CROP PRODUCTION TECHNOLOGY

Time of sowing:

Sowing time of jute may differ from area to area on the basis of the receipt of pre-monsoon showers, availability of residual moisture and variety. Generally, sowing in middle of March is optimum for all Capsularis varieties and the Olitorius varieties like JRO-524, JRO-878 and JRO-7835 while JRO-632 should be sown only after middle of April. Olitorius sowing may be staggered up to May. In Bihar and Uttar Pradesh, sowing is done up to mid July as per the onset of monsoon.

The recommended sowing for mesta crop is May-June for main season crop. However, in some areas particularly in some areas of Andhra Pradesh, rabi mesta is also raised. Sowing time for rabi mesta is February-March and usually sown with the sub-soil moisture. HC mesta being more susceptible to drought, it is usually sown under irrigated condition and also at early period. In India mesta is mainly a rainfed crop, coverage under HS mesta is maximum. However, HC mesta is also grown under rainfed condition in some areas, particularly is eastern and north-eastern states. Sowing should be done when there is sufficient moisture in the soil. A minimum of 21 per cent soil moisture content is required for germination. The seeds of *H. cannabinus* germinate within four days and seedling emergence is observed from fourth day onwards whereas *H. sabdariffa* seeds take five to six days to germinate.

10.2. Different Methods of sowing:

Sowing of jute can be done either by broadcast method or by line sowing method. Presently, 5 to 10 % of the area is hardly covered under line sowing in India. It has been established by the scientists that by adopting line sowing yield can be increased by 15 to 20 % over broadcast method. To ensure even distribution of seed, they are mixed with 3-4 times well powdered soil and broadcast cross-wise and after germination the excess plants are thinned out to maintain spacing of 10 cm (plant to plant). For line sowing, the land is prepared well and sowing is done with row to row spacing of: Capsularis – 30 cm, Olitorius – 25 cm and plant to plant spacing is maintained at 5 to 7 cm and this is done by mechanical means i.e. seed drill. A single row seed drill can cover about 0.1 to 0.15 ha per day. However, recently a multi row (4 row) seed drill has been developed and it can cover 0.8 to 1 ha per day. The depth of sowing is maintained at 2.5 to 3 cm. line sowing not only increases the yield but also reduces the cost of cultivation particularly by reducing the cost of intercultural operations which is main item of expenditure in jute cultivation.

Mesta is usually sown by broadcasting method. But as criteria of improved production technology, it is advocated to sow the crop in line. Line sowing can be undertaken with the help of seed drill. Line sowing has got certain advantages over broadcasting method such as

i) Plant growth is uniform since uniform spacing is maintained, ii) Intercultural operation like weeding, hoeing, etc. become easier and cheaper. Iii) Application of pesticides and top dressing of fertilizer is easier, iv) Yield is higher by about 15-20%, v) Requirement of seed is less etc.

10.3. Land preparation:

Jute seeds being small require very fine tilth. The land can be prepared by ploughing and cross-harrowing 3-5 times followed by planking. In acidic soils (pH <6.0), incorporation of 1-1.5 t/ha of lime, 30-40 days before sowing is necessary for better crop performance. Soil moisture between 21-45% is considered ideal for proper germination.

Mesta being a rainfed crop, land preparation is usually done with the receipt of pre-monsoon showers. However, in Andhra Pradesh, for raising rabi mesta, the land preparation is done early in February for sowing the crop with the help of sub-soil, moisture.

10.4. Seeding technologies:

Depending upon the species of jute and method of sowing, the seed rate of the two species recommended is under:

Species	**Seed rate in kg/ha**	
	Broadcasting	**Line sowing**
C. capsularis	10	7
C. olitorius	7	5

The seeds are sown in row 20 cm (*olitorius*) and 30 cm (*capsularis*) apart. The plants within the row should be thinned manually at two stages. First thinning is done 20 days after sowing (DAS), when the plants are of 5-10 cm height . At this stage, plants are thinned to a distance of 5 cm. In second and final thinning 35 DAS, when plants are of 12-15 cm height, and are thinned to a distance of 10 cm. Thus the optimum population varies from 3.33 (*capsularis*) to 5.0 lakh/ha (*olitorius*).

The optimum plant population for mesta is about 4 to 5 lakh per hectare. The recommended row to row spacing is 25 to 30 cm and plant to plant spacing is 7 to 10 cm. if the crop is sown by broadcasting method then the plant to plant spacing is maintained at about 12-15 cm by thinning. For maintaining optimum plant population the seed rate for the two species varies. However, the recommended seed rate is higher than the actual requirement for maintaining the desired plant population. This is done because of getting uniform plant population. After emergence, the excess plants are thinned out to get desired spacing. The seed rate of the two species in two method of sowings are as under:

Species	**Seed rate in kg/ha**

	Broadcasting	Line sowing
H. cannabinus	15-17	13-15
H. sabdariffa	13-15	11-13

Before sowing of seeds, it is always preferable to treat the seeds particularly to avoid the infection of the diseases to the crop. Seed treatment can be done with organo marcural fungicide like Agrosan GN of Ceresan at the rate of 5 gm per kg of seed or Dithane M45 at the rate of 4 gm per kg of seed or Bavistin at the rate of 2 gm per kg of seed.

10.5. Fertilizer management:

In general, the nutrient requirement of *capsularis* is more than that of *olitorius*. In soils with low organic carbon content, FYM application @ 5-10 t/ha, a month prior to crop sowing is recommended. The leaf fall from the standing crop and also root stubbles left in the soil after harvest results in recycling of handsome amount of nutrients besides organic matter in intensive cropping systems. Depending on soil fertility status, recommendations for use of fertilizers are:

Fertilizer	*C. olitorius*	*C. capsularis*
N	40 - 80 kg/ha	60 - 80 kg/ha
P	20 - 40 kg/ha	30 - 40 kg/ha
K	20 - 40 kg/ha	30 - 40 kg/ha

In heavy soils with low to moderate rainfall, all nutrients are applied as basal. In light soils and high rainfall situations, N is applied in 2 equal splits, ½ basal and ½ top dressing, i.e. preferably after weeding and thinning operations. Seed inoculation with *Azotobacter chroococum* and *Azospirillum brasilense* has been found promising to supplement part of N fertilizer. In acidic soils, P gets fixed; hence, their placement is better. K is usually applied as basal, but in leaching prone soils, split application is ideal.

In acid soils and regions with high rainfall, calcium and magnesium deficiency is common. Liming of soil @ 2-5 t/ha, once in 4 years or Dolomite application (40 kg/ha) is found promising as it supplies both calcium and magnesium.

In a medium fertile soil, the recommended dose of fertilizer for mesta is N-40 kg/ha, P2O5 – 20 kg/ha and K2O -20 kg/ha. Since, mesta is raised mainly under rainfed condition, the recommended dose of N in such cases is 25 kg/ha and it is mainly recommended for Andhra Pradesh.

10.6. Water management:

Jute requires about 50 cm water for its growth and development. In India about 15 % jute area is irrigated and the remaining area is rainfed. If the rainfall is not sufficient, the water requirement has to be supplemented through irrigation. For germination of jute seed, about 18-20 % soil moisture is required. At sowing time, if the soil moisture is not sufficient, then one pre-sowing irrigation is to be given. After sowing, usually one or two irrigations at an interval of about 20 days is required at the initial stages of growth. Thereafter monsoon rains supplement the irrigation. Jute is sensitive to both drought and water logging. At germination and knee-high stages, adequate soil moisture must be ensured by irrigation. During rainy season, the crop experiences water logging that adversely affects fibre quality. Provision of quick drainage in uplands will be beneficial to the crop. However, in lowlands, it may not be feasible.

In India, mesta is mainly raised as a rainfed crop. Since the pattern of rainfall during the sowing and growth period is highly erratic, desired yield is not obtained in mesta crop. For obtaining good yield, along with other inputs, the water requirement of the crop is to be fulfilled. The water requirement of mesta is about 50 cm. if the rainfall is uniformly is highly uncertain, in that case it is desirable to give one or two irrigation to mesta crop at an interval of 15 to 20 days.

10.7. Weed management:

Jute crop suffers from heavy weed infestation in the initial 6-8 weeks after sowing. Two-three hand weedings or mechanical hoeings are required to arrest weed menace. The first 2 manual weedings are combined with thinning operations at 20 and 35 DAS. The third weeding should be done 55-60 DAS. Due to continuous rains, sometimes manual weeding may not be possible. In such a situation, herbicide integrated with manual weeding is promising. Butachlor 50% EC or Pretilachlor 50% EC (pre-emergence, applied during sowing) @ 0.9-1.0 kg ai/ha combined with one hand weeding at 35DAS may effectively control the weeds. Recommended post-emergence herbicides for weed control include Quizalofop ethyl 5% @ 40-60 g ai/ha and should be applied 20 days after sowing.

Mesta is very susceptible to weed competition at early stage of growth. The growth rate of mesta is slower at this stage and over powered by weeds. The crop requires about two to three weeding/thinning operations depending upon the weed infestations. While two weedings are practiced the first one is done about three weeks after sowing and the second one is done at about five weeks after sowing. In row-cropping wheel hoe is used for weeding operations and thinning is done manually. Weeding may also be done with the application of herbicides. Amongst the various herbicides, Basalin gave better result for mesta crop. Application of Basalin (Fluchloralin) @ 2 litres per hectare as pre-sowing (3 days before sowing) will kill almost all the weeds except sedges. However, application of Basalin as above followed by one manual weeding will give good result.

10.8. Plant protection:

10.8.1. **Insect pests of Jute and their control measures:**

A. Indigo caterpillar (*Spodoptera exigua* Hlon) – This is a pest of seedlings of jute. The young caterpillars are gregarious and feed on the epidermal tissues by webbing up the leaves or by joining two or more adjacent leaves. After they grow, they disappear and feed on leaves by making small holes in lamina or by margin and defoliate the plants. The crop sown early in the month of March or early April suffers much while late sown one generally escapes damage. Both the species of jute are affected. Weeding out the affected seedlings during thinning and spraying the infested crop with Fenitrothion 0.10 per cent, control the pest.

B. Thrips (*Ayyaria chactophera* Carni) – The pest are minute in size, black in colour and swift in movement. *Olitorius* jute get infested with this pest at seedling stage. The pest generally avoid light, remain in the fold of apical buds and draw nourishment from them. During feeding they macerate the leaf tissues in between veins, and when infested buds unfold the pest moves upto the next bud and thus macerate all buds in regular succession. The macerated tissues soon die and become prominent as white streaks in unfolded leaves. The pest is more common when the whether is warm and humid and dry spell intermittently prevails. Spraying with Fenazaquin 10 per cent EC @ 1.5-2.0 ml/lit, control the pest.

C. Burrowing or Field cricket (*Brachytrypes achatinus* Stoll) –They are seldom detected during day. The cricket causes extensive damage to seedlings. The pest lives generally in burrows and becomes active during night. The insects with their strong pair of mandibles cut the jute seedlings at grounf level and drag away the cut-ends in burrows built in the field. The pest is more prevalent in loam and sandy loam tracts of Assam and sub-Himalayan West Bengal. The fields of annul recurrence is to be given pre-sowing soil treatment with 3 per cent Heptachlor dust or 5 per cent Aldrin dust @ 30 kg/ha and 20 kh/ha, respectively. In the standing crop the damage may be checked by poison baiting with 10 g of wheat of paddy bran with 500 g of ‘gur’ or molasses and 30 g of Aldrin 50 WP.

D. Jute stem-weevil (*Apion corchori* Marshall) – Their presence is detected by their feeding habit. The adult weevil feeds on top leaves by making minute holes on the leaf lamina. Later on the female weevil bores a hole on the shoot apex of the seedling to lay eggs. The developing grub tunnels to some distance into the stem and damage the tissues. As the plant grows, the site of injury shift to the nodal point where a knot persists even after retting. Such knotty fibre constitutes a defect in fibre quality. Jute stem-weevil causes substantial damage to *capsularis* jute. Uprooting of the damaged plants and spraying Fenitrothion 0.01 per cent of Sevimol 0.08 per cent concentration three times at 15 days interval control the pest.

E. Red mite(*Oligonychus coffea* Noitner) – Both nymph and adult suck the sap of the older leaves from the ventral surface and gradually the infestation spreads to all the leaves. The leaves soon become leathery, turn yellow and drop-off prematurely. The red mite affects *capsularis* jute. Intermittent whowers followed by dry spell with high humidity and poor interculture favours its infestation. Drenching ventral side of leaves with Dicofol (Kalthane

18 EC @ 850 ml/ha) 0.04 per cent or Binapacryl 0.04 per cent (Morocide 40 EC @ 375 ml/ha) twice at 15 days interval control the pest.

F. Semilooper (*Anomis sabulifera* Guen) – Both *capsularis* and *Olitorius* jute are prone to its attack. The semilooper mostly feeds on tender crown leaves (apical leaves) of both *capsularis* and *Olitorius* jute. The growth of the damaged plants is checked and plants induce to branching. They feed on leaves by making holes of irregular size and also by bitting of margin. In entire jute season, normally three waves of caterpillar attack are encountered with from end June to mid august, the second attack causes severe damage to the crop. It is common and most notorious of all the jute pests and widely distributed all over the jute growing tract. Providing perches for the predatory birds in the infested jute fields and spraying Fenvalerate 20 per cent EC @1 ml/lit or Cypermethrin 25 per cent EC @ 1-1.2 ml/lit on apical portion of the plants control the pest.

G. Hairy caterpillar (*Diacrisia oblique* Walker) – The caterpillars feed on the leaves of the plants. The ypung ones eat away the leaf tissues leaving only the outer membrane and skeleton thereof. The older caterpillars devour the entirer leaf. The pest is very destructive and in severe attacks the plants are entire defoliate leaving only bare stem standing in the field. It is serious pest in heavy rainfall areas of Assam, Bihar, Tripura and sub-Himalayan West Bengal while in other States it is sporadic in nature. Both *capsularis* and *Olitorius* jute are susceptible to this pest. Destroying the young gregarious larvae by plucking the leaves and putting them in bucket of kerosinised water and spraying *Lambda* Cyhalothrin 5 per cent EC @ 2 ml/lit, control the pest.

H. Yellow mite (*Hemitarsonemus latus* Banks) – It is highly destructive pest of both the species. Both adults and nymphs suck the juice of the lamina from dorsal side. The affected leaves present oily look but later turn to deep dull green with coppery brown shades. The laminae fold on the ventral face along the mid-rib and also along the secondary veins to give a crumpled appreance and finally the leaf curves along the mid-rib and downwards. The leaves infested heavily drop off prematurely. Growth of the plants gets checked with shortening of internodes. Warm and humid climate is conducive for development and spread of the pest. Dusting with lime-sulphur (3:1) @ 20 kg/ha and drenching thoroughly the ventral surface of the top leaves with Fenazaquin 10 per cent EC @ 1.5-2 ml/lit or Fenitrothion 0.10 per cent twice at interval of 15 days will control the pest.

I. Nematodes (*Meloidogyne incognita*) – The infestation is more in sandy loam and loamy soil where repeated jute cultivation is practiced. Nematodes affected the root and as a result gall or nodules are formed. In association with soil fungi, they affect the plants. As a result leaves first get yellow and gradually the plants wither away. Heavy gall formation is early stages of growth leads to arrest of growth of the crop. During crop season the infestation starts. Applying Carbofuran 3 kg a.i./ha or Aldicarb 3kg a.i./ha may control the pest.

10.8.2. **Diseases of Jute and their control measures:**

A. Seedling blight: It is caused by *Macrophomona phaseoli* (Tassi) Goid Fungi. The sowing of infected seed or presence of pathogen in the soil may cause this disease to both *capsulari* and *olitorious* jute at the seedling stage. The seedlings initially develop black lesions cotyledons which rot and wither; the tender stem then dries and turns brown. In humid condition it may turn black and rot. The incidences are in Hoogly, 24-Parganas, Malda, West Dinajpur in West Bengal; Purnea in Bihar; Cuttack in Orrisa and Tripura. Treatment of seeds wither copper fungicides before sowing, applying farm yard manure or compost in sufficient quantity and lime to soil where pH is low would control the incidence.

B. Stem rot: The disease is caused by the same pathogen as in seedling blight, M. *phaseoli.* Both types of jute are susceptible. Lesions appear mainly along the apex and, argine of the leaves and ultimately the whole leaf is infected. The pathogen travels through the petiole and reaches the node, where it starts stem rot. High humidity and temperature above 33^{o} C favour infection and its spread. The disease is prevalent in Assam Valley; Purnea in Bihar; Cuttack in Orrisa, Hoogly and sub-Himalayan West Bengal in particular, besides all jute tracts in general. Applying soil ameliorant like lime in acidic soil; potash between 25 to 50 kg K_2O/ha.; Providing good drainage and improving the porosity of soil through application of organic matter, and spraying Copper oxychloride (50 per cent) concentration or 0.10 per cent of Bavistin at first infection and seed treatment with *Trichoderma viride* @ 10 g/kg seed are recommended as control measures.

C. Root-rot: This is also caused by the same pathogen *M. phaseoli* and both spices of jute are susceptible. The fungus infects the tap root directly. The infected plant show wilting as the first recognizable symptoms without any symptoms on the shoot. Finally, the infected plants turns brown to deep brown and become rusty brown, and these plants look dry and withers completely. The disease is notice all over the growing areas. Lime application to soil having lower pH; potash to soil in high dose; following crop rotation; providing proper drainage and spraying 0.1 per cent Bavistin at an interval of 20-25 days 3 times, may be adopted as control measures.

D. Collar rot: The collar rot is also caused by *M. phaseoli* in both the spice of jute. The collarregion i.e., 10-15 cm of the stem at the bottom is affected. Cankerous would on stem lead to breakage and ultimately death of the plant. The disease is prevalent all over the jute growing tract where soil is slightly clayey. Applying soil ameliorant like lime in acidic soil; potash between 25 to 50 kg K_2O/ha; and ensuring proper drainage and application of organic matter to improve the porosity of soil would check its incidence. Spraying Copper oxycholoride (50 per cent Cu) at 0.75 per cent concentration or 0.10 per cent of Bavistin 2-3 times at 20-25 days of interval is also recommended.

E. Hooghly wilt in *olitorious*: This disease is of annual occurrence on a wide scale in *olitorius* jute in the districts of Howrah, Hoogly, and Bardhaman in West Bengal where jute is followed by potato in the same field. The disease is known as 'Hooghly wilt'. The primary pathogen is *M. phaseoli*, while the secondary pathogens include *Fusarium solani* (Mart) and

Pseudomonas solanaceaum. Soft brown or amber patches develop all over the stem which rapidly turn black and green colour of the stem fades quickly wilting occurs suddenly and rapidly. The stem withers and rots leads to death. Jute should note be followed by potao in the same field every year. Replacement of potato by 'aman' paddy or jute by 'aus' paddy or *Phaseolus mungo* replacing potato every third year should be practiced. Application of potash at the rate of 30 kg K_2O/ha reduce the incidence. Good drainage should be ensured. *Capsularis* jute is resistant to this disease and may be grown instead of *olitorius.*

F. Anthracnose of *capsularis* : The causal organism is *Colletotricum corchorum* Ikata and Tanaka. High humidity (above 84 per cent) and temperature above $33^{O}C$ favour infection. In beginning tiny, moist brownish black spores appear all over the stem. Latter on they coalesce together forming cankerous tissues. The stem may break from the infected point due to wind and die. The pods are also attacked by the fungus and shrivel. The disease is prevalent in Assam Valley, Surma Valley and Sub-Himalayan West Bengal. Treating the seeds with fungicides before sowing; growing resistant variety like JRC-212 and spraying Copper oxychloride (50 per cent Cu) at 0.75 per cent 2-3 times after 7 days interval are recommended as control measures.

G. Anthracnose of *olitorius*: The disease caused by the fungus *C. gleosporiods* Penz. The disease is serious when nitrogen is applied beyond 60 kg/ha. When plants are more than 80 days old numerous lenticular small spots appear all over the stem. In mild form these sports remain superficial and do not affect the crop substantially. In severe case the necrosis goes deeper and spots coalesce to from cankers and the crop is damage heavily. The disease is most prevalent in Assam. Application of nitrogen should be restricted between 20-40 kg/ha. Treating the field with lime where soil pH is below 6.2, addition of potash at the rate of 20 kg K2O/ha and spraying Copper oxychloride (50 per cent Cu) at 0.75 per cent initial phase of infection on the stem are some of the control measures.

H. Soft rot: This disease is found on both the species of jute. The disease is caused by *Selerotium rolfsii* west. The fungus is soil borne. The disease initiates infection in late Jully onwards when the plants become older. Soft, brown, wet patches appear on the basal region of the plant above the ground level. Epidermal layer peels off exposing the fibres Turing rusty brown. Eventually plant breaks off from the point of infection. Concentric ring of light and dark brown bands on the stem indicate the presence of soft rot. The fungus thrives on fallen jute leaves or plant of previous harvest. The disease is prevalent in Assam and sub-Himalayan West Bengal. Deep ploughing and clean cultivation along with spraying Copper oxychloride (50 per cent Cu) at 0.75 per cent at basal region of the plant and the ground control the disease.

I. Die-back or black-band: Mature plants of both the spices are susceptible to the disease to the disease, caused by *Diplodia corchori* Syd. The apex of the main stem or branches begins to wither and dry up progressively from tip downwards turning brown to black. Ultimately, the plant withers, leaves drop off. Lack of requisite moisture in soil and low fertility favour the disease. It is most prevalent in the terai and red soil areas. Spraying Copper oxychloride

(50 per cent Cu) at 0.5 per cent after fresh flush of flowers and seed treatment with Carbendazim 50 WP @ 2 g/kg of seed is recommended for control.

10.8.3. **Insect pests of Mesta and their control measures:**

A. Jassids (*Amrasca biguttula biguttula* **Ishida):** Jassid is one of the important sucking insects of mesta. It attacks both the species of mesta but the intensity of attack is more severe in *sabdariffa* mesta. August/September but decline from October. Both adults and nymphs injure the plant by sucking plant sap and injecting toxin saliva into the leaf tissue. The edges of the affected leaves first turn pale green, leter becomes yellowish green and finally red. In case of severe attack, the leaves curves downward and become crinkled. The plant growth becomes stunted and yield declines. Early sowing prevents the attack of Jassid. Jassid tolerant varieties like AMV-3 and AMV-4 is to be grown. Light trap may be used to control this pest. Seed treatment with carbofuran 3G @ 30 g/kg of seed prevent the attack upto 30 days age. On the standing crop if there is attack of this pest, Methyl Demiton (Metasystox 25 EC) 0.05% @ one litre (in 500 litre of water) per hectare or Dimethoate 0.05% @ 800 ml (in 500 litre of water) per hectare may be applied. The pest may also be controlled by biological method. The spider predator viz., *Chiracanthium mealnostoma* or *Thornisus katrajghatus* or *Oxyopes javanus* may be conserved in the field and this will suppress the attack of Jassids.

B. Mealy bug (*Maconellicoccous hirsutus* **Green**): Mealy bug is a predominant pest of *sabdariffa* mesta. Its attack is mostly confined to junctions of the plant. Both nymphs and adult female cause injury to the plant by thrusting their long filamentous styletes. The attacked region sweels and internodes become shorter and deep green colour is developed. The vertical growth of internode is arrested. Due to severe attack the growing tip is damaged and secondary branches develop. These secondary branches again got infested and resulted in “bunchy tops”, the characteristic symptom of this pest. At the time of extraction, the fibre snaps at the affected region resulted loss of fibre and ultimately reduction in yield. Crop rotation may be adopted to prevent attack in future. The bunchy top portion may be cut to prevent the spread of the pest. Chemically, the pest may be controlled by spray of Dimethoate (Rogor) 30 EC @ 0.05% (750 ml in 500 litre of water per hectare) or Metasystox 25 EC @ 0.05% (1 litre in 500 litre of water per hectare). Biological control measure may also be adapted. Four natural; predators *viz*., Hyperaspis maindroni, Spalgis epius, Chrysopa seclestes and Eublema silieula were identified to feed both eggs and nymphs of mealybug.

C. Semilooper (*Cosmofera erosa* **Green**)**:** Both the species of mesta are equally susceptible to semilooper. The pest usually appears in the months of September/October. The pest starts attacking the plant from apical leaves and gradually extends downwards. They start feeding from leaf margin and finally the whole leaf will be eaten away leaving only the midribs. In severe attack the growing points are also eaten away and thus pants become stunted and aften branching is induced resulted adverse effect on yield. The pest is nocturnal in habit and rmain hidden during day time. Mechanically, the pest may be controlled by the collection and

destruction of the caterpillars. Spraying Fenvalerate 20 per cent EC @1 ml/lit or Cypermethrin 25 per cent EC @ 1-1.2 ml/lit, control the pest.

D. Spiral borer (*Agrilus Acutus* **Thumb):** Spiral bores is found to attack mainly *cannabinus* mesta. It is most prevalent in high rainfall areas. The larva after hatching burrows its way beneath the cambium layer and starts feeding upon the woody tissues, making spiral around the stem beneath the bark and inner fibre layers are damaged. Infected regions swells up to form an elongated gall. Gall becomes week and breaks due to impact of strong wind. Seeds should be treated with Malathion 5% or Sevin 5% @ 10 gm/kg of seed. Spraying Fenvalerate 20 per cent EC @1 ml/lit or Cypermethrin 25 per cent EC @ 1-1.2 ml/lit, control the pest.

10.8.4. **Diseases of Mesta and their control measures:**

A. Foot and stem rot (*Phytohthora parasitica* **Muk**): This is primarily a soil born disease and mainly occurs under cloudy, high humid and low temperature condition. Usually, it is observed after heavy rains. Water logging conditions favours the spread of the disease. It is most prevalent in *sabdariffa* mesta: Plants of all ages is affected and affected both yield and quality of fibre. It is mostly found in September/October. Initially, withering of the terminal portion of the plant and pale colour of leaf is observed. After about 10 to 15 days of attack blackening of tissues at the base of the plant (foot region) is observed which gradually spread upto 60 cm height. The whole plant gradually wilted. During fibre extraction, the fibre breaks at the point of infection and fibre is discoloured. Water should not be allowed to stand in the field. Crop rotation should be followed. Roughing of the affected plants may be done. Resistant variety like AMV-3 may be grown. Seed treatment should be done with Dithane M-45 @ 3gm/kg of seed. Soil drenching may be done around the diseased plant with Dithane M-45 @ 2 gm/litre of water.

B. Leaf rot (*Phyllostica* sp**.):** The disease is occurred mainly in the month of August / September. Small concentrated ring like structures appear on the leaves and gradually increases in size and and gradually damaged the leaf. Dithane M-45 @ 0.2 per cent (2 gm/litre of water) may be applied in severe attack.

C. Tip rot (*Phoma sabdariffa***):** It is usually found in *sabdariffa* mesta. The sisease appears in young plants aged about 30 to 40 days. The young plants droop and gradually die. The stem turns white. Application of Blitox 0.3% (3 gm/litre of water) or Dithane M-45 @ 0.2 per cent (2 gm/litre of water) will reduce the incidence of the disease.

D. Collar rot (*Sclerotium rolfsii* **Sacc):** Both the species of mesta is attacked by this disease. When the plant is attacked by this disease, deep seated lesions are observed on the stem at the grounf level. Virtually, no control measure of this disease has so far been developed. However, water logging in the field should be avoided to prevent the attack of this disease.

E. Root rot (*Pythium perniciosum* **Serbino):** *Sabdariffa* mesta is usually attacked by this disease. Seedings and young plants are attacked by this disease. The root are decayed, the plants wilted and subsequently die. Water logging should be avoided. Before sowing, soil should be treated with Blitox of Copper oxycloride @ 205 kg/ha. On standing crop, Copper oxycloride at 0.05 to 0.75 per cent may be sprayed on soil to control the attack.

F. Anthacnose (*Colletotricum polacci***):** Mainly *cannabinus* mesta is susceptible to this disease. Initially terminal bud is attacked. Stipules and young leaves develop necrotic spots and withers. Stem infection appears as black lesions which later form cavities. Gradually defoliation occurs. Resistant variety like AMV-3 is to be grown. Seed treatment should be done with thiram @ 1.25 mg/kg of seed. Prophylactic spray with Copper oxycloride at 0.075 per cent may also be done.

G. Seedling rot (*Macrophomina phaseoli* **Maubl):** *Cannabinus* mesta is mainly susceptible to this disease. This disease is observed mainly under warm and high humid condition. The seedling initially develops black lesions on the cotyledons which rot and wither. Lesions appear along the apex and margin of the leaves and the whole leaf is infected on the growing plants. The pathogen travels through petiole and reaches the node and stem rot starts. Soil acidity should be corrected. Proper drainage should be maintained and potassium fertilizer should be applied, Copper oxycloride at 0.075 to 0.10 per cent may be sprayed.

10.9. Harvesting and post harvest operations:

10.9.1. Harvesting:

Jute is a bast fibre crop and can be harvested at any stage after a certain period of vegetative growth, usually between 100 to 150 days. Harvesting of jute crop at pre-bud or bud stage gives best quality fibre; however, the yields are low and older crop yields more quantity of fibre but the fibre becomes coarse and the stem does not ret properly. Hence, as a compromise between quality and quantity, early pod formation stage has been found best for harvesting. A 100-110 days crop may also be harvested to facilitate transplanting of paddy in time. Harvesting is done by cutting the plants at or close to the ground level with sharp sickles. In flooded lands, the plants are uprooted. The harvested plants are left in the field for 2-3 days for the leaves to shed. Next, the plants are tied into bundles 20-25 cm of diameter and the branching tops are lipped off to rot in the field.

The best time of harvesting is small pod stage for *cannabinus* mesta which usually occurs in October while for *sabdariffa* mesta it is at 50 per cent flowering which occurs in November. If the plants are harvested earlier to this, fibre yield will be low and many of the fibre are immature and soft and may loss at the time of extraction. If the harvesting is delayed or it is done at the maturity of the cop, the yield may be more but produces poor quality fibre which is brittle and less flexible as the cellulose reserves decline due to its utilization by developing fruits and seeds.

10.9.2. **Retting:**

Retting is one of the important operations governing the quality of fibre as prevailed at present. The bundles are kept in 30 cm deep water, and later placed side by side in retting water, usually in 2-3 layers and tied together. They are covered with water-hyacinth or any other weed that does not release tannin and iron. The float is then weighed down with seasoned logs or with concrete blocks or are kept emerged (at least 10 cm below the surface of water) with bamboo-crating. Clods of earth used as a covering material or as weighing agent produce dark fibre of low value. Retting is best done in slow moving large volume of clean water. The optimum temperature is around 34^{o}C. If fibre comes out easily from the wood on pressure from the thumb and fingers, retting is considered complete. Adequate retting facilities are not available everywhere. It is, therefore, necessary to develop a technology through which retting could be possible in a small volume of water and also in a short span of time. Some of the technologies like ribbon retting has already been developed and demonstrated for jute crop but being a labour intensive technology, it has not yet been popularized. Similar technology with cost effective in nature needs to be developed for mesta crops also.

10.9.3. **Extraction of fibre:**

Two methods of fibre extraction are practiced – single reed method and beat-break-jerk method.

In single reed method, four or five reeds are taken out and stripping started from the bottom; the fibre of each of the reeds is slipped out free from the stick up to 8-10 cm, then gripped and pulled out slowly from the rest of the stick. Extracted strips of the bundles are washed in clean water.

In beat-break-jerk method, a handful retted stems in left hand are gently beaten at the base with a mallet, then the woody core is broken and the extractor twist the bundles at the middle, grips the fibre where the bundle is broken and shakes the bundles vigorously to and fro in water. The broken sticks slip out and water wrung out of the fibre. The fibre is then washed in clean water, rung and eventually spread to dry, preferably in shade or mild sun. The beat-break-jerk method often leaves the broken sticks and make fibre somewhat entangled resulting in sticky fibre.

10.9.4. **Grading:**

Grading of fibre is done based on six parameters namely, strength, defect, root content, colour, fineness and density. As per BIS specification there are eight grade classification of jute, i.e., W1/TD1 to W8/TD8 (W indicates white jute and TD indicates Tossa jute).

10.10. Use and recommendation of farm implements and machines used for different operations:

The farm implements used for different operations in the cultivation of jute and mesta are mentioned hereunder.

A. Multi row Seed Drill:

This implement is developed by CRIJAF. 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 about 5-6 hrs/hectare. Seed requirement is 3-4 kg/hectare while sown with this multi row seed drill. Line sown crop favours better inter cultural operations especially weeding. The yield of fibre is comparatively higher.

B. Jute Weeder:

This implement is developed by CRIJAF. 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. This weeder is also useful in other line sown crops.

C. Manual Ribboner:

Manual ribboner has been developed by the research institutes/organizations for removing the ribbons from the plant. But the ribboning operation is yet to be made cost effective.

D. Jute Extractor/Bast Fibre Extractor:

Jute Extractor/Bast Fibre extractor has been developed by CRIJAF for extraction of ribbon/fibre. Some trials have been conducted but the machine has not been found cost effective and accordingly needs further improvement.

11. Cropping system:

Jute is one of the most suitable crop to fit in crop rotation. Since the harvesting duration of the crop is variable and accordingly it can be fitted in different crop rotations. Besides, shading of jute leaves improves the soil fertility. After the harvest of the jute crop the field remains clean, almost free of weeds. These are added advantage of jute to fit in a

crop rotation. The recommended/common practices of crop rotations with jute are indicated hereunder;

Irrigated condition:

Jute-paddy-potato
Jute-paddy-gram
Jute-paddy-mustard
Jute-paddy-wheat

Rainfed condition:
Jute-paddy-pulses
Jute-gram
Jute-mustard
Jute-paddy

This apart some intercropping with jute can also be done like, Jute with Greengram, Blackgram etc.

Some of the recommended/generally followed crop rotations with mesta are indicated hereunder;

Mesta - Groundnut
Mesta – Sesame
Mesta – Sunflower
Mesta – Maize