

**ACHIEVEMENTS**  
*of*  
**ICAR-CRIJAF, Barrackpore**



**भा.कृ.अ.प. -केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान**  
**ICAR-Central Research Institute for Jute and Allied Fibers**

*An ISO 9001: 2015 Certified Institute*

Barrackpore, Kolkata-700120, West Bengal

[www.crijaf.org.in](http://www.crijaf.org.in)



## Crop Improvement

The mandate of the division is to develop improved varieties of jute and allied fibre crops possessing with higher yield, better quality along with other traits like biotic and abiotic stress resistance, suitable for different jute and allied fibres growing areas of the country. Division of Crop Improvement covers research areas like plant genetic resources, genetics and plant breeding, biotechnology and statistics.

- **Variety developed:** JBO 1, low lignin *tossa* jute with yield potential of 30-35 q/ha, JBC 5, a white jute variety with 28-30 q/ha fibre yield and two varieties of kenafi.e. JRM 3 and JRM 5 with yield potential of 25-38 q/ha were released. JRO 2407, a *tossa* jute variety with yield potential of 35-40 q/ha, JRM 2, a kenaf variety with yield potential of 25-28 q/ha and JRR 1, a roselle variety with 27-30 q/ha of yield were recommended for release.
- **Plant genetic resources:** The germplasm pool was enriched through addition of nine germplasm accessions comprising jute (2), mesta (4) and sunnhemp (3) collected through exploration and acquisition from Assam and Chhatisgarh. Accessions CIN 007, CIN 571, JRC 517 and UPC 94 were found to have higher tolerance to salinity stress than JRC 321 in white jute. A core set of 33 accessions was developed using classificatory analysis from 393 accessions of *tossa* jute.
- **Pre-mature flowering resistance:** An accession of *tossa* jute (OIJ 251) was consistent for resistance to premature flowering showing 0.51% and 0.84% flowering after 45 DAS for mid-February and early-March sowing, respectively.
- **Fibre quality improvement:** In the screening for finer quality fibre, seventeen germplasm lines in *tossa* jute were found to have better fibre quality over best check variety JRO 878. Fourteen selections from inter-varietal crosses showed better fibre fineness (2.29-2.48 tex) than best check variety JRO 878 (2.56 tex).
- **Mapping population development:** RIL mapping population for different traits in both the jute species were developed and conserved for further use in breeding programme.
- **Species diversity:** Two cultivated species i.e. *C. capsularis* (*white jute*) and *C. olitorius* (*tossa jute*) exhibited high genetic diversity at molecular level (coefficient of similarity 0.12), which may be a major reason of cross incompatibility between these two species.
- **Interspecific hybridization:** High pod setting was observed in interspecific crosses between *C. trilocularis* and *C. pseudocapsularis*.
- **Genome size:** Of all the *Corchorus* species, *C. fascicularis* had the smallest nuclear genome (188 Mb) followed by *C. aestuans* (194 Mb), and except for *C. pseudo-olitorius*, all the other wild species had smaller nuclear genomes than those of the cultivated jute species. A unique loss-of-function bast-fibre-shy (bfs) mutant of *C. olitorius* has been identified, which represents a unique genomics platform for understanding the genetics and genomics of bast fibre development in jute. Chloroplast diversity analysis in *Corchorus* species including the two cultivated jute species resolved a total of nine unique haplotypes (haplo-1 to haplo-9). Both the cultivated jute species were distinguished by distinct haplotypes (haplo-2 and haplo-4), differing by 8-26 bp at two of the eight chloroplast microsatellite loci characterized.
- **Molecular map:** First-ever microsatellite- and amplified fragment length polymorphism (AFLP)-based genetic linkage maps have been constructed for *Corchoru solitorius* L. These two molecular maps would facilitate the detection of QTLs for fibre quality and other agronomic traits in the dark jute.



- **Seed production:** The special emphasis on seed production of newly released varieties resulted in production of 62 q certified and 64 q TL jute seeds at CRIJAF, Barrackpore. At CSRSJAF, Budbud, 12.88 q breeder seeds of 16 jute varieties (10 *olitorius* and 6 *capsularis*), 7.7 q foundation seed, 54.42 q TL seed of jute were produced. Nucleus seed of about 3.50 q of all the released varieties of jute, mesta and sunnhemp were also produced. Besides jute seed, 4 q TL seed of mesta, 3 q TL seed of sunnhemp, 205 q TL seed of paddy, 90 q TL seed of wheat, 15 q TL seed of mustard and 27 q TL seed of dhaincha were also produced.
- **Jute seed production in non-traditional areas:** In non-traditional jute seed growing areas of Purulia (Kashipur block) district of West Bengal, productivity of 6 to 8.5 q/ha quality jute seeds was obtained with 1-2 irrigations in a seed to seed crop duration of 90 days. The net income from jute seed production was Rs.24,750 to 27,000/- per ha as compared to Rs.3000 to 6000/- per ha in paddy.

## Crop Production

The mandate of the Division of Crop Production is to develop improved and economically viable production technologies suitable for various fibre based cropping system in different agro-eco regions for the farmers as well as to meet the industrial requirement for diversified uses. Division of Crop Production consists of four disciplines namely Agronomy, Soil Science and Microbiology, Plant Physiology and Agricultural Engineering & Farm Machinery. These four disciplines work in tandem for the fulfillment of the above mentioned mandate of the Division.

- Crop Rotation
- Crop Husbandry
- Improved Post Harvest Technology
- Physiological Basis of Improving Jute Yield and Quality
- Farm Machinery and Mechanization

### Crop Rotation

- Based on different land situation as well as availability of water for irrigation crop rotations have been developed for jute growing tract of India.
- Under assured irrigation conditions, jute-paddy-potato followed by jute-paddy-groundnut proved promising as compared to winter crops like wheat, mustard, paddy and vegetables.
- Under limited irrigation condition, jute-pigeon pea + black gram-green gram yielded highest return followed by jute-black gram-wheat.
- Under rain fed condition, jute-mustard (Toria) + Lentil was found to be the most profitable.

### Crop Husbandry

#### Alternate planting Material for Ramie

Propagation of ramie through rhizomes is costlier and there are problems in storage and transportation also. To overcome this problem and to meet the increasing demand of planting materials for ramie, waste stalk (< 2 feet) cutting is being used as an alternative source of ramie planting material in the off season (March & April) nursery at CRIJAF, Barrackpore with more than 80% success rate, which indicates that the materials can be utilized as a good source of quality planting material for effective expansion of ramie cultivation (Fig 1). Waste stock planting is cheap and non-destructive, besides their availability thorough out the year.



Fig 1. Ramie Waste stalks



## Weed Management

### Cultural Control

- In well-drained soil, mulching with rice straw @ 10 tons/ha reduced weed dry matter by 75%.
- Companion cropping with red amaranthus + radish and legume like green gram was found to be effective in suppressing weed growth.
- Soil solarization by black polythene reduced weed biomass by 50% as a result of higher soil temperature (55<sup>0</sup>C), which does not affect jute fibre yield, but not cost effective.

### Integrated Control

- Integrated approach combining cultural, chemical and rotational method performs better as compared to other control measures.
- Application of Butachlor 50% EC or 5G @ 1 to 1.5 kg ai/ha during jute sowing or within 48 hrs of jute sowing followed by one hand weeding/wheel hoeing has been found effective for weed control in jute, mesta and sunnhemp.
- Application of Pretilachlor 50% EC @ 0.8 to 0.9 kg ai/ha during jute sowing or within 48 hrs of jute sowing followed by one hand weeding/wheel hoeing was found effective for weed control in jute.
- Nail weeder operation (along the rope / in between the line) in jute field (broad cast/ line sowing) at early stage i.e. 4 to 5 days after the emergence of jute crop (on field capacity soil) reduces 80 to 85 % weeds.
- Application of post emergence, selective herbicide, Quizalofop ethyl 5% EC @ 1.5 to 2.0 ml/l + adjuvant @ 1.0 ml/l at 15-21 DAE coupled with one hand weeding, was found very effective for the control of grassy woods in jute/mesta field.

## Water Management

- Jute seed requires 22% moisture for assured germination and it responds to irrigation scheduling at 20 % and 20-40% available soil moisture under normal and deficit rainfall conditions respectively.
- *Olitorius* jute cultivar JRO 524 was found to produce 3-4 q higher fibre yield under continuous submergence (22-30 cm) from 60 DAS to maturity over *Capsularis* jute cultivars (JRC 321 & JRC 212).
- 20-60% higher yield can be obtained through surface and internal drainage over water logging.
- Scheduling of irrigation to ramie based on IW/CPE ratio 0.6 to 0.9 significantly increased the leaf area index as well as net photosynthetic rate and decreased the transpiration rate of the crop.
- Application of irrigation increased fibre yield of the crop by 25-34% during pre-monsoon period while in the post monsoon period the increase was to the tune of 25%.

## Drought Management

- *Capsularis* jute shows more tolerance to drought condition than *Olitorius* jute except cv. JRO 524.
- Green gram (cv Pant mung 5) has been found to be suitable insurance crop under drought environment in jute.
- Mesta and blackgram/maize strip cropping (5:5) produced 21.5 and 22.5 q fibre equivalent yield/ha under drought condition.
- One post sowing irrigation (5-7 cm) with N: P:K:: 60:30:30 was found to produce 28 to 32 q jute fibre/ha under 40- 45% deficit rainfall during crop establishment stage (15<sup>th</sup> March to 15<sup>th</sup> June).



- Application of elemental sulphur @ 30 kg/ha in jute soil (<20 kg/ha available sulphur) along with N: P: K :: 60:30:30 was found to produce 33-35 q/ha of jute and mesta fibre under rainfed condition.
- Jute sowing (seed @ 8 kg/ha) on open furrow (4 cm depth, developed by nine tyne cultivator) along with 1.5 to 2 t/ha rice straw mulch on seeded furrows weighed by soil clods has been found to produce 32 q jute fibre/ha under rainfed condition. Seed should be treated with malathion @ 15 g/kg jute seed.

### Nutrient Requirement and Management

- *Olitorius* jute requires 2.06 kg N, 1.66 kg P, and 5.18 kg K and *Capsularis* jute requires 3.14 kg N, 1.54 kg P, and 7.96 kg K for the production of 1 quintal of fibre.
- The recommended dose of fertilizer (N: P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O) for *Olitorius* jute in low fertility areas is 80:40:40, whereas in mid fertility areas, the recommended dose is 60:30:30.
- The recommended dose of fertilizer (N: P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O) for *Capsularis* jute is 60-80:30-40:30-40, depending on the fertility status of the soil.

### Soil Test Based Fertilizer Application

- Soil test crop response based targeted yield equation were developed for desired yield targets under IPNSS for crops such as jute (*C. capsularis* and *C. olitorius*), mesta, rice (different variety), wheat, mustard, lentil and garden pea for alluvial soils of West Bengal.
- Application of fertilizers as per soil test and targeted yield basis can achieve 40 q jute fibre, 50 q rice grain and 20 q lentil /ha in jute-rice-lentil sequence under alluvial soils of West Bengal.
- Soil test and targeted yield basis fertilizer application can achieve 30 q jute fibre/ha without application of phosphatic fertilizer where available P is >10 kg/ ha in alluvial soils of West Bengal.
- Application of fertilizers as per soil test and targeted yield basis can save fertilizers, money and get maximum returns over farmers' practices.
- The fertilizer recommendations developed for various yield targets are site specific. However, they can be advocated to related soil series existing in other agro-climatic zones also.

### Soil Fertility

- Application of NPK + FYM (10t/ha) enriched SOC after 40 years of cultivation with jute-rice-wheat and registered the highest active pool of soil organic carbon. The net SOC input was found in the order of NPK+FYM>NPK>NP>N>control.
- DTPA extractable micronutrients were found to be depleted due to continuous cropping.
- Soil available phosphorus was found to be depleted in "phosphorus omission" treatments after 40 years of continuous cropping.
- The critical level of soil available P (24 kg P<sub>2</sub>O<sub>5</sub>/ha) and sulphur (8.5 ppm sulphate sulphur) was evaluated.
- The placement of phosphatic fertilizer at 10 cms depth of soil was found to be better in relation to utilization of fertilizer P by sunnhemp.
- Phosphorus use efficiency of Sunnhemp crop was evaluated and found only 5% using <sup>32</sup>P.



- The maximum depletion of different fractions of potassium was observed in NP (imbalanced) treatments after 40 years of Long-term fertilizer experimentation with jute-rice-wheat cropping sequence.
- Application of 30 kg S /ha in combination with NPK (60:30:30) increased jute fibre yield by 20% and fibre strength by 13%.

### Soil Quality

- The mean weight diameter, available P, dehydrogenase activity and total N were key indicators of soil quality indexing identified in jute based cropping system.
- Biological indicators of soil quality identified were microbial biomass carbon, available N, nitro fixing bacteria and plant pathogenic bacteria. Relative efficiency of the treatments for maintenance of the biological soil quality is 100% NPK + FYM > 100% NPK > 100% NP > 100% N > control in jute – rice – wheat cropping sequence.
- In jute the population of bacteria (*Azotobacter* and phosphate solubilizers), fungi and actinomycetes in the jute rhizosphere were observed to be maximum in 100% NPK + 10t FYM/ha during all stages of crop growth.
- 100% NPK + FYM and 100% NPK showed positive change in soil quality that is aggradation of soil quality but other treatments showed negative change in soil quality and indicates degradation of the system in a long term fertility experiment consisting of jute – rice – wheat cropping sequence.

### Biofertilizer

- *Azotobacter* counts and total available N increased considerably in the plots cropped with jute.
- Dual inoculation of *Azospirillum brasiliense* and *Bacillus megaterium* were found promising for increased jute fibre yield. The total N fixation in post-harvest jute soil was found to vary between 7-17 mg/kg soil.
- Maximum increase in fibre production (0-24 %) achieved through inoculation of jute seed with *Azotobacter chroococcum* plus 75% inorganic N.
- Inoculation of jute seed with *Azotobacter chroococcum* can save 25% N.
- The total microbial biomass worked out is  $791 \times 10^6$ /g jute soil. The ratio of beneficial to harmful microbes is 1: 2.9.

### Nutrient Management for Sustainability

- Higher jute fibre, rice grain and wheat grain yield was recorded in 150% NPK and 100% NPK + FYM.
- Sustainable yield index (SYI) was considerably lower in control, N and NP. Greater SYI in jute was recorded under NPK + FYM followed by 150% NPK. Higher SYI in rice was recorded in 150% NPK followed by 100% NPK + FYM (10t/ha).

### Physiological basis of improving jute yield and quality

- Critical day length for flowering was found to be 12 hrs. 30 minutes in jute. Photoperiodic requirements for vegetative and reproductive growth have been determined to develop jute varieties to fit into multiple cropping sequences.
- Potential limit of C3 jute production from the radiation and carbon use efficiency under typical jute growing condition has been predicted. Using the value of the fraction of light intercepted at various stages of growth the total potential primary productivity (biomass)

of jute has been calculated to be 40.81 t ha<sup>-1</sup>, which is equivalent to fibre yield of 100 q/ha.

- As jute is related to vegetative growth and vascular tissue (phloem) development, a detailed study has been made using both growth analysis techniques as well as radioactive tracers to understand the growth pattern and phloem fibre formation.
- It was calculated from the experimental data that jute cultivation (120 d) in India removes about 55 Tg of CO<sub>2</sub> annually from the atmosphere. Jute retting has been estimated to add 0.00915 Tg CH<sub>4</sub> (methane) to the atmosphere.
- A jute ideotype model has been constructed for better utilization of solar energy and production of finer fibre. An exotic genotype PPO4 has been identified having higher photosynthetic efficiency and harvest index.
- A lignin deficient mutant (*dlpf*) of JRC 212 an elite *C. capsularis* cultivar has been identified and thoroughly characterized for lignin synthesis and registered as INGR No.04/07. It was established that lignin biosynthesis in secondary phloem fibre is developmentally controlled.

### **Improved Post Harvest Technology**

#### **Improved Retting Technology for Jute & Mesta:**

##### **Mechano Microbial Retting for Jute & Mesta**

The use efficient pectinolytic bacterial consortium developed by CRIJAF for retting has been exploited and it was found that green jute ribbons extracted from freshly harvested jute plants with the help of either power operated bast fibre extractor or manually operated jute ribboner (CRIJAF jute ribboner) could be retted within 5 to 7 days under various jute growing areas in farmers' field condition with quality improvement i.e. improvement in the grade from TD VI to TD IV. The net income is increased by at least Rs. 3000 to Rs. 4500/- per ha than conventional method. (Fig. 2, 3 & 4).

##### **In Situ Jute Retting**

CRIJAF have recently developed an in-situ retting technology for retting of the whole jute /mesta plants with less volume of ground water. A polyethylene lined circular micro pond of 6.5 m floor diameter, 7.5 m top diameter, 1 m deep with 1 m wide earthen embankment is sufficient to ret jute plants harvested from one bigha (0.13 ha) of land with the help of microbial consortium developed by CRIJAF within 12-15 days compared to 18 to 21 days under conventional retting. By adopting this method, farmers can earn additional income of Rs. 5000 to 6000 over conventional method with the reduction of transport cost and improvement in fibre quality at least by two grades from TD VI to TD IV (Fig. 5 & 6)

##### **Improved Large Scale Degumming Technology for Ramie**

CRIJAF has developed a novel process in which a bacterium *Bacillus pumillus* DKS1 having high pectinase activity is used in a mild alkali solution (0.1%) for degumming of ramie fibre. This process could reduce the gum content of ramie fibre significantly, which is evidenced by the weight loss of ramie fibre (25% in case of small scale and 24% in case of large scale degumming). The fibre tenacity and fineness can also be improved by this novel technology.



Fig 2. Extraction green ribbons using CRIJAF jute extractor



Fig 3. Spraying of microbial consortium over the green ribbons



Fig 4. Lustrous fibre obtained through retting of green ribbons using microbial consortium



Fig5. Spraying of microbial consortium over the radially arranged jute bundles



Fig 6. Fibre extraction in the *in situ* retting tank

## Farm Machinery and Mechanization

Agricultural Engineering & Farm Machinery section of the Crop Production division is engaged in the development of machines for mechanizing the cultivation and post harvest operation of jute and allied fibres.



## **CRIJAF Jute Seeder**

Manually operated multi-row (4 and 5 rows) seeder has been developed to sow jute seed in line. Seeder is operated by a man/women and sowing capacity is similar to the conventional broadcast about 5-6 hrs/hectare. Seed requirement is 3-4 kg/hectare about half of the broadcast method. Line sown crop favours better inter cultural operations especially weeding. The yield of fibre is comparable to broadcast field although better managed line sown field yields more fibre at the reduced cost. The seeder was commercialized and its cost (for the year 2010) is Rs. 3245 and Rs. 3650 for 4 and 5 rows, respectively.

## **CRIJAF Weeder**

Manually operated (Push and Pull type) weeder suitable to operate in between rows of jute crop was developed and it is easier to operate by a man/woman. It is light in weight (about 6 kg) and the angle of wooden handle can be adjusted to hold firmly as per the need (height) of the operator. Weeding capacity of the weeder is about 0.045 hectare/hour, which is about 5 to 10 times more than the weeding done with the help of khurpi manually. The cost of the weeder is about Rs. 1400/- . This weeder is also useful in other line sown crops. (Fig. 8)

## **CRIJAF Jute Extractor :**

It is light in weight (about 50 kg), feasible to operation in field condition by a man/women. Freshly harvested jute plants (5-6 nos) are fed by the tip end to 10-15 cm length in to the machine and after activating ribbon separation unit by pressing foot, the canes are pulled back manually. Green ribbon remains in the hand of the operator while unbroken stick is ejected forward. Green ribbon extraction capacity with this machine is equivalent to about 25 kg dry jute fibre/hour; whereas, by traditional whole plant retting method manual fibre stripping capacity of a person is about 5 kg dry jute fibre per hour. (Fig. 9)

## **CRIJAF Bast Fibre Extractor :**

Power operated portable machine was developed to extract green ribbon of jute, Mesta, Sunnhemp and Ramie plants by breaking the stick into small pieces. The machine works on the principle of beating the canes progressively down its length and scrapping when the operator pulls out the canes. It involves two directional feeding actions. The machine is powered by 1 HP motor, weight about 125 kg and feasible to operate in field condition. About 5-6 normal canes can be fed into the machine at a time by a person and per hour ribbon extraction capacity equivalent to dry fibre is about 25, 15, 8 and 10 kg Jute, Mesta, Sunnhemp and Ramie respectively. Cost of the machine is about Rs. 16,000/-. (Fig. 10)

## **‘Raspador’ Decorticator :**

For the extraction of Sisal and Ramie fibre directly from the harvested leaves/canes, the machine ‘Raspador’ Decorticator was developed, which is powered by 5 H.P motor/engine. The machine is portable and can be taken to the field for its operation. Sisal leaf or Ramie canes are fed in to the machine and manipulated manually to extract fibre. The machine works on the principle of rapid beating and scraping leaves/canes progressively down its length through a rotating drum having beater knives on the periphery. The rotating drum maintains clearance (in which leaves/canes travel) against the base plate for rasping action. It involves two directional feeding actions. A person can extract dry fibre in an hour about 10 kg sisal and 6 kg ramie (contains gum about 25 %). Cost of the machine is about rupees fifty thousand. (Fig. 11)

### CRIJAF FLAX Fibre Extractor :

The power operated CRIJAF FLax Fibre Extractor was developed to extract (scutch) flax fibre. It is portable, powered by 1.0 H.P motor and weigh about 105 kg. Dry retted flax or linseed stalks are fed manually into the machine and scutched fibre is collected by the same person. Fibre extraction could be done by single man/women in standing or sitting posture. The fibre extraction capacity of the machine is about 3-5 kg dry fibre per hour. (Fig. 12)

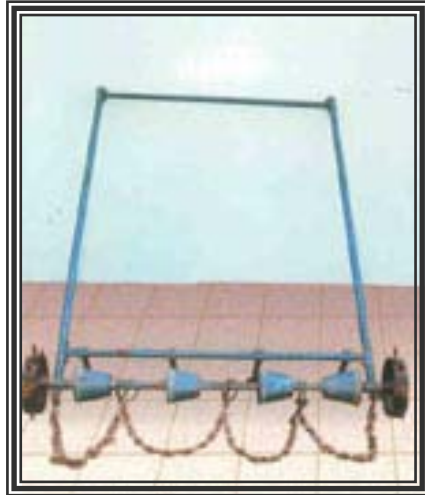


Fig. 7. CRIJAF Jute Seeder



Fig. 8. CRIJAF weeder



Fig. 9. CRIJAF Jute Extractor



Fig.10. CRIJAF Bast Fibre Extractor



Fig. 11. Raspador Decorticator



Fig.12. CRIJAF Flax Fibre Extractor

## Crop Protection

The Crop Protection Division consists of three disciplines *viz.*, Plant Pathology, Entomology and Nematology. The Division has focused on research pertaining to diagnostics, seasonal abundance, biological control, seed pathology, epidemiology, toxicology and host plant resistance with a primary objective to develop integrated pest and disease management techniques for jute and allied fibre crops.

### Chemical control of pests and diseases of Jute and Mesta

- Among the new acaricides, Fenazaquin 10 EC @ 1.5ml/l (new generation acaricide with novel mode of action) or fenpyroximate 5 EC @ 2 ml/l may be recommended for the management of yellow mite in jute.
- The toxicity in kenaf plants raised from Thiamethoxam 70 WS-treated seeds persisted beyond 50 days after sowing (DAS). Even at 75 DAS, the mealy bug infestation in Thiamethoxam-treated plants was 32 % less than control (Fig.1). Irrespective of stage of the crop, Thiamethoxam treated plants caused maximum mortality of flea beetle. This insecticide also favoured the root length, shoot length and root fresh weight of the treated plants.



(Fig. 1. Visual effect of treatments on mealy bug infestation in treated and untreated plants)

- Among the new fungicides, application of Tebuconazole 25.9 EC @ 1ml/l (0.1 % a.i.) as seed treatment and foliar spray at 45 DAS was most effective against stem rot of jute. The progress of disease over time was slowest in case of Tebuconazole 25.9 EC and Carbendazim 50 WP @ 2g/l. Tebuconazole 25.9 EC and Carbendazim 50 WP not

only managed the stem rot of jute effectively but also decreased the disease build up over the crop growth period drastically.

- Integrated use of seed treatment (ST) with Copper oxychloride (COC) @ 0.2 % a.i. followed by soil drenching with COC at 45 DAS and foliar spray of Mancozeb @ 0.2% at base of the plants was most effective in the management of on foot and stem rot (FSR) of mesta.

### Sources of resistance against pests

- The incidence of insect pests was observed to be less in the species containing resistant gene analogs viz., *C. pseudo-capsularis*, *C. tridens*, *C. fascicularis* and *C. aestuans*.
- In the natural field infestation, the *Capsularis* lines PADMA, NDC 2005-7 and JRC 4444 were less susceptible to stem weevil, semilooper and Bihar hairy caterpillar respectively. In *olitorius*, JRO 7835 and OIJ 38 were least susceptible to semilooper and Bihar hairy caterpillar respectively. Among the wild and cultivated species of jute, *C. aestuans* was least preferred host for Bihar hairy caterpillar.

### Biological control of jute pests

- *Beuveria bassiana*, a fungal antagonist and entomopathogen could be introduced into jute as an endophyte through seed treatment. Colonization of the entomopathogen in leaf, stem and pod was confirmed through culturing of plant tissues on selective medium and further detected by PCR.
- Under field condition the spore suspension of *B. bassiana* considerably reduced the damage caused by Bihar hairy caterpillar and semilooper and performed better than the commercial formulation (Fig. 2).



(Fig. 2. Infection of *Beuveria bassiana* on the larval stage of the Bihar hairy caterpillar)

## Seasonal incidence of pests and diseases

- The peak activity of mealy bug in kenaf was in mid-July. In subsequent periods the activity of mealy bug showed declining trend. The spiral borer infestation was more in early-sown Mesta crop compared to the late sown crop.
- The peak infestation of mite was observed on 55 DAS at 16<sup>th</sup> March of sowing and gradually it was declined and found nil at 100 and 115 DAS.
- The infestation of Mylloceros was less than 20% at 25 and 40 DAS the peak infestation was noticed at 55 DAS on 16 March sown crop, and the infestation started to decline throughout the cropping season with population density below 20%.
- The Semilooper infestation in the initial stage of the crop i.e. up to 40 DAS was nil and the two peak infestation was observed at 55 and 115 DAS in all dates of sowing.
- The incidence of stem rot in jute sown from March to June indicates early sown crop to be most susceptible to stem rot with 29.83% disease incidence. Crops sown later to March suffered less. Jute crop sown in the first week of April had lesser stem rot incidence than earlier sown crops and maximum fibre yield. In later crops although disease incidence was less, the yield also reduced.

## Botanicals for management of diseases of jute

- The aqueous leaf extract of neem (0.6%) was most effective against stem rot of jute with 46.98 % disease control in field condition (Fig. 3).
- The leaf extracts of turmeric, garlic and kalmegh also decreased the stem rot incidence significantly in jute. The essential oil of *Lippia geminata* (1000 ppm) inhibited the growth and spore germination of *Macrophomina phaseolina* by 100% over control *in vitro*.



Fig. 3. Effect of *Lippia geminata* essential oil on growth and spore germination of *Macrophomina phaseolina* after 7 days of treatment



- Aqueous root extract of *H. sabdariffa* at 1:20 dilution caused >90% juvenile (second stage) mortality of *Meloidogyne incognita* after 12 hrs exposure and after 24 hrs exposure it showed 100% mortality. At 1:40 dilution after 24 hours 96% mortality was recorded.

### Seed pathology

- Mid-August sown jute seed crop had least seed infection and discoloration with maximum seed yield. Foliar spray of Carbendazim 50 WP @ 0.1% at pod maturation stage reduced the seed infection and discoloration to maximum extent and improved the germination, seedling vigour and healthy seed yield significantly.

## ACHIEVEMENTS OF AGRICULTURAL EXTENSION TRANSFER OF TECHNOLOGY

The Extension section of CRIJAF take measures to transfer the technology generated by the Institute by various means. This is done through :

- **Research**

In the recent years studies on yield gap analysis in jute production, constraints in jute production, contribution of production factors in jute production, evaluation of jute-based cropping sequences, impact of newly developed jute varieties etc. have been conducted with special emphasis on farmer's perception.



Officials and farmers during field inspection



Assessment of drought management techniques at farmer's field

### **Demonstration**

Technology generated at the Institute on improved production technologies on jute such as on HYV, mechanized sowing of seed, pest & disease management, fertilizer management etc. are transferred by conducting frontline demonstrations in different villages of North-24 Parganas, Hooghly, Malda, Murshidabad and Nadia districts of West Bengal. In the XIth five year plan so far we have demonstrated on 100 ha area under farmers' field. These demonstration sites serve the purpose of technology assessment and dissemination to the participating and neighboring farmers pertaining to jute production technologies. Presently the demonstrations are being conducted in 50 ha area directly under farmers' field to motivate the farmers for quick adoption of jute production technologies.



Demonstration of furrow mulching at farmer's field



Field inspection by scientists



Demonstration of improved retting technology

### • Human Resource Development / Training

This includes capacity enhancement of the extension personnel and the researchers through training. National / state level trainings and seminars are conducted regularly for capacity enhancement of farmers, researchers and extension officials of the country with latest technical know-how. These programmes cover the entire gamut of production technologies pertaining to jute and allied fibre crops. Short duration (5 days) as well as long duration (21 days) training programmes on entrepreneurship development through diversification of jute products are also conducted on regular basis for farm women of weaker section to produce diversified products from jute fibre and marketing of the same through cooperative approach. The Institute has been successful in mobilizing financial support from the Directorate of Jute Development, Khadi Village Industries Commission and National Centre for Jute Diversification all under Govt. of India and Department of Science & Technology, Govt. of West Bengal for conducting most of the training programmes.



National Level Training for state officials at CRIJAF



Farmers training at Santoshpur, Hoogly



Farm-women getting trained in making jute handicrafts



### • Other extension activities

Dissemination of information are also done by other extension activities such as conducting visits of farmers and extension agencies as exposure to improved production technologies of jute; by organising group meetings / awareness camps, farmers day, seed sale counter and visits of the farmers and the students from different Institutions and States to expose them on the latest technological innovations (at the Institute Headquarters). In addition, the Institute participated in *melas* / exhibitions organised by different Institutions in the country and also conducted T.V./ Video programmes.



Seed sale counter at CRIJAF



Demonstration of jute extractor during Farmer's Day



Farmer – Scientist interaction at Village level



Exposure visit of Mesta farmers from A. P. at CRIJAF

## On-farm Testing

The Institute conducts programmes where the farmers and the extension personnel are exposed to the improved production technologies on jute under on-farm conditions in different villages in North-24 Pargans, Hooghly, Malda, Murshidabad and Nadia districts of West Bengal. The package includes use of proven technologies on improved varieties, seed treatment, method of sowing, fertilization practices, weed control, pest and disease management and improved retting method.

## Varietal Evaluation

The varieties demonstrated were JRO-8432, JBO-2003H, JRO-128, JRO-204 and S-19, which have been evolved from this Institute. JRO-524 was kept as a check variety. Sowing was done under irrigated conditions in the month of April-May

The highest fibre yield of jute across the locations was obtained from the variety JRO-204 (35.77 q ha<sup>-1</sup>) followed by JBO-2003-H (33.40 q ha<sup>-1</sup>), JRO-128(32.91 q ha<sup>-1</sup>), S-19 (31.73 q ha<sup>-1</sup>), JRO-524 (30.74 q ha<sup>-1</sup>) and JRO-8432 (29.13 q ha<sup>-1</sup>) (Table 1).

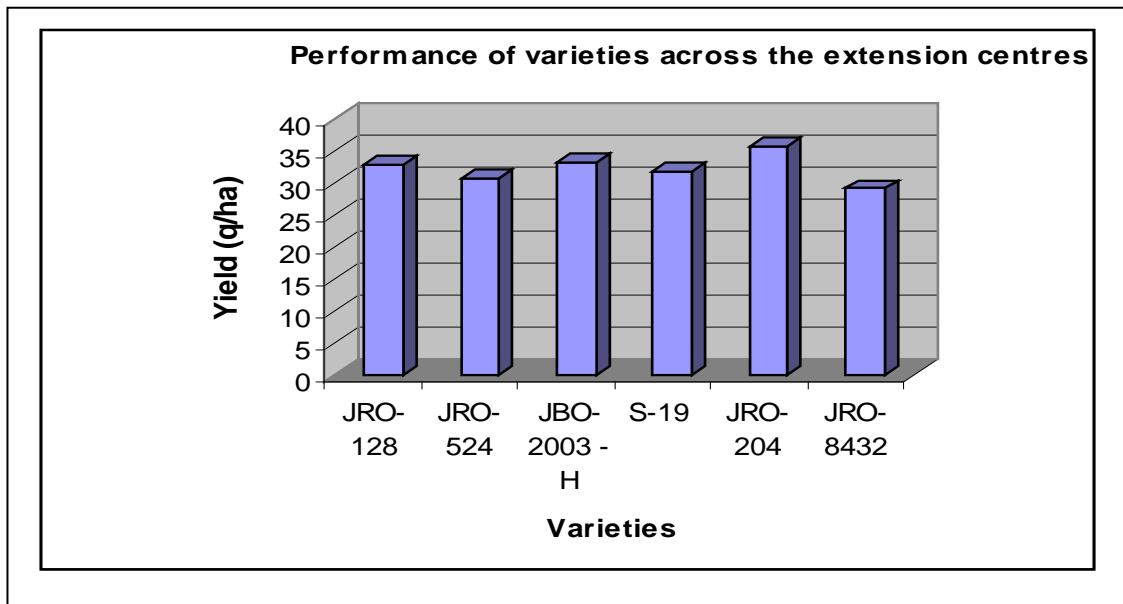
### Benefit-cost analysis

Highest net return per hectare was obtained from JRO-204 (Rs. 46887/-) followed by JBO-2003-H (Rs. 42,196/-), JRO-128 (Rs. 41,226/-), S-19 (Rs. 38,889/-), JRO-524 (Rs. 36,922/-) and JRO-8432 (Rs. 33,742/-) . On an average cost of cultivation per hectare was Rs. 23,924/- (Table 8). The local variety yielded only Rs. 29,840/- as net return per hectare against Rs. 25,786/- cost of cultivation.

In terms of benefit- cost ratio, the variety JRO-204 ranked first (2.96) followed by JBO-2003-H (2.76), JRO-128 (2.72), S-19 (2.63), JRO-524 (2.54), and JRO-8432 (2.41).

**Table 1: Economics of cultivation of improved jute varieties**

Sl. No.	Variety	Fibre Yield (q ha <sup>-1</sup> )	Cost of cultivation (Rs. ha <sup>-1</sup> )	Gross return (Rs. ha <sup>-1</sup> )	Net return (Rs. ha <sup>-1</sup> )	B:C ratio
1.	JRO-204	35.77	23,924	70,811	46,887	2.96
2.	JBO-2003 -H	33.40	23,924	66120	42,196	2.76
3.	JRO-128	32.91	23,924	65,150	41,226	2.72
4.	S-19	31.73	23,924	62,813	38,889	2.63
5.	JRO-524	30.74	23,924	60,846	36,922	2.54
6.	JRO-8432	29.13	23,924	57,666	33,742	2.41
7.	Local Variety	28.10	25,786	55,626	29,840	2.15





Varietals demonstration(JRO-204) under FLD



Demonstration of four row seed drill for sowing of jute

- **Farmers Day/Awareness Camp/ Farmers Group Meeting**

For increasing the awareness and interest of farmers towards jute and allied fibre production technologies the programmes viz. farmers day, awareness camp and group meetings are conducted on regular basis which provides opportunity to have farmer-scientists interface where the queries/problems of the farmers as the feedback are discussed at length. Farmers get first hand knowledge of the technologies developed by the institute on such occasions. Farmers from various jute growing districts viz. North-24 Parganas, Hooghly Malda, Murshidabad and Nadia districts of West Bengal attend such programmes.



Dignitaries at Farmer's Day at CRIJAF



Dignitaries visiting demonstration plots at CRIJAF

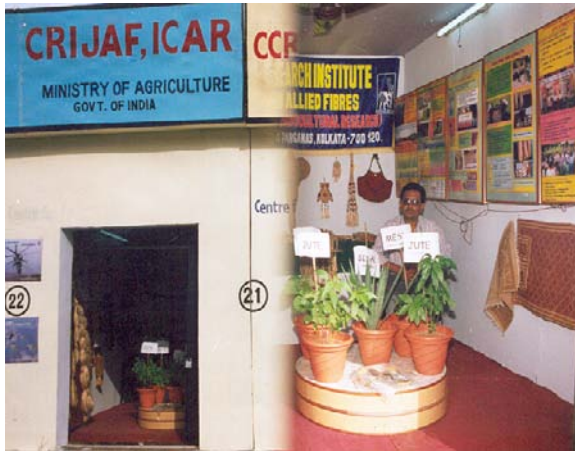
- **Exposure Visits of farmers & students**

The reputation of the Institute has attracted farmers, students and others interested in fibre production from various corners of the country, viz. Bihar, Orissa, Assam, Andhra Pradesh, Uttar Pradesh and Kerala, in addition from West Bengal to get themselves

exposed to production technologies of jute and allied fibre crops. Such programmes are conducted by the Institute round the year.

### Participation in *Mela* / Exhibition

The Institute participates in *melas*/exhibitions, organised by different Institutions / Societies, in Bihar, Orissa, Andhra Pradesh & West Bengal depicting the technological innovations in production of jute & allied fibres. Based on the materials and quality of exhibits, and the methodology of focusing the technologies to the visiting farmers, the pavilions of the Institute has also received awards on several occasions.



CRIJAF stall at National Expo at Kolkata



CRIJAF stall at Kisan Mela at Purnea, Bihar



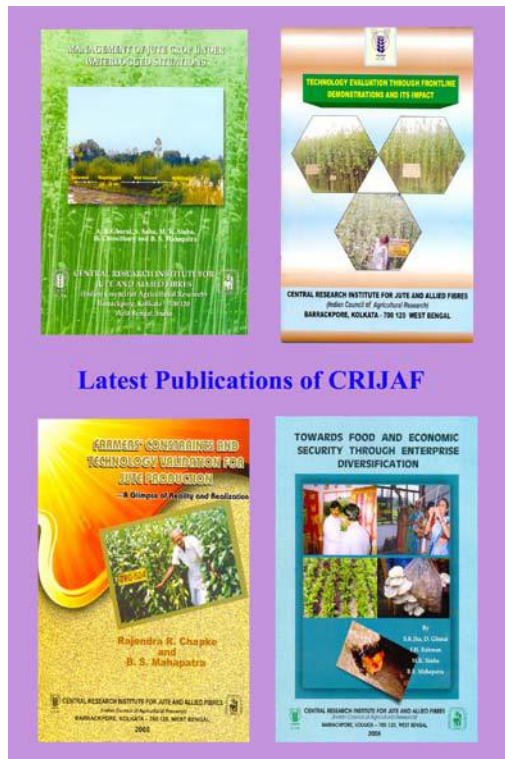
Visitors at CRIJAF stall at RAU, Pusa



Visitors at CRIJAF stall at ANGRAU, Hyderabad

### T.V./ Video Programme

The Institute has produced video films on “CRIJAF Activities and “ Improved Retting Technologies “ with the help of concerned scientists. Besides, interviews were telecasted on issues like farming strategies to cope with climate changes, marketing strategies to deal with middlemen problem, cost saving farmers friendly technologies a number of times on private T.V. channels and Doordarshan.



Some useful and latest publications from CRIJAF



Dignitaries visiting CRIJAF stall at RAU, Pusa

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