Content of Nutrients by Parts of Jute plant and its Recovery Rate as Influenced by Different preparations of Fiber

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Hessian-cloth which is made of jute fiber is a widely-used packaging material for various agricultural products such as rice, maize, cotton, sugar and coffee, and for mineral products as well. Jute canvas, a thick-woven jute cloth, is non-conductive to electricity, also of value as a cover material of electrical cords and wires.

Though many natural fibers have often suffered from competition with synthetic or chemical fibers, jute fibers have enjoyed a favorable position in these competitions as they are exceptionally receptive to moisture in nature and are cheap in their cost as a raw material, one of the most attractive attributes privileged by this fiber. It is not assured, however, that jute fibers will continue to be lucrative in the future as compared with artificial or chemical fibers or with papers. The same will be true for allied fibers such as kenaf (*Hibiscus cannabinus*), Roselle hemp (*Hibiscus sabdariff var. altissima*), and China jute (*Abutilon avicennas*). A further reduction in production costs is vital for jute and allied fibers.

Important items of production costs of jute are labor and fertilizers; they represent about 50% and 20% of the total costs respectively. Half of the labor cost goes to extracting fibers from stems, including decortication, soaking in water and retting of stems. Therefore, the reduction of costs should be so devised as to save labor inputs and decrease their costs as well as to economize the cost of fertilizers. The reduction of labor costs was proved possible by substituting the traditional hand method with mechanical decortication. About nine-tenths of the labor costs were proved to be reducible in the author's experiments. They furthermore indicate that the man-days required for retting can be decreased by soaking the decorticated husks separately in water and that a smaller amount of water (as well as of areas) is required for retting.

By mechanical decortication tissues other than fibers are so pulverized as to be easily decomposed in the soil and are used for materials for stable manures. This is undoubtly a successful way of depositing organic materials in the soil. The decorticator, if once introduced, may have so many-side effects on reduction of costs not only by decreasing labor inputs but changing all factors involved.

In the Southeast Asian countries jute fibers have so far been directly manufactured by soaking stems in water without decortication. A great amount of water is required in this way in retting stems, and also a great amount of organic matter other than fibers are washed away in the water; they are never to be regained as supplier of manures. Such a traditional practice does not lead to reducing the cost of fertilizers nor to preserving the fertility of the soil from degradation. The prevention of degradation is essential in the tropical zones as their soils are liable to be deficient in organic matter and hence to degradated in their physical properties.

The author has been engaged in research on the rationalization of manufacturing of jute fiber. In order to know the degree to which decorticators can reduce the cost of fertilizers, the amounts of fertilizer nutrients retained by different parts of the living jute plant were first compared. Then the amounts of nutrients recovered in products by different methods of manufacture were also compared with each other. The results are as follows. (The readers are requested not to quote the results by their absolute values shown but by percentage because the experiments were conducted in the temperate zone of Japan using indigenous varieties.)

Materials and Methods of Experiment

Indigenous Akagawa variety was used for experiment. Seeds were sown in oblong spacing, 60 cm × 10 cm (10 cm interval on rows which have 60 cm distance between each other) on January 1, 1964. After germination stands were thinned several times until the number of stands were reduced to 25 per meter. Fertilizers were applied at the level of 48 kg of three nutrients by each 1 hectare, all of which were applied as basic fertilizers.

Crops were harvested at the young capsule stage on September 15 by cutting stalks immediately above the ground. Then they were divided and measured by each part of the plant. A part of each division was dried and served for materials for analyzing the rate of dry matter.

The amount of N (nitrogen) contained in each of materials was quantified by the micro Kjeldahl method, those of P_2O_5 by the Vanadomolybdophosphonic yellow color method and of K_2O by the flame spectrophotometry. The underground parts of the plant were excluded in this experiment.

Results of the Experiment and Some Remarks Thereon

(1) Fresh weight, water content dry weight and proportion to the whole plant of each plant part

The total fresh weight of the plant per 1 ha amounted to around 23,000 kg and the rate of contents of water to 81% in leaves, 85% in xylem and pith, and 83% in bark, respectively. As the average rate of water-content of the whole parts was 83%, the weight of dry matters amounted to about 4,000 kg, of which 42% was occupied by the xylem and pith, 25% by the leaves and 17% by each of fibrous and non-fibrous parts of the bark. Yields of plants in the test plot were about the same as those reaped in the mean year for such indigenous varieties.

(2) Content of inorganic elements of each plant part

Rates of inorganic elements contained are shown in Table 2 by each part of the plant. Nitrogen is contained most in the leaf part, followed by the non-fibrous part and in turn by the fibrous part of the bark. P_2O_5 shows a similar trend: it is contained most in the

Table 1. Fresh weight, moisture content and dry weight of the different parts of jute plant

part of plant	leaf	xylem+pith	bark		total plant
			nonfibrous part	fiber	
fresh weight (kg/ha)	4,866	10,550	7,583		22,999
moisture (%)	80.81	84.85	83.03		83.39
dry weight (kg/ha)	934	1,599	632	655	3,820
index[1)]	24.5	41.9	16.5	17.1	100

$$1) = \frac{\text{dry weight of different parts}}{\text{dry weight of total plant}} \times 100$$

Table 2. Nutrient content of the different parts of jute plant (per dry matter weight)

part of plant	leaf	xylem+pith	bark		total plant (average)
			nonfibrous part	fiber	
N	3.73%	0.79%	1.41%	0.22%	1.51%
P_2O_5	0.69	0.19	0.41	0.03	0.32
K_2O	4.17	3.29	5.93	0.01	3.38

leaves; and in on-fibrous part, in xylem and pith and in the fibrous part, in descending order. On the other hand, K_2O is contained most in the non-fibrous part of bark, followed by the leaves by the xylem and pith and by the fibrous part of the bark in turn.

(3) Amounts of inorganic elements contained in each plant part

The amounts of inorganic elements per 1 ha are distributed in each part of the plant as shown in Table 3. Total N contents amount to 58 kg and 60% of which are cited in the leaves, 22% in the xylem and pith, 15% and 2.5% in non-fibrous and fibrous part of the bark respectively.

Total P_2O_5 content amounts to 12 kg, of which 53% is found in the leaves, 25% in the xylem and pith, 20% in the non-fibrous and 1.5% in the fibrous part of the bark.

Total K_2O amounted to 130 kg, of which 41% are found in the xylem and pith and 30% in each of the leaves and the non-fibrous part of the bark.

(4) Rates of recovery of inorganic elements by various types of manufacturing of fibers

Based upon the above results, the rates of recovery of inorganic elements are calculated by types of manufacturing of fibers. The results are shown.

By retting whole plants with leaves attached in water the rates of inorganic elements recovered in the soil are reduced to nill, because the xylem and pith of the plant are lost in water. Assuming, however, the xylem and pith were recovered in the soil, 22% of N, 25% of P_2O_5 and 41% of K_2O might not be lost.

In the case of the traditional water retting method of defoliated stems now prevailing in the Southeast Asian region, leaf parts of the plant can be recovered if farmers so desired, but the xylem and pith and the non-fibrous part of the bark are destined to be lost. (In reality, however, farmers rarely apply leaves to the soil for replenishing soil fertility.) In this assumption the rates of recovery would be 60% in N, 53% in P_2O_5 and 30% in K_2O. Assuming further the xylem and pith are also recovered, the rate of recovery would altogether amount to a considerable rate of 82% in N, 77% in P_2O_5 and 71% in K_2O.

In each case, however, some amount of the xylem and pith may be lost in water during retting, so the rates of recovery shown above for these parts are to be dis-

Table 3. Amount of nutrient in the different parts of jute plant cultivated in one hectare field

part of plant		leaf	xylem+pith	bark		total plant
				nonfibrous part	fiber	
N	kg/ha	34.8	12.6	8.9	1.4	57.7
	%	60.3	21.8	15.4	2.5	100
P_2O_5	kg/ha	6.4	3.0	2.6	0.2	12.2
	%	52.5	24.6	21.3	1.6	100
K_2O	kg/ha	38.9	52.6	37.5	0.1	129.1
	%	30.1	40.8	29.0	0.1	100

Table 4. Rate of recovery of nutrient influenced by the different preparation of jute (%)

preparation	N	P_2O_5	K_2O	part of recovery
whole plant retting(1)	0	0	0	none
defoliated stem retting(2)	60.3	52.5	30.1	leaf
decorticated bark rreting(3)	89.9	87.7	85.4	leaf, xylem, pith and half nonfibrous pert of bark

note (1) In this process, leaf, xylem and pith are thrown away or used for another purpose.

(2) In this preparation, leaves are able to use as manure, but xylem and pith are thrown away or used for another purpose.

(3) In this preparation, all parts except fiber are able to use as manure.

* Half amount of nonfibrous part of bark is recovered when the stem is decorticated by machine.

counted a little. Further studies are going on in this respect.

By retting mechanically decorticated bark in water, most parts of the plant will be recovered in the soil, i.e. 90% of N, 88% of P_2O_5 and 85% of K_2O are to be recovered respectively.

(5) Amounts of inorganic elements recovered

The amounts of inorganic elements recovered per 1 ha of land are calculated from the above results (Table 5). By whole plant water-retting, recovery of each element is nill. Assuming xylem and pith are recovered 12.6 kg of N, 3 kg of P_2O_5 and 52.6 kg of K_2O will be recovered as shown in the parenthesis of the table. By retting defoliated stems in water, recovery amounts to 31 kg in N, 6.4 kg in P_2O_5 and 40 kg in K_2O so far as farmers use such defoliation. Assuming further that the xylem and pith are also recovered, N will be 47 kg, P_2O_5 9.5 kg and K_2O 91.5 kg.

By retting only the bark parts which are decorticated mechanically, every part of the plant other than the fibrous part, i.e. leaves, xylem and pith and non-fibrous part of the bark, may certainly be left in the soil, which amounts to a substantial volume including 52 kg of N, 10.7 kg of P_2O_5 and 110 kg of K_2O.

Although jute is originally a fertilizer-consuming plant, nearly all or more than half of the nutrients are usually lost in the traditional manufacturing process of fibers in the Southeast Asian countries. Hence, if the traditional process were replaced by the mechanical decortication and then by the retting of only the bark part in water, most parts of nutrients absorbed by the plant could be recovered and fed back into the soil. Furthermore, the mechanized process would enhance efficiency of decortication and decrease the amount and space for water used for retting. In this process the machine breaks the xylem and pith parts so small that the pieces are readily available as green manure or as materials for compost.

Conclusion

Based upon the above results, the writer proposes that the decorticator should be introduced in the very process of production of jute and allied fibers, and suggests that the decorticator should be profitably used by a joint utilization by groups of farmers.

Table 5. Amount of recovery of mutrient influenced by the different preparation of jute.

preparation	N	P_2O_5	K_2O
whole plant retting	0 (12.6*)	0 (3.0*)	0 (52.6*)
defoliated stem retting	34.8 (47.4*)	6.4 (9.4*)	38.9 (91.5*)
decorticated bark retting	51.9	10.7	110.3

note: *This value is in the case of recovered xylem and pith.

Pathogenicity and Aetiology of *Pasteurella multocida*

L With special reference to hemorrhagic septicemia and fowl choleraL

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In the latter part of the last century, similar bacilli of Gram negative were frequently isolated from the septicemic material of various kinds of animals and fowls. They were characterized by bipolar stainability. As the interrelationship among a group of these similar bacilli derived from the various animals was not clear at that