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Ramie Fiber Production¹

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INTRODUCTION

Ramie is the name used to designate a stingless nettle plant and also the textile bast fiber obtained from the plant. This fiber plant has attracted an unusual amount of attention and financial exploitation. The interest in ramie has resulted because of the beautiful luster possessed by the fiber and its reported durability and great strength. It probably ranks first among all vegetable fibers in respect to strength.² The interest in this fiber was initiated when prizes were offered in India for improvements in methods of processing and has been great during the past 70 years. However, ramie is utilized little more today than it was 50 years ago.

What obstacles prevent this fiber from being more extensively used, and why is it still a relatively unimportant or minor fiber? An effort will be made in this circular, while discussing some of the agricultural problems connected with the successful growing of the crop, to point out some of the obstacles that have impeded the production of this fiber and that must be overcome if, under present economic conditions and competition from other plant fibers, a ramie industry is to be established in this country. A number of problems should be carefully considered by investors before the expenditure of capital.

The purpose of this circular is to answer numerous general inquiries for information about ramie. The discussion on the agricultural

¹ This circular is a revision of, and supersedes, Miscellaneous Circular No. 110, Ramie, A Fiber-Yielding Plant, by Lyster H. Dewey.

² MATTHEWS, J. MERRITT. TEXTILE FIBERS. Ed. 4, 1053 pp., illus. New York and London. 1924.

problems involved in producing the crop is not intended to advocate its commercial culture but is intended to serve as information for persons interested in experimental plantings and those who may be considering the possibilities of establishing this crop in the United States.

HISTORY AND BOTANY

Ramie was one of the principal plant fibers used in the Orient for making cloth before the introduction of cotton, which took place in China about 1300 A. D. Since then cotton has replaced ramie to a large extent. Although ramie seems to have been known in the Orient during earliest recorded times, it apparently was not known in Europe, Africa, or America until much later. No authentic records have been found of the occurrence or utilization of this fiber in ancient Egypt, although statements mention its use by the early Egyptians, but these were apparently made as the result of confusing ramie with flax. It was first described by Linnaeus, an eminent European botanist, in 1737 from specimens obtained from China, but apparently it was not known as a fiber plant west of central Asia until a century later.

Boehmeria nivea (L.) Gaud. is the botanical name of the plant known as ramie. Several closely related species produce fiber, but they are not so extensively utilized as *B. nivea*. It belongs to the nettle family but does not have the stinging hairs common among nettles. However, the shrublike stem and leaves are covered with inconspicuous hairs. The plant grows from perennial roots that produce stems or canes, as they are more commonly called. The canes may reach 8 feet in height and have little or no branching. They are small in diameter, usually less than one-half of an inch, and bear round to heart-shaped leaves that are dark green on the upper and white on the under surface. If the green stems are not cut and are allowed to mature, they usually turn brown and produce at the top clusters of male and female flowers, the latter developing very small seeds.

If the canes are cut during the growing season to obtain the fiber, a new crop of canes begins to grow, and under favorable conditions three or four crops may be obtained in a season, as the growth may be very rapid.

The name "rhea" is used in India in place of ramie and also was used formerly to designate the fiber produced in India. Although the name ramie is used in several languages to designate the common fiber plant, the crude fiber, which is obtained in China, is known in commerce as China grass. This crude fiber is prepared by hand-cleaning in China and has adhering gums. It is in strands from 3 to 5 feet long, greenish to yellow in color, and rather stiff because of the gum present on the fiber. These gums must be removed in manufacturing to obtain the beautiful lustrous fiber that has the appearance of silk.

WHERE CULTIVATED

China grass has been exported from China and Japan for many years, and these countries were the only source of supply until about 1938 when a small supply of fiber from acreage set out in the Philip-

pine Islands was available for export. Although ramie is very widely distributed in China, it is grown only in small patches and not as a field crop. The most productive areas are provinces along the Yangtze River, and Hankow and Kiukiang are the most important exporting centers, although much of the fiber from the interior must pass through the coastal ports Shanghai, Tientsin, or Canton. In Japan it is grown only to a limited extent.

Early attempts to cultivate ramie in Russia were unsuccessful. A report³ of recent attempts shows that out of 4,500 hectares (11,119 acres) of ramie started in 1929, only 1,633 hectares (4,035 acres) remained in 1939, mostly in western Georgia, Union of Soviet Socialist Republics. This represents plantings on 150 collective farms and a small area on noncollective farms. It has been tried experimentally in southern Europe, particularly in France, and more recently in Italy. It was cultivated in France between 1888 and 1894 to supply material for ramie cleaning-machine trials conducted by the French Government. However none of the machines were regarded as satisfactory at that time.

In Africa ramie has been widely grown experimentally. However, the only experiments of any size are believed to be one of 36 acres reported in Tanganyika Territory⁴ in 1937 and one of about 40 hectares (99 acres) reported in Libya⁵ in 1939.

In India, ramie grows wild in some regions. Attempts to cultivate the crop have not proved long lasting. The British Indian Government offered, as early as 1869, a prize of £5,000 for a machine to decorticate ramie. Trials were held in 1872 and in 1879, but the results were failures and the prize offer was later withdrawn. In recent years there has been no ramie fiber exported from India, and apparently there are only small areas cultivated in Bengal and Assam for domestic use by the natives.

About 1855, ramie was first introduced into the United States, and shortly thereafter it found its way into a number of Central American countries. A number of attempts have been made to start a ramie industry in the United States, Central America, and South America. Although the plant grows well in many sections of the Western Hemisphere, no industry has developed, probably because the machine preparation did not prove successful.

In the United States experiments have been conducted along the South Atlantic coast, the Gulf of Mexico coast, and in California by individuals, by State agricultural experiment stations (fig. 1), and by the United States Department of Agriculture. These experiments have proved the adaptability of the crop to certain regions and also have shown the soil relations necessary for successful culture. The most extensive plantings have been made by companies interested in testing new machines and methods of preparation. Many of the southern State experiment stations have maintained small plots of ramie for many years for observational purposes and as a source of propagating stock for people interested in testing the plant on a larger scale.

³ ZAITSEV, V. I. [NEW PLANTS AT THE ALL-UNION EXHIBITION (SOVIET RAMIE).] *Soviet Subtropics* 9: 21-24. 1939. [In Russian. English summary, pp. 62-63.]

⁴ EYRE, J. C. NOTES ON TRIALS OF RAMIE IN TANGANYIKA TERRITORY. *East African Agr. Jour.* 3: 176-179. 1937.

⁵ SCAVONE, GIUSEPPE. POSSIBILITÀ E CONVENIENZA DELLA COLTIVAZIONE DELLA RAMIA. *Ital. Agr.* 76: [327]-336, illus. 1939.

ADAPTATION

Ramie has been called a semitropical plant. Although it has been grown experimentally in the Tropics, its greatest commercial development has been in the semitropical regions. It has been reported that it grows better where the winters are cool enough to induce a resting period. However, severe freezing and repeated freezing and thawing are likely to kill the roots, especially if the frost reaches several inches in the ground. Plants seem to stand the winters at Washington, D. C., with some mulching, but mulching on a field scale might be expensive. Recent experiments in Italy have indicated that a Japanese variety of ramie shows surprising resistance to cold.

FIGURE 1.—An experimental planting of ramie being harvested by hand-cutting at one of the State agricultural experiment stations.

This may account in part for reports that ramie is grown in nearly every province of China to some extent, indicating there must be strains that are resistant to the cold conditions of northern China. However, there are no records to show that the plant will grow under cold conditions as well as it does in the so-called semitropics.

Regions where frost will not reach the roots and those having an annual well-distributed rainfall of at least 40 inches are the only ones recommended for this crop by some writers.

In the United States repeated experiments have indicated that the Southern States having high rainfalls are adapted for growing ramie. Although an abundance of moisture is necessary for heavy yields of ramie, moisture at harvesttime may cause a problem. Ramie produces a leafy top with a high moisture content, and it

must be removed quickly from the fields when cut, to allow the new growth to develop. The harvested ramie must be prepared quickly by one means or another or molding will occur with injury to the quality of the fiber. This problem of molding offers difficulties in regions of high humidity and rainfall. This factor has not given a great deal of trouble in the Orient, as there all China grass is prepared green shortly after harvest. However, it might be a serious problem in the United States if the crop should be grown on a large scale.

Ramie, after becoming well established, will withstand drought, but, as stated above, it must have an abundance of moisture for best yields. It apparently requires more moisture than cotton, corn, or

FIGURE 2.—Harvesting an experimental field of ramie. This ramie was allowed to dry a few days before being tied into bundles and removed from the field. Notice the abundance of leaves on the upper part of the stems. These induce molding under warm, humid, climatic conditions.

many other common field crops of the Cotton Belt. It has been grown with success experimentally under irrigation in California (fig. 2).

SOILS AND FERTILIZERS

A vegetative growth of stalks is required in ramie and not a production of seed. Hence, soils are required that will produce vegetative growth. The rich alluvial river bottoms that allow drainage are adapted to the crop. Although the light sandy soils of the Coastal Plain area of the South have given variable results, there have been frequent failures, possibly because of drought conditions affecting the plant, as well as the lack of fertility. Excellent results have been obtained with ramie on the Florida Everglades soils.

The removal of heavy yields of vegetative matter makes ramie a very serious soil-nutrient-depleting crop. Unless fertility is maintained in some way, poor yields are evident the second year or very soon thereafter. After the fiber has been prepared, the waste should be returned to the field. This would eliminate some of the expense of applying commercial fertilizer. It is difficult to recommend any general fertilizer formulas that would apply to all fields. However, it is essential to maintain in the soil an adequate supply of the three important elements common in most fertilizers, namely, nitrogen, phosphorus, and potassium. The soil nitrogen supply may be depleted quickly by ramie on sandy soils. Potash has given very beneficial results upon peat soils of the Everglades. In Japan heavy applications of compost and night soil have been used, and in China manure. In the United States commercial fertilizers should be used to maintain the fertility.

CULTURE

Ramie is usually propagated by pieces of rootstocks commonly called roots. The pieces of roots about 6 inches long serve the purpose well but involve more labor and expense in setting out a field than in planting a field of corn. The roots are usually planted in a slanting or upright position with the upper end 1 or 2 inches below the surface. Under favorable conditions of moisture and temperature the roots send up shoots in 2 weeks' time. The roots are most often set out in rows 3 to 6 feet apart and spaced 18 to 24 inches apart in the row.

Ramie seed may be used in planting but has some disadvantages for field planting. Ramie seed is not apt to breed true, and the resulting plants from seed represent many different types, which may not give the uniformity to the field of growth or time of harvesting that can be obtained by using one strain of rootstock. Further, the seed is difficult to obtain and may be expensive. The seeds are extremely small, and there are likely to be several million of them to a pound, although the number may be much smaller because of the presence of immature seeds and trashy flower parts. The very small seeds require special attention when planted in the seedbed so that they will not be placed too deep, so that the soil will not become dry on the surface where the seeds are sprinkled, and so that the damping-off disease will not become established in the seedbed. This disease develops under the warm, damp conditions favorable for the ramie seed growth. In addition to these difficulties encountered in the seedbed, the small seedlings when transplanted may die in warm, dry weather. All of these difficulties with the seed can be overcome, however, with proper conditions and care. The field planted with seedlings will not be productive the first year, whereas the field planted with roots may give one or more cuttings the first year.

In China and Japan the plants are cultivated by hand. In the United States the culture in experimental plots has been with common cultivators the first few years to keep down the weeds. Old plantings of ramie should be cultivated to break up the root-bound soil, promote soil aeration, and improve the physical and chemical soil structure, all of which are necessary for best results.

TIME AND METHODS OF HARVESTING

Although the first crop of ramie is usually obtained the second summer after the field has been established, there are records where as many as four crops have been taken during the summer following a fall planting in the Southern States. Under favorable conditions ramie may be expected to yield from two to four crops each year for a period of 10 years or longer. The productive period and yields will depend upon the original fertility of the land and the care taken to maintain the fertility by addition of fertilizers.

Harvesting should begin when the growth of the stems has stopped, which usually will coincide with formation of staminate

FIGURE 3.—Bundles of ramie stems before leaves have been stripped.

inflorescence. This stage of development often is a better index to follow than the turning brown of the lower half of the stems, which may be delayed. The timely cutting of the first and second crops may make it possible to harvest three or more crops each year.

In China all ramie crops are harvested by hand. This may be done by cutting; or the bark, which includes the fiber, may be peeled off the standing stalks in ribbonlike strips. Before cutting or peeling, the leaves should be stripped from the stalks. This is accomplished by hand in China where the plots are small, but this procedure would not be practical in handling large tonnages if ramie were grown on an extensive scale in this country (fig. 3).

It is difficult to understand how a ramie industry could exist in this country if ramie had to be cut and peeled by hand. A number of years ago a self-rake reaper was used experimentally in California in harvesting ramie. The machinery that has been developed for cutting and binding hemp in this country would probably be the best to use experimentally in handling ramie. In the Orient the ramie peelings are worked while green and moist when preparing the China grass. No successful method has been developed to process this material in the United States. It has been suggested that ramie be shocked and dried in the field or artificially dried before preparation. Shocking may be successful in some regions of the United States, but the crop is

FIGURE 4.—Ramie. First crop in background, growth (6½ feet) from April to July 23, at Washington, D. C.; second crop in foreground, 16 inches high, 10 days after the first crop was cut over. This growth was under ideal conditions on a moist, rich, sandy loam soil.

one that is very apt to heat and mold, so that natural drying encounters difficulties, and artificial drying involves expense that can hardly be justified. Ramie mowed and allowed to lie on the ground has dried well during periods of low humidity and sunshine.

After cutting, the ramie must be removed from the field as quickly as possible, because the succeeding new growth develops surprisingly fast (fig. 4). A new growth of 30 inches may follow a cutting within 2 weeks. Although this may not be common, it does serve to emphasize the necessity of removing the cut ramie quickly, so as to allow the new growth to develop.

FIBER PREPARATION

The Chinese farmer prepares his own ramie for sale as China grass. In the Orient this work is considered as part of the farming operation. There are probably many variations in the methods used by the Chinese in decorticating ramie. This consists of the separation of the fiber from the stalk and cleaning, so that the final product has had the outer skin of the stalks peeled or stripped off and the adhering plant tissue, which contains the fiber, scraped from these peelings. The tissues removed from the fiber consist of the brownish outer bark, the adhering cortical tissue, and much gum. The Chinese method is best accomplished when the material is fresh, and the peeled ribbons are kept in water until scraped. Crude implements of bone or sharp bamboo are used for scraping. After cleaning, the fiber is dried, but as might be surmised, it contains impurities present chiefly in the form of gums, which harden and make the fiber stiff and bind the ultimate fiber cells closely together in strands.

In the United States when the establishment of ramie as an agricultural crop has been considered, it has been realized that the Chinese hand-labor preparation involves a step in which American labor would not be able to compete on a cost basis. If the industry is to be successful here, a method must be developed to accomplish the decortication more economically.

For many years attempts have been made to perfect a machine that would take the place of hand decortication of ramie. Some machines have been invented to prepare the dry stems and some primarily to work the green stems, as it is the green stems that are prepared by the Chinese. Each method has certain advantages and disadvantages. Although a number of machines have been built, few, if any, have combined production and quality, and therefore, machines have not been adopted in commercial production. Although machines have been advocated for use in countries other than the Orient, most such countries have no commercial production of ramie and frequently little market for the prepared fiber. As far as is known, the only machine-prepared China grass is produced in the Philippine Islands. A small quantity has been produced there since about 1935. New uses must be developed and the fiber must be prepared cheaper than the Chinese article so that it can compete with other fibers before its culture is more widely advocated.

YIELDS

The yield of ramie stalks and the percentage of fiber may vary widely. There exist many misleading statements about yields, as they are frequently calculated from green material about which dry weights are unknown. Reports from China are variable, and average annual acre yields range from 400 to 700 pounds of prepared China grass.

At harvest under favorable conditions the plants contain a very high percentage of moisture, frequently above 70 percent. In addition, the leaves, which contain no fiber, may represent up to 50 percent of the harvested ramie by weight. If ramie is prepared for fiber by

the methods of the Orient, only the medium to long stalks are handled well, and as the plants may contain a number of short stalks at harvest, there is some waste in preparing long fiber, although the short stems might serve to make a short towlike fiber. The air-dry stems free of all leaves contain approximately 20 to 25 percent of crude China grass. This crude fiber must be degummed for spinning, and such fiber, free of wood but containing gums, will lose about 35 percent of its weight in degumming.

In experiments in the United States, ramie has yielded from less than 1 ton to a reported 45 tons of green stalks and leaves per acre in 1 year. The high yield represents ramie under very favorable conditions that allowed four cuttings, whereas the low yields were from ramie grown on sandy, infertile soils yielding only one cutting.

Ramie yields may increase under proper cultural conditions during the first 2 or 3 years until the roots have spread between adjacent plants. The field then may continue to be productive with fertilizer applications for 10 years or longer.

Based upon a number of reported yields the following percentages have been calculated, which are suggestive of the proportion of leaves, stems, and different grades of fiber in 100 pounds of green stalks and leaves containing a high percentage of moisture as harvested:

Material:	Percent
Stalks and leaves (green)-----	100.0
Stripped stalks-----	52.0
Air-dry stalks-----	10.4
Decorticated fiber-----	2.1
Degummed filasse-----	1.2

PRODUCTION

Available Chinese statistics indicate very little change in the ramie production or supply during the twentieth century. For nearly 40 years, this fiber has probably been handled in about the same manner. This may be understood if it is realized that about 75 to 85 percent is consumed locally in China. Various estimates would indicate a production of 100,000 long tons of China grass annually in China (96,000 tons⁶ in 1936). This production would place ramie about eighth in rank among plant fibers utilized by man. It is surpassed by cotton, jute, flax, hemp, sisal, abacá, and henequén. However, it is practically impossible, even with published statistics, to obtain any accurate data regarding the production and exports of ramie in China. This partly results from the confusion of the names of the fiber plants. In some provinces the statistics may be given for ramie alone, but in other provinces the statistics may be for ramie, hemp, and jute. The exports have not materially changed during the past 30 years, and have varied according to some estimates from 16,000 to 25,000 tons annually, but averaging about 20,000 tons.

In recent years Japan has been one of the principal buyers of Chinese China grass. It was estimated that before the Chinese-Japanese conflict, 68 percent⁷ of the Chinese exports of ramie went to Japan (13,400 tons in 1936). Ramie is also exported from China to

⁶ E.-V. L. LA RAMIE EN CHINE. *Revue Internatl. des Prod. Colon.* No. 157, pp. 1-3. 1939.

⁷ See footnote 6.

England, Germany, and France, where mills are located that manufacture it into various products.

China utilizes from 50,000 to 80,000 tons of China grass yearly. Most of this is utilized locally, but some is manufactured into cloth, which is exported as grass linen. Unfortunately, not all grass linen is pure ramie so again exact figures regarding this material are uncertain.

Japanese ramie production, while yet unimportant, has been increasing. In 1936, there was an estimated production of 1,200 tons in Japan, 600 tons in Chosen, and 1,500 tons in Taiwan. This was all utilized in Japan. Japanese plantations in the Philippine Islands have grown a little ramie in recent years. There was a reported⁸ area in excess of 300 hectares (741 acres) in the Philippines in 1938 from which 455 short tons of China grass were exported.

DOMESTIC MARKET AND IMPORTATIONS

The United States Bureau of Foreign and Domestic Commerce has prepared statistics, shown in table 1, of the importations of raw China grass or ramie fiber into the United States in recent years. These statistics indicate the limited demand that has existed in the United States in recent years for this material at the prevailing prices. The variations in the price of the fiber as shown in table 1 probably result from a number of factors, including the quality of the fiber. The better grades of China grass are well prepared, long, well bleached, fine, and flexible.

Statistics of the amount and value of manufactured yarns and woven materials of ramie imported into the United States are not available, but the importations are believed to be relatively small in comparison with yarns and fabrics made from some other textile fibers.

TABLE 1.—*Imports of ramie fiber into the United States, 1922-39*¹

Year	Long tons	Value	Year	Long tons	Value	Year	Long tons	Value
1922-----	(2)	\$7	1928-----	(2)	\$5	1934-----	9	\$584
1923-----	(2)	163	1929-----	(2)	28	1935-----	2	600
1924-----	1	263	1930-----	(2)	90	1936-----	47	9,258
1925-----	(2)	117	1931-----	6	272	1937-----	25	4,823
1926-----	(2)	38	1932-----	0	-----	1938-----	102	22,214
1927-----	(2)	57	1933-----	1	168	1939-----	(2)	30

¹ U. S. Dept. of Commerce annual reports, Commerce and navigation of the United States.

² Less than 1 ton.

MANUFACTURING AND USES

The first step in the processing of ramie is degumming, which has not in the past been considered as part of the agricultural preparation of the fiber, but the first step in manufacturing. The degumming process in ramie might be compared to the retting of flax, hemp, and jute. It consists of the removal of the gums adhering to the China grass. It changes the rather stiff, straw-colored

⁸ U. S. DEPARTMENT OF COMMERCE. RAMIE-PHILIPPINE ISLANDS: PRODUCTION AND EXPORT. Textile Raw Materials 1:389. 1939. [Mimeographed.]

coarse China grass into a bleached white, more or less finely divided, flexible fiber that lends itself more readily to spinning. There are many ways that the ramie mill may accomplish degumming, but care is necessary in the selection of the proper degumming procedure to insure that the fiber is not injured by the treatment during the removal of the gums.

After degumming the fiber is ready for spinning. Although the steps in spinning are in general similar to those used with other soft fibers, there are some special processes and certain machinery that have been developed for spinning the degummed fiber. This fiber is sometimes referred to as filasse.

In recent years mixtures of textile fibers have been popular, and ramie filasse has often been suggested for use with other fibers. In the United States it has apparently been prepared satisfactorily with wool and cotton, but little or no commercial use has been made of such experimentally prepared fabrics. These articles may have future potential values but may require a highly organized sales force to become established.

In the past some ramie has been prepared in mills in the United States. However, table 1 indicates the comparatively small quantities that have been imported in recent years. The yarns that were produced in this country during the early part of the twentieth century were used chiefly in the manufacture of incandescent gas mantles. The occasional importation made since 1920 has been mainly an importation of a ton or more of China grass to test a new method of preparation. The large quantity imported in 1938 was reported partially reexported.

The raw material, China grass, is obtained at rather a low price. However, the cost of degumming with the loss of approximately one-third of the weight in this process increases the cost of the degummed fiber. The degummed fiber is more expensive than cotton, which holds first place among the textile fibers used by man. Unless ramie can be produced cheaply enough to compete to some extent with cotton it will probably be confined to specialized articles with a limited usage.

In China the fiber is used for various fabrics, which compete with our linens. These fabrics are designated as Chinese linen, Canton linen, grass linen, or grass cloth, and may be used in embroidered doilies, drawn work, or table covers. The Swatow grass cloth is probably better known in America than any other ramie fabric made in China. Tablecloths, napkins, plushes, covering for upholstered furniture, curtains, dress goods, and knit goods have been made of ramie fiber.

The high yields of ramie under favorable conditions have attracted attention to it as a possible source of cellulose and for use in making high-grade papers. Very satisfactory cellulose yields have been obtained, and paper with excellent qualities has been prepared. In this field the fiber would have to be prepared much cheaper than for a textile fiber to compete with other sources of cheap raw material. Under existing economic conditions in the United States it may not be advisable to grow the crop for cellulose.

FIBER CHARACTERISTICS AND POTENTIAL VALUE

Ramie fiber is a bast fiber obtained from the inner bark of the ramie stem. Some other bast fibers are flax, hemp, jute, and sunn. Ramie fiber has a tensile strength greater than any of these fibers and has more elasticity and ability to withstand torsion than flax or hemp with which there are available comparative tests. Cotton fiber is a seed hair, and its origin permits different physical characteristics. Cotton is much weaker in tensile strength than ramie but is able to withstand torsion much better. Their elasticity is about equal. Raw silk, although weaker in tensile strength than ramie, surpasses ramie and even cotton in elasticity and torsion characteristics.

The methods used in decorticating and degumming ramie influence greatly the average length of the commercial filasse. Possibly a large proportion of the fiber is reduced to its ultimate cells. Flax, hemp, or jute are rarely reduced to their ultimate cells. The ramie-fiber ultimate cells are longer than those of any other plant yielding fiber utilized in the textile or cordage fields of commerce. They range from about $\frac{1}{2}$ inch to 20 inches in length and average about 6 to 8 inches, and from 0.002 to 0.003 inch in diameter. The ultimate cells of flax and hemp average about $1\frac{1}{4}$ inches in length and 0.0006 to 0.0015 inch in diameter. Although these latter fibers are much shorter, they are finer. The length of the ramie ultimate fiber cells should permit spinning into very fine numbers of great strength as the length to some extent would compensate for the disadvantage of the rather smooth surface which has low cohesion between fibers.

Ramie after degumming is white in color and is noted for its luster, but unfortunately some of this luster is frequently lost in preparation of woven goods because of the projecting ends of the fibers in the yarns. Ramie absorbs water more quickly than flax, dries out more quickly than flax, and is affected very little by this moisture. It is light and cool, washes well, and in clothing it absorbs perspiration easily and dries again quickly. Because its absorbent properties are excellent, it should be suitable for a number of uses where this property is valued.

Most of these characteristics favor ramie fiber, and it is because of these and because the plant may be grown easily in certain sections of the country, that financial expenditure has been stimulated to develop a machine that will cheaply extract fiber of a quality that will compete with the Chinese product. In view of the estimated cost of growing ramie in this country, little margin of operating costs would be left for the decorticating process if this fiber is to compete successfully with the imported product.

SUMMARY

Ramie was one of the principal plant fibers used in China before the introduction of cotton. It is grown commercially today in China, Japan, and the Philippine Islands. It has been grown experimentally in this and many countries and is adapted to a warm, temperate climate with an abundant rainfall on fertile soils.

The cultural methods for this crop are discussed in this circular, including the effect of rainfall and humidity on the harvesting and cleaning practices. The fiber preparation has always been a hand process in China which would make its culture in competition with other fibers difficult outside the Orient in countries where hand labor is not cheap.

Approximately 100,000 long tons of this fiber are produced annually, but a large proportion of it never leaves the Orient. Practically none is purchased by spinning mills in the United States. Ramie fabrics are imported into the United States and compete with flax linens in doilies, luncheon sets, and similar articles. The fiber is one of the strongest of the plant fibers and has great durability, absorbency, and luster. With these characteristics ramie fiber would be valuable if advantageously utilized.

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