RAMIE

(Boehmeria nivea)

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INTRODUCTION

The fibre obtained from Ramie plant *(Boehmeria nivea* L.) is one of the strongest vegetable fibre known in the world today. It possesses highest strength and length, good durability and absorbency with excellent lustre. These remarkable characters make it rather more suitable for use in the manufacture of wide variety of textiles and cordage products. However, despite its unique quality, ramie has received comparatively less prominence in the calendar of important crops of the world. Recently with the availability of more technical know how, the crop has started getting slightly more importance and the countries like China, Brazil and the Philippines have come forward with commercial cultivation. Besides, the other countries like Japan, Taiwan, Indonesia, Vietnam, Korea, Columbia, Malaysia and France have also started cultivating ramie in a limited scale. (Bally, 1957; Dempsey, 1954; Kirby, 1963; Greenhalgh, 1978).

EARLY HISTORY

The word "Ramie" has been designed from the ancient Malayan word, which is anglicized as "ramie". In India it is called by different popular names such as Rhea, Popah, KhunKoora, Kurkunda etc. (Kirby, 1963; Manersberger, 1954).

Ramie fibre has been in use since pre-historic times at least in China, India and Indonesia (Thieme, 1954). It is one of the oldest plant fibres known to have been cultivated in the orient and its use as a textile fibre in the east is of great antiquity. It is known to have grown in China for many centuries before even cotton entered in that country in 1300 AD. The fibre finds a reference in the ancient Indian literature i.e. drama "Sakuntala" written by Kalidas about 400 AD and also in Ramayana (Manersberger, 1954; Montogomery, 1954). Japan has been producing fabrics made of ramie fibre known as 'Echigojfu' and 'Satsumjofu' since ancient time. According to chronicle of Nester (900 B. C), the ships in volga (Russia) were utilizing ramie fibre for the preparation of their sails. Ramie fibre has also been found to be very popular in "Attaranjikhera" in D.P. between 1200-600 B.C. (Mitter, 1975).

The modern phase in the history of ramie is said to have begun only in 1960, when George Eberhard Rumph found the plants of ramie growing in the East Indies and he called them as *Ramium majus.* It was only by the end of the 19th century, that the seeds and plants of this valuable plant were transported to most of the other parts of the world where it is grown today (Monotogomery, 1954).

A crop of ramie

Although the crop is still not fully explored and has not received the required importance, it has become popular in several areas of Assam and North Bengal. It is known that during the regime of "Ahom" kings in Assam, ramie was introduced from Malaysia in 1278. Its widespread cultivation in Assam in the old days has been indicated by the names of places like Rehabari (meaning ramie farm) in Guwahati and Dibrugarh (Gogai 1981; Rahman, 1981). This indicates its popularity in this region since long. During British period several European firms started ramie plantations in Madras Presidency, some parts of Bihar and in many parts of Assam. The British Govt. was so much impressed by this crop that it offered even prizes and several incentives to the cultivators for growing ramie in India. It also offered a reward of 5000 lbs. for the development of a successful ramie fibre-extracting machine in India, but since the trials with the prototype developed were unsuccessful, the offer was withdrawn (Dempsey, 1975).

ORIGIN AND DISTRIBUTION

The genus *Boehmeria* Jacq. (n=7,13) has more than 100 species mostly tropical and subtropical of which some are shrubs, herbs and trees. Lawrence (1963) reported 80 species of this genus, while Berger (1954) has mentioned 50 species. It has further been reported that information is also available on at least 13 species in Western Hemisphere (Anon. 1948). About 40 species have been reported from Japan (Kirby 1963), 45 species from India (Hooker, 1885),.45 species from Ceylon (Triman, 1974) and 50 species from Eastern Asia (Ridley, 1967).

Although only one species *(B. cylindrica)* has earlier been reported to occur in the United States (Anon., 1948), Lawrence, however, reported 5 species. In India,

about 19 species have been reported from Assam, Meghalaya, Arunachal Pradesh, Sikkim and Kumaun hills (Hooker, 1885, Kanjilal *et al* 1940). Fischer (1926) reported 4 species from Western Ghats, while Cook (1958) reported 5 species from Western Peninsula. Prain (1958) also reported 2 species from Bengal plains. *B. nivea* is indigenotus to eastern Asia, from Japan down to eastern parts of China to Malaysia, but according to Vavilow (1951) ramie is indigenous to central and western China. The plant *(Boehme ria nivea L.* Gaud.) belongs to the family "Urticaceae" and is found grown even under natural conditions in several parts of Arunachal Pradesh, Assam, Nilgiri Hills and Kangra Valley of Himachal Pradesh (Kundu, 1958) Linnaeaus described this plant as "Urtica piyea" in 1737 after he received specimens of the plant from China (Luniak, 1949). It was however, redesignated as *"Boehmeria* " by Gaudichaud in 1826 in honour of George Rudolph Boehmer, a German professor at Wittenberg (Baily, 1949). Genus *Boehmeria* has two most useful species, one of them is called *B. nivea* which is also known as white ramie because of the white under surface of the leaves of the plant and B. utilis which is popularly known as green ramie because of the green under surface of the leaf and is generally referred to as *B. nivea* var *tenacissima.* The credit of locating ramie plant in India, however, goes to Dr. Buchanon Hamilton, who first found ramie plant growing wild in Goalpara (Assam) in 1908. Out of the two species available, *B. nivea* is mostly cultivated for commercial purpose in the world, and grows best in the temperate and subtropical regions. However, as far as yield is concerned, no difference were observed among *B. nivea a*nd *B. utilis* when they were grown in the experimental plots in Tanganayika (Kirby, 1963).

BOTANICAL DESCRIPTION

Ramie is a plant of perennial nature, which sends up a large number of straight slender stalks. These stalks grow upto the length of about 150 to 200 cm with a diameter of" 12 to 20 mm. depending upon the growing conditions. The shoot consists of several long and short serial sterns each called "Cane". Several canes together form a "clump" .

The leaves are alternate, long petioled and appear on the upper part of the stalks. They are heart shaped, broadly ovate and abruptly accuminate having a width of nearly 50 to 130 mm. and length varying in between 100 to 150 mm. with finally serrated margins. Leaves contain nearly 20 to 24% protein. The leaves are hairy with felty hairs and with white under face in case of *B. nivea* and with green undersurface

in case of *B. utilis.* The flowers are greenish white in colour, borne in declinate clusters in the axils of the leaves (Fig. 1 a). Male and female flowers are found on the same stalk. The female flowers are in axillary panicles, unisexual with five sepals and no petals. They are found on the upper part of the stalk. They have one celled, one seeded ovary and a slender style, hairy on one side (Fig. 1 c). The male flowers are arranged on the lower part, have five stamens and a rudimentary ovary (Fig.1 b). The male flowers open first and the flowers are wind pollinated. Seeds are produced in great number. They are very small in size and weigh nearly 7000 seeds per gramme (Fig.1d). The plants have rhizomatous roots which contain storage roots, small fibrous roots and rhizomes (sometimes also called as reproductive or lateral roots).

DESCRIPTION OF SOME IMPORTANT SPECIES

1. *B. malabarica.* Wedd. an erect shrub or a small tree; branches spreading bark greyish rough, thin; leaves alternate, 5-20 cm. length and 1.5 - 13 cm. breath, sub equal or eliptic, ovate lanceolate, used as a cattle fodder. Distributed in Assam, Maghalaya, Western ghats (upto 4000 ft) Western Peninsula, Sri Lanka, Indonesia (Java) and Bangladesh (Chittagaon).
2. *B. sidaefolia.* Wedd. A slender diffused under shrub; leaves opposite and alternate, 2.5-11.5 cm. length and 1.7 - 4.5 cm. breadth, ovate, lanceolate or elliptic, sharply serrated. Distributed in North Cachar Hills (Assam), Meghalaya, Arunachal Pradesh, Eastern Nepal and Sikkim.

A flowering spike of Ramie

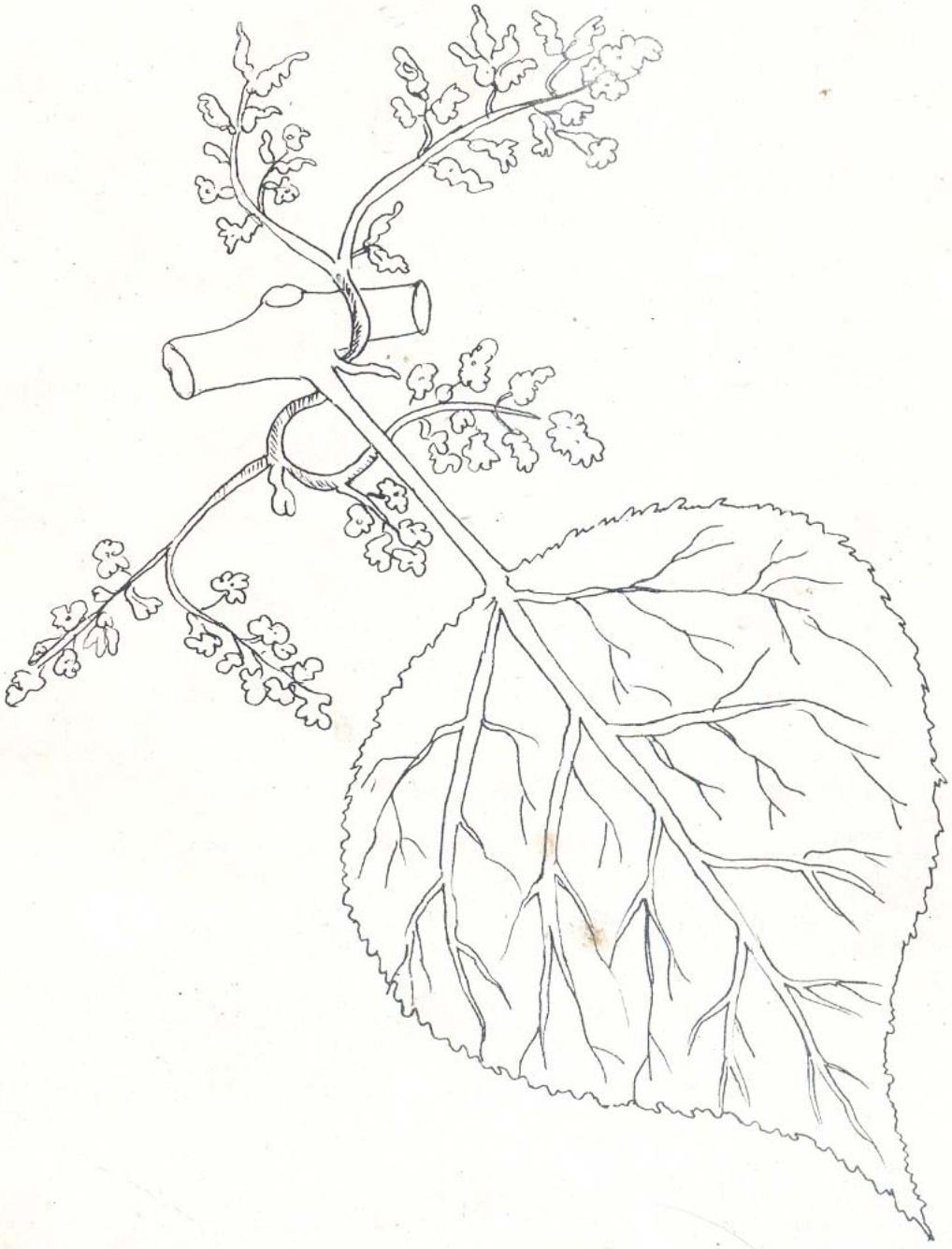


Fig. 1a. Ramie leaf and inflorescence

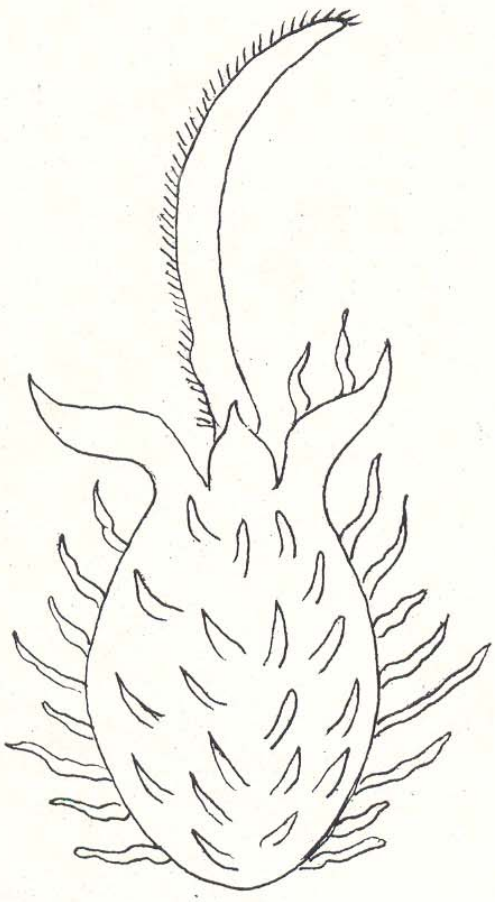
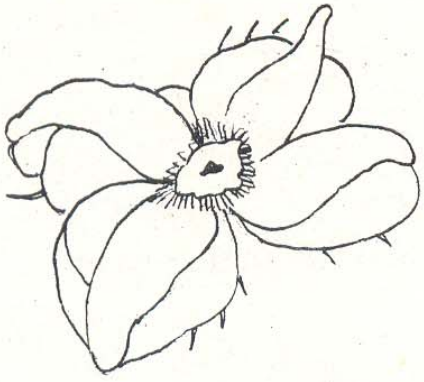


Fig. 1c. Female flower of ramie



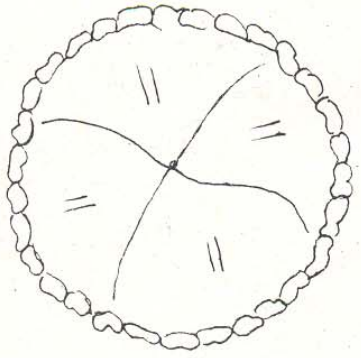


Fig. 1d. A fruit of ramie

Fig. 1b. Male flower of ramie

3. *B. nivea,* Gaud. Shrub; leaves 5 - 15 cm. long and 4 - 10 cm. Broad, broadly ovate or sub orbicular. Distributed in Assam, North Bengal, Bihar, Orissa and Uttar Pradesh (Kumaun Hills).
4. *B. macrophylla.* Don. A small tree or a large shrub, Bark brown, branches four angled, leaves opposite, 10 - 30 cm x 2.5 - 8 cm. in size, narrow, lanceolate, cordate. Distributed in Assam, Meghalaya, Bihar and Uttar Pradesh (Kumaun Hills).
5. *B. platyphylla.* Don. A variable large spreading shrub, branches succulent, more or less strigose, dark blackish contains a pith like structure inside; leaves opposite or sometimes alternate, 5 - 15 cm x 2.5 - 10 cm. in size, broadly ovate, ovate elliptic or suborbicular. *B. platyphylla* is an exceedingly variable plant split up into many varieties (Hooker, 1885) such as

B. platyphylla Don	Var	tomentosa
B. platyphylla Don	Var	longissima Hook.f.
B. platyphylla Don	Var	cinerasens Wedd.
B. platyphylla Don	Var	zeylenica Wedd.
B. platyphylla Don	Var	rugossima Wedd.
B. platyphylla Don	Var	rotundifolia Wedd.

Deodikar and Patwardhan (1959) reported *B. platyphylla* Don. from Western Ghats to be a possible source of textile bast fibre. The species is' distributed in Assam, Meghalaya (upto 4000 ft.) Simla, (9000 ft), Bihar, Orissa and Uttar Pradesh.

6. *B. hamiltoni* Wedd. An under shrub, branches slender, glabrous leaves opposite, 10 - 20 cm x 4 - 10 cm. in size, lanceolate. Distributed in Assam, Meghalaya, Nepal and Bhutan.
7. *B. polystachya* Wedd. A robust shrub, branches stout, glabrous, leaves opposite, sometimes alternate, 13 - 30 cm x 4 - 10 cm. in size, broadly ovate. Distributed in Arunachal Pradesh, Meghalaya, Kumaun hills & Bhutan.
8. *B. rugulosa* Wedd. A small tree leaves 7 - 15 cm x 2 - 5 cm. in size, alternate, elliptic lanceolate. Distributed in Naga hills, Someswar hill of Orissa and Uttar Pradesh.
9. *B. kurzi* Hook f. Very flebrous except' the spikes; leaves opposite, elliptic, oblong or lanceolate, 12 - 18 cm. x 5 - 6 cm. in size, branches slender. Distributed in temperate Himalayas.
10. *B. scabrella* Gaud. A shrub with soft glabrous or strigose more or less grooved branches, leaves opposite, 9-19 cm x 4 - 10 cm. In size, broadly

ovate, acuminate or cordate, sharply serrated. Distributed in Koina valley below Mahabaleswar, Orissa, Bihar (Chotanagpur), North Bengal & Uttar Pradesh.

11. *B. utilis* - Similar to *B. nivea* except that the lower surface of leaves is green in this species. Mostly found in China, the Philippines and Malaysia.
12. *B. helforii* BIume. A herb, leaves broadly. ovate, opposite sparsely hairy above petiole short.

CONDITIONS REQUIRED FOR GROWING

Ramie grows well in the areas having good rainfall and warm climate. The following type of soiland climate is best suited for ramie cultivation.

SOIL: The soils best suited for ramie are sandy loam or loamy, very sandy. The clayey or gravel soil is not suitable. The plant is too much sensitive to soil moisture conditions. It grows well in land, which have adequate supply of moisture, well distributed throughout the growing season. Soil must be well-drained i.e. high land and should have no problem of water logging or flooding. Flat and slopy lands are good. Ramie plants give poor growth in the dry sandy soil and the poorly drained soils. The soils deficient in calcium and poor in Base Exchange capacity are also not suitable unless proper liming is done and sufficient organic manure is added. The pH of the soils for ramie should be around 5.5 to 5.6.

CLIMATE : Ramie is grown best in a warm moist climate where the temperature during winters goes down to freezing. A temperature of approximately 25°C to 31°C during the summer and rainy months with annual rainfall of 1500 to 3000 mm. evenly distributed throughout the year is considered good for the growth of the crop. However, the crop makes very little growth during winters. It is usually grown at altitudes less than 300m above sea level. The ramie plants are very much sensitive to frost. Even strong winds are harmful as during storms the stalks rub with each other resulting in breaking and ultimate lodging of the canes. The relative humidity of 80% during the growing period is found to be best.

METHODS OF CULTIVATION

Ramie is propagated vegetatively through rhizomes for commercial production throughout the world. The cuttings of rhizomes are planted directly in the field and

the plants arising from them spread rapidly. Rhizomes are obtained from the roots of healthy and disease free plants which are dug out by a spade from an already established plantation. The rhizomes are then removed separately and cut into pieces of 10 to 15cm. in length. These pieces are planted in field immediately or may be stored in a shady place for a week or so before planting. The practice of propagation through rhizomes ensures good sprouting, clonal purity and is economical. It makes the cultural operations also simple. The quantity of rhizomes obtained from an unit area depends on the age of plantation and variety. Usually the quantity of rhizomes obtained from one hectare of 2 years old plantation can give enough planting material to cover at least 20 hectares of land.

As a perennial crop, ramie occupies the land for a number of years. It is, therefore, necessary that the land is deeply and thoroughly prepared. Planting should invariably be done under good soil moisture condition. The planting period may extend from May to September depending of course on the local seasonal conditions. Rhizomes are planted 45 c.m. apart within the row and 60 c.m. between two rows (Sarma, 1981). About 250 to 275 kg. of rhizomes are required for covering one hectare of land in a spacing of 60 cm x 45 cm.

Ramie can also be cultivated in open blocks or as intercrop with coconut plantations as is normally followed in the Philippines (Petruszka, 1977). Good results have been obtained when sufficient quantity of organic manure is applied in the field at the time of land preparation. Lime if needed should be applied at the time of land preparation itself at least 3 to 4 weeks before planting. The land is leveled after proper laddering.

Cultivation - 1st year :-

Planting is practised during the rainy season invariably under the good soil moisture condition. The furrows 5 to 6 cm. 'deep are opened in the planting bed on the day of planting. For this purpose a wheel how is generally utilised. After the furrows are ready, the rhizome cuttings are first distributed in the furrows by a man followed by another who places the cuttings in the horizontal position in the furrows at the desired spacing. The furrows are then covered with soil. It must be ascertained that the rhizomes are fully covered under the soil. They should never be left exposed.

Ramie is a crop with spreading habit, therefore, a good planting distance should be provided for proper growth and development. However, the planting

distance may vary considerably from place to place depending upon the soil fertility, soil type and variety used. (Dutta and Sanyal, 1958). Different spacings have been tried at the Ramie Research Station, Sorbhog and after long experiments it has been concluded that a distance of 45 cm. Between rhizome cuttings in a row with 60 cm. Rows apart from each other is optimum for getting good yields.

Planting materials of ramie
(Rhizomes and Cuttings)

Planting of Ramie in field through rhizomes

Planting of ramie in the field through stem cuttings

Approximately 3,750 to 4,000 rhizomes cuttings of 10 to 15 cm. length weighing hear about 250 to 275 kg. have been found to be sufficient to cover an area of one hectare. The sprouting of plants starts after a week or ten days after planting and continues till 3 to 4 weeks depending mainly on the soil type and the weather conditions. After the sprouting is complete, it must bf ascertained that all the gaps are properly filled through planting the rhizomes.

The crop is left as such for a month or two after the gap filling is completed. A fertilizer mixture of N, P and K @ 20:15:15 kg/ha is applied in between the rows after that the crop is allowed to establish itself in the field for nearly four months without any disturbance, (in case the planting is done in, April the plantation should not be disturbed upto August) and then cut back for subsequent crops (two cuttings may be obtained in the first year of April planting). Regular intercultural operations are applied to keep the plantations free from weeds and to keep the crop in proper condition.

Cultivation 2nd year onwards: -

The growth of ramie following the first planting is always uneven, branched and not so good. This is particularly not suitable for fibre extraction. The growth during winters is also like this only. However, with the advent of next summer, the plants are stagged or cutback at ground level, which encourages rapid development of new canes in the crop that follows. The harvest of crop for fibre purpose starts

only after this. All the important intercultural operations must be attempted properly. It has been observed that four crops can be harvested during the cropping season between April and November each year. After taking each harvest, the underground rhizomes send up new canes, which again provide fresh crop for the subsequent harvests.

CALENDER OF OPERATIONS

Ramie is a semi perennial crop. For better growth, the crop requires proper attention' and care. The operations are to be taken up at proper time and in proper way. The complete operations which 'are' needed to be attempted in its entire life cycle summarised in a calendar form are given below :

(A) FIRST YEAR

March	:	Planting site is selected.
April	:	Land preparation, trenching, manure application and liming.
May	:	Rhizomes are arranged.
May end to entire June	:	Planting is completed.
June-July	:	Rhizomes start sprouting within 15 days of planting. Gap filling if any is also completed. First dose of N, P, and K @ 20:10:10 kg/ha is also applied.
August	:	First harvesting is done after about
September	:	60 to 70 days of planting. Another dose of N, P and K@20:10:10 kg/ha -is also applied. Weeding is completed .after 3 weeks of harvesting.
October	:	The crop is allowed to grow.
November	:	Second harvesting is done after about 45 days of first harvesting
December	:	The field is kept clean, and March maintained.

(B) SECOND YEAR

April	:	Stagging back is done by the last week of April. For this the operation is done during the third week of April to mid May.
May	:	Weeding is done. The fertilizer in the form of N,P&K@30:15:15 is also applied-.to the crop.

June : First harvesting is done with the crop age of 50 days. Extraction is followed immediately after harvesting. After completing the harvesting the second dose of fertilizer @30:15:25 in the form of N, P & K in applied.

July : Weeding is done. Second harvesting is completed at 45 days after the first harvest. Third dose of N, P & K @30:15:25 is also applied.

August : Weeding is completed, Plant protection measures are taken.

September : Third harvesting is done at 45 days after second harvest.

October : Weeding is done.

November : Fourth harvesting is done at about 45 to 50 days after third harvesting. Fertilizer in the form of N, P and K @30:15:25 is applied.

December : Fifth harvesting is done if conditions are favourable. The field is kept clean by weeding.

Jan.-March : Lean period.

(C) THIRD YEAR

March : Mulching is done if the weather is too dry and if there is no irrigation facilities, organic manure @ 5 tonnes/ha is applied. Micronutrients like Zinc, Borax, Manganese etc. may also be applied if the soil is deficient in these nutrients or if deficiency symptoms appear.

April : Stagging back is done.

May-March : All the operations of second year are repeated.

(D) FOURTH. YEAR : All the operations of third year are repeated.

(E) FIFTH YEAR : All the operations of third year are repeated.

(F) SIXTH YEAR : All the operations of third year are repeated. After the last harvest the entire crop alongwith the rhizomes is uprooted.

The following 'operations are important in ramie cultivation.

(i) Time of stagging or cutback:

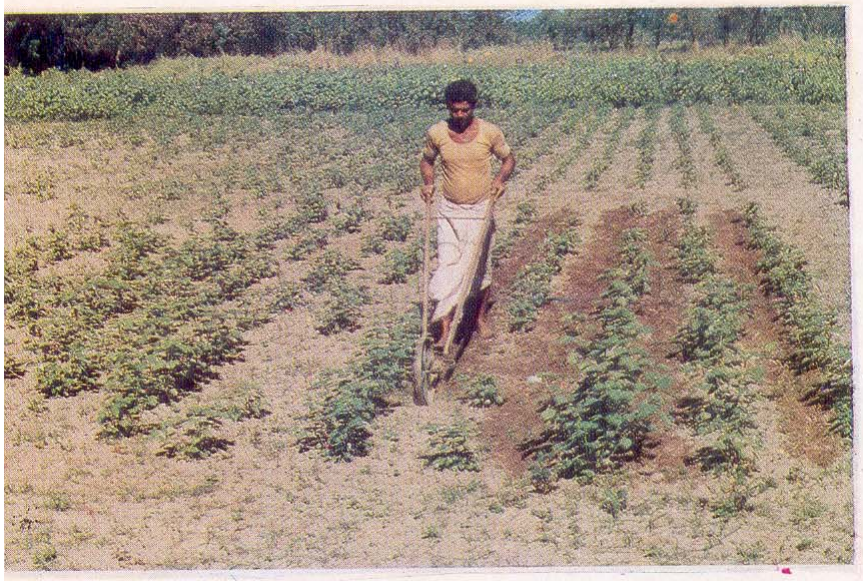
This is a very important operation which should be attempted timely and carefully. Slight mistake at this will adversely affect the subsequent growth of the crop and the final yield. This is the single important operation, which permits maximum growth of the crop if attempted properly. Experiments conducted at Ramie Research Station have indicated that the stagging or cut back should never be attempted earlier than 25th April.

(ii) Interculture :

After the stagging is completed the harvested canes are again cut into small pieces by a sharp sickle and spread over the field after weeding is complete. However, care should be taken that the young sprouts emerging from rhizomes are not damaged by the cut pieces. This operation helps in keeping the soil loose and friable and also permits the retention of soil moisture as well as adding organic fertilizer to the soil. Wheel hoeing is applied after the fertilizer application is completed in the first crop. It is easy to handle 2nd, 3rd and 4th crops, since only intercultural operations are required to keep the crop in proper condition. The weeding and wheel hoeing is sufficient to keep the crop healthy. Weeding is, however, considered one of the important part of intercultural operation in this crop. Experiments have indicated that the chemical herbicides such as paraquat or atrazine alone or in combination of both are effective against weeds of ramie field (Sarma *el al.* 1980). During winters the spaces between the rows may also be spaded for loosening the soil

Intercultural operation in ramie (Weeding)

Inter cropping of ramie with pineapple.



Intercultural operations in ramie (Wheel hoeing)

(iii) Fertilizer application :-

The application of fertilizer depends much on the composition of soil. The quantity of fertilizer required by the crop also depends on the number of crops harvested annually. In view of the fact that a large amount of green mass is harvested regularly in this crop, ramie naturally needs high amount of fertilization. Experiments conducted at Ramie Research Station at Sorbhog, Assam have shown that N, P and K @ 30 kg., 15 kg. and 15 kg./ha/cutting for initial three years and N60, P30 and K60 Kg./ha/cutting *for* subsequent years of production is optimum for getting good growth of the crop as well as well as for getting higher fibre yields (Sarma and Ghosh, 1981).

Ramie also responds well to the application of compost and F. Y. M, water hyacinth and other farm refuses have also been found effective for increasing higher fibre yields. The water hyacinth at the rate of 30 MT/ha may be applied. The practice of returning all waste materials to the field during fibre extraction, which has high value in the form of well rotten organic manure, is also recommended (Kirby, 1963). This not only helps in obtaining high yields but also contributes in the proper maintenance of the physical condition of the soil (Berger, 1968). Application of decortications waste in the field helps In obtaining certain nutrients like potash and in maintaining the nitrogen content of the soil and further helps in maintaining the nitrogen content of the soil (de Geus, 1967). The covering of plantation with at least 2.5 cm. thick fresh soil each year has also been found to be effective.

PESTS AND DISEASES

The infestation of insects pests and diseases in this crops has not been so alarming in India at present (Ghosh and Ghosh, 1971). Among the insects, hairy caterpillar *(Spilosoma obliqua)* has been reported to infect the ramie plants only moderately. Ramie leaf roller *(Syleptra derogata)* and leaf eating caterpillar *(Spodoptera exigua)* have also been observed from time to time (Ghosh and Ghosh, 1971, Mustafee, 1977). The incidence of the attack of these insects can easily be controlled by spraying 0.04% of endosulfan or sumithion.

No major diseases have been reported in Ramie. Carpospores leaf spot caused by *Cercospora boehmereae* is sometimes observed in the ramie plantations, but the damage has never been so high (Chaudhury, 1957). this disease can be controlled by dusting or spraying any common copper fungicide.

Chlorosis, caused by the deficiency of calcium and organic matter, sometimes assumes serious nature. It can, however, be controlled by adopting proper cultural practices.

HARVESTING

As mentioned above, normally four cuttings can be obtained per year following the year of planting at a sequence of 50-45-45 and 50 days crop age. In this way a total of nearly 1200 and 1800 kg. ha of fibre can be obtained easily. The yields, however, depend much on the type of soil, climate, variety, management of plantation and pests and diseases. In case the first plantation is done early in the

year then even one or two cuttings may be obtained in the first year itself but it should be avoided as far as possible.

It is proper to harvest the crop for better yield when the following symptoms are available.

1. Lower parts of the stem takes coppery red colour.
2. Lower leaves turn yellow and begin to shed.
3. New sprouts begin to appear above the ground.
4. Bark is easily peeled off the stem.

The studies conducted at the Ramie Research Station have indicated that all the above symptoms are exhibited by the crop when the plants are about 45 to 50 days old in age. The age of plant thus can be kept as a reliable guide in this respect. Good results have been obtained when the first and fourth crops are harvested around 50 days and second and third crops around 45 days of crop age.

Harvesting is done by cutting the canes sufficiently close to the ground with the help of a sickle. After the harvest, the plants are stripped off the leaves carefully in the field itself with the help of hand or with the sickle, without causing any damage to the canes. The canes are then sorted out on the basis of their thickness to facilitate decortications.

The harvesting should be planned carefully. It should be in relation to the decortication capacity of the machine and its availability. The present day used 'LASSIS' decorticator has daily capacity of decorticating stalks from an area of about 500 sq. mt., yielding approximately 750 to 900 kg. of green material, if it is allowed to operate only for eight hours. It is always advisable to make the best use of the machine. For this purpose, harvesting from the first crop from an area of about 5000 sq. mt. (0.5ha) is staggered for a period of ten days @ 500 sq. mt per day by commencing harvest at 45 days crop age in the last plot. If this is done, the crops for second, third and fourth harvests will mature progressively at their respective crop ages according to the capacity of the decorticators. This will permit a continuous harvest and supply to the decorticator except for a small period in between the cuttings which may be utilized for the maintenance of the decortication machine.

EXTRACTION

Ramie belongs to the group of baste fibre crops, but the fibre is not extracted in the way jute and mesta etc. are obtained after retting instead fibres are extracted by decorticators. This is because of the fact that the pectinuous substances in ramie

are very difficult to remove. If ramie stems are immersed in water as in ordinary retting, the "pectins do not easily dissolve, with the result "the: retting water does not become acidic and the bacterial action cannot then take place. The fibre in ramie is extracted from the freshly harvested green stalk (after defoliations) with the help of decorticating machine. This machine operates on the raspador principle and works at the speed of 600 to 700 rpm with the help of a diesel oil engine or an electric motor. The machine helps in removing the outer bark and also crushes and removes the central woody portion, some gums and waxes. The product obtained through decortication is crude decorticated fibre still containing nearly 25 to 30% gum. However, it is generally free from the cortical tissues.

Harvesting of ramie

DECORTICATION

The decorticating machine, which is normally utilised for extracting fibre in Sisal *(Agave sisalana)* can be used for ramie also with some adjustments. The machine which is recommended and also mostly used is the prototype decorticator known as 'LASSIS' has been designed by the erstwhile Jute Agricultural Research Institute (I.C.A.R) Barrackpore (West Bengal).

The decorticator consists of a brass beater or breaker plate and metal drum which is fitted with steel beater blades or knives arranged at equal distance on the periphery of the drum. Before the machine starts operation, the beater plate is made parallel to the beater blades and the clearance between them is adjusted according to the diameter of the stalks. When the machine is set for operation, the defoliated stalks are introduced into the machine through the feeder hole. Nearly two third of

the portion of the stalks is crushed at first. During the operation the woody portion of the stalks are crushed and the vegetative portion is scrapped out from the fibre by the action of beater blades against the beater plate. By holding the crushed fibre end, the operation is repeated from the another end of the stalks. The number of the stalks inserted at a time into the machine is usually 2 to 6 depending upon the diameter of the stalks.

Decortication of ramie

The machine requires a minimum of three persons for efficient operations. One person is kept for lifting the stalks from the ground and hand over to the feeding man, another person feeds the stalks into the machine and the third one is kept for immediate washing of fibres. It is advisable to complete the decortication of all the harvested stalks the same day. In case some stalks are left they should be kept moist by sprinkling water regularly till the decortication is done on next day.

After the decortication is complete it is advisable to return all the waste to the field for enriching the organic matter content of the soil. The decorticated fibre is washed to prevent any meshiness. The wet fibres are then dried under the sun for two to three days by hanging them on bamboo frame works. In big plantations the dried fibre is also further processed by brushing machines or by horizontal Jute softeners.

DEGUMMING

One of the most important problems associated with the ramie fibre is its proper degumming. The fibre extracted by the decorticators contain nearly 25 to 30% gum. This fibre must be properly degummed before spinnable fibre is obtained. The

gums of ramie are composed of primarily of araban and xylans (hemicellulose), which are relatively insoluble in water but easily soluble in alkaline solutions (Kirby, 1963). Different types of alkaline solutions are, however, used for chemical degumming and the choice of any particular chemical or combination of chemicals depends much on their cost and efficiency (Kirby, 1963). Mostly alkaline solutions like caustic soda, sodium tripoly phosphate, sodium sulphate, sodium carbonate, sodium paraphosphate, sodium silicate and sodium citrate are commonly used for this purpose. These alkalies help in breaking the pectins in the ribbons without attacking the cellulose in the fibres. Degumming is still considered as a trade secret by the various mills who have very well perfected this art. A slight mistake in the degumming process can spoil the quality of fibre and cause the spinner a considerable loss. Some patents have now been published related to the degumming of fibre in Ramie.

The most important factor involved in the degumming of ramie fibre is the concentration of the chemicals, temperature and the time of penetration of the degumming solution to all parts of the ribbons. Penetration of the degumming solution is yet another important technological problem which has to be mastered for degumming ramie at commercial scale.

The perfectly degummed fibre is pale creamy in colour. In order to make it even more whiter it is bleached with chlorine or hydrogen peroxide or in combination of both.

The degumming process in the ramie fibre production is a most important factor. Generally two types of degumming have been recommended.

1. Microbial degumming.
2. Chemical degumming.

1. Microbial degumming :-

Certain mixed bacterial cultures capable of utilising gums of ramie as source of carbon and energy are isolated from different indigenous ources such as rhizosphere of ramie plants, legume crops etc. These cultures are developed in liquid medium. The decorticated fibre is treated with these liquid bacterial cultures. In this process the gums are removed by the bacteria. The degummed fibre is then washed in water. This method has not become popular since it is difficult to get the needed bacterial culture and the degumming is also not perfect.

2. Chemical degumming :-

This Institute has developed and perfected the technique of chemical degumming. In this method the ramie fibre is initially boiled in the aqueous alakaline solution and then washed in water. The alkaline solution helps in dissolving the gums which are removed by washing. The steps followed in this process are as follows:

1. One percent sodium hydroxide is prepared and taken to a vat.
2. Raw decorticated ramie fibre is then immersed into this solution. The fibre and liquid ratio may be kept at 1:6 or 1:7. Some suitable wetting agents may be used.
3. The fibre-liquid mixture is then boiled at a temperature of 96-98 C for two hours. The boiling may be done by means of steam generated from a baby boiler operated by power.
4. The fibre is then washed in water and then dried.
5. This process helps in reducing the gum content to 5%. In case the boiling is done at a higher temperature of 120-125 C for two hours, the gum content is reduced to even 2%.
6. Use of 0.5% of sodium sulphite helps in improving the tenacity of the fibre.
7. Bleaching of fibre is done with the help of an oxidising agent such as dilute hypochlorite, hydrogen peroxide or chlorine dioxide. Bleaching is however, optional. It makes the fibre more whiter and soft.
8. The bleaching is followed by washing in water & drying perfectly in hot air.
9. If required the drying is again done at this stage.
10. The oiling of the fibre with a sulphonated hydrocarbon as softening agent may be done to facilitate combing and carding.

Petruszka (1977) suggested the following steps for degumming ramie fibre commercially.

1. Boiling the raw decorticated ramie fibre for one hour at 80 lbs pressure/sq. inch (6 kg/cm2) at 160°C temperature. The water to dry fibre ratio to be maintained at 6:1. The alkali salts like 6% sodium hydroxide, 3% sodium sulphate, 3% sodium tripolyphosphite and 3% organic phosphate are used for degumming.
2. Washing the degummed fibre with water.
3. Bleaching the fibre with an oxidising agent such as hydrogen peroxide or chlorine dioxide at 82°C, pH 9.0 (This is an optional step).
4. Washing the fibres and neutralising with diluted acetic acid.

5. Mixing the fibre with an oil emulsion such as sulphonated hydrocarbon using 3 to 4% on the weight of dry fibre to facilitate combing or carding.
6. Centrifuging the fibre.

After degumming, the ramie fibre is commercially a pure cellulosic composed of 96 to 97% cellulose, 3 to 4% -cellulose and 0.1 to 0.2% ash.

FIBRE YIELD

The annual yield of fibre varies much in relation to soil and climate, variety used, management of cultivation, fertilizers applied, pest and disease, number of crops harvested per year and decortication method utilised. On an average annual yield of fibre may vary from 1200 kg to 1800 kg/ha.

RENOVATION AND REPLANTING

Although ramie is a perennial crop, it needs replanting after every 5 to 6 years. Normally the roots become too dense and bunchy after the fourth year with the result the plants start throwing smaller and week stalks. It ultimately reduces the fibre yield. This can, however, be controlled to some extent by the application of a large quantity of compost and other nitrogenous fertilizers, prunning the root stocks and proper earthing up of the plantations. This slight extra care helps in getting satisfactory yields for another two years. In this way the plantation can easily stand for 6 to 7 years. The yields, however, again go down after that period. In real sense good and economic yields are obtained only up to third year of plantation with a total of twelve harvests and the decline in gross return starts after 4th production years. Hence it is always advisable to go for replanting after every 12 harvests. This will ensure profitable returns (Sarma and Ghosh 1981)

Digging of rhizomes in ramie

A) VARIETIES AVAILABLE

The following varieties of ramie have been recommended for commercial cultivation in India. They are - R-1411, R-1452 and R-67-34 (Kanai). Besides the above varieties, the following varieties are also available for cultivation. The sources and main distinguishing characters of all the varieties are given below (Sarma & Ganguly, 1982).

Sl. No.	Variety	Sources	Distinguishing Characters
1.	R-1411	Selection from "Florida Commercial".	Stipule light pink, petiole faint pink, midrib greeenish red, leaf roundish ovate.
2.	R-1412	Selection from an exotic type "E 53-42".	Stipule light pink, petiole very light pink, midrib greenish red, leaf broad ovate.
3.	R-1452	Selection from an exotic type "E 51-71"	Stipule light pink, petiole very light pink, midrib greenish red, leaf broad ovate.
4.	R-67-34	Seedling selection from exotic type "E 5-76".	Stipule and midrib of leaf undersurface light pink, leaf broad ovate.
5.	R-67-40	Seedling selection from seed material received from Taiwan.	Stipule and petiole light pink, midrib of leaf undersurface greenish red, leaf broad ovate.
6.	R-67-59	-do-	Stipule light pink, petiole faint pink, midrib and undersurface of leaf is greenish red, leaf broad ovate, surface pinkish white, portion of leaf margins albino.
7.	R-67-20	-do-	Stipule pink, petiole deep pink, midrib of leaf undersurface pink, leaf ovate.
8.	R-67-21	-do-	Stipule light pink, petiole pink, midrib of under surface greenish red, leaf ovate, Lamina crumpled, albino patches in leaf margins.

9.	R-67-30	-do-	Stipule and petiole, light pink, midrib, of leaf and under surface greenish red, leaf ovate a material Selection from Stipule and petiole lanceolate.
10.	R-67-35	Selection from a material called P.I. London.	Stipule and petiole pink, midrib of leaf undersurface greenish, leaf broad ovate.
11.	R-67-36	-do-	Stipule and petiole pink, midrib of leaf undersurface greenish, leaf broad ovate.
12.	R-67-38	Selection from a Japanese material called "Tatulyama" short.	Stipule light pink, midrib and the undersurface of leaf is greenish red, leaf ovate lanceolate.
13.	R-67-43	Selection from a Japanese material called "Tatutyama" short.	Stipule light pink, petiole and midrib of leaf undersurface pink, leaf board ovate with coarse texture.
14.	R-67 -44	Selection from a Japanese material called "Kagasai"	Stipule and petiole pink, midrib and leaf undersurface light pink, leaf ovate, stem thicker.
15.	R-67-45	-do-	Stipule light pink, petiole faint pink midrib and leaf undersurface greenish red, leaf broad ovate.
16.	R-67-46	Selection from a Japanese material called"Miyasaki-112"	Stipule light pink, petiole faint pink, midrib and leaf undersurface is greenidh red leaf ovate with coarse texture.
17.	R-67-51	Clonal Selection from "Halrulic"	Selection from petiole faint pink, midrib and under surface of leaf is greenish red, leaf ovate smooth.
18.	R-67-52	Slonal selection from "Seikeishim"	Stipule and midrib like 67-46 petiole very light pink, leaf ovate truncate.

These eighteen varieties of ramie have been evaluated for different useful yield contributing characters. Records on various useful yield characters like yield of green

plants, plant height, dry decorticated fibre defoliated stalks and fibre percentage . alongwith quality of characters of under gummed fibre have been presented (Table-l and Table-2).

TABLE -1 : Evaluation of ramie varieties for useful for useful yield characters

Sl. No.	Variety (MT/Ha.)	Green Plant	Defoliated Stalk (MT/ha.)	Plant height (cm)	Fibre percentage on the basis of total green weight	Dry decorticated fibre (q/ha.)
1.	R-67-51	95.28	71.97	122.5	5.38	29.01
2.	R-67 -46	100.22	65.64	139.1	3.45	20.22
3.	R-67 -36	94.91	62.00	129.3	3.56	20.19
4.	R-67-34	73.48	47.16	121.3	4.89	19.39
5.	R-67-20	65.09	50.05	104.1	5.19	18.59
6.	R-67 -44	89.04	57.49	130.1	3.34	17.26
7.	R-67 -43	88.20	57.29	120.5	3.15	15.82
8.	R-67-38	84.07	52.4 7	118.3	3.32	15.34
9.	R-67-35	77.65	55.69	117.3	3.61	14.52
10.	R-67-21	70.39	51.96	107.3	3.76	14.38
11.	R-67 -52	51.51	39.43	95.4	5.11	14.10
12.	R-1452	48.59	36.50	96.5	5.28	13.30
13	R-67 -45	76.94	51.06.	115.1	3.11	13.02
14.	R-67-30	54.32	44.24	99.2	4.24	12.64
15.	R-1412	46.18	36.50	97.8	4.94	12.39
16.	R-1411	50.81	37.74	88.0	4.45	11.12
17.	R-67-40	79.78	50.94	109.7	2.78	10.92
18.	R-67 -59	48.72	35.21	98.8	3.79	9.53
CD		14.55**	8.36**	28.9**	1.64**	3.65**

TABLE -2 : Evaluation of ramie varieties for quality characters

Sl. No.	Variety (MT/Ha.)	Total gum (%)	Tenacity (gm./tex)	Fitness (tex)
1.	R-67-40	31.1	27.8	0.64
2.	R-67 -59	27.6	33.5	0.49
3.	R-67-20	27.8	32.2	0.51
4.	R-67-21	27.0	28.1	0.81
5.	R-67-30	29.1	27.4	0.77
6.	R-67-34	21.9	26.4	0.65
7.	R-67-35	27.1	26.1	0.53
8.	R-67-36	22.6	29.9	0.76
9.	R-67-38	24.1	30.1	0.65
10.	R-67 -43	24.9	27.2	0.76
11.	R-67 -44	24.5	33.4	0.47
12.	R-67 -45	25.1	27.5	0.54
13.	R-67 -46	24.8	32.5	0.48
14.	R-67 -51	24.9	27.6	0.64
15.	R-67 -52	27.7	32.1	0.56
16.	R-1411	26.7	27.4	0.85
17.	R-1412	25.2	26.3	0.71
18.	R-1452	24.8	32.0	0.71

RESEARCH WORK DONE AND FUTURE WORK NEEDED

Agriculture Research work on ramie has been carried out at the Ramie Research Station at Sorbhog (Assam) a sub centre of the Central Research Institute for Jute & Allied Fibers (I.C.A.R.), during the last more than. three decades. The studies have yielded good results in varietals improvement, cultivation methods, harvesting process and its schedule, control of insects and diseases, good decortication of fibre and the degumming of fibre etc.

The most important line of work which still needs attention is to explore more efficient and cheaper methods of degumming of fibre in the crop. The research on degumming may be initiated by even other scientists of the country and a more co-ordinate effort may be attempted to evolve a really suitable and economical process. This offers a real challenge to the organic chemists who can identify the exact constituents of the gum and find out the solvents which can easily dissolve it. The

microbiologists should also come forward to help in finding out why ramie fibre can not be retted the way Jute and Mesta fibre are retted in water. The microbiologists should also try to find out the particular microorganism which can remove vegetable matter and gum from ramie fibre under industrial conditions. In France, a pectinolytic, anaerobic bacterium *Clostridium carallium* has been invented which can ret ramie plants easily. At the Pasteur Institute in Paris, a ferment " Ferment Pectinolytic C 8" has also been developed for this purpose. In Japan, the species of *Bacillus Viz. B. subtiilis* var. pectinovores and *B. mesentericus* Var. *pectinovores* and in India *B. subtilis* and *Aspergillus niger* were found to have yielded good retting effects and produced fibre similar to the fibre obtained through chemical deguming (Kirby 1963).

A view of the Ramie Research Station, Sorbhog (Assam)

Low cost decorticators suitable for medium or small scale operations must be designed by our agricultural engineers. This is a line of work which must be taken up on priority basis like the work on degumming of fibre. Unless the more efficient, cheep and easily portable decorticators are developed it will be difficult to propagate ramie cultivatiop in India.

Research on the varietals improvement are also necessary. Varieties, suitable for different agro climatic regions of the country with good stability must be developed without any further delay. Selection of ramie varieties from exotic collections' like Mayasaki-ll 0, Mayasaki-1l2, Saikaiseshin, Marakami, Hakahi, Kagiban-5, Tochgi-16, Steel wire, Tatsutayama etc. are expected to yield good results. An elaborate ramie breeding programme should immediately be initiated.

a) While selecting varieties of ramie, the following criteria may be preferred. Adaptation to existing condition of the soil, rainfall and temperature.
b) Posses suitable characteristics for facilitating mechanical decortication like varieties with loose bark and softer stalks.
c) No branching tendency of canes.
d) Resistance to diseases and pests.
e) Varieties having least gum content (as far as possible).
f) Faster growth of the canes.
g) Desirable characteristics of fibre quality.

Besides above, the research on developing technology of growing ramie as a mixed crop with coconuts and areca nuts is also required for its proper development in this country.

FACTORS AFFECTING CULTIVATION

Kirby (1963) states that of the various statements which are sometimes made in the country, ramie is not that easy crop to grow. It is a fact that it grows in fairly wide range of conditions, but with slight unfavourable conditions, the yield of fibre goes down considerably and the cost of production goes high. Therefore, efforts must be made to get good yields of fibre even in the first and second years, which are particularly less productive than the crop of third years. Efforts should also be made to maintain constant high yields during all the years even in slight unfavourable climates.

Research laboratory of Ramie Research Station, Sorbhog (Assam)

INPUTS

Ramie is a relatively expensive and difficult crop to grow which occupies the land for a number of years. It needs not only well drained high lands with high organic content but also requires a large amount of skilled labourers. Weeding is considered to be an important cultural operation involving about 40% of the total cultivation cost (Sharma et al, 1981 A). Ramie is generally grown in sandy loam soils which require heavy fertilization to ensure high yields. Most of the workers agree that ramie is a soil depleting crop and that large quantity of fertilizers are also needed to maintain a high level of production over the years. As evident from the table-3, the up take of nutrients in ramie is also high specially calcium.

Table-3

Annual nutrient withdrawal by ramie/ha of 13.99 kg. of dry decorticated fibre.

Sl. No.	Elements	Uptake (kg./ha.)
1.	Nitrogen (N)	213.76
2.	Phosphorus (P20S)	59.37
3.	Potash (K20)	130.34
4.	Calcuim (CaO)	383.97
5.	Magnesium (MgO)	92.35

Availability of land and the capital are the two major problems in ramie cultivation in India. Initially, the crop requires a large expenditure including involvement of large number of labourers as mentioned above. In view of the high initial investment on ramie cultivation, individual farmers may not be enthusiastic in taking up ramie cultivation. The availability of sufficient land IS also a constraint. For commercial exploitation, ramie must be planted in a large area. Individual farmers may not have such a large area of land with them. Therefore, the State Govt. should come forward to undertake ramie plantation on a large scale in Govt. land. The surplus land of the tea estates in Assam and North Bengal may also suitably be utilised for ramie plantation. Small farmers may be encouraged to form co-operatives to grow ramie. Such arrangements may be made through the blocks. The Assam Riha Samabay Samity, may also be involved in ramie cultivation and marketing.

YIELD

Not much attention has been given to develop ramie varieties for specific areas. The availability of enough planting materials is yet another problem in expending ramie cultivation in this country.

DEGUMMING

Degumming is yet another important factor in the cultivation of ramie in India. Degumming is still treated as a trade secret by the mills that have perfected this art very well. A slight mistake in degumming can completely ruin the fibre. An easy method of degumming which can be used at the field village level needs to be developed.

MARKET

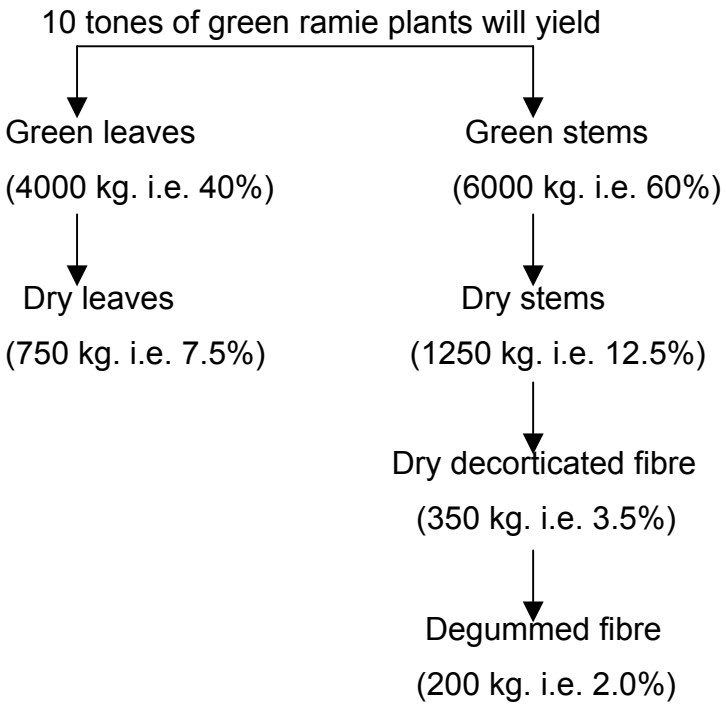
At present in India ramie has not been cultivated on a commercial scale. Hence the correct position of market is not available. The imposition of heavy excise duty of Rs.12/- per kg. on the fibre of ramie till now badly affected its commercial cultivation in the country. Besides there was also a 15% advalorem on its weaving against only 10 to 15 paise per kg. on spinning and 2 to 3% on weaving on the comparable cotton yarn. Unless this heavy exise duty and advalorem was drastically reduced or removed by the Govt. of India, this crop had doubtful prospects. However, the exise duty and advalorem have been reduced to some extent by the Govt. of India in its new textile policy.

In short, problems related to the ramie cultivation in India can be summarised as follows :

1) Lack of proper technical know how for cultivating ramie in India. Research developments and the proper management techniques should be made available to the farmers.
2) Non availability of sufficient number of cheap, efficient and easily portable decortication machines for the extraction of fibre.
3) Proper degumming of ramie fibre, non availability of cheap and easy method of degumming of fibre.
4) Lack of assured market for fibre. The formation of a central agency which can provide proper coordination between-the producers and consumers may help future expansion of its cultivation in India to a great extent.
5) Imposition of heavy excise duty on the fibre and advalorem on its weaving.

ECONOMICS OF CULTIVATION

Normally the variables such as yields, labour cost, the cost of inputs, capital requirements, expected cost and the prices of competitive cost are taken into account for analyzing the cost benefit ratios. As a plantation crop the cost of cultivation in ramie assumes a pattern in which the expenditure and gross income are progressive in character. As already mentioned, the crop does not give any produce in the year of planting, and it is the second year from which the gross income starts. It is thus apparent that the major cash flow problem occurs in the initial year of planting. However, ramie being a perennial crop produces fibre for at least five years in succession. The yields at various stages can be increased by following proper management practices. Hence for analysing the levels of production, care must be taken at different stages of its production. The approximate weight losses involved in the processing of fibre in ramie is given below:



The stem and leaves together contain nearly 80% moisture and thus 10 tones of green plants are equal to 2 tones of dry plants which in turn yield about 350 kg. of decorticated fibre. This will ultimately give 200 kg. of de gummed fibre.

GROSS INCOME

It has been observed under the Sorbhog conditions that an approximate gross profit of Rs.1,39,750/- per ha can easily be obtained from ramie. This can be calculated if the cost and expenditure incurred on different items is splitted. It is observed that the price of

degummed fibre in the today market is Rs.30/- per kg. and the price of rhizomes is Rs. 10.00/- per kg. on an average nearly 900 kg. of fibre and rhizomes are obtained per ha./year. At present the labour cost is Rs.48/- per day for eight working hours. The price of capital requirement such as land, fencing, cost of decorticators have been excluded from the cost of cultivation which has come to Rs.8000/- per ha/year (Table-4).

The different operations and inputs required for the cultivation of ramie are as follows:

Operations	Inputs
1. Land preparation (10%)	(1) Rhizome - 400 kg.
2. Liming (2%)	(2) Lime - 4000 kg.
3. Planting (5%)	(3) Urea or Ammonium or - 260 kg. Sulphate - 600 kg.
4. Staging & harvest (20%)	(4) Single - 625 kg. Superphosphate
5. Weeding (40%)	(5) Muriate - 100 kg. of potash
6. Fertilization (30%)	(6) Decorticator -2 nos.
7. Decortication, washing and drying of fibre (20%)	

LEVELS OF PRODUCTION

A decline in the gross income from fibre is, however, indicated from the third production year due to poor crop growth, advance in age of plantation and also overcrowding. This results in the appreciable increase in the cost of cultivation. The plantations give more economic return in the first and second production years. Though the plantation is normally extended upto six years there is actually decline in production from the third year. Replanting after 12 cutting, therefore, seems to be more advantageous. The replanting is, however, affected by two main factors (1) The life cycle of the crop and the soil condition and (2) The cost and profit involved in the replanting.

ECONOMIC EFFICIENCY

The cultivation of ramie will be more profitable if it is taken up on commercial scale like in Brazil and the Philippines. In such commercial plantation, there is a trade off between the level of capacity utilization and the control of production flow which utilizes managerial skill. This in turn of course necessitates considerable coordination and organisation. In case the plantation is proposed to be undertaken in

small family plots, then it is advisable to have some form of co-operative to make full advantage of various economics of scale on the processing side.

The processing of fibre through degumming is very important and complex problem. It is always not asvisable to undertake growing and degumming of ramie by the same agency. The degumming and. marketing aspects should be entrusted to some other agencies like established textile concern or Government marketing and "Industrial Organizations. Any programme to undertake both the production and degumming will require quite a heavy financial commitment which may not become ultimately profitable. In case the production of undegummed ramie and degumming of fibre are done separately by agencies, only then the technical and financial investment is more likely to be economically viable. The technical efficiency must be combined with the economic efficiency for economic viability.

PACKAGE OF PRACTICES

The package of practices followed for the ramie cultivation is given below:

(i) Soil - Soil should be sandy loam with sufficient organic matter, well drained, must not have the problem of water logging. Highlands are more suitable.

(ii) Climate - Warm and moist climate, temperature varying in between 24°C and 29°C, rainfall between 1500 to 2500 mm. free from strong winds and frost.

(iii) Topography - Flat or slope, altitude between 300 m. MSL can be tried as intercrop with coconut and areca nuts as done in the Philippines.

(iv) Land preparation - Repeated ploughing and cross ploughing and laddering till the land is free from weeds and stubbles. Addition of sufficient compost of F. Y. M @ 30 tonhes/ha.

(v) Planting Time - In rainy season from May to September or October under good soil moisture condition.

(vi) Varieties - R-l411, R-l4l2, R-l449, R-l452 & R-67-34 (Kanai).

(vii) Spacing - 30 to 45 cm. between the plants in a row and 60 cms. between the rows.

(viii) Rhizome rate – 300 to 400 kg.

(ix) Fertilizer

application - Application of lime 3 to 4 tonnes depending upon the pH of the soil at least one month before planting. Fertilizer dose of N30Pl5 and Kl5 kg/ha cutting.

(x) Interculture - Periodical weeding and mulching following plantation and after each cutting and staging depending upon the intensity of weeds and other problems in the field.

(xi) Harvest - Around 50days from first and fourth cuttings and around 45 days for second and third cuttings. Plants should be cut at ground level.

(xii) Extraction of fibre -

By decorticator, the decortication, washing and drying of fibre should be done on the same day. The decorticator may be operated either by oil engine or electric motor of 5 H. P. at 700 to 800 rpm.

(xiii) Plant protection -

Spraying of endosulfan or sumithion @ 0.04% against Caterpillar, leaf roller and leaf eating beetles and copper fungicide (Oxychloride) against Cercospora leaf spot disease.

DEVELOPMENT

Now-a-days the market is always in search of any new vegetable fibre which is strong and possesses some other extraordinary qualities. Ramie can certainly claim to have most of these characters. If the simplified technique of degumming is worked out without adversely affecting the quality and strength of fibre, many avenues will soon open for ramie. The argument for further research in this direction is strengthened more by the continuous rising cost of petroleum based synthetic fibres and other fibres like cotton etc. in the market.

Ramie can prove one of the most useful crops of our country and needs all the required attention from now itself. Its fine potentiality as a blend has given further scope of its utilisation in different forms. The Bongaigaon Refinery and Petrochemical Ltd. (BRPL) are expected to produce nearly 30,000 tonnes of synthetics per year from 1995 onward. It is expected that at least 30% of this synthetic may be made available for blending purpose. Hence sizeable area of nearly 14 to 15 thousand hectares under ramie must be planted at the first instance. Unfortunately ramie cultivation in India till now has been on a very limited scale in

some parts of Assam, North Bengal and Maharashtra only. The total area under ramie may not even exceed 500 acres in India, and the production may be only insignificant. It is assumed that nearly a total of 15,000 tonnes of blending material like cotton, viscose, endi, munga etc. may be required by 1998 for utilising the part of the synthetics produced by BRPL. The possibility of procurring such large quantity of cotton, endi, tesar or mung a is not bright.. The alternative substitute for cotton or viscose is only ramie. Hence a large scale cultivation of ramie is immediately required.

The importance of ramie fibre is increasing gradually in the various textile industries due to its good durability, high tenacity, good lustre and long staple length. Considering the edaphoclimatic requirement of ramie, the districts of Jalpaiguri, Coochbehar of West Bengal and the Kamrup, Barpeta, Goalpara, Darrang, Karbi-Anglong, Lakhimpur and Sibsagar districts of Assam may be regarded as possible places for ramie cultivation. Because of the perennial nature of the crop which involves regular maintenance and huge initial investment, small farmers under private sector may not like to go for commercial cultivation of ramie. It is therefore, suggested that surplus land in tea gardens and other Govt. land available in Assam, North Bengal and in the various districts of North Eastern Regions may be utilised for developing ramie in India.

Ramie plantation has another socio-economic aspect as well. In a country like India where there is an acute problem of employment, extension of ramie cultivation will generate employment opportunities to the rural poor since the crop is labour intensive. The full value of ramie plant becomes more evident when it is found that the leaves can also be used as a source of highly nutritive green food for cattle. The leaves are rich in protein, mineral and carotene and are also palatable. In this way ramie growers can derive extra benefit from the luxuriant foliage of this crop.

Till now no such study has been made to assess the actual requirement of ramie fibre in our country vis-a-vis its availability. Hence before taking up any development programme for raising this crop, demand enquiries with particular reference to the identification of the organization, existing or prospective, who will be making use of ramie fibre and the economic viability of the project in its overall perspective have to be made by Some agency and on the finding of the enquiry committee the strategies for development of ramie in India can be fixed accordingly to achieve the target or requirement in a phased manner.

Ramie also fits well within the concept of village industry where the ingenuity can be marred with the local resources. The Khadi and village Industries therefore, may be able to find out more outlets for the utilisation of ramie fibre in village textile industries and thereby help the Poor masses by producing at least a low cost durable fabric for them.

It is really unfortunate that despite good potentiality of growth, development and utilisation of ramie in our country, virtually no serious efforts have so far been made for the proper development of this one of the most useful crops of our country.

On 25th August, 1985 Govt. of India has further announced certain concessions in the excise duty and the advalorem on ramie fibre and its blends with other synthetics. Now the excise duty on the Polyester-ramie blended yarn has been brought down to Rs. 4/- per kg. only and the excise duty on ramie fabrics containing more than 30% of weight of polyester fibre has been reduced to 5% advalorem only. These concessions announced by the Govt. should infuse a new spirit among the cultivators in our country. Govt. of India has also recommended the use of more quantity of cheap fibre like ramie and directed that the entire requirement of controlled cloth should be met from this sector in future.

While planning to develop this crop III our country on a large scale, the following points should be taken into consideration -

1. The land under food crops should never be disturbed.
2. Surplus lands of Govt. agricultural farms, sericulture farms, reserve forests and the ceiling lands acquired from the Tea estates may be selected at Govt. level for foundation seed production as well as large scale commercial plantations.
3. As per suggestions given by the National Commission of Agriculture, ramie plantation by small farms on co-operative basis may be organised. This may be done through department of Agriculture Tribal Co-operative Marketing Development Federation (TRIFED) and the Department of Rural Development.
4. The Khadi and Village Industry may utilise the fibres through the small scale Industries in villages since it is understood that a large number of looms in villages are lying idle in Assam due to non-availability of raw materials.
5. Spinning and weaving aspects of ramie fibre should be developed by conducting trials on different spinning systems in different spinning mills and Handloom Research and Design centre.

6. The marketing of raw fibre as well as finished products should not pose any problem to growers. For this purpose. a central agency may be formed to provide proper co-ordination among the growers, customers and researches for the success of this crop as well as to open new vistas for ramie based agro-industries in our country.

PROPERTIES OF FIBRE

The textile value of ramie fibre is remarkable because of its silky, luster, unparallel strength, durability and its suitability as blend with all natural and man made fibres. Ramie has exceptionally long ultimate fibre cells which range from 120 to 150 mm. approximately. This is nearly six times more than cotton, ten times more than flax and eight times more than silk (Petruszka,1977). Ramie fibre is extremely white in colour and does not change colour with exposure to sunlight etc. It can absorb moisture and also give it up quickly with no shrinking and stressing effects on it. Ramie fibre also resists the action of chemicals better than other fibres and has high resistance to the effects of bacteria and fungus including mildew. It has, however, been observed that the undegummed fibre is sometimes affected by some organisms in warm and humid conditions. About its absorbency quality, Coss and Tayler (1948) also found that upon total immersion it can absorb water 100% within 10 mts. and 195% in 72 hours only. The fibre also takes the dye readily.

Research laboratory of Ramie Research Station, Sorbhog (Assam)

The specific gravity of fibre ranges from 1.50 to 1.55. The chemical constituents of ramie fibres have been analysed (Table-5). Some of the important physical and chemical properties of ramie have been compared with other fibers like Flax, Hemp, Cotton and Jute (Table-6). The comparative data of the range of some mechanical properties and densities of different natural and man made fibres have been presented in Table-5. It is evident from the data that the properties of ramie fibre after degumming makes it most attractive textile material even better than Cotton. One single ultimate fibre cell of ramie has a tensile strength of 17-20 gm, while the average of one ultimate fibre cell of cotton is 7 gm only. Single strand of fibre of ramie is finer and stronger as compared to other fibres. The specific weight, of ramie fibre clearly indicates that ramie, vscose and cotton are comparable to each other in their specific weights (Table - 10). The ultimate fibre cells of ramie are also more in length, breadth and L x B ratio as compared to other fibres like cotton etc. (Table - 11).

Studies made on gravimetric fineness of the filament of major textile fibres indicate that ramie is the finest fibre with a fineness of 0.4 - 0.8 tex., which is far better then cotton. This places ramie fibre much higher then any other fibre (Table 12), as far as quality is concerned.

The physical properties of the single strand of the major fibres have been studied in detail. The studies clearly indicate that ramie fibre possesses better tenacity, better extension at break, better Hayman's angle of oriculation, moisture regain and is superior in the transverse swelling in water and degree of crystallinity as compared to most of the other fibres including cotton. (Table - 13)

The tensile strength of single fibre strand of the major fibres has also been studied. Since the products will be required to be washed with soap and soda, the nature of the changes in fibre after each washing must be studied. The experiments conducted on this have clearly indicated that even after repeated washing the tensile strength of yarns of ramie is not affected much as compared to other fibres. Even after forty washings, the tensile strength remains 93% in case of ramie while it goes down to 82% in cotton, 81 % in spun rayon and 34% in flax. (Table - 14)

Various fibres can be ranked on the basis of important physical characters. Ramie fibre is ranked first in durability; tensile strength, length of fibre cells, finesses and colour. However, flax fibre scores better rank as far as the characters of cohesiveness, uniformity and pliability are concerned (Table -15).

Spinning from gummed fibre of ramie:

It has been found that there is also a' need of spinning of gumed fibre of ramie in many cases. For this purpose a special process has been developed on jute/flax machinery. With the help, of cationic surfactant chemicals and hydro mechanical process, the fibres of ramie are kneaded by the usual carding machines of jute fibre. Softening machines with angular rollers are needed for reducing the moisture percentage of 25-30 percent in ramie fibre. It has been found out that 50-60 tex grade of fine yarn can be obtained from gummed ramie fibre by using "revospinning" roller machines. The gummed ramie fibre do not have interlocked link nets. Since they are long and strong they are entangled in the roller machines, if used longitudinally. In order to overcome this difficulty in production, the fibres are cut into 30 cm pieces before using them in the machines. Spun in this fashion in jute system, the ramie yarn can be used for making shoe canvas and soles, sewing twine, coarser fabrics etc. Such items are usually produced from flax fibre.

Spinning from degummed ramie fibre:

The degummed ramie fibre when spun on jute system produces excellent and stronger yarn than cotton; since the ramie fibre is better preserved in the jute system. The performance of ramie fibre in wool system is mote better then jute systems. The process of combing makes the fibre more better.

It has been found out that the properties of jute-ramie blended yarn are much better than those of all jute yarns. By adding 40 percent ramie it is possible to get yarn of 55tex. Rigidity of this fine yarn is more. Ramie fibre under wet conditions possesses double the strength of jute fibre. It has also been observed that for producing fine and strong yarn, ramie fibres are better even than Viscose.

Pieces of 38 mm degummed ramie fibre can also be spun on cotton system. Since ramie fibre is slightly broader than cotton, it is, therefore, not possible to get fine yarn as that of cotton (30 counts). However, ramie polyester blend in the cotton system produces better yarn than polyester-cotton blends. A blend of 30:70 (ramie: polyester) increases rigidity in the wet condition. It has also been found out that 100 mm ramie fibre blended with wool and polyester can be spun in wool system. Similarly ramie fibres alone or ramie-tasar or ramie-munga blend can be spun on silk system. However, the moister content of ramie fibre should properly be controlled.

METHODS TO IMPROVE FIBRE QUALITY

The fibre quality in this crop is closely related to the textile industry. Generally the fibre quality is considered as the most important of its utilisation.

The fibre quality in ramie is affected by the following factors -

1. Degree of fibre maturity: If the fibre is immature the process of degumming becomes difficult. The carding also becomes difficult in case of still strips.
2. Decortication: Crude decortication leads to impurities. The proportion of chemicals needed for degumming also increases.
3. Outer bark of plants: The outer bark sticks to the fibre even after degumming. This affects bleaching.
4. Spots: The disease spots on the stem and spots caused by wind decrease the textile strength.
5. Rusted foot in raw fibre: Rusted foot in raw fibre makes drying difficult.
6. Water content: Higher water content in the fibre make the fibre mildewed.
7. Fibre count: Fibre count is the most important component which determines the quality. If the fibre count is low, it would be difficult to make quality grade products. For example, to spin 36 counts pure ramie yarn, the fibre count of the raw material should be about 1500-1600 and to spin 48-72 count pure ramie yarn, the fibre count. should be around 1800.

Since the fibre count is the most important factor of the quality, efforts are needed to improve it. The following measures are suggested:

1. Asexual propagation should be strictly followed in order to maintain the original genetic purity.
2. Localization of varieties should be followed. Location specific varieties should be developed. This will help in stabilising the varieties and also give proper and identical counts from that area.
3. Use of fertilizers also is to be properly monitored. The use of organic fertilizers should be encouraged. The inorganic fertilizer adversely affect the quality of fibre in ramie. The fibres in such cases become thicker.

INTERNATIONAL SITUATION

The annual fibre production of ramie in the world is around 120 thousand tones. China is the biggest producer followed by Brazil and the Philippines. The fibre of ramie is utilised in the international market in the form of decorticated and degummed fibre for use in yarns and fibrics. Brazil meets 60% of the world supplies, while Japan imports 90% of ramie produced in the Philippines. Japan has a major share of marketing ramie in the world. The price of ramie in the international market is showing an increasing trend due to its popularity and shortage in supply.

Table – 4 : Economics of Ramie of Cultivations (One Ha. Area)

Sl. No.	Particulars	1st Year (2 crop)	2nd crop (2 crops)	3rd year (4 crops)	4th year (4 crop)	5th year (4 crop)	Progressive Total
1.	Yield of Fibre	600 Kg.	1200 Kg.	1200 Kg.	1000 Kg.	500 Kg.	4500 Kg.
2.	Yield of Rhizomes	375 Kg.	750 Kg.	750 Kg.	750 Kg.	2250 Kg.	4875 Kg.
3.	Price of fibre of @ 30/- per kg.	18,000	36,000	36,000	30,000	15,000	1,35,000
4.	Price of rhizomes @ 10/- per kg.	3,750	7,500	7,500	7,500	22,500	48,750
5.	Price of fibre + rhizome (item No. 3 + 4)	21,750	43,500	43,500	37,500	37,500	1,83,750
6.	Cost of cultivation with Non-Recurring expenditure excluding the cost of decortication machine.	8,000	8,000	10,000	10,000	8,000	44,000
7.	Gross	13,750	35,750	33,500	27,500	29,500	1,39,750

Note : From hectare of ramie plantation at the end of 5th year with 16 crops, the gross income is Rs. 1,39,750/-. Therefore, the gross income per year will be Rs. 22,500/- per ha excluding the cost of decorticator or the decorticating charges.

TABLE – 5 : CHARACTERISTICS OF RAMIE FIBRE

(A) **Physical properties:**

(i) Ultimate fibre cell length	120-150 mm.
(ii) Ultimate fibre diameter	40 to 60 kg.
(iii) Tensile strength	95 kg/mm2
(iv) Moisture regain	12%

(B) Chemical properties:

(i) Ash content	1.5%
(ii) Fat and wax content	0.32%
(iii) Pentosan	4.03%
(iv) Lignin	0.54%
(v) Acetyl	0.63%
(vi) Uronic anhydride	5.39%
(vii) Halo cellulose	95.5%
(viii) Alpha cellulose	86.5%
(ix) Gum content	21.6%

(C) Mechanical properties:

(i) Tenacity	4.5 to 8.8 g/den
(ii) Strength	100 to 110%
(iii)Breaking extension-dry	3 to 7%
(iv)Breaking extension-wet	1.5 to 5%
(v) Density	1.51 to 1.55 g/c.c.

Table – 6 : Physical and Chemical Characteristics of Ramie and other vegetable Fibres

Sl. No.	Characteristics	Ramie	Flax	Hemp	Cotton	Jute
1.	Ultimate fibre length (mm)	20-250	13-14	15-25	30-60	0.75-6.0
2.	Ultimate fibre diameter (mm)	40-60	17-20	15-30	14-16	5.0-2.5
3.	Tensile strength (kg/mm2)	95	78	83	45	3.0-6.0
4.	Moisture regaining capacity (%)	12	12	12	8	-
5.	Cellulose (%)	72-79	64-86	67-78	88-96	64.4
6.	Lignin (%)	1.0	5.1	6.4	-	11.8
7.	Hemicellulose (%)	27-30	31-14	27-18	12-4	25-4

Table – 7 : Mechanical Properties and Densities of various man made and vegetable fibres

Sl. No.	Fibre	Tenacity g/tax	Strength wet as % of dry	Breaking Wet	Extension (%) Dry	Density g/cc
1.	Cotton	1.7-6.3	75-79	3.0-12.0	6.0-13.0	1.52-1.56
2.	Ramie	4.5-8.8	100-110	1.5-5.0	3.0-7.0	1.51-1.55
3.	Flax	2.6-8.0	100-110	1.5-5.0	3.0-7.0	1.48-1.50
4.	Hemp	3.0-7.0	100-105	1.5-5.0	-	1.48-1.49
5.	Jute	2.0-6.3	90-105	1.0-2.0	2.0-3.0	1.44-1.49
6.	Nylon	4.0-6.0	85-90	10.0-55.0	12.0-60.0	1.12-1.15
7.	Terelene	4.5-6.0	100.0	2.5-15.0	12.0-60.0	1.38-1.48
8.	Decron	4.0-5.0	95-100	18.0-30.0	18.0-30.0	1.00-1.38
9.	Orlon	4.0-5.3	90-100	15.0-20.0	15.0-20.0	1.12-1.19
10.	Rayon	0.8-1.8	50-80	16.0-17.0	25.0-70.01	1.30-1.33

QUALITY AND SPINNING

(A) Quality:

The properties which mainly govern the quality or spinning the fibre are fineness, length, strength, extensibility, rigidity and the surface structure. Experimental results have indicated that the fibre for spinning the quality yarn should have the lowest possible cross sectional' area, intrinsic strength, higher modulus of elasticity and moderate inerfibrillar frictions. Some of the important varieties of ramie have been evaluated for quality at undegummed and degummed stages (Table-8 and 9). The data indicates their higher standard of quality.

TABLE – 8 : QUALITY EVALUATION OF UNDEGUMMED FIBRE OF FIVE IMPORTANT VARIETIES OF RAMIE

Variety	Gum %	Tenacity gltax.	Fineness (Tax)
1. R-1411	22.0	29.6	0.77
2. R-1412	23.2	31.2	0.66
3. R-1449	25.5	28.6	0.71
4. R-1452	24.8	*28.T*	0.63
5. R-6734	20.0	28.0	0.66

TABLE – 9 : QUALITY EVALUATION OF DEGUMMED FIBRE OF FIVE IMPORTANT VARIETIES OF RAMIE

Sl. No.	Variety	Av. Fineness in denier	Breaking strength	Breaking length in c.m.	Resistance length g/den	Degumming kg/m. loss (%)
1.	R-141	6.75	7.45	67.05	101.24	23.80
2.	R-1412	6.70	7.01	63.10	95.28	26.20
3.	R-1449	7.91	7.10	63.90	96.48	24.30
4.	R-1452	5.60	8.81	79.17	119.54	29.30
5.	R-67-34	4.50	8.20	74.12	112.58	26.80

(B) Spinning :

Methods of spinning of ramie fibre differe

Table-10 : Specific weight or True density (gm/cc) of different fibres.

Fibres	Specific wt.
Wool	1.28 – 1.33
Acetate silk	1.30-1.33
Silk	1.35
Jute	1.45
Roselle	1.45
Kenaf	1.47
Flax (Linen)	1.50
Ramie	1.51-1.54
Viscose	1.52-1.56
Cotton	1.50-2.56
Sunnhemp	1.53
Flax	1.55
Sisal	1.45

Table -11 : Ultimate fibre cells of different fibres

Fibres	Length (mm)	Breadth x 10 mm	Ratio (LxB)
Flax	26-65	10-35	1700 : 1
Tossa jute	0.8-6.0	5-25	110 : 1
White jute	0.8 – 6.0	5-25	110 : 1
Roselle	1.5-3.5	10-31	110 : 1
Kenaf	2-11	13-34	140 : 1
Sunnhemp	5-20	12-35	450 : 1
Ramie	20-25	15-80	3500 : 1
Cotton	15-16	15-20	1300 : 1
Sisal	0.5-0.6	5-40	150 : 1

Table -12 : Gravimetric fitness (filaments) of the fibres of important fibre crops

Fibres	Length (mm)
Flax (linin)	2.5 – 6.0
Jute (olit)	2.0 – 5.0
Jute (caps)	1.25 – 4.0
Roselle	2.8 – 5.5
Kenaf	3.5 – 5.5
Sunnhemp	5.5 – 17.0
Ramie	0.4 – 0.8
Cotton	0.10 – 0.30
Sisal	16-35

Table -13 : Physical properties of the fibres of different fibre crops

Fibre	Tenacity (g/den)		Herman's angle of orientation (X-ray in degrees)	Moisture regain (100%)	Transverse swelling in water %	Degree crystallinity (X-ray qualitative)
	Filament	Bundle				
Flax	45-55	30-36	6-7	22.0	20-24	Very high
Jute (T)	35-50	16-35	7-9	36.0	20-24	High
Jute (W)	30-45	13-30	7-9	36.0	20-22	High
Roselle	25-40	120-30	8-10	35.5	20-22	High
Kenaf	30-45	16-30	9-12	38.0	20-22	High
Sunnhemp	12-35	15-35	9-10	28.5	18-20	High
Ramie	40-65	18-40	7-8	17.5	12-15	Very High
Sisal	40-45	22-36	-	35.0	18-22	-
Cotton	20-45	-	33-44	24.0	20-22	-

Table -14 : Tensile strength of yarns (after washing by 5% of soap and 5% soda) of major Textile fibres

Washing Stages	Cotton	Spun rayon	Ramie & spun rayon (50%x50%)	Ramie	Flax (Linen)
At the beginning	100%	100%	100%	100%	100%
After 5 washings	95%	98%	98%	95%	90%
After 10 washings	95%	95%	96%	95%	70%
After 15 washings	93%	93%	94%	95%	62%
After 20 washings	92%	90%	91%	94%	53%
After 30 washings	85%	81%	87%	94%	36%
After 35 washings	84%	81%	86%	93%	37%
After 40 washings	82%	81%	84%	93%	37%

Table -15 : Rankings of various textile fibres on the basis of important physical characters

Characters	Ranks			
	Ist	IInd	IIIrd	IVth
Durability	Ramie	Flax	Hemp	Jute
Tensile strength	Ramie	Hemp	Flax	Jute
Length of fibre cells	Ramie	Flax	Hemp	Jute
Cohesiveness	Flax	Hemp	Jute	Ramie
Fitness	Ramie	Flax	Hemp	Jute
Uniformity	Flax	Ramie	Hemp	Jute
Pliability	Flax	Ramie	Jute	Hemp
Colour	Ramie	Flax	Hemp	Jute

USES OF FIBRE

The various useful properties of ramie fibre enable it to be used in many diverse ways (Greenhalgh, 1978). Practically all the end products which are manufactured from cotton, hemp, flax or silk can also be made from ramie and its specific properties make it particularly, .more acceptable in humid conditions (Petruszka, 1977). The most important use of ramie fibre is in clothing fabrics where it is used either alone or in blends with other fibres. Some of the products made of this fibre are superior in quality than others. Ramie is increasingly being used as a blend with synthetic fibres. Since this not only reduces cost but also helps to counter balance the lack of absorption of the synthetic fibres which in turn help in reducing ramie's poor grease resistance and thereby widens its range of utilization. The easy fabrics made of blends of ramie and synthetics are considered ideal for clothing in tropical climates (Baily, 1949; Kirby,1963).

The Government of India has also announced that efforts should be made to produce more cheap cloths with the help of cheap fibres like ramie in its new textile policy. Government of India does not favour the policy of using more and more cotton with polyesters.

The ramie fibre shows resistance to bacterial action and when wet the strength also increases considerably. This property also makes it more suitable *for* the manufacture of curtains and toweling materials, twines, threads, pullybelts, ropes and cordages, fishing nets., fire hoses, water carrying bags, ammunition belts, camouflage nets, cartidge cloths, industrial packings, canvas upholstery fabrics, furnishing materials etc. It is also used *for* the manufacture of shoes, shoe sewing threads, cigarette papers and even the papers for currency notes.

In brief the uses of ramie can be summarised as follows:

i. Manufacture of the shirting and suiting materials, table cloths, bed sheets and bed covers and curtain cloths.
ii. Manufacture of the products which require high strength like twines, threads, pullybelts, ropes and cordages and fishing nets.
iii. Manufacture of fibre hoses, water carrying bags & other impermeable fabrics.
iv. Manufacture of shoe sewing threads which are much superior in strength then any other thread.
v. Manufacture of several defence articles like amunition belts, camouflage nets, cartidge cloth, parachute chords etc.
vi. Manufacture of gas mentles, roving for electric batteries.

vii. For industrial packings, canvas, upholstery fabrics, paper pulp, sails of ships etc.

viii. Manufacture of special papers like cigarette paper and the papers for currency notes.

Ramie can easily be blended with almost all the fibres like cotton, flax, silk, wool, munga, endi and polyester fibres successfully. This widens its range of utilisation in the textile industries to a great extent. For example, ramie can be blended in various proportions like 30:70, 33:67, 35:65 and 40:60, with polyesters. The fibre of ramie can also blend nicely with wool and a 50:50 mixture with wool is reported to be stronger than even the carpets. The experiments conducted at the Handloom Research and Design Centre, Guwahati (Assam) also indicate that ramie can be efficiently blended with munga and endi.

Various products of ramie fibre

Utilisation of ramie, cotton and wool after blending

Because of uniform characteristics of ramie for certain properties, the fibre of ramie can be blended with cotton as well as with wool for fineness diversification. Some of the suggested uses may be in.

(1) New fashion dimensions

(2) New fabric development

(3) New garment advantages

(4) New styling advantages

(5) New trade marks

FUTURE PROSPECTS

As an under exploited fibre crop ramie has got promising economic value in North East India especially in Assam. There lies a good prospect for this potential crop in the region because of the suitable agro climatic conditions prevailing in this area.

Ramie fits well with the concept of village industry where the ingenuity can be marred to local resources. The Khadi and Village Industry Board can make a beginning here. The producer must find an outlet for ramie production in his domestic textile industry and thereby help the poor masses by producing a low cost durable fabric.

Polyester is generally blended with cotton and viscose fibres. Both cotton and vicose fibres are not available in the region of North East India. Instead the region can substitute ramie for cotton or viscose if large scale plantation of the crop is undertaken. Extension of ramie cultivation can also reduce the country's dependence on imported long staple fibres and there is a good possibility of ramie to take the place of the substitute for flax which is presently imported.

The National Commission of Agriculture has also recommended the expansion of ramie cultivation in the states of Assam and other neighbouring states in North East Region. Ramie cultivation in these regions will always be paying so long the textile industries maintain the demand (Ghosh and Ghosh 1971). Terelyne-Ramie and Polyester-Ramie garments may become universal choice, once its superiority over cotton or polyester cotton fabrics is demonstrated. Recently a programme for the production of 'low priced fabric has been formulated by the Department of Textiles, Government of India. On 28th August, 1985, Govt. of India has also announced substantial duty reliefs for polyester fibre, polyester-cotton blended yarn and pollster-viscose blended yarn for increasing the consumption of blended fabrics in its new textile policy. The government is now deliberately encouraging the use of man made fibre to reduce the dependence of the textile industry on cotton, the supply of which was generally fluctuating according to weather and several other factors. Government is thinking to even export cotton or its yarn if it is’ found surplus. This leaves a good scope for developing ramie more rapidly in our country and now every effort should be made to bring this crop in the fore front.

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