FAMILY AND SPACING AFFECT STEM PROFILE OF LOBLOLLY PINE AT AGE 19

Joshua P. Adams, Samuel B. Land, Jr., and Thomas G. Matney[1]

Abstract—Profile measurements were taken on a stratified sample of 19-year-old trees from 8 North Carolina families and a commercial Mississippi-Alabama check established at 3 spacings (5 x 5, 8 x 8, and 10 x 10 feet). Measurements were first fitted on a single profile equation using multiple-regression. Data were also segregated by family, spacing, and family-by-spacing and fitted on the equation. These new model types were tested using the reduction-sum-of-squares principle. Stem volumes were calculated using the different model types and compared. A significant decrease of error was obtained from the reduction-sum-of-squares method, indicating that accuracy of stem-volume estimation can be increased by accounting for family and spacing in the profile equation.

INTRODUCTION

Many species have natural form deviations due to age, butt-swell, silvicultural treatments, dominance, site, stand density, and heredity (Bügen and Münch 1929, Liu and Keister 1978). Deviations in form have been observed in pines by Baldwin and others (2000) and Allen (1993). These papers attributed form variation to different levels of competition. However, some variation is attributed to genetics. McLauchlin (1998) found significant differences in taper below d.b.h. between families of loblolly pine.

Many studies have favored selection on height for genetic improvement in growth and yield (Foster 1986, Gwaze and others 1997, McKeand 1988), while others have favored selection on diameter (Kusnander and others 1998, White and Hodge 1992). The Western Gulf Forest Tree Improvement Cooperative incorporates some measure of profile in their selection by basing selection on juvenile per-acre volume (Raley and others 2003). However, they use a common stem form for all families. The selection on height, diameter, or common form leaves no means to account for stem profile variation that may be present among families.

This study investigates variation in stem profile among families at age 19 and discusses the importance that these differences may have on selection gains. Because selection is practiced at early ages, juvenile traits are explored for correlations with profile differences. More accurate family selection and volume prediction may be possible by accounting for family-specific stem profiles.

METHODS

Containerized seedlings of eight open-pollinated families in North Carolina (NC) and one open-pollinated "genetic check" (bulk seed lot) from east-central Mississippi (MS) and west-central Alabama (AL) were provided by Weyerhaeuser Company. The 8 families were selected based on 12-year-old progeny tests to represent ideotypes of fast growth with small crowns (NC1 and NC8), fast growth with large crowns (NC4 and NC7), slow growth with small crowns (NC3 and NC6), and slow growth with large crowns (NC2 and NC5).

Seedlings were planted from April 22 to May 7, 1985, at two sites on the John Starr Memorial Forest (Mississippi State University school forest) in Winston County, MS. The experimental design consisted of a randomized complete block design with four replications at each site. The two sites were an old field and a cutover-and-site-prepared area. Treatments were arranged in split-split plots, where each rep was split into 3 spacings (5 x 5, 8 x 8, and 10 x 10 feet). Each spacing was split into a mixed family plot and a pure family plot. The pure family plot contained nine subplots, each having one family or the check. A single or double border row was planted around each subplot. The interior trees of each pure family subplot covered an equal area of 0.0367 acre. Survival, d.b.h., and total height were measured at ages 5, 9, 13, and 17 years. Crown length was measured at ages 9, 13, and 17.

Two trees from each 1-inch diameter class from each family in each spacing were selected for sampling. Selected trees had no major defects or fusiform galls (Cronartium quercuum f. sp. Fusiforme), and they could not be in the border rows. A partial profile of the stem was used for development of profile equations. Lee (2002) showed that full profiles and partial profiles were statistically the same at the 0.05 significance level. Measurements of diameter and height were taken with a caliper and tele-Relaskope at stump height (approximately 0.5 feet), 2 feet, d.b.h., midpoint between base of live crown and d.b.h., base of live crown, midpoint between base of live crown and top of the tree, and top of the tree.

Heights and diameters of the 361 sampled trees were fitted with regression on 2 third-degree polynomials conditioned through d.b.h. to characterize profiles. The data were first fitted on a general model that used all sampled trees. Then, data were segregated by family, spacing, family-by-spacing, ideotype, and ideotype-by-spacing and fit as separate models. The subset models were tested against the general model using the reduction sum of squares method described by Graybill (1961).

A computer program was written to apply the general model profile and subset model profiles onto age 17 height and d.b.h. measurements for all non-border trees > 4.5 inches d.b.h. Cubic foot volumes for every 4-foot segment of the stem, up

[1] Graduate Student and Professors, respectively, Mississippi State University, Department of Forestry, Mississippi State, MS 39762.

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