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Effects of Age of Farm-Grown *Eucalyptus* on Seasoning Quality of Wood and its Utilization in Pakistan

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ABSTRACT

Age in fast growing *Eucalyptus camaldulensis* Dehn has little effect on wood properties like shrinkage, warp and splits. The wood from all age groups is equally defect prone giving low lumber recovery (lower LRF % values) and needs further treatments for dimensional stabilization irrespective of the age group. It can be felled at any age from 5-years and onward. *Eucalyptus* species in Pakistan have the potential for traditional uses and as such it can be harvested at a relatively young age. It should be sawn to end use shape, into dimension stock, treated and seasoned for utilization.

Key Words: *Eucalyptus camaldulensis* Dehn; Tree age; Seasoning shrinkage; Warp

INTRODUCTION

Pakistan has a considerable shortage of wood and wood products (Khan & Sheikh, 1986). In 1983-84, forestry contributed 0.35% to GDP but by 1998-99 had decreased to 0.11%. The area under forests in Pakistan including Azad Kashmir and Northern Areas, is only 16.702 million hectares (m ha) out of total land area 87.98 m ha. Of this, area private plantations (farm forestry) represents 2.256 m ha (Anonymous, 2000). The estimated demand for timber and firewood in Pakistan in 1997 and 1998 was 453000 m^3 and 505000 m^3, respectively. However, the supply of timber and firewood was 184000 m^3 and 199000 m^3, respectively in 1998 and 1999 (Anonymous, 2000).

In order to meet the increasing demand of wood supply in the country, a number of fast growing *Eucalyptus* species have been introduced as an alternative to slower growing native species like Sheesham (*Dalbergia sissoo),* Kikar (*Acacia nilotica),* Bakain (*Melia azedarch)* and Mulberry (*Morus species).* Amongst these, *E. camaldulensis* and *E. tereticornis* have shown to be more adaptable to a variety of ecological conditions and consequently have been planted more frequently than any other species of the genus (Siddiqui & Mahmood, 1986). However, *Eucalyptus* wood has not yet been considered commercially because of questions about its properties, potential end uses and problems of seasoning.

Most of the *Eucalyptus* species develop growth stresses in wood and spiral in the grain due to their fast rate of growth resulting wood prone to major defects such as warp (twist, bend etc.), surface cracks and end splits. These defects are exhibited when the wood is sawn and seasoned and the recovery of the sawn wood is very low (Siddiqui & Mahmood, 1986). The age of tree when it is fell and sawing patterns may affect the development of these defects (Qadri, 1983). There are reports in the literature that 19-33 years-old, plantation grown *Eucalyptus globulus* Labill. ssp. *globulus* had the potential to produce merchantable structural sawn products and with careful management the quality of these products could be improved (Yang & Waugh, 1996). In Pakistan, however, there are very few research reports on these aspects of *Eucalyptus* wood. The present studies, therefore, were planned to determine the effect of age of *Eucalyptus* tree when it is fell on the wood defects developing during sawing and seasoning and to examine the suitability of *Eucalyptus* for drying and seasoning.

MATERIALS AND METHODS

Farm grown *Eucalyptus camaldulensis* Dehn trees from the research area of the department of Forestry at Post Graduate Research Station, University of Agriculture, Faisalabad were used for this study. Ten trees having age groups of 5-years (4 trees), 8-years (3 trees), and 14-years (3 trees) were randomly selected, felled, logged and transported to the Wood Testing Laboratory of Department of Forestry, University of Agriculture, Faisalabad. From the original logs wood specimens measuring 2.5 cm x 5 cm x 30 cm (thickness x width x length) were prepared from the outermost boards ($1/3^{rd}$ of the radius position from pith) at the breast height position (1.5 meters above the ground. The total number of samples prepared in each age group was 73 from 5-year old trees, 53 from 8-yrs old trees and 104 from 14 years old trees. All specimens were planed with automatic fixed gauge planer to give sharp edges i.e. all four dimensions at right angle to each other, labeled and stacked at right angle to each other. The specimens were then air-dried for 90 days at ambient conditions (temperature 15-25^0C. The data for moisture loss (%), shrinkage along various planes, warp expressed as lumber recovery factor (percent volume of a sample produced/recovered after

removing defects per unit actual air-dried sample volume) and wood density (kg m^{-3}) were recorded following the methods described by Walker (1993) and Haygreen and Bowyer (1989). The data so collected were analyzed statistically using one-way ANOVA single factor (the age). Least significant difference test at 0.05 probability level was applied to compare the means (Montgomery, 1991).

RESULTS AND DISCUSSION

The results for various wood responses (study parameters) are indicated in Tables I and II. From the silvicultural management point of view it is important to know at what stage the *Eucalyptus* tree can be harvested. As *Eucalyptus* is a fast growing tree and farmers are eager to get early income from their produce this study was designed to decide the appropriate age of tree for felling.

The moisture contents (%) in 14-year old tree were significantly lower ($p<0.05$) from 5-years or 8-years trees, but with the moisture contents decreasing with increasing tree age, there was no significant difference in moisture contents between 5-years and 8-years old trees. The tangential shrinkage and longitudinal shrinkage in 14-years old trees was significantly higher ($p < 0.05$) from 8-years old trees but 5-years old tree did not show any significant difference in tangential or longitudinal shrinkage from other age groups. In case of twist and total lumber recovery after removing all defects data from 8-years age group trees was significantly different from that of 5-years or 14-years age group but there was not a significant difference in twist in 5-years or 14 years age groups. As a consequence 8-years old trees had the lowest LRF_{twist} (60%) and lowest overall lumber recovery after removing all defects. The data also showed that twist was the main problem that reduced the lumber recovery (lower LRF%) and was more severs in 8-years old trees. Density was also significantly different in the three age groups. It was significantly lower in 5-years old trees than from the rest of the two age groups. The data also depicted that youngest trees of 5-years age gave highest LRF % and proved to be better harvested at shorter rotation.

When confidence interval (CI 95%) was used to compare the difference in mean response of three age groups (Table II), the twist in 5-years old trees was significantly lower (higher LRF twist %) while there was no difference in (LRF twist %) of 8-years and 14-years age groups. The total recovered volume (LRF vol %) of all three age groups was significantly different from each other, highest in 5-years old trees and lowest in 8-years old trees.

Other parameters such as radial shrinkage, cup, bend, crook, surface cracks and end splits were negligible and did not affect the wood quality to any considerable extent, regardless of age.

Various deformations in wood are subject to growth stresses. The severity of growth stresses appears to be subject to varying growth rate controlled by both genetic and environmental factors i.e. (Hillis, 1978). Growth stresses are less severe if the trees are subject to less competition. The least stressed logs are liable to come from open grown trees on farmlands (Walker, 1993). Many defects like bend, cup, crook, end split and checks were negligible in the specimens, perhaps due to less growth stresses in open farm grown trees. Walker (1993) also described that small stems are less likely to end split or heart check but are likely to warp on sawing due to much steeper longitudinal stress gradient. The results of this study also conform it in case of twist that appeared as the major defect in older trees.

Regardless of the species or where the forests are established, the variation in wood properties between trees can be great (Walker, 1993). Growth stresses are more severe in hardwoods, particularly marked in *Eucalyptus* species. Thus there are opportunities for upgrading the quality of wood in fast growing species by proper sawing techniques (particularly by quarter sawing). Walker (1993) has suggested that the diameter should be 75 cm, the butt log then will be large enough to quarter saw efficiently.

Significant differences in wood density between provenances have been shown to exist in *Eucalyptus*

Table I. Effect of age on shrinkage (%) along various planes after seasoning in Eucalyptus

Tree age (Years)	Shrinkage (%)				
	Tangential	Radial	Perimetric	Longitudinal	Volumetric
5	5.26	6.20	5.58	1.95	13.37
8	4.76	6.45	5.18	1.77	13.15
14	5.53	5.05	5.43	2.18	13.24
$LSD_{0.05}$	0.665	NS	0.635	0.486	1.701

Table II. Effect of age on lumber recovery factor (%), moisture loss (%) and wood density (kg m^{-3}) after seasoning in Eucalyptus

Tree age (Years)	LRF (%)			Moisture loss (%)	Wood density (kg m^{-3})
	Bend	Twist	Volume		
5	97.68	85.30	83.87	45.78	670.30
8	93.23	59.53	56.51	45.79	706.81
14	97.81	72.99	72.79	43.71	695.35
$LSD_{0.05}$	NS	(12.08)	(11.86)	NS	(41.154)

camaldulensis Dehn (Walker, 1993). In the present study marked variation in density was observed (lower in younger trees). These results are contrary to the findings of Yang and Waugh (1996), who described that basic density of the young trees was likely to be comparable to that of the mature forests if the age difference is taken into consideration. However, silviculture that is aimed towards reducing rotation age can have a very strong effect on wood properties (Walker, 1993). There seems to be very general agreement between all who have studied wood property variations in Eucalyptus that tree to tree differences are usually large and wide variability is a constant feature of the wood.

Previously the studies conducted in Pakistan were based on wood density, its variations and related strength properties. Under present studies the characteristics parameters were emphasized from the end use viewpoint with particular references to age effect. From this study it was concluded that *Eucalyptus* species in Pakistan have the potential for traditional uses. It can be felled at any age from 5-years and onward. In most of the seasoning related responses (warp or twist) in wood it is equally defect-prone and needs stabilization treatments irrespective of the age group. It should be sawn into end use component's shape (dimension stock) immediately after felling and then treated and seasoned.

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