Fibre dimensions variation in *Toona ciliata* wood collected from different sites of Himachal Pradesh

[1]Bandana Dhiman, [2]Kulwant Rai Sharma, [3]Yogesh YadavRao Sumthane
Ph.D Scholars
Department of Forest Products, College of Forestry
Dr. Y. S. Parmar, University of Horticulture and Forestry, Nauni, Solan-173230 India.

Abstract : Fibre length and diameter of *Toona ciliata* wood from different sites of nine districts of Himachal Pradesh was measured. For fibre dimension measurement, samples were extracted from diameter at breast height of Toon tree. Significant variations have been found among the different sites at 5 per cent level of significance. The longest fibre length of 1.097 mm was found in Baddi of Solan district and the shortest of 0.785 mm in Ghanahati of Bilaspur district. Whereas, the fibre diameter ranged from 0.020 to 0.022 mm.

Index Terms: **Fibre dimension,*Toona ciiata*,variations**

I.INTRODUCTION

Toona ciliata M.J. Roemer is a tall rainforest tree distributed from India and southern China, through south-east Asia and New Guinea to the east coast of Australia (Archer, 2000). In Indian subcontinent, *T. ciliata* occurs from eastern Pakistan to Bangladesh, including the tropical parts of the sub-Himalayan tract and the Western Ghats, India (Conn and Damas, 2006). *Toona ciliata* is the most wide-ranging out of the four *Toona* species (Hua and Edmonds, 2008) and is persistent once established (Weber, 2003). It grows best on rich alluvial or volcanic soils having a neutral to acid pH-range in windsheltered positions. Toon wood has distinct heartwood and sapwood, distinct growth rings, fine to medium texture and straight grain. The mean values of fiber length, fiber width increases from pith to bark, and fiber wall thickness had a little variation. Toon wood with wood specific gravity of 0.45 used for the production of a wide range of wood-based products, among which are high quality-sawn wood, conventional particleboards, cement-wood boards and plywood (Bufalino *et al.*, 2012), but the quality pulp indicative index doesn't suggest its wood for package paper production (Nisgoski *et al.*, 2011).

The state of Himachal Pradesh extends from the Shiwalik hills in the south to the Great Himalayan range, including a slice of Trans-Himalaya in the north. Geographically, the latitudinal and longitudinal extent of Himachal Pradesh is situated between $30^0 22' 44''$ to $33^0 12' 40''$ N and $75^0 45' 55''$ to $79^0 04' 20''$ E. The state is compact in shape and almost wholly mountainous, with altitude varying from 300 m in plains of Kangra and Una to nearly 7,000 m in Central Himalayan range of Lahaul and Spiti. It covers a geographical area of 55,673 km^2, which is about 1.69 % of India's total area (Census of India, 2011). In Himachal Pradesh it is known as

'toon', found in Humid and Sub-humid subtropical zone and lower areas of Wet temperate Zone climatically, being distributed all over Shiwalik region and Flood Plains physiographically. It is an important timber species and people are growing it on their farm lands.

Strength of any wood is uncovered by exploring its anatomical properties. Among all anatomical elements, fibres are basic and important cells which provide strength to wood. Toon wood from different sites are selected to measure fibre dimensions and to find variations among them for promoting proper utilization of the wood which was studied in the live wood samples of *Toona ciliata* taken from different sites of Himachal Pradesh.

II. MATERIAL AND METHODOLOGY

I.1 Sample Extraction

The samples were collected from different 25 *Toona ciliata* sites of nine districts which fall between sub-tropical to sub-temperate zones of Himachal Pradesh with different elevations ranging from 500 m to 2000 m amsl. Different sites of *Toona ciliata* were selected in different districts where species is naturally growing. For analysis, two wood samples on same tree were extracted with increment borer at right angle at d.b.h height. Extracted cylindrical samples were cut into thin slices for further maceration.

I.2 Fibre length and diameter (mm)

Length and diameter of toon wood fibre were determined by macerating extracted samples in Jeffery's solution, *i.e.* 10 per cent chromic acid and 10 per cent nitric acid, for 48 hours (Pandey *et al.*, 1968). The samples were thoroughly washed with water before staining to remove chromic acid as it reacts and make coagulates with safranine. Then samples were stained with safranine and fibre clumps were separated with help of needle for clear observation under microscope, and mounted with 10 per cent glycerin. The measurement was taken with the help of ocular micrometer of 15X fitted eyepiece of microscope with 4X magnification objective lens which was standardized with the help of stage micrometer.

III. STATISTICAL ANALYSIS

The recorded data were subjected to randomized block design analysis as described by Panse and Sukhatme (1978) and Chandel (1984).

Analysis of variance (ANOVA)

The analysis of variance table was set up as under:

Source of variation	Degrees of freedom	Mean sum of square	Variance ratio
Replication	(r-1)	Mss	Mss/Mse
Treatment	(t-1)	Mst	Mst/Mse
Error	(r-1)(t-1)	Mse	
Total	(r x t)-1	M_T	

Where,

r = number of replications

t = number of treatments

Mss = mean sum of square due to replications

Mst = mean sum of square due to treatments

Mse = mean sum of square due to error

The critical difference (CD) was calculated as follows:

CD= SE (d) x $t_{0.05}$

Where,

SE (d) = standard error of difference was calculated as

SE (d) = $\sqrt{2Mse/r}$

$t_{0.05}$ = t value at 5 per cent at error degree of freedom

IV. RESULTS AND DISCUSSION

The variation in fibre length and width of toon wood samples from different sites were found to be significant. The longest fibre length of 1.097 mm was recorded in Baddi which was statistically at par with Rajgarh (1.009 mm). The shortest fibre length was noticed in Ghanahati (0.785 mm). The highest value for fibre width was recorded in Sugh (0.02200 mm), which was statistically at par with Baddi and Una (0.02050 mm). Whereas, the lowest value of 0.02000 mm was noticed in all remaining sites.

Table - Variation in fibre length (mm) and fibre width (mm) of different toon sites

Sr. No.	Sites (District)	Fibre length (mm)	Fibre width (mm)
1	Arki (Solan)	0.850	0.02100
2	Baddi (Solan)	1.097	0.02100
3	Bhota (Hamirpur)	0.890	0.02000
4	Chambaghat (Solan)	0.855	0.02000
5	Dehra (Kangra)	0.945	0.02000
6	Ghagas (Bilaspur)	0.899	0.02000
7	Ghanahati (Shimla)	0.785	0.02000
8	Ghumarwin (Bilaspur)	0.925	0.02000
9	Jogindernagar (Mandi)	0.898	0.02000
10	Mandi (Mandi)	0.860	0.02000
11	Nahan (Sirmaur)	0.962	0.02000
12	Nainikhad (Chamba)	0.926	0.02000
13	Nauni (Solan)	0.947	0.02000
14	Nurpur (Kangra)	0.925	0.02000
15	Palampur (Kangra)	0.890	0.02000
16	Rajgarh (Sirmaur)	1.009	0.02000
17	Rehan (Kangra)	0.878	0.02000
18	Renuka (Sirmaur)	0.905	0.02000
19	Sadhupul (Solan)	0.895	0.02000
20	Sarahan (Sirmaur)	0.913	0.02000
21	Shahpur (Kangra)	0.913	0.02000
22	Sugh (Kangra)	0.885	0.02200
23	Sujanpur (Hamirpur)	0.888	0.02000
24	Sundernagar (Mandi)	0.914	0.02000
25	Una (Una)	0.935	0.02050
	Mean	0.912	0.02018
	SE (d)	0.025	0.00025
	$CD_{0.05}$	0.049	0.00050

After critical scrutiny of analysis, it was found that the longest fibre length was noticed in Baddi and widest fibre diameter was in Sugh and both sites are at low elevation and under water stress conditions due to high temperature as compare to sub-temperate sites. It was clear from the variations that anatomical dimension differ from site to site, as growth affected from site conditions. Similar results have been obtained by Malan and Gerischer (1987), while working on eucalyptus have observed that fibre length increased due to growth stress. Jiang *et al*. (2004) have also observed significant variation in fibre length of *Leucaena leucocephala* and *Populus* varieties. Tavares *et al.* (2011) have found significant site differences in *Acacia melanoxylon* for fibre length. Nisgoski *et al*. (2011) have reported that the mean values of fibre length and fibre width, increased from pith to bark and fibre wall thickness had a little variation. The variability in anatomical characteristics has

profound influence on properties of wood (Burley and Palmer, 1979). The general pattern of variation in wood element dimensions is found not only within a species but has also been observed within a tree (Rao and Rao, 1978; Pande *et al.,* 1995).

V. CONCLUSION

Fibres are important component of any tree which provide strength and give rise to wood density. Longest and thickest the fibre, strongest will be the wood with high wood density which is desirable property for timber purpose. In this study different dimensions of toon wood fibres were noticed, which vary due to different site conditions.

VI. REFERENCES

[1] Archer, R. H. 2000. Meliaceae Seed Plants of Southern Africa. In: Leistner, O.A. (Ed.), National Botanical Institute, Pretoria, 10: 353.

[2] Conn, B. J and Damas, Q. 2006. *Toona ciliata* M. Roem. Guide to trees of Papua New Guinea.

[3] Hua, P and Edmonds, J. M. 2008. *Toona ciliata* (Endlicher) M. Roemer, Fam. Nat. Syn. Monogr. 1; 131. 1846. In: *Flora of China* vol 11: Oxalidaceae through Aceraceae. St Louis, MO, USA: Missouri Botanical Garden, 112–115.

[4] Weber, E. 2003. Invasive Plant species of the world. A Reference guide to Environmental Weeds. Wallingford, UK: CABI Publication.

[5] Bufalino, L., Albino,V. C. S., Sá, V. A., Correa, A. R. R., Mendes, L. M., Almeida, N. A. 2012. Particleboards made from Australian red cedar: processing variables and evaluation of mixed species. *Journal of Tropical Forest Science*, 24(2): 162-172

[6] Nisgoski, S., Trianoski, R., de Muniz, G. I. B., Monteiro de Matos, J. L., Batista, F. R. R. 2011. *Toona ciliata* wood anatomy and fiber characteristics for paper production. *Floresta*, 41(4): 717 -728.

[7] Census of India. 2011. Census handbook of Himachal Pradesh, Government of India.

[8] Pande, P. K. 2011. Variations in wood properties and growth in some clones of *Populus deltoides* Bartr. ex Marsh. *American Journal of Plant Sciences*, 2(5): 644-649.

[9] Panse, V. G and Sukhatme, P. V. 1978. Statistical method for agricultural workers, ICAR, New Delhi. 610p.

[10] Chandel, S. R. S. 1984. A handbook of agriculture statistics. Achal Prakashan, Mandi, Kanpur. 565p.

[11] Malan, F. and Gerischer, G. 1987. Wood Property Differences in South African Grown *Eucalyptus grandis* Trees of Different Growth Stress Intensity. *Holzforschung*, 41: 331-335.

[12] Jiang, X., Zhang, L., Zhang, Q., Chen, Y., Yu, Z. K. and Xie, H. 1994. Genetic variation is basic wood properties of 36 clones of *Populus deltoides*. *Forest Resesarch Chinese Academy of Forestry*, 7(3): 253-258.

[13] Tavares, F., Quilho, T. and Pereira, H. 2011. Wood and fibre characteristics of *Acacia melonoxylan* and comparison of *Eucalyptus globules*. *Cerne, Lavras*, 17(1): 61-68.

[14] Burley, J. and Palmer. R. R. 1979. Pulp and wood densitometric properties of *Pinus caribaea* from Fiji. C.F.I. Occasional Paper No. 66p.

[15] Rao, B. S. S and Rao, R. V. 1978. Variation in length of vertical elements within one tree of *Betula pubercens* Ehrh. *Journal of the Indian Academy of Wood Science*, 9: 105-110.

[16] Pandey, S. C., Puri, G. S and Singh, J. S. 1968. Research methods in plant ecology. Bombay, Asia Publication House. pp. 44-46.