TECHNICAL NOTE: SOLID WOOD PROPERTIES OF *EUCALYPTUS CAMALDULENSIS* PLANTED FOR PULPWOOD PRODUCTION IN THAILAND

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(Received September 2011)

Abstract. Solid wood properties of two *Eucalyptus camaldulensis* clones (clone A and clone B), derived from different pulp and paper companies and planted in Thailand for pulpwood production, were investigated to evaluate the possibility for lumber production. Clone A had significantly higher Young's modulus, greater density, and straighter grain compared with clone B. These results suggest that some clones may have more favorable properties for lumber production than others. Thus, wood properties should be included in clonal trials and early testing of this species.

Keywords: Basic density, Young's modulus, shrinkage, interlocked grain, *Eucalyptus camaldulensis*.

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Wood and Fiber Science, 44(1), 2012, pp. 108-110

INTRODUCTION

Eucalyptus is one of the fast-growing plantation tree species. Because of the characteristics of fast growth, the main wood products from *Eucalyptus* plantations are wood chips used as raw material for pulp and paper or fiberboards (Cossalter and Pye-Smith 2003). However, the price paid for wood chips from fast-growing species is sometimes too low. Conversely, many fast-growing species are considered to have potential for lumber production. In this study, to investigate the possibility for lumber production, solid wood properties were studied in two commercial clones (A and B) of plantation-grown *Eucalyptus camaldulensis* trees, which were selected for pulpwood production in Thailand.

MATERIALS AND METHODS

The experimental site, *E. camaldulensis* progeny test stand of Kasetsart University, was located in Wang Nam Khieo, Nakhon Ratchasima, Thailand (14°29′52″ N, 101°56′16″ E). Four-yr-old trees from two commercial clones, A and B, were used in this study. These two clones were originally selected and improved by different commercial pulp and paper companies in Thailand for pulpwood production. In this study, these two clones were selected because of good growth characteristics compared with other clones. Diameter and stress wave velocity (SWV) of stems were measured for 15 trees in each clone according to a previous method (Ishiguri et al 2007). Stress wave propagation time of stem was measured between 0.5 and 1.5 m above the ground by a commercial handheld stress wave timer (Fakopp Enterprise, Agfalva, Hungary). Five trees for each clone were randomly cut down for analyzing wood properties. Two logs (≈2 m long) were obtained from one tree at 1.3-3.3 m and 3.3-5.3 m above ground for determining dynamic Young's modulus (DMOE) by a tapping method (Ishiguri et al 2005). Natural frequency of longitudinal vibration caused by sound, emitted by hitting the cross-section of a specimen with a hammer, was measured using a handheld Fast Fourier Transform analyzer (AD-3527; A&D Company, Limited, Tokyo, Japan). Mean value of DMOE was determined by averaging values from two logs obtained from a tree. Disks (50 mm thick) were also collected from a tree at 1.3 and 5.3 m above ground for measuring basic density (BD). BD was measured at 10-mm intervals from pith to bark in 73 blocks from 10 trees. Mean value of BD in a tree was calculated by averaging data collected from 1.3 and 5.3 m above ground. Radial and tangential shrinkage from green to oven-dry conditions was measured according to the Japan Industrial standard. Three specimens (20 [L] × 20 [R] × 20 [T] mm) in each tree (total 30 specimens from 10 trees) were prepared from the disk collected at 1.3 m above ground. Mean value of shrinkage was also calculated in each tree. For evaluating interlocked grain, disks (50 mm thick) obtained from 1.3 m above ground were split along the base line drawn in a long axis of the transverse section with a wedge-shaped knife. After splitting, lengths of splitting line and baseline were measured on digital images of the transverse section by image analyzing software (ImageJ). Interlocked grain was evaluated as ratio of length of splitting line to length of baseline. In all properties, mean value in each tree was calculated for a significance test. A significant difference in mean value between clones was performed by the t-test.

RESULTS AND DISCUSSION

Table 1 shows mean values of wood properties in two clones. Significant differences in wood properties were found between clones A and B. Stem diameter of clone B was larger than that of clone A, suggesting that clone B had faster growth rate than clone A. Mean values of wood properties in clone A, except for interlocked grain, were higher than those of clone B. Young's modulus of lumber can be predicted by SWV of stems and DMOE of logs (Ross et al 1997; Wang et al 2001; Dickson et al 2003). Also, BD is positively related to mechanical properties of wood (Kollman and Côté 1984).

Table 1. Differences in mean value of wood properties between two clones of 4-yr-old *Eucalyptus camaldulensis*.[a]

Property	Clone A			Clone B			Significance
	n	Mean	SD	n	Mean	SD	
Stem diameter (mm)	15	89	9	15	98	10	*
Stress wave velocity of stem (km/s)	15	34	1	15	31	1	**
Mean dynamic Young's modulus of logs (GPa)	5	107	6	5	8	5	**
Mean basic density (kg/m^3)	5	490	10	5	430	10	**
Radial shrinkage (%)	5	55	3	5	4	4	**
Tangential shrinkage (%)	5	125	4	5	104	8	**
Interlocked grain (%)	5	101	6	5	222	69	*

[a] n, number of trees; SD, standard deviation; * significance at the 5% level; ** significance at the 1% level.

Thus, clone A might have more favorable wood properties than clone B. Conversely, shrinkage from green to oven-dry conditions in clone B was lower than in clone A. Because lower values in shrinkage led to higher dimensional stability of lumber, clone B had higher lumber dimensional stability than clone A. Mean value of interlocked grain in clone A was half that in clone B, indicating that clone B had severely interlocked grain compared with clone A. Based on these results, we found differences in wood properties between the two clones selected for pulpwood production by growth characteristics. Clone A had favorable properties for lumber production, such as high density, high mechanical properties, and straight grain.

CONCLUSION

This study investigated solid wood properties of two *E. camaldulensis* clones planted for pulpwood production in Thailand. At 4 yr of age, significant differences in wood properties were found between the two clones. These results suggest that wood properties should be included in clonal trials and early testing of this species. Although this species is mainly planted for pulpwood production in Thailand, some clones may have favorable properties for lumber production. Thus, medium or long rotation management practices to produce timber-quality wood should be considered.

ACKNOWLEDGMENTS

We express our appreciation to the National Research Council of Thailand for financial support during the tree plot establishment and initial maintenance.

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