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Effects of propagule type on genetic parameters of wood density and growth in a loblolly pine progeny test at ages 10 and 11 years

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Abstract Nine full-sib families of loblolly pine (*Pinus taeda* L.) were produced by a 3×3 factorial mating design. Rooted cuttings and seedlings of full-sib families were tested together in two field locations. Twelve-millimeter wood increment cores were collected from 10- and 11-year-old test trees. On each of the two sites, there were six blocks and a split-plot design, with propagule type as the whole plot and family as the sub-plot. In addition to the collection of wood samples, height and diameter of 1,600 trees were measured. No significant differences were found between cuttings and seedlings for wood density and growth traits. Significant family variation was found for growth and wood density. Genetic parameters estimated for wood density and growth traits using seedlings and rooted cuttings showed that individual-tree and family heritability estimates from rooted cuttings were similar to or higher than those from seedlings for all traits. Half-sib breeding values for parents were highly correlated based on seedling and rooted cutting estimates for height (0.95) and wood density (0.99) but not for diameter (0.56), which suggests that wood density and height breeding value estimates from rooted cuttings in clonal progeny tests can be estimated by traditional seedling tests, but not for tree diameter.

Keywords *Pinus taeda* · Wood density · Heritability · Clones · Vegetative propagation

Introduction

Loblolly pine (*Pinus taeda* L.) is the most important commercial timber species in the southeastern United States (McKeand et al. 2003). Shorter rotations and increased growth rates are causing changes in the properties of wood produced in loblolly plantations because higher proportions of juvenile wood, or core wood, are harvested from younger trees (Burdon et al. 2004; Zobel and Talbert 1984). Density is an important indicator of wood quality in loblolly pine because it is correlated with strength of lumber and pulp yield (Einspahr et al. 1969; Megraw 1985; van Buijtenen 1969). The genetic variation and potential improvement of wood density in loblolly pine has been well studied, but the differences among propagule types in loblolly pine have not been characterized. Loblolly pine breeding programs are exploring the use of clonal progeny tests (Baltunis et al. 2007), thus understanding potential differences between propagule types is essential for interpreting measurements of wood density in clonally propagated progeny tests.

Genetic variation of wood density in loblolly pine has been quantified in several previous studies. Heritability estimates of wood density in individual trees and half-sib families of loblolly pine are generally high (Atwood et al. 2002; Balocchi 1990; Belonger 1998; Gwaze et al. 2001; Loo et al. 1984; Talbert et al. 1983; Williams and Megraw 1994; Zobel et al. 1978). Genetic correlations between wood density and growth traits in loblolly pine vary from slightly negative (Atwood et al. 2002; Loo et al. 1984) to slightly positive (Stonecypher et al. 1973; Williams and Megraw 1994). Both positive and negative genetic correlations between growth rate and wood density have been reported in other forest tree species (Zobel and Talbert 1984).

Rooting stem cuttings for production of loblolly pine planting stock is a method of vegetative propagation that

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