Variation In Basic Density, Fibre And Vessel Morphology Of Eucalyptus Tereticornis Sm. Clones

P. Sreevani, R.V. Rao

Abstract: The basic density, fibre and vessel morphology of five clones of Eucalyptus tereticornis developed by ITC Bhadrachalam were reported. The five clones represented by four trees each of four and half years old, were from Sarapaka, Andhra Pradesh. Significant variation have been found among the clones. Basic density is positively correlated with fibre length, vessel diameter and positively correlated with vessel frequency while other characteristics have no effect. The results obtained in this study have shown the suitability of raw material for paper and pulp where the required basic density is met with. Mainly these clones are primarily tried to meet the requirements of paper and pulp industry.

Key Words: Basic Density, fibre and vessel morphology, clones, Paper and Pulp.

Introduction:

Eucalyptus tereticornis, known as Mysore gum in India and forest gum in Australia, is one of the most extensively planted eucalypt species in India. It is planted to meet the ever increasing demand for pulp wood and solid wood requirements of the Industry. ITC, Bhadrachalam Paper Boards Ltd., Andhra Pradesh, has come out successfully, after a number of trails, with some commercial clones of this species with improved productivity (Lal *et al.* 1993, 1997). There are only a few studies made on assessment of wood quality of *Eucalyptus tereticornis* from India belonging to different ages and localities of ordinary seed source (Purkayastha *et al.* 1979, Sharma & Bhandari 1983, Bhat & Bhat 1984, Bhat 1986, Bhat *et al.* 1987, Bhat 1990, Singh & Naithani 1994). Rao *et al*. (2002) initiated work on the assessment of the wood quality of *Eucalyptus tereticornis* clones. In this paper where studies made on basic density, fibre and vessel morphology of five commercial clones of ITC, Bhadrachalam which are about 4-5 years of age and grown in a clonal demonstration plot under rain fed conditions at Sarapaka, Andhra Pradesh are presented.

1] Materials and Methods:

Materials for this study were four trees from each of the five clones of ITC, Bhadrachalam numbered 3,4,6,7 and 10. These clones planted at an espacement of 1m x 1m except one clone (clone 10) where the espacement was 3m x 2m in red soil under rainfed conditions at Sarapaka, Andhra Pradesh, India the trees were cut at 10 cm above ground level and 1m length billets up to the height of 3m were collected for Investigation.

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The average mid-girths of the billets of the different clones were 43.5 cm (clone 3), 31 cm (clone 4), 38 cm (clone 6), 33 cm (clone 7), 42 cm (clone 10). At the time of felling, the trees were four and half years old. From each billet a part (0.25 cm) of it was cut and set aside for paper and pulp studies and 5 cm thick discs were cut to study percentage of heartwood and sap wood, general features and gross structure. From the remaining part 2.5 cm wide radial strips were prepared. From these strips 1 cm on either side of the pith was removed and from the remaining lengthwise sticks were prepared. From these sticks 11 blocks were made and 10 blocks were used to find the basic density which was determined by using oven-dry weight / green volume of the sample. The eleventh block was used for anatomical studies. Only one side of the radius was sued for the study as our earlier findings showed non-significant difference on both sides of the pith (Rao *et al.* 2002). Silvers taken from 1 cm 3 blocks from billets of each clone and macerated with 30% nitric acid and a few crystals of potassium chlorate (Jane 1970). Fibre and vessel dimensions were measured from the macerated material. Thirty measurements per tree for each of the fibre and vessel characteristics were taken. Fibre wall thickness was calculated by deducting the fibre lumen diameter from the fibre diameter. One-way ANOVA and Tukey's test was performed to compare the clones. A simple correlation coefficient was performed to examine the inter-relationships among the anatomical properties and density.

2] Results and Discussions:

Basic density differed significantly between the clones at 1% level (Table.1) the highest basic density was recorded for clone 4 (0.583 g cm-3) and the lowest for clone 3 (0.514g cm-3). Grzeskowiak *et al.* (2000) also reported significant differences in basic density in two *E. Grandis x camaldulensis* clones. Purkayastha *et al.* (1979) showed that basic density (0.538 g cm-3 to 0.640 g cm-3) of 8 to 9 year old *Eucalyptus* hybrid (probably *E. tereticornis*) varied significantly among five localities. However, Bhat and Bhat (1984) found that the mean basic density of 1-year-old trees of *E. tereticornis* from Kerala was 2.6% greater than the overall mean density of five different plantations of 8 to 9-year-old trees as reported by Purkayastha *et al.* (1979). The present study, however, did not show higher value in any clone compared with the data provided by Bhat and Bhat

(1984). Quilho and Pereira (2001) showed that the wood basic density in *E. globulus* differed depending on the sites where they were grown. Best and worst sites produced higher and lower densities respectively and density was independent of growth rate. From the above discussion, it becomes evident that basic density varies with age and locality. Since these clones are primarily tried to meet the requirements of the paper and pulp industry, it is worthwhile to consider the suggestion of Ikemori *et al.* (1986) who stated that basic density which was in the range of 480 to 570 kg m-3 was ideal for paper and pulp. The results obtained in this study have shown the suitability of raw material for paper and pulp where the required basic density is met with.

Table 1. Basic density and Anatomical properties of *Eucalyptus tereticornis* clones.

Property	Clone number					Significance
	3	4	6	7	10	
Basic density (g cm-3)	0.514 a	0.583 b	0.550 c	0.529 d	0.541 e	* *
Fibre length (µm)	907 b	948 a	925 c	886 d	946 a	*
Fibre diameter (µm)	12.54	12.73	13.01	13.08	13.06	NS
Fibre lumen diameter (µ m)	7.89 a	7.74 a	7.33 b	7.49 b	7.33 b	*
Wall thickness (µ m)	4.64 b	4.98 c	5.67 a	5.59 a	5.72 a	* *
Vessel frequency	19 a	15 b	15 b	18 a	14 b	* *
Vessel diameter (µm)	111a	127 b	135 c	115 d	121 e	* *
Vessel element Length (µm)	393	392	399	379	389	NS

NS = not significant * Significant at 5% level
** Significant at 1% level

The values sharing common alphabet do not differ significantly at 0.05 probability level.

3] Fibre Characteristics:

Fibre length, fibre lumen diameter, significantly differed between clones at 5% level and wall thickness at 1% level whereas fibre diameter was non significant (Table.1). Maximum fibre length found in clone 4 and minimum in clone 7. Clone 4 and 10 were significantly different from other three clone with regard to fibre length. Fibre lumen diameter was significantly higher in clone 3 and 4, wall thickness was significantly higher in clone 6,7and 10. The fibre lengths published so far for this species were 880 um (Dadswekk 1972; age not known), 742-804 um (Purkayastha *et al.* 1979, 8-9 years), 750-820 um (Laxmi Chauhan *et al.* 1983; 9 years), 660-790 um (Sharma & Bhandari 1983; 8-10 years), 738 um (Bhat 1986; 9-10 years). A comparison of the values obtained in the present investigation with those above shows that the mean fibre length of any clone is longer than what has been reported for trees of higher age group of ordinary seed source.

4] Vessel Characteristics:

Vessel frequency, Vessel diameter showed significant differences at 1% level between the clones (Table.1). Where as Vessel element length was non-significant. The mean vessel frequency ranged from 14 mm-2 (Clone 10) to 19 mm-2 (Clone 3). The mean vessel diameter ranged from 111 um (clone 3) to 135 um (clone 6). Clone 3 and 7 had significantly higher vessel frequency than the other three clones. However, the higher values obtained for Vessel frequency in the present study compared to what has been reported by Purkayastha (1982) and Agarwal and Laxmi Chauhan (1988).

Table 2. Correlation coefficients between basic density and anatomical properties:

		Fibre				Vessel		
Basic density		Length (Fl)	Diameter (Fd)	Lumen diameter (Fld)	Wall thickness (Wt)	Frequency (Vf)	Diameter (Vd)	Length (Vl)
Basic density	1							
Fl	**0.495**	1						
Fd	0.070	0.297	1					
Fld	0.057	0.265	0.228	1				
Wt	0.007	0.030	**0.627**	**-0.615**	1			
Vf	**-0.639**	-0.399	-0.123	-0.403	-0.420	1		
Vd	**0.620**	0.371	0.076	-0.362	0.347	**-0.716**	1	
Vl	0.186	0.123	-0.254	0.053	-0.250	-0.031	-0.011	1

N = 20. Bold type indicates significance at the 0.05 probability level.

[5] Inter-relationship between Basic density and Anatomical properties:

A positive correlation between Basic density and Fibre length, Vessel diameter (r =0.620), a negative (r =0.495) and correlation with Vessel frequency (r = 0.639). Negative correlation was observed between (Table.2) Vessel frequency (r =0.716) and Vessel diameter and also between Lumen diameter (r= 0.615) and Wall thickness. Positive correlation deserved between fibre diameter (r=0.627) and wall thickness. The various correlations, as found in the present study, were suggestive of Complex inter-relationship existing between anatomical characteristics in these newly introduced clonal materials.

Conclusions:

Significant variations in Anatomical properties and basic density were observed in five clones of four and half years old trees except for Fibre diameter and Vessel element length. Basic density was positively influenced by Fibre length, Vessel diameter and negatively influenced by Vessel frequency.

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