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The Influence of Cambial Age on Fiber Dimension in Maple Wood

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Abstract: This study carried to the relationships between cambial age and fiber dimension in maple wood (*Acer velutinum* Boiss). For this purpose, three normal maple trees were randomly cut down from the Noshahr site located in the northern part of Iran. Disks of wood were at breast height. The testing samples were papered along the radial axis from the pith to the bark to determine fiber properties. Analysis of variance (ANOVA) indicated that the cambial age on fiber properties had significant effect on wood fiber properties and morphological features. There aren't relationships between cambial age and fiber features of maple wood. with increasing cambial age, the values of fiber length, cell wall thickness, slenderness ratio and Runkel ratio increased while fiber width, lumen diameter and flexibility ratio decreased.

Key words: Maple wood % Cambial age % Fiber dimension

INTRODUCTION

Wood consists of matrix of fiber walls and air spaces. Its structural properties vary from pith to bark, from the tree base to the top and from the stem to the branches and roots [1]. The primary structural block of wood is the tracheids or fiber cells. These cells vary from 16 - 42 micrometers in diameter and from 870 - 4000 micrometer long [2]. The variations in wood properties are attributable to the different distribution patterns of its micro structures, its arrangement, size and dimension of components cells. In hard wood, the cells that make up the anatomical organization are the vessels, fibers, parenchyma cells and the wood rays. Fibers are the principal element that is responsible for the strength of the wood [2, 3]. Ocloo and Laing [4] reported on the major contributors to the strength of *Celtis adolfi-friderici*, *Celtis mildbraedii and Celtis zenkeri* to include wall thickness of the vessels and fibers, the fractional wall volumes of the vessels and fibers and the length of the fibers. These anatomical properties according to [4, 5] have a positive correlation on the strength characteristics of wood.

Fiber length is one of the quality parameters for pulpwood [6]. It has been extensively studied in relation to tree age and within tree position [7, 8]. Fiber dimension are determined by the dimensions of the cambial fusiform cells from which they are derived and by the process that occurs during cell differentiation [9, 10]. Fiber length and cell wall thickness have been reported to show gradual increase from pith to bark [11, 5]. The increases in fiber length from pith to bark according to [5] are due to the increasing age of the tree with a resulting effect on cell wall development. Rulliaty and America [12] reported a decreasing trend in wood fiber length from the tree base to the top. This decreasing trend on wood fiber length is attributable to the influence of the growth promotion substances which are close to the growing tip. These growth promoting substances initiate rapid production of cells at this point with decreasing maturation time thereby resulting in the production of short cells at the tree top.

The main objective of the study were to investigate the variation in fiber length, fiber width, cell wall thickness, lumen diameter, flexibility ratio, slenderness ratio and Runkel ratio between different cambial age classes of maple wood (*Acer velutinum* Boiss) in radial position form the pith to the bark.

MATERIAL AND METHODS

A total of 3 maple trees (*Acer velutinum* Boiss) were sampled in Khanican forests (Noshahr province in north of Iran). All the trees were randomly selected, taking into account stem straightness and the absence of obvious decay. The sample disks were taken at breast height. The age and diameter of all trees was 55 to 60 years and 30

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Table 1: Analysis of variance (ANOVA) between cambial age and fiber properties

Fiber properties		Sum of Squares	df	Mean Square	F
Fiber length	Between Groups	6179376.058	27	228865.780	4.105**
	Within Groups	2.966E7	532	55747.952	
	Total	3.584E7	559		
Fiber width	Between Groups	1536.919	27	56.923	2.692**
	Within Groups	11251.162	532	21.149	
	Total	12788.081	559		
Cell wall thickness	Between Groups	116.514	27	4.315	4.585**
	Within Groups	500.660	532	.941	
	Total	617.174	559		
Lumen diameter	Between Groups	1171.107	27	43.374	2.121**
	Within Groups	10880.221	532	20.452	
	Total	12051.328	559		
Flexibility ratio	Between Groups	9494.932	27	351.664	2.759**
	Within Groups	67804.245	532	127.452	
	Total	77299.177	559		
Slenderness ratio	Between Groups	19180.460	27	710.387	3.108**
	Within Groups	121580.690	532	228.535	
	Total	140761.150	559		
Runkel ratio	Between Groups	80375.490	27	2976.870	3.053**
	Within Groups	518695.903	532	974.992	
	Total	599071.393	559		

** Significant at 0.01

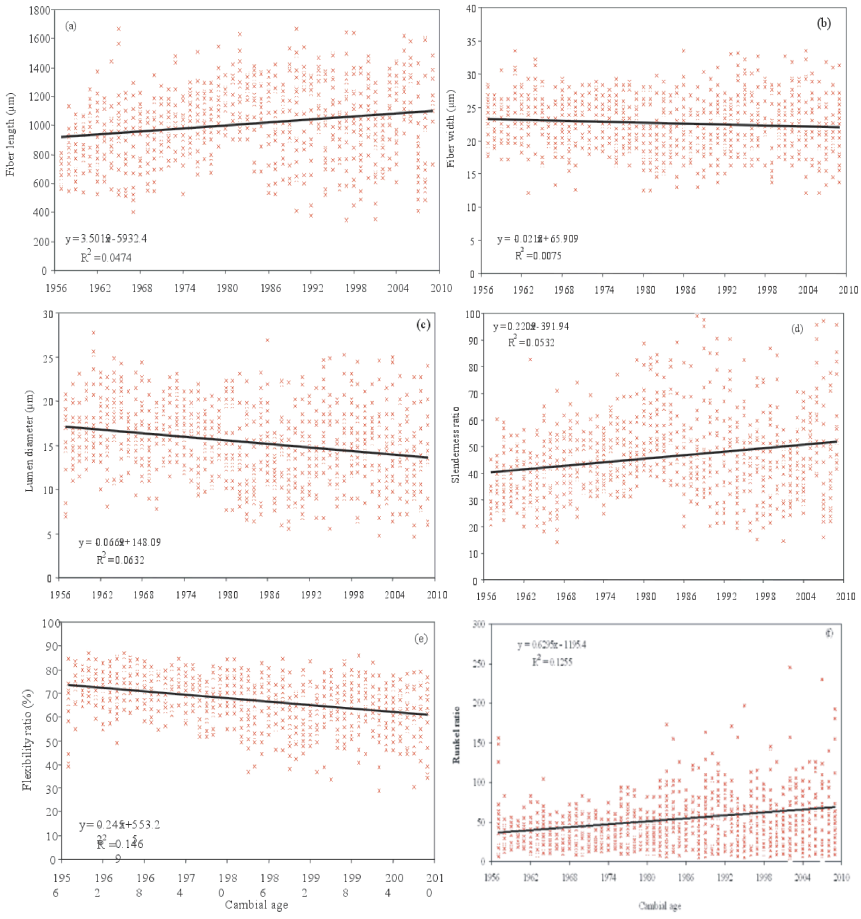

Fig. 1: The relationships between cambial age and fiber properties of maple wood

to 35 cm, respectively. Study area was located at 51°27' 45"-51°23' 45" E longitude and 36°37' 45"–36°33' 15" N latitude. The altitude of sea level for this site was 100 m. The soil texture of this region was clay to clay-loam with a clay percentage of 30 to 35%. The annual rainfall and annual average temperature was 1302 mm and 16°C, respectively. October (256 mm) and November (216 mm) are high-rain months and July (32.6 mm) is a low-rain month. The mean monthly temperature reaches its maximum level in August (25.4°C) and July (25.2°C). The mean of monthly maximum temperature and monthly minimum temperature was 19.5 and 12.7°C for Noshahr site.

A disk, 5 cm in thickness, was removed from each tree at breast height level for evaluation of fiber dimension properties. The fiber dimensions of the early wood of every ring from the radial direction were measured for each of the tree samples disks. After macerating them with Jeffrey's solution (10% nitric acid: 10% chromic acid: water, 1: 1: 18), the dimensions of 20 fibers (fiber length, fiber diameter and fiber cell wall thickness) of every ring were measured using the Leica Image Analysis System.

To determine the effect of cambial age on biometry features, statistical analysis was conducted using the SPSS programming method in conjunction with the analysis of variance (ANOVA) techniques. Duncan'smultiple range test (DMRT) was used to test the statistical significance at the " = 0.05 and " = 0.01 levels.

RESULTS AND DISSCUSION

Analysis of variance (ANOVA) indicated that the cambial age had significant effect on fiber properties (fiber length, fiber width, cell wall thickness, lumen diameter and flexibility and Runkel ratio of maple wood (Table 1). There aren't strong relationships between cambial age and fiber properties. With increasing cambial age, the values of fiber length, cell wall thickness, slenderness ratio and Runkel ratio increased while the fiber width, lumen diameter and flexibility ratio decreased (Figure 1).

CONCLUSION

Analysis of variance (ANOVA) indicated that the effect of cambial age on fiber features of maple wood (*Acer velutinum* Bois) were significant. With increasing cambial age, the values of fiber length, cell wall thickness, slenderness ratio and Runkel ratio increased while fiber width, lumen diameter and flexibility ratio decreased. There isn't relationship between age cambial and fiber features in maple wood.

REFERENCE

1. Rupert, W., M.D. Geofery and E. Robert, 2002. High-resolution analysis of radial and wood density in Eucalyptus nitens, grown under different irrigation regimes.
2. Panshin, A.J. and C. de Zeeuw, 1980. Text book of Wood Technology, Structure, Identification, Properties and Uses of the commercial wood of the United States and Canada, McGraw Hill Book Company, New York, pp: 722.
3. Desch, H.E. and J.M. Dinwoodie, 1983. Timber, Its structure, Properties and Utilization, 6th Edition. Published by Macmillan Education Limited, pp: 410.
4. Ocloo, J.K. and E. Laing, 2003. Correlation of Relative Density and Strength Properties with Anatomical properties of the wood of Ghana Celtis species. Discovery and Innovation, 15(314): 186-197.
5. Onilude, M.A., 2001. Journal of Tropical Forest Resources, 17(1): 154-159.
6. Jorge, F., T. Quilho and H. Pereira, 2000. IAWA Journal, 21(1): 41-48.
7. Hudson, I., L. Wilson, C. Sandercock and R. Sands, 1995. Within ring variability of Wood microstructure in Eucalyptus nitens. In: B.M. Potts, N.M.G. Borralho, J.B. Reid, R.N. Cromer, W.N. Tibbits and C.A. Raymond (eds), Eucalyptus plantation: Improving fibre yield and quality: CRC for temperate Hardwood Forestry. Hobart., pp: 110-115.
8. Sandercock, C.F., R. Sands, B.G. Rideoutt, L.F. Wilson and I. Hudson, 1995. Factors Determining wood microstructure in Eucalyptus. In: B.M. Potts, N.M.G. Borralho J.B. Reid, R.N Cromer, W.N. Tibbits and C.A. Raymond (eds), Eucalyptus Plantations: Improving fibre yield and quality: CRC FOR Temperate Hardwood Forestry. Hobart, pp: 5-9.
9. Ridoutt, B.G. and R. Sands, 1993. Within-tree variations in cambial anatomy and xylem cell differentiation in Eucalyptus globules. Trees, 8: 18-22.

10. Ridoutt, B.G. and R. Sands, 1994. IAWA Journal, 15: 417-424.
11. Bendtsen, B.A., 1978. Forest Product Journal, 28(10): 61-72.
12. Rulliaty, S. and W.A. America, 1995. Natural variations in wood quality indicators of Indonesia big leaf Mahogany (*Swietenia macrophylla*) King XX IUFRO World Congress Proceeding, Tempere, Finland, pp: 205.