# Mesta

## (Hibiscus Cannabinus & Hibiscus Sabdariffa)

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## INTRODUCTION

Mesta is common word used for both *Hibiscus cannabinus* and *H. sabdariffa* which produces good fibre of commerce. These two species belong to the family Malvaceae with chromosome number 2n=36 and 2n=72 respectively. *H. cannabinus* is f) popular in the Western world as kenaf. *Hibiscus cannabinus* is known by various names in India such as Bimli, Deccan hemp, Gogu, Channa, Ambadi, Gongkura, Sunkura, and Sunbeeja etc. while *H. sabdariffa* is known as roselle, java jute, Thai jute, Pusa hemp, Tengrapat, Lalambadi, Chukair, Yerragogu, Palechi and Pundibeeja etc. Besides India the mesta is grown mainly in Argentina, China, Cuba, Egypt, Hewti, Guatamala, Italy, Iran, Indonesia, Mozambique, North Africa, New Guina, Peru, Spain, South Africa, Southern Part of Zimbabwe, Thailand, U.S.A and Russia.

The two major fibre yielding species of *Hibiscus* i.e. *H. cannabinus* and *H. sabdariffa* have the following characteristics.

### H. cannabinus (Kenaf)

The species *cannabinus* has been found to grow so far north and south of equator in Africa and undoubtedly varies in the same way whenever the plant is found growing wild, it is probable that the mixtures merge. Generally, the species grows best in the warmer regions between the latitude of 300N and 300S. It does, however, grow wild or is successfully cultivated at latitudes much farther from the equator for instance on the Southern shores of Caspian sea in Southern Russia, in Manchuria and Korea.

Since the *cannabin us* is cultivated at some distance north and south of equator, it is clear that the plant is capable of withstanding a considerable degree of cold. In the equatorial range of Africa the wild plants are found growing best in places where the temperature ranges from 15°C to 30°C.

Variations are existing in different species of mesta and even in different varieties of same species. For example in case of *H.kitaibelifolius,* the plants possess a short flowering period which covers all the activities including reproduction. From the appearance of first flower on the plant, the plant practically ceases to grow. Another variety of *cannabinus* collected from Java was found to have a longer flowering period and the plants continued to grow even after the initiation of flower. Many exotic collections have been found to very much in their flowering and growth behaviour.

The plant is hermaphrodite, annual, producing large cream coloured flowers characterised by a reddish purple or scarlet throat. The flowers are short lived opening in the early hours of morning before sunrise and closing by noon of the same day. While *cannabinus* is generally considered as self pollinated, but a small amount of cross pollination may be effected by bees and other insects.

The colour of the stem is generally green. However, some types with reddish stem are also found. The reddish colour generally appears after the plants attain a certain age in some of the types. This has been attributed due to sunlight rather than a varietals character. The plants when mature may attain a height or four meters with a basal diameter of nearly 1.5 to 2.5 cm.

Most variable character in mesta is the leaf. Both compound and simple leaves may be found on the same plant or same type may have all of one leaf shapes. Leaf shapes also vary with the type of variety. Generally variety 'viridis' possesses entire leaves while the variety "vulgaris" has divided leaves. The variety 'simplex' has red stem with divided leaves while the variety 'purpureus' possesses purple stem and divided leaves.

The shape of the leaves also arise on the same stem. They are of entire shape at the bottom, may be trilobular at slightly higher point and five to seven lobed at the top of the stem. The arrangements of leaves also differ in the varieties. In some varieties the petiole is at right angle to the stem while in other it is having an angle of 60° or 30°.

The varieties of *cannabinus* also differ in their flowering behaviour. This difference depends on the type of variety used for different purposes. The fibre yielding varieties flower with the onset of short days. For normal growth a day length of 13 ½ hours is good for cultivating variety for fibre purpose. The harvesting of crop depends generally on the formation of buds or opening of flowers on the plant.

Photoperiodism plays an important role in the cultivation of *cannabinus* in the world. The *cannabinus* types do not flower in Cuba until the day length is shortened to about 12 to 121/2 hours. The short days do not begin at the latitude of 230N until the beginning of September, no matter when the seeds are sown during the period from April to August. The plants will not flower till September-October. For the purpose of fibre production it is considered desirable to obtain plants with longer stems without branches of fruiting stalk, since these interrupt the continuity of the fibres and sowing must begin when the days are longer to coincide with the proper amount of rainfall.

*H. cannabinus* is capable of adapting itself in variety of soils and climatic conditions. The crop can not, however, tolerate frost. The crop can be grown up to the

height of 3000 ft above sea level at a latitude of 450N to

48 N in Russia and to a latitude of 300S in South Africa.

For its good growth, a well drained sandy loam soil most suited. Mesta does not grow in waterlogged conditions. It, however, requires a rainfall of 50 to 65 cm during its growth period.

The seed capsules are cylindrical, pubescent bearing from 18 to 20 seeds per capsule. The seeds are grey in colour. The seed is badly affected by the temperature of soil. A soil temperature of 15 to 20°C is most suitable for the germination of seeds.

Fibre of mesta being dried

**H. sabdariffa (Roselle)**

The flowers of *sabdariffa* are comparatively smaller than those of *cannabinus.* The predominant types have cream to light yellow flowers, having a scarlet to magenta throat and a green or slightly reddish stem depending on the variety. In India the *sabdariffa* is called 'roselle' and all the *sabdariffa* types are classified into four main groups according to the extent of pigmentation present on the stem. They are full green, green pigmented, green light red and red.

The leaves in 'roselle' are generally palmate, deeply lobed and alternately borne on the stem. The plants are normally non branching and attain a height of nearly 3 to 3.5 mts with a basal diameter of 1.0 to 2.0 cm.

Many wild forms of *sabdariffa* &re found in Uganda which closely resemble *H. machowii* and is considered as the immediate wild progenitor of *sabdariffa.* The actual fibre forms have developed from edible types through a long process and may be interogressed by *H. asper* and *H. machowii.* The tall fibre yielding type was isolated and described by P. J. Webster (1914) in Thailand as *H. sabdariffa* var. *altissima* from some seeds received from Gold Coast (W. Africa). This variety was accidentally introduced into India as a single seed in admixture with some of other consignment of seeds from Java (Indonesia). It was first described by Khan (1930) as a new type of roselle hemp. It is clear that the species of *sabdariffa* consists of two distinct types, wild and cultivated. The calyces of the wild types are fleshy and a are used for making jellys and jams and produce fibre of inferior quality. The tall types with less branches are cultivated for fibre purpose and they belong to *H. sabdariffa* var. *altissima.*

*Sabdariffa* types are best cultivated in between 100N and 300S, where the temperature is not less than 100C and not more than 3SoC together a rainfall sufficient to give at least 10 inches during each month of the growing period. The air too must be still and humid to bring about a rapid and healthy growth. Strong winds, prolonged period of cool foggy weather interrupt and check its growth. The *sabdariffa* types in general are not responsive to photoperiodism, although the plants of *sabdariffa* types tend to be short day. These types can be grown in soils having a pH of 4.4 to 7.8.

Both *H. cannabinus* and *H. sabdariffa* types require following factors for their proper growth.

1. Enough moisture in soil during the growing period.
2. Rainfall should be at least 100 mm or more per month during the crop cycle with a fairly uniform temperature.

The two species of mesta resemble more or less in most of the characters as described above. However, they differ in some characters which help in the identification of these two species. The following characters may help in this direction

I. The apex of the epicalyx (bractiole)is entire in cannabinus and inconspicuously channeled in sabdariffa.

II. The sepal nectary (gland) in cannabin us is prominent (swollen) while it is much less conspicuous (shrunken) in sabdariffa.
III. The stem of sabdariffa is flexible while it is more or less rigid in cannabinus.

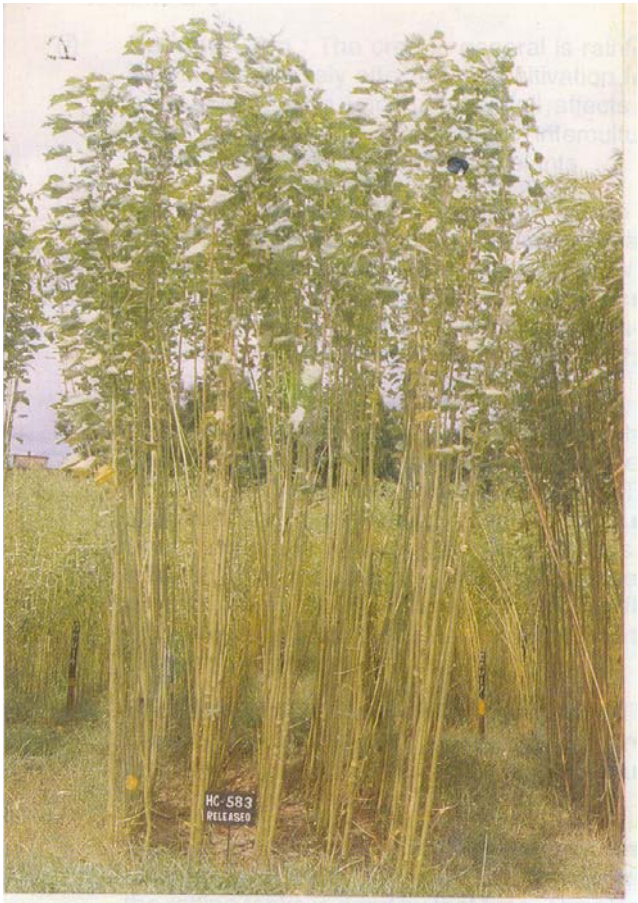
**Mesta in relation to India**

India had to loose about 80% of total jute production area at the time of partition of the country during 1947. The jute crop needs a specific set of climatic conditions, therefore, the cultivation of jute could not be extended beyond the states of West Bengal, Assam, Bihar, Orissa, and parts of U.P. and Tripura. As a result the production of jute fell below the requirement of mills. Mesta can, however, be grown even in those areas where jute is not grown under wider climatic and soil conditions with much less care. This helped the country to expand more area under mesta. At present Mesta is grown in an area of more than 26 lakh hectares with a production of more than 12 lakh bales.

## CULTIVATION OF MESTA FOR FIBRE PRODUCTION

A warm humid climate is considered most suitable for growing both the species of mesta. Both grow well in the drier rain fed areas. The *sabdariffa* being better drought resistant type. In areas where the rainfall is 50 to 90 mm, the *cannabinus* mesta suits better by virtue of shorter duration and comparatively faster growth than the other. None of them can stand water logging and both are grown in kharif season in India. As mentioned earlier they require rich loamy soils although they may grow in a variety of soils including new and old alluvium & lateritic loam. The acid soils are not suitable without proper amendment. The *sabdariffa* types develop chlorosis with high pH of the soil.

In India *sabdariffa* mesta is generally grown in larger parts covering areas from Karnataka to Tripura including Maharastra, Andhra Pradesh, West Bengal, Bihar, Orissa and Meghalaya. In Tripura and Meghalaya the mesta is grown in highlands either as a pure crop or in mixture with rice. In West Bengal and Bihar it is grown in sandy to sandy loam marginal lands. In Orissa it is grown in the hilly districts of Koraput and Kalahandi. Andhra Pradesh has maximum area under *sabdariffa* mesta in the country.



A crop of Kenaf ( *H. Cannabinus* )

Inspite of the fact that mesta can grow in a wide range of climate and soil conditions, its cultivation has been restricted due to certain inherent constraints. These constraints affect the fibre yields in this crop. Some of the major constraints are -

I. **Rainfed Crop:** The crop in general is rain fed. This has adversely affected the cultivation to a great extent. The uncertain rainfall affects its time of sowing and other intercultural operations and also the growth of plants.
II. **Marginal Crop:** Mesta is generally grown by marginal and small farmers. They are poor and cannot afford to invest more money in growing this crop. Moreover, it is market oriented crop and as such 95% of the crop is necessarily sold and only 5% is retained by the farmers for their own use.
III. **Non-availability of good seed:** There has been difficulty in producing good quality seeds of improved varieties in the country. The standard and high yielding varieties have not been notified for release. This has adversely affected the breeder & foundation seed production. The present level of the production of quality seeds of mesta is hardly 5% of the total requirement.
IV. **Broadcast crop:** Mesta is generally sown by broadcast method. Line sowing is hardly followed. The farmers also do not give much importance to this crop.
V. **Inadequate retting facility:** Since the mesta crop takes more time to harvest, the water in the retting tanks is dried by that time. The plants have to be kept after harvesting till the next season of rains. This adversely affects the fibre yield as well as fibre quality.
VI. **Marketing:** It is most unfortunate that the country has not been able to develop good market for mesta fibre. The farmers generally do not get remunerative price of their produce. This discourages them to grow mesta next time.

**Land preparation**

The land is ploughed and cross ploughed thrice to four times depending upon the type of soil. The ploughing is followed by laddering. This helps in pulverising the soil properly. The ploughed field is made free of weeds and stubbles and leveled properly. The pulverised soil helps in the proper operation of seed drills etc. It is advised to apply organic manure before the land is prepared. Recommended dose of inorganic fertilizer is also applied as a basal dose after the preparation of land.

**Sowing**

In India, mesta is normally sown by broadcasting method. However, under the extension and transfer of technology programme line sowing has been advocated. Line sowing has been found to have certain advantages such as -

i. Plant growth is uniform since uniform spacing is maintained in the field.
ii. Intercultural operations like weeding, hoeing etc. are easier to attempt.
iii. Application of fertilizers and pesticides etc. also become easier.
iv. Higher yields are obtained in line sowing. Less quantity of seed is required in line sowing.

While sowing it is essential to adjust the distance from seed to seed in the field. The can be managed by adjusting seed drills. For broadcasting sowing, the seed is scattered in the field in crosswise manner and then the laddering is done to cover the seeds. Generally a sowing depth of 2.5 to 3 cm is maintained for good germination. Proper moisture in the soil at the time of sowing is also very much essential. Soil moisture of 20-32 percent is good for the germination of seeds.

A spacing of 25 to 30 cm between rows and 7 to 10 cm between plants is recommended for good yields. In case of broadcasting sowing, plant to plant spacing is maintained at 12-15 cm by thinning. It is recommended to treat seeds with any fungicide to prevent the attack of diseases.

Seed quantity and seed rate varies in between two species of mesta in India. A seed rate of 15 to 17kg/ha under broadcast and 13-15 Kg./ha in line sowing in *cannabinus* has been recommended. Similarly seed rate of 13-15kg/ha under broadcast and 11-13kg/ha under line sowing is recommended in case of *sabdarffa.*

**Manuring**

Balanced application of fertilizer at proper time is very important for a crop. A balanced fertilizer dose also helps in the improvement of physical properties of soils as well. A proper balance between organic and inorganic doses is important for proper plant growth.

Organic fertilizer in the form of compost at the rate of 10 to 12 tones per ha is recommended. Nowadays it is difficult to get so much of compost. It is, therefore, advised to atleast, apply 4 to 5 tones of compost to the crop for better growth. It is advisable to apply organic manure before the land is prepared for sowing.

Application of inorganic fertilizer to the crop of mesta is also important. Nitrogen is essential for cell enlargement and for division of cells at faster rate.

Phosphorus helps in proper root development. Potassium is most important in inducing drought tolerance in this crop. This element also induces resistance to pests and diseases. Besides, it helps in the development of fibre cells properly. A fertilizer dose of N, P and K at the rate of 40:20:20 is recommended for higher fibre yields.

The inorganic fertilizer is applied in two split doses of N, P and K. The nitrogen is applied as a top dressing into two split doses one at the time of first weeding and another half after six weeks of sowing. The P and K are applied as basal dressing before sowing.

The nutrient uptake .by a crop grown in one hactere of land has been studied. It has been found that the crop of *cannabinus* can lift easily about 172 kg of nitrogen, 13 kg of phosphorus, 72 kg of potassium and 150 kg of calcium. This clearly indicates that a crop of *cannabinus* mesta responds quite well towards the application of nitrogen and calcium. Similarly *sabdariffa* lifts 100 kg of nitrogen, 31 kg of phosphorus, 148 kg of potassium and 153 kg of calcium. The *sabdariffa* needs more potassium and phosphorus as compared to *cannabinus.* Requirement of other nutrients is more or less same.

**Intercultural operations**

Weeding, thinning and hoeing are three major intercultural operations attempted in mesta crop. Among these weeding takes nearly 25-30% of the total cost of production. If the weeding is not done at proper time, whole crop is adversely affected.

The growth behavior of both the species differs. The growth in case of *sabdariffa* is slow in the initial stages and picks up at later stages, while the growth in *cannabinus* is faster at the initial stages but slows down in later stages. It has been observed that after 60 days of age the growth in *sabdariffa* picks up and surpasses the height of *cannabin us.* It is therefore essential to keep the fields clean up to nearly 40 to 45 days. After that crop grows and covers the weeds.

Weeding and thinning is generally done simultaneously. The first weeding is done at the age of three weeks of crop and the second weeding is done after five weeks of age of the crop. It is always advisable to attempt thinning at the time of first weeding. After each weeding hoeing is attempted with the help of wheel hoe to loosen the soil.

Weeding with the help of herbicide is also done now-a-days. Although there is no good herbicide recommended for mesta, basalin has given slightly better results. The basalin (Flucholoralin) @ 2 litres per ha as presowing (3 days before sowing) is recommended for mesta weeds.

**Irrigation**

It is also advisable to irrigate the mesta fields for better yields. However, no irrigation is generally, applied to this crop. The water requirement of mesta is about 50 cm. It is, therefore, desirable to give one or two irrigations at an interval of 15 to 20 'days during sowing time.

**Harvesting**

Harvesting time is very important in bast fibre crops like jute and mesta. A proper stage of harvesting gives higher yield as well as better quality of fibre. If the plants are harvested prematurely in early stage the quality of fibre is good but the fibre yield is poor. In case the plants are harvested late the fibre yield is better but the quality of fibre goes down. It is therefore necessary to properly understand the course of development of the plant from the seedling stage to the growth stage.

Mesta has been found to have two distinct phases of growth like other crops. These are vegetative phase and reproductive phase. During the vegetative phase the energy of the plant is concentrated in the development of formation and maturation of vegetative parts like stem, leaves and roots. During early phase of growth the plants absorb water at a high rate and often takes in most of the nitrogen, potassium and phosphorus and utilises it for the growth development. The materials are trans located between the leaves, the roots and the stem. This period is also marked with the cambial activity. The cambium deposits xylem inside and phloem outside. This phloem forms fibre of use. It is better to enhance the period during the cambial activity. More is this period, more will be the formation of fibre in the plant and ultimately more will be the fibre yield. The fibre cells formed inside normally do not mature physiologically. They are soft containing nearly 40% of their fibres cells in thin walled state. Since these fibre are soft they are liable to be lost during extraction. This reduces the yield. Therefore, it is necessary to wait for the harvest till these fibres are fully mature.

After the completion of vegetative phase, the carbohydrates start accumulating and the rate of synthesis of protein and the production of new

vegetative tissues start declining. The water content in the new vegetative organs also declines. This results in the rapid accumulation of carbohydrates and decline of proteins.

The reproductive phase is devoted to the formation of flowers and the development of fruits and seeds on the plant. This phase is marked by three stages namely flower initiation, anthesis and fruiting. In the flower initiation stage, the buds start forming, the growth of internodes is almost checked and the overall activity of the photosynthesis, mineral and water movement is retarted. The cambial activity at the lower part of the stem also stops leaving slight activity of cambium at the upper level. The cambial activity completely stops at the anthesis stage.

The third stage of reproductive phase of the plant goes slowly as the younger flowers continue to bloom even though the older flowers start setting seeds. At this stage the synthesis of proteins and carbohydrates and absorption of water and minerals increase. As the fruits start developing, the nutrients starts accumulating in the fruits and seeds. After this phase, the cambial activity completely stops and clearly becomes differentiated into xylem and phloem elements and since the cambium does not exist at this stage the secondary growth also stops.

From the above it is clear that the best time to harvest mesta for fibre is when the plants are left with ten or twelve flowers. The exact time of harvesting will depend on the growth and the accumulation of cellulose and hemicelluloses. The taller plant will have some of the lower fruits matured without depending much on the reserves in the fibres, while the shorter plant may not have sufficient reserves to mature even a single fruit and should therefore be harvested before the first capsule is mature.

Harvesting is done normally by cutting the plants close to the ground with the help of sickle. In some areas the plants of mesta are also uprooted. Such plants take more time to ret and the quality of fibre is adversely affected. The hardy root portion takes more time for retting and the extraction also becomes difficult in such cases. After the harvesting, the plants are sorted out according to the thickness of stems. This is followed by bundling of plants in convenient sizes of 25 to 30 cm in diameter. These bundles are kept standing- in the field for two or three days for shedding of leaves. The shedding of leaves also simultaneously help in shrinking and rupture of the bark which helps in the entrance of retting micro organisms. In some areas the mesta plants are even kept for 2 to 3 months after harvesting for want of sufficient retting water. These plants are retted when water is available or can be decorticated and the ribbons may be retted in less volume of water.

**Decortication**

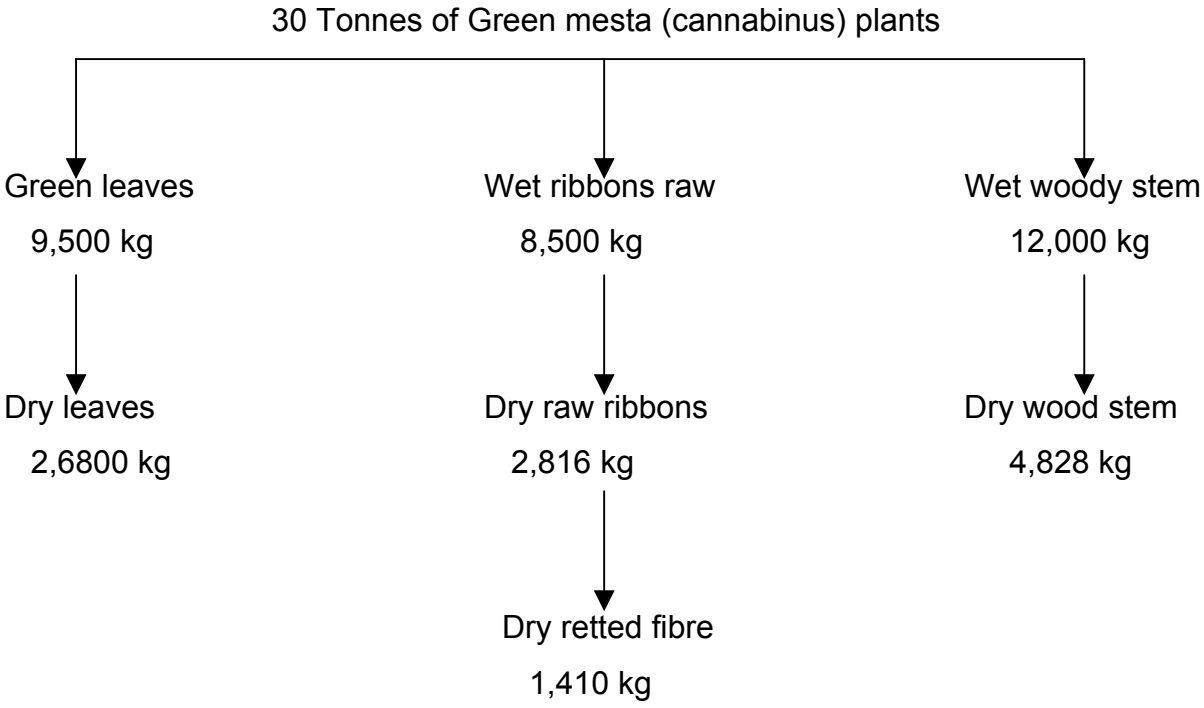
In the mechanical extraction of fibre, decorticators are also used for decortication of fibre from the stem. Many decorticators have been developed in the world. Some of them are described below.

Mr. James Windburn first invented a machine for extracting fibre of flax. All the modern machines (decorticators) are based on this principle only. Later on Dr. Aristida Angioline of Italy patented a machine which was later on manufactured by Adriao Gordilla Bros. & Co., Italy. This decorticator has the capacity to extract 95% of the fibre from dry, unretted mesta stalks. Now an American company has taken over its production. After this Mr. B. G. Gundy, an Agricultural Engineer of the then Govt. of Rhodesia developed a decorticator which became popular as Gundy decorticator. These decorticators were used for extracting fibre from the dried stems of mesta.

Some decorticators have also been developed for extracting fibre from green plants. Mr. F. Michotte, a French engineer developed a decorticator which was able to handle 10 to 15 quintals of green stalks of mesta per hour. It was operated with the help of a 4H.P. engine. Another decorticator was also developed in France by MIS Foure of Limoges. This decorticator was called as 'Capella' and was found very efficient for jute and mesta. A decorticator named 'Krojofuji' was developed in Japan but the machine could not become popular. Mr. Gilbert Brereton of New Orleans fabricated a 'Renifier' docorticator. This machine was able to cut and decorticate the plants of one acre within one hour. The Hubert decorticator of Germany and Guthrie decorticator of USA also became popular.

A crop of rossele ( *H. sabdariffa* )

Total breakdown of the green and dry components of one hectare of good mesta crop is given below –




The cannabinus mesta is cheaply cultivated in India. However, the mandays required for cultivating the crop mechanically are less as compared to crop cultivated manually. The breakup calculated for cultivating one hactere of mesta crop is given below –

| **Manually cultivated** | | **Mechanically attempted** | |
|---|---|---|---|
| **Type of work** | **Mandays** | **Type of work** | **Mandays** |
| 1. Land preparation | 15 | Land preparation | 10 |
| 2. Laddering and application of fertilizer | 5 | Laddering and application of fertilizer | 5 |
| 3. Sowing | 15 | Sowing | 5 |
| 4. Weeding and other intercultural operations | 25 | Mechanical Weeding | 10 |
| 5. Harvesting | 20 | Mechanical harvesting | 10 |
| 6. Bundling etc. | 5 | Mechanical bundling | 5 |
| 7. Hauling and Retting | 40 | Decortication | 10 |
| 8. Extraction & washing | 60 | Retting and drying | 20 |
| 9. Drying | 5 | Bailing | 5 |
| 10. Bailing & Transportation | 10 | | |
| | 220 | | 80 |
| Estimated fibre yield = 15 q | | Estimated fibre yield = 20 q | |

The above comparison clearly indicates that the fibre obtained the mechanical methods is cheaper and also more fibre yield is obtained. The mechanically decorticated mesta is crating more interest and becoming more popular because of following reason –

(i) In countries with higher labor cost, the decorticated fibre can be produced for more cheaply.

(ii) Yields per hectare of decorticated fibre are greater than under corticated fibre.

(iii) In many countries including India there is a scarcity of retting water. In these countries the mechanical decortication may be the only practice.

The mechanical countries including India there is a scarcity of retting water. In these countries the mechanical decortication may be the only practice.

| Advantages | Disadvantages |
|---|---|
| (i) All the residue are left in the field. | (i) Additional labour is needed forgreen stripping. |
| (ii) Upto 70% less weight is transported to the retting tanks. | (ii) Retted fibre tends to be inferior in colour to that produced from whole stalk. |
| (iii) Less water is needed for retting. | - |
| (iv) Fibre washing is easier and the loss of fibre is less | - |

The dried fibre of *cannabinus* mesta contains about 15 percent moisture and is shorter, a little less flexible, stronger, more lustrous and more durable as compared to jute. The mesta fibre is blended with jute fibre for local burlap manufacture.

Fibre of mesta after bundling

From the economic standpoint, mesta fibre production offers distinct advantage over other crops specially for developing countries because of following:

(i) Mesta is potentially profitable crop that is not in world surplus.

(ii) It provides as a domestic resources, the raw material for industrialization.

(iii) It can be grown on uplands providing a greater cash return than other crops.

(iv) It requires less labour than jute and can be produced more cheaply.

(v) The fibre is one that is used in varying amounts in all countries.

**Retting**

Retting is the process which helps in removing of fibre from the stem with the help of the action of chemicals or microbes present in the retting water. Two types of retting is followed in jute and mesta (i) Chemical retting (ii) Biological retting.

The Chemical retting is affected by certain chemicals like ammonium oxalate, sodium oxalate or 'Hiparal'. The chemicals remove gums, pectins, lignins without affecting the quality of fibre. Hiparal is a mixture of enzymes extracted from a tropical fungus named *Thielaviopsis paradoxa.* The Hiparal is mixed with pectinases developed from *Bacillus caratavarius* in equal proportion. Since chemical retting is quite costly biological retting is followed in most of the countries.

The biological retting is of three types (i) Stack method; (ii) Ribbon method and (iii) Steep method. Under the stack method the plants are bundled and bundles are stacked and some fungal culture is utilized for retting of the stacked plants. The stack retting is not followed in India and in the other nearby countries. The ribbon retting is also practiced in some countries. The bark of the green plants is extracted with the help of a ribboner and the ribbons are retted in the retting water. Ribbons may also be retted by chemical method since less quantity of chemicals are required for retting purpose. The steep method of retting is very popular in almost all the mesta producing countries. Ribbon retting offers certain advantage in the sense that all the residues are left in the field, upto 70% less weight is transported, less water is required for retting, retting time is shortened and fibre washing is easier. The steep retting consists of the bundling of mesta plants after the harvest in the convenient sizes. The bundles are kept in standing position in 50 to 60 cm deep water for nearly 3 or 4 days. This helps in retting of the hard lower portion of the bark. In some cases a few plants of dhaincha or sunnhemp are inserted in the bundles of mesta. Since dhaincha and sunnhemp are bit softer they decompose early as compared to mesta and help in activating the microbial process needed for retting. After 3 to 4 days the standing bundles are laid down in the retting water and slightly drowned (nearly 10cm) in water with the help of some weights made of cement or stones.

Some grasses like water hyacinth is also put on the lying bundles to cover them. Care should be taken not to put any weighed material which release tanine and iron. The tanine makes the fibre black in colour when it comes in contact with iron. After a few days a part of the submerged plant is taken out and tested for the loosening of fibre. If the fibre comes out from the wood retting process is taken as complete.

The extraction of fibre is done by following two methods i.e. single plant extraction method and beat break or jerk method.

Under the single plant extraction method, the fibre is extracted from a single plant individually. Each plant from the bundle is taken out and with the help of fingers the fibre is extracted, washed and kept. This method gives comparatively better quality of fibre.

The beat break or jerk method is generally followed in almost all the mesta producing countries. In this case a total of 10 to 12 plants are taken at a time and the bottom portion of these plants are beaten with a mallet to loosen the fibre at that place. The bundles are then broken at the middle which helps in loosening the fibre.

This loosened fibre is held by hand and a jerk is given to the plants. This process of jerk removes the stick from the fibre. In this process some fibre is, however, left attached with the sticks and goes waste and the quality of fibre in general is adversely affected.

The bundles of wet fibre after washing are kept by the side of retting water. Later on these bundles are opened and the wet fibre is dried on bamboo frames under the sun. After 3 or 4 days of drying the fibre is properly assorted and bundled in different grades of commerce.

**Factors affecting retting**

Retting is an important process in the life cycle of mesta for fibre production. The process helps in removing fibre from the plant with the help of certain bacteria and fungi. The retting, however, depends on various factors which are described below -

(i) Volume of water

The retting is perfect in slow moving clean water. The bacteria in such water eat up protein and release pectin, tannin and other gummy substances. In slow moving water these released impurities are removed and the fine fibre is left. While in the stagnant water they remain in the retting water. The ratio of retting water to the plant material should be 20:1.

(ii) Temperature of water

It has been found that the temperature of retting water should be around 34°C. At this temperature the retting can take place in 12-15 days easily. The pH of the retting water should be around 6.5 - 7.0

(iii) Age of crop

Immature crop or early harvested crop rets faster than the mature and late harvested crop.

(iv) Fertilizer applied to the crop

The crop where higher doses of fertilizer is used, takes less time to ret.

**Varieties of mesta suitable for fibre production**

Mesta has many varieties cultivated and suitable for different countries. Most of the countries of the World have bred their own varieties for their local needs. However, some of the important varieties of mesta are given below –

**(A) H. cannabinus (kenaf)**

Good high yielding varieties of *cannabinus* have been developed in the country. Some of them are

a) HC-583 : This is a selection from a material collected from Nigeria. It was developed at CRIJAF, Barrackpore. The plants are green with irregular light flush of red pigment. The leaves are entire and cordate. The plants flower in 150-180 days after sowing. The flowers have yellow petal with red stigma. The seed colour is grayish black. The variety is suitable for sowing in the month of April and is suitable for growing in the states of West Bengal, Assam and Orissa. The variety can give fibre yield of 25-30 q/ha.

b) AMC-108 : This variety is the result of selection of indigenous material and was developed at Agricultural Research Station, Amadalavalasa (A. P.). The plants are light red in pigmentation which even extends to the petiole. The leaves are deeply lobed (5-7 lobes) and slightly red pigmented. It takes 150 days to mature for harvest. The seeds are grayish black in colour. The variety is suitable for April-May sowing in the Southern region of the country, (Bihar and Orissa). The fibre yield is upto 25-30 q/ha.

c) HC-269 : The variety has been developed at CRIJAF Barrackpore. It is a selection from a local material. The plants are green with irregular flush of red pigment. The leaves are entire and green. The variety matures within 145-160 days for fibre purpose. The seeds are grey and sub remiform in shape. The variety can be sown in April and can yield upto 20-25 q/ha of fibre.

**(B) Hibiscus sabdariffa (Roselle)**

a) **HS-4288:** This variety has been developed at CRIJAF Barrackpore and is a selection from a cross between variety RT-1 (nonbristled) X RT-2 (bristled). The plants are green with red pigmentation at nodes. The leaves are deeply lobed with at least 5 lobes in each leaf. The upper surface of petiole is red and the lower surface of petiole is green. The variety takes 180 days to flower. The seeds are of coffee colour and reniform. The variety can be sown from mid April to May. It yields 18-20 q/ha of dry fibre. The variety is suitable to grow in West Bengal, Assam, Tripura and Bihar.

b) **HS-7910:** The variety was developed at CRIJAF, Barrackpore. It is a selection from a cross between HS-4288 X RT-1. The plants are green with irregular flush of red pigment which further extends with the maturity of crop. The

variety is devoid of bristles on the stem. The leaves are deeply lobed, slightly more reddish than HS-4288. It takes around 180 days to flower. The seeds are reniform and of coffee colour. It can be sown during the month of May and yields upto 18-20 q/ha of dry fibre. Most suitable for the states of West Bengal, Assam, Orissa and Bihar.

c) **AMV-1:** The variety has been developed at Agricultural Research Station, Amadalavalasa (Andhra Pradesh). It is the result of selection made from an indigenous material. The plants are of crimson purple colour with completely green base upto the height of 35-40 cm. The stem is bristled. The leaves are deeply lobed. The petiole is purple in colour. It takes 180-200 days to flower depending much upon the time of sowing. The seeds are of brown colour. The variety is sown normally in between mid April and early May. The fibres yield of 15-17 q/ha is obtained. The variety is suitable for Andhra Pradesh and Orissa.

d) **AMV-2:** This variety has also been developed at Agricultural Research Station, Amadalavalasa (A. P.) It is the result of the selection made from an indigenously collected material. The stem is pink coloured having green base and is fully bristled. The leaves are deeply lobed. The plants take 180-200 days to flower. The seeds are brown and of smaller size. The variety can be sown in early May and is suitable for Andhra Pradesh and Orissa. Fibre yield upto 17 q/ha.

e) **AMV-3**: This is a selection from a cross between AMV-1 X ER-79. The stems are pink with bristles. The leaves are deeply lobed. The plants take 180-200 days to flower. The seeds are brown and smaller in size. Suitable for early May sowings in the states of Andhra Pradesh and Orissa. Fibre yield is upto 18 q/ha.

f) **AMV-4**: This variety is also the result of selection from the cross between AMV-1 and AS-163 made at the Agricultural Research Station, Amadalavalasa (A.P.). The stem is pink in colour with bristles. The leaves are deeply lobed. The variety flowers in between 180-200 days after sowing. The seeds are slightly of bigger size than AMV-1 and AMV-2. The variety is suitable for May sowing in the state of Andhra Pradesh. Fibre yield is upto 20 q/ha.

## CULTIVATION OF MESTA FOR SEED PURPOSE

Mesta is sown late in the month of July or even in August for seed purpose. The requirement of seeds for raising a good crop of mesta in one hectare of land is nearly 10-12 kg in case of *cannabinus* and 7.5-9.0 kg in case of *sabdariffa.* The land is prepared as usual and the sowing is attempted in rows in a spacing of 40x10 cm. Normally the seed crop of mesta is not favoured with any fertilizer. The crop is raised and harvested when most of the capsules are mature. The seed crop should generally be sown about two months before the day length shortens to about 12 or 121/2 hours as large number of flowers are required for seed production.

The seeds start to ripen from the lowest capsule in succession upwards till the time they are fully matured. The capsule shatters when it is fully mature and the harvesting is done before this. The mature plants are left in the field until all the capsules have ripened. The seeds can be thrashed out by beating the capsules on a tarpaulin. The threshing of seeds in mesta is slightly difficult because the bristles on capsules create problems for the workers.

Decorticator of mesta

Seed yield in both *cannabinus* and *sabdariffa* are highly variable. Generally in *cannabinus* the light insensitive and early maturing varieties give higher seed yields (upto 1200 kg/ha) while in *sabdariffa* types the seed yield is low. Since the seed size in *sabdariffa* is smaller the proportionate yield~ are more or less same. Some of the Indonesian types give higher seed yield of even 1300 kg/ha. However, in normal cases the seed yield is 700800 kg/ha. According to the basic fundamental rule, a seed crop of mesta covering an area of one hectare will give sufficient seeds to cover 20 ha of land.

It has been estimated that one kg seeds of *cannabinus* varieties if counted comes to nearly 35, 000 to 40,000 in number. A plant of *cannabin us* variety contains 40 to 60 capsules and each capsule have 15 to 25 seeds in it. The varieties of *sabdariffa* have 50 to 100 capsules per plant and each capsules possesses 15 to 20 seeds in it.

The seeds of mesta should be stored in perfect dehumidified conditions. Seeds with 8 percent moisture content can retain viability for more than five to six years if stored upto 10°C temperature. The mesta seeds are generally affected by weevil's attack. It is, therefore, recommended that the seeds should be treated with Malathion or fumigated by Carbon disulphide before they are stored.

The seeds of *Hibiscus cannabiuus* also produce good edible oil. Nearly 21% oil can be extracted. The oil has been found to be good for culinary purposes. It has already become popular in many countries of Africa and Asia including India. After the seeds are harvested, they are dried properly under the sun for a day or two depending on the sunlight. The dried seeds are then sent to the crushing mills. The oil so extracted is refined properly and tinned for general market sale.

Mesta oil is already in use by the soap industries in almost all parts of the world. After the extraction of oil, sufficient quantity of oil cake is left behind. This oil cake is used as a cattle feed. The oil cake contains following ingredients -

| | | | |
|---|---|---|---|
| (i) | Moisture | - | 9.26% |
| (ii) | Proteins | - | 29.18% |
| (iii) | Oil | - | 9.76% |
| (iv) | Crude materials | - | 15.68% |

The oil of mesta is also rich in certain physical and chemical properties. The analysis of oil is given below -

(A) Physical properties:

(i) Acid value = 2.10% by weight

| | | |
|---|---|---|
| (ii) Saponification value | = | 187-190% by weight |
| (iii) Iodine value | = | 90-94 by weight |
| (iv) Refractive index at $40^0$C | = | 1.465 q |

(B) Chemical properties:

| | | |
|---|---|---|
| (i) Palmitic acid | = | 15.8% |
| (ii) Stearic acid | = | 6.8% |
| (iii) Oleic acid | = | 51.0% |
| (iv) Linoleic acid | = | 26.4% |

Higher value of iodine value clearly indicates that the mesta oil can easily be mixed with any other edible oil. Higher value of oleic and linoleic acid also provide advantage of this oil over other edible oils.

**CULTIVATION OF MESTA FOR FLESHY CALYCES**

Wild forms of *sabdariffa* have been found to possess fleshy calyces on their flower buds. These calyces have been used for many culinary purposes since long. In southern parts of India the pickles prepared out of these calyces are most popular. The types with fleshy calyces can be grown in a variety of soils with the pH ranging in between 4.4 to 7.8. The area should have a rainfall of 100 to 150 mm, with a temperature range of 30°C to 3SoC. Excess of rainfall may lead to water logging and result in the infection of diseases.

The land of growing plants with fleshy calyces is prepared as usual and the crop is generally sown in rows in the last week of May in India. If needed the sowing may even be attempted in the first week of June. The rows are kept 40cm apart with a distance of 15-20 cm between plants in a row. Approximately 9 to 10kg of seeds are required for sowing a hectare of crop. The germination of seeds takes place within 2 to 3 days if soil moisture of 25-30% is available.

The seedlings, if required are thinned in two installments when they are 10 to 20 cm tall. A dose of nitrogen, phosphorus and potash in the form of ammonium sulphate, single super phosphate and muriate of potash is added at the rate of N20, P20 and K 10. The P and K are applied preferably at the time of land preparation before sowing and-- after the thinning is over. This helps the plants to grow well and produce more fleshy calyces. Two weedings and wheelhoeings are sufficient to raise a good crop.

The plants grow and start forming flower buds within 130-150 days after sowing. The calyces are collected just before the opening of flowers. The calyces collected at this stage are good in taste. More fleshy calyces can be, had if the plucking is done just at the time of opening of flowers. The calyces are plucked by hand in baskets like tea leaves. These calyces are then sent for the preparation of different items like jam, jellys and pickles.

About 30 quintals of fleshy calyces can be had from one hectare of good mesta crop.

Varieties suitable for fleshy calyces

(i) Long Calyx type

The variety is dwarf, branched, nonbristle, red and resistant to lodging. It possesses alternate leaves, which are palmately lobed, with glaburos lamina. The flowers are axillary, solitary, 4 to 6 cm. in diameter and bloom for longer period. Epicalyx is inconspicuously channeled. Calyx is fleshy, thick, broad and nonbristle. Petals are generally of sulphur-yellow in colour. Nearly 1500 plants can be accommodated in 100 sq.m. plot.

A view of the crop of long fleshy calyx type

**CULTIVATION OF MESTA FOR PAPER PULP**

*Hibiscus cannabinus* is also utilised for the production of paper pulp in many countries like North America, Central and Northern African countries and in CIS countries of , earstwhile USSR. India is already using mesta for paper pulp.

The cultivation of mesta crop for paper pulp is done almost in the same manner as it is done for fibre purpose. However, the main emphasis is given on the thick and tall plants. The thick plants produce more pulp. Therefore, to get the thick plants the row to row distance in the field is increased from 30cm to 40cm. The intercultural operations etc. are also the same as in the crop grown for fibre.

After the crop has attained the age of nearly 120 days, the harvesting of the crop for paper pulp is started. The harvesting is done by sharp cutters specially designed for this purpose. The cut plants are brought out of the field and further chopped in small pieces. This is done mostly after the shading of leaves. The thin chopped material is then bundled and transported to paper mills. The economics of harvesting and handling are the two main aspects on which the acceptance or rejection of mesta as a crop for paper pulp will depend.

The following factors have been found to be important for the acceptance of mesta for paper pulp -

(i) It is important to know the proper form in which the mills would like to accept mesta for paper pulp. It has been observed that the mills normally need good chopped and properly bundled raw material.

(ii) The instruments used for processing the mesta plants for the purpose of paper pulp should be perfect. The cultivators should keep sharp choppers and cutters for this purpose. The mechanical pulp generally requires a short precise cut and the chemical pulp would need less exacting cut.

(iii) The raw material also needs proper transportation. It is advisable to transport the cut material in bail form. A cotton press may be used for bailing purpose.

(iv) The chopped material should also be stored properly. It has been found out that with the initial moisture of about 50%, the chopped material may be stored for a longer period. More moisture in the chopped material adversely affects the storing.

**Varieties suitable for paper pulp**

a) **MT-150** : The variety has been developed by CRIJAF, Barrackpore. It is a selection from indigenous material. The plants are grown with irregular flush of red pigment. The leaves are entire and green in colour. The flower is with yellow petal and red stigma. The seeds are grey in colour. This variety is most suitable for the production of paper pulp. It

yields upto 30 tonnes of green matter per ha. Suitable for sowing in West Bengal, Assam, Orissa and Andhra Pradesh for paper pulp.

Studies have indicated that the bark portion of the plant gives maximum pulping material than woody component of the stalk. The final pulp must contain about 30 to 40% of the bast pulp.

It has been estimated that a 100 ton per day capacity bleached pulp plant would require raw material from nearly 15, 000 to 20, 000 acres of mesta crop or from 700 to 800 hectares of crop to run round the year. One hectare of mesta crop has been found to yield 10 to 15 tonnes of pulp easily.

**DISEASES OF MESTA**

Both *H. cannabinus* and *H. sabdariffa* are affected by many diseases in this country. Some of the major diseases are described below -

**(A) H. cannabinus**

(a) Anthracnose -

This is the disease caused by fungus *Colletotrichum hibisci* (syn.-Volutella).

The stem of the plants are affected in patches. This disease makes whole plant to wilt. A proper spray of copper oxychoride (50% copper fungicide at the rate of 3kg per/ha) checks this disease to a great extent. The disease may attack at any time of plant growth. The leaves also may be affected leading to defoliation. The flowers, seed capsules and older parts of stem are affected badly.

(b) Tip rot -

In this case the tips of the growing plants, stipules, young leaves, leaf buds etc. are affected by the fungus called *Phoma* spp. (syn. - *Trichosphaeria* spp.). The tip turns brown and the further growth of the plant is checked. Any of the copper fungicide can be used for controlling this disease.

(c) Root rot/collar rot -

The prevalence of high relative humidity during July and August helps in spreading this disease. Presence of high moisture in the soil for long time also causes this diseases. The disease is caused by *Rhizoctonia bataticola* alone or in combination with *Fusarium oxysporum.* After the attack the plants start wilting and finally die. Seed treatment with organo mercurial componds or captan helps in controlling it.

(d) Eye rot -

This disease is caused by *Myrothecium roridum* fungus which creates eye shpaed patches on the stem and leaves. The disease can be controlled by the spray of any copper fungicide. The disease is marked by necrotic spots on stem initially smaller. Later on they elongate and become brown. Ultimately the infected stem is broken.

**(B) H. sabdariffa (Roselle)**

(a) Foot and stem rot -

This disease is caused by the infection of *Phytophthora parasitica* var. sabdariffae. This fungus is both soil and water borne and the infection starts when there is water stagnation in the field. It is a serious disease in India. The lower portion of the plant (stem) turns black and the plant dies. It has been observed that the varieties with pigmented stem are less affected by this disease.

(b) Leaf spot -

This disease is predominantly found in this country. The leaf lobes are attacked. They start rotting. First of all the tips of leaves start blackening and thereafter whole leaf becomes black. The leaves start falling and ultimately the plant growth is adversely affected. This disease is caused by a fungus *Phoma sabdariffae.*

**PESTS OF MESTA**

**(A) H. cannabinus**

The cannabinus mesta is affected by many pests in India. Some of the major one's are as follows -

(a) Spiral borer -

It is a serious pest of mesta. The insect bores through the main stem of the plant. It forms rings on the main stem and the stem breaks from that portion. This pest causes heavy damage to the crop. The fibre obtained from the infected plants become useless. This pest is known as *Agrilus acutus.* A spray of endrin has been found to be effective to some extent.

(b) Root knot nematodes -

The root knot nematodes also affect mesta plants. The infection is caused by *Meloidogyne incognita.* After the infection of nematodes, the plants also develop chlorosis. The infection is more pronounced in sandy loam soils. Proper crop rotations have been found to be useful.

**(B) H.sabdariffa**

(a) Mealy bug

In this case the tip of the plant is crowded with leaves and the further growth of the plant is completely checked. The symptoms are caused by a insect called *Maconellicoccus hirsutus.* This may be controlled by a spray of Parathion (0.04%) or Fenitrothion (0.04%).

(b) Flea beetle

This is a beetle which feeds on the leaf lamina of this mesta. Although it has not proved so serious even than it needs proper control. This beetle is known as *Nisotra orbiculate.* It can be controlled by dusting SHC (10%) powder on the leaves.

**GENERAL**

The mesta has proved very economical in cultivation because of certain distinct advantages over other crops in the developing countries. This is because of the following -

(i) It is a potentially profitable crop which is not in world surplus.

(ii) It provides raw material for industrialization and also for domestic use.

(iii) The crop can be grown on upland soils providing good cash return than other crops.

(iv) The crop requires less labour than jute and can be produced cheaply.

(v) The fibre is useful for every country.

Although the fibres of jute and mesta are used more or less in the same manner, the prices of both vary. The mesta fibre is always cheaper than jute because of the following reasons.

(i) The mesta fibre in India is of poor quality and is not exported, but blended with jute for local burlap manufacture.

(ii) Prior to 1962, the only large producer of mesta for export was Thailand. The rapidly expanding production was and still poorly graded.

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