Integrated pest and disease management

for jute and allied fibres

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Jute and allied fibre crops suffered due to the ravages caused by several pests and diseases. Like other crops change in pests and disease scenario is evident in jute and allied fibre ecosystem also. Some minor pests and diseases like mealy bug on jute and mesta and yellow vein mosaic disease of mesta have turned to be major ones, on the other hand the incidence of some major diseases like Hooghly wilt has come down to less than 1-2%. One of the major constraints in the management of pests and diseases of jute and allied fibres is the availability of resistant varieties. Hence, there is an urgent need to screen the available germplasm at CRIJAF with a view to identify the sources of resistance. In this endeavour hundreds of germplasm were screened against most virulent pathotype of Macrophomina *and resistance sources were identified both among* tossa *and* white *jute accessions. The proposed IPM and IDM practices are quite effective in addressing the problem due to pests and diseases.*

Intensive cultivation of high-yielding, fertilizer responsive cultivars of jute brought forth the problem of pests and diseases. A few relatively less important pests and diseases turned to be major ones. Mesta, sunnhemp, ramie, flax and sisal are the major allied fibre crops, which cannot be ignored to meet the increasing demand of natural fibres. They also suffer due to the ravages caused by several insect pests and diseases. Hence, protection of bast fibre crops from the attack of pests and diseases deserves much attention.

Major pests of jute

Yellow mite, stem-weevil, semilooper, hairy caterpillar are the major pests of jute. Yellow mite (*Polyphagotarsonemus latus*) is one of

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Sunnhemp wilt

Jute stem rot

the most destructive pests of jute and significant yield loss occurs regularly. Both nymphs and adults suck the sap from the ventral surface of young leaves, which curls ventrally giving inverted boat-shaped appearance. The leaves do not grow to their full size; they turn coppery-brown and drop prematurely. The vertical vegetative growth of the crop is arrested, internodes become shortened and significant yield loss occurs regularly. Under severe damage the internodal length is reduced by two folds. *Tossa* jute suffers more due to yellow mite infestation than the *white* jute. The quality of the fibre was also found to be deteriorated due to the attack of yellow mite.

Stem weevil *Apion corchori* is a pest on both the species of *Corchorus.* However, *C. capsularis* (*white* jute) suffers more than *C. olitorius* (*tossa* jute). It exists throughout the cropping season and it damages the early sown crop sometimes to such an extent that hardly any fibre can be obtained. Grubs feed on the internal tissues, which affects the growth of the plant. Loss of apical meristem checks the vertical growth and subsequently induces branching. In older plants mucilaginous substances are produced around the tissues damaged by the larva bind the fibres together; the fibres break at these points during processing and result in 'knotty fibre'. Thus the stem weevil infestation affects the fibre both in terms of quality and quantity. The yield loss has been estimated at about 18% on 'JRC 212'.

Jute semilooper, *Anomis sabulifera* (Noctuidae: Lepidoptera) is one of the important foliage pests of the crop and occurs in all the jute growing tracts of India. Crop loss due to this pest has been estimated at up to 50%. Slender light green larvae start damage from unopened leaves, which represent the most susceptible portion of the plant. Around 95% of the damage is restricted to nine fully opened leaves from the top. Repeated damage by this pest checks crop growth and induces profuse branching, resulting in reduction of fibre yield. Pods and unripe seeds of the seed crop are also being damaged by semilooper.

Hairy caterpillar (*Spilosoma obliqua*) is a polyphagous pest attacking several crops including the bast fibre crops jute and mesta. However, jute is the preferred host than mesta; further the *tossa* jute is somewhat tolerant to the hairy caterpillar as compared to *white* jute. It was once considered as a sporadic and irregular pest on jute, but nowadays it is a regular and major pest on jute. The incidence of hairy caterpillar is more in Assam and Bihar. The female moth lays eggs in groups and a single female may lay up to 1000 eggs. Upon hatching the larvae are gregarious and scrap the chlorophyll content of the leaves. Later they disperse to the entire field and prefer to defoliate the older leaves.

Mealy bugs were once considered as minor pests of jute. *Ferrisia virgata* and *Pseudococcus filamentosus* var. *corymbatus* (Pseudococcidae: Hemiptera) were the two species recorded earlier. Recently, yet another species *Phenacoccus solenopsis* has

Bihar hairy caterpillar

emerged as a new threat to jute and mesta. The damage is caused mostly by the nymphs, which suck the sap from leaf, petiole, stem and pod. Repeated attacks on the stem cause the development of crust due to which fibre bundles resist separation at the time of retting, resulting in the formation of "barky fibre". More damage is caused to seed crop, which does not put forth more number of pods.

Integrated pest management for jute

Resistant varieties: *White* jute cultivars 'NDC 8812' and 'NDC 9801' are resistant to stem weevil and moderately resistant to semilooper. The *tossa* jute variety 'JRO 878' is also less susceptible to stem weevil attack. 'JRO 524', 'JRO 7835' and 'JRC 212' are tolerant to yellow mite, whereas 'JRO 878' is highly susceptible. The resistant / tolerant varieties may be preferred to avoid the colossal loss due to insect pests.

Cultural practices:

- Optimal date of sowing is the 4th week of March for 'JRO 524', whereas 2nd week of April is the optimum date of sowing for other varieties to minimize the pest incidence.

Jute mealy bug

- Self-sown plants and weeds should be removed properly to avoid carryover of the pests.
- It is suggested to pluck the leaves with early stage gregarious larvae of Bihar hairy caterpillar prior to spray insecticides. It is one of the important cultural practices needs to be followed in the management of jute pests.

Insecticides: Economic threshold level for semilooper is 15% of defoliation on 'JRO 524'. If the infestation crosses the ETL, then endosulfan (0.075%) or carbaryl (0.1%) or cypermethrin (0.03%) may be recommended. The same recommendation holds good for managing the grey weevil also. Endosulfan (0.075%), carbofuran (1 kg a.i./ha) and cypermethrin (0.03%) are quite effective in managing the stem weevil. Insecticidal interference is required as soon as the mite population crosses the ETL of 110 mites per leaf (preferably in the second unfolded leaf). Two rounds of endosulfan (0.04%) spray at fortnightly intervals can take care of the mite yellow population. The incidence gradually declines from border to inner rows in case of yellow mite with reverse trend in case of semilooper. Hence, care should be taken accordingly to get reliable population estimates as well as spraying insecticides.

Major diseases of jute

Stem rot caused by *Macrophomina phaseolina* is an economically important disease of jute. Anthracnose is of regular occurrence especially in *capsularis* belt. Black band, soft rot and Hooghly wilt are the diseases of minor importance.

Macrophomina phaseolina is the causal organism of stem rot in jute, the sclerotial stage of which is *Rhizoctonia bataticola*. The disease is prevalent in all the jute growing regions of the world. Both *tossa* and *white* jute varieties are equally susceptible to this disease. Average yield loss due to this disease has been estimated at around 10-15%. Hot (34 ± 1°C) and humid weather favours faster development of the disease. Though commonly known as the stem rot, the symptom is not restricted to the stem only. The pathogen attacks any part of the plant at any stage of growth thus causing seedling blight, damping off, collar rot, stem rot and root rot.

Anthracnose is of regular occurrence in the *capsularis* belt of India, viz. Assam, North Bengal, Bihar and Uttar Pradesh. The causal agents are *Colletotrichum corchori* for *C. capsularis* and *Colletotrichum gloeosporioides* for *C. olitorius*. Continuous rain, high relative humidity and temperature of around 35°C are congenial for the faster development of this disease. *White* jute is more susceptible and *tossa* jute is rarely affected.

Black band is caused by *Botryodiplodia theobromae*. The pathogen is seed borne as well as air borne and has a very wide host range. It was a minor disease in the past, but the incidence is gradually increasing nowadays.

Soft rot is a disease of minor importance caused by *Sclerotium rolfsii*. This is primarily a soil borne fungus. It grows in the litter of fallen jute leaves. When the weather is hot and the soil is wet, it grows and initiates infection in the collar region. Both *tossa* and *white* jute are equally susceptible.

Hooghly wilt is caused by *Ralstonia solanacearum (=Pseudomonas solanacearum)*, while *Rhizoctonia bataticola* and *Meloidogyne incognita* facilitate the entry of the primary pathogen. This disease is most prevalent in the areas where jute is followed by potato or other solanaceaous crops. While *olitorius* jute suffers from Hoogly wilt, there is no report of *capsularis* jute being attacked by it so far.

Jute crop or its wild relatives are not very much prone to the viral diseases. Jute mosaic, chlorosis and yellow vein are the viral diseases reported to occur on jute. In India, the incidence of jute mosaic (Syn. jute leaf mosaic, jute yellow mosaic, jute golden mosaic) caused by a

Yellow mite infested plant

member of *Begomovirus* was reported in *capsularis* jute from West Bengal and Assam. The virus is transmitted by the whitefly *Bemisia tabaci*.

Integrated disease management for jute

Resistant varieties: Resistant varieties are not available at the cultivators level for managing the *Macrophomina*. However, six *white* jute accessions, viz. CIM 036, CIM 064, CIN 109, CIN 360, CIN 362 and CIN 386 were identified as resistant. Four *tossa* jute accessions OIN 125, OIN 154, OIN 651 and OIN 853 were categorized as moderately resistant to *Macrophomina phaseolina*. These accessions will be utilized for the breeding programmes to develop disease resistant varieties of jute.

Clean cultivation: Deep ploughing during summer and clean cultivation by removing the left over of all the previous crops are essential to prevent primary source of infection by *Sclerotium rolfsii*, the causal agent of soft rot disease.

Soil amelioration: Acid soils are in general preferred for most pathogens. If the soil is acidic, then lime @ 2-4 tonnes/ha should be applied depending upon the soil pH. Lime application needs to be done at least a month before the sowing otherwise the seedlings will be damaged. A neutral soil having pH between 6.5 and 7.5 is preferable for healthy crop. Indiscriminate use of fertilizers particulary the nitrogenous fertilizers, makes the soil acidic.

Healthy seed: Infected seeds serve as the primary source of inoculum. Therefore, healthy seeds should be used after treating them with recommended fungicides. Seed treatment with carbendazim @ 2.0 g/kg or mancozeb @ 5.0 g/kg or *Trichoderma viride* @ 10.0 g/kg of seed may be recommended for managing the *Macrophomina* disease complex, anthracnose, blackband and Hooghly wilt. Seeds with 15% or more infection should be avoided even after treatment to contain the spread of anthracnose incidence.

Sowing time: The crop can be escaped from some diseases by slight adjustment in the sowing time. Jute sown after second week of April suffers less from stem rot and root rot. Sowing time however, needs adjustment depends on the preceding and the succeeding crops in the cropping sequences.

Fertilizer application: Application of nitrogen beyond 80 kg/ha and in new alluvial soils even above 60 kg/ha promotes the incidence of stem rot, root rot and collar rot. Thus judicious application of nitrogenous fertilizers is recommended.

Spacing: Closer spacing is conducive for the spread of the stem rot, but optimum spacing of 30´5-7cm for *white* jute and 20-25´5-7 cm for *tossa* jute results in lesser incidence of the disease.

Weeding: *Macrophomina phaseolina* and *Sclerotium rolfsii* have a very wide host range including a number of weeds. Timely weeding should be done to avoid the spread of disease from the weeds.

Crop rotation: Non-host crop should be selected for rotation to reduce the incidence of *Macrophomina* disease complex as well as Hooghly wilt of jute. Rice/wheat/mustard may be selected, but not potato or other solanaceous vegetables for more than two consecutive years. Jute-paddy rotation in rainfed and jute-paddy-wheat sequence under irrigated condition is recommended to contain the spread of the disease. By adopting cultural practices particularly appropriate crop rotation in Hooghly district, the disease has come down to 1-2% as against above 40% in the late eighties.

Yellow vein mosaic of mesta

Fungicides

- Foliar spraying of carbendazim (0.2%) or copper oxychloride (0.75%) is suggested for the management of *Macrophomina* disease complex, anthracnose, blackband and soft rot.
- Integration of control measures consisting of maintaining soil pH 5.6 – 6.0, application of organic manure @ 5 tonnes/ha, seed treatment with carbendazim @ 2 g/kg of seed, foliar spraying of carbendazim @1.5 g/l of water when disease incidence reached 2% and soil application of *T. viride* @12×10^6 spores/ml during sowing could reduce the incidence

of stem rot to a greater incidence.

- In general, roguing of diseased plant and spraying of insecticides such as imidacloprid, thiamethoxam and acetameprid could prevent the spread of the viral diseases.

Major pests of mesta

Mesta suffers due to ravages caused by a number of insect pests. Spiral borer, mealy bug, and flea beetle are the major pests of both kenaf (*Hibiscus cannabinus*) and roselle (*Hibiscus sabdariffa*). The major pests however, have limited geographical distribution and do not occur in all the mesta growing states of India. West Bengal is the only state, where all the major pests cause economic damage to mesta crop.

Spiral borer, *Agrilus acutus* (Buprestidae: Coleoptera) is a pest on both kenaf and roselle. Larva makes tunnel spirally throughout the entire length of the stem beneath the cambium layer. The course of the spiral inside the stem is generally recognized by elongated gall (9-15 cm). The portion of the stem above the gall dries up and ultimately dies.

Mealy bug, *Maconellicoccus hirsutus* (Pseudococcidae: Hemiptera) is a major pest on both the species of mesta. Nymphs and adults suck the sap from apical portion of the plant and eventually arrest the vertical growth of the internodes. The attacked region becomes deep green in colour with swellings. Secondary branches are put forth with the appearance of "bunchy tops". The fibre of attacked plants snaps during retting at the infested points

Flea beetle, *Nisotra orbiculata* [=*Podagrica orbiculata*; *Podagrica bowringi*] (Curculianidae: Coleoptera) attack commences in seedling stage and ceases just before harvest. The eggs are laid in clusters either under dry leaves or under the cracks and crevices of the soil. The larvae on hatching feed on roots. Week-old seedlings are highly susceptible to this pest and hence resowing is warranted frequently. Adults are more injurious to the crop as they feed on the tender portion of the stem besides damaging the leaves. Intermittent showers followed by dry spell with high humidity observed to be conducive for its multiplication.

Integrated pest management for mesta

- Crop sown during mid-April to mid-May suffer more due to spiral borer than what was sown on later dates. Hence sowing may be taken up during second fortnight of May in the spiral borer endemic areas.
- Flea beetle thrives well on the alternate hosts *Sida* and *Hibiscus vitifolius* in the absence of mesta crop. Hence, the field should be maintained weed free.
- Carbofuran @ 1 kg/ha is very effective in managing the spiral borer. Swabbing the stem with methyl demeton (2.5% @ 20 ml/ plant) at 45 cm above the soil surface can also take care of this pest. Dimethoate and methyl demeton are effective in managing the mealy bug. Neem oil @ 5ml/l and carbaryl (0.1%) are effective in managing the flea beetle.

Major diseases of mesta

In mesta, foot and stem rot caused by *Phytophthora parasitica* var. *sabdariffae*, soft rot / collar rot caused by *Sclerotium rolfsii* and yellow vein mosaic caused by begomovirus are the important diseases.

Foot and stem rot is the most important disease of mesta in India causing loss to the extent of 10 – 25%. It is more serious in roselle than kenaf. In severe cases, more than 40% crop loss in roselle was observed. It is prevalent in all the mesta growing areas of India. The fungus causes seedling damping-off, seedling blight, foot rot and stem rot. The infected plant struggles for survival by producing secondary roots above the rotten portion of the stem. Collar rot is more prevalent in kenaf varieties than roselle. The incidence is not yet alarming. Phoma leaf spot caused by *Phoma sabdariffae*, eye rot caused by *Myrothecium roridium* and root rot caused by *Macrophomina phaseolina* alone or in combination with *Fusarium oxysporum* are the minor diseases of mesta.

Rootknot nematode

Yellow vein mosaic of mesta is spreading at an alarming rate. The fibre loss due to this disease has been estimated to be 12.78-17.45%. Viruliferous whitefly could effectively transmit the virus with 78-85% transmission efficiency. Three whiteflies per plant are sufficient to transmit the disease. *B. tabaci* also acts as vector for spreading a leaf curl disease on kenaf.

Integrated disease management for mesta

- None of the cultivated varieties are resistant to the foot and stem rot disease, but 'AMV 1', 'Roselle Type 1' and 'AP 481' were observed to be moderately resistant. Red bristled *H. sabdariffa* lines are more resistant than others.
- Seed treatment with copper oxychloride (5 g/kg of seed) is more effective in managing *Phytophthora parasitica* var. *sabdariffae*, the causal organism of foot and stem rot disease.
- Spraying copper oxychloride @ 5-7 g/l of water, directed towards base of the plants helps in managing the diseases of mesta.
- The vector of yellow vein mosaic of mesta (*B. tabaci*) can be managed effectively by imidaclorprid 17.8 SC (3 ml/10 l of water) and thiamethoxam 25 WG (5g/20 l of water).

Major pests of sunnhemp

Top shoot borer, *Laspeyresia tricentra* and the hairy caterpillar *Utetheisa pulchella* are the most serious pests of sunnhemp.

Top shoot borer, *Laspeyresia tricentra* (Eucosmidae: Lepidoptera) is a serious pest attacking crops in the younger stages. Average loss of fibre due its attack has been estimated as around 17% in 'K 12 Yellow' and 21% in 'K 12 Black'. Infestation generally starts after 15-30 days of monsoon break and most severe in September and October. The larva bores in to the shoots of young plants and characteristic galls are formed at the regions within which the larva feeds. Side branches are given out, which ultimately reduce the value of the fibre. It also damages the pods and feeds on the developing seeds when the crop is in bearing.

Sunnhemp hairy caterpillar, *Utetheisa pulchella* (Arctiidae: Lepidoptera) is one of the most serious and specific pest of this crop. It occurs in all the sunnhemp growing tracts of India. The larva feeds on the foliage. It also bores into the pods and eats away the seeds.

Integrated pest management for sunnhemp

- Since the larvae of sunnhemp shoot borer undergo hibernation during off-season (November-June) in the soil, summer ploughing should be done to expose the larvae to scorching sun and predatory birds. Moreover, the ploughing should be done to a depth of at least 15 cm, as the larvae hibernate in the soil up to a depth of 14 cm.
- It is advocated to sow the crop in early June. It has already been realized that the early sown crop escapes from heavy incidence of shoot borer, which would otherwise devastate the entire crop during September-October.
- *B. brevicornis* was observed to parasitize the larvae of sunnhemp hairy caterpillar *U. pulchella.* Since the mass multiplication technology has already been standardized and several private firms are also engaged in the mass production of *B. brevicornis,* inundative releases of this parasitoid may be tried in the IPM programmes.
- Whenever the population goes beyond the control of cultural and biological means, any contact insecticide may be recommended to manage the sunnhemp hairy caterpillar. Carbofuran @ 0.5 kg a.i./ha followed by two sprays of carbaryl (0.1%) may take care of the sunnhemp crop from the shoot borer attack.

Major diseases of sunnhemp

Fusarial wilt (*Fusarium udum* f.sp. *crotalariae*) is an important disease of sunnhemp. Generally the incidence is in the range of 10-12%, but under favourable condition the incidence may as high as 60-80%. Affected plant gradually withers, droops down and ultimately dies within a day or two. Usually the whole plant wilts, but partial wilting is also noticed. The fungus survives in the soil as well as in crop residues as facultative parasite. It attacks the plant through the thinner roots, rootlets and even through the cracking in the basal portion of the stem. The incidence increases with decreasing temperature and increasing crop age.

Anthracnose (*Colletotrichum crotalariae*) is yet another important disease of sunnhemp. Infection first starts on cotyledon and subsequently spread to the stem and growing point. Soft discoloured areas on the cotyledon are the indication of this disease. The affected seedlings droops from the point below cotyledon. The infected seedlings generally die. With the growth of seedlings the plants become resistant to the disease. Cloudy weather and continuous rain favours the disease to spread quickly in thickly populated crop.

Sunnhemp mosaic (SHMV) is an economically important disease. The first visible symptom appears in 10-12 days after infection, where mottling can be seen on the youngest leaves. As the disease progresses, patches of light and dark green areas become more prominent. Diseased leaves are smaller and in severe cases the growth of lamina is generally abnormal. Dark green raised areas from the upper surface are frequently seen with corresponding depression on the lower surface. The infected

plant remains shorter in height and as a consequence the fibre yield is greatly reduced. The disease is transmitted through mechanical means. The severity of the disease increases with the onset of monsoon.

Integrated disease management for sunnhemp

- April sowing of tolerant variety like 'K 12 Yellow' and 'SH 4' can effectively manage the wilt and mosaic diseases of sunnhemp.
- Mid-April to May sowing is recommended to reduce the anthracnose incidence on sunnhemp.
- Seed treatment with carbendazim @ 2 g/kg can reduce the wilt and anthracnose diseases.
- Foliar spraying with carbendazim checks the secondary spread of anthracnose.

Major pests of ramie, flax and sisal and their management

Ramie: The hibiscus mealy bug, *M. hirsutus* is a serious pest on ramie. It causes stunting and swelling of the stem besides deformation of the leaves. Incidence of this pest not only reduces the yield, but deteriorates the quality of the fibres. The hairy caterpillar, *Spilosoma obliqua* also causes damage to ramie crop. *Spodoptera litura* and *Amsacta moori* were recorded as pests on ramie in India, however they are of minor importance.

Flax: Flax succumbs to very limited number of insect pests. The struggle is chiefly against the flea beetles and thrips especially in European countries but not in Indian subcontinent. The flea beetles, *Longitarsus parvulus* and *Aphthona euphorbiae* cause damage to flax as long as it reaches a height of 7 cm. They bite seed lobes, seedlings, stem and leaves. The damage made before sprouting usually eliminates the entire plant. *Thrips angusticeps* and *Thrips linarius* are the two thrips species attacking flax. *T. linarius* is very specific to flax. The damage is more conspicuous after the plant reaches a height of about 30 cm. In view of their very small size, thrips hide in the tuft of the terminal buds and hence systemic insecticides are preferred over contact insecticides till the opening of floral buds. Seed treatment with imidacloprid or thiamethoxam is very effective in managing the flax flea beetles.

Sisal: Agaves are relatively problem-free, except for the aggravating agave snout weevil (sometimes referred to as sisal weevil), *Scyphophorus acupunctatus* (Curculionidae: Coleoptera). *Sisal weevil* has been a major problem in Mexico, Africa and Indonesia. However, it has not yet been reported as a pest on agave in India. Larvae bore galleries into the plants. Adults also tunnel into the stem and feed on the tender tissues. In case of severe attacks, plants in nurseries may die. In addition to the feeding damage, the insect favours the development of secondary fungal or bacterial rots. Removal and destruction of the infected plants, as well as of weevils and grubs, will reduce the build-up of population. Upon initial detection of adult activity, a single application of a systemic insecticide may be enough to minimize crop losses due to sisal weevil.

Major diseases of ramie and sisal, and their management

Ramie: Cercospora leaf spot caused by *Cercospora boehmeriae* and *C. krugiana* is quite common and widespread in nearly all the ramie growing tracts of Assam. The yield loss due to this disease is insignificant. Affected plants are not killed outright. If the plant is very young and the spotting is very severe, then the growth is retarded. The disease appears as circular to angular spot on the upper surface of the leaf. Sometimes the spots which are 1-8 mm in diameter and dark brown to nearly black in colour are limited by the leaf veins. The disease is observed throughout the year, but severe during late-September to early-January. In severe infection more than 60% of leaves are affected and 30-60% of the leaf area on an average destroyed by spotting. Leaves severely spotted turn yellow and fall prematurely. The disease can be controlled by dusting or spraying copper fungicides such as Blitox-50.

Damping off is yet another important disease of ramie caused by *Rhizoctonia solani*. The fungus attacks foot of the stem or crown of the roots rendering tissues at that region weak and subsequent collapse of the seedlings. Moisture content of soil and humidity are important factors for seedling disease. Sterilization of soil of seed bed using formaldehyde (1:50) is the best possible remedy available.

The disease eye rot caused by *Myrothecium roridum* attacks leaves as well as stem. Infection of leaves results in both qualitative and quantitative loss of fibre. The first symptom appears as irregular, small, round tan coloured spots about 1 mm in diameter on the upper surface of the lamina. As the disease advances the spots become circular and elongated to irregular, and brown to dark brown in colour. In case of severity, the incidence of disease is reported to be 7-10%. The disease can be controlled by spraying copper fungicides.

Sisal: Zebra disease of sisal is associated with three different species of *Phytophthora*, viz. *P. nicotianae*, *P. aracae* and *P. palmivora*. Dark black, water soaked lesions with concentric wavy rings appear on the leaves. The older leaves touching moist soil are more susceptible to infection. In adult plants, generally infection begins from older leaves nearer to ground level.

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In both *A. sisalana* and 'Bamra hybrid-1' ('Leela'), zebra leaf spot appear as small lesions on the lamina, which rapidly enlarge with alternate concentric rings and light greenish yellow margin. At the centre of the spots formation of gummy exudates is often observed. Small spots coalesce to form larger spots and gummy exudates solidify giving crystalline brown appearance. Spike and bole rot phase of the disease has been recorded exclusively in Bamra hybrid in advance stage of infection. Foliar spray of RidoMil MZ-72 or indofil M-45 is recommended to manage this disease. However, these fungicides are not effective to check the bole and spike rot phase of the disease.

Nematodes and their management

Root-knot nematode (*Meloidogyne igconita*, *M. javanica)* is one of the economically important pests of jute and mesta. The average extent of damage has been estimated at about 15–20%.

Both *tossa* and *white* jute were susceptible to it. Roselle is resistant, while kenaf is susceptible to this nematode. Root-knot nematode facilitates entry of other bacterial pathogen *Ralstonia solanacearum* and fungal pathogen *M. phaseolina* by creating injury on plant roots and cause heavy damage. Cultural practices like, removal of stubbles, weeding, thinning, crop rotation with paddy and wheat for two years could reduce root-knot nematode population in jute field.

SUMMARY

Tossa jute is more susceptible to insect pests than *white* jute with the exception of stem weevil. Yellow mite, semilooper and stem weevil are the major pests of jute. Efforts are on the way to manage the mealy bug (*Phenacoccus solenopsis*), an emerging threat to jute and mesta. Ramie, sisal and flax are practically free from economic damage of insect pests in India. Endosulfan, carbaryl and cypermethrin are the insecticides recommended for the management of insect pests. Stem rot is an economically important disease of jute. Hooghly wilt was once considered as a major threat to jute crop. After detailed investigation, the CRIJAF has made a recommendation to alter the cropping sequence by incorporating a cereal crop. As a consequence the incidence of the disease has come down to 1-2% or even less. Although resistant varieties are not available at cultivators level, six *white* jute accessions were identified as resistant genotypes against the most virulent pathotype of *Macrophomina phaseolina*. *Tossa* jute accessions OIN 125, OIN 154, OIN 651 and OIN 853 were categorized as moderately resistant to *M. phaseolina* after rigorous screening at Sorbhog. Carbendazim, mancozeb and copper oxychloride are in use for the management of diseases of jute and allied fibres. Allied fibre crops are also suffered due to incidence of economically important diseases, best-pet practices are however available to contain the diseases.

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