. Revenue amount of Rs. 14.8 lakh has been generated in ICAR Seed project during 2017-18. (Source: NSP. Contributors: C. S. Kar, A. Bera and H.R. Bhandari).



Fig. 2.6. Certified seed production of Paddy variety MTU 7029 at CSRSJAF, Budbud



Fig. 2.7. Truthfully label seed production plot of Sunnhemp variety at CSRSJAF, Budbud

2.3. Seed Production programme under NFSM Commercial Crops (Jute)

Three quintals Breeder seed of mesta (both kenaf and roselle) were produced against a target of 5 q and 18.36 q of foundation seed of jute (Variety CO58, JRO204 and S-19) were produced in BCKV, farms of Govt. of West Bengal, JRS, Katihar and KVK, Bankura against a target of 30 quintals. In addition, 17.69 q quality jute seed of new varieties like JRO 204, S-19, JBO 2003 H were produced under seed village programme. (Source: NSP. Contributors: C. S. Kar, A. Bera and H.R. Bhandari).

2.4. Human Resource Development

Table 2.3. List of training programmes organised under NSP

Name of the training	Venue and date	Beneficiaries
Quality seed production of different crops.	Bud Bud, 08 Nov 2017	Tribal farmers (50) of WB
Improved technologies for seed production of kharif crops under TSP	Bankura, 24 March 2018	Tribal farmers (100) of Bankura, WB
Exhibition on seeds of improved varieties of jute and allied fibres	CRIJAF, Barrackpore, Kolkata. 07 Nov 2017	150 farmers of WB
Seed day	CRIJAF, Barrackpore, Kolkata. 17 March 2018	200 farmers of WB

3. Biotechnology

3.1. Functional Genomics in Jute

3.1.1. The draft genome of *C. olitorius* cv. JRO-524 (Navin)

The whole genome shotgun (WGS) sequence of a leading Indian dark jute (*C. olitorius*) variety JRO-524, popularly known as 'Navin' has been decoded. The draft genome resolved into 377.3 Mbp, with a *K*-mer-estimated genome size of 415 Mbp and 57,087 protein-coding genes predicted *ab initio* (Table 3.1).

Table 3.1. Summary statistics of de novo-assembled draft genome of *C. olitorius* cv. JRO-524 (Navin).

Index	Statistics
Raw reads	52,507,986
High-quality merged reads	24,996,514
Number of assembled contigs	52,373
Size of assembled contigs (bp)	377,376,943
Longest contig (bp)	177,749
Shortest contig (bp)	500
Number of contigs > 1 kb	41,086
Number of contigs > 10 kb	11,958
Number of contigs > 100 kb	38
Mean contig size (bp)	7,206
Contig N50 (bp)	16,573

Reannotation using evidence from RNA-seq alignments as intron hints predicted a total of 47,434 protein-coding genes (Table 2). The Eukaryotic GeneFinding (EGF) method of Blast2GO predicted 47,035 protein-coding genes from the unmasked genome (377.3 Mbp) of *C. olitorius* cv. JRO-524 that covered 25,108 sequence regions, with a total length of 209.4 Mbp (Table 3.2). When all known and unknown repetitive sequences including low-complexity regions and transposable elements (such as MITEs and LTRs) were masked, exactly the same numbers of protein-coding genes were predicted from identical sequence length and regions. No differences were observed in the total numbers of mRNAs (47,434), exons (217,043) and CDSs (209,879) annotated in masked versus unmasked genomes. An examination of retrieved annotation features showed that distributions of CDSs, exons and transcripts per gene were identical between masked and unmasked genomes (Fig. 3.1). In this *C. olitorius* genome, ~50 % of repeat elements were found to be masked, which is much higher than that reported for its closest genome of cocoa (25.7 %).

Table 3.2. Summary gene prediction statistics for masked and unmasked genomes of *C. olitorius* cv. JRO-524 (LLWS01000000) annotated by RNA-seq-based (WebAUGUSTUS) Eukaryotic GeneFinding (EGF) module of Blast2GO.

Feature	Unmasked	Masked
Sequence regions	25,108	25,108
Total length (bp)	209,390,614	209,390,614
Genes	47,035	47,035
mRNAs	47,434	47,434
Exons	217,043	217,043
CDSs	209,879	209,879

It was characterized further by much higher proportion of retro-transposons (45.7 %) than DNA transposons (5.5 %), which perhaps explains the wide spectrum of intraspecific genome size variation in *C. olitorius*.

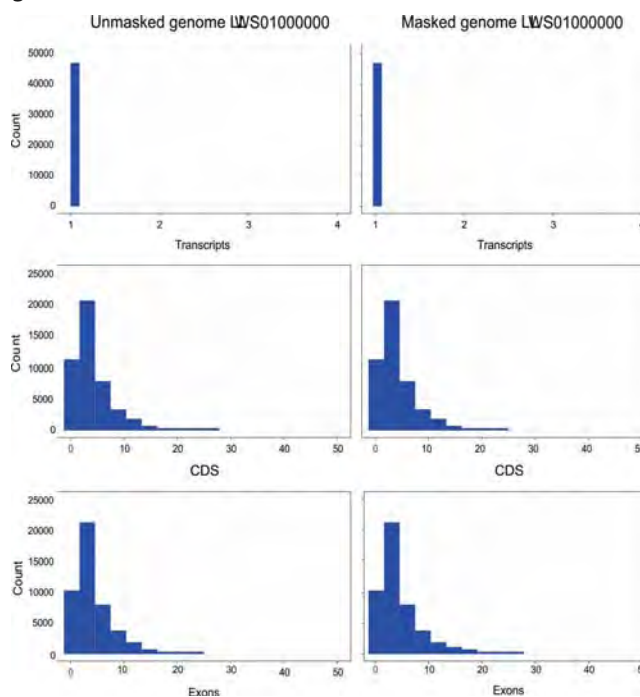


Fig. 3.1. Histograms of exons, CDS and transcripts per gene annotated in masked and unmasked genomes of *C. olitorius* cv. JRO-524. Features were retrieved as TxDb objects with the R package GenomicFeatures.

Using seven genetically anchored chromosome-scale pseudomolecules, the decoded *C. olitorius* genome was found to have maximum syntenic relationship with cocoa (*Theobroma cacao*) followed by diploid cotton (*Gossypium raimondii*), however, collinearity was not conserved (Fig. 3.2). The WGS

sequence of *C. olitorius* was drafted in collaboration with ICAR-NRCPB, New Delhi (Prof. Dr. NK Singh). (Source: ICAR-NPTC-3070. Contributors: D. Sarkar).

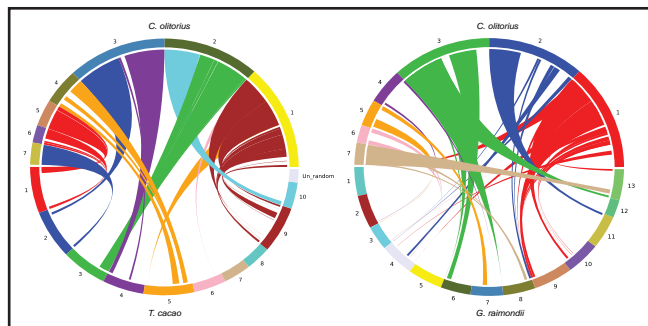


Fig. 3.2. Synteny mapping of the *C. olitorius* cv. JRO-524 (Navin) genome with those of cocoa (*T. cacao*) and diploid cotton (*G. raimondii*).

3.1.2. Development of phenylpropanoid pathway-specific and regulatory gene-specific SSR markers in jute

The phenylpropanoid pathway is a crucial entry point for biosynthesis of several secondary metabolites that contribute to numerous functional traits related to stress tolerance, pest/pathogen resistance and many developmental processes. An attempt was made to develop genic SSR markers for genes associated with phenylpropanoid pathway. The GenBank Transcriptome Shotgun Assembly (TSA) accession GBSD00000000 of *Corchorus capsularis* cv. JRC 212 was mined for SSRs using the MicroSatellite identification tool (MISA). Both mono- and poly-nucleotide repeats were selected in the search criteria. The structural genes of phenylpropanoid biosyntheses were identified from the transcriptome database GBSD00000000 following KEGG (Kyoto encyclopaedia of genes and genomes) pathway mapping (Kanehisa et al. 2012). The upstream shikimate-aromatic amino acid (AAA) pathway and phenylpropanoid pathway genes were selected from the KEGG pathway mapped genes of jute. Regulatory gene sequences were identified from searching against PInTFDB database. A total of 12,772 SSRs (37.3%) identified to be distributed in 10,041 unigenes, with an average frequency of one SSR per 3.86 Kb, of which 37.7 % were long repeats. About 46.2% of the SSR loci were distributed within 300–2000 nt, while 16.4% were at the transcription start site (1–25 nt). A total of 39 phenylpropanoid biosynthesis gene specific SSR markers were designed. These SSR markers are from 39 isoforms of 20 different enzymes catalyzing 37 different reactions (Table 3.3). A total of 2163 SSR sequences in 1,624 TF-

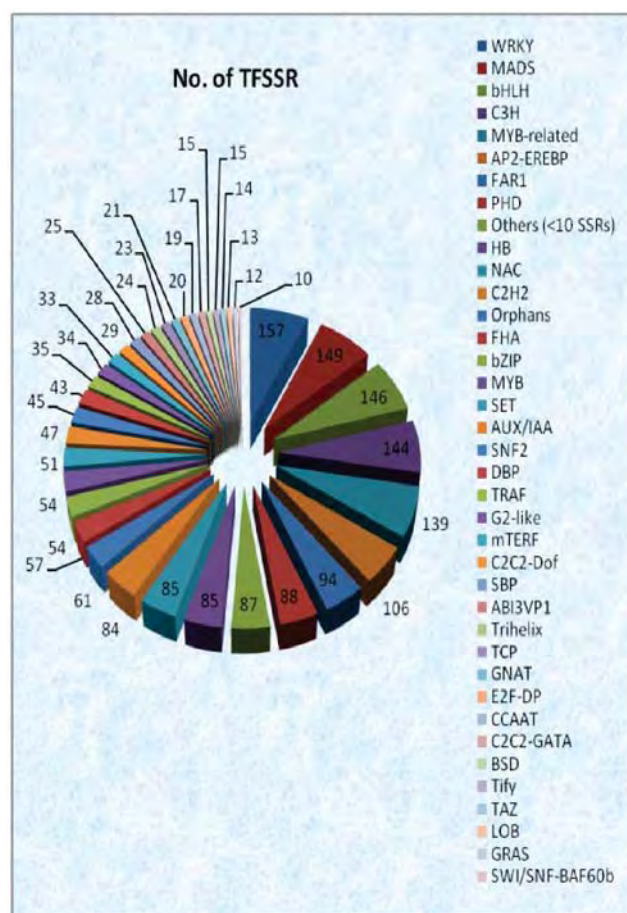
unigenes belonging to 65 TF families were identified, of which TFs involved in regulation of phenylpropanoid biosynthesis were more abundant (Fig. 3.3). The frequency of TF-specific SSRs (48.5%) was higher than that of other SSRs (35.6%); there were 1-8 TF-specific SSRs identified per unigene, with a size range of 10-263 nt. A total of 440 RG-specific SSR primers were designed from 54 TF gene classes. Further, 600 SSR primers from another 1500 randomly selected SSR motifs were also designed. A total of 1058 unigene sequences containing PPG-specific, RG-specific and other SSR sequences were mapped to 30,096 genes of *C. capsularis* cv. CVL-1 genome database with 91.87 % match. One hundred and twenty markers were validated in *C. capsularis*, of which 105 produced 1–6 amplicons. Out of these, 41 markers were selected for genetic diversity analysis in 21 *C. capsularis* and 14 *C. olitorius* genotypes. The PPG-specific- and RG-specific SSR markers generated a total of 65 alleles. The polymorphism information content (PIC) of PPG-specific SSR and RG-specific SSR markers were higher in *C. olitorius* (0.35) than in *C. capsularis* (0.30). The genic SSR markers differentiated JRC 212 from JRC 321, and JRO 524 from JRO 204, which indicate that these markers may be used for varietal fingerprinting. These markers may be linked with lignin and other phenylpropanoids-associated traits like fibre fineness, stress tolerance and medicinal values. (Source: JBT 4.1, NPTC project 3052. Contributors: D. Sarkar, P. Satya, N.K. Singh, S Datta, J Mitra, C.S. Kar)

Table 3.3. List of phenylpropanoid pathway gene-specific SSRs identified from *C. capsularis*

SSR ID	Unigene ID	Gene
JRCgm26982	S1_26982	3-Deoxy-D-arabino-heptulosonate 7-phosphate synthase
JRCgm26358	S1_26358	5-O-(4-coumaroyl)-D-quinic acid 3'-monooxygenase
JRCgm13951	S1_13951	Caffeic acid O-methyltransferase
JRCgm25296	S1_25296	Caffeic acid O-methyltransferase
JRCgm11486	S1_11486	Caffeoyl-CoA O-methyltransferase
JRCgm28286	S1_28286	Caffeoyl-CoA O-methyltransferase
JRCgm29496	S1_29496	Caffeoyl-CoA O-methyltransferase
JRCgm22356	S1_22356	Chorismate mutase

SSR ID	Unigene ID	Gene
JRCgm22319	S1_22319	Cinnamoyl-CoA reductase 1
JRCgm30441	S1_30441	Cinnamyl alcohol dehydrogenase
JRCgm30740	S1_30740	Cinnamyl alcohol dehydrogenase
JRCgm7845	S1_7845	Cinnamyl alcohol dehydrogenase
JRCgm23751	S1_23751	Flavonoid 3'-hydroxylase
JRCgm11730	S1_11730	Flavonoid 3'-hydroxylase
JRCgm8505	S1_8505	Flavonol synthase
JRCgm2317	S1_2317	Flavonol synthase/flavanone 3-hydroxylase
JRCgm11913	S1_11913	Glucan endo-1,3-beta-glucosidase precursor
JRCgm24900	S1_24900	Glucan endo-1,3-beta-glucosidase precursor
JRCgm23814	S1_23814	Leucoanthocyanidin dioxygenase
JRCgm23615	S1_23615	Leucoanthocyanidin reductase
JRCgm22559	S1_22559	Periplasmic beta-glucosidase precursor
JRCgm11110	S1_11110	Peroxidase
JRCgm13570	S1_13570	Peroxidase
JRCgm22226	S1_22226	Peroxidase
JRCgm23422	S1_23422	Peroxidase
JRCgm24026	S1_24026	Peroxidase
JRCgm28860	S1_28860	Peroxidase
JRCgm30617	S1_30617	Peroxidase
JRCgm31833	S1_31833	Phenylalanine ammonia-lyase
JRCgm30525	S1_30525	Phenylcoumaran benzylic ether reductase -like protein
JRCgm9485	S1_9485	Phenylcoumaran benzylic ether reductase -like protein
JRCgm25701	S1_25701	Prephenate aminotransferase
JRCgm11647	S1_11647	Serine carboxypeptidase like
JRCgm24871	S1_24871	Shikimate dehydrogenase
JRCgm24509	S1_24509	Tryptophan synthase
JRCgm5005	S1_5005	β glucosidase
JRCgm5606	S1_5606	β -glucosidase
JRCgm25822	S1_25822	β -glucosidase
JRCgm28932	S1_28932	β -glucosidase

Fig. 3.3. Transcription factor specific SSRs identified from *C. capsularis*



3.2. Mining Novel Alleles for Stress Tolerance in Jute and Allied Fibres

3.2.1. Genome-wide analysis of the aquaporin gene family in jute (*C. olitorius* and *C. capsularis*)

Aquaporins (AQPs) are member of the Major intrinsic protein (MIP) superfamily which function as membrane channels and play critical role in the transport of water and therefore are of pivotal interest in understanding water stress tolerance in crop plants. Jute genomes have been recently sequenced and genome-wide analyses was performed to identify AQP gene in both *tossa* and white jute.

Aquaporin protein sequences of jute were retrieved from Uniprot (<http://www.uniprot.org>) and nucleotide sequences were retrieved from NCBI (*C. olitorius* assembly GCA_001974825.1 for cv. O4; *C. capsularis* assembly GCA_001974805.1 for cv. CVL 1). Nucleotide and protein

sequences of cacao (*T. cacao*) and diploid new world cotton (*G. raimondii*) were retrieved from Phytozome database (<https://phytozome.jgi.doe.gov/pz/portal.html>). The two species were selected based on their whole-genome sequence availability and closeness in Malvaceae family. The putative jute aquaporin genes were identified with BLASTp using 108 known aquaporin genes as query sequences against the jute local databases. The query sequences were carefully chosen from well annotated and related genomes, viz. *Arabidopsis thaliana*, *Medicago truncatula*, *Populus trichocarpa*, *Solanum lycopersicum*, *G. raimondii* and *T. cacao*.

In case of *C. olitorius* cv. O4, total 39 AQP genes were identified including nine NOD26-like intrinsic proteins (NIPs), eight tonoplast intrinsic proteins (TIPs), 12 plasma membrane intrinsic proteins (PIPs), and eight small basic intrinsic proteins (SIPs) based on sequence similarities and phylogenetic position with *T. cacao*, *G. raimondii* and *A. thaliana*. Similarly, in *C. capsularis* cv. CVL 1, total 35 AQP genes were identified including 11 PIPs, 10 NIPs, eight TIPs, and three SIPs (Fig. 3.4).

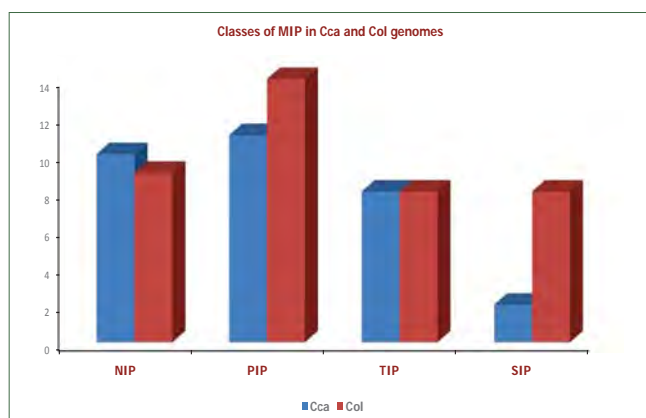


Fig. 3.4. Classes of MIP in *C. capsularis* and *C. olitorius* genomes

The predicted jute AQP genes were classified into subgroups based on sequence alignment and phylogenetic relationship with clearly classified AQPs from *Arabidopsis*. Multiple sequence alignments of amino acid sequences of jute AQPs and those of *A. thaliana*, *G. raimondii* and *T. cacao* were performed using CLUSTALW implemented in MEGA7 software. A phylogenetic tree was then constructed using maximum likelihood (ML) method (Fig. 3.5). The aquaporin subgroups PIP, TIP, NIP, SIP, and XIP formed in the phylogenetic tree were classified in accordance with the nomenclature of known AQPs that were used as a query in initial BLAST search. The phylogenetic tree was visualized using iTOL (<http://itol.embl.de/help.cgi>).

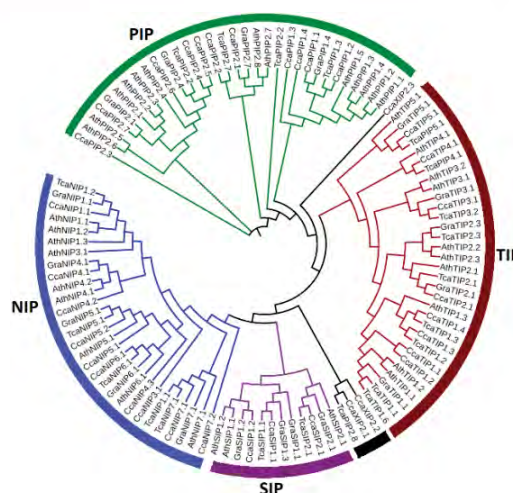


Fig. 3.5. Phylogeny of *C. capsularis* aquaporin genes

Conserved domains within the jute AQP protein sequences were identified using NCBI's Conserved Domain Database (CDD, www.ncbi.nlm.nih.gov/Structure/cdd/cdd.shtml). Transmembrane domains were detected using TMHMM 2.0 (www.cbs.dtu.dk) (Fig. 3.6). The Isoelectric Point (pI), molecular weight and grand average of hydropathy (GRAVY) of the amino acid sequences were predicted by Sequence Manipulation Suite (SMS) V2 available at geneinfinity web server (<http://www.geneinfinity.org>). (Source: JBT 4.7. Contributors: S. Datta, J. Mitra, D.N. Saha, P. Satya and Anil Kumar).

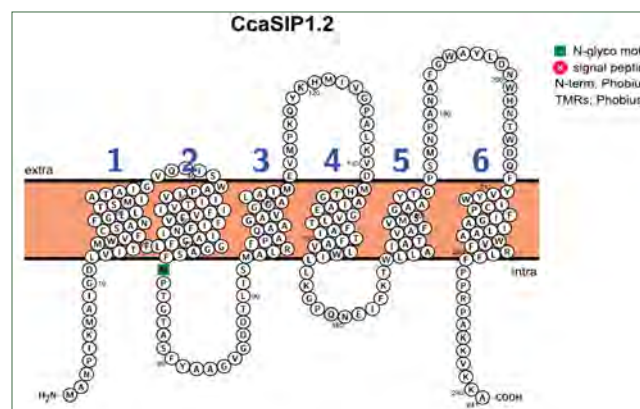


Fig. 3.6. Detection of transmembrane domains in jute aquaporin genes

3.2.2. Genome-wide analysis of the heat shock factor (Hsf) genes in jute (*C. olitorius* and *C. capsularis*)

Heat shock transcription factors (Hsfs) regulate heat stress response by regulating the expression of heat shock proteins and are of immense importance in response to abiotic stress in plants. However, till date, Hsfs of jute have not been studied in detail and therefore a genome wide comprehensive analysis of the sequences,

evolutionary relationships, and domain profiles of jute Hsf genes were performed using bioinformatics. A total of 17 Hsfs each were identified from *C. olitorius* and *C. capsularis*. Hsf protein sequences of jute were retrieved from Uniprot (<http://www.uniprot.org>) and nucleotide sequences were retrieved from NCBI (*C. olitorius* assembly GCA_001974825.1 for cv. O4; *C. capsularis* assembly GCA_001974805.1 for cv. CVL 1). The peptide and coding sequences of candidate Hsfs of *C. olitorius* and *C. capsularis* were used for BLAST search with *G. raimondii* and *T. cacao* Hsfs as query sequences. Using Heatster program, highly conserved DBD were detected in the putative sequences and sequences lacking DBD were rejected. In *C. capsularis*, ten (58.8%) of the Hsfs were categorized as class A. Among the class A, 2 belong to the A1 subfamily, 1 each to A2 and A3, 2 to A4, 1 to A5, 2 to A6, and 1 to A9. Class B consisted of 7 (41.2%) Hsfs, of which 1 belong to the B1 subfamily, 2 each to B2 and B4, and 1 each to B3 and B5. Similarly, in case of *C. olitorius*, ten (58.8%) of the Hsfs were categorized as class A. Within the class A, 2 belong to the A1 subfamily, 1 each to A2 and A3, 2 to A4, 2 to A6, and 1 each to A8 and A9. Class B consisted of 6 (35.3%) Hsfs, of which 1 belong to the B1 subfamily, 2 each to B2 and B4, and 1 to B5. Only one Hsf (5.9%) of the 17 Hsfs belong to class C in *C. olitorius* (Fig. 3.7, 3.8).

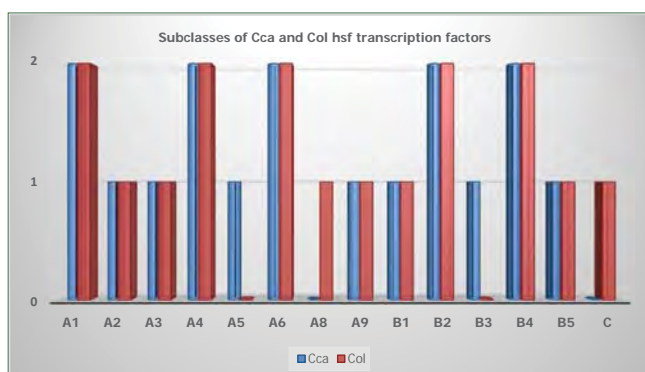


Fig. 3.7. Subclasses of *C. capsularis* and *C. olitorius* Hsf transcription factors

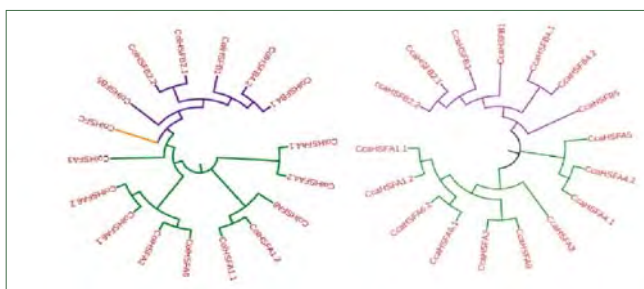


Fig. 3.8. Hsf genes in *Corchorus* genome

The amino acid sequences of Hsf proteins from *C. olitorius* and *C. capsularis* were aligned with *G. raimondii* and *T. cacao* in ClustalX and neighbor-joining phylogenetic was constructed in MEGA (Fig. 3.9). (Source: JBT 4.7. Contributors: S. Datta, J. Mitra, D.N. Saha, P. Satya and Anil Kumar).

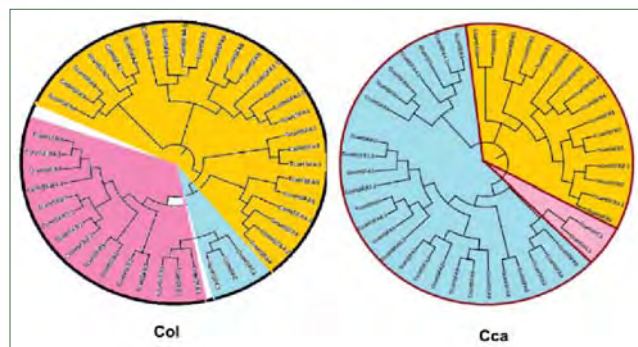


Fig. 3.9. Phylogenetic analysis of *Corchorus* HSF genes with *T. cacao* and *G. raimondii*

3.3. Bioinformatics in Fibre Crops

3.3.1. RT-qPCR gene expression of self-incompatibility genes from sunnhemp transcriptome assembly

Earlier a transcriptome assembly (41,727 unigenes) was generated from flower buds of sunnhemp (*Crotalaria juncea* L.) cultivar SUN-053 (SWASTIKA) in pursuit to identify self-incompatibility genes. As a part of validation of the transcriptome assembly and identification of self-incompatibility like genes/transcripts, a standalone BLASTX analysis was performed using the NCBI BLAST+ v.2.3.0 at E-value cutoff of $1e-5$. The sunnhemp transcripts were used as query sequences against the 1,009 plant self-incompatibility related proteins, 20 S-locus receptor kinases, 215 G-type lectin S-receptor-like serine/threonine-protein kinase (from *Glycine max*, *M. truncatula*, and *A. thaliana*), and 393 S-locus cysteine-rich proteins derived from the NCBI database (as on July-2016) as subject. From the BLASTX output, manual and a random selection of the few self-incompatibility related transcripts showing similarity to S3 self-incompatibility locus (Cj-S3), Cysteine-rich receptor-like protein kinase (Cj-SCR), S-locus receptor kinase (Cj-SRK), self-incompatibility associated ribonuclease (Cj-T2-Rnas3), S-phase kinase-associated protein (Cj-SKP1), and M-locus protein kinase (Cj-MLPK) were selected for RT-qPCR primer designing. Additionally, BLASTP analysis was also performed to identify Restorer of fertility (Rf-like) associated transcripts using 72 plant Rf proteins derived from the NCBI database. Three Rf-like transcripts (Cj-OsRF1, Cj-RsRf1, Cj-BnRf1) similar to *Oryza sativa* Rf, *Raphanus sativus* Rf and *Brassica napus* Rf proteins, respectively were also selected for RT-PCR primer designing. In the process five reference genes (Tubulin, Actin, elongation factor 1 α , glyceraldehyde 3-phosphate dehydrogenase, and cyclophilin A) were also selected for RT-qPCR reference gene assessment.

For the gene expression analysis, RNA was extracted from four different tissues (shoot, developing seed, anthers and

pistils) of *C. juncea* cv. Sun-053 and two different tissues (anthers and pistils) of a self-compatible wild species *C. retusa*. First strand cDNA synthesis was conducted from genomic DNA free RNA samples and RT-qPCR was performed using the above self-incompatibility and Rf primers and SYBR Green I master mix. All gene expression levels were normalized using reference gene EF1 α as an internal control. The Figure 3.10 describes the results of RT-qPCR gene expression dynamics in different tissues and plants of sunnhemp. (Source: CI-JBT 4.4. Contributors: D.N. Saha, S. Datta, A.K. Chakraborty and P. Satya).

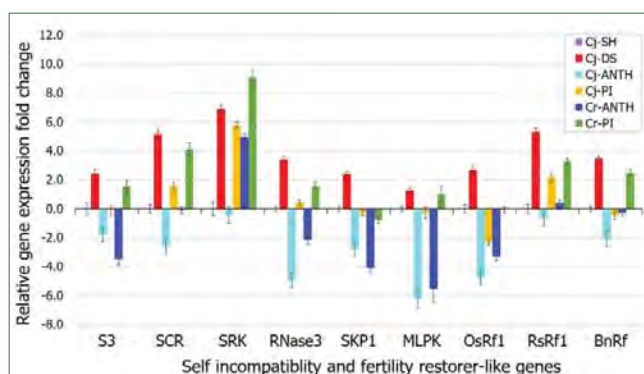


Fig. 3.10. Relative quantification of self-incompatibility and fertility restorer-like transcripts in different tissues of sunnhemp. All data are shown as the log₂-transformed C_q values of mean expression levels (bars) and standard error (error bars) from three technical replicates. The fold change of gene expression is represented in bar graphs relative to *C. juncea* shoot (Cj-SH) tissue. Cj: *Crotalaria juncea*; Cr: *Crotalaria retusa*; SH: shoot; DS: developing seed; ANTH: anthers; PI: pistils

3.3.2. Genome-wide characterization of heat shock factors from flax

In order to identify candidate genes for high-temperature stress tolerance in fibre flax, the genome sequence of flax from the Phytozome database v.12 was mined based on Hidden Markov Model (HMM) profile and Pfam ID, PF00447. Thirty four (34) heat shock factor (HSF) genes with typical DNA-binding domain (DBD), and hydrophobic heptad repeat A/B domains (HR-A/B) were identified from the flax genome and mapped their physical locations on the flax chromosomes. Comparative homology analysis classified them into three broad groups A, B and C and into different sub-categories within them (Fig. 3.11a). The arrangement of protein motifs and gene structural features was also worked out. For validation of LuHSF genes, RT-PCR analysis was performed on RNA samples extracted from 21-day old seedlings of fibre flax genotypes JRF-1 and Viking treated with heat stress at 40 °C for 12 hours and control conditions. RT-PCR analysis in cDNAs prepared from the genomic DNA-free RNAs showed a differential gene expression pattern of some of the LuHSF genes (Fig. 3.11b). Their regulatory role in abiotic stress response was predicted

from the localization of diverse *cis*-acting elements in the promoters of LuHSF genes. Identification of DNA-binding interfaces on the LuHSF proteins, and predictions of guide RNA sequences with minimum off-target effects for gene editing provides a valuable resource for functional studies or initiating genome engineering towards development of high temperature stress tolerant flax cultivars. (Source: JBT 10.3. Contributors: Dipnarayan Saha and Jiban Mitra).

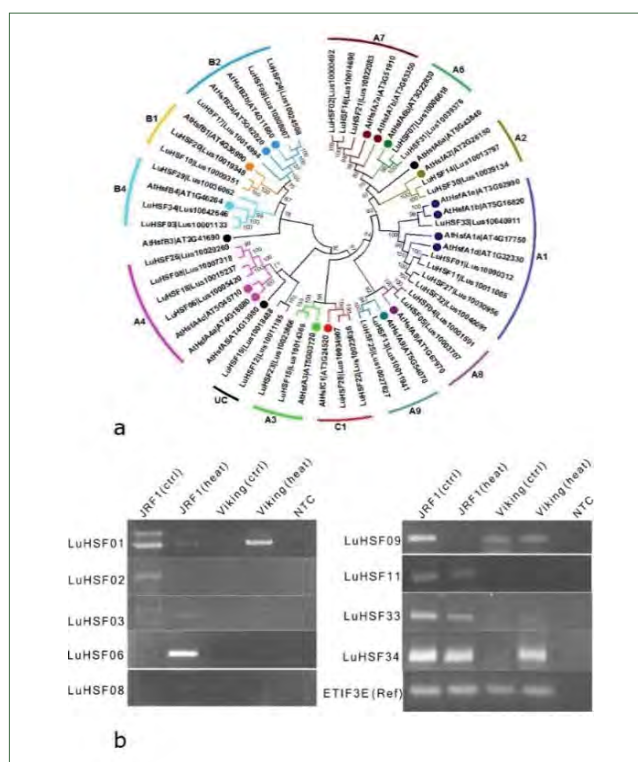


Fig. 3.11. (a) Phylogenetic grouping of the 34 LuHSF genes. (b) Gene expression variation in some LuHSF genes in seedlings of fibre flax genotypes JRF1 and Viking under controlled and heat stress conditions. Eukaryotic transcription initiation factor 1A (ETIF) gene was used as reference gene in the RT-PCR analysis. Ctrl: control; heat: high-temperature stress 40 °C for 12 hours; NTC: no template control.

3.4 Genetic Engineering and Tissue Culture

3.4.1. In vitro plantlet regeneration in flax (*L. usitatissimum*)

Seed germination: Fully mature seeds of var. JRF2 obtained from the Gene Bank, ICAR-CRIJAF (released as fibre flax Tiara) were surface sterilized and transferred to the germination medium. 100 seeds were used at a time. About 98% seed germination was observed on MS medium after 10 days, which was used as source for initiating *in vitro* tissue culture.

In vitro callus induction: Hypocotyls of 10d old seedlings were excised and transferred on to callus induction MS

medium containing synthetic growth hormones viz. 0.5 mg/l 2, 4-D and 0.5 mg/l Kinetin (Kin) and incubated at $25\pm 2^\circ\text{C}$ in dark for 2 weeks (Fig. 3.12a). 98.5% callus induction was observed which prospects scope of flax tissue culture amply.

In vitro callus multiplication: Healthy primary calli were excised out and subcultured on callus maintaining medium containing MS with 0.5 mg/l 2,4-D, 0.5 mg/l Kin and 0.05 mg/l IAA shown best results (97.2%) for profuse callus proliferation in dark at $25\pm 2^\circ\text{C}$ after 3 weeks.

Shootlet regeneration: Fresh healthy, highly proliferative calli were shifted to regeneration medium made up of MS with various doses of PGRs and kept for 3 weeks as mentioned in Methodology. Initially light green patches appeared on calli surface which indicates onset of chlorophyll biogenesis (Fig. 3.12b) followed by shootlet regeneration. Maximum shootlet (94.6%) regeneration was observed on MS medium containing 1.5 mg/l Kin with average of 15.65 shootlets per explants (Fig. 3.12c).

Shootlet elongation: Each single shootlet was transferred to elongation medium containing MS with 2 mg/l Kin or 2 mg/l BAP or with 0.5 mg/l GA_3 (20 culture tubes were used at a time in each treatment). MS with 2 mg/l Kin showed superior performance with 7.46 ± 0.54 cm average height of shootlets in comparison to remaining other two treatments.

Root Induction: After 2 weeks, elongated shootlets from both the treatments were transferred to root induction medium containing $\frac{1}{2}$ MS with various doses of IBA and IAA singly. After 15d, roots started appearing and maximum (83.5%) profuse long robust rooting was observed (Fig. 3.12d) in case of rooting medium fortified with 1.5 mg/l IBA. Average no. of rooting per shootlet was found to be 14.66 with mean length of 4.63 ± 0.62 cm.

Hardening and rearing in open range: Rooted plantlets were taken out from the rooting medium, washed to remove adhered agar and shifted to autoclaved Hoagland solution (pH-5.8) for 4 days in culture tubes for acclimatization. Majority of the plants got acclimatized, which were further shifted to small pots containing sterile vermiculite, covering the whole pot with polyethylene bags. After 7 days the hardened plants were transferred to sterile soil in medium size plastic pots and grown up to maturity. Hardening was found to be mediocre and the percentage was about 46.8%. Finally 43.7% plants were grown to maturity with appreciable seed setting. (Source: JB 9.3. Contributors: A.B. Mandal and Kanti Meena).

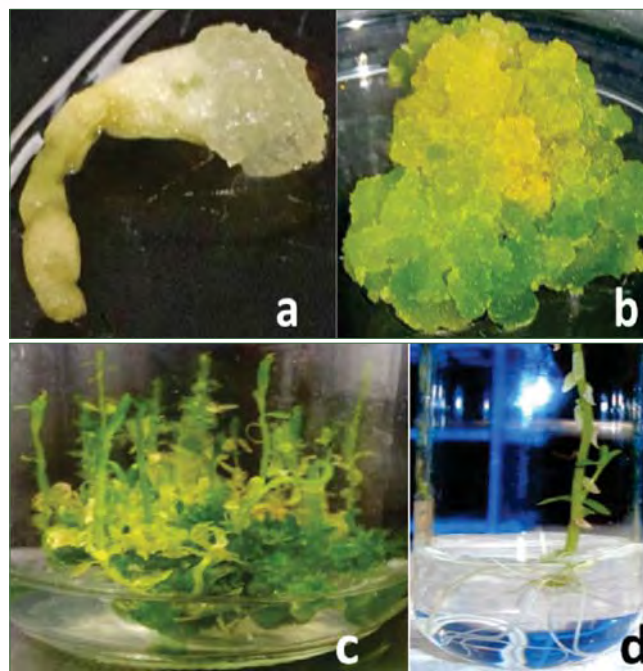


Fig. 3.12: *In vitro* culture of flax for plantlet regeneration. Legends: A. Hypocotyl derived calli, B. Appearance of green patches on proliferating calli surface on CMM indicating chloroplast biogenesis, C. Profuse shootlet regeneration on RM, D. Induced rooting

3.4.2. Optimization of Agrobacterium-mediated genetic transformation involving pCAMBIA1305.2 in flax (var. JRF2):

Highly proliferating calli derived from 12d old hypocotyl (Fig. 3.13a) of flax var. JRF2 were treated with acetosyringone (AS) and infected with pure culture of *Agrobacterium* LBA4404 containing pCAMBIA1305.2 vector. Infected calli were washed with timentin, blot dried under LAF and shifted to radio sterile culture plates for plantlet regeneration following standard tissue culture process as outlined above. From the bulk Agro-infected calli, some (10 samples in each treatment) were used for GUS histochemical assay following the protocol outlined by Jefferson *et al.* 1987. In 77.5% calli, bluish spots (foci) were observed thus confirming GUS expression of reporter gene at transient level (Fig. 3.13c), prospecting ample scope of stable transgene expression. In nutshell, *Agrobacterium*-mediated genetic transformation has been optimized for transgenic development, which offers a sound protocol to dispense economically important gene into flax system for transgenic development, which is underway. (Source: JB 9.3. Contributors: A. B. Mandal and Kanti Meena)

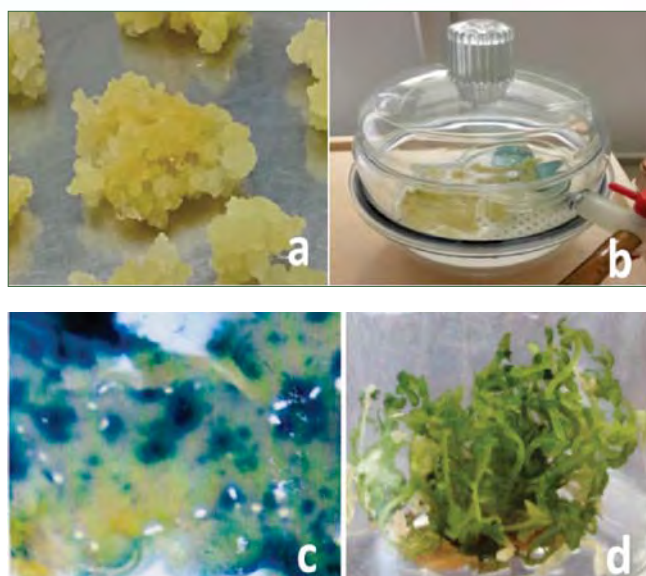


Fig. 3.13. Transformation of calli in flax. Legends: A. Hypocotyl derived calli from var. JRF2 on CMM, B. Vacuum infiltration of calli with LBA4404 (containing pCAMBIA1305.2), C. GUS assay of Agro-infected calli after 48h of co-cultivation, D. Shootlet regeneration from infected calli

3.4.3. Floral-dip transformation in *olitorius* jute (JRO524 & S19) using Cry 1A(b)

Seeds of two *olitorius* jute var. JRO524 & S19 were sown in pots under glasshouse condition with regular watering as seed crop in the middle of Oct 2017. Emergence of primary inflorescence was checked regularly for floral-dip transformation. Floral-dipping was done following protocol of Bastaki & Cullis, (2014) with modifications involving *Agrobacterium* cells (at an O.D.₆₀₀ of 0.5) suspended in infiltration medium (IM) (5.0% sucrose + 0.1% Tween-20) and the buds were dipped in IM for 1-2 min and covered with plastic wrap to maintain high humidity in the dome for overnight. The procedure was repeated in the succeeding day after 48h, then plastic wrap was removed and the plants were allowed to grow to maturity with utmost care. Upon floral-dip transformation, the buds were analysed for transient expression of the reporter gene after 48h. Collected buds were stained for GUS histochemical assay following protocol developed by Jefferson *et al.* (1987). Maximum buds displayed positive results (~98%), which confirmed transgene/s introgression (Fig. 3.14a,b). Mature capsules of floral-dipped buds were collected and were sown to obtain T₁ generation plants (Fig. 3.14c). (Source: JB 9.3. Contributors: A.B. Mandal and Kanti Meena).



Fig. 3.14. Differential GUS expression in different flower parts of jute. Legends: A. Gus stained flowers obtained from floral-dip transformation as compared to non-transgenic unstained control set. B. GUS expression in individual flower of *olitorius* jute var. JRO524. C. T₁ generation plants

3.4.4. In vitro micropropagation in ramie

Nodal explants from field grown plants of a highly productive variety (RS 67-34), when cultured on MS medium supplemented with 2.0 mg/l N6-BA and 2.0 mg/l AgNO₃ produced maximum shootlets (46) per explant in 6 passages (21d passage duration). ½ MS medium with 30 % sucrose was found to be most effective for rooting of *in vitro* developed shootlets. Those plantlets were acclimatized successfully and hardened under glass house condition. About 90% *in vitro* micropropagated plantlets survived, which were transferred at 12-14 cm height to larger pots to grow *in natura*. No ectopic expression in respect of any morphological characters was observed in comparison to the parental stock. Clonal fidelity test at genomic and protein levels also confirmed their true to type plant. (Source: JB 9.3. Contributors: A.B. Mandal and Kanti Meena).

3.4.5. Callus induction and plantlet regeneration from leaf pieces and petiole

Leaves from 1 year old field grown plants were cultured on MS medium fortified with 2,4-D (0.02 mg/l) and 4 mg/l BA, kept in 16/8 h light and dark photoperiod for callus induction. Bright white callus started appearing after a week culture, at 21 days those calli were transfer to the

callus multiplication medium with half doses of hormones used in CIM (callus induction medium). High doses of synthetic auxin put forth profuse rooting from culture explant. (Source: JB 9.3. Contributors: A.B. Mandal and Kanti Meena).

3.4.6. DNA fingerprinting of kenaf and roselle varieties

A total of 19 varieties including 10 roselle and 9 kenaf were screened with RAPD primers (OPA & OPD series). A maximum of 15 bands with six polymorphic bands were generated among different mesta varieties with OPA-11 primer (Fig. 3.15). Among roselle varieties presence of unique band was observed in var. AMV-2, AMV-4, HS4288 & HS 7210, whereas among kenaf variation was observed in var. MT-150, HC-583, JBM-G-4, JBM-81, JRM-3 and JRKM. This primer highly differentiated the kenaf varieties.

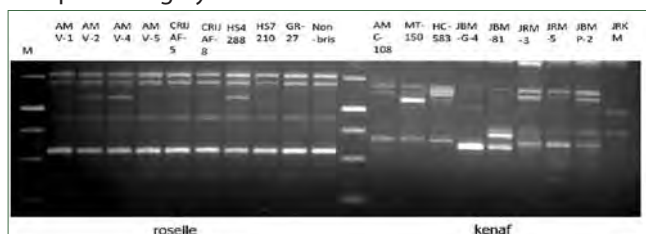


Fig. 3.15. RAPD profile of OPA -11 among mesta varieties.

Screening sterile and fertile lines for polymorphism: Genomic DNA of individual sterile and fertile lines of kenaf was used to make bulk and those bulks were screened with different molecular markers. Among those, two markers (jute intron linked marker and kenaf EST-SSR-11) showed polymorphism among the fertile and sterile bulk in agarose gel and 6 % polyacrylamide gel (Fig. 3.16). (Source: JBT 4.5. Contributors: Kanti Meena, P. Satya and S.K. Pandey).

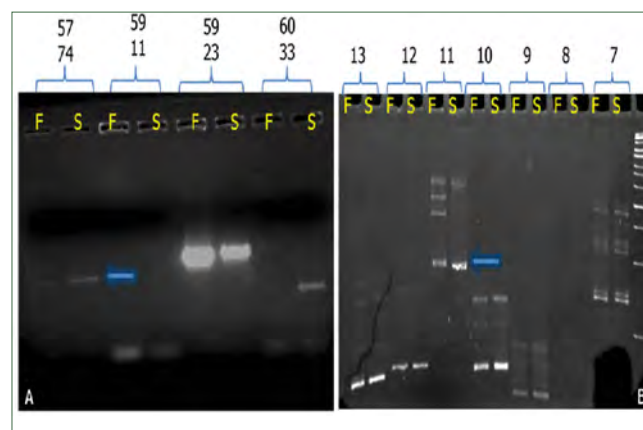


Fig. 3.16. Screening of bulk fertile and sterile lines using A. jute intron linked marker; B. kenaf EST-SSR marker, M: 1kb DNA ladder, F: fertile bulk, S: sterile bulk.

4. Soil and Nutrient Management

4.1. Soil Health

4.1.1. Long term fertilizer experiment (LTFE)

Long-term (46 years) effect of continuous application of farmyard manure and inorganic fertilizer either alone or in combination on crop yields, nutrient uptake and soil properties were evaluated in a permanent field in jute-rice-wheat cropping system. During the period under report jute (cv. JRO 524), rice (cv. Kshitish), and wheat (cv. UP 262) were cultivated with different combination of fertilizer and manurial treatments.

Crop yield: Yield of jute, rice and wheat ranged from 11.01 to 27.77 q/ha, 20.33 to 36.11 q/ha and 4.23 to 25.17 q/ha, respectively, under different treatments (Table 4.1). Application of fertilizers, alone or in combination with FYM significantly increased the yield of jute, rice and wheat over control. Highest yield of rice and wheat was recorded in 100% NPK+ FYM treatment, whereas highest yield in jute was recorded in 150% NPK treatment. The 150% NPK treatment was found to be at par with the application of 100% NPK+ FYM.

Table 4.1. Yield of jute, rice and wheat during 2016-17 in LTFE

Treatment	Yield (q/ha)		
	Jute	Rice	Wheat
50% NPK	17.93 ^d	30.93 ^b	13.00 ^f
100% NPK	24.80 ^{abc}	33.27 ^{ab}	22.33 ^{bcd}
150% NPK	27.77 ^a	33.35 ^{ab}	24.67 ^{ab}
100% NPK+HW	20.27 ^{bcd}	31.53 ^b	22.00 ^{cd}
100% NPK +Zn	18.22 ^d	32.51 ^{ab}	22.67 ^{bc}
100% NP	21.36 ^{bcd}	34.23 ^{ab}	20.00 ^e
100% N	21.73 ^{bcd}	34.62 ^{ab}	18.67 ^e
100% NPK + FYM	25.16 ^{ab}	36.11 ^a	25.17 ^a
100 % NPK- S	20.02 ^{cd}	33.31 ^{ab}	21.67 ^{cd}
Control	11.01 ^e	20.33 ^c	4.23 ^g

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

Nutrient uptake: Nutrient uptake by jute, rice and wheat was higher in fertilized plots as compared to the unfertilized control. Application of 100% NPK+FYM resulted in higher uptake of N, P in jute (103.05, 36.39 kg/ha) and rice (85.31, 16.01 kg/ha) (Fig. 4.1 and 4.2). N, P and K uptake by jute, rice and wheat increased with increasing dose of fertilizer. Total K uptake varied from 59.78 to 120.68 kg/ha in jute, 37.36 to 66.60 kg/ha in rice and 19.03 to 92.68 kg/ha in wheat, respectively (Fig. 4.3). The highest potassium uptake was found in 100% NPK+FYM, followed by 150% NPK in rice and wheat, while in maximum potassium uptake in jute was found in 150% NPK treated plot. The lowest K uptake was observed in control plots in all the crops.

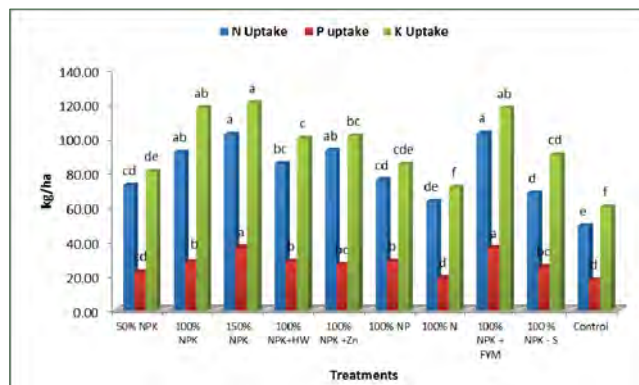


Fig. 4.1. Nutrients uptake by jute under different treatments

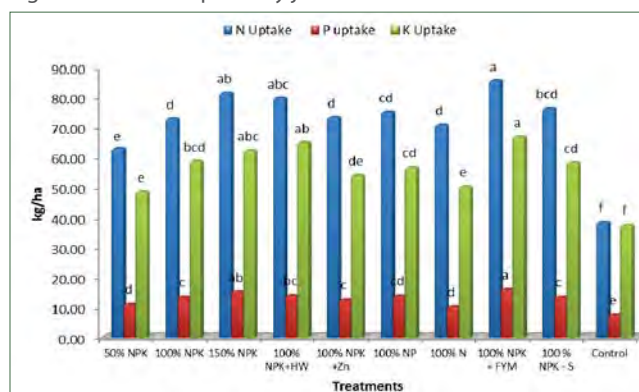


Fig. 4.2. Nutrients uptake by rice under different treatments

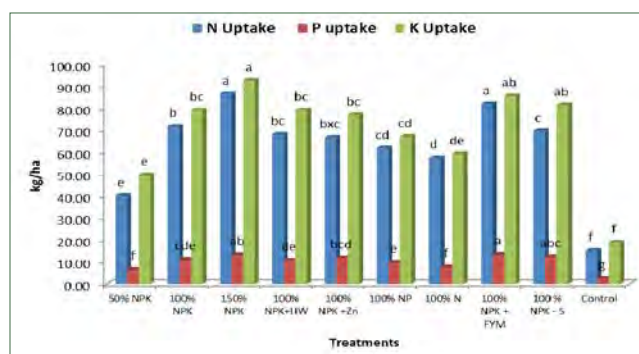


Fig. 4.3. Nutrients uptake by wheat under different treatments

Soil properties: Major physico-chemical properties of surface soil were presented in Table 4.2. The soil pH ranged from 7.27 to 7.54. Continuous cropping without application of any organic manure and chemical fertilizers resulted in the lowest concentration of organic carbon (OC) in the soil. Among different treatments, soils supplied with 100% NPK+FYM had as much as 65% higher OC when compared with no-fertilizer/no-manure control. There was significant difference among the treatments with respect to N, P and

K availability in soil. Highest available K was observed in 150% NPK treated soil while the highest available N and P were observed in 100% NPK+FYM treated soil. Integrated use of organic manure and chemical fertilizers resulted in a positive influx of nutrients thereby increased OC, available nitrogen, available phosphorus and available potassium in the soil from 0.60 to 0.92%, 182 to 271 kg/ha, 6.3 to 65.6 kg/ha, and 122 to 200 kg/ha respectively. (Source: JC 5.2. Contributors: D.K. Kundu, S.P. Mazumdar, A.R. Saha, B. Majumdar, A.K. Ghorai and M.S. Behera)

Table 4.2. Effect of chemical fertilizer and organic manures on physico-chemical properties of surface soil

Treatment	pH	Organic Carbon (%)	Available Nutrients		
			N (kg/ha)	P (kg/ha)	K (kg/ha)
50% NPK	7.32 ^{ab}	0.70 ^b	235 ^c	31.4 ^c	154 ^d
100% NPK	7.35 ^{ab}	0.73 ^b	240 ^b	45.4 ^b	177 ^b
150% NPK	7.37 ^{ab}	0.73 ^b	266 ^{ab}	63.2 ^a	204 ^a
100% NPK+HW	7.39 ^{ab}	0.74 ^b	232 ^c	27.9 ^c	177 ^b
100% NPK+Zn	7.33 ^{ab}	0.73 ^b	238 ^b	29.6 ^c	177 ^b
100% NP	7.33 ^{ab}	0.73 ^b	235 ^c	30.4 ^c	127 ^e
100% N	7.27 ^b	0.71 ^b	230 ^c	7.2 ^d	128 ^e
100% NPK+FYM	7.54 ^a	0.92 ^a	271 ^a	65.6 ^a	200 ^a
100% NPK-S	7.33 ^{ab}	0.69 ^b	245 ^{ab}	27.0 ^c	166 ^c
Control	7.33 ^{ab}	0.60 ^c	182 ^d	6.3 ^d	122 ^e

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

4.1.2. Modelling carbon sequestration under jute based agro-ecosystem

Soil organic carbon (SOC) sequestration in response to long term fertilizer management practices under jute-rice-wheat agro-ecosystem in alluvial soils was studied using a modelling approach. Fertilizer management practices included nitrogen (N), phosphorus (P) and potassium (K) fertilization, manure application and root-stubble retention of all three crops. Soil C model RothC was used to simulate the critical C input rates needed to maintain initial soil C level in long time scale (1972-2016, 44 years).

SOC change was significantly influenced by the long term fertilizer management practices and the edaphic variable of initial SOC content. The effects of fertilizer combination 100% NPK+FYM' on SOC changes were significant over 100% NPK fertilization. If the 100% NPK fertilizer along with manure applied with stubble and roots retention of all crops, alluvial soils of such agro-ecosystem would act as a net C sink, and the average SOC density kept increasing from 18.18 Mg/ha during 1972 to the current average of ~22 Mg/ha during 2065. On an average, the critical C input was estimated to be 5.30 Mg C/ha/yr, depending on local soil and climatic conditions (Fig 4.4). The critical C input could be effectively estimated using a summary model driven by current SOC level, mean annual temperature, precipitation, and soil clay content. Such information

will provide a baseline for assessing soil C dynamics under potential changes in fertilizer and crop residues management practices, and thus enable development of management strategies for effectively mitigating climate change through soil C sequestration. (Source: JA 6.0. Contributors: A.K. Singh, M.S. Behera, D. Barman, A.R. Saha, S.P. Mazumdar and D.K. Kundu)

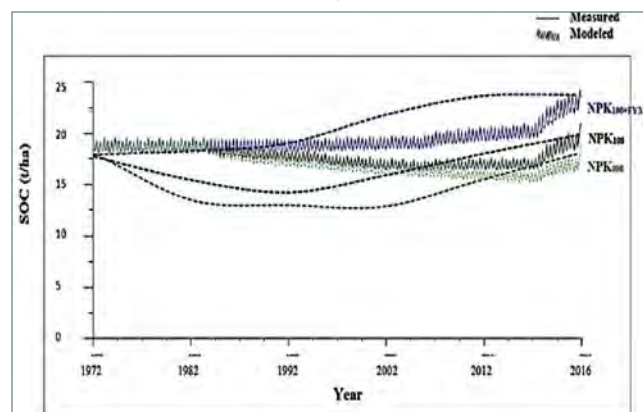


Fig. 4.4 Carbon sequestration under jute-rice-wheat cropping system

4.1.3. Soil health characterization and carbon sequestration potential in ramie based cropping system

Study conducted to quantify labile and recalcitrant pools of soil organic carbon (SOC) as affected by various ramie based cropping systems. Composite soil samples were collected from four different depths (0-20, 20-40, 40-60 and 60-100 cm) under each ramie based systems i.e., total 144 samples were collected from Ramie Research Station, Sorbhog, Assam. Among the Carbon pools, the contribution of very labile pool (VLP) to total organic carbon was much higher compared to other two fractions, labile pool (LP) and less labile pool (LLP). The very labile pool constituted the largest percentage of TOC under all treatments and varied from 32 to 41% in surface soils, whereas non labile pool (NLP) constituted 24-31% of TOC in the surface soil (Fig 4.5). Across all treatments, a relatively higher proportion of the carbon fraction was found in surface soil whereas it was found to decrease with increasing soil depth. At the surface layer (0-20 cm), effect of different land uses on VLP was significant, whereas the land use effect on LP, LLP and NLP was non-significant. The effect of cropping system on less labile pool was not significant, whereas all other fractions varied significantly due to cropping systems, indicating that these fractions are mainly responding to cropping. In soil profile under different land uses, there was a tendency of DTPA-extractable soil micronutrient concentrations to decrease with soil depths. Statistical analysis showed that land use, and soil depth effects were

significantly different for the entire test DTPA-extractable micronutrient concentrations (Mn and Fe) indicating that both land use and soil depth were key factors that affect DTPA-extracting soil micronutrient distributions in profiles. The storages of available micronutrients were comparatively greater in natural ecosystems (fallow) than in ramie based ecosystems. (Source: JA 7.2. Contributors: S.P. Mazumdar, S. Mitra, A.R. Saha, B. Majumdar, and Mukesh Kumar)

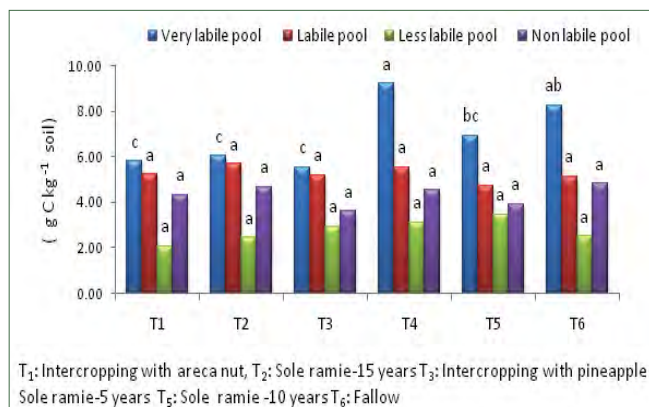


Fig. 4.5. Soil carbon pools under different land uses (0-20 cm)

4.2. Nutrient Management

4.2.1. Soil test and integrated plant nutrient management for sustainable agriculture

A fertility gradient was developed using maize as exhaust crop with the application of various levels of N, P and K which is evidenced by increasing trend of dry matter yield of maize from lower to higher fertility gradient as well as available N, P and K status. Soil test targeted yield (ST-TY) equations for rice (Banskathi) and potato (Kufri Jyoti) have been derived with all the basic data i.e., nutrient requirement, soil, fertilizer and organic efficiency.

Rice (Banskathi)	Potato (Kufri Jyoti)
FN= 6.89 T-0.60 SN-0.29 ON	FN= 1.58 T-0.80 SN-0.33 ON
FP= 1.81 T-0.87SP-0.08 OP	FP= 0.34 T-0.76 SP-0.20 OP
FK= 3.38 T-0.45SK-0.06 OK	FK= 0.82 T-0.55SK-0.07OK

The field verification trials on jute (JRO 204) and potato (Kufri Jyoti) were undertaken in the farmers' fields at different locations. Application of fertilizers as per ST-TY without and with FYM achieved the target of 40 q/ha jute fibre yield with (-) 10.0 and (-) 8.0 % deviation, respectively (Table 4.3.). Application of fertilizers as per ST-TY without and with FYM achieved the target of 30 t/ha tuber yield of potato with (+) 12.7 and (+) 16.7% deviation (Table 4.4) (Source: JC 5.6. Contributors: A.R. Saha, B. Majumdar, S.P. Mazumdar and Mukesh Kumar)

Table 4.3. Verification of IPNS fertilizers prescription equations of jute (JRO 204) in farmers' fields during 2017 (mean value of five locations)

Treatments	Yield (q/ha)	Gross income (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	Yield deviation (%)	B:C ratio
Farmer's Practice	29.9	95571	59751	35820	-	0.60
RDF	32.0	102554	59780	42774	-	0.70
ST-TY (35 q/ha)	33.3	106502	59357	47145	-4.8	0.80
ST-TY + FYM (35 q/ha)	34.7	110976	59096	51880	-0.8	0.90
ST-TY (40 q/ha)	36.0	115200	60419	54457	-10.0	0.90
ST-TY + FYM (40 q/ha)	36.8	117760	60111	57358	-8.0	0.95

Table 4.4. Verification of IPNS fertilizer prescription equations of potato (Kufri Jyoti) in farmers fields, 2017-18 (mean of four locations)

Treatments	Yield (t/ha)	Gross income (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	Yield Deviation (%)	B:C ratio
Farmer's Practice	28.6	227544	100350	127194	-	1.30
RDF	29.3	233322	96711	136610	-	1.40
ST-TY (28 t/ha)	31.6	252051	97770	154281	12.9	1.60
ST-TY + FYM (28 t/ha+FYM)	32.9	261815	97452	164362	17.5	1.70
ST-TY (30 t/ha)	33.8	269585	98990	170595	12.7	1.70
ST-TY + FYM (30 t/ha+FYM)	35.0	278751	98672	180079	16.7	1.80

4.2.2. Long term effect of ST-TY equation based INM on nutrient budgeting and quality of soil under jute - rice - lentil sequence

An experiment was initiated to study the long term effect of ST-TY equation based integrated nutrient management on yield, value addition, nutrient budgeting and quality of soil under jute-rice-lentil sequence in 2010-11. The treatments were T₁- control, T₂- ST-TY (5 t/ ha), T₃- ST-TY (4 t/ha), T₄- T₃+FYM

(5 t/ha), T₅-T₃ + Azotobacter+ PSB, T₆-T₄+Azotobacter+PSB, T₇-FYM @ 5 t/ha, T₈-T₇+Azotobacter+PSB, T₉-Recommended dose of fertilizer (RDF), T₁₀-Farmers practice (FP) and T₁₁-Fallow . Azotobacter was used as biofertilizer in jute but in case of lentil *Rhizobium* was used instead of Azotobacter. Under long term trial on jute-rice-lentil sequence, application of fertilizers as per ST-TY could achieve the target of 40 q/ha of jute fibre with (-) 4.5 % deviation. Integration of ST-TY with FYM achieved the targeted yield of jute fibre (35 q/ha) with (+) 2.68 % yield deviation (Table 4.5). Agronomic efficiency of P and K fertilizers increased with the integration of FYM and bio-fertilizers with ST-TY over RDF.

Table 4.5. Effect of ST-TY based fertilizers application on jute yield and agronomic efficiency

Treatments	Yield (q/ha)	Agronomic Efficiency (kg/ kg)		
		N	P	K
T ₁ - Control	18.6			
T ₂ - STCR-TY(40 q/ha)	38.2	12.2	40.8	26.5
T ₃ - STCR-TY(35 q/ha)	33.0	11.4	36.1	23.6
T ₄ - T ₃ +FYM @ 5 t/ha	35.9	14.8	46.9	30.4
T ₅ - T ₃ +Biofertilizers (Azotobacter+PSB)	34.7	13.8	43.5	28.3
T ₆ - T ₄ +Biofertilizers (Azotobacter+PSB)	37.9	16.5	52.2	33.9
T ₇ - FYM @ 5t/ha	23.6	-	-	-
T ₈ - T ₇ +Biofertilizers (Azotobacter+PSB)	24.8	-	-	-
T ₉ - RDF	30.0	14.0	28.0	28.0
T ₁₀ -Farmer's Practice (FP)	24.0	9.2	11.0	11.0

Application of fertilizers as per ST-TY could achieve the target of 50 q/ha of rice with (-) 2.8% yield deviation. Integration of ST-TY with FYM and bio fertilizers achieved the targeted yield of rice (40 q/ha) with (+) 12.75 % yield deviation (Table 4.6). Application of inorganic fertilizers on ST-TY basis with and without organic manure showed positive response in respect to sustainability of crop yield and soil fertility status in comparison to RDF and Farmers practice.

Table 4.6. Effect of ST-TY based fertilizers application on rice yield and agronomic efficiency

Treatments	Yield (q/ha)	Agronomic efficiency (kg/kg)		
		N	P	K
T ₁ - Control	26.9			
T ₂ - STCR-TY(40 q/ha)	48.6	16.1	62.0	33.4
T ₃ - STCR-TY(35 q/ha)	44.5	21.5	70.4	38.3
T ₄ - T ₃ +FYM @ 5 t/ha	45.1	23.3	79.1	42.3
T ₅ - T ₃ +Biofertilizers (Azotobacter+PSB)	45.2	23.5	79.6	42.6
T ₆ - T ₄ +Biofertilizers (Azotobacter+PSB)	45.9	24.4	82.6	44.2
T ₇ - FYM @ 5 t/ha	32.1	-	-	-
T ₈ - T ₇ +Biofertilizers (Azotobacter+PSB)	30.9	-	-	-
T ₉ - RDF	40.9	17.5	35.0	35.0
T ₁₀ -Farmer's Practice (FP)	35.8	15.1	17.8	17.8

Moreover, integrated management practices showed clear advantage in improving the soil structural stability (Table 4.7) and incorporation of FYM along with inorganic fertilizer and biofertilizers significantly increased all the carbon fractions over control and other treatments. .

Table 4.7. ST-TY based long term fertilization on soil aggregates and structural indices

Treatment	BD (Mg/m ³)	WSA (%)	MWD (mm)	GMD (mm)
T ₁ - Control	1.42	37.1	0.39	0.38
T ₂ - STCR-TY(40 q/ha)	1.32	49.5	0.53	0.38
T ₃ - STCR-TY(35 q/ha)	1.29	47.2	0.49	0.32
T ₄ - T ₃ +FYM @ 5 t/ha	1.26	66.0	0.94	0.60
T ₅ - T ₃ +Biofertilizers (Azotobacter+PSB)	1.30	57.1	0.64	0.42
T ₆ - T ₄ +Biofertilizers (Azotobacter+PSB)	1.23	70.5	1.34	0.91
T ₇ - FYM @ 5t/ha	1.27	64.4	0.80	0.47
T ₈ - T ₇ +Biofertilizers (Azotobacter+PSB)	1.26	65.8	0.80	0.59
T ₉ - RDF	1.29	61.2	0.68	0.34
T ₁₀ - Farmer's Practice (FP)	1.28	51.3	0.61	0.44
Std. Dev.	0.05	10.5	0.27	0.18

Demonstrations under STCR: Demonstrations on soil test and targeted yield based fertilizer application in jute, and potato were conducted in farmers field of different villages of Nadia district under STCR covering an area of 0.9 ha, and 0.5 ha, respectively for the above mentioned crops. The targeted yield was achieved with $\pm 10\%$ yield deviation. Numbers of beneficiary farmers were 5 and 4 for jute, and potato, respectively. A field day cum capacity building programme was organized for farmers (50 farmers) at Bhabanipur, Haringhata, Nadia on 26th Feb, 2018. (Source 5.6a. Contributors: A.R. Saha, B. Majumdar, S.P. Mazumdar, Mukesh Kumar).

4.2.3. Soil quality index (SQI) as influenced by tillage and residue management in jute based cropping Systems

Field experiment conducted with zero tillage (ZT), zero tillage + residue (ZT + R) along with conventional tillage (CT) under most predominant cropping systems *i.e.* Jute-rice-wheat/lentil/mustard systems to assess the dynamics of soil quality status under contrasting tillage and cropping systems in alluvial soils of Indo-Gangetic plains. Surface soil samples were collected and analyzed for soil physico-chemical properties (pH), electrical conductivity: (EC); bulk density: (BD); clay content, Mean weight Diameter: (MWD); Available N, P and K and Soil Organic Carbon: (SOC) etc. The results (Table 4.8) revealed that soil organic carbon (SOC) was significantly and positively correlated

with clay content (0.99**), MWD (0.83**), Av-N (0.68**), Av-P (0.40*), Av-K (0.58**) and EC (0.41*) but negatively correlated with BD (0.74**). Evaluation of soil quality using soil quality index (SQI) under different tillage and cropping system (Fig. 4.6) showed that soil quality index values are significantly higher in jute-rice-lentil as compared to other cropping systems. Among the tillage treatments, soil quality under conventional tillage was at lower side as compared to ZT and ZT+R. This indicated that minimum soil disturbances coupled with residue retention improved and/or optimized soil properties and provided better soil environment for plant growth (Source: JA 6.0. Contributors: R. Saha, M.S. Behera, S.P. Mazumdar, Mukesh Kumar, D. Barman, A.R. Saha, B. Majumdar, R.K. Naik and D.K. Kundu)

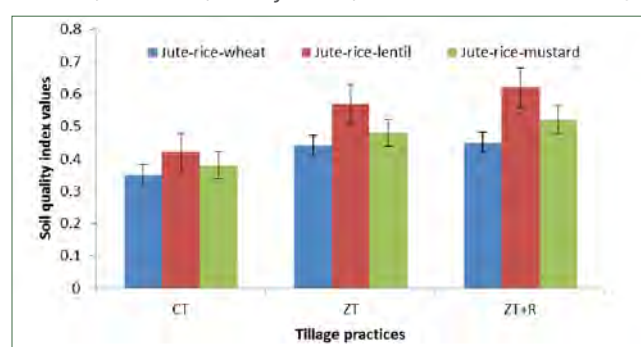


Fig. 4.6. Soil quality index values under various tillage and cropping systems; CT- Conventional tillage, ZT- Zero tillage, ZT+ R- Zero tillage with residue.

Table 4.8. Correlation matrix of soil quality parameters (n=27)

Parameters	pH	EC (dS/m)	Clay (%)	BD (g/cm ³)	SOC (%)	MWD (mm)	Avail N (kg/ha)	Avail. P (kg/ha)	Avail. K (kg/ha)
pH	1.00								
EC (ds/m)	0.44*	1.00							
Clay (%)	-0.41*	-0.78*	1.00						
BD (g/cm ³)	0.80**	0.89**	-0.98**	1.00					
SOC (%)	-0.36*	-0.41*	0.99**	-0.74**	1.00				
MWD (mm)	-0.89**	-0.80**	0.99**	-0.99**	0.83**	1.00			
Avail. N (kg/ha)	-0.79**	-0.90**	0.98**	-0.99**	0.68**	0.98**	1.00		
Avail. P (kg/ha)	0.14	0.82**	-0.29	0.48*	0.40*	-0.32	-0.49*	1.00	
Avail. K (kg/ha)	-0.60*	-0.98**	0.88**	-0.96**	0.58*	0.90**	0.96**	-0.71**	1.00

**indicates significant at the P <0.01 level, * indicates significant at the P <0.05 level.

5. Crop Husbandry

5.1. Jute

5.1.1. Assessment of productivity and nutrient management of selected jute based cropping system

System productivity, sustainability and soil nutrient status of five jute based cropping sequences were assessed under variable nutrient and crop residue management practices. The highest system productivity was recorded in jute-rice-baby corn system (146.5 q/ha) followed by jute-rice-garden pea system (89.4 q/ha). Among nutrient and crop residue management practices higher system productivity (78 q/ha) was recorded in F_1R_1 treatment (100% RDF with crop residue incorporated soil). Sustainability yield index estimated after completion of five years of crop cycle was the highest in jute-rice-garden pea (0.90) followed by jute-rice-mustard-mung bean (0.83) cropping system. Higher carbon management index (CMI) (50.9) was recorded in jute-rice-mustard and mung bean cropping system. Application of 100 % RDF with crop residues recorded higher CMI (48) compared to other nutrient and crop residue practices (Fig. 5.1). Soil nutrients (N,P and K) status was determined after five years of cropping system indicated +ve N balance in jute-rice-mustard-mung bean (17.5 kg N/ha), jute-rice- baby corn (12.5 kg/ha) and jute-rice-garden pea (9.45 kg/ha) (Fig. 5.2). Application of reduced doses of NP K (F_1R_0) treatment had -ve N balance (5 kg/ha) in soil. The highest value of P and K in soil was recorded in jute-rice-wheat system. The lowest P in soil was recorded in rice-rice system and jute-rice-mung bean cropping system. (Source: JA 5.6. Contributors: Mukesh Kumar, S Mitra, A.K. Ghorai and B Majumdar).

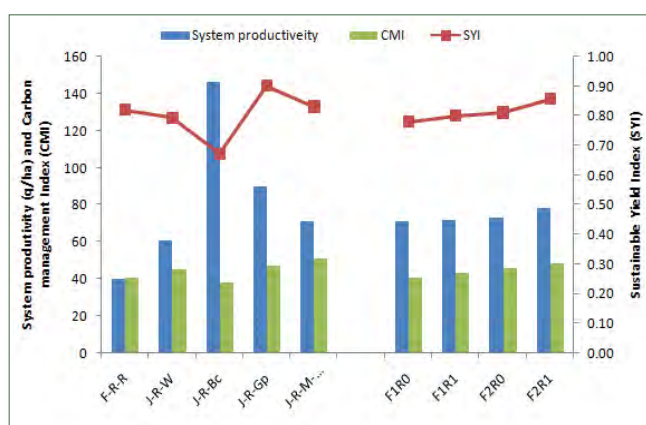


Fig. 5.1. System productivity, sustainability index and carbon management index of different jute based cropping systems under nutrient and crop residue management practices.

J-jute, R-rice, W-wheat, Bc-baby corn; M-mustard, Mu- mung bean; F_1 -75% NPK; F_2 -100% NPK; R_0 -No residue; R_1 -residue incorporation in soil.

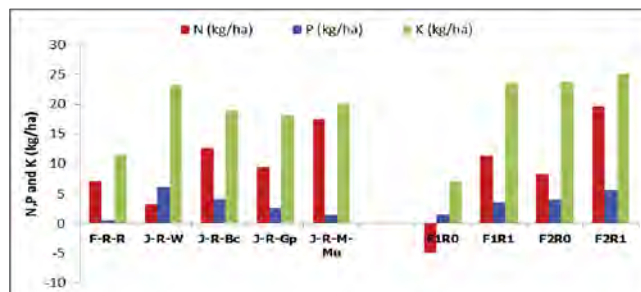


Fig. 5.2. Nutrients (N, P and K) balance in soil after five years of different jute based cropping systems under nutrient and crop residue management practices.

J-jute, R-rice, W-wheat, Bc-baby corn; M-mustard, Mu- mung bean; F_1 -75% NPK; F_2 -100% NPK; R_0 -No residue; R_1 -residue incorporation in soil.

5.1.2. Scope of growing spices, medicinal and aromatic plants (MAPs) in jute based cropping system

5.1.2.1 Feasibility of growing MAPs and seed spices in jute (fibre) based cropping system

Maximum jute equivalent yield of 130.67 (q/ha) was recorded with jute-kharif rice-potato followed by jute-kharif rice-ashwagandha (84.90 q/ha) and jute-kharif rice-asalio (81.52 q/ha) (Table 5.1) Cropping sequence with RDF + 5 t/ha FYM recorded 10.30% higher yield than cropping sequences with only RDF. The highest net return (Rs.2,06,209/ha) was obtained from jute-kharif rice-potato followed by jute-kharif rice-ashwagandha (Rs. 1,62,814/ha). Whereas benefit cost ratio was higher in jute-kharif rice-asalio (2.14) and lowest in traditional cropping sequence jute-kharif rice-potato (1.82).

5.1.2.2. Performance of MAPs in jute seed and autumn rice based cropping system

Jute-stevia-autumn rice cropping sequence recorded highest jute equivalent yield of 228.80 q/ha followed by jute-ajwain-autumn rice (86.03 q/ ha) and jute-fennel-autumn rice (84.40 q/ha). Application of RDF+5 t/ha FYM recorded 7% higher yield compared to only RDF. The highest net return of Rs.3,22,487 was recorded in case of jute-stevia-autumn rice cropping system which was 70% higher compared to traditional crop tomato. This was followed by dill seed (Rs. 1,82,325) and ajwain (Rs. 1,52,725). Considering the system economics, jute-ajwain-autumn rice cropping sequence recorded maximum B:C ratio of 2.58 followed by stevia (2.41). Jute-ajwain-autumn rice was the most profitable cropping sequence of the system.

Table 5.1. Interaction effect of cropping system and fertility levels on jute equivalent yield (JEY) and system economics in jute (fibre)-kharif rice-MAPs sequence

	Treatments	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	Mean
JEY (q/ha)	F ₁	78.19	83.05	73.64	72.97	69.12	118.96	82.65
	F ₂	84.85	86.75	81.25	78.33	73.47	142.38	91.17
	Mean	81.52	84.90	77.44	75.65	71.29	130.67	
	CD (P=0.05)	C=0.048 F=0.022 C x F=0.053						
Net return (Rs/ha)	F ₁	142769	157378	125618	120321	110501	186368	140492
	F ₂	161409	168251	147040	137807	120421	226050	160163
	Mean	152089	162814	136329	129064	115461	206209	
	CD (P=0.05)	C= 1149.79 F=208.08 C x F=509.70						
B:C ratio	F ₁	2.09	2.18	1.95	1.89	1.84	1.81	1.96
	F ₂	2.19	2.24	2.07	2.01	1.88	1.83	2.03
	Mean	2.14	2.21	2.01	1.95	1.86	1.82	
	CD (P=0.05)	C= 6.857 F=4.99 C x F=1.225						

C₁=jute-kharif rice-asalio, C₂=jute-kharif rice-ashwagandha, C₃=jute-kharif rice-isabgol, C₄=jute-kharif rice-menthol mint, C₅=jute-kharif rice-senna, C₆=jute-kharif rice-potato F₁= RDF, F₂= RDF+ 5 t FYM/ha.

5.1.2.3. Performance in jute fibre cum seed and boro rice based cropping system

Jute-nagella-boro rice recorded maximum JEY of 96.26 q/ha followed by coriander (91.62 q/ha) (Table 5.2). Considering the system economics, jute-nagella-boro rice recorded highest net return of Rs. 1,87,853 which is 30.02% higher than that of traditional sequence. Application of FYM with RDF enhanced the yield by 12%. The Maximum B:C ratio (2.26) was recorded in jute-nagella-boro rice cropping sequences followed by jute-coriander-boro rice (2.17). (Source: JA 6.9 Contributors: M.S. Behera, D.K. Kundu, S Satpathy, A.K Jha and R K Naik)

5.1.3. Estimation of competition effects in jute-mungbean intercropping system

Three-way parallel row systematic design in 1:1 alternate row arrangement was applied to estimate the competition effects in jute-mungbean intercropping system. Jute (cv.NJ 7010) and mungbean (cv TMB 37) crops were sown on 29th March, 2017. The arrangement of 27 spacing combinations were - 3 levels (22.5, 20, 17.5 cm) of inter-row spacing for each component crop together with varying intra-row spacings (jute- 5, 6.5, 8 cm and mungbean – 8, 10, 12 cm), each spacing varied independently of the other factors. As spacing variations between adjacent harvest areas are very small and systematic, plants could be considered

Table 5.2. Interaction effect of cropping system and fertility levels on jute equivalent yield (JEY) and system economics of jute (fibre cum seed) - boro rice-MAPs and spices based cropping system

	Treatments	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	Mean
JEY (q ha ⁻¹)	F ₁	82.96	93.32	85.30	83.74	87.62	85.92	86.47
	F ₂	92.54	99.21	87.68	88.52	95.63	91.56	92.52
	Mean	87.75	96.26	86.49	86.13	91.62	88.74	
	CD (P=0.05)	C= 2.14 F=1.21 C x F = 2.96						
Net return (Rs/ha)	F ₁	151446	177489	148313	137204	161342	145727	153587
	F ₂	173255	198217	162818	151749	184623	158622	171547
	Mean	162350	187853	155566	144477	172982	152174	
	CD (P=0.05)	C=471.62 F=282.14 C x F=691.11						
B:C ratio	F ₁	2.09	2.19	2.07	1.88	2.11	1.94	2.04
	F ₂	2.15	2.33	2.13	1.96	2.23	1.98	2.13
	C Mean	2.12	2.26	2.10	1.92	2.17	1.96	
	CD (p=0.05)	C=0.007 F= 0.009 C x F=0.002						

C₁=jute-asalio-boro rice, C₂=jute-nagella-boro rice, C₃=jute-methi-boro rice, C₄=jute-garden pea-boro rice C₅=jute-coriander-boro rice, C₆=jute-isabgol-boro rice., F₁= RDF, F₂= RDF+ 5 t FYM/ha

as almost equally spaced. Therefore guard rows are not needed between the harvest areas. Mungbean pods were picked on 03.06.2017 (i.e., at 66 DAS) and jute harvested on 26.06.2016 (i.e., 88 DAS). The highest jute fibre yield was recorded at 35 cm row spacing while the highest mungbean yield was at 40 cm spacing (Source JST 6.1, Contributors: A.K. Chakraborty and A. K. Ghorai)

5.2. Sisal

5.2.1 Production potential and economic benefit of intercropping of medicinal and aromatic plants (MAPs) in sisal plantation

Considering the total sisal equivalent yield of different spices, MAPs grown as intercrops, *safed musili* recorded maximum yield of 31.72 q/ha followed by aloe-vera (31.35 q/ha) and vetiver (32.82 q/ha) in case of MAPs. Among spices, fennel registered yield of 30.60 q/ha. The traditional tuber crop *i.e* elephant footyam recorded yield of 24.45 q/ha followed by vegetable crop okra (18.63 q/ha). *Safed musili* recorded maximum return of Rs. 1,81,892 followed by Aloe-vera (Rs. 1,70,020). Among the spices, fennel (Rs. 1,57,553) and elephant footyam (Rs. 1,09,764) registered higher net return. (Source: JA 6.9 Contributors: M.S. Behera, D.K. Kundu, S Satpathy, A. K Jha and R K Naik).



Fig. 5.3 Lemon grasses intercrop in sisal plantation



Fig. 5.4 Vetiver in sisal plantation

Table 5.3. Effect of different drip irrigation regimes on dry weight of sisal in fruit-fibre system

	Treatments	I ₁	I ₂	I ₃	Mean
	Sisal yield (q/ha) 7 Years old sisal plantation	C ₁	14.66	15.22	13.26
C ₂		16.56	17.15	14.89	16.20
C ₃		18.21	19.54	17.57	18.44
C ₄		14.01	15.12	13.65	14.26
I Mean		15.86	16.75	14.84	
CD (P=0.05)		C=0.018 I=0.005 C x F=0.012			
Sisal yield (q/ha) 2.5 Years old sisal plantation	Treatments	I ₁	I ₂	I ₃	C Mean
	C ₁	7.19	8.21	7.11	7.50
	C ₂	6.72	7.49	6.19	6.80
	C ₃	4.99	5.94	4.37	5.10
	C ₄	6.76	7.65	6.29	6.90
	I Mean	6.41	7.32	5.99	
CD (P=0.05)	C=0.065 I=0.021 C x F=0.034				

C₁= Guava C₂= Sapota C₃= Custard Apple C₄= Mango, I₁=100% PE, I₂=80% PE, I₃=60% PE

5.2.2. Use of Drip irrigation for improving productivity of sisal-based fruit-fibre system

Highest sisal yield of 18.44 q/ha was recorded in case of custard apple followed by sapota (16.56 q/ha). Irrigating the fruit plants at 80% PE recorded higher yield in all fruit plants compared to 100% PE and 60% PE, where fruit plants were taken up in existing 4 years old plantation (Table 5.3). However, in new plantation where sisal and fruit plants were planted together, the gestation period of sisal was reduced by 6 months.



Fig. 5.5. Guava in sisal plantation

As a result of which harvesting was taken up from 2.5 years of old plantation. The result indicated maximum sisal yield of 7.50 q/ha in case of guava (Fig.5.5) followed by mango (6.90 q/ha) (Fig.5.6). Irrigating the fruit plants at 80% PE resulted in maximum plant height compared to 100% PE and 60% PE. Considering the plant height, guava recorded the maximum plant height of 390 cm followed by mango (230 cm). (Source: SLA 1.6 Contributors : M.S. Behera, D.K. Kundu and A.K.Jha.)



Fig. 5.6. Mango in sisal plantation

6. Biotic and Abiotic Stresses

6.1. Pest Management

6.1.1. Isolation and characterization of pheromone components of jute semilooper, *Anomis sabulifera*

The abdominal tips of female virgin adult were sliced and dissolved in n-hexane to carryout gas chromatography coupled with electro-antennogram detector (GC-EAD) and mass spectrometry studies for isolating the probable behavioral modifying compounds dissolved in the solvent.

Electroantennogram studies (EAG): Antenna of male *A. sabulifera* were mounted on to the electrodes of EAG to study the response against five standards (Z,Z) 9,12-heneicosadiene, (Z,Z,Z) 9,12,15-heneicosatriene, (Z,Z) 9,12-octadecadienal, octadecanal, female pheromone gland extract and n-hexane as control for the probable behaviour modifying stimulance. The male antenna of *A. sabulifera* showed a response of 4.00mV, 2.25mV, 3.75mV, 1.5mV, 5mV and 1.80mV respectively to all the standards examined in the EAG (Fig-6.1).

Electroantennogram studies (EAG) coupled with Gas-Chromatography: Antenna of male *A. sabulifera* were mounted on to the electrodes of EAG and insect volatiles of female pheromonal gland extracts were analyzed by gas chromatography coupled with electro-antennogram detector (GC-EAD). The injected sample (1.0 μ l) was equally split between a flame ionization detector (FID) and the EAD. The male antenna showed a response to compounds eluted at various time intervals commencing from 6.21 minute to 37.24th minute respectively to GC-EAD programme. (Fig. 6.2)

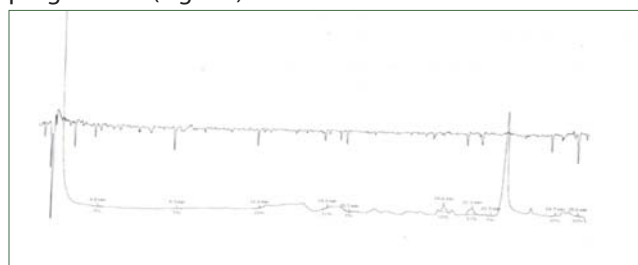


Fig. 6.2. GC-EAD response of adult *A. sabulifera* male antenna to female pheromone gland extracts

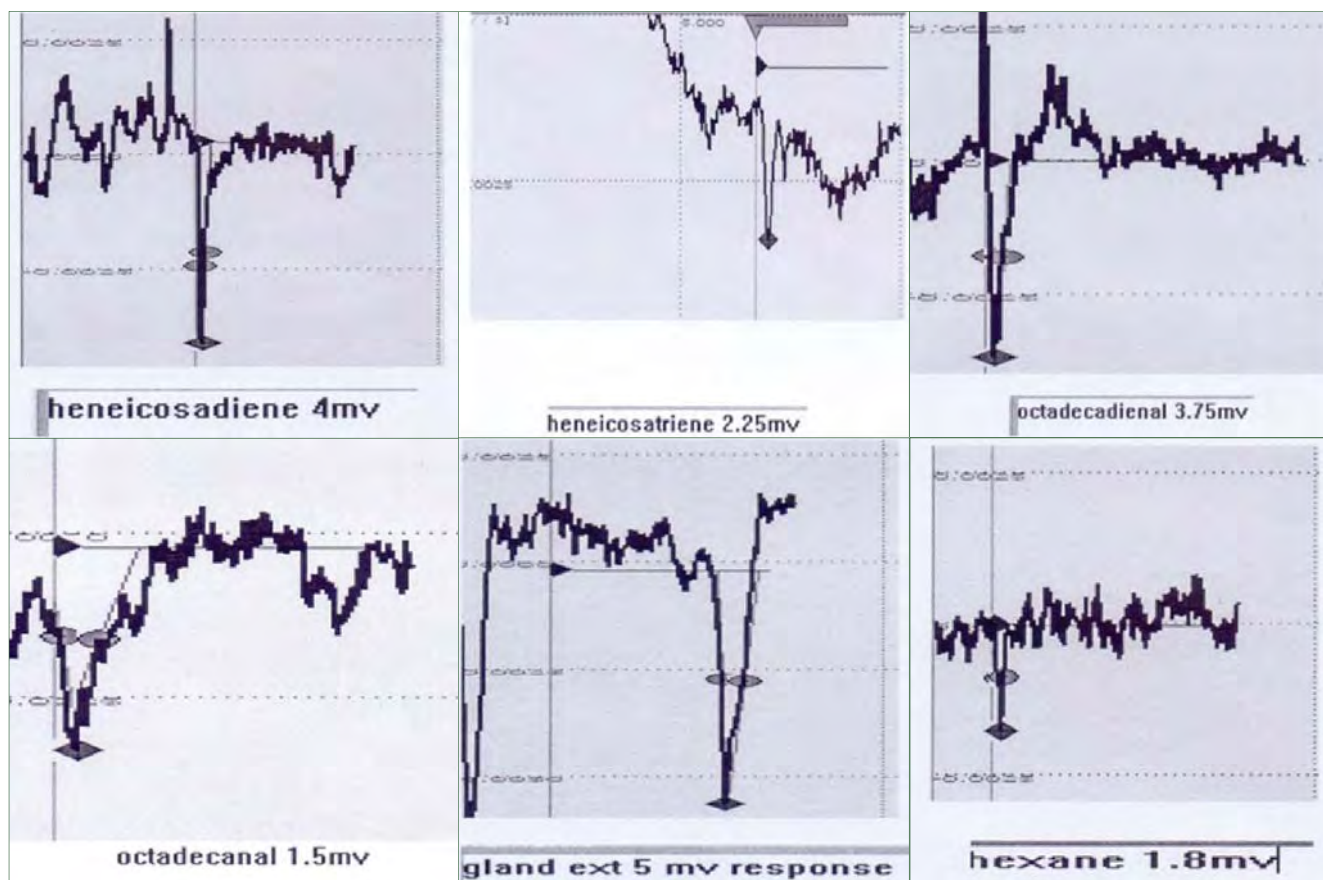


Fig. 6.1. EAG response of 4.00 mV, 2.25 mV, 3.75 mV, 1.5 mV, 5 mV and 1.80 mV respectively to all the standards examined

Gas-Chromatography-Mass Spectrometry (GC-MS): GC-MS analyses of insect volatiles from female pheromonal glands revealed presence of compounds, heneicosadiene and (Z,Z,Z) 9,12,15-heneicosatriene at retention timings 25.52th and 25.84th (Table 6.1, Fig. 6.3). Further validation with synthetic compounds viz., heneicosadiene, (Z,Z,Z) 9,12,15-heneicosatriene and heneicosane proved the presence of heneicosadiene and (Z,Z,Z) 9,12,15-heneicosatriene in the female pheromonal gland extracts based on the response and retention time in the GC-EAD and GC-MS studies respectively. (Source: J.E. 1.6. Contributors: V. Ramesh Babu, B.S. Gotyal and S. Satpathy).

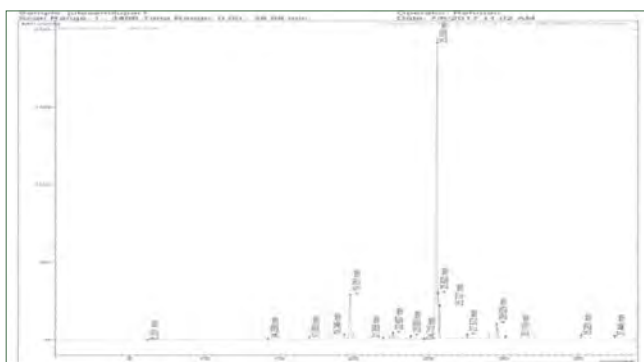


Fig. 6.3. GC-MS analysis of female adult *A. sabulifera* pheromone gland extracts

Table 6.1. GC-MS analysis of female adult *A. sabulifera* pheromone gland extracts

S. No	Retention time (mins)	Compound
1	5.132	Methane isothiocyanate
2	5.804	3-methyl-2-butenic acid
3	6.251	Benzene 1,3-trimethyl
4	14.259	Phenol, 2,4,6-tri(1-methyl)
5	17.002	Tri-n-Butyltin hydride
6	17.160	p-Acetoxy Phenyl-2-butanone
7	19.346	11-Hexadecen-1-ol acetate
8	19.967	3-Eicosyne
9	20.417	Cis-9-Hexadecenal
10	21.957	1E,8Z-10-Tetradecatriene
11	22.385	5-Heptadecene,1-bromo
12	22.602	9,12,15-Octadecatrienoic acid
13	23.190	9,12-Octadecadienoic acid
14	23.540	5-Heptadecene,1-bromo

S. No	Retention time (mins)	Compound
15	24.477	E11-Methyl-12-tetradecen-1-ol acetate
16	25.52	(Z,Z) 9,12-Heneicosadiene
17	25.84	(Z,Z,Z) 9,12,15-Heneicosatriene
18	27.569	8-Hexadecyne
19	30.117	7-Octadecyne-2-Methyl

6.1.2. Identification of VOCs of *C. aestuans* accession imparting specific resistance mechanism against hairy caterpillar of jute

The effects of volatiles from the chopped leaves of the resistant jute species viz., *C. aestuans*, *C. pseudo-olitorius*, *C. tridens*, *C. trilocularis*, *C. fascicularis* (wild) and the cultivated susceptible species, *C. olitorius* (Cv. JRO-204) on the preference of hairy caterpillar feeding was studied. Intact and chopped leaves of these jute species placed individually and randomly assigned (2 species at a time) in chambers of Y-shaped olfactometer indicated significant feeding preference of the larvae to the cultivated species with least preference for *C. aestuans* (WCIN-179). In case of *C. aestuans* (WCIN-179) the behavioral response of *S. obliqua* moth showed antennal response at 0.2mV to a compound at 9.5 min with GC-EAD programme. The GC-MS analysis of VOCs from *C. aestuans* indicated that insect-repellent compounds, benzene-1 ethyl-3 methyl, dodecane and tridecane were eluted at 6.70, 12.13 and 14.17 min. respectively. Other jute species have different set of VOCs and not as unique as it is present in *C. aestuans* (WCIN-179) that makes it resistant due to non-preference mechanism. The uniqueness and novelty of this accession of *C. aestuans* (WCIN-179) is confirmed on the basis of very unique biochemical and VOC profile which makes it resistant against hairy caterpillar through multiple mechanisms. As *C. aestuans* is crossable with the cultivated species, *C. olitorius*, hence, it is quite practical that this accession can further be used for insect resistance breeding program in *tossa* jute. The germplasm line has been submitted to NBPGR, New Delhi for registration. (Source: JE 1.8. Contributors: B. S. Gotyal, R. Rao Korada, S. Satpathy and V. Ramesh Babu).

6.1.3 Evaluation of elite jute varieties against yellow mite

The elite varieties of jute were evaluated against mite on the basis of infestation of adult stages, mite days, tolerance index and over all susceptibility against the pest under field condition. At 35 DAS, significantly lowest population

was recorded on in JRO 524 (7.22/cm²) at par with JRO 204 (10.66/cm²). JROM 1, JRO 2407 and JBO 1 were more susceptible to mite at this stage with 22.88, 22.10 and 19.33 mite/cm² respectively. Further there was increase in mite infestation. Subsequently, at 55 DAS during the peak period of infestation (Table 6.2), JRO 524 and JRO 204, recorded significantly less mite population (20.99 and 23.77/ cm² respectively). These varieties recorded significantly lower mite population than JROM 1, S 19 and JRO 2407 (31.10, 32.66 and 36.77 mite/cm²). Consistently least susceptibility of JRO 524 to yellow mite infestation was still reflected at 65 DAS. In the three varieties (JRO 524, JRO 8432, JRO 204) the population build up was slower which varied from 14.77 to 24.90/cm² compared to 35.50 and 35.53 mite/cm² in JROM 1 and JRO 2407 respectively. On the basis of relative mite infestation and mite days, JRO 524 and JRO 204 were consistently more resistant.

Table 6.2. Relative infestation of yellow mite (adults) on elite jute varieties

Varieties	Yellow mite adults/cm ² leaf				Mite days	
	35DAS	45DAS	55DAS	65DAS	50 DAS	Cumulative
JRO 524	7.22 ^e	19.55 ^d	20.99 ^e	14.77 ^d	673.16 ^f	1546.30 ^e
JROM 1	22.88 ^a	31.98 ^{ab}	31.10 ^{bc}	35.50 ^{ab}	1179.83 ^{ab}	2611.29 ^b
JROG 1	16.99 ^{bc}	24.33 ^{cd}	28.44 ^{bcd}	31.50 ^{bc}	940.96 ^d	2166.35 ^c
JBO 1	19.33 ^{ab}	31.55 ^{abc}	26.66 ^{cd}	28.73 ^{ab}	1091.00 ^{bc}	2401.40 ^b
JRO 2407	22.10 ^a	35.10 ^a	36.77 ^a	35.53 ^a	1290.93 ^a	2921.25 ^a
S 19	17.01 ^{bc}	26.66 ^{bcd}	32.66 ^{ab}	29.43 ^{ab}	1030.96 ^{cd}	2398.00 ^b
JRO 8432	13.44 ^{cd}	25.77 ^{bcd}	26.33 ^d	22.93 ^{bc}	913.20 ^{de}	2088.42 ^c
JRO 204	10.66 ^{de}	22.66 ^d	23.77 ^{de}	24.90 ^{cd}	797.66 ^{ef}	1808.10 ^d
CD (P=0.05)	4.21	6.74	4.40	5.76	130.32	215.70

Mite-days gives better estimate of mite infestation that indicates the total duration of mite life stages (days) in the plant. It estimates the cumulative mite duration across the generations (Table 6.2). Till 50 DAS, JRO 524 recorded significantly less mite days (673.16) followed by JRO 204 (797.66) which was 1290.93 and 1179.83 in JRO 2407 and JROM 1 respectively. Cumulative mite days during the active growth period of the crop also recorded same trend. JROM 1 and JROM 2407 recorded significantly highest cumulative mite days (2921.25 & 2611.29 mite/cm²) during the critical period of infestation. (Source: JE 1.9. Contributors: S. Satpathy, B.S. Gotyal, V. Ramesh Babu, and S.P. Mazumdar).

6.1.4. Tolerance and susceptibility index of elite jute varieties against mite infestation

Besides the population density, the relative damage symptoms on terminal leaves of different varieties were graded. Tolerance index (TI) of the elite varieties was determined on the basis of expression of damage symptoms. The plants sustaining least damage were graded in a scale of 1-5, the higher the grade indicates more tolerant. At 40 DAS, the TI varied from 1.90 in JROM 1 to 3.93 in S 19. At 50 DAS, JRO 524 was rated to be most tolerant (4.00) and JRO 2407 being the least tolerant (1.73) (Table 6.3). The mean TI during the peak mite activity period indicates least tolerance in JRO 2407, JROM 1 and JROG 1. All the other elite varieties recorded better TI (3.40 to 3.86) over these 3 varieties. Susceptibility index (SI) of the elite varieties was determined considering the two factors i.e., mite days and the corresponding TI during the critical period of mite infestation. The SI of the elite varieties varied from 179.43 in JRO 524 to 708.58 in JRO 2407. JRO 204, JRO 8432 and S 19 also recorded less SI. In terms of susceptibility index JRO 2407 was significantly most susceptible. (Source: JE 1.9. Contributors: S. Satpathy, B.S. Gotyal, V. Ramesh Babu, and S.P. Mazumdar).

Table 6.3. Tolerance and susceptibility index of elite jute varieties against yellow mite

Varieties	Tolerance Index (TI)			Susceptibility Index (SI)
	40DAS	50DAS	Mean	
JRO 524	3.73 ^a	4.00 ^a	3.86 ^a	179.43 ^c
JROM 1	1.90 ^a	1.96 ^c	1.93 ^b	612.44 ^a
JROG 1	2.93 ^{ab}	2.60 ^{bc}	2.76 ^{ab}	348.12 ^b
JBO 1	3.46 ^a	3.33 ^{ab}	3.40 ^a	338.48 ^b
JRO 2407	1.93 ^b	1.73 ^c	1.83 ^b	708.58 ^a
S 19	3.93 ^a	3.33 ^{ab}	3.63 ^a	286.65 ^{bc}
JRO 8432	3.86 ^a	3.66 ^{ab}	3.76 ^a	252.50 ^{bc}
JRO 204	3.6 ^a	3.46 ^{ab}	3.53 ^a	232.77 ^{bc}
CD (P=0.05)	1.30	1.15	1.18	107.18

6.1.5. Evaluation of acaricides for toxicity and persistency against yellow mite of jute

The toxicity and persistency of systemic acaricides were evaluated under glass house condition against yellow mite till 16 days after treatment (DAT) on 35-day old potted jute plants. The tested acaricides had significant effect on reducing the egg density of yellow mite. The egg density in different treatments at 3 DAT varied from 0-16.33 mite/cm² which was 23.00 to 31.00/cm² leaf area during the pre-treatment period (Table 6.4). Except flonicamid 50 WG, wettable sulphur 80% and control, no other treatment

recorded any egg deposition. The persistent effect of diafenthiuron and fenpyroximate continued till 8 DAT and no oviposition was recorded in these two treatments. During this period, the egg density in the control plant was 55.33 mite/cm². At 16 DAT significantly least egg density was recorded in fenpyroximate 5EC (6.66 mite/cm²) followed by spiromesifen 22.9 EC. Among the acaricides tested for toxicity and persistency, fenpyroximate 5EC (0.005%) was found to be most effective followed by diafenthiuron 50WP (0.05%) and spiromesifen 22.9EC (0.016%).

Table 6.4. Effect of acaricides on egg density of yellow mite in jute

Treatments	Egg density per cm ² leaf area			
	Pre-treat	Post treat-I (3 DAT)	Post treat-II (8 DAT)	Post treat-III (16 DAT)
Fonicamid 50WG(0.025%)	25.00(5.04) ^a	9.33(3.13) ^c	13.67(3.76) ^b	12.67(3.63) ^b
Spiromesifen 22.9EC(0.016%)	23.00(4.77) ^a	0.00(0.71) ^d	4.33(1.99) ^c	8.00(2.86) ^{bc}
Diafenthiuron 50WP(0.05%)	31.00(5.58) ^a	0.00(0.71) ^d	0.00(0.71) ^d	11.66(3.48) ^b
Dinotefuran 20SG(0.025%)	28.67(5.36) ^a	0.00(0.71) ^d	5.67(2.40) ^c	10.33(3.28) ^{bc}
Fenpyroximate 5EC(0.005%)	28.00(5.33) ^a	0.00(0.71) ^d	0.00(0.71) ^d	6.66(2.64) ^c
Wettable sulphur 80%(0.12%)	27.33(5.26) ^a	16.33(4.09) ^b	12.35(3.58) ^b	23.33(4.87) ^a
Control	27.85(5.51) ^a	25.33(5.06) ^a	55.33(7.46) ^a	30.67(5.57) ^a
CD (P=0.05)	NS	0.44	0.96	0.72

Figures in the parentheses are $\sqrt{0.5+x}$ transformed values

The effect of acaricides on suppression of mite population was significant till 16 DAT (Table 6.5). There was no mite infestation in fenpyroximate 5EC (0.005%) treated jute plants till 8 DAT and even 16 DAT recorded significantly least number of mites (8.33 mite/cm²). Spiromesifen 22.9 EC was also quite effective. The mite population in this treatment was suppressed to 0.00, 5.00 and 17.33 mite/cm² till 3, 8 and 16 DAT respectively compared to 46.33

Table 6.5. Effect of acaricides on population density of yellow mite in jute

Treatments	Mite per cm ² leaf area			
	Pre-treat	Post treat-I (3 DAT)	Post treat-II (8 DAT)	Post treat-III (16 DAT)
Fonicamid 50WG(0.025%)	50.67(7.12) ^a	9.00(3.06) ^c	16.33(4.10) ^b	32.67(5.70) ^{bc}
Spiromesifen 22.9EC(0.016%)	46.33(6.82) ^a	0.00(0.71) ^d	5.00(2.26) ^{cd}	17.33(4.21) ^d
Diafenthiuron 50WP(0.05%)	50.67(7.07) ^a	0.00(0.71) ^d	2.33(1.54) ^{de}	29.33(5.45) ^c
Dinotefuran 20SG(0.025%)	44.00(6.66) ^a	0.00(0.71) ^d	8.33(2.93) ^c	32.67(5.74) ^{bc}
Fenpyroximate 5EC(0.005%)	56.00(7.50) ^a	0.00(0.71) ^d	0.00(0.71) ^e	8.33(2.96) ^e
Wettable sulphur 80%(0.12%)	50.00(7.10) ^a	18.00(4.29) ^b	15.33(3.95) ^b	40.33(6.38) ^b
Control	44.00(6.67) ^a	58.00(7.64) ^a	42.33(6.53) ^a	52.00(7.23) ^a
CD (P=0.05)	NS	0.50	0.96	0.81

Figures in the parentheses are $\sqrt{0.5+x}$ transformed values

mite/cm² during the pre-treatment period. At 16 DAT, the persistent toxicity of fenpyroximate 5EC was quite evidenced with significantly lowest mite population (8.33 mite/cm²) followed by spiromesifen 22.9 EC (17.33 mite/cm²). (Source: JE 1.9. Contributors: S. Satpathy, B.S. Gotyal, V. Ramesh Babu, and S.P. Mazumdar).

6.1.6. Residual and index of persistence toxicity of acaricides against yellow mite

Among the acaricides, fenpyroximate 5EC (0.005%) showed highest residual toxicity (95) and IPT (1520) compared to

only 51 and 816 respectively in case of wettable sulphur (Fig. 6.4). Spiromesifen 22.9EC (0.016%) also had very good residual toxicity. These two acaricides were most effective due the persistence toxicity, high translaminar activity and efficacy against both immature and mobile stages. (Source: JE 1.9. Contributors: S. Satpathy, B.S. Gotyal, V. Ramesh Babu, and S.P. Mazumdar).

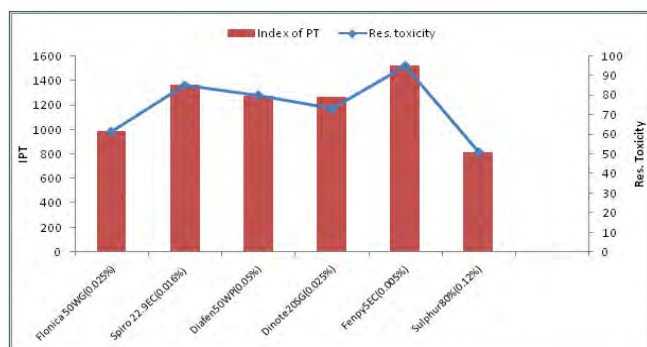


Fig. 6.4. Persistent toxicity of acaricides against yellow mite

6.1.7. Effect of endophytic *Lecanicillium lecanii* and *Beauveria bassiana* on jute mealybug and hairy caterpillar

Efficacy of *L. lecanii* and *B. bassiana* strains (1×10^8 CFU/ml) were tested against jute mealy bug crawlers and second instar larvae of Bihar hairy caterpillar (BHC) singly as well as in combination. The mortality of mealybug and BHC was 49.50% to 86.3% and 26.4% to 84.5% respectively in different treatments. In case of mealy bug, combined application of endophytic *L. lecanii* -VL8, VL15 and *B. bassiana* (BbM-isolated from dead mealybug) (T5) recorded highest mortality of 86.3% followed by *L. lecanii* -VL8, VL15 + *B. bassiana* -ITCC 5408 (T6) (78.3%). Whereas, in case of BHC, combined application of endophytic *L. lecanii* -VL8, VL15 and *B. bassiana* -ITCC 5408 (T6) recorded maximum mortality of 84.5% followed by *L. lecanii* -VL8, VL15 + *B. bassiana*-BbM) (T5) (75.3%). The results indicated that *L. lecanii* was more effective than *B. bassiana* against mealy bug and *B. bassiana* performed better against BHC. However, combined application of *L. lecanii* and *B. bassiana* caused greater mortality against both the pests (Fig. 6.5). (Source: JM 8.8. Contributors: C. Biswas and S. Satpathy).

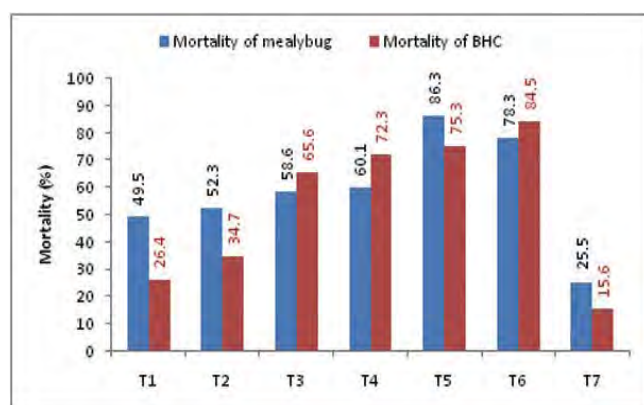


Fig. 6.5. Mortality (%) of jute mealy bug and hairy caterpillar under different treatments of *L. lecanii* and *B. bassiana*. T1: VL8, T2: VL15, T3: ITCC 5408, T4: BbM, T5: VL8+VL15+BbM, T6: VL8+VL15+ITCC5408, T7:Control

6.2. Disease Management

6.2.1. Identification of fungal pathogens causing stem lesion of jute

Pathogen associated with the stem lesions of jute from different fields were isolated. These belonged to 6 morpho-groups and four ITS-RFLP categories. To establish their identities, molecular phylogeny of 2 representative isolates from each 6 groups were selected. Phylogeny was based on 2 genes, ITS region of rDNA and translation elongation factor 1- α (TEF). These were amplified from genomic DNA of the selected fungi and sequenced bi-directionally. The sequences were aligned, edited manually when required. The final sequences were deposited at the GenBank (Table 6.6).

Table 6.6. Details of the GenBank accessions of different isoaltes

Isolate	GenBank Accession		Identity
	ITS	TEF	
CJMR99	MF480336	MF522196	<i>Diaporthe tulliensis</i>
CJMR95	MF480337	MF522205	<i>Diaporthe melonis</i>
CJMR100	MF480338	MF522197	<i>Diaporthe tectonae</i>
CJMR101	MF480339	–	<i>Colletotrichum</i> sp.
CJMR108	MF480340	MF522199	<i>Lasiodiplodia iraniensis</i>
CJMR114	MF480341	–	<i>Colletotrichum</i> sp.
CJMR135	MF480342	MF522201	<i>Macrophomina phaseolina</i>
CJMR137	MF480343	MF522200	<i>Lasiodiplodia iraniensis</i>
CJMR156	MF480344	MF522198	<i>Diaporthe tectonae</i>
CJMR148	MF480345	MF522204	<i>Lasiodiplodia theobromae</i>
CJMR140	MF480346	MF522203	<i>Lasiodiplodia theobromae</i>
CJMR164	MF480347	MF522202	<i>Macrophomina phaseolina</i>

Sequences from the test fungi and those of the related species (mostly type specimen) were trimmed to select similar portions of the target genes for phylogeny (Fig. 6.6). Molecular phylogeny was performed using MEGA6. Both maximum likelihood (ML) and maximum parsimony (MP) methods were used to construct the

phylogenetic tree. Accordingly, the pathogens infecting jute belonged to three families viz. Diaporthaceae (*Diaporthe* spp.), Glomerellaceae (*Colletotrichum* spp.) and Botryosphaeriaceae (*Lasiodiplodia* spp., *Macrophomina phaseolina*) of Ascomycota. (Source: JM 8.5. Contributor: K. Mondal).

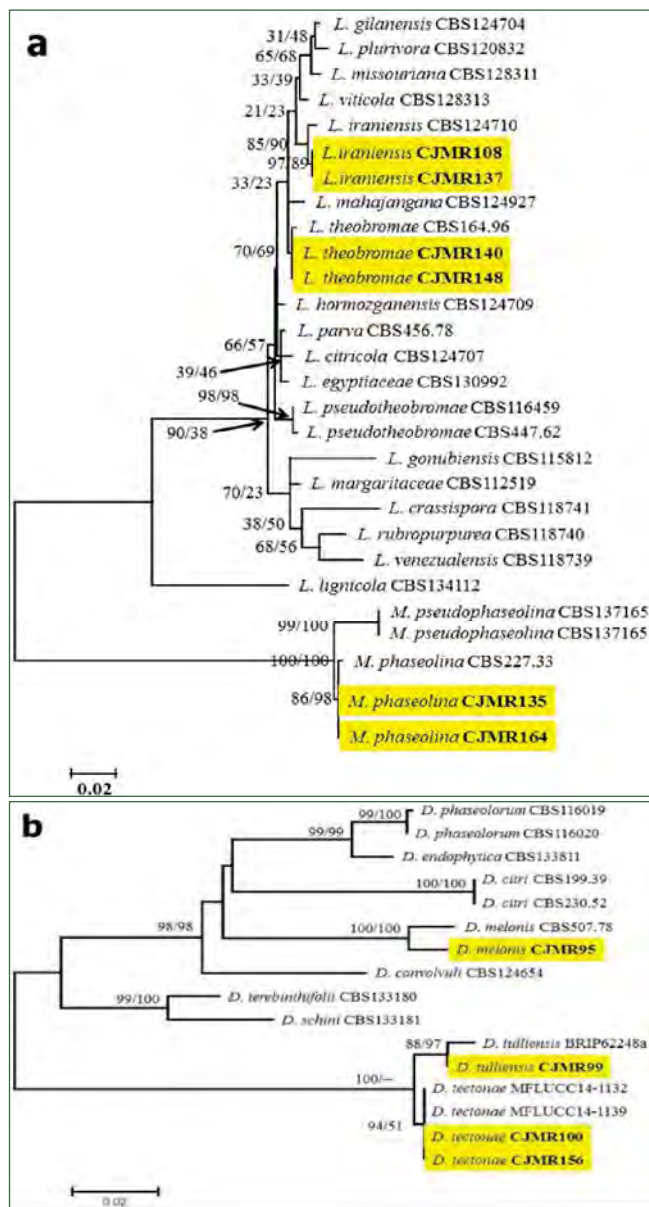


Fig. 6.6. Phylogenetic relationship of pathogenic species identified from stem rot of jute

6.2.2. Field efficacy of soil application of bleaching powder and fungicides for management of stem rot of jute

Effect of preventive soil application of bleaching powder @ 20, 30 and 50 kg/ha (7 days before sowing) was compared

with seed treatment (ST) and foliar spray (FS) of different fungicides (0.1%) at 45 DAS in controlling the stem rot incidence in jute (Table 6.7). Seed treatment (ST) with carbendazim 50 % WP followed by one foliar spraying at 45 DAS @ 0.2% was the best in controlling the jute stem rot. This treatment recorded significantly lowest (21.84 %) stem rot incidence at 90 DAS at par with of ST and foliar spray of tebuconazole 25.9% and the soil application of bleaching powder @ 30 and 50 kg/ha. Soil application of bleaching powder @ 30 kg/ha and sowing after 7 days was statistically at par with the best fungicidal treatments of tebuconazole and carbendazim resulting in less stem rot incidence of 0.48 – 22.5% .

Table 6.7. Effect of soil application of bleaching powder (BP) and fungicides on stem rot disease incidence of jute

Treatment	Stem rot incidence (%)				
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS
SA of BP @ 20 kg/ha	2.00 (8.02)	3.30 (10.40)	9.18 (17.61)	16.92 (24.23)	30.11 (33.28)
SA of BP @ 30 kg/ha	1.69 (7.46)	4.75 (12.58)	9.77 (18.21)	17.54 (24.71)	22.50 (28.31)
SA of BP @ 50 kg/ha	1.74 (7.48)	3.65 (10.93)	9.74 (18.04)	17.16 (24.36)	23.93 (29.27)
ST and FS of Tebuconazole	2.02 (8.13)	5.68 (13.70)	8.79 (17.16)	16.70 (23.96)	21.91 (27.90)
ST and FS of Trifloxystrobin	3.79 (10.57)	5.70 (13.79)	10.84 (19.04)	21.87 (27.87)	31.78 (34.31)
ST and FS of Kresoxim methyl	1.98 (7.77)	4.81 (11.91)	7.55 (15.69)	19.64 (26.23)	28.70 (32.37)
ST and FS of Carbendazim 50% WP	1.87 (7.60)	5.27 (13.12)	7.38 (14.82)	13.65 (21.66)	21.84 (27.85)
Check	2.05 (8.18)	8.38 (16.52)	11.04 (19.30)	24.03 (29.35)	37.67 (37.86)
CD (P= 0.05)	3.65	4.93	6.14	4.57	2.03

Figures in the parenthesis are arc sine transformed value, SA-Soil application, ST-Seed treatment, FS- Foliar spray

6.2.3. Development of IPM module for jute

IPM module consisting of cultural (sowing in line with 5 - 6 lakh plants /ha, NPK: 60:30:30), chemical (soil application of Ca(OCl)₂ @ 30 kg/ha at 7 days before sowing (DBS), seed treatment with (a) carbendazim @ 2g/kg + (b) imidacloprid @ 4g/kg, application of pesticides: spiromecifen @ 1 ml/l, profenophos @ 2 ml/l); biological (*Trichoderma viride* @ 10g/kg before sowing and spraying of neem oil @ 3 - 4 ml) components was effective against major insect pests of jute (cv. JRO 204).

Stem rot was reduced to 2.67% in complete IPM module (with cultural, chemical and biological components) from 19.28% in farmers' practice (Table 6.8). Yellow mite was reduced to 1.2% in complete IPM module (with cultural, chemical and biological components) from 11.18% in farmers' practice. Greater fibre yield and benefit cost ratio of 31.46 q/ha and 1.61 was observed in complete IPM module as compared to 14.7 q/ha and 1.28, respectively, in farmers' practice. (Source: JM. 9.1: Contributors: R. K. De, V. Ramesh Babu and Shamna, A.).

6.2.4. IPM module in farmers' fields

IPM module consisting of cultural (sowing in line with 5 - 6 lakh plants /ha, NPK: 60:30:30, ; chemical (soil application of $\text{Ca}(\text{OCl})_2$ @ 30 kg/ha at 7 days before sowing (DBS), seed treatment with (a) carbendazim @ 2g/kg + (b) imidacloprid @ 4g/kg, application of pesticides: spiromecifen @ 1 ml, profenophos @ 2 ml); biological (*Trichoderma viride* @ 10g/kg, before sowing and spraying of neem oil @ 3 - 4 ml) components were evaluated in farmers' fields in three different villages, namely, Paschim Shimla, Makaltala and Malikapur in North 24 District of West Bengal. In all the three locations, the IPM module was more effective than the farmer's practice in reducing the incidence of stem rot and yellow mite (Fig. 6.7). Incidence of stem rot under IPM in Paschim Shimla, Makaltala and Malikapur villages was 11.36, 14.10 % and 10.8 % respectively compared to 39.60 %, 40.20% and 44.80 % respectively in the farmers' practice. In case of yellow mite also the infestation in IPM was 11.5 % to 15.40 %, which was 39.60 to 44.80 % in farmers' practice. (Source: JM 9.1. Contributors: R.K. De, V. Ramesh Babu and Shamna, A.).

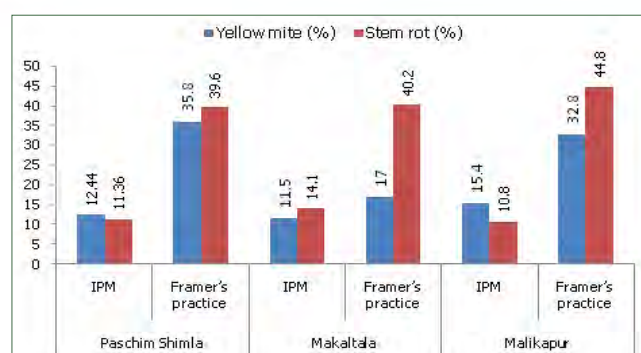


Fig. 6.7. Effect of IPM on yellow mite and stem rot incidence in jute infested field

6.2.5. Evaluation of some new fungicide molecules for management of *Macrophomina phaseolina* in jute

All the fungicide treatments reduced stem rot of jute significantly compared to check with highest root rot of 42.2% and percent disease index (PDI) of 30.6. Pre-sowing seed treatment with carbendazim + spraying was the best treatment in managing stem rot of jute with lowest root rot of 15.1% and PDI of 11.3. It was followed by tebuconazole with root rot of 17.8% and PDI of 13.7 and hexaconazole with root rot of 19.6% and PDI of 18.2. Minimum reduction of jute stem rot was recorded in propineb (Table 6.9). (Source: JM 9.1. Contributors: R.K. De, V. Ramesh Babu and Shamna, A.).

Table 6.8. Effect of IPM module on major disease and pest incidence in CRIJAF Farm

Treatments	Stem rot (%)	Yellow mite (%)	Indigo caterpillar (%)	Hairy caterpillar (%)	Fibre Yield (q/ha)	B:C Ratio
T1- Complete IPM Module	2.67(9.35)	1.22(6.01)	1.35(3.14)	0.54(4.16)	31.46	1.61
T2- T1 without cultural components	3.07(10.09)	1.48(.58)	1.27(3.53)	0.64(4.53)	27.74	1.46
T3- T1 without chemical components	5.00(12.91)	1.65(8.96)	1.28(4.69)	0.69(4.74)	26.80	1.44
T4- T1 without biological component	4.45(12.11)	2.21(8.28)	1.91(4.66)	0.81(5.12)	25.18	1.44
T5- T1 without cultural and Chemical components	4.13(11.47)	2.12(7.80)	2.12(4.50)	0.69(4.74)	24.19	1.45
T6- T1 without cultural and Biological components	6.01(14.19)	2.61(10.10)	2.27(5.72)	0.87(5.30)	21.75	1.37
T7- T1 without chemical and Biological components	9.12(17.53)	3.09 (3.32)	2.70(7.45)	0.76(4.97)	20.47	1.33
T8- Farmers' practice	19.28(26.02)	11.18(22.65)	4.28(14.37)	4.81(12.67)	14.74	1.28
CD (P= 0.05)	2.89	1.64	0.94	1.29	1.53	-

Figures in the parentheses are arc sine transformed values.

Table 6.9. Effect of new fungicide molecules on disease incidence in jute

Treatment	Root rot (%)	PDI*
Seed treatment with carbendazim + spraying carbendazim at 45 DAS	15.11(18.33)	11.38 19.57)
Seed treatment with propineb + spraying propineb at 45 DAS	31.38(27.01)	25.00 29.77)
Seed treatment with tebuconazole + spraying tebuconazole at 45 DAS	17.84(20.08)	13.79(21.66)
Seed treatment with difenconazole + spraying difenconazole at 45 DAS	26.43(24.72)	19.97 26.37)
Seed treatment with hexaconazole + spraying hexaconazole at 45 DAS	19.68(21.16)	18.27(25.04)
Seed treatment with tricyclazole+propiconazole + spraying tricyclazole + propiconazole at 45 DAS	24.37(23.55)	17.06(24.26)
Seed treatment with azoxystrobin + difenconazole + spraying azoxystrobin + difenconazole at 45 DAS	22.47(22.71)	16.05(23.53)
Check	42.21(31.59)	30.62(33.15)
CD (P=0.05)	4.13	5.05

Figures in the parentheses are arc sine transformed values. * PDI based on stem rot and root rot

6.2.6. Effect of sisal types and abiotic factors on incidence of zebra disease

In a survey programme on disease incidence of sisal in Sambalpur, Sundargarh and Jharsugda districts of Odisha indicates 13.3 to 34.7% disease incidence in *Agave sisalana* and 17.0 to 48.3 % disease incidence in Bamra Hybrid-1 (Table 6.10). (Source: SLM 1.0. Contributors: A K Jha, R.K. De and S. Sarkar).

Table 6.10. Zebra disease (*Phytophthora* spp.) reaction in different sisal types at 15 days interval

Date	Disease Severity In Nursery Stage (4-5 months old)		Disease Severity In 2-3 years old suckers	
	<i>Agave sisalana</i>	Bamra Hybrid-1	<i>Agave sisalana</i>	Bamra Hybrid-1
15 th June 17	2.9 (09.8)	3.9 (11.3)	2.9 (9.9)	4.0 (11.5)
30 th June 17	8.4 (16.8)	9.0 (17.4)	8.0 (16.3)	8.7 (16.9)
16 th July 17	25.0 (29.9)	25.7 (30.4)	18.7 (25.6)	20.0 (26.6)
31 st July 17	26.0 (30.6)	28.0 (31.9)	27.7 (31.7)	29.0 (32.6)
16 th Aug 17	41.0 (39.8)	42.3 (40.6)	31.7 (34.2)	35.0 (36.3)
31 st Aug 17	42.7 (40.8)	43.7 (41.4)	35.0 (36.2)	37.3 (37.6)

Date	Disease Severity In Nursery Stage (4-5 months old)		Disease Severity In 2-3 years old suckers	
	<i>Agave sisalana</i>	Bamra Hybrid-1	<i>Agave sisalana</i>	Bamra Hybrid-1
15 th Sept 17	44.3 (41.7)	46.3 (42.9)	41.0 (39.8)	42.3 (40.6)
30 th Sept 17	48.7 (44.2)	50.7 (45.4)	44.3 (41.7)	48.3 (44.0)
15 th Oct 17	49.7 (44.8)	54.7 (47.7)	45.0 (42.1)	48.7 (44.2)
CD (P=0.05)	2.6	2.8	3.2	3.7

Figures in parentheses are arc sine transformed value

In nursery stage, disease severity ranged from 2.9 to 49.7% in *Agave sisalana* and 3.9 to 54.7% in Bamra Hybrid-1. In case of 2-3 years old suckers, disease severity ranged from 2.9 to 45.0% in *Agave sisalana* and 4.0 to 48.7% in Bamra Hybrid-1. Maximum severity of the disease in sisal nursery was recorded in the month of October.

Maximum, minimum and average temperature showed significantly negative correlation with disease severity in both the varieties of sisal i.e., *Agave sisalana* and Bamra Hybrid-1 under both nursery stages and 2-3 years old suckers. Rainfall showed significantly positive correlation with disease severity in both the varieties, *Agave sisalana* and Bamra Hybrid-1 (Table 6.11).

Table 6.11. Correlation coefficient between disease severity and weather variables

Weather parameter	Disease Severity in Nursery Stage		Disease Severity in 2-3 years old suckers	
	sisalana	Bamra Hybrid-1	A. sisalana	Bamra Hybrid-1
Max. Temp*	-0.564	-0.551	-0.542	-0.532
Min. Temp.	-0.053	-0.049	-0.030	-0.036
Av. Temp.	-0.382	-0.371	-0.356	-0.353
Rainfall (mm)*	0.024	0.016	0.073	0.070
Max. RH (%)	-0.269	-0.275	-0.312	-0.328
Min. RH (%)	-0.463	-0.451	-0.431	-0.449
AV. RH (%)	-0.422	-0.415	-0.413	-0.432

*Significant at 5% level

Table 6.12. Zebra disease (*Phytophthora* spp.) reaction in different sisal type (2017-18)

Sisal Type	PDI	Reaction
<i>A. furcraea gigantea</i>	67.0 (54.9)	HS
<i>A. fourcroydes</i>	54.7 (47.7)	HS
<i>A. miradorensis</i>	8.7 (17.1)	MR
<i>A. angustifolia</i>	22.7 (28.3)	MS
<i>A. cantala</i>	22.3 (28.2)	MS
<i>A. americana</i>	43.0 (40.9)	S
<i>A. veracruz</i>	74.7 (59.9)	HS
<i>A. nirvana</i>	74.6 (59.9)	HS
<i>A. amaniensis</i>	22.0 (27.9)	MS
<i>A. sisalana</i>	40.7 (39.6)	S
Bamra hybrid-1	51.0 (45.6)	HS
CD (P=0.05)	5.3	

Figures in parentheses are arc sine transformed value

Out of 11 spp. tested under natural epiphytotic condition, none was found resistant to the disease. One spp. (*A. miradorensis*) showed moderately resistant reaction and three spp. (*A. angustifolia*, *A. cantala* and *A. amaniensis*) showed moderately susceptible reaction and rest 7 species showed susceptible and highly susceptible reaction (Table 6.12).

All the 8 fungicides tested were effective in reducing the zebra disease of sisal in both nursery and sucker stage. However, fosetyl –Al @2.0g/l gave the best control followed by azostrobilin and fenamidon 10% + mancozeb 50% WG as compared to check. Among others, tebuconazole 50% + trifloxystrobin 25% and cymoxanil 8%WW + mancozeb 64% WW were also found to be effective (Table 6.13).

Table 6.13. Efficacy of fungicides against zebra disease at nursery stage and one year suckers (*A. sisalana*)

Fungicide	PDI at nursery stage	PDI at sucker stage
Metalaxyl 8% + Mancozeb 64% @2.5g/l	28.0(31.9)	24.0(29.3)
Carbendazim 12% + Mancozeb 63% WP @2.5g/l	39.7(39.0)	40.3(39.4)
Copper oxychloride @3.0g/l	28.7(32.4)	30.3(33.4)
Tebuconazole 50% + Trifloxystrobin 25% @3.0g/l	26.7(31.1)	28.0(31.9)
Azostrobilin	17.3(24.6)	19.7(26.3)
Cymoxanil 8%WW + Mancozeb 64% WW@2.5g/l	20.3(26.8)	24.7(29.8)
Fenamidon 10% + Mancozeb 50% WG	19.0(25.8)	20.7(27.0)
Fosetyl –Al @2.0g/l	16.7(24.1)	18.7(25.6)
Check	46.7(43.1)	44.0(41.6)
CD (P=0.05)	2.7	2.9

Figures in parentheses are arc sine transformed value

Table 6.14. Efficacy of oil-cakes against zebra disease at nursery stage and one year suckers (*A. sisalana*)

Oil-cakes @ 10.0 q/ha	PDI at nursery stage	PDI at sucker stage
Neem	22.0(27.9)	20.5(26.9)
Karanj	25.8(30.5)	24.3(29.5)
Mahua	28.3(32.1)	29.3(32.7)
Linseed	37.0(37.5)	37.3(37.6)
Mustard	45.3(42.3)	39.8(39.1)
Check	47.8(43.7)	43.0(40.9)
CD (P=0.05)	2.2	2.0

Figures in the parenthesis are arc sine transformed values

All the 5 oil cakes tested were effective in reducing the zebra disease of sisal in both nursery and sucker stage. However, neem cake @10.0q/ha gave the best control followed by karanj, mahua and linseed cake as compared to check (Table 6.14). (Source: SLM 1.0. Contributors: A K Jha, R.K. De and S. Sarkar).

6.2.7 Assessment and management of diseases in flax

Vascular wilt of flax (*Fusarium oxysporum* f. sp. *lini*): Initially wilt infected plants appear sickly yellowing, started wilting at the top followed by whole plant wilting and eventually the plant dried with brown discolouration both on stem

and leaves. Three types of symptoms are noticed namely early wilt, late wilt and partial wilt. In early sown crop in the first week of October all the types of symptoms were noticed whereas in November sown crop mostly early wilting was recorded. The disease incidence varies from 5.4 (30DAS) to 18.1(70 DAS) percent in 27 October sown crop whereas in 10 November sown crop the disease increased from 0.5 to 12.8% up to 60DAS. Similarly in 25 November sown crop also the incidence increased from 1.6 (30DAS) to 9.4% (60 DAS). The pathogen was isolated from the infected wilt plant.

Sclerotial Disease: Frequently the infection of sclerotial rot with characteristic presence of mycelial mat as well as sclerotial structure was noticed just at ground level of the infected plant. The infected plants subsequently wilted.

Effect of date of sowing, fertilizer and seed treatment on vascular wilt: The date of sowing had significant effect on the incidence of wilt. In early sown crop in the last week of October the incidence of wilt was significantly higher (18.1%) than the November (10 November and 25 November) sown crop. There was no significant difference in different doses of fertilizers (NPK:: 40:40:40, 60:40:60 and 60:40:80) on the incidence of wilt (10.2-10.9%). Similarly seed treatment with carbendazim and Trichoderma formulation has no significant reduction in wilt incidence. (Source: Contributors: S.K. Sarkar and K. Mondal).

6.3. Weed Management

6.3.1. Eco-physiological studies of weeds in jute

6.3.1.1 Weed density under different fertility level of soil

A study was conducted to understand the relationship between weed composition and N P K status of soil under long term fertilizer experiment (LTFE). *Cyperus rotundus* population was higher in marginal or lower fertility condition i.e., Control (216 /m²), 50% NPK (158/m²) and 100% NPK (210/m²) treatments (Table 6.15). Higher density (208/m² and 160 m²) of *Leptochloa chinensis* recorded with 150% NPK and 100% NPK +FYM, respectively. Control and 100% N treatments resulted in lower number of weed species compared to other treatments.

Table 6.15. Weed population (No./m²) in different fertilizers treatments

Weed species	Control	50% NPK	100% NPK	150% NPK	100% NP	100% N	100% NPK+ FYM
<i>Cyperus rotundus</i>	216	158	210	16	84	4	10
<i>Echinochloa colona</i>	0	20	0	24	0	12	20
<i>Eleusine indica</i>	0	2	8	0	0	0	4

Weed species	Control	50% NPK	100% NPK	150% NPK	100% NP	100% N	100% NPK+ FYM
<i>Digitaria sanguinalis</i>	40	32	16	40	104	16	94
<i>Leptochloa chinensis</i>	0	20	40	208	10	72	160
<i>Trianthema portulacastrum</i>	20	0	14	30	4	0	24
<i>Physalis minima</i>	16	0	6	124	112	12	96
<i>Phyllanthus niruri</i>	76	72	36	120	8	32	90
<i>Cleome viscosa</i>	16	0	0	10	4	0	32
<i>Portulaca oleracea</i>	0	4	2	4	8	16	26

Weed density also varied with status of N P and K in soil. It was observed that lower value of N and P in soil lowered weed density and vice versa (Fig 6.8). Higher N and P content in soil under 150% NPK and 100% NPK + FYM treatments resulted in higher weed density. Lower P status in soil under 100% N treatment resulted in lower weeds density despite higher N content in soil.

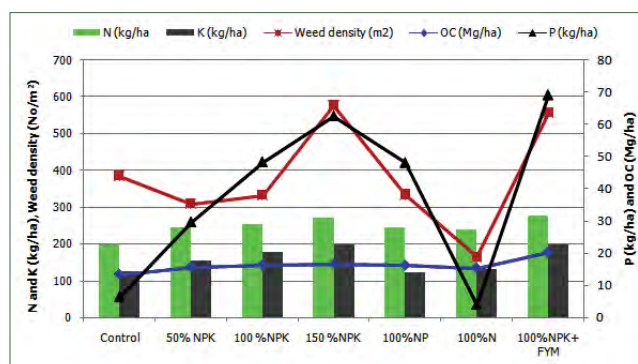


Fig 6.8 Weed density under different soil nutrient status

6.3.1.2. Effect of crop residue incorporation on weed density

Weed density in jute under different crop residues and their placement with pre-emergence herbicides application indicated that rice, wheat and corn residue @ 4 t/ha each reduced the grass and broad leaved weed population as compared to garden pea and mung bean residue @ 2 t/ha each. None of the crop residues could reduce the *Cyperus* population in jute. Crop residues retained on soil surface reduced the weed population compared to no residue application. However, weed population was at par with crop residue incorporation into soil. Butachlor and pretilachlor @ 1.0 kg /ha significantly reduced the grass and broad leaved weed population in jute. Interaction effect of type of residues and their placement was found

significant and it was observed that rice, wheat and corn residue retained on soil surface significantly reduced grass weeds than garden pea residue either retained or incorporated in soil (Fig. 6.9).

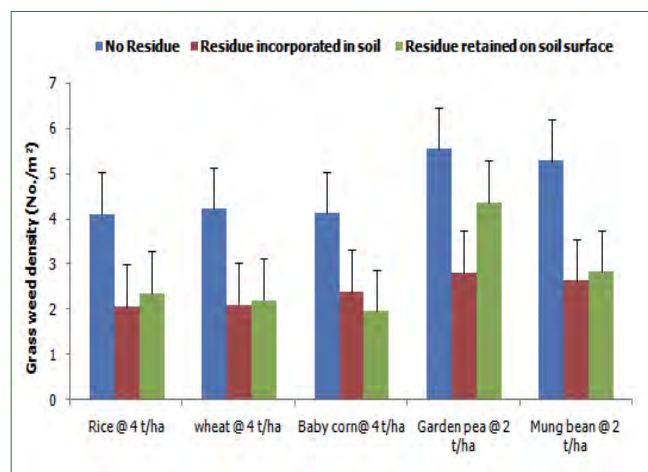


Fig 6.9. Interaction effect of crop residues and their placement on grass weeds in jute

Broad leaved weeds (BLW) density was significantly higher in garden pea and mung bean residues compared to rice, wheat and corn residues treatments. Significantly lower BLW was recorded in wheat residue retained on soil surface compared to rice, corn, pea and mung bean either residue incorporated or retained on soil surface (Fig 6.10). (Source JA 5.9. Contributors: Mukesh Kumar ; A.K. Ghorai and D.K. Kundu)

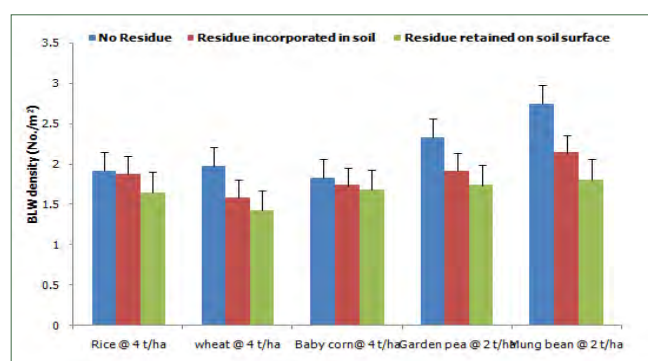


Fig 6.10. Interaction effect of crop residues and their placement on broad leaved weeds in jute

6.3.2. Development of low cost and eco-friendly integrated weed management technologies

6.3.2.1. Evaluation of pre-emergence and post emergence herbicides for jute

Ipfencarbazone @ 68.43 and 91.24 a.i. g/ha reduced grassy weeds by 87 % and 90% , respectively, broad leaved weed by 52% and sedge by 40%. Ipfencarbazone @ 68.43 to 114 g ai/ha had no toxicity on jute seedlings when sprayed

immediately after jute sowing followed by irrigation. It has no harmful effect on jute germination even if it is applied on field capacity of soil and yielded jute fibre 33 to 40 q/ha. No adverse impact of herbicides were recorded on rice yield in sequence (31-35 q/ha). The post-emergence haloxofop- R-methyl 10.5 EC controlled more than 98% grassy weeds in jute seed crop when applied at 15 DAS @ 94.5 to 157 a.i. g/ha . It did not have any bad effect on jute crop and produced significantly higher jute seed over manual weeding (Table 6.16)

Table 6.16. Effect of different weed management treatments on weeds and jute seed yield

Treat-ments	Grass weed (No./m²) before spray	Weed control efficiency % (Grass)	Broad leaved weeds (No./m²)	Sedge (No./m²)	Seed yield (q/ha)
Haloxofop R methyl 10.5 EC 94.5 g/ha (15 DAE)+ 1HW	306	100	251	16	12.5
Haloxofop R methyl 10.5 EC 126 g/ha (15 DAE)+1HW	464	100	356	69	13.33
Haloxofop R methyl 10.5 EC 157 g/ha (15 DAE)+ 1HW	632	100	91	42	13.93
Quizalofop ethyl 10EC @ 42 g/ha (15 DAE)+1HW	499	100	160	27	12.5
Manual weeding once (15 DAE)	544	80	176	0.5	10.62
Manual weeding twice (15 and 21 DAE)	500	95	120	15	11.52
Unweeded control	560	0	128	11	3.51
CD (P=0.05)	-	-	-	-	1.39

DAE- Days after crop emergence

6.3.2.2. Weed smothering by intercropping green gram with jute (1:1)

Intercropping of green gram (TMB-37, matures in 52-55 DAS) with jute sown from 3rd to 10th March recorded green gram yield 9.0 /ha and jute fibre yield 30.5 q/ha. In jute and green gram mixed cropping, green gram yielded 7.2 q/ha and in relay cropping 6.2 q/ha with jute fibre yields were 30.6 and 24.0 q/ha, respectively. The pulse grain yield of cv. Sukumar (Fig 6.11), small grain variety, matures in 65 DAS) was 7.0 q/ha and the jute fibre yield was 31 q/ha. Weed biomass was 76% lower than manual weeding twice at 25 DAS by reducing sunlight transmission up to 90% by green mung canopy.



Fig 6.11. Jute and green gram intercropping: NJ 7010 + Sukumar (1:1)

6.3.2.3. Modification in nail weeder assembly for higher weed control efficiency

Mechanical weeder usually controls only the weeds in between rows (80-85%). But the weeds within rows are left out which are controlled manually (Fig 6.12). Using modified CRIJAF manual weeder more than 95% of weeds can be controlled following the procedure mentioned below.

Principle of operation: Operate the tool in between crop rows to remove composite weed flora (80-85%). To remove weeds within crop rows, at 8-10 days after crop germination (10-12 cm seedling height) remove the central nail (3rd from either side, Fig 6.13) from the nail assembly. Keep the crop rows in between front wheels of CRIJAF nail weeder and set the open space (in between 2nd and 4th nails) over the crop rows for operation. At field capacity moisture stage by to and fro movement of the weeder, operate the tool over crop rows (8-10 days old sunnhemp as test crop and 10-12 cm seedling height) as usual. Weeds within the crop rows are removed (80-90%) and soils within the crop rows are pulverised. The disturbances to the young seedlings are minimum. More than 95% of total weeds can be controlled by using CRIJAF nail weeder and its assemblies at different time. The necessity of the herbicides may be eliminated. (Source JA 7.3. Contributors: A.K. Ghorai, Mukesh Kumar and S. Roy)



Fig 6.12. Weeds left out with in crop rows while the tool is operated to control weeds between crop rows



Fig 6.13. Central nail (3rd from either sides) of nail assembly is removed for operation over rows

6.3.3. Field level demonstration on jute and green gram intercropping under NFSM-CC-jute

Under normal rainfall situation in North-24 Parganas, the mean green gram yield was 4.72 q/ha (max 5 q/ha) and mean jute fibre yield was 27.25 q/ha (Fig 6.14). Under very high rainfall (180 mm from 19th April to 30th May) the mean green gram yield was 3.20 q/ha and jute fibre yield was 29.4 q/ha. In mixed cropping, green gram yield ranged from 2.68-3.80 q/ha and mean jute fibre yield was 32 q/ha [in Murshidabad and 24 PGS (N)]. (Source: JA 7.3, Contributors: A.K. Ghorai, Mukesh Kumar and S. Roy).



Fig. 6.14. Field level demonstration on jute and green gram intercropping at Amdanga

6.4. Abiotic Stress

6.4.1. Foliar application of plant growth regulator / elicitors in jute under drought stress

Twenty seven days old jute plants grown in pots were subjected to drought by withholding irrigation. Along with this, above ground part of additional sets of plants were sprayed with five different plant growth regulators/elicitors i.e., ascorbic acid (AsA), p-amino butyric acid (pABA), salicylic acid (SA), tri-iodobenzoic acid (TIBA), urea + magnesium sulfate and subjected to drought. Plants were allowed to withstand the stress until there was leaf rolling. It was found that jute plants could tolerate moisture deficit stress up to 6% soil moisture content at 5 cm depth. Among the plant growth regulators/elicitors, AsA showed the best stress removing performance in terms of plant height and leaf rolling (Fig. 6.16).



Fig. 6.15. Recovery of jute plants on re-watering after seven days moisture deficit stress

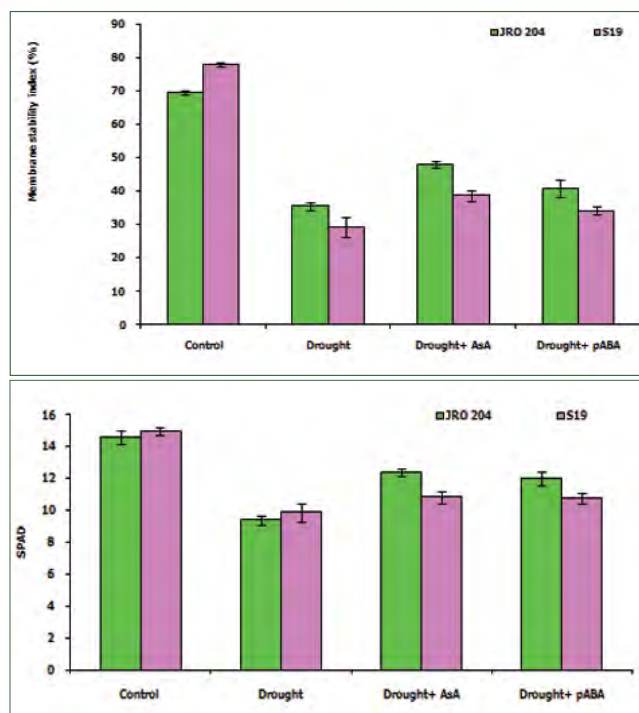


Fig. 6.16. Membrane stability index (MSI) and chlorophyll content of 12 days old jute seedlings under drought with exogenous AsA and pABA

Jute seedlings of JRO-204 and S-19 at twelve days growth stage were subjected to drought/osmotic stress with 8% PEG-6000. Additional sets of plants were sprayed with 10 mM AsA and 10 μ M pABA separately. Plants under drought showed reduced membrane stability, chlorophyll content, fresh and dry biomass, plant height and increased root length. Plants with exogenous AsA and pABA showed increased plant height, membrane stability and chlorophyll content as compared to drought. However, the plants with AsA exogenous application showed better response. Again, JRO-204 showed better performance as compared to S-19 at twelve days growth stage. (Source: JA 7.4. Contributors L. Sharma, J. Mitra, S. Mitra, P. Satya, D. Barman and S. Roy).

6.4.2. Endophytic fungal entomopathogen induced water stress tolerance in jute

Jute seeds of *C. olitorius* (cv. JRO 204) were treated with 6 endophytic *B. bassiana* strains, viz., ITCC 5408, ITCC 5562, ITCC 4563, ITCC 6063, ITCC 4796 and ITCC 4512 @ 1 g ml⁻¹ of *B. bassiana* conidial suspension (1×10^8 conidia ml⁻¹) for each strain for establishment of the endophytes in the seed. Pots under treatment with each of the six *B. bassiana* isolates as well as untreated control were subjected to 5 different water application treatments i.e., watering at 2, 3, 4, 5 and 6 day interval with equal quantity of water (Table. 6.17). The pots were kept in a glass house and were observed regularly. All the six *B. bassiana* strains showed endophytic

colonization in jute which was revealed by cultivation on selective media as well as by PCR. The treated samples gave amplification (205 bp). Endophytic colonization of certain strains conferred water stress tolerance. All the untreated plants showed wilting when watering was done at an interval of 3-day or more. However, ITCC 5408 treated plants could survive at 6-day interval watering without any wilting. In case of ITCC 5562 and ITCC 4563, only 16.32% and 20.26% plants wilted respectively at 6-day interval watering. Significant role of these endophytic *B. bassiana* strains in delaying the wilting under moisture stress was clearly evidenced. Proline estimation was done from samples of *B. bassiana* treated as well as untreated plants as its accumulation occurs in plants in response to drought stress. The highest concentration of proline (1.78 mg/g) was recorded in ITCC 5408 treated plants followed by ITCC 5562 (1.46 mg/g) and ITCC 4563 (0.85 mg/g). In

untreated plants proline concentration was as low as 0.21 mg/g (Fig. 6.17) (Source: JM 8.8. Contributors: C. Biswas and S. Satpathy).

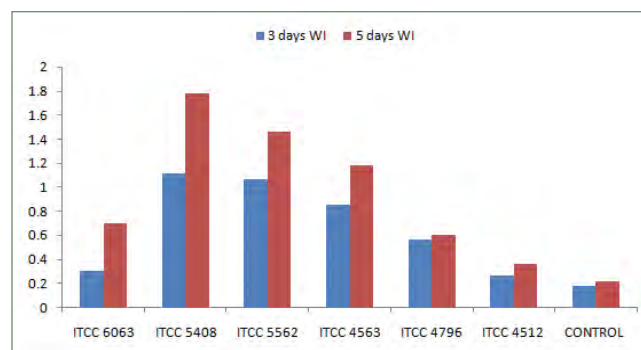


Fig. 6.17. Proline level (mg/g of tissue) in jute plants treated with different endophytic Bb isolates under moisture stress

Table 6.17. Effect of endophytic *B. bassiana* isolates on physiological wilting of jute plants (%) under different watering intervals

<i>B. bassiana</i> isolate	Per cent wilted plants				
	2 DWI	3 DWI	4 DWI	5 DWI	6 DWI
ITCC 6063	22.97(4.84) ^b	64.41(8.05) ^c	74.23(8.64) ^b	99.6(10.00) ^d	99.87(10.01) ^d
ITCC 5408	0.00(0.71) ^a	0.00(0.71) ^a	0.00(0.71) ^a	0.00(0.71) ^a	0.00(0.71) ^a
ITCC 5562	0.00(0.71) ^a	0.00(0.71) ^a	14.00(3.81) ^a	15.92(4.05) ^c	16.32(4.10) ^b
ITCC 4563	0.00(0.71) ^a	0.00(0.71) ^a	13.66(3.76) ^a	13.63(3.75) ^b	20.26(4.55) ^c
ITCC 4796	69.99(8.39) ^d	76.56(8.77) ^d	99.30(9.98) ^d	98.96(9.97) ^d	99.06(9.97) ^d
ITCC 4512	23.06(4.85) ^b	56.56(7.55) ^b	76.20(8.75) ^c	99.70(10.00) ^d	99.46(9.99) ^d
Control	40.63(6.4) ^c	75.96(8.74) ^d	99.06(9.97) ^d	99.36(9.99) ^d	98.73(9.95) ^d

DWI: days watering interval. The means with common superscripts in column are not significantly different ($P < 0.05$) by DMRT. Figures in the parentheses are $\sqrt{0.5+x}$ transformed values

7. Farm Mechanization and Post-harvest Technology

7.1. Farm Mechanization

7.1.1. Development of multi-crop manual seed drill

A light weight four-row manual seed drill has been developed for line sowing of jute and other small seeded crops (Fig. 7.1). The seed box is fabricated with polypropylene random (PP-R) material, which is light in weight and weather resistant. The seed dispensing holes are made on the larger diameter of conical frustum shaped seed box to drop one or two seeds at a time. Short and light weight chains as seed covering device are fixed through short piece m.s. flat on the driving shaft to avoid entangle during operation. The frame of the machine was compacted to reduce the weight and thereby reducing drudgery of the operator. The overall weight of the machine has been reduced to about 9-10 kg from existing 15-17 kg. The cost of the machine is calculated to be around Rs. 3000/-, which is quite affordable to marginal and small farmers. The laboratory calibration of seed drill showed seed rate of 3.0-3.5 kg/ha and 60-70% uniformity of seed distribution along the rows with seed spacing of 30-50 mm. (Source: JAE 3.4. Contributors: R.K. Naik, A.K. Ghorai, S. Sarkar and S.K. Jha).



Fig.7.1. Multi-crop seed drill (Manual operated)

7.1.2. Development of multi-crop seed drill (power operated)

An experimental model of power operated six-row seed drill machine has been developed to get higher field capacity than manual seed drill which can be attached with power tiller (Fig 7.2). Main parts of the machine are seed hopper, ground wheel, metering mechanism, frame/tool bar, furrow openers, seed covering device. Two ground wheels of 320 mm diameter transmit power to the metering shaft through chain and sprocket drive. Seed from hopper is collected by metering device and drops behind the furrow opener near the ground though seed tubes. Chains attached behind the furrow opener acts as ladder. The adjustable rubber wheel is used for transport

of machine in road condition. The laboratory calibration of seed drill showed seed rate of 2.5-3.0 kg/ha and 50-60% uniformity of seed distribution along the rows with seed spacing of 25-40 mm. The machine has been tested for its field efficiency both at ICAR-CRIJAF farm and farmers' field during the crop session 2018-19 (Fig 7.3, 7.4, 7.5). The average depth of seed placement was found to be 25-30 mm with row to row spacing of 250 mm. The field capacity at average operational speed of 1.45-3.0 km/h was measured to be 0.35-0.4 ha/h. (Source: JAE 3.4. Contributors: R.K. Naik, A.K. Ghorai, S. Sarkar and S.K. Jha).



Fig. 7.2. Field trial of seed drill (Power operated) at ICAR-CRIJAF Farm



Fig. 7.3. Field trial of seed drill (Power operated) at village: Duttapara



Fig. 7.4. Field trial of seed drill (Power operated) at village: Boraghata



Fig. 7.5. Jute crop at village: Boraghata sown with multi crop seed drill (Power operated)

7.1.3. Improved weeder for Gangetic alluvial soil

The manually operated push and pull type “CRIJAF Single wheel jute weeder” has been tested in the farmers’ field in line sown jute crop (Fig 7.6). At average speed of operation of 28.08 m/min, the field capacity was found to be 0.026-0.28 ha/h and field efficiency of 76.7 per cent. Field capacity is affected by cutting width, moisture content of soil, weed intensity and physical condition of operator. The average draft of the weeder was found to be 29.7 kg and it is within the physical limit of the operator. The working width of the weeder was 18 cm and depth of operation was 5-6 cm. Weeding operation with this tool reduces drudgery, labour and cost requirement in line sown crops. (Source: JAE 3.4. Contributors: R.K. Naik, A.K. Ghorai, S. Sarkar and S.K. Jha).



Fig. 7.6. CRIJAF single wheel jute weeder in farmers’ field

7.2. Post Harvest Technologies

7.2.1. Studies on ribbon retting methods for quality fibre extraction in jute and mesta

Three machines i.e. bast fibre extractor, manual jute extractor and jute decorticator were used to extract ribbons from harvested jute (120 DAS) and mesta (130 DAS) plants. The machine-extracted jute and mesta ribbons were retted in polythene lined pond with varying retting conditions i.e. with and without microbial culture (CRIJAF SONA), vertical and horizontal steeping. The average duration of ribbons retting with microbial culture was 7-10 days against 13-15 days without culture. Average fibre recovery for jute was 6.4-6.9 % and for mesta it was 7.3% on green weight basis. Maximum fibre recovery was obtained from the ribbons extracted by the jute decorticator for both jute and mesta (Fig. 7.7). Fibre obtained from manual jute extractor exhibits 5% more strength than bast fibre extractor and 10% more strength than jute decorticator. Microbial culture mediated retting improved the fibre strength by 10-12% and 20-25% for jute and mesta, respectively. The average fibre fineness of 2.4 tex to 2.9 tex for jute and 2.4 tex to 3.2 tex for mesta were obtained with ribbon retting. (Source: JA 5.8. Contributors: R.K. Naik, B. Majumdar, S.P. Mazumdar and M.S. Behera)

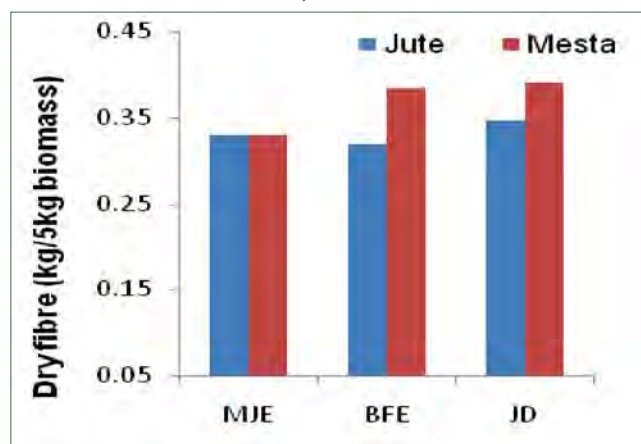


Fig. 7.7. Effect of crop harvest on recovery and strength of fibre (MJE-Manual Jute Extractor, Bfe-Bast Fibre Extractor, Jd-Jute Decorticator)

8. Jute and Allied Fibre Informatics

8.1. Mobile App for Farmers

ICAR-CRIJAF has developed an Android App named “Jute Agri” for dissemination of information about the present status of the sector, improved varieties, production and protection technologies and marketing of jute. This app can be downloaded from google play store with search word ‘ICAR-CRIJAF’ or ‘CRIJAF’. Present version of the app is 1.0 with size of 3.06 MB. This app is compatible with any smartphone having android version 4.4 or higher.

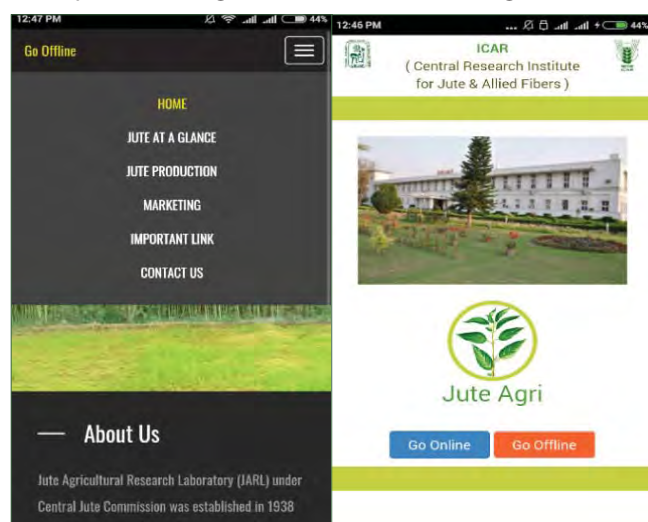


Fig. 8.1. Offline and online page of android App named “Jute Agri”

This app has both offline and online features (Fig. 8.1). Even farmers can access information without internet using offline features once they have downloaded and installed the app. All updated information of area, production, productivity, use of jute, diversified products and import-export scenario have been incorporated in the section ‘Jute at a glance’ section, while soil, climate, season, varieties, weed, nutrient, diseases and pest management technologies in ‘Jute production section’. Harvesting, retting, processing and storage of jute for fibre and seed production technologies have also been described under “jute production section”. Aspects related to marketing, MSP, fibre quality and grading along with diversified use of jute have been well organised in “marketing section”. Farmers can also browse the activities of related organizations through ‘important link’ section. For giving any feedback farmers can use email provided in ‘contact us’ section.

8.2. Climate change risk assessment for advisory services through Decision Support System (DSS)

Jute production often experiences the extreme climatic events during its 110-120 days growth period. A simple

drought index, standardized precipitation index (SPI) was used to assess the exposure of jute in dry and wet situation. Two month-SPI was computed for each of the major jute growing districts of West Bengal from the sum of monthly total rainfall of April and May using 100-year (1901-2000) monthly rainfall data (Source: IMD, Pune) (Fig. 8.2). April-May rainfall data were considered for computing SPI because these two months are the crop establishment period of jute that is sensitive to any climatic aberration, and the occurrence of drought during this period has negative consequences in crop growth and yield, which will be ultimately considered as a vulnerability factor for jute production.

Temporal and spatial variabilities of drought severity were identified in 12 major jute growing districts of West Bengal using 2-month SPI values by following drought severity classification of FAO (Rome) based on SPI, viz., moderately drought (SPI: -1.00 to -1.49), severely drought (-1.50 to -1.99), and extremely drought (<-2.0). Frequency distribution of the 100-year 2 month-SPI values revealed that the highest number of extremely drought and severely drought during April-May occurred in the district of Malda (13 times) and Birbhum (54 times), respectively. But, the highest number (10 times) of moderately drought occurred in Malda, Birbhum and North 24-Parganas. However, there was no drought occurrence during April-May in the districts of Cooch Behar and Jalpaiguri (Fig. 8.3). In general, on the basis of the total number of occurrence of drought during April-May, highest number of drought incidence were found in the district of Birbhum (76 times), followed by Malda (68), Bardhaman (63), Murshidabad (52), North Dinajpur (50), Hooghly and North 24-Parganas (47), Nadia (46), Howrah (39), South Dinajpur (28). (Source: JA 7.1. Contributors: D. Barman, A.K. Chakraborty, P. Satya, B.S. Gotyal, A.K. Singh, R. Saha, S.P. Mazumdar, Shamna A., S. Mitra, and Laxmi Sharma).

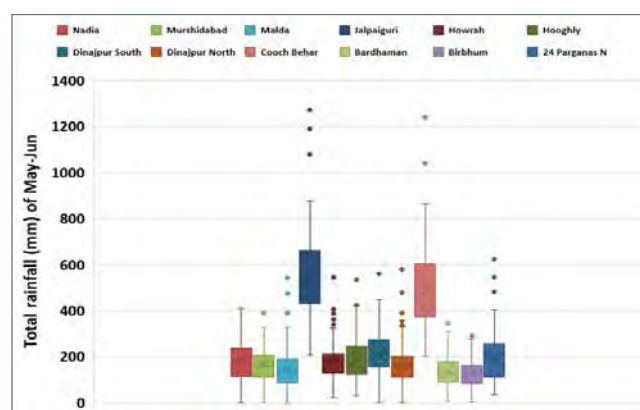


Fig. 8.2. Variability of total rainfall of the months of May-Jun during 100-year period (1901-2000) in the major jute growing districts of West Bengal

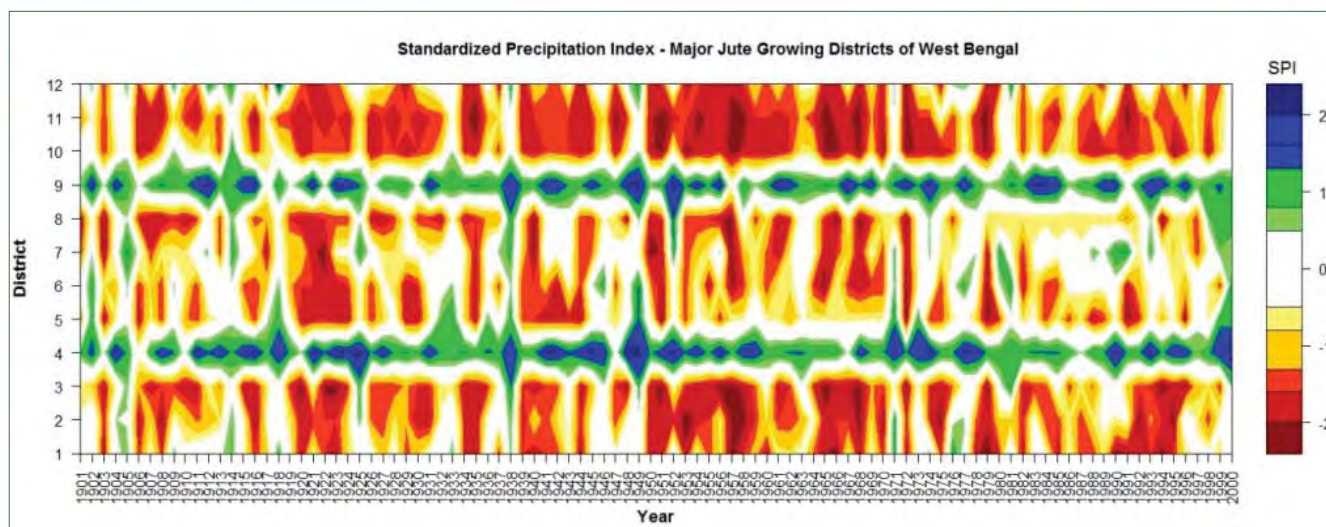


Fig. 8.3. Drought variability in major jute growing districts of West Bengal using 2-month SPI value of Apr-May in 100-year period (1901-2000)

8.3. Agrometeorological Database Management System (ADBMS)-cum Agroadvisory system

A web-based Agrometeorological Database Management System (ADBMS)-cum-Agroadvisory System has been developed for storing, updating, retrieving, and analysing the long-term temporal and spatial climatic data for agricultural advisory services to the farmers with an embedded agro-advisory module and its earlier proposed name JAFmet© has been changed as JuteMet© with a relevant logo for better understanding to common end users. JuteMet© has been developed in .NET environment scripting in C++/Java/html language. The web pages have been designed and configured with text, figures, maps, pictures, etc. for easy understanding of all types of end users including farmers.

The ADBMS-cum-Agroadvisory System contains different pages, viz. *Home Page*: It describes about the JuteMet© and its functioning and usefulness to the end users including farmers; *Target Area*: This section describes the targeted cultivation area of jute and allied fibre crops; *Agromet Observatory*: It shows the real picture of an observatory; *Location*: It contains the locations of agrometeorological observatories of CRIJAF and its four substations (Bamra, Budbud, Pratapgarh, and Sorbhog); *Instruments*: The functions along with a picture of a particular surface instrument installed at the observatory are given in this section, which can help for better understanding of climate data; *Climatic Normal*: The annual and seasonal (*kharif*, *rabi*, and *summer*) climatic normal of the weather parameters are presented in tabular format in this section for all the observatories, which gives idea about the

long term average climatic condition in the target areas; *Climate and Crop*: This section deals with the climatic requirement of jute and allied fibre crops for their growth and development; *Agroadvisory*: This section has two options such as *Dynamic Advise* for sending weather based contingency planning through registered e-mail IDs of the stakeholders, and *General Advise* for know-how of agronomic management and related operations; *Weekly Weather*: This section is for uploading current weekly weather condition; *ADMIN LOGIN*: Administrator will login here to add, edit, modify, and generate report of the climate data. (Source: JA 7.1. Contributors: D. Barman, A.K. Chakraborty, A.K. Singh and R. Saha).

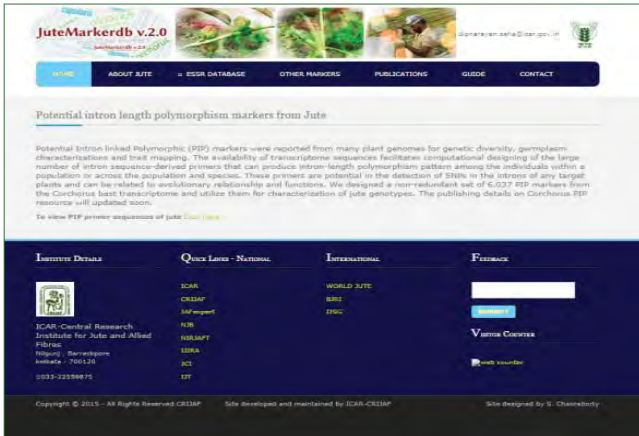
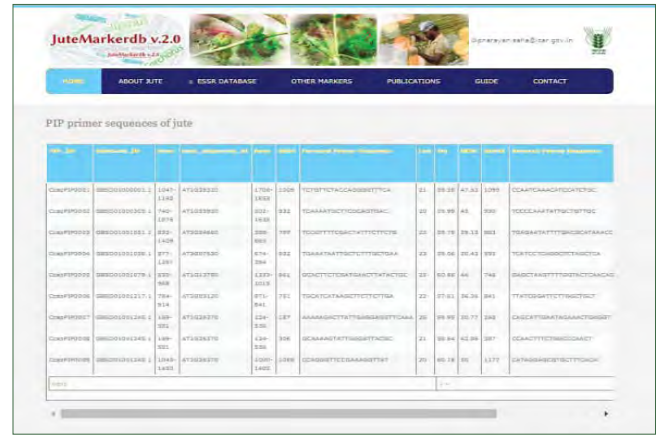
8.4. Up-gradation of JuteMarkerdb

A database on Simple Sequence Repeat (SSR) markers derived from the published jute unigene sequences have been developed and hosted. The database is named JuteMarkerdb and is available at <https://juteMarkerdb.icar.gov.in/index.aspx>. Using the Relational Database Management System (RDBMS) and Microsoft-based SQL server with ASP.NET v4.5 environment we incorporated 2079 SSR markers with detailed information related to each marker. The database makes use of SQL queries to provide users with the SSR primer data and other information through customized query mode and batch mode. The database is completely user-friendly and promises to help jute breeders, researchers and academicians to mine useful information and sequences of molecular markers for non-commercial research purpose.

With the advancement and availability of jute genome sequences, the database is under up gradation with renewed and enriched genomic resources. The upgraded

version of the JuteMarkerdb will consist of a BLASTn or BLASTn-alike tool to enable researchers to compare existing SSR marker binding sites on the three jute genomes and on the genome of a genetically close species *Theobroma cacao*. Work is also in progress to include other novel

molecular markers mined from the jute genome, such as Intron-Linked Polymorphic (ILP) markers, Transposable Element-derived markers, and cross-genome polymorphic SSR markers. (Source: CI-JBT 4.4. Contributors: D.N. Saha, S. Datta, P. Satya and A.K. Chakraborty)

PIP ID	Accession ID	Gene	Gene Chromosome	Gene Size	Forward Primer Sequence	Len (bp)	Reverse Primer Sequence	Len (bp)	Forward Primer Orientation
CIAPPIP001	SR020100001.1	1247-1342	AT5G39242	1704-1833	CTCTTCTACAGGATTTTCA	21	AGGGAAATAGTCTCTC	19	5' to 3'
CIAPPIP002	SR020100002.1	740-1018	AT5G39261	820-1036	TCAAAATCTCGGATGAC	20	ATGATATATGATGATG	20	3' to 5'
CIAPPIP003	SR020100003.1	830-1458	AT5G39265	898-1462	TGGTTTGGATCTCTCTC	23	AGATATATGATGATG	23	5' to 3'
CIAPPIP004	SR020100004.1	871-1391	AT5G39282	924-1394	TGAAATATCTCTCTCTCA	23	ATGATATATGATGATG	23	5' to 3'
CIAPPIP005	SR020100005.1	920-969	AT5G39281	1022-1029	GACTCTCTGATGATGATG	22	ATGATATATGATGATG	22	5' to 3'
CIAPPIP006	SR020100006.1	794-824	AT5G39282	876-941	TGATCTAGATCTCTCTCA	22	ATGATATATGATGATG	22	5' to 3'
CIAPPIP007	SR020100007.1	130-351	AT5G39276	124-326	AAGAGCTTATGAGATGATG	26	ATGATATATGATGATG	26	5' to 3'
CIAPPIP008	SR020100008.1	148-351	AT5G39276	134-326	SCAAATATGATGATGATG	21	ATGATATATGATGATG	21	5' to 3'
CIAPPIP009	SR020100009.1	1043-1463	AT5G39279	1000-1462	CGAGATGATGATGATG	20	ATGATATATGATGATG	20	5' to 3'

Fig. 8.5. Web pages of JuteMarkerdb

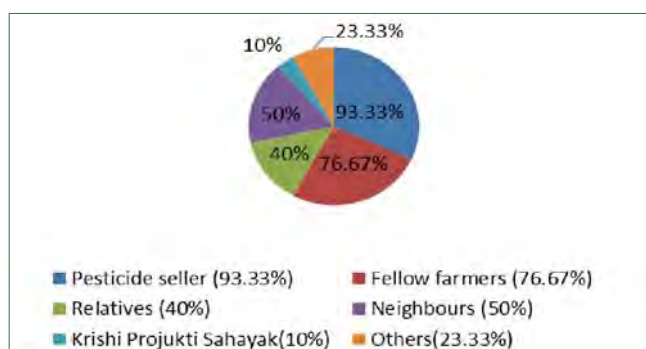
9. Technology Assessment and Transfer

9.1. Research

9.1.1. Assessing farmers' perception about plant protection practices in jute-based cropping system

A scale has been constructed to measure farmers' attitude towards plant protection practices based on Likert's method of summated rating. Reliability and validity of the scale has also been ascertained. The study was conducted, on a pilot basis, in predominantly jute-rice-mustard cropping sequences of Durgapur village of North 24 Parganas.

All the respondents (n=30) were in the category of high level of positive attitude towards plant protection practices and were aware of hazards of pesticides use, banned / restricted pesticides for agricultural use. Regarding use of pesticides, it was observed that pesticide dealer/seller (93.33 %) are the major sources of information (Figure 1).



Sources of information regarding use of pesticides

Majority of the respondents (95%) owned up to 0.5 ha land and had an experience of pesticide application of more than 20 years. Selection of particular pesticide by the respondents was determined by the factors like fast knock-down effect of the insecticide followed by their past experience. One third of the respondents (33.33%) followed safe storage of pesticides, proper disposal of empty bottles of pesticides and washing of hands after pesticides application. However, most of them (90%) ignored the use of face mask and hand gloves. In case of insect attack of field crops, different combinations of insecticides are applied by the respondents. Around one third of them applied higher (25–30%) than recommended dose of plant protection chemicals. In jute-based cropping system expenditure for pesticides was maximum in rice (Rs. 8,000/ha) followed by jute (Rs. 5,500/ha) and mustard/lentil (Rs. 2,500/ha).

(Source: JEXA 5.7; Contributors: S. Kumar, Shamna A., M.L. Roy and B.S. Gotyal)

9.1.2. Assessment of farmers' perception on impact of climate variability in jute-based cropping system

Jute crop is often affected by climate variability, in terms of unusual heavy or low rainfall, prolonged drought, sudden rise or fall in temperature which causes crop damage, premature flowering, insect pest and weed infestation etc. These incidences ultimately lead to decline in fibre production both in terms of quantity and quality.

A study has been conducted taking a random sample of 50 farmers from Kumra and Babbur villages of North

Table 9.1. : Effects of climate variability in jute-based cropping system as perceived by the farmers (n=50)

Perceived effects	MWS*
Heavy rainfall during harvesting has been causing huge yield losses	2.16
Jute is being affected due to prolonged drought and incidences of heavy rainfall during its early growth stages	2.04
Insect and disease infestation has become virulent and high due to prolonged hot and humid weather	1.94
Heavy fog in day time during winter season has increased insect and disease infestation in potato and mustard	1.90
Desirable soil moisture has become unavailable during sowing time of crops	1.84
Soils have become drier and hard due to increased soil temperature	1.70
Incidences of flower drops have been increased in lentil and pea due to high winter temperature and production suffers due to reduction in winter days	1.64
Water availability during retting period has become scarce	1.60
Water holding capacity of soil has been reduced	1.52
Duration of traditional cropping seasons has been distorted	1.50

*Mean weighted score

24 Parganas district to identify the effects of climate variability on jute-based cropping system as perceived by the farmers. The respondent farmers had a farming experience ranging from 10-30 years. Jute-based cropping patterns practised by the farmers were reported as jute-rice-potato, jute-rice-lentil/gram/pea and jute-rice-mustard. Majority of the farmers (90%) have perceived that climatic components and its occurrences have varied from last 10-15 years. Table 9.1. depicts the effects of climate variability in jute based cropping system as perceived by the respondent farmers.

The farmers have adopted the measures like use of organic manure and resistant/tolerant varieties to cope up with adverse effect of moisture stress and insect pest infestation due to unexpected variability in weather parameter. (Source: JEXA 5.8; Contributors: M.L. Roy, S.K. Jha, S. Sarkar, A.K. Ghorai, A.K. Singh, S. Satpathy & A. Chakraborty)

9.2. Frontline Demonstrations (FLDs)

FLDs on latest high yielding varieties and other improved production technologies of jute were organized in villages of Nadia, North 24 Parganas, Murshidabad and Hooghly districts of West Bengal through the extension centres of the Institute under National Food Security Mission (NFSM) - Commercial Crops (Jute). Altogether, 345 demonstrations covering 87.75 ha on jute were conducted in the above districts. Other than above extension centres, FLDs were also conducted at Bolagarh, Hanskhali, Badshahpur, Mirzapur, Nawada & Golghat. Altogether, 620 demonstrations were conducted in 162.75 ha area.

Table 9.2.: Area covered under each component of frontline demonstration programme

Name of Village	No. of farmers	Area (ha) under different technologies				Retting through CRIJAF SONA
		Line sowing	Mechanical weed control	Total area (ha)		
Kumra (North 24 Parganas)	82	9.43	12.57	22.00	CRIJAF SONA powder were given to all the centres for full area	
Madhusudanpur (Hooghly)	77	10.50	12.25	22.75		
Brahmapur (Nadia)	102	10.50	10.50	21.00		
Sargachchi (Murshidabad)	84	3.50	18.50	22.00		
Total	345	33.93	53.82	87.75		

9.2.1. Varietal evaluation

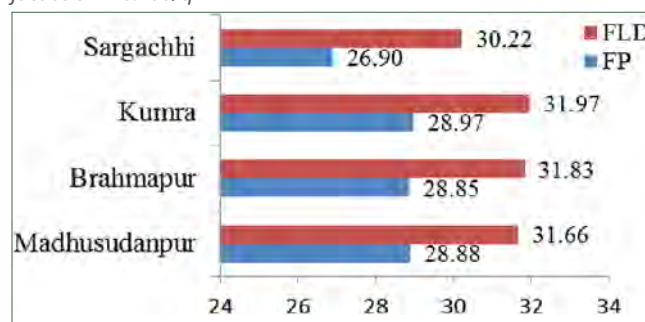
The *tossa* jute variety i.e. JRO 204 (*Suren*) was demonstrated for assessing yield performance in the farmer's field in 87.75 ha area in four extension centres

located at Nadia, North-24 Parganas, Hooghly and Murshidabad. Sowing was done under irrigated condition in the month of April-May. The fibre yield of jute across the locations was 31.42 q/ha which gave a net return of Rs. 60,832 against Rs. 68,548 cost of cultivation while local check (JRO-524) yielded 28.40 q/ha only giving a net return of Rs. 34,581.

Table 9.3. : Economic evaluation of improved jute variety at different locations

Variety	FY (q/ha)	TCC (Rs./ha)	GR (Rs./ha)	NR (Rs./ha)	B:C
JRO 204	31.42	68548	129380	60832	1.89
Local Check	28.40	77315	111896	34581	1.45

FY-Fibre Yield, TCC-Total Cost of Cultivation, GR-Gross Return, NR-Net Return, B:C-Benefit:Cost Ratio, Price of jute fibre - Rs.3,300/q ; jute stick - Rs.400/q



Yield of JRO 204 in different locations under FLD and farmers' practices

9.2.2. Weed management

In order to reduce the cost of weeding and increase profitability of jute cultivation, the demonstrations of mechanical weed management through CRIJAF Nail Weeder were laid in the farmers' field in 53.82 ha. Demonstration on weed management resulted in 2.35-3.24 q/ha more fibre yield over farmers' practice (27.90 – 28.97 q/ha). Saving on cost of human labour was in the range of Rs.8,094 -14,304/ha.

Table 9.4. : Economics of jute cultivation (Rs./ha) through weed management

Location/Particulars	IC (Rs./ha)	HLC (Rs./ha)	TCC (Rs./ha)	FY (q/ha)	GR (Rs./ha)	NR (Rs./ha)	B:C
Madhusudanpur							
NW	16124	43745	59869	31.83	131776	71907	2.20
FP	19222	58049	77271	28.88	113788	36517	1.47

Location/ Particulars	IC (Rs./ ha)	HLC (Rs./ ha)	TCC (Rs./ ha)	FY (q/ ha)	GR (Rs./ ha)	NR (Rs./ /h)	B:C
Brahmapur							
NW	16196	45727	61923	32.09	132857	70934	2.15
FP	18880	57016	75896	28.85	113675	37779	1.50
Kumra							
NW	16135	44007	60142	32.15	133103	72961	2.21
FP	18805	56792	75597	28.97	114143	38546	1.51
Sargachhi							
NW	15832	52975	68807	30.25	125237	56430	1.82
FP	19526	61069	80595	27.90	105884	24941	1.31

IC- Input Cost, HLC-Human Labour Cost, TCC-Total Cost of Cultivation, FY-Fibre Yield, GR-Gross Return, NR-Net Return, B:C-Benefit Cost Ratio, FP-Farmer's Practice; Price of jute fibre - Rs.3,300/q; jute stick - Rs.400/q.

9.2.3. Line sowing

Demonstrations on manual 4-row seed drill were conducted in an area of 33.93 ha in three districts. This technology improved the fibre yield by 2.28-2.81 q/ha. It also saved the cost of human labour in jute cultivation to the extent of Rs.5,258-5,998/ha over farmer's practice. The effect of this intervention was maximum at Brahmapur (Rs. 5,998/ha).



Demonstration of CRIJAF- Nail weeder at farmers' field



Demonstration of CRIJAF- Multi-row seed drill at farmers' field

Table 9.5. : Economics of jute cultivation (Rs./ha) under line sowing through multi row seed drill

Location/ Particulars	IC (Rs/ha)	HLC (Rs/ha)	TCC (Rs/ha)	FY (q/ha)	GR (Rs/ha)	NR (Rs/ha)	B:C
Madhusudanpur							
MRS	16524	52791	69315	31.48	130334	61019	1.88
FP	19222	58049	77271	28.88	113788	36517	1.47
Brahmapur							
MRS	16196	51018	67214	31.56	130658	63444	1.94
FP	18880	57016	75896	28.85	113670	37774	1.50
Kumra							
MRS	16135	50824	66959	31.78	131569	64610	1.96
FP	18805	56792	75597	28.97	114142	38545	1.51
Sargachhi							
MRS	15832	54969	70801	30.18	124954	54153	1.76
FP	19526	61069	80595	27.90	105884	24941	1.31

IC- Input Cost, HLC-Human Labour Cost, TCC-Total Cost of Cultivation, FY-Fibre Yield, GR-Gross Return, NR-Net Return, B:C-Benefit Cost Ratio, FP-Farmer's Practice; Price of jute fibre - Rs.3,300/q; jute stick - Rs.400/q

9.2.4. Improved retting through CRIJAF SONA

In comparison to conventional method of jute retting, use of CRIJAF SONA (23 kg for 1 ha harvest) during retting reduced the retting period by 6-9 days at all the centres. At all the locations, the improvement in quality (1-2 grade) and fibre colour *i.e.* yellowish to bright golden was also observed. Jute growers could earn additional income of Rs. 250-400/q due to the higher price for the improved quality of fibre. This method also reduces the fibre: water ratio.

Table 9.6. : Qualitative evaluation of improved retting through CRIJAF SONA

Extension Centre	Fibre Quality		Retting Duration (days)		Additional Income (Rs./q)
	Im-proved	Conven-tional	Im-proved	Conven-tional	
Madhusudanpur (Hooghly)	TD 3-4	TD 5-6	11-15	18-21	Rs. 400/q
Bramhapur (Nadia)	TD 3-4	TD 5-6	11-13	18-21	Rs. 400/q
Sargachhi (Murshidabad)	TD 4-5	TD 5-6	17-20	26-28	Rs. 250/q
Kumra (North 24-Parganas)	TD 3-4	TD 5-6	10-12	16-18	Rs. 350/q

9.2.5. Impact of FLD on production and economics

Through the FLD programmes, the yield increase over the conventional method was recorded to be 10-12%. Maximum yield improvement was recorded in Murshidabad (12.32%) followed by Nadia (11.23%), North 24 Parganas (10.68%) and Hooghly (10.21%). It was also observed that demonstrations of CRIJAF Nail Weeder and Multi-row Seed Drill have reduced the cost of deploying manual labour over the manual weeding upto 12-17%. Highest reduction in cost of manual labour (16.85%) was observed in Hooghly followed by North 24 Parganas (16.51%), Nadia (15.16%) and Murshidabad (11.56%). The overall gain in income of the farmers were calculated to be about Rs 30,000/- ha over the traditional method. Murshidabad farmers had the maximum net return (Rs 30,301/ha) followed by farmers of North 24 Parganas (Rs 30,241/ha), Hooghly (Rs 29,946/ha) and Nadia (Rs 29,415/ha).

9.2.6. Farmers' feedback

Farmers were satisfied with the performance of technological interventions implemented by ICAR-CRIJAF at their field. Improved variety of jute (cv. JRO 204) yielded more fibre in comparison to local variety cultivated

by farmers. More than 95% farmers stated that line sowing through Multi Row Seed Drill (MRSD) saved seed whereas around 90.67% farmers told that it facilitated in intercultural operation. More than 70% revealed that during the harvesting operation, line sowing helped very much. The other benefits of line sowing were less infestation of insect, pest and diseases (64%) and healthy crop canopy (78%). In case of weed management, farmers told that nail weeder reduced labour cost (87.33%), helped in line making (80.67%), facilitated soil erosion (76.67%), made less dependent on herbicides (71.33%) and helped in soil moisture conservation (67.33%). Similarly, the farmers perceived that application of CRIJAF SONA to be quite beneficial, simple and compatible to their production system. This technology has reduced the retting period, improved the fibre grade and helped in fetching higher selling price of fibre as reported by 91.33%, 86% and 79.33% of the farmers, respectively. All these technologies helped in reducing the cost of cultivation, increasing the fibre yield and quality and net return in comparison to their traditional practices. (Source: JEXA 4.7; Contributors: S.K.Jha, Shailesh Kumar, Shamna A., M.L. Roy and R.K. Naik)



Progressive farmer awarded by Director, ICAR CRIJAF



Research-Extension-Farmer interaction at Madhusudanpur village

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

Jute-ICARE project initiated in the year 2015 by National Jute Board (NJB) in technical collaboration with ICAR-CRIJAF and Jute Corporation of India (JCI) in four jute growing blocks of West Bengal and Assam covering 12331 ha area and 21548 farmers. The objective of the project was to support the small and marginal jute growers with certified seed, mechanization in sowing and weed control and to accelerate retting by using microbial consortium so that the jute growers can get good quality jute fibre and fetch higher price for their produce. The four main components of the project are : a) use of certified seed (cv. JRO 204), b) line sowing using CRIJAF multi-row seed drill, c) mechanical weeding by using CRIJAF Nail weeder and CRIJAF Single wheel jute weeder and d) improved retting by using microbial consortium (CRIJAF SONA).

From the encouraging result of Jute-ICARE since its beginning, during 2017-18, the project was implemented in 48 blocks of jute growing states like West Bengal, Assam, Bihar, Odisha, Meghalaya and Andhra Pradesh covering 70628 ha area and 1,02,372 jute growers. About 500 MT of certified seed of jute, 500 nos each of CRIJAF multi-row seed drill and CRIJAF Single wheel jute weeder and 206 tonnes of CRIJAF SONA were distributed among the jute growers during 2017-18. ICAR-CRIJAF has actively participated in the Jute-ICARE project to provide technical support to the farming community in terms of training and demonstrations for use of these CRIJAF technologies in the project area. ICAR-CRIJAF has conducted four in-house trainings for master trainers, so that they can disseminate these technologies fruitfully to the farming communities. Besides these four in-house trainings, scientists and technical persons of ICAR-CRIJAF have conducted 200 on-farm training-cum-demonstrations in all the jute growing areas under Jute-ICARE for the farming communities in collaboration with (NJB & JCI). ICAR-CRIJAF/ National Jute Board and Jute corporator of India also helped in making the leaflets, printed materials about the technologies distributed among the farming community. The feedback data received from the jute growers was very encouraging. The yield of jute fibre was raised from 24 q/ha to 30 q/ha through use of certified jute seeds, line sowing, weed control by mechanical weeder and improved retting by CRIJAF SONA. Quality of jute fibre was improved from grade 5 to grade 4 and grade 3. (Source: Jute ICARE; Contributors: B. Majumdar, S. Sarkar, S. K. Jha, R. K. Naik, A.R. Saha, R. Saha and S. Satpathy)



Scientists of ICAR-CRIJAF participating in the on-farm training cum demonstration programmes



Use of multi-row seed drill for line sowing by farmers under the guidance of scientists



Improved retting demonstration by CRIJAF SONA and resultant golden fibre

9.4. Mera Gaon Mera Gaurav (MGMG):

Under MGMG programme ICAR-CRIJAF adopted 55 villages of nearby districts like North 24 Parganas, Nadia, Hooghly and Paschim Midnapore. Scientists of the institute are frequently visiting the adopted villages and interacted with farmers on different agricultural technologies and various beneficial programmes of Government of India like *Pradhan Mantri Fasal Bima Yojana (PMFBY)*, *Pradhan Mantri Krishi Sinchai Yojana (PMKSY)*, *Swachh Bharat Abhiyan*, Soil Health Card etc. to make the farmers aware of these programmes. During 2017-18 three MGMG programmes were conducted at adopted villages of Goaldah in Swarup

Nagar Block of North 24 Parganas, Madhusadanpur in Singur block of Hooghly district and Geedah in Barrackpore II block of North 24 Parganas. About 500 hundred farmers were benefitted from such activities.

9.5. Other extension activities

The extension section also organizes scientist farmer's interaction, exposure visit, awareness camps to solve the problems of jute agriculture faced by the farmers. Besides, the technologies developed by the Institute were also showcased in different exhibitions and agri-fairs (Table 9.7.)

Table 9.7. : Participation of the Institute in different agri-fairs/exhibitions

Agri-fair	Date	Location	No. of visitors
32 nd Annual Titu Meer Fair	17-19 November, 2017	Athghara, North 24 Pgs	200
Exhibition at 82 nd Annual convention of the Indian Society of Soil Science	11-14 December, 2017	Amity University, Kolkata	300
Bajarapore Gramin Pradarshani-O-Mela	14-17 December, 2017	Alukaranbarh, Purba Mednipur	500
Sundarban Krishi Mela-o-Lokosanskriti Utsav	20-29 December, 2017	Kultali, Sundarban, South 24 Parganas	500
Krishi Mela	13- 19 April, 2017	Piprakothei, Motihari	300
Exhibition at 1 st International Extension Congress	1-3 February, 2018	ICAR-CIWA, Bhubaneswar	250
Regional Agriculture Fair for Eastern Region -2018	24-26 February, 2018	BAU, Sabour, Bhagalpur	500
Krishi Unnati Mela-2018	16-18 March, 2018	ICAR-IARI, New Delhi	500



Exhibition at 82nd Annual convention of the Indian Society of Soil Science, Amity University, Kolkata



Dr. T. Mohapatra, DG (ICAR) & Secy. DARE visiting ICAR-CRIJAF stall during exhibition at International Extn. Congress, ICAR-CIWA, Bhubaneswar

10. AINP on Jute and Allied Fibres (AINPJAF)

All India Network Project on Jute and Allied Fibres functions through 9 SAUs and 4 ICAR Institute based centres across 8 JAF growing states with its headquarter at ICAR-CRIJAF, Barrackpore, Kolkata. A total of 68 projects comprising of 271 trials were conducted on jute, mesta, sunnhemp, ramie, flax and sisal during 2017-18 under crop improvement, crop production and crop protection programme.

10.1. Crop Improvement

Under crop improvement programme, thirty-five projects comprising of 155 trials were conducted on jute and allied fibre crops in different centres of All India Network Project on Jute and Allied Fibres.

10.1.1. Release and notification of JAF varieties

Four varieties of jute and allied fibre crops namely, NJ 7010 (Rani) of *tossa* jute, BCCC 1 (Shweta) of white jute, JBMP 3 (Priya) of kenaf and JRR 17 (Ayush) of roselle were recommended for release and notification by the Central Sub-Committee on Crop Standard, Notification and Release of Varieties vide Gazette notification no. S.O. 1379(E), dated, 27.03.2018.

10.1.2. Identification of JAF varieties for release

One variety each in kenaf (JBMP-4), roselle (JRHS-1) and sunnhemp (SUIN-3) have been identified for central release during the 13th Annual Workshop of AINPJAF held at BCKV, Kalyani during 10-11th March, 2018.

10.1.3. Evaluation of jute germplasm

Fifty accessions of *Corchorus capsularis* were screened for fibre yield and yield components in five locations. An overall mean of 9.8 ± 1.3 g/plant was recorded for fibre yield over five locations with a range of 7.1 g/plant (CIN-114) to 12.3 g/plant (CIN-93). Three genotypes outperformed better check JRC-517 (12.0 g/plant) for fibre yield. Among the five locations, Coochbehar centre recorded highest mean performance for fibre yield (19.26 ± 4.4 g/plant) and the entry CIN-89 recorded highest fibre yield of 26.7 g/plant in this location.

Fifty accessions of *Corchorus olitorius* were screened for fibre yield, plant height, basal diameter and green weight in five locations. Average fibre yield over the locations was recorded to be 9.7 ± 1.1 g/plant with a range of 7.2-12.7 g/plant. Four accessions outperformed best check JRO-204 (11.4 g/plant) for fibre yield. Among the five centres, Coochbehar centre recorded highest mean fibre yield of 15.6 ± 3.4 g/plant and the accession OIN-112 recorded highest fibre yield of 22.4 g/plant in this centre.

10.1.4. Evaluation of mesta germplasm

Fifty accessions of *Hibiscus sabdariffa* were evaluated for fibre yield and yield related traits in two locations. An overall mean of 11.3 ± 2.6 g/plant was recorded for fibre yield over two locations with a range of 6.5 g/plant (RIN-16) to 17.7 g/plant (RIN-19). Three genotypes outperformed better check AMV-5 (15.9 g/plant) for fibre yield. Among the two locations, Katihar centre recorded highest mean performance for fibre yield (17.2 ± 4.6 g/plant) and the entry RIN-3 recorded highest fibre yield of 29.3 g/plant in this location.

Fifty accessions of *Hibiscus cannabinus* were tested in Aduthurai centre for fibre yield and yield related traits. Fibre yield/plant ranged from 3.0 (KIN-107 & KIN-165) to 11.5 g (KIN-100) with a mean of 6.4 ± 2.2 g/plant. Eight accessions exceeded better check AMC-108 (8.9 g/plant) for fibre yield.

10.1.5. National Hybridization Programme (NHP)

The F_7 , F_2 and F_1 progenies of white jute of different cross combinations were evaluated in Kalyani, Kendrapara, Katihar, Bahraich, Coochbehar and Nagaon centre and promising line have been identified and selected for further evaluation.

In *tossa* jute, F_6 , F_4 , F_2 and F_1 progenies of different cross combinations were evaluated along with two check varieties (JRO 524 and JRO 204) in Kalyani, Rahuri, Katihar, Nagaon and Kendrapara. Promising cross combinations at different centres have been identified for further evaluation.

A total of 15 F_7 progenies of roselle were evaluated at Amadalavalasa and Aduthurai centres. Promising cross combinations have been selected for further station trials.

10.1.6. Yield evaluation trials

Tossa Jute (*C. olitorius*)

JET: Test entry JROBA-3 turned out to be the best performing entry and recorded 35.09 q/ha of fibre yield followed by NJ-7082 (33.35 q/ha) and JROP-2 (31.79 q/ha) which recorded significantly high fibre yield than national check JRO 524 (29.41 q/ha).

AVT-I: Test entry JROCS-6 was found to be the best performer with 29.96 q/ha followed by check variety JRO 204 (29.92 q/ha), NOJ 27-26 (29.40 q/ha) and JRO 15-22 (29.08 q/ha).

AVT-II: Analysis on mean over location and year mean (grand mean) suggested that test entry JROMU-1 (33.64

q/ha) was the highest fibre yielder followed by NJ-7055 (33.62 q/ha) were on par with best check JRO 8432 (32.49 q/ha).

White jute (*C. capsularis*)

JET: Check variety JRC 517 (31.56 q/ha) recorded high fibre yield followed by JRCJ-12 (31.34 q/ha), BRJC-1 (31.20 q/ha), JRC 698 (31.12 q/ha) and NCJ-33-9 (31.06 q/ha).

AVT-I: Test entry JRCJ-10 (29.89 q/ha) recorded high fibre yield followed by JRCJ-11 (29.73 q/ha), JRCPS-2 (29.42 q/ha) and best check JRC 517 (28.70 q/ha).

AVT-II: Analysis of mean over location and year mean suggested that check variety JRC 517 (32.17 q/ha) recorded highest fibre yield followed by JRCJ-8 (31.53 q/ha) and JRCJ-9 (31.52 q/ha).

Kenaf (*H. cannabinus*)

JET: Test entry JRK-16-5 turned out to be the best performing entry and recorded 31.51 q/ha of fibre yield followed by best check AMC 108 (30.28 q/ha), JRK-16-1 (30.15 q/ha) and JRK-16-3 (29.55 q/ha).

AVT-I: National check AMC 108 was best performer with 28.29 q/ha fibre yield followed JRK-2015-2 (27.07 q/ha), JRHC-4 (26.78 q/ha) and JRK-2015-1 (26.47 q/ha).

AVT-II: Analysis on mean over location and year mean suggested that test entry JRHC-3 (28.66 q/ha) was the highest fibre yielder followed by national check AMC 108 (28.13 q/ha) followed by HC 583 (26.26 q/ha), JRK-2014-1 (26.11 q/ha), and JRK-2014-1 (26.08 q/ha).

Roselle (*H. sabdariffa*)

JET: Test entry AHS-310 turned out to be the best performing entry and recorded 29.63 q/ha of fibre yield followed by AHS-309 (28.70 q/ha) and AHS-307 (28.59 q/ha).

AVT-I: National check AMV 5 was best performer with 27.24 q/ha fibre yield followed JRHS-5 (26.76 q/ha), AHS-286 (26.75 q/ha), AHS-298 (26.61 q/ha) and AHS-303 (26.44 q/ha).

AVT-II: Analysis on mean over location and year mean suggested that test entries JRHS-4 (28.25 q/ha) and JRHS-3 (27.88 q/ha) recorded significantly high fibre yield than best check HS 4288 (26.71 q/ha).

Sunnhemp (*C. juncea*)

JET: Check variety SH 4 turned out to be the best performing entry and recorded 12.17 q/ha of fibre yield followed by SUIN 53 (11.68 q/ha), SUNC-6 (11.59 q/ha) and SUNC-4 (11.17 q/ha).

AVT-II: Analysis on mean over location and year mean suggested that none of the test entries were superior to

best check varieties SH 4 (7.46 q/ha) and SUIN 053 (7.42 q/ha) for fibre yield.

Ramie (*B. nivea*)

JET: None of the test entries performed better than check varieties R-67-34 (8.25 q/ha/yr) and R-1411 (6.12 q/hq/yr.).

Flax (*L. usitatissimum*)

JET: None of the test entries performed better than check variety JRF 2.

AVT-I: Test entries JRF-14 (143.0 q/ha) and JRF-12 (140.1 q/ha) performed better than check variety JRF 2 (138.0 q/ha) for green biomass yield.

AVT-II: Considering mean performance over locations none of the test entries performed better than the check variety JRF 2 for plant height (105 cm) and green biomass yield (165.7 q/ha).

Special trait trials

H. sabdariffa calyx yield

JET: Test entry AHC-2 recorded highest calyx yield of 10.46 q/ha followed by AHC-1 (9.82 q/ha), HSLC-1 (9.68 q/ha), HSLC-2 (6.38 q/ha).

H. sabdariffa leaf yield

JET: Test entry, AHLV-2 recorded highest leaf yield of 330.54 q/ha followed by HSLV-1 (316.62 q/ha), AHLV-1 (313.92 q/ha) and HSLV-2 (305.88 q/ha).

C. olitorius leaf yield

JET: Check variety JRO 204 recorded highest leaf yield of 176.0 q/ha followed by COL-3 (168.9 q/ha), JROV-3 (161.7 q/ha) and JRO 524 (144.0 q/ha).

C. olitorius biomass yield

AVT-I: Test entry JROB-2 was found to be the best performer with 643.02 q/ha followed by JROB-3 (606.99 q/ha), COB-3 (605.64 q/ha), JROB-1 (571.42 q/ha) recorded high biomass yield.

10.2. Crop Production

During 2017-18, 23 projects comprising of 76 trials were conducted in jute and allied fibre crops at different AINPJAF centers under crop production programme.

The test entry NJ 7050 recorded significantly higher fibre yield compared to both the check varieties JRO 524 and JRO 8432 at Kalyani, West Bengal and over check variety JRO 8432 only at Kendrapara, Odisha, respectively. Fibre

yield of jute increased significantly up to the fertilizer dose of 60:13:25 kg NPK/ha at Kendrapara, Odisha; up to fertilizer dose of 80:17.5:33.3 kg/ha at Katihar, Bihar and up to fertilizer dose of 100:21.8:41.7 kg/ha at Kalyani, West Bengal.

At Bahraich, application of fertilizer on ST-TY basis, in presence and absence of organic manure achieved the targeted yield (3.2 t/ha) of jute. Similarly, ST-TY based fertilizer application achieved the target yield of rice also. At Katihar, ST-TY based fertilizer application in presence or absence of organic manure could achieve the target yield of jute (3.2 t/ha) with (-) 2.5% and (+) 4.8% yield deviation, respectively. At Aduthurai, application of fertilizer on ST-TY basis in presence or absence of organic manure could not achieve the targeted yield of mesta (2.8 t/ha). In acid soils of Nagaon, application of fertilizer (100% NPK on ST-TY) could not achieve the targeted yield (3.5 t/ha) of jute. Incorporation of FYM along with inorganic fertilizer (100% NPK on ST-TY) achieved the targeted yield of mesta (3.5 t/ha) with (-) 5.26% yield deviation. At Amadalavalasa, application of fertilizer (100% NPK on ST-TY) along with organic manure in presence or absence of lime achieved the targeted yield of mesta.

Application of pretilachlor 50 EC 900g/ha with one hand weeding effectively reduced the weeds biomass effectively and recorded the highest fibre yield 40.69 and 33.10 q/ha at Kalyani and Nagaon, respectively. Application of butachlor 1.5 kg/ha with one hand weeding effectively reduced the weeds biomass and recorded about 7 q/ha higher fibre yield and net return compared to unweeded control at Coochbehar. Two hand weeding recorded the higher fibre yield, however was at par with mechanical weeding (Nail weeder twice + one hand weeding) at Kendrapara and Katihar centres. Application of pretilachlor 50 EC @ 900 g/ha with one hand weeding recorded the highest mesta fibre yield (21.58 q/ha and 21.15 q/ha) with weed control of (94 and 97%) at Amadalavalasa and Aduthurai, respectively. Mesta+groundnut intercropping system had little suppressive effect on weeds but recorded higher mesta fibre yield (19.24 q/ha) and mesta equivalent yield (30.5 q/ha) at Rahuri.

Among 16 weed species recorded in experimental farm as well as in different blocks in Kendrapara region, *Echinochloa colonum* was the dominant weed species (density-57.3-133/m² and IVI- 67.9-97.6%). Among eight weed species recorded in Mathabhanga blocks (Coochbehar), *Phyllanthus niruri* was the dominant weeds. While in Bahraich *Cyperus rotundus* was the dominant weed species with density of 52.7-101 /m² and IVI (91.5 -111.6 %) of in different surveyed blocks. In Nagaon region, out of 18 weed species, *Cynodon dactylon* grass weed was the dominant weed (density 13.7/m² and IVI-31%) experimental farm and Bajaigaon block while, *Mimosa*

pubica was dominant in farmers field of Samugohi block of Nagaon. At Kalyani among ten weed species recorded *Cyperus rotundus* was the dominant weed (density 65.3 -86.6 /m² and IVI – 57-74.3%) in the experimental farm as well as in farmers' fields of all the surveyed blocks of south Bengal.

In mesta vegetable intercrop, among all weed species weed *Amaranthus viridis* was dominant in all blocks of Aduthurai while, *Cynodon dactylon* among was the dominant in grass weed in all surveyed blocks of Aduthurai. At Amadalavalasa, *Digitaria Sanguinalis* was the dominant weed (density-30.0/m² and IVI -39.8%), in experimental farm, Jalmuru and Amdavalasa block. Among broad leaved weed *Celosia argentic* and *Phyllanthus niruri* were the dominant weed species in all blocks of Amadalavalasa.

Maximum system rice equivalent yield (169.76 q/ha) and net return (Rs. 131337/ha) and B:C ratio (2.37) was recorded with when brinjal was grown as component crop on reinforced soil columns in transplanted rice fields in 8:1 row ratio system followed by rice + brinjal (4:1 row ratio) system at Coochbehar, West Bengal and is recommended for the region.

Application of FYM @ 5 t/ha recorded significantly higher seed yield (14.25 q/ha) of jute over control (no FYM) while the seed yield and yield attributing characters of jute increased significantly with increase in fertilizer dose upto 60: 26: 50 kg NPK/ha at Rahuri, Maharashtra. Among the fertilizer treatments, the 80: 17.5: 33.3 kg NPK/ha dose recorded maximum net return (Rs. 99654/ha) and B:C ratio (2.7) at Rahuri.

The organic carbon (SOC) contents are higher in Morigaon district (range: 1.21-1.31 %) as compared to Nagaon district (range: 0.94-1.14 %) of Assam. Both the districts of North Bengal belonged to low SOC category though the SOC content of the soils of Cooch Behar district is significantly high (0.67-0.69%) as compared to that in Alipurduar district (0.23-0.43%). The bulk SOC content ranged between 0.35 to 0.81 % in Bahraich district, U.P 0.54-0.93 % in Jalgaon district, Maharastra and 0.52-0.67 % in Kendrapara district, Odisha. In general, soils from Rahuri had better labile C pools status than that of Bahraich and Kendrapara.

Fibre yield of roselle entries JRHS 1 and AHS 255 were significantly higher over test entry HS 4288 at Kendrapara, Odisha. Test entry JRHS 1 recorded significantly higher fibre yield over the other test entries AHS 255 and JRHS 2 as well as both the check varieties at Aduthurai, Tamil Nadu. Roselle entry AHS 255 recorded significantly higher fibre yield over other test genotypes and check varieties at Amadalavalasa, Andhra Pradesh. Maximum fibre yield was recorded up to fertilizer dose of 60:13:25 kg NPK/ha with 80: 17.5: 33.3 kg NPK/ha at Kendrapara, Odisha and

Aduthurai, Tamil Nadu while fibre yield of roselle increased significantly up to fertilizer dose of 60:13:25 kg NPK/ha at Amadalavalasa, Andhra Pradesh.

The fibre yield of kenaf entry JRK 2013-2 recorded significantly higher fibre yield than that of both the check varieties HC 583 and AMC 108 at Aduthurai, Tamil Nadu and Amadalavalasa, Andhra Pradesh and only over check variety AMC 108 at Kendrapara, Odisha. Fibre yield of kenaf increased significantly up to fertilizer dose of 60: 13.: 25 kg NPK/ha (F_3) at Kendrapara, Odisha, up to 80:17.5:33.3 kg NPK/ha at Aduthurai, Tamil Nadu and at Amadalavalasa, Andhra Pradesh.

At Amadalavalasa, Andhra Pradesh, maximum seed yield of mesta was recorded with sowing of mesta on 1st July, with moderate spacing of 45 cm x 10 cm and topping at 45 DAS.

At Bahraich, Uttar Pradesh, intercropping of mesta with rice in 3:4 row ratio recorded significantly higher system mesta equivalent yield (MEY) (36.35 q/ha) over other intercropping systems followed by mesta + groundnut system (31.94 q/ha). At Amadalavalasa, Andhra Pradesh, intercropping of mesta with maize (2:1 row ratio) recorded highest system productivity (90.10 q/ha), net return (Rs. 241720/ha) and B:C ratio (8.56) which was significantly higher than sole mesta or mesta based other intercropping systems.

The sunnhemp test entry Sanai 12 receiving NPK @ 20:60:60 kg/ha recorded significantly higher fibre yield (7.10 q/ha) over the other test entry JRS 2013-1 as well as the check varieties SUIN 053 and SH 4, at Amadalavalasa, Andhra Pradesh and Aduthurai, TamilNadu.

Maximum seed yield of sunnhemp at was recorded with closer spacing of 30 cm x 10 cm at Rahuri, Maharashtra and with wider spacing of 60 cm x 10 cm at Amadalavalasa, Andhra Pradesh. The seed yield of sunnhemp increased significantly up to fertilizer dose of 20:40:40 kg NPK/ha at Rahuri, Maharashtra and up to 20:60:60 kg NPK/ha fertilizer dose at Amadalavalasa, Andhra Pradesh. These are recommended for seed production of sunnhemp in both the states.

Among the methods of planting tested, ridge and furrow method recorded significantly higher total annual fibre yield over other planting methods at Barrackpore and Cooch Behar, West Bengal. Substitution of 150% of RDN by 25% through ramie compost or FYM recorded significantly higher fibre yield of ramie over 100 and 150% RDN in inorganic form at Barrackpore, West Bengal while at Cooch Behar, 150% RDN recorded significantly higher fibre yield of ramie over other fertilizer treatments.

Increase in nitrogen dose increased fibre yield of ramie significantly up to 50 kg N/ha/cut dose from 2nd cutting

onwards and also in total annual fibre yield of the crop at Barrackpore, West Bengal. The total annual fibre yield increased significantly up to highest potassium dose of 50 kg K/ha/cut at Barrackpore. The fibre yield of ramie increased significantly with successive increase in potassium dose up to 25 kg/ha level only at Sorbhog, Assam.

The INM treatments (application of NPK @ 60:30:60 kg/ha + sisal waste @ 20 t/ha or NPK @ 90:30:60 kg/ha + sisal waste @ 20 t/ha) recorded significantly higher fibre yield of sisal (21.0 – 21.8 q/ha) over recommended dose of NPK @ 120:30:60 kg/ha (13.2 q/ha) thereby indicating a savings of 30 – 60 kg N/ha in sisal at Bamra, Odisha.

The system sisal equivalent yield of sisal – legume (green gram, blackgram, cowpea, horse gram) or sisal – oilseed (sesamum, niger) intercropping systems were 2.71 – 5.9 q/ha more compared to sole sisal crop (6.08 q/ha) and the legumes were comparatively more beneficial than the oilseed components in terms of yield enhancement at Bamra, Odisha.

The pooled data of fibre yield of flax of 2014-15 and 2016-17 seasons revealed that fibre yield of flax increased significantly with sowing the crop up to 15th November and with fertilizer nitrogen application up to 80 kg N/ha level at Pratapgarh, Uttar Pradesh. At Cooch Behar, significantly plant height of flax were recorded with sowing the crop on 1st November (126.8 cm) and application of nitrogen @ 120 kg/ha (119.4 cm).

The pooled data of 2014-15 to 2016-17 revealed that maximum fibre yield of flax was recorded with $N_{120}K_{60}$ treatment (15.17 q/ha) which was statistically at par to fibre yield recorded with $N_{80}K_{60}$ (14.80 q/ha) treatment at Barrackpore, West Bengal.

Highest fibre yield of flax was recorded with pre-emergence application of pendimethalin 30% EC @ 750g/ha while pendimethalin 1.0 kg a.i./ha recorded significant reduction in weed growth compared to other herbicide treatments at Barrackpore, West Bengal. However, pendimethalin 1.0 kg a.i./ha showed higher phytotoxicity also compared to other treatments.

At Pratapgarh, Uttar Pradesh, maximum fibre yield of flax was recorded with $N_{40}K_{60}$ treatment (29.04 q/ha) which was statistically at par with the fibre yield recorded with $N_{40}K_0$ (27.62 q/ha) and $N_{120}K_{30}$ (27.40 q/ha) treatments, respectively.

In Barrackpore, maximum fibre yield of flax was recorded with irrigation based on I_3N_4 (IW/CPE ratio 0.8 + 120 kg N/ha) treatment (15.56 & 26.10 q/ha, respectively) which were statistically at par with yield of I_3N_3 (IW/CPE ratio 0.8 + 80 kg N/ha) treatment (14.68 q/ha) at Barrackpore, West Bengal (23.51 q/ha).

10.3. Crop Protection

Under crop protection programme, ten projects comprising of 40 experiments were conducted in jute and allied fibre crops at different AINPJAF centers during 2017-18.

Survey and surveillance of insect pests and diseases of jute were conducted in all the AINP centers. In jute, yellow mite, semilooper, Bihar hairy caterpillar and stem weevil were the most common insect pests. The yellow mite infestation was more consistent across the centres with maximum infestation of 54.16, 6.02, and 8.60, mite population/ cm² leaf area on 2nd unfolded leaf at Barrackpore, Coochbehar and Nagaon, respectively coinciding at 55 DAS to 63 DAS during last week of May to end-June. Maximum infestation of Bihar hairy caterpillar was noticed at Barrackpore where 92.67 per cent infestation occurred during mid-July at 125 DAS. The BHC damage at Nagaon was 53.80 % followed by Nagaon (20.64%) and Coochbehar (16.67%) occurred between 55 to 85 DAS respectively. Infestation of indigo caterpillar (10.70 %) and grey weevil (25.67%) was specific to Nagaon and Barrackpore respectively.

Jute semilooper infestation was observed at Barrackpore, Coochbehar, Katihar, Budbud and Nagaon with maximum of 90.50%, 15.19%, 25.60%, 50.00% and 12.24 % plant damage respectively from 45 DAS to 105 DAS. The period of semilooper infestation was from second fortnight of June to last week of August. Stem weevil infestation was noticed in all the centers except Kendrapara and Coochbehar. At Barrackpore, Nagaon, Budbud and Katihar, maximum stem weevil infestation was found from May to mid-July with 13.33%, 4.30 %, 10.71% and 8.19 % plant damage at 30 DAS to 85 DAS. In general yellow mite, grey weevil, indigo caterpillar and stem weevil were more prevalent during the early crop growth period whereas Bihar hairy caterpillar and semilooper were active during the later part of the crop period. During July, peak activity of the larval parasite (Tachinid fly) was recorded to be 6.67-10.00 % on BHC at Nagaon.

Stem rot, anthracnose and mosaic diseases were common in jute. The infestation of leaf mosaic of white jute was very specific to Katihar and Kendrapara centers with incidence of 7.89% and 11.67% respectively during 105 DAS. Seedling blight incidence was observed only at Nagaon with 4.90 % plant damage at 35 DAS. Incidence of anthracnose was observed at Nagaon, Katihar and Kendrapara centers during August with maximum incidence of 23.90%, 2.00% and 9.67% respectively. Maximum incidence of stem rot was observed from mid-June to September with 13.81 %, 1.78 (PDI), 19.33 %, 7.04 %, and 8.24 (PDI) and 28.00% at Barrackpore, Coochbehar Kendrapara Katihar, Nagaon and Budbud respectively. The incidence of root rot disease was maximum 3.66%, 2.01 %, 14.00 %, 9.25% and 15.70 % at Barrackpore, Coochbehar, Kendrapara, Katihar

and Nagaon, respectively., In mesta, at Amadalavalasa maximum infestation of aphids, whiteflies and leafhoppers were 45.56, 1.80 and 0.32/ plants respectively. The infestation of semilooper and mealybug was 72.00 % and 14.00% at 45 DAS and 65 DAS, respectively. In Budbud, maximum mealybug and YVMV incidence of 31.05% and 21.74% was observed at 40 DAS during third week of July. Under Budbud condition, the BHC and stem borer damage in sunnhemp was 13.51% and 10.80% respectively at 40 DAS.

The promising germplasm lines of *tossa* jute free from mite infestation were OIN-89, OIJ-04, OIN-90, OIN-96, OIN-97, OIN-98, OIN-106 and OIN-111 at Coochbehar. Other lines with least infestation were OIN-90, OIN-97, OIN-98 (3.01-3.87mite/cm²) at Kendrapara. Some of the lines exhibiting relatively resistant against stem weevil with no damage were OIN-89, OIN-90, OIN-93, OIN-99, OIN-112, OIN-122, OIN-123, OIN-132 at Katihar and OIN-94, OIN-119 (1.54-2.53%) at Kendrapara. Germplasm OIN-86 at Coochbehar and lines OIN-87, OIN-97, OIN-118, OIN-121 and OIN-123 at Katihar, were free from stem rot disease incidence whereas, lines OIN-97, OIN-102, OIN-103, OIN-109, OIN-111, OIN-112, OIN-120, OIN-122, OIN-123 and OIN-131 were found to be moderately resistant to stem rot incidence at Kendrapara.

Among the *white* jute germplasms, CIN-100, CIN-97, CIN-101, CIN-121, CIN-122, CIN-123, CIN-101, were least susceptible to semilooper at Coochbehar, Katihar and Kendrapara respectively. The lines CIN-100, CIN-101, CIN-121, CIN-122, CIN-123, CIN-125 and CIJ-127 were found to be resistant to yellow mite with <1 mite/cm² of leaf at Coochbehar while CIN-85, CIN-91, CIN-92, CIN-93, CIN-84, CIN-116, CIN-123 and CIN-124 (6.58-14.55 mite/cm²) at Bahraich. Two promising lines against stem weevil with least infestation were CIN-97 and CIN-104 while lines with least susceptibility at Bahraich were CIN-86, CIN-90, CIN-105, CIN-111, CIN-117, CIN-119, CIN-122 and CIN-127 (0.15-2.53 %). The white jute accessions, CIN-85, CIN-87, CIN-110, CIN-96, CIN-97, CIN-108, CIN-110, CIN-119 and CIN-135 were resistant to stem rot at Kendrapara. Most promising lines against root rot and stem rot were CIN-119 and CIN-02 respectively at Bahraich.

At Amadalavalasa, among the forty eight accessions of *Hibiscus sabdariffa* germplasm all the lines were highly susceptible to foot and stem rot disease. The disease incidence among the entries varied from 56.60% in AR-79 to 92.90% in AR-46. The disease incidence in the check variety- AMV-5 was 84.20%.

By comparing the mean percent disease indices (PDI) of all the six centres, namely, Barrackpore, Kendrapara, Nagaon,

Katihar, Coochbehar and Sorbhog (RRS), it was observed that out of 23 elite lines, only six germplasm/cultivars (OIJ -150, OIN-125, JBO-1, JRO-128, S-19 and JBO-2407) showed the PDI values below 5 and considered resistant to stem rot. The susceptible check, JRC-412(C) exhibited high mean PDI value of 14.93 across the locations. However, PDI value of more than five was recorded in case few promising varieties, namely, JRO-524, JRO-204, JRO-632, CO-58, JRO-66 and JRO-8432, respectively, with 6.8, 5.9, 5.9, 5.1, 5.6 and 5.3.

Foliar application of agricultural grade mineral oil @ 3 ml/litre + neem oil @ 3 ml/litre at 35 DAS and 50 DAS was found most effective for management of yellow mite in jute at Kendrapara, Coochbehar and Nagaon, with highest fibre yield of 29.03, 28.30 and 29.78 /ha respectively.

At Barrackpore, the line sown crop performed significantly better over broadcast sowing in terms of reduced yellow mite infestation and increased yield. Whereas the treatment of seed treatment with carbendazim 50 WP @2g/kg seed + spraying of spraying of spiromesifen 240 SC @ 0.7 ml/lit at 35 DAS + spraying of tebuconazole @ 0.15% at 45 DAS + spraying of λ -cyhalothrin 5 EC @ 0.6ml/L at 55 DAS was significantly superior with less mite (4.56 mite/cm²) and semilooper damage (12.62%) and highest yield (19.18 q/ha). The main and subplot treatments had non-significant on stem rot incidence.

In Kendrapara, the line sown jute crop treated with seed treatment with carbendazim 50 WP @2g/kg seed + spraying of spraying of spiromesifen 240 SC @ 0.7 ml/lit at 35 DAS + spraying of tebuconazole @ 0.15% at 45 DAS + spraying of λ -cyhalothrin 5 EC @ 0.6ml/L at 55 DAS recorded least mite (3.79 mite/cm²), semilooper damage (4.78%), reduced incidence of stem rot (4.04 PDI) and highest yield (28.33 Q/ha). In Coochbehar also similar trend in result was obtained.

In Nagaon, the effect of line sown was significant only with respect to reduced mite infestation, BHC damage and enhanced yield (26.59 q/ha). The treatment, with seed treatment with carbendazim 50 WP @2g/kg seed + spraying of spraying of spiromesifen 240 SC @ 0.7 ml/lit at 35 DAS + spraying of tebuconazole @ 0.15% at 45 DAS + spraying of λ -cyhalothrin 5 EC @ 0.6ml/L at 55 DAS had significantly less pest and disease incidence and highest yield (28.85 q/ha). The interaction effect was non-significant.

In Katihar also seed treatment with carbendazim 50 WP @2g/kg seed + spraying of spraying of spiromesifen 240 SC @ 0.7 ml/lit at 35 DAS + spraying of tebuconazole @ 0.15% at 45 DAS + spraying of λ -cyhalothrin 5 EC @ 0.6ml/L at 55 DAS was significantly effective in reducing the damage of yellow mite, BHC and Hairy caterpillar.

Among the new fungicide molecules for management of *Macrophomina phaseolina* caused disease complex in jute, at Barrackpore, pre-sowing seed treatment with carbendazim + spraying of carbendazim at 45 DAS was the best treatment in managing stem rot of jute with lowest root rot of 15.1% and PDI of 11.3. Whereas at Coochbehar seed treatment with (azoxystrobin + difenoconazole) @ 1.0 ml/kg seed + spraying of (azoxystrobin + difenoconazole) @ 0.075 % at 40-45 days of crop age was found to be best treatment with highest fibre yield of 26.52 q/ ha. Similarly at Nagaon centre, the seed treatment with (tricyclazole + propiconazole) @ 1.0 ml/kg seed + spraying of (tricyclazole + propiconazole) @ 0.1 % at 40-45 days of crop age was found to be superior with fibre yield of 30.00q/ ha. At Kendrapara, among all the treatments, seed treatments with tebuconazole @1.5ml/kg of seed +spraying of tebuconazole @0.15% at 40-45 days of crop age was found to be best where incidence of stem rot and root rot was significantly low and similar result was recorded in Katihar also with 28.7 q/ ha.

At Budbud, application of fungicides did not showed significant effect on the extent of seed infection and disease incidence in seed crop. Although the mid-July sown crop recorded numerically least PDI (9.34) was at par with other treatments. Maximum seed yield (5.65 q/ha) was obtained from mid-July sown crop which was at par with the mid-August sown crop.

At Amadalavalasa, in AVT-I The foot and stem rot disease on different entries of roselle was recorded. Significantly least infected entry with foot and stem rot disease were JRHS 5 (35.8%) and HS 303 (37.2%) at 120 DAS and in AVT-II significantly least infected entry with foot and stem rot disease was JRR-2014-1(23.4%) at 120 DAS. In AVT I, JRHS 5 recorded least infestation of aphid, leafhopper and mealybug. In AVT-II low incidence of leafhoppers was recorded in JRHS 5 (0.32 /plant) and AHS 298 (0.35 /plant). Similarly the leaf damage by semilooper was low in AHS 286 (16.39%) and AHS 298 (18.06%).

10.4 Tribal Sub Plan

The Tribal Sub Plan programme had been taken up by AINP units of BCKV, UBKV, JRS Kendrapara and RARS, Nagaon. The programme was conducted in 11 villages belonging to 5 districts of West Bengal, Assam and Odisha covering 57.8 ha area and 265 tribal farmers participated in the programme. In south Bengal, the activities were carried out in Srikrishnapur and Matiagacha villages of North 24 Paragana district whereas in north Bengal, activities were carried out in Badalgir, Atialdanga, Jaigirbalabari, Rajarhat and Putimari villages of Dinhat II and CoochBehar I blocks of CoochBehar district. In Odisha, the TSP activities were taken up in Dhasahi and Beusahi villages of Anandapur

block of Keonjhar district while in Assam; the TSP programme was taken up in Mazgaon Jajori village in Morigaon district and Kotohguri village in Nagaon district. The objective of the programme was to improve the socio-economic status of the tribal farmers through introduction of improved agriculture and allied activities in the tribal populated areas.

Demonstration of new variety JBO 2003- H, line sowing with CRIJAF Multi Row Seed Drill, integrated nutrient management (INM) and integrated weed management (IWM) in jute recorded 2.02 – 2.91, 3.39 – 3.46, 3.11-3.94 and 3.90 – 4.78 q/ha more fibre yield and additional net return of Rs. 7070 - 10185/ha, Rs.7365 - 7610/ha, Rs. 8870 - 15805/ha and Rs. 15604 - 17684/ha over existing variety JRO 524 at Matiagacha and Sri Krishnapur villages of North 24 Parganas district of West Bengal. The demonstration of line sowing in jute using CRIJAF Multi Row Seed Drill recorded 4.0 q/ha more fibre yield over broadcasting (24 q/ha) and the farmers got additional net return of Rs. 16100/ha while the demonstration on balanced fertilizer application in jute recorded 3.0 q/ha more fibre yield over broadcasting (23 q/ha) and the farmers got additional net return of Rs. 10050/ha at Badalgir, Atialdanga, Jaigirbalabari, Rajarhat and Putimari villages of Dinhata II and CoochBehar I blocks of CoochBehar district, West Bengal.

The demonstration on weed control in jute at Dihasahi village of Keonjhar district of Odisha, on an average, recorded 5.7 q/ha additional fibre yield and Rs. 15756/ha additional net return and over farmers practice (hand weeding). Similarly, the demonstration on IPM in jute at Beusahii village of Keonjhar district of Odisha recorded 6.5 q/ha additional fibre yield and Rs. 10930/ha additional net return over farmers practice.

At Nagaon and Morigaon districts of Assam, the demonstration of new jute variety Tarun recorded 7.88 - 12.30 q/ha of additional fibre yield and additional net return of Rs. 10460 -16485/ha over JRO 524 variety in farmers' fields at Majgaon Jajori and kotohguri villages. Demonstration on improved cultivation practice (line sowing with CRIJAF Multi Row Seed Drill along with weeding by post emergence spray of quizalofop ethyl in Majgaon Jajori or weeding by both application of CRIJAF Nail Weeder and post emergence spray of quizalofop ethyl in Kotohguri) in jute indicated that the improved method of sowing and weeding recorded 10.42 – 12.15 q/ha of additional fibre yield over famers' practice (broadcasting + hand weeding) (21.50 -23.45 q/ha) in the study area with additional net return of Rs. 6714/ha at Majgaon Jajori to Rs. 44998/ha in Kotohguri village over famers' practice.



Inaugural address by Dr. C. Chatopadhyay, Vice Chancellor, UBKV, Coochbehar



Prof. B. K. Senapati, Dean of Research, BCKV Kalyani addressing the audience



Director, ICAR-CRIJAF addressing the delegates of AINPJAF workshop



Scientists and delegates participating in the 13th Annual Workshop of AINPJAF at BCKV, Kalyani

11. Krishi Vigyan Kendra

KVK, Purba Bardhaman (erstwhile KVK, Burdwan) was established in April 2005 and KVK-II, North 24 Parganas was recently established in 2016 under the administrative control of the ICAR-CRIJAF. Major activities of KVK are to implement On Farm Trials (OFTs) for evaluation of location specificity of various technologies, Front Line Demonstrations (FLDs) of established technologies and trainings for farmers, farm women, rural youths and extension workers. Besides, exposure visits, field day, method demonstration and other activities are also conducted for the farmers.

11.1. On Farm Trials (OFTs)

Seven OFTs were conducted by the KVK, Purba Bardhaman for evaluation of different recommended technologies and finding out the location specificity of the technologies under the existing farming system. The salient findings of these OFTs are illustrated below.

- System yield of jute crop was significantly higher in case of mixed cropping with green amaranthus (48 q/ha) compared to single cropping (33.8 q/ha). In case of jute + green gram intercropping (1:1) system productivity was lowest (28.7 q/ha). But profitability of this option was best (Return : Cost = 1.83) as compared to FP (Return : Cost = 1.41), single cultivation by line sowing (Return : Cost = 1.56) and Jute + Amaranthus (Return : Cost = 1.64).
- In Rice-Mustard cropping system, application of Zn and B in conjugation improved the productivity of rice and mustard in comparison to single application. Application of either Zn or B along with RDF increased productivity significantly over FP. Application of 100% RDF + 5 kg Zn/ha as basal in both seasons + 1 kg B/ha basal technology option (TO1) and 100% RDF + 1 kg B/ha basal (TO2) was found best and resulted in at par productivity of rice (60.5 q/ha and 62.2 q/ha rice in TO2 and TO3, respectively) and mustard (13.45 q/ha and 14.89 q/ha mustard in TO2 and TO3, respectively).
- Application of organic matter enhanced productivity of sesame significantly over FP (For

TO2, i.e., 75% RDF + FYM (5 t/ha) -35% and TO3, i.e., 50% RDF + FYM (5 t/ha) + Vermicompost (2.5 t/ha) – 48%) or over recommended dose (For TO2 -14% and TO3 – 25%). Vermicompost application was found to be the best option regarding productivity (9.24 q/ha) and cost-effectiveness (1.94).

- Rabi onion variety NHRDF Red 3 recorded higher productivity and profitability. NHRDF Red 3 produced 31% and 19.5% more as compared to farmer's variety Sukhsagar and NHRDF Red, respectively. Profitability was highest in NHRDF Red 3 (2.93).
- Evaluation of performance of different varieties of okra revealed that variety SVOK0001 was best in terms of yield (107 q/ha), profitability and tolerance to YVMV (9% disease incidence). Productivity of Parbhani Kranti (82 q/ha) and BBX-9 (92 q/ha) was at par.
- Assessment of efficacy of growth promoter in fish feed on fish productivity under pond ecosystem of Burdwan showed application of Choline chloride @ 250 gm per bigha in the growout pond increased the growth rate of fish fingerling survivability significantly. Use of Choline chloride as growth promoter resulted in healthy fish seed. Its use also significantly increased the fish yield to 24.6 q/ha.
- Feed application in fish ponds through pole and bag in the growout pond increased the growth rate of fish significantly. The pole and bag methods (demand bag feeding) come out as the best option of feeding fishes as far as IMC is concerned (34.1 q/ha).

11.2. Front Line Demonstrations (FLDs)

A total of 1111 FLDs were conducted on jute, rice, groundnut, sesame, greengram, mustard, lentil, chickpea, onion, annual moringa, brinjal, fodders (sorghum, maize, berseem, oat, rice bean) and fishery. In fishery sciences, FLD was conducted on monosex *tilapia*. The salient findings of the FLDs are given below in Table 11.1.

Table 11.1. Details of FLDs conducted by CRIJAF KVKs during 2017-18

Technology	No. of Demo	Output	
		Yield (q/ha)	% increase over FP
KVK, Purba Bardhaman			
Improved production technology of jute (cv. JRO 204)	55	30.20	12.34
Nutrition management in groundnut (cv. TG 37A)	102	19.12	9.90
Sulfur and boron nutrition in sesame (cv. RT 346)	278	8.96	9.26
Sulfur nutrition in green gram (cv. SML 668)	153	9.64	12.90
Nutrition management in mustard (cv. JD 6)	133	15.60	25.20
Integrated disease management in lentil (cv. WBL 77)	148	10.40	22.00
Sulfur management in chickpea (cv. JAKI 9218)	105	10.44	28.00
Agronomic practices of brinjal (Bhangar Selection)	20	255.00	16.00
Improved agronomic practices of Sorghum as fodder (Sudexchari)	6	894.00	12.40
Package of demonstration of maize as fodder (African Tall)	5	410.00	17.10
Improved agronomic practices of Rice bean as fodder (Bidhan 2)	5	248.00	21.50
Improved agronomic practices of Oat as fodder (Kent)	10	410.00	15
Package of demonstration of Berseem as fodder (Wardhan)	10	468.00	17
Improved Cultural Practices if T <i>Tilapia</i> (GIFT)	1	35.00	133
KVK- II, North 24 Parganas			
Improved variety of jute (cv. JRO 204)	20	32.00	18.00
Improved retting of jute with 'CRIJAF Sona'	20	32.00	1 Grade
SRI Method of rice cultivation	30	70.00	20.00
Vegetable cultivation in jute bag reinforced soil columns at rice fields	10	40.00	-



Cluster FLD on Groundnut.



FLD on improved variety (JRO 204) of jute.



Cluster frontline demonstration on oilseeds



Demonstration of improved retting method of jute using CRIJAF Sona

11.3. Trainings

Various mandated and sponsored training programmes on agriculture, horticulture, animal and fishery sciences, plant protection, agricultural extension and home sciences

(Table 11.2) were conducted by the KVKs for effective dissemination of knowledge and skill on various improved technologies among stakeholders.

Table 11.2. Details of training programmes conducted by CRIJAF KVKs

Target group	No. of Trainings	No. of Participants					
		General			SC/ST		
		Male	Female	Total	Male	Female	Total
KVK, Purba Bardhaman							
Practicing farmers	70	1645	37	1682	402	36	438
Rural youths	25	101	50	151	19	13	32
Extension functionaries	11	200	32	232	30	11	41
Vocational training	2	0	34	40	0	6	6
KVK-II, North 24 Parganas							
Practicing farmers	3	153	19	172	25	0	25
Total	111	2099	172	2277	476	66	542



Vocational training on kantha stitch

11.4. Extension Activities

A number of on-campus and off-campus extension activities were organized by the KVKs during 207-18. Some important extension activities conducted by the KVKs are described below.

Awareness Programme on Pradhan Mantri Fasal Bima Yojana (PMFBY): An awareness programme on PMFBY was organized by KVK-II, North 24 Parganas on 26.07.2017 at ICAR-CRIJAF, Barrackpore. Eighty nine farmers and farm women from Barrackpore-I, Barrackpore-II, Barasat-I and Hasnabad blocks of North 24 Parganas district participated in this programme. Officials from Agricultural Insurance Company of India Limited (AICIL), Kolkata region were invited in this programme to aware and sensitize the farmers about PMFBY.



Farmers' training on improved retting of jute



Dr. D.K. Kundu, HoD, Crop Production Division, ICAR-CRIJAF addressing the farmers



Mr. Ahijit Dey, A.O., AICIL detailing the PMFBY scheme to the farmers

New India Manthan- Sankalp se Siddhi programme: As per directives from ICAR, CRIJAF KVKs duly observed 'Sankalp se Siddhi' to take the oath of doubling of farmers income by 2022. The programme was arranged by KVK, Purba Bardhaman at Ranigunj on 29.08.17 and was presided over by Hon'ble MoS, HI&PE, Shri Babul Supriyo. Around 450 farmers participated in that programme. KVK-II, North 24 Parganas organized this programme on 26.08.2017 at ICAR-CRIJAF, Barrackpore where Hon'ble MP and Member of Parliamentary Committee on Agriculture, Dr. Tapas Mondal was present as chief guest. The programme was attended by about 200 farmers.



Hon'ble MoS, HI&PE, Shri Babul Supriyo addressing Sankalp se siddhi programme at Ranigunj



Hon'ble MP, Dr. Tapas Mondal addressing Sankalp se siddhi programme at ICAR-CRIJAF, Barrackpore

Soil test awareness camps: A total of 6 nos of awareness camps were organized in Andal, Ranigunj, Jamuria and Barabani blocks of Burdwan district at the behest of Hon'ble MoS, HI&PE, Shri Babul Supriyo. A total of 1050 farmers participated in the camps and about 850 soil health cards were distributed.

Mahila Kisan Diwas: As per directives from ICAR, KVK, Purba Bardhaman duly observed 'Mahila Kisan Diwas' on 15.10.2017 in its campus at Budbud with the objective of gender mainstreaming in agriculture. About 56 farm women from nine villages of Galsi I & II, Ausgram I, Kanksa blocks participated in the programme. The selected progressive farm women were conferred awards for their achievements.



Celebration of Mahila Kisan Diwas

World Soil Day: World Soil day 2017 was observed by KVK, Purba Bardhaman on 05.12.17 at Ranigunj to make farmers aware about importance of soil health management for sustainable production. About 230 participants from various villages of Ranigunj, Andal and Jamuria blocks participated in the programme. This important day is also celebrated by KVK-II, North 24 Parganas at ICAR-CRIJAF, Barrackpore. About 100 farmers of North 24 Parganas district participated in this programme.



World Soil Day celebrated at Ranigunj



World Soil Day celebrated at ICAR-CRIJAF, Barrackpore

Foundation seed production: KVK, Purba Bardhaman produced 240 q foundation seed of paddy (cv. MTU 7029) to cater the needs of quality seed in the region. The KVK earned Rs. 9 lakh from selling of the seed to various growers and progressive farmers in seed village mode.



Foundation seed (paddy) distribution to farmers

Mati Utsav: KVK, Purba Bardhaman is the only KVK in West Bengal that participated in the prestigious *MATI UTSAV* held at Purba Bardhaman during January 2018.



Shri Ashis Banerjee, Hon'ble MIC of Agriculture, Govt. West Bengal visiting the KVK stall

Farmer-Scientist Interaction: KVK, Purba Bardhaman organized one Farmer-Scientist interaction programme sponsored by ATMA Burdwan in February 2018. The programme was participated by about 130 progressive farmers and extension officials of line departments. Another Farmer-Scientist interaction programme was organized by KVK-II, North 24 Parganas on 5 December, 2017 (World Soil Day).

Clean India Campaign – Swachhta hi Seva Abhiyan and Swachh Bharat Pakhwara: The KVKs duly observed *Swachhta hi Seva Abhiyan* from 15.09.17 to 02.10.17. Various activities like cleaning of farm campus, cleaning of nearby tourist spot, cleaning of public places, seminars, devotion of labour in creating public toilet was done during the period. It also observed *Swachh Bharat Pakhwara* during 16-31 May, 2017.



Construction of low cost toilet

SAC meeting: The XIV meeting of Scientific Advisory Committee (SAC) of KVK, Purba Bardhaman was held on 18th January, 2018. The meeting was chaired by Dr. Jiban Mitra, Director (Actg.), ICAR-CRIJAF. General recommendations which were given apart from specific recommendations are:

- KVK should continue to work in entire Burdwan district till new KVK is established for newly formed Paschim Bardhaman district after partition of the district.
- In order to increase outreach of KVK, every SMS should adopt at least 2-3 villages each year in different *Gram Panchayats*.
- Documents on 'Resource support system' and 'Technological inventory' of the district should be prepared comprising of all available resources, facilities and technologies developed by the ICAR, SAUs and other concerned development organizations of West Bengal.

- New and improved varieties developed by the ICAR, SAUs & State Government must be introduced through OFT. Seed production of latest varieties should be tried in participatory mode. Feasibility of formation of Seed Bank may be explored. Documentation of activities through good quality photographs must be done. Photographs should be so taken as to reflect the visual difference of the technology tested with farmer's practice. Permanent sign board on each FLD site should only be used.



SAC meeting held at KVK, Purba Bardhaman

Technology week and Webcasting of Hon'ble PM's speech: Technology week was observed during 15–17 March, 2017 by KVK, Purba Burdwan in its campus at Budbud. On the first two days, various training sessions on agriculture and allied subjects were organised. On the last day, Hon'ble PM's speech in the *Krishi Unnati Mela* at ICAR-IARI, New Delhi was webcasted. Around 220 participants from various parts of the district participated in the event.

Hon'ble PM's speech was also webcasted before farmers at ICAR-CRIJAF, Barrackpore on 17.03.2018. About 200 farmers participated in this programme.



Webcasting of Hon'ble PM's speech at KVK, Purba Bardhaman



Webcasting of Hon'ble PM's speech at ICAR-CRIJAF, Barrackpore

12. Training and Capacity Building

12.1. Human Resource Development (HRD)

12.1.1. Preparation of annual training plan for the year 2017-18

The Annual Training Plan of ICAR-CRIJAF for the year 2017-18 was prepared after a comprehensive training need analysis. A total of 36 employees were planned to be trained from different categories of employees including 15 scientists, 3 technicals, 10 administrative and 8 skilled supporting staffs.

12.1.2. Training undergone

The institute trained 46 of its employees under various categories with a 128% realization of training target utilizing 90.2% of the allocated budget. A total of 16 scientists, 2 technical staffs and 15 administrative staffs were trained in various categories of research, training and administrative matters.

Most of the trainees received training from premier institutes having high expertise in the area of training, such as ICAR-NBAIR, ICAR-IARI, ICAR-IASRI, ICAR-CRIJAF, ISTM, NIFM, ICAR-NAARM and MANAGE.

Table 12.1. Total no. of employees and no. of employees undergone training during 2017-18

Category	Total employees (No.)	Employees undergone training (No.)	Training realization as per ATP (%)
Scientists	45	16	106.7
Technical	46	2	66.7
Administrative staff	37	15	187.5
SSS	14	13	130.0
Total	142	46	115.0

12.1.3. Trainings conducted at ICAR-CRIJAF

A three days training programme was organized on "Identification of wild species of jute and allied fibre crops" during 21st to 23rd November, 2017 at ICAR-CRIJAF, Barrackpore. A total 13 of skilled supporting staff of the institute attended this training programme. The training programme consisted of lectures, lab-practicals and field identification of wild and weedy germplasm of jute, mesta, sisal, ramie and sunnhemp. Several lectures were delivered including morphological characterization for identification of plant species, 'Identification of wild species of Jute' 'Overview of wild species of allied fibre and their identification', 'Descriptors of Jute germplasm' etc., which were very relevant to this training. Trainees were very much satisfied with the lectures and training arrangement.

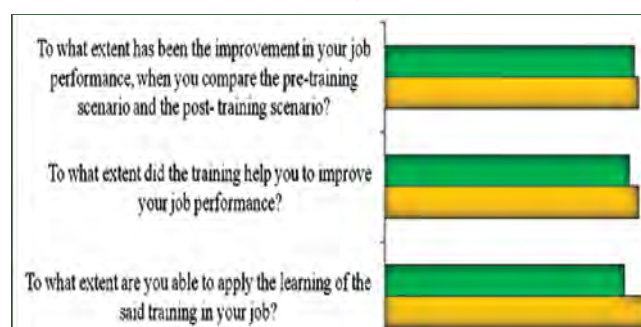
Another training programme on "Increasing genetic potential of jute and allied fibre crops through novel breeding and biotechnological approaches" was conducted from 05.03.2018 to 15.03.2018 for improving skill and expertise of the scientists and researchers working in this area. The training module was designed to provide theoretical knowledge on advanced genomic technologies, transgenics, novel breeding approaches, molecular markers, biosafety concerns as well as practical hands on experience on DNA and RNA technologies including isolation of DNA and RNA from polyphenol rich tissues, CDNA preparation, RT-PCR, handling software related to diversity analysis, genomic researches and advanced statistical analyses. A total of 14 Scientists/Asst. Professors from ICAR-CRIJAF, Bidhan Chandra Krishi Viswavidyalaya, Mahatma Phule Krishi Vidyapeeth and Rajendra Agricultural University successfully completed the training programme.

Table 12.2. Trainings organized by HRD cell

Category	Trainings organized (No.)	No. of Participants		
		ICAR-Institutes	Others	Total
Scientists	1	8	6	14
SSS	1	21	6	27

12.1.4. Impact assessment

To follow-up the impact of trainings received by employees in previous year, an impact analysis was conducted as per the proforma designed by the HRD section of ICAR. A total of 48 employees of different categories were included in the assessment. The response of the employees on a 1-5 scale for five questions were around 4, revealing high realization of training received by the employees. The same was ratified by the reporting officers of the employees. (Source: HRD Cell; Contributor: P. Satya).



Response of ICAR-CRIJAF employees on questions related to impact assessment of training



Participants of training programme on Identification of wild species



Hands on training on genomics being provided in Biotechnology lab



Director, ICAR-CRIJAF with trainees attending programme on genetic improvement of fibre crops



Inaugural address by Dr. Amit Bera during training on Identification of wild species

Table 12.3. Training organized by ICAR-CRIJAF and its Sub-stations

Name of the Programme/Training	Date	No. of Participants
ICAR-CRIJAF (HQ)		
Training on 'Scientific soil and nutrient management in jute crops', Goaldah village	3 April, 2017	31
Training on 'Improved jute production technologies' under ATMA, Haringhata Block, Nadia District	24 April, 2017	16
Farmers' training on 'Improved production technologies of jute' under ATMA, Chapra Block, Nadia District	25-28 April, 2017	15
Training on 'Improved production technologies of jute' under ATMA, Shahibganj District, Jharkhand	16-20 May, 2017	14
Training on 'Weeds and pests-disease management in jute crops', Goaldah village	1 June, 2017	31
Trainers' training-cum-demonstration on 'Improved retting technology of jute' under Jute-ICARE Programme	June 28, 2017	40
Farmers training-cum-scientist interaction on 'Smart jute farming through capacity building of scheduled caste farmers in West Bengal'	22 July, 2017	55
Farmers' Day	25 July, 2017	200
Training programme on rice cultivation under TSP	27-28 October, 2017	51
Farmers' Training-cum-exposure visit sponsored by ATMA, Gangarampur block, Dakshin Dinajpur	16-17 November, 2017	17
Training on 'Identification of wild species of jute and allied fibres' at ICAR-CRIJAF	21-23 November, 2017	13
Training on 'Operation & maintenance of farm implement for sowing and weeding in jute, Goaldaha village	24 January, 2018	29

Name of the Programme/Training	Date	No. of Participants
ICAR-CRIJAF (HQ)		
Training on 'Operation & maintenance of farm implement for sowing and weeding in jute', Panji village	27 January, 2018	53
Training on 'Operation & maintenance of farm implement for sowing and weeding in jute' Panchkahaniya village	14 February, 2018	24
Trainers' Training on 'Improved Production Technologies of Jute' under Jute-ICARE Programme	20-21 February, 2018	65
Farmers' training on 'Field demonstration on climate smart jute farming', ICAR-CRIJAF	6-8 March, 2018	124
Training on 'Improved production technology of jute and allied fibres' under NFSM (Commercial Crop) jute programme	20-22 March, 2018	20
CSRSJAF, Bud Bud, Burdwan		
Training on 'Improved technologies for seed production under TSP'	8 November, 2017	150
Training on 'Quality seed production of jute & mesta under NFSM (CC)'	6-7 August, 2017	
State level training of officers under NFSM (CC)-Jute based cropping system	8 September, 2017	
Sisal Research Station, Bamra, Odisha		
Brainstorming workshop on sisal grading and electronic instrumentation (Organized by ICAR- NIRJAFT, Kolkata in association with SRS, Bamra)	25 August, 2017	70



Training Programme on "Improved Production Technologies of Jute" under ATMA, Shahibganj District, Jharkhand



National Level Training on "Improved Production Technology of Jute and Allied Fibres" under NFSM (Commercial Crop) Jute Programme

Table 12.4. Seminar/Symposium/Conference/Workshop attended by the Scientists

Programme	Place and date	Name of the participant/s
XXXII Annual Group Meeting of AICRP-National Seed Project (crops) 2017" conducted by IISS, Mau	SKRAU, Bikaner 22-24 April, 2017.	Dr. Amit Bera
International Conference on "Contemporary Issues in Integrating Climate- The Emerging Area of Agriculture, Horticulture, Biodiversity, Forestry; Engineering Technology, Applied Science and Business Management for Sustainable Development (AGROTECH-2017)"	Kalimpong, West Bengal 11-12 May, 2017	Dr. H.R. Bhandari
National Conference on "Enhancing Nutritional Security Through Climate Smart Farming Practices"	BCKV, Kalyani, WB 9-10 June, 2017	Dr. D.K. Kundu Dr. Ritesh Saha Dr. M.S. Behera Dr. A.K. Singh

Programme	Place and date	Name of the participant/s
Seed Producers' Meet 2017	Burdwan, WB 18 July, 2017	Dr. H.R. Bhandari
Jute ICARE training	Nadia, WB 19-21 July, 2017	Dr. S. Datta
Brainstorming Session on "Reclamation of Acid Soils in Eastern Region of India"	ICAR-NBSS&LUP Regional Centre, Kolkata 11 August, 2017	Dr. D.K. Kundu Dr. A.R. Saha
Workshop on "Innovative Custom Hiring of Farm Machinery"	The Institution of Engineers, Kolkata 19 August, 2017	Dr. R.K. Naik
Brainstorming Workshop on 'Sisal Grading and Electronic Instrumentation'	SRS, Bamra, Odisha 25 August, 2017	Dr. D.K. Kundu
5 th Annual South Asia Biosafety Conference	Taj West End, Bangalore, Karnataka 11-13 September, 2017	Dr. S. Datta
NJB Seminar on "Dissemination of Feasibility Study of Activated Charcoal From Jute Stick"	Kolkata, WB 16 October, 2017	Dr. D.K. Kundu Dr. R.K. Naik Dr. S.K. Jha Dr. A.K. Ghorai
International Conference and Expo on "Agriculture & Veterinary Sciences: Research Technology"	Hyderabad, India 23-25 October, 2017	Dr. V. Ramesh Babu
Third International Conference on "Bio resource and Stress Management (ICBSM)"	SIAM, Jaipur, Rajasthan 8-11 November, 2017	Dr. Amit Bera
DST-NRDMS Project Review Meeting	DST-NRDMS, New Delhi 10-11 Nov 2017	Dr. A.K. Singh
National Seminar on "Crop Protection: Current Trend and Future Perspective"	SASRD, Nagaland University, Nagaland 16-18 November, 2017	Dr. S. Satpathy
Seminar in the 11 th Indian Fisheries and Aquaculture Forum (IFAF)	ICAR-CIFT, Cochin 21-24 November, 2017	Dr. G. Ziauddin
International Conference on "Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS- 2017)"	MPUAT, Udaipur, Rajasthan 2-4 December, 2017	Dr. S.K. Pandey
National Conference-NCVEG-17	ICAR-IIVR, Varanasi 9-11 December, 2017	Dr. S. Satpathy
National Seminar on "Developments in Soil Science – 2017"	Amity University, Kolkata 11-14 December, 2017	Dr. A.R. Saha, Dr. B. Majumdar, Dr. R. Saha, Dr. A.K. Singh, Dr. S.P. Mazumdar, Dr. D. Ghorai, Dr. S. Sasmal
Review Meeting on "Progress on ZTMC (Zonal Technology Management Centre) Activities in ICAR Crop Institutes in The Southern Indian Zone"	ICAR-IIMR, Hyderabad, 16 December, 2017	Dr. S.K. Sarkar
National Conference on "Innovative framing for Food and Nutritional Security in Changing Climate"	BCKV, Kalyani, WB 12-13 January, 2018	D. S. Kumar Dr. Shamna A. Dr. M.L. Roy
Scientific Advisory Committee (SAC) meeting	KVK, Burdwan 18 January, 2018	Dr. A.K. Singh

Programme	Place and date	Name of the participant/s
International symposium on "Biodiversity and Bio Banking"	IIT Guwahati, Assam 27-29 January 2018,	Dr. B.S. Gotyal Dr. Maruthi, R.T.
National Seminar cum Panel Discussion on "Doubling Farmers' Income: Role of Agricultural Mechanization"	Visva-Bharati, Sriniketan, WB 29 January, 2018	Dr. R.K. Naik
1 st International Extension Congress on "New Horizons of Extension-Challenges and Opportunities"	ICAR-CIWA, Bhubaneswar 1-3 February, 2018	Dr. M.S. Behera
XVI-AZRA International Conference on "Applied Zoological Research for Sustainable Agriculture and Food Security"	BHU, Varanasi 9-11 February, 2018	Dr. S. Satpathy
13 th Annual Workshop of AINP-JAF	BCKV, Kalyani, WB 10-11 February, 2018	All Scientists of ICAR-CRIJAF
International Conference on "Sustainability of Smallholder Agriculture in Developing Countries under Changing Climate Scenario"	CSAUT Kanpur 14-17 February, 2018,	Dr. M.S. Behera
Workshop on "Developing Multi-Disciplinary Approach in Project Formulations and Innovations in Agriculture & Allied Sectors"	ICAR-CIFRI, Barrackpore 17 February, 2018	Dr. A.K. Singh
National Agronomy Congress on "Redesigning Agronomy for Nature Conservation and Economic Empowerment"	GBPUA & T, Pantnagar, Uttarakhand 20-22 February, 2018	Dr. Amit Bera Dr. Mukesh Kumar
Brain Storming-cum-Interaction Meet on "Engineering Interventions for Production and Processing of different Crops"	ICAR-CIAE, Bhopal 26-27 February, 2018	Dr. R.K. Naik
Krushi Odisha 2018	Bhubaneswar 6-9 March, 2018	Dr. M.S. Behera
International Conference on "Novel Applications of Biotechnology in Agricultural Sectors: Towards achieving Sustainable Development Goals-2018"	BHU, Varanasi 20-21 March 2018	Dr. H.R. Bhandari
Brainstorming Session on "Market, Prospect and Innovations of Natural Fibers"	ICAR-NIRJAFT, WB 26 March, 2018	Dr. D.K. Kundu
National Seminar on "Agri-chemicals for A Benign Environment" and the 5 th Annual Convention of the "Society for Fertilizers & Environment"	BCKV, Kalyani, WB 29 March, 2018	Dr. D.K. Kundu Dr. R. Saha

Table 12.5. Training undergone by the Scientists/Staff Members

Training Programme	Place & Date	Name of Participant
Scientists		
Harnessing NGS Data for Genetic Enhancement in Crops	ICAR-IIWBR, Karnal 3-12 October, 2017	Dr. A. Anil Kumar
Nano-technological Approaches in Pest and Disease Management	ICAR-NBAIR, Bengaluru 15-24 November, 2017	Dr. V. Rarnesh Babu
Advances in Simulation Modelling and Climate Change Research towards Knowledge Based Agriculture	ICAR-IARI, New Delhi 16 November-6 December, 2017	Dr. A.K. Singh
Recent Advances of Bioinformatics in Agricultural Research: A Practical Perspective	ICAR-IASRI, New Delhi 01-21 December, 2017	Dr. Maruthi R.T.
Good Practices in Extension Research and Evaluation	ICAR-NAARM, Hyderabad 11-16 December, 2017	Dr. S.K. Jha

Training Programme	Place & Date	Name of Participant
Scientists		
Analysis of Multivariate Data	ICAR-NAARM, 14-20 December, 2017	Dr. A.K. Chakroborty
Short Course Training Programme on "Isolation, identification and characterization of sex pheromones in lepidopteran pests".	CSIR-IICT, 26 December, 2017-04 January, 2018	Dr. V. Ramesh Babu
Training of Trainers Program for Agriculture Extension Service Provider	IGKVV, Raipur 4-6 January, 2018	Dr. S.K. Jha
Training on 'Agriculture Knowledge Management'	MANAGE, Hyderabad 19-21 February, 2018	Dr. S. Sarkar
Increasing genetic potential of jute and Allied fibre crops through novel breeding and Biotechnological Approaches.	ICAR-CRIJAF, Barrackpore 5-15 March, 2018	Dr. S.K. Sarkar Dr. S.K. Pandey Dr. A. Bera Dr. B.S. Gotyal Dr. A.K. Jha Dr. S. Roy Dr. L. Sharma Dr. S. Ray
Administrative and Technical Staffs		
Public Financial Management System (PFMS), GFR, 2017 and Goods & Service Tax (GST)	ICAR-NRRI, Cuttack 11-12 September, 2017	Shri S. Ghosh Shri R.R. Debnath Shri T. Ghosh
Training on PFMS	CPRI, Shimla, 11 -15 September, 2017	Shri B.N. Mukhopadhyay
Workshop on "E-Office-01"	ISTM, New Delhi 12-13 October, 2017	Shri B.N. Mukhopadhyay
Reservation in Service for SC/ST/OBC	ISTM, New Delhi 13-15 November, 2017	Shri S.Bhattacharyya
Identification of Wild Species of jute and allied fibres	ICAR-CRIJAF, Barrackpore 21-23 November, 2017	S.B. Rajbanshi, D.N. Kundu
Orientation Training-cum- Refresher Course for SMSs	ICAR-ATARI, Kolkata. 01 December, 2017	Dr. D. Ghorai
Orientation Training-cum-Refresher Course for SMSs	ICAR-ATARI, Kolkata 04 December, 2017	Dr. S. Sarkar, Mr. S. Garai

13. Meetings and Events

13.1. Institute Research Committee (IRC) Meeting

The Institute Research Council (IRC) meeting was conducted under the chairmanship of the Director, ICAR-CRIJAF to review the proposal of new projects as well as progress of the on-going in-house projects and achievements of externally funded research projects during 10-11 April, 2017. Director CRIJAF complimented Dr. A.B. Mandal and Dr. A.K. Singh for getting two externally funded projects and requested the scientists to pursue for externally funded projects. He also complimented the scientists for their commendable achievements and transfer of technologies especially in Jute-ICARE programme. Dr. S.K. Sarkar, Pr. Scientist and in-charge PME Cell co-ordinated the meeting.



Presentation of research projects during IRC meeting

13.2. Farmers' Training Programme on Improved Production Technologies of Jute

A farmers' training programme on "Improved Production Technologies of Jute" was organized at ICAR-CRIJAF, Barrackpore during 25-28 April, 2017. This training programme was sponsored under ATMA by Assistant Director of Agriculture and Convenor, FIAC Chapra block of Nadia district. Twelve farmers of Chapra block with their ATM, KPS and ADA participated in this training. During the training programme the participants were oriented about different segments of improved production technologies of jute.



The participants during the inaugural session of the training

13.3. Swachh Bharat Pakhwada

As per directives of Government of India, "Swachh Bharat Pakhwada" was organised at ICAR-CRIJAF, Barrackpore during 16-31 May, 2017. The campaign started with 'Swachhta Pledge' to all the staff members administered by the Director. Various cleaning operations/programmes at institute including staff quarters premises, yoga therapy, quiz etc. were organised in well planned manner under the directives of Dr. S. Satpathy, Chairman, Swachh Bharat Abhiyan Committee. The programme was co-ordinated by Dr. R.K. Naik, Sr. Scientist and in-charge Estate and Maintenance Cell. Similar programme was also organised at sub-stations as well as Krishi Vigyan Kendra, Burdwan and North 24-Parganas.





Different events organised during Swachh Bharat Pakhwada

13.4. Swachh Bharat Pakhwada in MGMG Adopted Village

Awareness programme on Swachh Bharat Pakhwada was organized on 20th May, 2017 among the jute farmers of MGMG adopted village at Goadah in Swarupnagar block of North 24 Parganas district. About 60 farmers of Goadah and nearby villages participated in the programme. Scientists of ICAR-CRIJAF emphasised about general cleanliness by the villagers and farmers, awareness of cleanliness among the students and children of the villages, educated the farmers about Good Agricultural Practices (GAP) or clean agricultural systems and also advised for mental cleanliness which not only creates a better human society but also helps one to work more efficiently to reach higher goal.



MGMG farmers participated in Swachh Bharat Pakhwada



Awareness about Swachh Bharat among the school students

13.5. Visit of Dr. J.S. Sandhu, Deputy Director General (Crop Science), ICAR, New Delhi

Dr. J.S. Sandhu, DDG (CS) visited ICAR-CRIJAF on 19th June, 2017. He addressed the scientists of the institute and underlined the issues like diversification of agriculture with inclusion of pulses, large scale production of microbial retting consortium - CRIJAF Sona at CRIJAF in PPP model, economic analysis of different technologies including farm machineries developed by the institute, submission of details technologies to DAC for wide popularization, diversified uses of jute, state specific strategies etc.



Dr. J.S. Sandhu, DDG (Crop Science) interacting with scientists and staffs of ICAR-CRIJAF

13.6. Hindi Workshop

The Hindi Cell of ICAR-CRIJAF, Barrackpore organized one day Hindi Workshop on 20.06.2017 with major objectives to reduce the inertness among the employees to use Hindi in day to day official work. Dr. J. Mitra, Director, ICAR-CRIJAF chaired the inaugural session of the workshop. Dr. Ramesh Mohan, Hindi Professor (Hindi Education Programme), MoHA, Nizam Palace, Kolkata deliberated on Rajbhasha policies, rules, grammar etc. Dr. S.K. Pandey, In-charge, Hindi Cell and Mr. Manoj Kumar, Assistant co-ordinated the programme.



Participants during Hindi Workshop

13.7. Farmers' Training Programme on Improved Retting Technology of Jute

Training programme on 'Improved Retting Technology of Jute' was organized by KVK for the farmers of North 24 Parganas on 24th June, 2017. Twenty four farmers and farm women from Barasat I block of North 24 Parganas participated in this programme. The participants were oriented about improved retting technology of jute using CRIJAF Sona. A film was also shown to the trainees on this aspect. The training was coordinated by Dr. M. L. Roy, I/c KVK and Dr. B. Majumdar, Principal Scientist (Soil Science) acted as resource persons. Packets of CRIJAF Sona powder were distributed amongst the farmers. Trainees were also sensitized about Pradhan Mantri Fasal Bima Yojana (PMFBY), Pradhan Mantri Krishi Sinchai Yojana (PMKSY) and Swachh Bharat Mission.

13.8. International Yoga Day, 2017

'International Yoga Day' was celebrated on 21.06.2017

at ICAR-CRIJAF. Sh. Anup Kumar Chakraborty, disciple of Yogaguru Baba Ramdev, trained the staff members about various *asanas* as well as *pranayamas* with their merits as well as precautions. About 125 staff members participated in the programme.



Practicing yoga during International Yoga Day

13.9. Trainers' Training-cum-Demonstration Programme on Improved Retting Technology of Jute

A trainers' training-cum-demonstration programme on Improved Retting Technology of Jute was organized at ICAR-CRIJAF, Barrackpore on 28th June, 2017. The training programme was sponsored under Jute-ICARE programme. Twelve Block Supervisors, 24 Master Trainers, Deputy Marketing Manager and Marketing Manager of JCI from West Bengal, Assam, Odisha and Bihar participated in this programme. During the training programme, the participants were oriented about improved retting technology of jute using CRIJAF Sona. A film was also shown to the trainees on this aspect. Dr. B. Majumdar, PS (Soil Science), Dr. M.L. Roy, Scientist (Agricultural

Extension). Dr. S. Sarkar, PS (Agronomy) and Dr. S.K. Jha, PS (Agricultural Extension) coordinated the training.



Participants with resource persons during group photo session

13.10. Institute Management Committee (IMC) Meeting

The 33rd Institute Management Committee (IMC) meeting of ICAR-CRIJAF for 2017-18 was held on July 6, 2017 under the Chairmanship of Dr. Jiban Mitra, Director, ICAR-CRIJAF. Other members present in the meeting were Prof. Srikumar Pal, DoR, BCKV; Mr. Ashis Lahiri, ADA, Govt. of West Bengal; Dr. A. Raja, Principal Scientist, ICAR- CICR; Dr. S. K. Mishra, Principal Scientist, ICAR-NRRI; Dr. A. Selvi, Head, Biotechnology, ICAR-SBI; Dr. Amitav Mohanty of DuPont India Pvt. Ltd; Mr. Ashok Kumar Das and Mr. Umasankar Singh, Farmers' representative. Sh. Rajib Lal, CAO as Member Secretary, organized the meeting. Heads of the Divisions/Sections, SIC of AINP on JAF, SICs of Regional Stations, PC (I/c)s of KVK Purba Bardhaman and North 24 Parganas (Nilganj), SIC, PME cell and FAO, ICAR-CRIJAF were also present in the meeting.



Dr. Jiban Mitra, Director, ICAR-CRIJAF is chairing the IMC meeting



Dr. S. Mitra, PS Scientist and In-charge, AINPJAF presenting the achievements of the Institute in IMC meeting

13.11. Farmers' Day-2017

'Farmers' Day-2017' was organised on 25.07.2017 at Brahmapur village of Haringhata block in Nadia district to sensitize the farmers about the recent developments on improved production technologies of jute. More than 200 progressive farmers participated in this programme. Farmer-scientist interaction and retting demonstration were also conducted for better awareness of the farmers about new jute production technologies. The farmers adopting the CRIJAF technologies also expressed their views. Farmers from Hooghly, Nadia, Murshidabad and North 24 Parganas participated in the programme.



Dr. Jiban Mitra, Director, ICAR-CRIJAF addressing the farmers



Dr. Jiban Mitra, Director, ICAR-CRIJAF distributing 'CRIJAF SONA' among the farmers



Farmer giving feedback on CRIJAF technology



Mr. Abhijit Dey, A.O., AICIL detailing the PMFBY scheme to the farmers



Demonstration on use of 'CRIJAF SONA' during the Farmers' Day

13.12. Awareness Programme on Pradhan Mantri Fasal Bima Yojana (PMFBY)

An awareness programme for farmers on PMFBY was organized by the KVK North 24 Parganas (Nilganj) on 26.07.2017 at ICAR-CRIJAF, Barrackpore. Eighty nine farmers and farm women from Barrackpore-I, Barrackpore-II, Barasat-I and Hasnabad block of North 24 Parganas district participated in this programme. Officials from Agricultural Insurance Company of India Limited (AICIL), Kolkata region sensitized the farmers about PMFBY. At the onset of the programme, Heads of Divisions of ICAR-CRIJAF, Nodal Officer and I/c PC of the KVK explained different aspects of the policy. After that officials from AICIL detailed the scheme to the farmers in a very simple and effective manner.

13.13. Independence Day

Independence Day, 2017 was celebrated on 15th August, 2017 at ICAR-CRIJAF. Dr. Jiban Mitra, Director, ICAR-CRIJAF hoisted the National Flag. It was followed by recitation of National Anthem in the occasion. The ex-service security personnel of the institute paid Guard of Honour to the Tricolour. In this occasion the sacrifices of great Indians during the Independent Movement were remembered. Director, Head of the Divisions, In-charges of the Sections and Units, Administrative Officer, FAO and other senior officers conveyed the message of Independence Day in this occasion and encouraged the young and the children, assembled at the venue, for dedication and service to the Nation.



Dr. Jiban Mitra, Director, ICAR-CRIJAF addressing on the Independence Day

13.14. New India Manthan-Sankalp se Siddhi Programme

On 26th August, 2017 KVK -II, North 24 Parganas organized a programme on "New India Manthan-Sankalp se Siddhi" to commemorate 75th anniversary of 'Quit India Movement' for making a New India by 2022 as envisioned by Hon'ble

Prime Minister of India. Hon'ble Member of Parliament, Dr. Tapas Mandal greeted the gathering and articulated the importance of New India Manthan-*Sankalp se Siddhi* programme. He also applied the farmers to take advantages of Government Schemes and Policies for doubling their income. He lauded the role of ICAR-CRIJAF and its KVKs for the efforts put in by its scientists for serving the farming community. A video message for *Sankalp Se Siddhi* by Hon'ble Prime Minister and an inspirational film of Ministry of Agriculture & Farmers Welfare were also shown to all the participants on this occasion. All farmers and guests present in this programme taken *Sankalp se Siddhi* pledge. The function was attended by about 200 farmers.



Pledge taking ceremony



Dr. Tapas Mandal, Hon'ble MP visiting the exhibitions on this occasion

13.15. Hindi Saptaha

Hindi Week was celebrated during 14th -20th September 2017 at ICAR-CRIJAF, Barrackpore. Dr. Jiban Mitra, Director of the institute inaugurated the programme. He requested the staffs of the institute to make efforts to use Hindi in official communication as the region is under 'C' zone. Smt. Rita Bhattacharyya, former Chief Manager, *Rajbhasa* Division of United Bank of India, Kolkata as Chief Guest highlighted the importance of Hindi as *Rajbhasa* and appreciated the staffs of the institute to develop habit and working in Hindi. Several competitions were also arranged and the staffs enthusiastically participated in the competitions.

13.16. Swachhta hi Seva campaign

The campaign entitled '*Swachhta hi Seva*' was celebrated during September 15 to October 2, 2017. The programme started with pledge taking ceremony. Various programmes like *Seva Divas*, *Samagra Swachhta Divas*, *Sarvanta Swachhta Divas*, *Swachhta* at tourist spot and construction of low cost bio-toilet making were performed during this period.



Low cost bio-toilet making



Cleaning of farm road



Cleaning of departmental premises

13.17. Celebration of Vigilance Awareness Week

Programme at Institute: As per the directives from the Council, ICAR-CRIJAF-conducted various programmes during the observance of Vigilance Awareness Week – 2017 (30th Oct. to 4th Nov. 2017). Dr. Jiban Mitra, Director, administered the Integrity Pledge to all the staffs of the institute on 30.10.17 followed by a debate competition on the theme topic, “My vision- Corruption free India”. Quiz Competition was also organised on 01.11.17 to create interest and awareness among the employees on matters related to vigilance, corruption, major scams, institutions and organizations related to vigilance in India and outside. In a sensitization programme for staffs of different categories the Director, Head of Divisions, SIC of sections, Vigilance Officer and the Finance and Accounts Officer addressed the staffs and elaborated about the bad effects of corruption in public office, society and the country. The senior officials stressed about the importance of integrity, vigilance, good governance and self-discipline in public life.

Programme outside institute: During the VAW-2017, ICAR-CRIJAF organized various programmes like Quiz Competition and Sensitization Programme at Sewli High School, Sewli, Sharada Shishu Shiksha Niketan, Sewli, West Bengal State University, Barasat and IRDM Faculty Centre, Ramakrishna Mission Ashram, Narendrapur. Besides, 54 farmers of Madhusudanpur and nearby villages of Singur block participated in an awareness programme on vigilance and corruption. (Source: Dr. S. Satpathy, Vigilance Officer)



Debate competition on VAW-2017



Quiz competition and Sensitization Programme at Sewli High School, North 24 Pgs.



Pledge taking ceremony on VAW-2017



Winner of the Quiz competition awarded VAW-2017 at RKMVU, Narendrapur

13.18. Research Advisory Committee (RAC) Meeting

The Research Advisory Committee (RAC) meetings of the ICAR-CRIJAF were held at Barrackpore and CSRSJAF, Budbud, Burdwan during 7-8 November, 2017 under the chairmanship of Dr. S. A. Patil, Ex-Director, ICAR-IARI,

New Delhi. The committee discussed in details the research activities of scientists of ICAR-CRIJAF during the last one year. The RAC was satisfied with the Action Taken Report (ATR) presented in the meeting. Under the broad mandate of the Institute, the RAC made specific recommendations for further strengthening of the research activities of the Institute.



RAC meeting chaired Dr. S.A. Patil, Ex- Director, IARI



Visit of RAC Team at CSRSJAF, BudBud

13.19. Celebration of Constitution Day

Constitution Day was celebrated on 27.11.17 at ICAR-CRIJAF and its sub-stations. The preamble of the constitution was read out on the occasion. The Director, CAO and other senior officials highlighted the importance of constitution in the success of Indian democracy. Besides, the uniqueness and greatness of Indian constitutions scripted by *Bharat Ratna* Dr. B.R. Ambedkar were also remembered.



Reading out preamble of Constitution on Day Constitution

13.20. Celebration of Agricultural Education Day

Agricultural Education Day was celebrated on 3rd December 2017 at ICAR-CRIJAF, Barrackpore in order to sensitize the school students on the contribution of Indian Agriculture in Indian Economy and livelihood and to provide an outlook of agricultural sciences as a future career option. A series of events was organized to celebrate this auspicious day at the Institute, including interactive discussion, essay competition, career counselling and field tour. About 60 students from nearby schools participated in these events. Dr. Shamna A., Dr. P. Satya and Dr. Suman Roy shared the information on career opportunities in agriculture and allied sectors. Leaflets were also distributed to the students highlighting the career opportunities in agriculture.



Essay writing competition in Agricultural Education Day



Distribution of prizes to winning participants

13.21. Celebration of World Soil Day

A farmer-scientist interaction meeting and an awareness programme on the occasion of 'World Soil Day' (5th

December 2017) was organised by KVK North 24 Parganas (Nilganj) at ICAR-CRIJAF, Barrackpore. Dr. Jiban Mitra, Director, ICAR-CRIJAF highlighted the importance of soil testing and urged the farmers to make use of the Soil Health Cards for the betterment of farming practices. About 100 farmers of North 24 Parganas district participated in this programme. A video film on World Soil Day 2017 from Soil Health Card Portal was screened before the farmers to motivate them to make best use of this farmer-friendly programme. Farmers were informed about the message of Hon'ble Prime Minister through 'Man ki Baat' programme on 27th November 2017 to motivate the farmers about use of Soil Health Card and use of balanced soil nutrients.



Dr. Jiban Mitra, Director, ICAR-CRIJAF addressing the world soil day

13.22. Brainstorming workshop at Sisal Research Station, Bamra

A brainstorming workshop on "Sisal Grading and Electronic Instrumentation" was organised at Sisal Research Station, Bamra on 25th August, 2017 by ICAR- NIRJAFT, Kolkata. About 70 farmers from Jharsuguda and Sambalpur districts of Western Odisha participated in the programme.



Brainstorming workshop at SRS, Bamra

13.23. Institute Foundation Day

The 65th Institute Foundation Day of ICAR-CRIJAF was celebrated on 9th February, 2018. Sports and game competitions were organized among the staff and their family members and the winners were awarded with prizes. Director (Acting), Dr. J. Mitra cut the cake on the occasion.



Celebration of Institute Foundation Day

He greeted all the staffs and family members in this special occasion. Director, HODs and other senior officials deliberated on the achievements and golden history of the Institute. The contributions of promising scientists were also recalled.



Staff members participating in Foundation Day sports

14. Awards and Recognitions

14.1. Awards

- Dr. D. K. Kundu, Head of Division (Crop Production) was inducted as *Fellow of the Indian Society of Soil Science* at the 82nd Annual Convention of the Society at Kolkata on 11th December 2017 in recognition of his outstanding contributions in development of techniques for improving nitrogen use efficiency in lowland rice, conservation and recycling of nitrate for sustaining soil fertility in rainfed rice through inclusion of drought-tolerant and dual-purpose legumes in cropping system.



Dr. D.K. Kundu inducted as Fellow of Indian Society of Soil Science

- Dr. Amit Bera, Scientist was awarded with Best Oral presentation in the theme entitled 'Effect of scarification treatments on seed coat imposed dormancy in five wild species of Genus *Corchorus*' in the Third International Conference on Bio-resource and Stress Management on 8-11 November, 2017, Jaipur.
- Dr. M.S. Behera, Principal Scientist was awarded with 'Krishi Gaurav Samman 2017' by Bhartiya Krushi Anusandhan Samiti and Krushi Anusandhan Sanchar Kendra, Karnal-132001
- Dr. D. Barman, Sr. Scientist was awarded with Jagar Nath Raina Memorial Awards 2017, conferred by SADHNA, Society for Advancement of Human and Nature, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan for the Best Research Paper in the journal, *Agroforest System*.
- The ICAR-CRIJAF sports contingent participated in ICAR Zonal Sports Tournaments-2017 (Eastern Zone) held at ICAR-RCER, Patna from 12th to 17th

November, 2017. Total 11 medals (3 gold + 4 silver + 4 bronze) were won by the contingents. Volley ball team (smashing) won the Gold Medal in team event. Among individual events Sh. Uma Sankar Das won Gold Medal in long jump and high jump, Sanjay Sethi won Bronze in long jump, Laxman Pradhan won Silver in cycle race. Sh. Ritesh Kumar won four medals in high jump (silver), 1500m race (Silver), 800m race (Bronze) and 400m race (Bronze).



Players showing the medals Felicitation of the participants

14.2 Recognitions

- Dr. A.K. Chakraborty, Scientist was invited as a guest lecturer at the Institute of Agricultural Science, Calcutta University for teaching course on Agricultural Statistics for M. Sc. (Ag.) students.
- Dr. D.K. Kundu, Principal Scientist has been selected as Editor for the Journal of Indian Society of Soil Science, New Delhi during the year 2017-18.
- Dr. D.K. Kundu, Principal Scientist has been selected as member of the Executive Council, Kolkata Chapter of the Indian Society of Soil Science for the year 2017-18.
- Dr. P. Satya, Principal Scientist, served as member, Editorial Board of Indian Journal of Genetics and Plant Breeding for the year, 2017-18.
- Dr. Ranjan Kumar Naik, Sr. Scientist (FMP) has been nominated as Member of Selection Committee for Recruitment of Subject Matter Specialist (Agril. Engg.) at Krishi Vigyan Kendra (KVK), Purulia on 2nd November, 2017.
- Dr. Ritesh Saha, Principal Scientist has been nominated as External Examiner for evaluation of dissertation and the viva-voce examination of

M.Sc students in Soil Science and Ph.D student in Agricultural Meteorology discipline at BCKV, Mohanpur, Nadia, for the year 2017.

- Dr. S.K. Sarkar, Principal Scientist has been nominated as External Examiner for evaluation of Ph.D thesis at Viswa Bharati University, Santiniketan and UBKV, Pundibari, Coochbehar for the year 2017.
- Dr. S. Sarkar, Principal Scientist was invited by the Editor, Yojana (Publication Division, Govt. of India) for preparation of articles in Bengali based on English write-ups of renowned personalities like Prof. M.S. Swaminathan on Central Budget and Indian Agriculture.
- Dr. S. Sarkar, Principal Scientist was invited by the Society for Advancement of Agricultural Innovations (SAAI) for Lead Lecture/ Paper on "Jute: Best alternative to polythene" at the National Conference on "Innovative Farming for Food and Livelihood Security in Changing Climate" organized at BCKV, Kalyani during 12-13 January, 2018
- Dr. S.K. Sarkar, Pr. Scientist (Plant Pathology) has been nominated as member of Selection Committee for Recruitment of Subject Matter Specialist (Plant Protection) at Krishi Vigyan Kendra (KVK), Purulia on 1st November, 2017.
- Indian Council of Agricultural Research selected ICAR-CRIJAF as the Regional Office for National Agricultural Education Accreditation Board (NAEAB) for Eastern and North Eastern Region. Dr. S.K. Sarkar, Pr. Scientist (Plant Pathology) has been selected as Regional Co-coordinator
- Dr. S. Satpathy, HoD, Crop Protection was invited to chair Technical Session on IPM and deliver a lead lecture in the National Seminar on "Crop Protection: Current Trends and Future Perspective" organized by SASRD, Nagaland University, Medziphema, during 16-18 November, 2017.
- Dr. S. Satpathy, HoD, Crop Protection was invited by Indian Society of Vegetable Science to deliver an invited lecture in the National Conference-NCVEG-17 at ICAR-IIVR, Varanasi during 9-11 December, 2017.
- Dr. S. Satpathy, HoD, Crop Protection delivered an invited lecture in the XVI-AZRA International Conference on Applied Zoological Research for Sustainable Agriculture and Food Security held at I.Ag.Sc, BHU, Varanasi during 9-11, February, 2018.

15. Research Projects

15.1. In-house Research Projects

Project no.	Project title and investigator(s)	Duration
Crop Improvement		
CI-1: Genetic resource management and utilization of jute and allied fibre crops		
JB 1.1	Introduction, maintenance, characterization and conservation of jute, mesta and flax germplasm: <i>J. Mitra</i> (w.e.f. 04.07.2017), <i>A. Bera</i> (w.e.f. 04.07.2017), <i>A. Anil Kumar</i> (w.e.f. 22.11.2012), <i>D. Saha</i> (w.e.f. 04.09.2014) and <i>S. Dutta</i> (24.04.2015)	1997-Long term
CI-2: Breeding jute for higher fibre productivity and quality		
JB 9.5	Development of DNA fingerprint for varietal identification in jute: <i>J. Mitra</i> , <i>C.S. Kar</i> and <i>A. Anil Kumar</i>	2014-18
JB10.1	Genetic improvement of jute genotypes to biotic stresses: <i>A. Anil Kumar</i> , <i>K. Mondal</i> and <i>B.S. Gotyal</i>	2015-20
JB 10.4	JB 10.4 Genetic improvement of jute and mesta for diversified end use : <i>P. Satya</i> , <i>S. K. Pandey</i> , <i>S. Roy</i> and <i>Soham Roy</i> (w.e.f. 23.10.2017)	2017-21
CI-3: Breeding mesta for higher fibre productivity and quality		
JB 9.6	Evaluation and selection for high fibre yield and other diversified uses in roselle (<i>H. sabdariffa</i>): <i>Maruthi R.T.</i> , <i>A. Anil Kumar</i> and <i>A.R. Saha</i>	2014-18
JB10.0	Genetic enhancement of kenaf using conventional and molecular approaches for fibre yield and quality improvement: <i>S.K. Pandey</i> , <i>P. Satya</i> and <i>P.N. Meena</i>	2015-20
CI-4: Breeding allied fibre crops for higher fibre productivity and quality		
JB10.2	Genetics of self-incompatibility and development of improved fibre yielding populations in sunnhemp (<i>Crotalaria juncea</i> L.): <i>Maruthi, R.T.</i> and <i>S. Datta</i>	2015-18
JB10.3	Genetic improvement of flax (<i>Linum usitatissimum</i>) for higher fibre productivity and fibre quality: <i>J. Mitra</i> , <i>D.N. Saha</i> , <i>Monu Kumar</i> and <i>Kunal Mandal</i>	2016-22
CI-5: Genetic improvement of jute and allied fibre crops through biotechnology		
JB 9.3	Towards harnessing cell technological approaches for the enhancement of jute and allied fibre: <i>A.B. Mandal</i> , <i>Kanti Meena</i> and <i>R.K. De</i>	2013-18
JBT 4.5	Genetic purity testing and varietal fingerprinting in mesta using molecular markers: <i>Kanti Meena</i> , <i>P. Satya</i> , <i>S.K. Pandey</i>	2016-19
JBT 4.6	Fixation of a Multiparent Advanced Generation Inter-Cross (MAGIC) population of <i>Corchorus olitorius</i> : <i>D. Sarkar</i> and <i>P. Satya</i>	2017-20
JBT 4.7	Mining novel alleles for genome engineering applications for herbicide and stress tolerance in jute and allied fibers: <i>S. Datta</i> , <i>J. Mitra</i> , <i>D.N. Saha</i> , <i>P. Satya</i> and <i>A. Anil Kumar</i>	2017-20
CI-6: Bio-informatics of jute and allied fibre crops		
JBT 4.4	Development and utilization of resources for bioinformatics and database in jute and allied fibres: <i>D.N. Saha</i> , <i>S. Datta</i> and <i>A.K. Chakraborty</i>	2015-18
JST 6.1	Estimation of competition effects in jute-mungbean intercropping system : <i>A.K. Chakraborty</i> and <i>A.K. Ghorai</i>	2016-18
Crop Production		
CPDN-1: Studies on integrated management of weeds and ecofriendly agro-chemicals for JAF crops		
JA 5.6	Assesment of productivity and nutrient management for selected jute base cropping system : <i>M Kumar</i> , <i>A.K. Ghorai</i> , <i>S. Mitra</i> , <i>B. Majumdar</i>	2011-Sept. 2017

JA 5.9	Eco-physiological studies for weeds in jute : <i>Mukesh Kumar, A.K. Ghorai, S. Sarkar and D.K. Kundu</i>	2015-18
JA 7.3	Development of low-cost and eco-friendly integrated weed management technologies for jute : <i>A.K. Ghorai, M. Kumar and S. Roy</i>	2017-20
CPDN-2: Development of sustainable JAF-based cropping systems for increased farm income		
JA 6.9	Prospect of growing medicinal and aromatic plants in jute and sisal based cropping system : <i>M.S. Behera, S. Satpathy, D.K. Kundu, A.K. Jha and R.K. Naik</i>	2014-18
SLA 1.6	Use of drip irrigation for improving productivity of sisal based fruit-fibre system in central plateau region of India : <i>M.S. Behera, D.K. Kundu and A.K. Jha</i>	2015-19
JA 5.7	Conservation agricultural practices of jute based cropping systems under climate change scenario: <i>R. Saha, M.S. Behera, Mukesh Kumar, A.R. Saha, B. Majumdar, S. Paul Mazumdar, D. Barman, D.K. Kundu and R.K. Naik</i>	2015-20
JA 7.4	Physiological basis of drought tolerance at early growth stage in jute (<i>C. olitorius</i>) : <i>L. Sharma, J. Mitra, S. Mitra, P. Satya, D. Barman and S. Roy</i>	2017-20
JA 7.5	Physiology of flowering behaviour of jute under different photoperiod regimes : <i>S. Roy, D. Sarkar, P. Satya, L. Sharma, H.R. Bhandari and A. K. Jha</i>	2017-20
CPDN-3: Studies on soil-water-plant relationships in JAF crops		
JA 6.0	Modelling carbon sequestration under jute based agro-ecosystem : <i>A.K. Singh, S. Paul Mazumdar, D.K. Kundu, A.R. Saha, M.S. Behera and D. Barman</i>	2015-18
JA 7.2	Soil health characterization and carbon sequestration potential in ramie based cropping system in Eastern India: <i>Sonali Paul Mazumdar, S. Mitra, B. Majumdar, Monu Kumar and M. Kumar</i>	2016-19
CPDN-5: Farm mechanization and by-product utilization in JAF agriculture		
JAE 3.4	Development of manual multi-crop seed drill and dry land weeder for Gangetic alluvial soil : <i>R.K. Naik, A.K. Ghorai, S. Sarkar and S.K. Jha</i>	2014-18
JA 7.1 (DSS)	Climate change risk assessment in jute production and related advisory services through Decision Support System : <i>D. Barman, P. Satya, A.K. Singh, A.K. Chakraborty, R. Saha, S. P. Mazumdar, Shamna A. and S. Mitra</i>	2016-21
CPDN-6: Development of improved water-saving methods for retting jute and mesta		
JA 5.8	Studies on ribbon retting methods for quality fibre production in jute and mesta : <i>R.K. Naik, B. Majumdar, S.P. Mazumdar and R. Naik</i>	2015-18
Crop Protection		
CPTN-1: Insect pests-plant interaction and the pathogen system in JAF crops		
JM 8.5	Basic studies to understand process of stem rot disease development in jute : <i>K. Mandal, C. Biswas and C.S. Kar</i>	2014-18
JE 1.8	Studies on the role of VOCs conferring host plant resistance in jute : <i>B.S. Gotyal, Rajasekhara Rao (ICAR-CTCRI, Bhubaneswar), S. Satpathy and V. Ramesh Babu</i>	2015-18
JE 1.9	Bio-ecology and management of sucking pests in jute : <i>S. Satpathy, B.S. Gotyal and V. Ramesh Babu</i>	2016-21
CPTN-2: Investigation on PGPR and Bio-control for pest and disease management in JAF crops		
JM 8.8	Studies on entomopathogenic endophytes for pest management in jute with special reference to <i>Lecanicillium lecanii</i> : <i>C. Biswas and S. Satpathy</i>	2015-18
CPTN-3: Ecological, behavioural and epidemiological studies on pests and diseases of JAF crops		
JE 1.6	Preliminary studies on sex pheromones of major insect pests of jute and allied fibre crops : <i>V. Ramesh Babu, B.S. Gotyal and S. Satpathy</i>	2014-18

JM 9.1	Investigation on diseases of flax and their management : <i>S.K. Sarkar and K. Mandal</i>	2017-20
CPTN-4: Standardization and validation of IPM technologies in JAF crops		
JM 9.0	Development of IPM module for jute : <i>R.K. De, V. Ramesh Babu and Shamna A.</i>	2015-20
Agricultural Extension		
EXTN-1: Impact assessment of various technology transfer programme of CRIJAF		
JEXA 5.4	An analysis on outcome of technological interventions under TSP in Makaltala: <i>Shamna A, S.K. Jha, S. Kumar and S. Sarkar</i>	2014-18
JEXA 5.5	Agro-economic studies on the effect of technological interventions on livelihood of selected tribal farmers of Dakshin Dinajpur : <i>S. Sarkar, S. Saha (KVK), C. Jana (KVK), B. Goswami (KVK) and J. Dutta (UBKV)</i>	2015-18
JEXA 5.7	A study on farmers perception regarding plant protection management practices in jute based crop sequence of West Bengal : <i>S. Kumar, B.S. Gotyal, Shamna A and M.L. Roy</i>	2017-19
JEXA 5.8	Climate variability vis-à-vis jute-based cropping system in West Bengal-an appraisal based on farmers' perspective : <i>M.L. Roy, S.K. Jha, S. Sarkar, A.K. Ghorai, A.K. Singh and A.K. Chakraborty</i>	2017-20
Sisal Research Station, Bamra, Odisha		
Sisal-1: Development of improved production and protection technologies of sisal		
SLM 1.0	Studies on disease distribution, intensity and identification of sources of resistance against <i>Phytophthora</i> spp. causing zebra disease of sisal (<i>Agave sisalana</i>) <i>A.K. Jha, S. Sarkar and R.K. De</i>	2012-17
Ramie Research Station, Sorbhog, Assam		
Ramie-1: Collection maintenance, evaluation and utilization of ramie germplasm		
RB 1.0	Collection, maintenance and evaluation of ramie germplasm: <i>Monu Kumar and Amarpreet Singh</i>	Long term
Central Seed Research Station for JAF		
CSRSJAF 1.0	Investigations on crossing barriers in inter-specific crosses in the genus <i>Crotalaria</i> <i>H.R. Bhandari and Maruthi R.T.</i>	2017-20

15.2. Externally Funded Projects

Sponsor	Project title and Principal Investigator(s)	Duration
Mega Seed Project (MSP)	Seed production in agricultural crops and fisheries: <i>C.S. Kar.</i>	Long-term
DAC	Protection of jute varieties and DUS testing project: <i>Amit Bera</i>	Long-term
AICRP, LTFE (JC 5.2)	To study changes in soil quality, crop productivity and sustainability under jute-rice-wheat cropping system (LTFE) : <i>D.K. Kundu</i>	Long-term
AICRP-STCR (JC 5.6)	Soil test and resource based integrated plant nutrient supply system for sustainable agriculture : <i>A.R. Saha</i>	Long-term
AICRP-STCR (JC 5.6a)	Long term effect of ST-TY equation based INM on yield, value addition, nutrient budgeting and quality of soil under jute-rice-lentil sequence : <i>A.R. Saha</i>	Long-term
BRNS	Induction and characterization of <i>tossa</i> jute (<i>Corchorus olitorius</i>) mutants for fibre yield attributes and quality parameters : <i>S.B. Chaudhary (upto 5.7.17), A. Anil Kumar (w.e.f. 5.7.2017 as PI)</i>	2014-17

Sponsor	Project title and Principal Investigator(s)	Duration
NFSM	Commercial crop-jute : <i>C.S. Kar</i>	2014-18
NFSM-Sub-project	Front Line Demonstration (FLD) on jute: <i>S.K. Jha</i>	Long-term
ICAR-NATP Subproject 3070	Genome sequencing and functional genomics of bast fibre quality : <i>D. Sarkar</i>	2015-18
MSME	IP facilitation centre for jute products and other regional handicrafts of West Bengal : <i>C. Biswas</i>	2016-21
DST	Natural Resource Management for Climate Smart Jute Farming through Capacity Building of Scheduled Caste Farmers in West Bengal : <i>A.K. Singh</i>	2016-19
DST	Development of an efficient in vitro micro-propagation protocol for production of healthy propagules in ramie (<i>Boehmeria nivea</i> L. Gaud) as planting material for enhanced productivity in sustainable scale : <i>A.B. Mandal</i>	2016-19
NRSC, ISRO	Quantitative assessment of carbon and moisture fluxes over Jute based agro-ecosystem: Integrating ground observations, Satellite data and modelling : <i>D. Barman</i>	2018-20

16. Publications

16.1. Research Papers

- Arora, S., Mahato, A.K., Singh, S., Mandal, P., Bhutani, S., Dutta, S., Kumawat, G., Singh, B.P., Chaudhary, A.K., Yadav, R., Gaikwad, K., Sevanthi, A.M., Datta, S., Rajee, R.S., Sharma, T.R., Singh, N.K. (2017). A high-density intraspecific SNP linkage map of pigeonpea (*Cajanus cajan* L. Millsp.). *PLoS ONE*, 12(6): e0179747.
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16.2. Bulletin

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16.3. Book Chapters

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16.4. Training Manual

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16.5. Popular Articles

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16.9. Radio Talk

- Dr. B. Majumdar, Principal Scientist participated as an expert in the "*Khet Khamarer Katha*" programme for farming community of India and Bangladesh on a topic "*Pater Bhalo Falan O Unnoto Gunomaner Aansh*" broadcasted by the Akāshvani Maitree Channel of All India Radio, Kolkata on 15/05/2017.
- Dr. S. Sarkar, Principal Scientist participated as an expert in the "*Khet Khamarer Katha*" programme for farming community of India and Bangladesh on a topic '*Unnata Paddhatite Pāt Chās*' broadcasted by Akāshvani Maitree Channel of All India Radio, Kolkata on 14/05/2017
- Dr. S. Sarkar, Principal Scientist delivered a radio talk on '*E samaye pāt chāse ki ki karaniyo*' in popular radio programme *Ajker Chās Bās*, broadcasted by Akashvani Kolkata 'A' on 16.5.2017.
- Dr. M.L. Roy, Scientist delivered a radio talk on 'IPM in Rice' in popular radio programme "*Krishi Kothar Asor*" broadcasted by Akashvani Kolkata on 20.07.2017.

17. Library, AKMU, ITMU and PME Cell

17.1. Library, Information and Documentation Unit

The institute library performs its designated services and activities such as acquisition of books and journals, exchange of literature, classification and cataloguing of documents and other documentation works. The library has rich collection of books and journals of different agricultural and basic sciences especially on jute and other fibre crops such as sisal, ramie, flax, sunnhemp, mesta, etc. The library holds popular magazines, newsletters and annual report of various research organizations, proceedings, research highlights of the ICAR institutes, SAUs and other useful reading materials received from different relevant organizations. The library has a collection of over 10,305 books and 11,720 bound volume of journals during 2017-18. AGRIS CD is available in the library from 1971 to 2005 for easy access of abstracts of different publications. CRIJAF publications were provided to over 350 different organizations in India and abroad. The institute publications likes Annual Report, AINPJAF Report, JAF news were distributed to different institutes, stakeholders of jute and allied fibres and visitors. Library also provides internet and reprography services to the readers along with Document Delivery Services (DDS) system by Consortium for e-Resources in Agriculture (CeRA) to access different journals online. Under the DDS system the library had sent copies of publications as per request to researchers/academicians of different agricultural institutes and SAUs for India. (Source: Library; Contributor: Mukesh Kumar).

17.2. Agricultural Knowledge Management Unit (AKMU)



The main activities of ICAR-CRIJAF Agricultural Knowledge Management Unit (AKMU) are maintenance and provision of internet and Email facilities, designing, developing and maintenance of Institute Website and Video Conferencing Systems and other computer related works including LAN and systems management in the Institute. AKMU activities also include periodical updating of Institute website. The

ICAR-IASRI developed online applications viz., Personnel Management Information System Network (PERMISNET), Project Information and Management System of ICAR (PIMS-ICAR), Half Yearly Progress Monitoring System of Scientists (HYPM), ICAR KRISHI portal are also updated in connection with PME cell.

AKMU has designed and developed new website of ICAR-CRIJAF (crijaf.org.in) as per the ICAR guidelines. The Institute website provides overall research activities and achievements of the institute and its research centres. The contents of the institute website are periodically being updated.

100 Mbps leased line internet connectivity under National Knowledge Network (NKN) was provided by ICAR. The internet and Email services were available round the clock for the employees of the Institute. The internet services are spread over more than 100 users of all categories of staff are using the internet and e-mail services in the institute. Beside the NKN connectivity, one BSNL broadband is also available at AKMU as backup. Maintenance of LAN infrastructure in the Institute is done through CISCO Gigabit Switches and the whole LAN is distributed through a SONICWALL firewall installed at AKMU with fibre optic backbone connectivity to all buildings. Server centric Antivirus & Antispam, Web & Application filter and Intrusion detection & Prevention (IDP) are installed to support the virus protection for the end users. The IP based video conferencing system is active at ICAR-CRIJAF-AKMU to conduct video conference between two locations, that can be connected for communication. AKMU also facilitates the multimedia presentations for various lectures, training, workshop, seminars, symposia etc. (Source: AKMU; Contributor: C.S. Kar and N. Paul)

17.3. Institute Technology Management Unit (ITMU)

17.3.1. Follow up action on patent applications

First examination report of 386/KOL/2010 (CRIJAF Nail Weeder) and 319/KOL/2010 (CRIJAF Herbicide Applicator) have been received and reply of the inventor has been communicated to the patent attorney, M/s MKC and Associates for further processing. Application for approval of National Bio-diversity Authority (NBA) regarding 1036/Kol/2008 (An Improved Process of Large Scale Degumming of Ramie Fibre) was filed (Form III) (Source: Dr. S.K.Sarkar).

17.3.2. Germplasm Registration

Following germplasms have been registered during 2017-18

Crop	Botanical Name	National Identity	Donor/Other	Novel Unique Trait(s)
Jute	<i>Corchorus olitorius</i> L.	IC0503186	OMU 005	Superior fibre wedge length and diameter
Jute	<i>Corchorus olitorius</i> L.	IC0503703	OMU 007	Superior bark cross section length
Jute	<i>Corchorus olitorius</i> L.	IC0503297	OMU 018	High number of fibre cells/fibre bundle
Jute	<i>Corchorus olitorius</i> L.	IC0621946	Sdf (Super dwarf) mutant	Extremely dwarf mutant with around 1/10 th plant height of wild type
Jute	<i>Corchorus olitorius</i> L.	IC0621948	llpf (low lignin phloem fibre mutant)	Low lignin content of fibre (6.7%) at 120 days after sowing. Unique morphology having undulated stem petiole and main leaf vein
Jute	<i>Corchorus olitorius</i> L.	IC0621949	Pfr 59 (pre-mature flowering resistant 59)	Absolute absence of pre-mature flowering when sown in the first week of February
Jute	<i>Corchorus olitorius</i> L.	IC0621650	WCIN 009	High iron content in leaves (173.75 mg/kg fresh weight)

(Source: Dr. S.K.Sarkar)

17.3.3. Commercialization of the technologies

M/s Bengal Biotech & Research, West Bengal has been awarded the non-exclusive license for large scale production and sale of CRIJAF SONA for a period of 1 year w.e.f. 15th March, 2018 (Source: Dr. S.K.Sarkar).



MoU signed with M/s Bengal Biotech & Research

17.3.4. Royalty

During 2017-18, total Rs. 25,32,325/- was received as royalty payment of various commercialized technologies (CRIJAF-Nail Weeder, CRIJAF Multi-row Seed Drill, CRIJAF SONA, CRIJAF Flax Fibre Extractor, CRIJAF Single Wheel Jute Weeder and CRIJAF Herbicide Applicator).



M/s Krishi Udyog representative handing over a cheque as royalty payment to Director, ICAR-CRIJAF

17.3.5. Outreach Programme

Technologies like JRO 204, Multi-Row Seed Drill, CRIJAF SONA, Single Wheel Jute Weeder through Jute I-CARE have been disseminated in large area (65,000 ha) among 1.10 lakhs farmers in jute growing areas of West Bengal, Assam, Odisha, Bihar during 2017-18 under the programme Jute-ICARE sponsored by National Jute Board, Kolkata. (Source: Dr. S. Satpathy).

17.3.6. Workshop on ITMU

Dr. S.K. Sarkar, I/c ITMU, ICAR-CRIJAF attended the review meeting of ZTMC (Zonal Technology Management Centre) at ICAR-Indian Institute of Millets Research, Hyderabad on 16th December, 2017. Different aspects of IPR issues like patent application status, commercialization of technologies, registration of jute varieties and royalty

earnings were discussed at length. As per the follow up actions ICAR-CRIJAF submitted its technology profiles and success stories to the ZTMC, Hyderabad.



Participants at review meeting of ZTMC (Zonal Technology Management Centre), at IIMR, Hyderabad

17.3.7. Uploading in Krishi Portal

Various information like Institute publication (Annual Reports, JAF News, Visions) and technologies (CRIJAF SONA, CRIJAF Multi Row Seed Drill, CRIJAF Nail Weeder, CRIJAF Herbicide Applicator) invented by the scientists of ICAR-CRIJAF are uploaded in ICAR-Krishi Portal (*krishi.icar.gov.in*). (Source: ITMU; Contributor: S.K. Sarkar)

17.4. Prioritization, Monitoring and Evaluation (PME) Cell

The PME cell of ICAR-CRIJAF was established as per guidelines of the Council. It comprises of a group of four scientists headed by a Principal Scientist and one Assistant Chief Technical Officer. 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. Important activities performed

by the cell are conducting Institute Research Council (IRC) meeting, maintaining Research Project Proforma (RPP), processing of files for CAS of scientists, coordinating online submission of Half Yearly Progress Monitoring (HYPM) report of all the Scientists of the Institute, updating online programme–PERMISNET and PIMS-ICAR. Coordinating reply of Parliamentary question, Annul Plan, DARE report, ATR of Directors’ meet and Regional Committee Meetings and coordination of research audit of the institute. The PME cell also facilitates in providing the research information of the institute to other departments and stakeholders (Source: PME Cell; Contributor: S.K. Sarkar)

17.4.1. Collaborative research programmes

ICAR-CRIJAF has initiated a number of collaborative research programmes with several prestigious institutes and organizations to improve the quality of research programmes on jute and allied fibres and to strengthen linkages among the stakeholders to disseminate knowledge and technologies for benefitting jute farming community. In 2017-18 following collaborative activities were undertaken.



ISRO team monitoring the installation of Eddy Tower at ICAR-CRIJAF

S. No	Name of the collaborative organization	Type of activity undertaken
1	National Remote Sensing Centre (ISRO), Hyderabad	Assessment of carbon and moisture flux in jute based cropping system
2	CSIR-Indian Institute of Chemical Technology, Hyderabad	Isolation and characterization of sex pheromones of insect pests of jute
3	ICAR-National Research Centre on Plant Biotechnology, New Delhi	Genome sequencing and development of genomic resources in jute
4	ICAR-National Institute of Research on Jute and Allied Fibre Technology, Kolkata	Fibre quality testing, training and technology dissemination
5	Integrated Rural Development and Management, Narendrapur, Kolkata	Teaching, research and human resource development
6	Northern India Textile Research Association, Ghaziabad	Production of quality flax seed (JRF2) for area extension of flax in Northern India
7	NJB and JCI, Ministry of Textiles, Govt. of India, Kolkata	Promotion of CRIJAF technologies, training, Jute-ICARE and other programmes
8	Agriculture Department, Govt. of W. Bengal	Dissemination of CRIJAF technologies and training
9	Directorate of Jute Development, Govt. of India, Kolkata	Sharing of expertise for transfer of technologies as well as implementation of NFSM programme

18. राजभाषा कार्यान्वयन (Official Language Implementation)

भाकृअनुप-केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान के लक्ष्य, कार्यक्षेत्र तथा राजभाषा गतिविधियाँ

केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान एक प्रमुख राष्ट्रीय संस्थान है जिसे पटसन एवं समवर्गीय रेशा उत्पादन में वृद्धि हेतु आवश्यक अनुसंधान तथा उसे किसानों तक पहुँचाने का दायित्व सौंपा गया है। इस संस्थान की स्थापना वर्तमान स्थान नीलगंज, बैरकपुर, कोलकाता में सन् 1953 के दौरान हुई जिसका कुल क्षेत्रफल 62.8 हेक्टेयर है।

संस्थान के अनुसंधान कार्य को तीन प्रभागों नामतः फसल उन्नतिकरण (Crop Improvement), फसल उत्पादन (Crop Production) और फसल सुरक्षा (Crop Protection) तथा पाँच अनुभागों जैसे – जैव प्रौद्योगिकी, कृषि अभियांत्रिकी, फार्म मशीनरी एवं पाँवर, कृषि विस्तार तथा कृषि मौसम विज्ञान के अंतर्गत व्यवस्थित किया गया है। इन अनुसंधान प्रभागों एवं अनुभागों की सहायता हेतु फार्म, वर्कशाप, पुस्तकालय, संस्थान प्रौद्योगिकी प्रबन्धन एकक, कृषि अनुसंधान सूचना प्रणाली कक्ष, प्रशासन अनुभाग, वित्त व लेखा अनुभाग भी कार्यरत हैं। संस्थान में मौलिक, सामरिक तथा क्षेत्र अनुकूल अनुसंधान कार्य हेतु आवश्यक प्रयोगशालाएँ व क्षेत्रीय सुविधाएँ उपलब्ध हैं।

संस्थान ने पटसन एवं समवर्गीय रेशा तथा बीजों से संबंधित अनुसंधान कार्य हेतु देश के विभिन्न भागों में 4 अनुसंधान केन्द्रों की स्थापना की है, जो निम्नवत हैं:

1. रेमी अनुसंधान केन्द्र, सरभोग, असम (वर्ष 1959 में स्थापित), कुल क्षेत्रफल 60 हेक्टेयर।
2. सीसल अनुसंधान केन्द्र, बामरा, ओड़िशा (वर्ष 1962 में स्थापित), कुल क्षेत्रफल 106.4 हेक्टेयर।
3. सनई अनुसंधान केन्द्र, प्रतापगढ़ उत्तर प्रदेश (वर्ष 1963 में स्थापित), कुल क्षेत्रफल 12.4 हेक्टेयर।
4. केन्द्रीय पटसन एवं समवर्गीय रेशा बीज अनुसंधान केन्द्र, बुदबुद, वर्दवान, पश्चिम बंगाल (वर्ष 1956 में स्थापित), कुल क्षेत्रफल 86.1 हेक्टेयर।

इन केन्द्रों के अलावा बहु-स्थानीय परीक्षण तथा तकनीकी प्रणालियों की पुनः स्थापना हेतु अखिल भारतीय पटसन एवं समवर्गीय रेशा

नेटवर्क परियोजना के तहत विभिन्न राज्य कृषि विश्वविद्यालयों में 9 तथा भारतीय कृषि अनुसंधान परिषद के संस्थानों में 4 केन्द्र स्थापित हैं तथा इन केन्द्रों का नोडल एकक बैरकपुर मुख्यालय है।

राजभाषा गतिविधियाँ:

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

इस संस्थान के वैज्ञानिकों द्वारा कृषकों के जीवन यापन में गुणात्मक सुधार हेतु उन्हें पटसन एवं समवर्गीय रेशे वाली फसलों के महत्वपूर्ण कृषि तथ्यों से अवगत कराया जाता है। कृषि के क्षेत्र में इस संस्थान की साकारात्मक भूमिका रही है। विकासात्मक गतिविधियों एवं जानकारीयों को अन्य भाषाओं के साथ-साथ हिन्दी में भी किसानों तक पहुँचाने में यह संस्थान प्रयासरत है। के.प.स.रे.अ.सं. एक वैज्ञानिक संस्थान होते हुए भी यहाँ राजभाषा हिन्दी को काफी बढ़ावा दिया जाता है। संस्थान के राजभाषा अनुभाग ने हिन्दी पदों के अभाव के बावजूद संस्थान में कार्यरत वैज्ञानिक/अधिकारियों के बलबूते राजभाषा के प्रचार-प्रसार हेतु अनेकों उल्लेखनीय कार्य किए गए हैं। भाकृअनुप-के.प.स.रे.अ.सं. में हुई इन उपलब्धियों का संक्षिप्त विवरण प्रस्तुत है:

प्रशासनिक उपलब्धियाँ:

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

- 21 विहित फार्मों एवं 10 मानक मसौदे द्विभाषी हैं तथा बाकी फार्मों एवं मानक मसौदों का द्विभाषी रूप तैयार किया जा रहा है।
- अधिकांश रजिस्ट्रों के शीर्षक द्विभाषी हैं। बाकी रजिस्ट्रों के शीर्षक द्विभाषी रूप में किये जा रहें हैं।
- संस्थान में अधिकांश रबर की मोहरें, नाम पट्ट, शीर्षक-पत्र इत्यादि द्विभाषी हैं। समय-समय पर आवश्यकतानुसार मोहरें एवं नाम पट्ट द्विभाषी रूप में बनवाये जाते हैं।

- संस्थान की राजभाषा कार्यान्वयन समिति की बैठकों में होने वाली चर्चायें सिर्फ और सिर्फ हिन्दी में ही होती हैं।
- अन्य भाषा-भाषी लोगों के हिन्दी शब्द ज्ञान हेतु प्रतिदिन हिन्दी का एक शब्द लिखा जाता है।
- हिन्दी अनुभाग में प्रविष्टियाँ, टिप्पणी एवं मसौदा लेखन व अन्य कार्य हिन्दी में होते हैं।
- संस्थान के कम्प्यूटरों में द्विभाषी रूप में काम करने की सुविधा उपलब्ध है तथा बाकी में हिन्दी सॉफ्टवेयर के माध्यम से द्विभाषी रूप में काम करने की व्यवस्था की जा रही है।
- 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 कक्षाएँ चलायी जाती हैं। नवम्बर, 2014 में 18 अधिकारियों एवं कर्मचारियों ने प्राज्ञ परिक्षायें उत्तीर्ण किये।
- हिन्दी अनुभाग में प्रविष्टियाँ, टिप्पणी, मसौदा लेखन व अन्य कार्य हिन्दी में होते हैं।
- हिन्दी में प्राप्त पत्रों के शत-प्रतिशत उत्तर हिन्दी में ही दिए जाते हैं।
- 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।
- 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, शब्दकोष, सरकारी टिप्पणियाँ एवं कार्यालय उपयोगी संदर्भ पुस्तकें मँगवाई जाती हैं।
- संस्थान में मूल रूप से हिन्दी में काम करने पर दी जानेवाली प्रोत्साहन योजना को वर्ष 2001 से लागू किया गया है।
- भारतीय कृषि अनुसंधान परिषद के दिनांक 31.03.1991 के परिपत्र के अनुसार संस्थान की राजभाषा कार्यान्वयन समिति की बैठकें आयोजित की जाती हैं।
- कार्यालय में प्रयुक्त सभी उपस्थिति पंजी के शीर्षक व शीर्ष नाम तथा उनमें अधिकारियों/कर्मचारियों के नाम हिन्दी और अंग्रेजी दोनों भाषाओं में लिखे जाते हैं।

संस्थान में दिनांक 20 जून, 2017 को एक दिवसीय हिंदी कार्यशाला का आयोजन

केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान, बैरकपुर, कोलकाता की राजभाषा कार्यान्वयन समिति के तत्वावधान में हिन्दी का कार्यसाधक ज्ञान रखने वाले संस्थान के प्रशासनिक एवं तकनीकी अधिकारियों/कर्मचारियों की हिन्दी में काम करने की झिझक को दूर करने के उद्देश्य से दिनांक 20 जून, 2017 को एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया।



हिन्दी कार्यशाला में प्रतिभागियों का स्वागत करते हुए प्रभारी, हिन्दी कक्ष, डा. एस.के. पाण्डेय

इस कार्यशाला की अध्यक्षता संस्थान के निदेशक, डा. जीवन मित्र ने की। निदेशक महोदय ने उद्घाटन भाषण में कहा कि कार्यालयीन कार्यों में हिंदी का प्रयोग करना हमारा संवैधानिक एवं नैतिक दायित्व है। उन्होंने संस्थान के सभी अधिकारियों एवं कर्मचारियों से कार्यालयीन कार्यों में सरल हिंदी शब्दों का प्रयोग करने का आग्रह किया। उन्होंने अधिकारियों से कहा कि इस कार्यशाला का लाभ उठाते हुए वे अपने दैनंदिन कार्यों में हिंदी का सर्वाधिक प्रयोग करें। डा. एस. सतपथी, प्रभागाध्यक्ष, फसल सुरक्षा ने कहा कि हमारा संस्थान "ग" क्षेत्र में स्थित होने के बावजूद इस संस्थान के अधिकारियों/कर्मचारियों के द्वारा राजभाषा हिंदी का यथा संभव प्रयोग किया जा रहा है। हमारा यही प्रयास रहा है कि इस प्रकार के आयोजनों के माध्यम से उन्हें हिंदी में और अधिक कार्य करने के लिए प्रेरित किया जाए। डा. दिलीप कुमार



मुख्य वक्ता, डा. रमेश मोहन झा, हिन्दी प्राध्यापक, हि.शि.यो., निजाम पैलेस, कोलकाता प्रतिभागियों को संबोधित करते हुए।

कुण्डु, प्रभागाध्यक्ष, फसल उत्पादन ने कहा कि हिंदी इस देश में सर्वाधिक बोली तथा समझी जाने वाली भाषा है इसलिए इसे राजभाषा का दर्जा प्राप्त है। उन्होंने सभी कर्मचारियों से टिप्पण/आलेखन में हिंदी का प्रयोग करने का आग्रह किया। डा. सुनीति कुमार झा, प्रधान वैज्ञानिक द्वारा स्वागत भाषण दिया गया, उन्होंने अपना वक्तव्य रखते हुए कहा कि हिंदी को कार्यालयीन कार्यों में अपना ही इसके प्रति सच्चा सम्मान होगा तथा हम सभी अपना अधिक से अधिक कार्य हिंदी में करने का संकल्प लें और मिलकर ऐसे वातावरण का निर्माण करें जिससे शत-प्रतिशत कार्य राजभाषा हिंदी में ही हो।



मुख्य वक्ता, डा. रमेश मोहन झा, हिन्दी प्राध्यापक, हि.शि.यो., निजाम पैलेस, कोलकाता प्रतिभागियों को प्रशिक्षण प्रदान करते हुए।

श्री राजीव लाल, मुख्य प्रशासनिक अधिकारी ने भी हिन्दी कार्यशाला में भाग लेते हुए सभी अधिकारियों एवं कर्मचारियों से कार्यालयीन कार्य हिन्दी में करने का आह्वान किया साथ ही फाइल कवर में प्रशासनिक शब्दावली तथा वाक्यांशों की प्रिंटिंग कराने का भी सुझाव दिया जिससे इसका कार्यालयीन कार्यों में प्रयोग किया जा सके। श्री गौरांग घोष, वित्त एवं लेखा अधिकारी ने भी हिन्दी कार्यशाला में भाग लिया। डा. रमेश मोहन झा, हिन्दी प्राध्यापक, हिन्दी शिक्षण योजना, राजभाषा विभाग, गृह मंत्रालय, भारत सरकार, निजाम पैलेस, कोलकाता को मुख्य वक्ता के तौर पर आमंत्रित किया गया था। उन्होंने अध्यापन के दौरान राजभाषा नीति, नियम, अधिनियम, हिन्दी व्याकरण तथा हिन्दी टिप्पण एवं मसौदा लेखन, वर्तनी की अशुद्धियां, लिंग इत्यादि विषयों पर ऐसे उदाहरण प्रस्तुत किए जो कि प्रतिभागियों के जेहन में अक्षरसः समा गए। उन्होंने प्रतिभागियों को राजभाषा संबंधी अड़चनों से अवगत कराते हुए उनकी वैचारिक कमियों को दूर करने के गुर भी सिखाये। सभी प्रतिभागियों ने पूरे सत्र के दौरान बड़े ही उत्साहपूर्वक ज्ञानार्जन किया। उन्होंने हिन्दी टिप्पण तथा मसौदा लेखन का अभ्यास भी कराया तथा उसके बाद खुली चर्चा का आयोजन किया गया

जिसमें प्रतिभागियों द्वारा पुछे गये प्रश्नों का उत्तर मुख्य वक्ता ने सोदाहरण दिया। संस्थान के निदेशक, डा. जीवन मित्र तथा सभी प्रभागों के प्रभागाध्यक्ष भी पूरे कार्यशाला सत्र के दौरान मौजूद रहे। इस कार्यशाला का संचालन डा. सुनीति कुमार झा, प्रधान वैज्ञानिक, डा. सुरेन्द्र कुमार पाण्डेय, प्रधान वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने श्री मनोज कुमार राय, सहायक के सहयोग से किया। कार्यशाला का समापन डा. सुरेन्द्र कुमार पाण्डेय के धन्यवाद ज्ञापन के साथ सम्पन्न हुआ।

संस्थान में दिनांक 14 मार्च, 2018 को एक दिवसीय हिन्दी कार्यशाला का आयोजन

भाकृअनुप-केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान, बैरकपुर, कोलकाता की राजभाषा कार्यान्वयन समिति के तत्वावधान में दिनांक 14 मार्च, 2018 को राजभाषा हिन्दी के प्रगामी प्रयोग को बढ़ावा देने तथा राजभाषा संबंधी अधिनियमों, नियमों एवं आदेशों के अनुपालन हेतु एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया। इस कार्यशाला में बड़ी संख्या में संस्थान के वैज्ञानिकों/अधिकारियों/कर्मचारियों ने भाग लिया। श्री फतेह बहादुर सिंह, प्राध्यापक, हिन्दी शिक्षण योजना, भारत सरकार, गृह मंत्रालय, राजभाषा विभाग, निजाम पैलेस, कोलकाता को मुख्य वक्ता के तौर पर आमंत्रित किया गया था। इस कार्यशाला की



प्रभारी, हिन्दी कक्ष, डा. एस.के. पाण्डेय हिन्दी कार्यशाला में प्रतिभागियों का स्वागत करते हुए।

अध्यक्षता संस्थान के निदेशक, डा. जीवन मित्र जी ने की। उन्होंने अपने अध्यक्षीय संबोधन में कहा कि संघ की राजभाषा नीति का मूलमंत्र सद्भावना, प्रेरणा एवं प्रोत्साहन है, साथ ही उन्होंने संस्थान में सरल, सुबोध एवं आसान हिन्दी शब्दों/वाक्यों के प्रयोग पर जोर देते हुए संस्थान के सभी अधिकारियों एवं कर्मचारियों से राजभाषा संबंधी आदेशों का अनुपालन सुनिश्चित करने का

आग्रह किया। डा. एस. सतपथी, प्रभागाध्यक्ष, फसल संरक्षण ने कहा कि राजभाषा को अपनाकर हम अपने कार्यालय में इसका



संस्थान के निदेशक, डा. जीवन मित्र एक दिवसीय हिन्दी कार्यशाला में प्रतिभागियों को संबोधित करते हुए।

अधिकाधिक प्रयोग करें। उन्होंने वार्षिक पत्रिका 'रेशा किरण' के द्वितीय संस्करण को प्रकाशित करने का सुझाव दिया। डा. दिलीप कुमार कुण्डु, प्रभागाध्यक्ष, फसल उत्पादन प्रभाग ने कहा कि भारत सरकार की राजभाषा नीति सीधी, सरल एवं प्रेरणादायी है, इसका प्रयोग हम सबको करना चाहिए। डा. चन्दन सौरव कर, प्रधान वैज्ञानिक ने अपने संबोधन में कहा कि राजभाषा में कार्य करना सरल व सहज है इसे हमें कार्यालयीन कार्यों में अधिकाधिक प्रयोग करना चाहिए। श्री गौरांग घोष, वित्त एवं लेखा अधिकारी ने अपने संबोधन में कहा कि हिंदी हमारी सभ्यता व संस्कृति की पहचान है, इसलिए प्रत्येक अधिकारी/कर्मचारी को चाहिए कि वह अधिक से अधिक कार्य हिंदी में करें। उन्होंने आगे बताया कि हिंदी कार्यशाला का आयोजन मार्च महीने के पूर्व अथवा पश्चात में करना अधिक



मुख्य वक्ता श्री फतेह बहादुर सिंह, हिन्दी प्राध्यापक, हि.शि.यो., निजाम पैलेस कोलकाता प्रतिभागियों को प्रशिक्षण प्रदान करते हुए।

उचित होता। अतिथि वक्ता ने पत्राचार के विभिन्न रूपों जैसे कार्यालय टिप्पणी, परिपत्र, कार्यालय ज्ञापन, कार्यालय आदेश एवं पारिभाषिक शब्दावाली इत्यादि पर चर्चा की जिससे यह कार्यशाला बहुत ही उपयोगी रही। मंचासीन अधिकारियों, अतिथि एवं प्रतिभागियों का हार्दिक अभिनंदन एवं स्वागत करते हुए डा. सुरेन्द्र कुमार पाण्डेय प्रधान वैज्ञानिक एवं प्रभारी, हिंदी कक्ष ने श्री मनोज कुमार राय, सहायक के सहयोग से कार्यक्रम का संचालन किया। कार्यक्रम का समापन डा. सुनीति कुमार झा, प्रधान वैज्ञानिक एवं प्रभारी, कृषि प्रसार अनुभाग के धन्यवाद ज्ञापन के साथ सम्पन्न हुआ।

संस्थान में "हिन्दी सप्ताह" का आयोजन

सरकारी काम-काज में राजभाषा हिन्दी के प्रति जागरूकता पैदा करने तथा उसके प्रभावों में गति लाने के उद्देश्य से संस्थान में दिनांक 14 से 20 सितम्बर, 2017 के दौरान 'हिन्दी सप्ताह' का आयोजन किया गया, जिसका उद्घाटन संस्थान के निदेशक, डा. जीवन मित्र ने की। मुख्य अतिथि/वक्ता के रूप में श्री चन्द्रशेखर सिंह, पूर्व सहायक निदेशक (रा.भा.), गुणवत्ता आश्वासन निदेशालय, वाणिज्य एवं उद्योग मंत्रालय, भारत सरकार, निजाम पैलेस, कोलकाता को आमंत्रित किया गया था। डा. सुरेन्द्र कुमार पाण्डेय, प्रधान वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने इस अवसर पर उपस्थित संस्थान के अधिकारियों एवं कर्मचारियों का हार्दिक स्वागत करते हुए उन्हें हिन्दी सप्ताह के अंतर्गत आयोजित किए जानेवाली विभिन्न हिन्दी प्रतियोगिताओं की जानकारी देते हुए उनसे यह आग्रह किया कि वे अधिकाधिक संख्या में भाग लेकर इस आयोजन को सफल बनाएं। निदेशक, डा. जीवन मित्र ने अपने अध्यक्षीय संबोधन में कहा कि राजभाषा कार्यान्वयन की दिशा में इस संस्थान ने अच्छी प्रगति की है जिसके कारण हिन्दी के प्रयोग में साकारात्मक प्रगति हो रही है।



हिन्दी सप्ताह समारोह के उपलक्ष्य पर निदेशक महोदय, डा. जीवन मित्र संस्थान के अधिकारियों/कर्मचारियों को संबोधित करते हुए।

उन्होंने आगे कहा कि राजभाषा हिन्दी साधारण जनमानस विशेषकर, किसान भाइयों के साथ संपर्क बनाने का बेहतर माध्यम है क्योंकि इसे लगभग हर भारतीय समझता अथवा बोलता है। डा. एस. सत्पथी, प्रभागाध्यक्ष, फसल सुरक्षा ने अपने उद्घाटन अभिभाषण में संस्थान के समस्त अधिकारियों/कर्मचारियों को कार्यालय में हिन्दी के अधिकाधिक प्रयोग पर बल दिया, इसके लिए उन्होंने प्रत्येक अधिकारी/कर्मचारी को अपने शासकीय कार्यों में सहज व सरल हिन्दी का प्रयोग करने की अपील की। डा. दिलीप कुमार कुण्डु, प्रभारी प्रभागाध्यक्ष, फसल उत्पादन ने कहा कि इस देश में अनेक भाषाएं बोली जाती हैं मगर राजभाषा हिन्दी का अपना अलग ही स्थान है। साथ ही उन्होंने सभी अधिकारियों/कर्मचारियों से राजभाषा हिंदी में कार्यालयीन कार्य करने की अपील की। डा. सब्यसाची मित्रा, प्रधान वैज्ञानिक एवं प्रभारी, ए.आई.एन.पी. ने अपने संबोधन में कहा कि राजभाषा हिंदी का यथा संभव प्रयोग हमारे संस्थान द्वारा किया जा रहा है।



संस्थान के अधिकारी/कर्मचारी हिन्दी सप्ताह समारोह में भाग लेते हुए।

हमारा यही प्रयास रहना चाहिए कि कार्यालयीन कार्यों में हिंदी का प्रयोग अधिकाधिक किया जाए। मुख्य अतिथि श्री चन्द्रशेखर सिंह ने अपने व्याख्यान में राजभाषा के महत्व एवं उसके कार्यान्वयन हेतु हमारे दायित्व तथा राजभाषा नियम अधिनियम के बारे में अधिकारियों/कर्मचारियों को विस्तार पूर्वक अवगत कराया।

‘हिन्दी सप्ताह’ के दौरान संस्थान के हिन्दीत्तर भाषी तथा हिन्दी भाषी अधिकारियों/कर्मचारियों के लिए विभिन्न प्रतियोगितायें आयोजित की गईं जिसमें संस्थान के अधिकारियों/कर्मचारियों ने बड़े उत्साह पूर्वक भाग लिया।



संस्थान के अधिकारियों एवं कर्मचारियों द्वारा हिन्दी सप्ताह समारोह के उपलक्ष्य पर आयोजित प्रतियोगिता में भाग लेते हुए।

‘हिन्दी सप्ताह’ समापन समारोह दिनांक 20 सितम्बर, 2017 को डा. एस. सत्पथी, प्रभागाध्यक्ष, फसल सुरक्षा की अध्यक्षता में आयोजित की गयी। इस अवसर पर मुख्य वक्ता, श्री राकेश कुमार पाठक, सहायक निदेशक, केन्द्रीय अनुवाद ब्यूरो, राजभाषा विभाग, गृह मंत्रालय, 78वीं-बालीगंज, सर्कुलर रोड, कोलकाता सादर आमंत्रित थे। उन्होंने अपने व्याख्यान में कहा कि संस्कृत और हिन्दी देश के दो भाषा रूपी ऐसे स्तंभ हैं जो देश की संस्कृति, परंपरा और सभ्यता को विश्व के मंच पर बखूबी प्रस्तुत करते हैं। आज विश्व भर से विद्यार्थी हमारी भाषा और संस्कृति को जानने के लिए हमारे देश का रुख कर रहे हैं। हिन्दी बहुत ही सरल, सहज और आसान भाषा है जिसका हमें कार्यालयीन कार्यों में सर्वाधिक प्रयोग करना चाहिए। श्री राजीव लाल, मुख्य प्रशासनिक अधिकारी ने अपने संबोधन में संस्थान के अधिकारियों/कर्मचारियों को कहा कि 14 सितम्बर, 1949 को संविधान सभा ने एक मत से यह निर्णय लिया कि हिन्दी ही भारत की राजभाषा होगी। अतः हम सभी का कर्तव्य बनता है कि राजभाषा हिन्दी का प्रयोग कार्यालयीन कार्यों में अधिकाधिक करें। श्री गौरांग घोष, वित्त एवं लेखा अधिकारी ने प्रशासनिक कार्यों को हिन्दी में करने पर बल दिया। डा. सुरेन्द्र कुमार पाण्डेय, प्रधान वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने अपने समापन भाषण में संस्थान में किये जा रहे हिन्दी कार्य की प्रगति का उल्लेख किया। समापन समारोह में मंचासीन डा. सुनीति कुमार झा, प्रधान वैज्ञानिक एवं प्रभारी, कृषि प्रसार अनुभाग, मुख्य वक्ता श्री राकेश कुमार पाठक तथा श्री गौरांग घोष, वित्त एवं लेखा अधिकारी के द्वारा विभिन्न प्रतियोगिताओं के प्रथम, द्वितीय व तृतीय स्थान प्राप्त सफल प्रतिभागियों को पुरस्कार प्रदान किया गया। तत्कालिक भाषण (एक्सटेम्पोर)/कविता-पाठ प्रतियोगिता में श्री सुमन राय, वैज्ञानिक-प्रथम, श्री सुरजित बर्मन, सहायक-द्वितीय एवं शाहिद मुख्तार, वरिष्ठ तकनीकी सहायक-तृतीय, हिन्दी श्रुतलेखन, पठन

तथा शब्द पर्याय लेखन प्रतियोगिता में डा. रंजन कुमार नायक, वरिष्ठ वैज्ञानिक-प्रथम, श्रीमती नीना मण्डल, निजी सहायक-द्वितीय एवं डा. राजीव कुमार दे, प्रधान वैज्ञानिक-तृतीय, हिंदी टाइपिंग प्रतियोगिता में श्री चन्दन कुमार वर्मा, सहायक-प्रथम, श्री रवि मिश्रा, सहायक प्रशासनिक अधिकारी-द्वितीय एवं श्री आर.आर. देबनाथ, कनिष्ठ लेखा अधिकारी-तृतीय, हिंदी अनुवाद प्रतियोगिता में श्री मानिक लाल राय, वैज्ञानिक-प्रथम, श्री सुब्रत भट्टाचार्य, सहायक प्रशासनिक अधिकारी-द्वितीय एवं श्रीमती नीना मण्डल, निजी सहायक-तृतीय, हिंदी टिप्पण, मसौदा तथा पत्र लेखन (हिंदीतंत्र भाषियों के लिए) प्रतियोगिता में श्री सुब्रत भट्टाचार्य, सहायक प्रशासनिक अधिकारी-प्रथम, श्री आर.आर. देबनाथ, कनिष्ठ लेखा अधिकारी-द्वितीय एवं श्रीमती नीना मण्डल, निजी सहायक-तृतीय तथा हिंदी टिप्पण, मसौदा तथा पत्र लेखन (हिंदी भाषियों के लिए) प्रतियोगिता में श्री रितेश कुमार, सहायक-प्रथम, श्री चन्दन कुमार वर्मा, सहायक-द्वितीय एवं श्रीमती लक्ष्मी शर्मा, वैज्ञानिक-तृतीय स्थान प्राप्त किये।



हिन्दी सप्ताह के समापन समारोह के उपलक्ष्य पर पुरस्कार वितरण।

कार्यक्रम का उद्घाटन तथा समापन समारोह का संचालन डा. सुरेन्द्र कुमार पाण्डेय, प्रधान वैज्ञानिक एवं प्रभारी, हिन्दी कक्ष ने श्री मनोज कुमार राय, सहायक के सहयोग से किया। कार्यक्रम का समापन डा. सुनीति कुमार झा, प्रधान वैज्ञानिक एवं प्रभारी, कृषि प्रसार अनुभाग के धन्यवाद ज्ञापन के साथ सम्पन्न हुआ।

सीसल अनुसंधान केन्द्र, बामरा, ओडिशा में हिन्दी दिवस का आयोजन

सीसल अनुसंधान केन्द्र, बामरा, ओडिशा में दिनांक 14 सितम्बर, 2017 को हिन्दी दिवस का आयोजन किया गया। केन्द्र प्रभारी एवं वरिष्ठ वैज्ञानिक, डा. अजीत कुमार झा ने कार्यक्रम का उद्घाटन किया और राजभाषा के महत्व और इसकी उपयोगिता पर प्रकाश डाला, साथ ही इस कार्यक्रम में केन्द्र के सभी कर्मचारियों से

कार्यालयीन कार्यों में इसके अधिकाधिक प्रयोग करने की अपील की। इस कार्यक्रम में केन्द्र के 04 कर्मचारियों तथा 9 टी.एस.सी.एल ने भाग लिया। इस उपलक्ष्य में केन्द्र में तात्कालिक भाषण प्रतियोगिता का आयोजन किया गया, जिसका विषय "राजभाषा हिन्दी का राष्ट्रीय स्तर पर महत्व" था, जिसमें केन्द्र के समस्त कर्मचारियों ने उत्साह पूर्वक भाग लिया।



सीसल अनुसंधान केन्द्र, बामरा, ओडिशा में हिन्दी दिवस का आयोजन

रेमी अनुसंधान केन्द्र, सरभोग, बरपेट्टा, असम में "हिन्दी सप्ताह" का आयोजन

रेमी अनुसंधान केन्द्र, सरभोग, बरपेट्टा, असम में हिन्दी सप्ताह उद्घाटन समारोह दिनांक 14.09.2017 को आयोजित किया गया, जिसमें केन्द्र के सभी कर्मचारियों (तकनीकी, प्रशासनिक, टी.एस.सी.एल.) ने उत्साहपूर्वक भाग लिया।



रेमी अनुसंधान केन्द्र, सरभोग, बरपेट्टा, असम में हिन्दी सप्ताह का आयोजन केन्द्र प्रभारी ने हिन्दी सप्ताह के उद्घाटन समारोह 14.09.2017 के उपलक्ष्य पर राजभाषा हिन्दी पर संक्षिप्त भाषण प्रस्तुत किया तथा साथ ही हिन्दी सप्ताह के दौरान केन्द्र में आयोजित होने वाले

कार्यक्रमों के बारे में संक्षिप्त जानकारी भी दी। कुछ तकनीकी, टी.एस.सी.एल. तथा प्रशासनिक कर्मचारियों ने भी राजभाषा के बारे में जानकारी दिया। हिन्दी सप्ताह उद्घाटन समारोह का समापन जलपान वितरण के साथ सम्पन्न हुआ।

केन्द्र प्रभारी, रेमी अनुसंधान केन्द्र, सरभोग, ने हिन्दी सप्ताह के समापन समारोह के अवसर पर केन्द्र में हिन्दी का उपयोग कैसे करें, उस पर भाषण दिया तथा इसका कार्यालयीन कार्यों में प्रयोग पर बल दिया। तकनीकी, प्रशासनिक कर्मचारी तथा टी.एस.सी.एल ने भी राजभाषा हिन्दी पर प्रकाश डाला तथा हिन्दी सप्ताह समापन समारोह दिनांक 20.09.2017 को जलपान वितरण के साथ समाप्त हुआ।

सनई अनुसंधान केन्द्र, प्रतापगढ़, उत्तर प्रदेश में हिन्दी दिवस का आयोजन

दिनांक 14 सितम्बर, 2017 को सनई अनुसंधान केन्द्र, प्रतापगढ़ में हिन्दी दिवस का आयोजन किया गया। हिन्दी दिवस के उद्घाटन समारोह के अन्तर्गत केन्द्र के प्रभारी, श्री देशराज मीना ने अपने सम्बोधन में कहा कि हिन्दी ही एकमात्र ऐसी भाषा है जो सम्पूर्ण राष्ट्र को एकता के सूत्र में पिरोने का कार्य करती है क्योंकि किसी भी राष्ट्र के सर्वांगीण विकास में उस देश की राष्ट्रभाषा का सर्वोच्च योगदान होता है।



सनई अनुसंधान केन्द्र प्रतापगढ़ में हिन्दी दिवस का आयोजन

इस अवसर पर केन्द्र के वरिष्ठ तकनीकी सहायक, श्री सुरेन्द्र प्रसाद प्रजापति ने हिन्दी भाषा के विकास एवं उसके विकास के सहभागी पुरोधाओं का क्रमवार परिचय कराया। सभा को श्री संदीप प्रकाश, सहायक एवं श्री पारसनाथ पाल, उच्च श्रेणी लिपिक ने भी संबोधित किया और अपने दैनिक कार्यों एवं कार्यालयीन कार्यों में इसको बढ़ावा देने का संकल्प लिया। उक्त कार्यक्रम के सफल आयोजन में केन्द्र के सभी कर्मचारियों का योगदान उल्लेखनीय रहा।

केन्द्रीय पटसन एवं समवर्गीय रेशा बीज अनुसंधान केन्द्र, बुद बुद, बर्द्धवान, पश्चिम बंगाल में हिन्दी दिवस का आयोजन

केन्द्र प्रभारी एवं वैज्ञानिक, डा. हेमराज भण्डारी ने दिनांक 14.09.2017 को हिन्दी दिवस का आयोजन किया। केन्द्र के समस्त अधिकारियों एवं कर्मचारियों ने समारोह में भाग लिया। केन्द्र प्रभारी ने हिन्दी के महत्व पर प्रकाश डाला। केन्द्र के सभी कर्मचारियों ने राष्ट्रीय एकता और हिंदी के महत्व के बारे में अपने-अपने विचार व्यक्त किए। उक्त समारोह के उपलक्ष्य पर विभिन्न कर्मचारियों ने हिंदी लिखने-पढ़ने की क्षमता का प्रदर्शन किया।



केन्द्रीय पटसन एवं समवर्गीय रेशा बीज अनुसंधान केन्द्र, बुदबुद, बर्द्धवान, पश्चिम बंगाल में हिन्दी दिवस का आयोजन।

कृषि विज्ञान केन्द्र, बुदबुद, बर्द्धवान, पश्चिम बंगाल में हिन्दी दिवस का आयोजन

कृषि विज्ञान केन्द्र, बुद बुद, बर्द्धवान में दिनांक 14.09.2017 को हिन्दी दिवस का आयोजन किया गया। इस अवसर पर बर्द्धवान जिला के अलग-अलग गाँवों से करीब 50 पुरुष एवं महिला कृषकों ने भाग लिया। कार्यक्रम की शुरुआत भारतीय संस्कृति में हिन्दी का महत्व तथा इसके समृद्धि पर बल देने की अवधारणा के साथ शुरू हुआ। इस कार्यक्रम में कृषकों तथा कृषक महिलाओं के लिए "भारतीय कृषि की समस्या और संभावना" नामक विषय पर हिन्दी में भाषण प्रतियोगिता का आयोजन किया गया। इस प्रतियोगिता में बेहतर प्रदर्शन करने वाले प्रतिभागियों को पुरस्कृत भी किया गया। कार्यक्रम के मुख्य अतिथि, डा. हेमराज भंडारी, प्रभारी वैज्ञानिक, केन्द्रीय पटसन एवं समवर्गीय रेशा बीज अनुसंधान केन्द्र, बुद बुद, बर्द्धवान ने भी राजभाषा हिन्दी के बारे में अपने विचार रखे तथा इस कार्यक्रम में उपस्थित समस्त कर्मचारियों से इसके यथोचित प्रयोग का आह्वान किया।

19. Distinguished Visitors

Name of the Visitor	Affiliation	Date
Dr. J.S. Sandhu	DDG (Crop Science), ICAR, New Delhi	19 June, 2017
Dr. S.S. Singh	Director, ICAR-ATARI, Kolkata	10 August, 2017
Mr. Rajan Agrawal	Director, DARE and CVO, ICAR, New Delhi	16 August, 2017
Dr. Tapas Mandal	Hon'ble Member of Parliament, Nadia	26 August, 2017
Mr. Chhabilendra Roul	Special Secretary (DARE) & Secretary (ICAR), New Delhi	10 October, 2017
Dr. S. A. Patil	Chairman, RAC, ICAR-CRIJAF	7 November, 2017
Dr. R.K.Singh	ADG (Commercial Crops), ICAR, New Delhi	7 November, 2017
Mr. S. N. Tripathi	FA, DARE, New Delhi	17 November, 2017
Dr. A.K. Vyas	ADG (HRD), ICAR, New Delhi	12 January, 2018
Mr. Sujit Mitra	Director (Personnel), ICAR, New Delhi	27 January, 2018
Dr. C.D. Mayee	Former Chairman, ASRB, New Delhi and Chairman, QRT, ICAR-CRIJAF	21 February, 2018
Mr. Arvind Kumar	Secretary, National Jute Board, Kolkata	4 May 2017 21 February, 2018
Dr. K.V.R. Murthy	MD, JCI, Kolkata	21 February, 2018
Dr. V.S. Tomar	Former VC, JNKVV, Jabalpur	10 March, 2018
Dr. D.K. Sharma	Former Director, ICAR-Central Soil Salinity Research Institute, Karnal	23 March, 2018



Dr. C.D. Mayee, Chairman, QRT, ICAR-CRIJAF interacting with CRIJAF scientists



Dr. J.S. Sandhu, DDG (Crop Science) is interacting with scientists and staffs



Dr. V. S. Tomar former VC, JNKVV, Jabalpur visiting the research field at CRIJAF



Dr. Tapas Mandal, Hon'ble MP, participated in "Sankalp Se Siddhi" programme at ICAR-CRIJAF



Dr. Jiban Mitra, Director, ICAR-CRIJAF welcoming Dr. R.K.Singh, ADG (CC) in RAC meeting



Mr. Chhabilendra Roul visiting the fermentation unit of microbial retting formulation CRIJAF SONA



Dr. A.K Vyas, ADG (HRD), ICAR addressing the scientists of ICAR-CRIJAF



Sh. S.N.Tripathi, FA, DARE visiting the Fermentation Unit for preparation of CRIJAF Sona

20. Staff Position

Table 20.1. Staff position of ICAR-CRIJAF along with the sub-stations as on 31.03.2018

Category	Sanctioned strength	Staff in position					Total
		CRIJAF (HQ) Barrackpore	CSRSJAF BudBud	RRS Sorbhog	SRS Bamra	ShRS Pratapgrah	
Scientist	74+1 (RMP)	44	01	00	01	01	47
Technical	108	27	08	02	02	02	41
Administrative	62	32	01	03	01	02	39
SSS	92	07	02	00	01	00	10

Table 20.2. Staff position at Krishi Vigyan Kendra, Budbud, Purba Bardhaman as on 31.03.2018

Designation	Sanctioned strength	Persons in position
Programme Coordinator	01	00
Subject Matter Specialist	06	04
Farm Manager	01	01
Programme Asstt. (Computer)	01	01
Programme Asstt. Assistant	01	01
Stenographer	01	00
Driver	02	02
Supporting Staff	02	02
Total	16	12

21. Personnel

21.1. Staff in Position

Name	Designation	E-mail id
Dr. J. Mitra	Director (Actg.)	Jiban.Mitra@icar.gov.in
Division of Crop Improvement		
Dr. J. Mitra	Pr. Scientist (Plant Breeding) and HoD	Jiban.Mitra@icar.gov.in
Dr. A.B. Mandal	Pr. Scientist (Plant Breeding)	Asit.Mandal@icar.gov.in
Dr. D. Sarkar	Pr. Scientist (Biotechnology)	Debabrata.Sarkar@icar.gov.in
Dr. C.S. Kar	Pr. Scientist (Plant Breeding)	Chandan.Kar@icar.gov.in
Dr. S. Datta	Pr. Scientist (Biotechnology)	Subhojit.Datta@icar.gov.in
Dr. D. Saha	Pr. Scientist (Biotechnology)	Dipnarayan.Saha@icar.gov.in
Dr. P. Satya	Pr. Scientist (Plant Breeding)	Pratik.Satya@icar.gov.in
Dr. A.K. Chakraborty	Scientist (Agril. Statistics)	Asim.Chakraborty@icar.gov.in
Dr. S.B. Choudhary	Scientist (Plant Breeding) (upto 7.07.2017)	Shashi.Choudhary@icar.gov.in
Dr. A. Bera	Scientist (Seed Technology)	Amit.Bera@icar.gov.in
Dr. H.K. Sharma	Scientist (Plant Breeding) (upto 7.07.2017)	Hariom.Sharma@icar.gov.in
Mr. L.L. Kharbikar	Scientist (Biotechnology) (upto 29.07.2017)	Lalit.Kharbikar@icar.gov.in
Mrs. K. Meena	Scientist (Biotechnology)	Kanti.Meena@icar.gov.in
Dr. A. Anil Kumar	Scientist (Plant Breeding)	Anil.Kumar@icar.gov.in
Dr. Maruthi R.T.	Scientist (Genetics)	Maruthi.RT@icar.gov.in
Dr. S. Ray	Scientist (Biotechnology) (w.e.f. 16.10. 2017)	Soham.Ray@icar.gov.in
Mr. B. Ghosh	Technical Officer	Basudeb.Ghosh@icar.gov.in
Mr. A. Mukhopadhyay	Technical Officer	Ashim.Mukhopadhyay@icar.gov.in
Division of Crop Production		
Dr. D.K. Kundu	Pr. Scientist (Soil Science) & I/c, HoD	Dilip.Kundu@icar.gov.in
Dr. A.K. Ghorai	Pr. Scientist (Agronomy)	Asesh.Ghorai@icar.gov.in
Dr. A.R. Saha	Pr. Scientist (Soil Science)	Amit.Saha@icar.gov.in
Dr. B. Majumdar	Pr. Scientist (Soil Science)	Bijan.Majumdar@icar.gov.in
Dr. S. Sarkar	Pr. Scientist (Agronomy)	Sitangshu.Sarkar@icar.gov.in
Dr. H. Chowdhury	Pr. Scientist (Agril. Chemistry) (upto 13.04.2017)	Hemanta.Chowdhury@icar.gov.in
Dr. R. Saha	Pr. Scientist (Soil Physics)	Ritesh.Saha@icar.gov.in
Dr. M.S. Behera	Pr. Scientist (Agronomy)	Madhusudan.Behera@icar.gov.in

Name	Designation	E-mail id
Dr. A.K. Singh	Pr. Scientist (Soil Science)	Arvind.Singh3@icar.gov.in
Dr. D. Barman	Sr. Scientist (Soil Physics)	Dhananjay.Barman@icar.gov.in
Dr. (Mrs.) S.P. Mazumdar	Scientist (Soil Science)	Sonali.Majumdar@icar.gov.in
Dr. M. Kumar	Scientist (Agronomy)	Mukesh.Kumar2@icar.gov.in
Dr. R.K. Naik	Sr. Scientist (Farm Machinery & Power)	Ranjan.Naik@icar.gov.in
Mr. M. Ramesh Naik	Scientist (Agronomy) (On study leave from 08.08.2016)	M.Naik@icar.gov.in
Dr. Suman Roy	Scientist (Plant Physiology)	Suman.Roy@icar.gov.in
Dr. (Mrs.) Laxmi Sharma	Scientist (Plant Physiology)	Laxmi.Sharma@icar.gov.in
Mrs. M. Saha	Scientist (Soil Science) (w.e.f. 12.10.2017)	madhumonti.saha@icar.gov.in
Mr. G.G. Basu	Technical Officer (upto 31.11.2017)	Gobinda.Basu@icar.gov.in
Mr. Sk. Phirose	Technical Officer	Sk.Phirose@icar.gov.in
Mr. D.K. Patra	Technical Officer	Dilip.Patra@icar.gov.in
Mr. K. B. Roy	Technical Officer	Kalyan.Roy@icar.gov.in
Mr. S. Biswas	Technical Officer	Saurav.Biswas@icar.gov.in
Division of Crop Protection		
Dr. S. Satpathy	Pr. Scientist (Entomology) & HoD	Subrata.Satpathy@icar.gov.in
Dr. R.K. De	Pr. Scientist (Plant Pathology)	Rajib.De@icar.gov.in
Dr. S. Biswas	Pr. Scientist (Plant Pathology)	Subrata.Biswas@icar.gov.in
Dr. K. Mandal	Pr. Scientist (Plant Pathology)	Kunal.Mandal@icar.gov.in
Dr. S.K. Sarkar	Pr. Scientist (Plant Pathology)	Surja.Sarkar@icar.gov.in
Dr. C. Biswas	Pr. Scientist (Plant Pathology)	Chinmay.Biswas@icar.gov.in
Dr. B.S. Gotyal	Scientist (Entomology)	Bheemanna.Gotyal@icar.gov.in
Dr. V. Ramesh Babu	Scientist (Entomology)	Veegala.Babu@icar.gov.in
Mr. P.N. Meena	Scientist (Plant Pathology) (On study leave from 01.01.2017)	Prabhu.Meena@icar.gov.in
Mr. K.P. Debnath	Technical Officer	Kalipada.Debnath@icar.gov.in
Mr. P.K. Biswas	Technical Officer	Pabitra.Biswas@icar.gov.in
Agricultural Extension Section		
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Dr. (Mrs.) Shamna A.	Scientist (Agril. Extension)	Shamna.A@icar.gov.in
Dr. M.L. Roy	Scientist (Agril. Extension)	Manik.Roy@icar.gov.in
Mr. B. Sarkar	Technical Officer	Baul.Sarkar @icar.gov.in
Mr. R. K. Roshan	Technical Officer	Rakesh.Roshan@icar.gov.in

Name	Designation	E-mail id
Agricultural Meteorology Unit		
Dr. D. Barman	Sr. Scientist (Soil Physics) & I/c	Dhananjay.Barman@icar.gov.in
Mr. S. Sarkar	Technical Officer	Sudhir.Sarkar@icar.gov.in
All India Network Project on Jute and Allied Fibres		
Dr. S. Mitra	Pr. Scientist (Agronomy) & I/c	Sabyasachi.Mitra@icar.gov.in
Dr. S.K. Pandey	Pr. Scientist (Plant Breeding)	Surendra.Pandey@icar.gov.in
Mr. A. Mondal	Technical Officer	Akshaya.Mondal@icar.gov.in
Agricultural Knowledge Management Unit		
Dr. C.S. Kar	Pr. Scientist (Plant Breeding) & I/c	Chandan.Kar@icar.gov.in
Mr. N. Paul	Asst. Chief Technical Officer	Nilanjan.Paul@icar.gov.in
Prioritization, Monitoring and Evaluation Cell		
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Dr. R. Saha	Pr. Scientist (Soil Physics)	Ritesh.Saha@icar.gov.in
Dr. S. Datta	Pr. Scientist (Biotechnology)	Subhojit.Datta@icar.gov.in
Mr. N. Paul	Asst. Chief Technical Officer	Nilanjan.Paul@icar.gov.in
IPR & Institute Technology Management Unit		
Dr. S.K. Sarkar	Pr. Scientist (Plant Pathology) & I/c	Surja.Sarkar@icar.gov.in
Ramie Research Station, Sorbhog, Assam		
Dr. A. Singh	Scientist (Agronomy) & I/c (upto 14.07.2017)	Amarpreet.Singh@icar.gov.in
Mr. Monu Kumar	Scientist (Plant Breeding) (On study leave from 14.11.2016)	Monu.Kumar@icar.gov.in
Mr. B. Ramchiary	Technical Officer	Birbal.Ramchiary@icar.gov.in
Mr. M.K. Das	Technical Officer	Munindra.Das@icar.gov.in
Mr. A. Basumatary	Technical Officer	Ananda.Bsamatary@icar.gov.in
Sisal Research Station, Bamra, Odisha		
Dr. A.K. Jha	Sr. Scientist (Plant Pathology) & I/c	Ajit.Jha@icar.gov.in
Sunnhemp Research Station, Pratapgarh, Uttar Pradesh		
Dr. M.K. Tripathi	Pr. Scientist (Agronomy) & I/c (upto 19.07.2017)	Manoj.Tripathi@icar.gov.in
Central Seed Research Station for Jute and Allied Fibres, Budbud, West Bengal		
Mr. H.R. Bhandari	Scientist (Plant Breeding) & I/c	Hem.Bhandari@icar.gov.in
Mr. L.N. Ghosh	Technical Officer	Lakshmi.Ghosh@icar.gov.in

Name	Designation	E-mail id
Library		
Dr. M. Kumar	Scientist (Agronomy) & I/c	Mukesh.Kumar2@icar.gov.in
Krishi Vigyan Kendra (KVK), Purba Bardhaman		
Dr. D. Ghorai	SMS (Agriculture) & I/c PC	Dipankar.Ghorai@icar.gov.in
Dr. Golam Ziauddin	SMS (Fishery Science)	Golam.Ziauddin@icar.gov.in
Dr. S. Sarkar	SMS (Horticulture)	Subrata.Sarkar@icar.gov.in
Dr. (Mrs.) M.S. Singh	SMS (Agricultural Extension)	Monica.Singh@icar.gov.in
Mr. S.S. Kundu	Technical Officer	Soumya.Kundu@icar.gov.in
Mr. S. Garai	Senior Technical Officer	Sandipan.Garai@icar.gov.in
Krishi Vigyan Kendra-II (KVK), North 24 Parganas		
Dr. M.L. Roy	Scientist (Agril, Extension) & I/c PC	Manik.Roy@icar.gov.in
Administration & Accounts		
Mr. P.K. Jain	Chief Administrative Officer (w.e.f 08.01.2018)	Pradyumna.Jain@icar.gov.in
Mr. G. Ghosh	Finance & Accounts Officer (w.e.f 21.04.2017)	Gauranga.Ghosh@icar.gov.in
Mr. S. Ghosh	DDO	Samar.Ghosh@icar.gov.in
Mr. R. Mishra	AAO (Purchase & Store)	Ravi.Mishra@icar.gov.in
Mr. S. Bhattacharyya	AAO (Administration-I)	Subrata.Bhattacharyya@icar.gov.in
Mr. S.K. Bala	AAO (Administration-II)	Subrata.Bala@icar.gov.in
Mr. S.K. Pal	AAO (Store)	Subrata.Pal@icar.gov.in
Official Language Cell		
Dr. S.K. Pandey	Pr. Scientist (Plant Breeding) & I/c	Surendra.Pandey@icar.gov.in
Farm Management Committee		
Dr. D.K. Kundu	I/c, Head (Crop Production) & Chairman	Dilip.Kundu@icar.gov.in
Dr. A.K. Ghorai	Pr. Scientist (Agronomy)	Asesh.Ghorai@icar.gov.in
Dr. M.S. Behera	Pr. Scientist (Agronomy)	Madhusudan.Behera@icar.gov.in
Dr. M. Kumar	Scientist (Agronomy)	Mukesh.Kumar2@icar.gov.in
Dr. R.K. Naik	Sr. Scientist (Farm Machinery & Power)	Ranjan.Naik@icar.gov.in
Dr. A. Bera	Scientist (Seed Technology)	Amit.Bera@icar.gov.in
Building Maintenance Cell		
Dr. R.K. Naik	Sr. Scientist (Farm Machinery & Power)	Ranjan.Naik@icar.gov.in
Mr. S. Sarkar	Technical officer	Sudhir.Sarkar@icar.gov.in

Name	Designation	E-mail id
Academic and HRD Committee		
Dr. J. Mitra	Pr. Scientist (Plant Breeding) & HoD, Chairman	Jiban.Mitra@icar.gov.in
Dr. P. Satya	Pr. Scientist (Plant Breeding)	Pratik.Satya@icar.gov.in
Women Cell		
Dr. (Mrs.) S.P. Mazumdar	Scientist (Soil Science) & Chairperson	Sonali.Majumdar@icar.gov.in

21.2. Promotion

Name	Designation	Promoted to	w. e. f.
Scientist			
Dr. H.R. Bhandari	Scientist (RGP 6000/-)	Sr. Scientist (RGP 7000/-)	16.12.2014
Dr. S.K. Pandey	Sr. Scientist	Pr. Scientist	10.07.2015
Dr. P. Satya	Sr. Scientist	Pr. Scientist	01.09.2015
Dr. V. Ramesh Babu	Scientist (RGP 6000/-)	Sr. Scientist (RGP 7000/-)	15.09.2015
Dr. A. Singh	Scientist (RGP 6000/-)	Sr. Scientist (RGP 7000/-)	15.09.2015
Dr. A. Anil Kumar	Scientist (RGP 6000/-)	Sr. Scientist (RGP 7000/-)	15.09.2015
Dr. M.S. Behera	Sr. Scientist	Pr. Scientist	11.06.2016
Dr. A.K. Singh	Sr. Scientist	Pr. Scientist	06.12.2016
Dr. Maruthi R.T.	Scientist (RGP 6000/-)	Sr. Scientist (RGP 7000/-)	01.01.2017
Dr. D. Barman	Scientist (RGP 7000/-)	Sr. Scientist (RGP 8000/-)	07.01.2017
Dr. A. Bera	Scientist (RGP 7000/-)	Sr. Scientist (RGP 8000/-)	08.01.2017
Technical staff			
Mr. S. Garai	Programme Assistant	Sr. Tech. Officer	18.04.2016
Mr. S. Biswas	Sr. Tech. Assistant	Technical Officer	20.04.2017
Mr. J. Pal	Sr. Technician	Technical Assistant	06.07.2016
Mr. S. N. Pal	Sr. Technician	Technical Assistant	10.07.2016
Mr. S.P. Datta	Tech. Assistant	Technical Assistant	16.07.2017
Mr. S. P. Prajapati,	Tech. Assistant	Technical Assistant	16.07.2017
Mr. K. B. Roy	Sr. Tech. Assistant	Technical Officer	17.09.2017
Mr. A. Mondal	Sr. Tech. Assistant	Technical Officer	17.10.2017
Mr. R. K. Roshan	Sr. Tech. Assistant	Technical Officer	29.10.2017
Mr. B. L. Prasad	Sr. Technician	Technical Assistant	17.01.2018
Mr. L. Pradhan	Sr. Technician	Technical Assistant	17.01.2018
Supporting Staff			
Mr. D. Ch. Dey	Skilled Support Staff	3 rd Financial upgradation under MACP Scheme	01.12.2017
Mr. S.S. Halder	Skilled Support Staff	3 rd Financial upgradation under MACP Scheme	16.02.2018

21.3. Superannuation

Name	Designation	Date of Retirement	Place of Posting
Mr. S. Mukherjee	SSS	31.10.2017	Barrackpore
Mr. G. G. Basu	TO	31.11.2017	Barrackpore
Mr. S.K. Dey	SSS	31.12.2017	Barrackpore
Mr. P. Das	SSS	31.12.2017	Barrackpore

TO= Technical Officer, SSS= Skilled Supporting Staff

22. Financial Statement and Revenue Generation

Table 22.1. Financial Statement of ICAR-CRIJAF, Barrackpore for the year 2017-18

(₹ in Lakhs)

Sub-Head	Grants B.E. 2017-18	Grants R.E. 2017-18	Grants Expenditure 2017-18
Establishment Charges	1563.00	1570.00	1569.43
Wages	450.00	310.00	296.25
Retirement Benefit	404.00	460.00	426.70
O.TA.	0.25	0.25	0.02
T.A.	30.00	22.00	21.91
Loans & Advance	20.00	20.00	8.50
Other Charges	403.00	375.00	355.38
Works-Maintenance			
a) Residential	45.00	55.00	53.29
b) Non Residential	43.75	70.75	68.15
c) Equipment & others	16.00	10.00	9.99
d) Minor Works	23.00	25.00	24.85
Major Works	0.00	0.00	0.00
H.R.D	8.00	6.00	5.42
Equipment	20.00	20.00	19.82
Vehicle	0.00	0.00	0.00
Information Technology	7.00	7.00	6.38
Furniture	0.00	0.00	0.00
Library Books & Journals	0.00	0.00	0.00
Total	3033.00	2951.00	2866.09

Table 22.2. Financial Statement for AINP on Jute & Allied Fibres, and KVKs (Burdwan & North 24 Pgs.) for the year 2017-18.

(₹ in Lakhs)

Head	Target	Achievement (Upto 31-03-2018)
A.I.C.R.P on J & AF	307.00	301.95
K.V.K - Purba Bardhaman	145.00	143.65
K.V.K- 24 Parganas(N)-II	15.00	14.79

Table 22.3. : Actual Realization of Revenue Receipts 2017-18

(₹ in Lakhs)

Institute/ Sub-stations	Total Revenue
CRIJAF (H.Q.)	31.13
CSRSJAF, Bud Bud	5.74
Ramie Research Station	1.86
Sisal Research Station	1.88
Sunnhemp Research Station	1.31
TOTAL	41.92

23. Meteorology

Table 23.1. Meteorological data of ICAR-CRIJAF, Barrackpore, West Bengal

Month	Air temperature (°C)		RH (%)		Rainfall (mm)	Rainy days	Bright sunshine (hrs)	Pan evaporation (mm/day)	Wind Speed (km/hr)	Soil temperature (°C)					
	Max	Min	Max	Min						0636 IST			1336 IST		
										5 cm	15 cm	30 cm	5 cm	15 cm	30 cm
Apr-17	35.3	25.4	90.9	62.7	1.0	-	6.1	5.4	5.6	29.9	31.2	30.1	39.6	35.9	31.3
May-17	36.6	25.4	90.5	61.2	64.0	4.0	7.8	5.8	4.3	30.5	32.0	33.5	41.0	37.1	33.6
Jun-17	34.6	26.5	91.6	71.5	204.2	13.0	4.7	4.1	3.3	29.5	30.5	31.6	37.1	34.3	32.0
Jul-17	31.5	25.6	95.3	81.6	437.8	20.0	1.8	2.6	2.3	28.1	28.8	29.4	32.3	31.0	29.5
Aug-17	32.2	25.6	95.0	78.4	304.1	14.0	2.9	2.4	2.0	28.2	28.9	29.4	33.1	30.2	29.6
Sep-17	33.5	25.5	93.3	72.5	193.8	9.0	4.0	2.6	1.5	28.3	29.1	29.6	34.9	32.3	29.7
Oct-17	31.0	23.3	95.4	74.7	333.2	12.0	4.7	2.2	2.0	25.9	26.9	27.8	32.4	29.7	27.8
Nov-17	28.4	13.6	93.5	54.7	80.4	3.0	7.1	2.0	1.4	19.7	21.7	24.0	28.6	25.5	24.0
Dec-17	25.4	14.1	97.5	59.5	21.0	2.0	5.7	1.6	1.5	16.3	18.2	19.8	25.4	21.9	19.9
Jan-18	23.9	9.3	96.2	47.4	0.0	-	6.7	1.7	1.6	11.4	14.4	16.3	24.3	19.3	16.4
Feb-18	29.6	15.7	95.8	43.9	0.0	-	7.1	2.7	1.6	18.6	21.1	22.1	32.7	26.6	22.2
Mar-18	34.0	20.7	92.0	42.0	17.8	1.0	6.5	4.0	2.2	24.4	26.6	27.6	37.5	32.3	27.7

(Source: Agricultural Meteorology Unit. Contributor: D. Barman and Sudhir Sarkar)

Table 23.2. Meteorological data of Sisal Research Station, Bamra, Odisha

Month	Temp. in °C			Relative Humidity %			Rainfall (mm)	Rainy days
	Max.	Min.	Mean	0653 IST	1353 IST	Mean		
Apr-17	43.1	21.3	32.2	65	15	40	00	0
May-17	42.5	25.0	33.7	63	31	47	19.2	4
Jun-17	31.3	21.5	26.4	77	38	57.5	188.6	15
Jul-17	32.2	21.5	26.8	88	70	79	515.2	19
Aug-17	32.6	20.9	26.7	88	74	81	506.2	17
Sep-17	34.4	23.4	28.9	85	66	75.5	117.2	6
Oct-17	29.9	21.2	25.5	81	48	64.5	188.4	7
Nov-17	28.2	18.8	23.5	82	37	59.5	3.2	1
Dec-17	27.6	9.7	18.6	81	44	62.5	00.00	-
Jan-18	28.2	10.8	19.5	85	42	63.5	00.00	-
Feb-18	23.3	16.1	24.7	87	30	58.5	00.00	-
Mar-18	35.4	16.4	25.9	83	25	54.0	00.00	-

(Source : SRS, Bamra; Contributor: A.K. Jha)



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

*Agr*search with a *h*uman touch



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