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Retting of Green Jute Ribbons (*Corchorus capsularis* var. CVL-1) with Fungal Culture

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Abstract: Isolated fungi of *Aspergillus clavatus*, *Rhizopus* sp., *Zygorinchous* sp., *Sporotrichum* sp., *Trichoderma* sp., *Penicillium* sp. and *Curvularia* sp. were tested for their retting efficacy on green jute ribbons. In laboratory condition as well as in field condition, *Sporotrichum* sp. retted green ribbons of jute (var. CVL-1) in 7 days whereas both *Trichoderma* sp and *Curvularia* sp. retted green ribbons in 11 days. In case of retting by *Sporotrichum* sp., no adverse effect on the fiber bundle strength and fiber yield was observed and according to Pressley Index, fiber strength was found to be 10.82 lbs/mg and fiber yield was about 2.8 Kg out of 40 Kg green ribbons.

Key words: Jute, green ribbon, retting, *Sporotrichum* sp., fiber yield

Introduction

Jute fiber is obtained from retting the plants by steeping in water of pond, ditches, rivers etc. Retting is accomplished by the joint action of water and microbes, particularly by bacteria. It is well known that the value of jute fibre lies in its strength, soften, fineness, weight, length, colour and luster. All these qualities depend mostly on the proper period of retting. Over retting and under retting definitely affect the above mentioned qualities of jute fibers (Islam *et al*., 1995). Moreover, the retting period varies with the thickness and maturity of the stem and the retting of jute proceeds from the upper portion towards the base. Microorganisms attack cambium and secondary phloem and cannot attack the hard wood. The decomposition of the parenchymatous tissues proceeds due to the secretion of enzymes by the microbes. The vascular system of the jute stem is cemented by the pectic substances which are hydrolyzed by the enzymes. Three kinds of enzymes namely pectisinase, pectase and pectinase are found to be effective on the pectic substances. The enzyme pectisinase converts the pectic substances into soluble pectin which is then activated by the enzyme pectase to produce pectic acid (Bhuiyan *et al*., 1979). This pectic acid is then converted into glutamic acid by the action of the enzyme pectinase. At the initial stage of attack the growth of bacteria is vigorous and as the reaction proceeds, the growth rate begins to decrease due to the fact that at high pH value the growth of bacteria is vigorous and as enzymatic reaction increases; the production of acid in the retting water, which decreases the pH value, so that growth of bacteria also decreases. The bacterial enzymes separate the barks (the fibrous portion) from the woody core and fibers are extracted manually, where the barks of the plants contained the fibrous matter (Gomes *et al*., 1989; Tangu *et al*., 1981; Kabir *et al*., 1996). Then the fibers are dried well and marketed (Ali *et al*., 1969; Ahmed and Choudhury, 1968).

Jute plant including its fibre and stick is a typical source of lignocellulose. Bioconversion of cellulosic and lignocellulosic materials into many useful products (e.g. cellulases, alcohols, organic acids etc.) have received considerable attention. Cellulases produced by several fungi, e.g. *Trichoderma resei* and its mutants were studied in detail during the past two decades (Andreotti *et al*., 1980, Eriksson *et al*., 1981; Mandels and Sternberg, 1976). However, relatively higher cost of production of these cellulases has hindered the industrial application of these enzymes. In course of screening programme with several wild strains of fungi for hunting alternative sources of cellulases, Kabir *et al*. (1996) found *Gliocladium virens* to be a good producer of cellulases and hemicellulases.

In most of the jute growing areas of Bangladesh (Jessore, Kushtia, Rangpur, Dinajpur, Bogra and Rajshahi) there are scarcity of retting water. Therefore, if the barks are separated prior to retting in green condition, then it requires half the quantity of water required for whole plant retting (Ali *et al*., 1976). Moreover, if the ribbon could be retted with fungi, water requirement comes to almost nil since fungi can grow in moist condition. The present investigation was therefore undertaken to explore the possibility of using fungi in retting of green ribbons of jute.

Materials and Methods

Pieces of jute (*Corchorus capsularis*, var. CVL-1) ribbons were taken from the middle of the stem, weighing 30 g and were used as retting materials. Fungi namely *Aspergillus clavatus*, *Rhizopus* sp., *Zygorinchous* sp., *Sporotrichum* sp., *Trichoderma* sp., *Penicillium* sp. and *Curvularia* sp., isolated previously from laboratory, were grown in 100 g sterilized wheat bran in 20 ml conical flask at 29°C. The retting was conducted using these fungi aseptically and a control was maintained where distilled water used instead of fungal culture without changing the experimental retting condition. The fiber strength was tested and expressed in terms of value in Pressley Index (Ramamurthy *et al*., 1987) where

$$\text{Pressley Index} = \frac{\text{Breaking Load (lb)}}{\text{Mass of the fiber bundle (mg)}}$$

Chemical analysis of the basic constituents of the fiber were also examined (Wood and Bhat, 1988; Ghosh and Dutta, 1983). All the experiments were carried in laboratory condition unless otherwise specified.

A large scale study of fungal (*Sporotrichum* sp.) retting in field condition was also carried out with 40 kg of jute (*C. capsularis*) ribbon where the experiments were conducted to find out the effect of fungi in retting of green ribbons of jute in field condition, grade and strength of fiber obtained from fungal retting was also measured according to Ghosh and Dutta (1980, 1983).

Results and Discussion

Out of the fungi tested, only *Sporotrichum* sp. retted green

ribbons in 7 days, *Trichoderma* sp. and *Curvularia* sp. took longer period of time (11 days) and other fungi showed insignificant progress of retting (Table 1). Fiber strength of the fiber retted by *Sporotrichum* sp. was calculated to be 11.80 lbs/mg and the strength of fiber retted by other fungi was not significant (Table 2). After retting chemical constituents of the jute ribbons (Table 3) was decreased; the pectin percentage was only 0.5% whereas in before retting it was 4.6%. The results shows that the pectin content decreased in better retting resulting higher colour and softness of the fiber. From Fig. 1 it was observed that fibers obtained by fungal retting were brighter in colour.

Table 1: Effect of different fungi in green ribbon retting of jute (*Corchorus capsularis* var. CVL-1).

Fungal culture	Retting time (days)
Control	18
Aspergillus clavatus	17
Rhizopus sp.	16
Zygorinchous sp.	12
Sporotrichum sp.	7
Trichoderma sp.	11
Penicillium sp.	16
Curvularia sp.	11

Table 2: Growth of fungi in green ribbon and jute fibre grade and fibre bundle strength after retting with these fungi.

Fungi culture	Growth pattern	Fibre grade	Pressley index (lbs/mg)
Control	-	C	8.89
Aspergillus clavatus	+	C	9.00
Rhizopus sp.	+	C	8.88
Zygorinchous sp.	+ +	C	9.01
Sporotrichum sp.	+ + + +	A	11.80
Trichoderma sp.	+ +	C	8.58
Penicillium sp.	+	B	10.13
Curvularia sp.	+ +	C	8.85

+ = Degree of uniformity in growth

Table 3: Chemical analysis of jute before and after retting with *Sporotrichum* sp.

Chemical constituent	Before retting (%)	After retting (%)
Lignin	15.22	12.69
Pectin	4.61	0.50
Fat	0.71	0.34
Protein	5.20	4.08

Table 4: Effect of *Sporotrichum* sp. on green ribbon retting and fibre quality.

Treatment	Green weight of ribbon (Kg)	Fibre yield (Kg)	Retting time (days)	Fibre grade	Fibre bundle Strength
Sporotrichum sp.	40	2.8	7	A	11.82
Control	40	1.9	18	C	8.87

+ =Degree of uniformity in growth

Main disadvantages faced during fungal retting was that the fungi did not grow uniformly on the substrate (Ali *et al.*, 1976; 1989; Ahmed and Choudhury, 1968) but in this study it was found that *Sporotrichum* sp. grew uniformly over the green ribbons. In previous report Eshaque (1982) reported that fungal retted jute fiber looses strength whereas in the experiment reported here the fiber bundle strength did not loss at all. On the contrary, it was same as that of A-grade fibers

(Fibers, Before retting) (Fibers, After retting)

Fig. 1: Retting of green jute ribbons (*C. capsularis* var. CVL-1) by fungus, *Sporotrichum* sp.

(Table 2) when retting with *Sporotrichum* sp., *Trichoderma* sp. and *Curvularia* sp. retted green ribbons but affected the fiber strength which might be due to the presence of cellulase enzymes of these two microbes.

Sporotrichum sp. retted the bulk green ribbons at field conditions in 7 days and grew uniformly over the ribbons (Table 4) where the bundle strength of fiber was found to be 10.82 lbs/mg and the fiber strength was also not effected by this fungus. Moreover, the fiber yield was 2.8 Kg out of 40 Kg green ribbons. In control, no progress of retting was observed. The fiber bundle strength did not loss at all and the fiber was of A-grade (Table 4) indicating that retting with *Sporotrichum* sp. would be a very significant process specifically in the water scarce area of northern district of Bangladesh where very poor quality of fiber are produced due to the scarcity of sufficient retting water. In both, laboratory and field conditions, soft fiber with better strength and grade was obtained by retting the green ribbons with *Sporotrichum* sp. compared with other fungal retting. Like *Glicladium virens* (Kabir *et al.*, 1996), *Sporotrichum* sp. deserves further attention as it has found to be efficient in retting green jute ribbon and fast growing with a short lag phage. These findings would be a fruitful field of study in future concerning better retting of jute in water scare area of jute growing countries in the world.

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