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Rotation-Age Results from a Loblolly Pine Spacing Trial

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ABSTRACT

This study reports cubic-foot volume yields for particular product definitions from a 25-year-old loblolly pine spacing trial and shows how closely, in the absence of thinning, total and merchantable wood production are linked to initial spacing. Results at the close of the study indicate that (1) high-density plantations can be managed on short rotations for woody biomass production; (2) pulpwood yields can be maximized at a planting density in the neighborhood of 680 trees/ac; (3) the production of solidwood products, without imposing thinning, requires lower establishment densities, with as few as 300 trees/ac planted resulting in a substantial proportion of the total yield recovered as large sawtimber; and (4) a ratio of between-row to within-row planting distances of at least 3:1 does not substantially affect yield production. Considered together, the results of this study suggest that no single planting density is optimal for the wide array of product objectives for which loblolly pine is managed in the South. Rather, managers must select an appropriate planting density in view of the products anticipated at harvest.

Keywords: growth and yield, density, spacing, *Pinus taeda* L.

Few decisions have a greater impact on the growth and development of loblolly pine plantations than how many trees are planted per acre. Managers know that planting density will affect the quantity and quality of wood harvested at rotation, as well as the type and timing of intermediate silvicultural treatments.

Given the importance of initial spacing on the growth and development of forest stands, spacing trials have been established for many tree species. Evert (1971) published a comprehensive review of many spacing studies established where plantation forestry is practiced. He noted that results from many of these studies were limited because of inadequacies in the definition of study objectives, the experimental design, the longevity of the study, or the measurements collected. For loblolly pine, two of the better known studies with at least 25 years of history are the Hawaii spacing trial on the island of Maui and the Calhoun Experimental Forest trial in South Carolina (Harms et al. 1994).

In an effort to increase understanding of how loblolly pine plantations grow in the southern United States, a set of loblolly pine spacing trials was established at four sites in Virginia and North Carolina in the spring of 1983. The primary goals for the study were to (1) evaluate the effects of spacing and density on the growth, development, and survival of loblolly pine trees; (2) provide data for modeling growth and yield relationships; and (3) determine the optimal (in a biological or growth and yield sense) planting densities for particular product objectives. This report presents results related to goal 3 of the study. Yield in relation to four definitions of stand volume was analyzed, namely stand volume and volume of all trees above a specified threshold diameter limit for pulpwood, chip-and-saw, and sawtimber utilization.

The Study

Design and Field Procedures

The experimental design for the study was the nonsystematic design presented by Lin and Morse (1975) in which plots of different sizes and shapes containing equal numbers of trees fit together to form a compact block (Figure 1). Applying this design, a spacing factor (F) of 4 ft was chosen, and four levels of that factor (1F, 1.5F, 2F, and 3F) were selected and randomly assigned to row and column positions on a two-dimensional grid. The intersection of the row and column factors defined 16 plots, each with a specific spacing and density. The factorial arrangement of 16 plots, each with seven rows and seven trees within each row, made up a compact block of about 2.5 ac, including guard trees (Figure 1). Each block contained 4 square plots (4×4, 6×6, 8×8, and 12×12 ft) and 12 rectangular plots (4×6, 4×8, 4×12, 6×4, 6×8, 6×12, 8×4, 8×6, 8×12, 12×4, 12×6, and 12×8 ft). Thus, each rectangular plot had a companion plot that was the same spacing and density but shifted 90 degrees with regard to the row and column spacing (e.g., 4×12 ft and 12×4 ft have the same spacing and density, but the row direction of one is the column direction of the other). Additional details of the experimental design as applied to this study can be found in Amateis et al. (1988); Burkhart (2002) provides an overview of design options for spacing trials.

Four sites were selected, two in the Piedmont and two in the Coastal Plain (Table 1). All sites were cutover areas that had received mechanical site preparation and burning treatments following harvest. Three blocks were established at each site. In most cases, blocks at a site were contiguous, or nearly so. The planting stock used was genetically improved 1-0 loblolly pine bareroot seedlings. The two Coastal Plain sites were planted with material from Coastal Plain

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