FIBRE STUDIES OF *Pinus caribaea*, *Leucaena leucocephala* AND *Acacia auriculiformis*

A. B. Siddique
A. R. Chowdhury

ABSTRACT

Fibre dimensions of *Pinus caribaea*, *Leucaena leucocephala*, and *Acacia auriculiformis* were studied to assess their suitability for making paper pulp. The results obtained with *Pinus caribaea* grown in Bangladesh were comparable with those in the literature. The fibre dimension characteristics of *Leucaena leucocephala* predicted the suitability of the species for pulp making. *Acacia auriculiformis* showed similar fibre properties with those of civit.

সারসংক্ষেপ

কাগজের মণ্ড তৈরীর উপযুক্ততা নির্ণয়ের জন্য পাইনাস ক্যারিবিয়া, লিউসেনা লিউকোসেফেলা এবং একাসিয়া অরিকলিফরমিস্ গাছের আঁশের দৈর্ঘ্য, প্রস্থ ইত্যাদি নিরুপণ করা হয়। বাংলাদেশে জন্মানো পাইনাস ক্যারিবিয়ার তন্তুগত গুণাগুণ বিদেশে জন্মানো পাইনাস ক্যারিবিয়া গাছের সমতুল্য। লিউসেনা লিউকোসেফেলা আঁশের বৈশিষ্ট্যতা মণ্ড তৈরীর উপযুক্ততা নির্দেশ করে। একাসিয়া অরিকলিফরমিসের তন্তু সিভিটের অনুরূপ।

INTRODUCTION

There are about 600 hardwood species in the forests of Bangladesh. But none of the indigenous species is available in short rotation and in large quantities to use in the pulp mills. So selection of fast growing exotic species for plantation is necessary for a sustained supply to the pulp and paper industries.

Pinus caribaea is an exotic softwood suitable for plantation in the tropical zone. It has favourable growth rate and fibre dimensions which indicate its potentiality as a raw material for pulping (Palmer and Gibbs 1967).

Large scale plantation of giant ipil ipil (*Leucaena leucocephala*) are being raised

A. B. Siddique, Senior Research Officer and A. R. Chowdhury, Research Assistant, Pulp and Paper Division, Forest Research Institute, Chittagong, Bangladesh

throughout the tropical and sub-tropical regions of the world (Negi and Chawla 1983). It is a fast growing species and is widely planted in southern America, the Philippines and recently in India for its multipurpose use, viz., as fuel wood, in charcoal making, as fodder and in pulp making (Shiveshwar *et al*, 1983/84). This tree grows straight and attains a height of 5–6 *m* during the first year. One hectare of ipil ipil plantation may produce about 100 tons of pulp wood in three years rotation (Rajan *et al.* 1984).

Acacia auriculiformis is an Australian hardwood and it has a variety of uses, viz., in making charcoal, lacquer products and for toys (Rajan *et al.* 1984). It also serves as a substitute of *Wrightia tinctoria*. It was thus felt necessary to study the fibre properties of these species to assess their suitability as a pulping raw material.

MATERIALS AND METHOD

Pinus caribaea was collected from the Bangladesh Forest Research Institute campus. Ipil ipil was supplied by the Divisional Forest Officer, Chittagong and *Acacia aurifuliformis* was collected from Kaptai road side plantation. Disc of 5 to 8 cm in thickness from each of the species was cut at 60 cm from the ground level. The sample for fibre dimension studies was taken from the fifth ring of each of the species. Specimen of match stick size was cut from the fifth ring of the disc and was macerated in a 1 : 3 mixture of 10 % solution of chromic acid and nitric acid. The macerated fibres were thoroughly washed with distilled water and temporary slides were made. The fibre length observations were taken under a compound microscope. The weighted average fibre length was then calculated. Specimen of size 0.64 cm x 0.64 cm x 1.27 cm was taken from the fifth ring of each disc for the measurement of fibre diameter and cell-wall thickness. The wood specimen was then boiled in distilled water till it was softened for making micrometer sections. Fifty observations were taken for the study of fibre diameter and cell-wall thickness from the cross sections of wood.

RESULTS AND DISCUSSION

The weighted average fibre length of three plantation species, viz.. *Pinus caribaea*, giant ipil ipil and *Acacia auriculiformis* are given in Tables 1 and 2. Table 1 shows that *Pinus caribaea* grown in Bangladesh was comparable with the species grown in different parts in Fiji (Palmer and Gibbs 1968). Ipil ipil showed comparable fibre length with gamar (*Gmelina arborea*) and *Albizia falcataria*. Fibres of *Acacia auricu,-iformis* were shorter than those of gamar and *Albizia falcataria*. They are comparable with those of civit. The fibre length is an important factor for paper strength, because it influences tear resistance in particular and to a lesser extent burst, tensile and fold (Tamolong 1966). Pulp properties depend not only on the fibre length but also on lumen and fibre diameters. Moreover, the suitability of a species for paper making is predicted by the runkel ratio (Runkel 1949). It was found that the runkel ratio is less than unity for all the species

under investigation. This indicates the possibilities of making good quality pulp from these species. *Acacia auriculiformis* showed shorter fibre length. However, it was characterized with higher flexibility coefficient and relative fibre length (Table 3). So it is concluded that it may also be suitable for paper making.

Table 1. Fibre dimensions of *Pinus caribaea* along with the data obtained elsewhere

Name of species	Weighted fibre length (mm)	Fibre diametre (micron)	Cell-wall thickness (micron)
1. *Pinus caribaea* (FRI, Bangladesh)	3.09	41.1	5.52
2. *Pinus caribaea* (Sabha, Fiji)	3.02	38.4	4.21
3. *Pinus caribaea* (Seaqaqa, Fiji)	3.10	54.3	5.50

Table 2. Fibre dimensions of *Acacia auriculiformis* and giant ipil ipil compared with other species

Species	Weighted average fibre length (mm)	Fibre diameter			Lumen diameter			Cell-wall thickness		
		Max (Micron)	Min (Micron)	Av (Micron)	Max (Micron)	Min (Micron)	Av (Micron)	Max (Micron)	Min (Micron)	Av (Micron)
Pinus caribaea	3.09	54.6	27.3	41.1	46.2	16.8	29.9	12.6	3.15	5.52
Giant Ipil Ipil	1.26	24.5	11.4	16.4	17.9	8.15	12.6	4.07	0.81	1.89
Acacia auriculiformis	0.87	22.0	10.6	15.6	16.3	4.89	10.1	5.70	1.22	2.68
Al. falcataria (*Albizia molucanna*)	1.27	36.1	22.5	29.5	27.0	18.0	20.0	6.76	4.51	4.73
Gamar (*Gmelina arborea*)	1.21	40.6	24.5	28.3	31.6	13.5	18.3	9.01	2.25	5.00
Civit (*Swintonia floribunda*)	0.94	36.1	18.0	25.4	18.0	9.01	13.9	9.01	4.51	7.40

Table 3. Fibre properties of plantation species

Species	Runkel ratio 2 CWT/LD	Flexibility Coefficient LD/FD	Relative fibre length FL/FD
Pinus caribaea	0.369	0.727	75.2
Giant ipil ipil	0.299	0.773	77.0
Acacia auriculiformis	0.530	0.648	55.7
Al. falcataria (*Albizia molucanna*)	0.472	0.679	42.3
Gamar	0.556	0.643	44.5
Civit	1.06	0.540	35.4

REFERENCES

1. Negi, J. S. and Chawla, J. S. 1983. In- Indian Pulp and Paper 38(2) : 17–20
2. Palmer, E. R. and Gibbs, J. A. 1967. The pulping characteristics of *Pinus caribaea* from Sabah. Bulletin of Tropical Products Institute, U. K. 23 pp
3. Palmer, E. R. and Gibbs, J. A. 1968. The pulping characteristics of *Pinus caribaea* from Fiji. Bulletin of Tropical. Forest Products Institute, U. K. 27 pp
4. Runkel, R. O. H. 1949. Ueber die Herstellung von Zillstoft ans der Holz-Gatlung Eucalyptus and Versuche nitzwei unterschiedliche *Eucalyptus* avten. Das papier 3 : 476–490
5. Rajan, B. K. C., Kushalappa, K. A. and Khan, K. A. 1984. Forest Products Abstracts 7(9) : 272
6. Shiveshwar, R. M., Raja Rao, J. H., Pai, N. M., Meshramkar, P. M. and Deb, U. K. 1983/1984. Indian Pulp and Paper. 38(4) : 5-13
7. Tamolong F. H. 1966 Fiber dimensions of some Philippine fibrous material. The Philippine Journal of Forestry Nos. 1-4 : 59-60