GROWTH RATES AND GENETIC PARAMETERS OF LOBLOLLY PINE IN SOUTHERN BRAZIL

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Abstract: -- Loblolly pine *(P. taeda* L.) is planted throughout the southern United States from latitude 30° - 38°N, with approximately 10 million ha of plantations established. Loblolly pine is also an important species in many other countries, including Brazil where 1 million ha of plantations have been established from latitudes 20° - 32°S in the states of Matto Grosso do Sul, Sao Paulo, Parana, Santa Catarina, and Rio Grande do Sul. In the southern US, mean annual increments (MAI) are approximately 10 m^3/halyr with rotation ages from 25-30 years. In southern Brazil, MAI is around 25 m^3/ha/yr with rotation ages from 20-25 years.

Much of the difference in growth rates of loblolly in the two countries can perhaps be attributed to the relatively mild climate of southern Brazil. Data from Macon, Georgia, USA and Otacilio Costa, Santa Catarina state, Brazil illustrate typical climates for the regions. Mean annual preciptation is around 1100 mm in Macon and 1700-1800 mm in Otacilio Costa. Both summer high and winter low temperature extremes are greater in the southern US than in Brazil. Macon averages 45 frost days per year, Otacilio Costa average 30 frost days per year.

Data from 10 progeny tests of loblolly pine *(P. taeda* L.) established by Igaras Papeis e Embalagens southern Brazil were analyzed to examine height, diameter and volume growth rates and genetic parameters of growth traits. Parameters calculated included heritability (h^2) , proportion of dominance (d^2), type B genetic correlation (r_B) which measures genotype x environment interaction, and juvenile-mature genetic correlations (r_g). A total of 310 FS families involving crosses among 83 parents were represented in the data. Generally, measurements of height and diameter were available at three ages: 3, either 8 or 9, which is referred to as age 8 for convenience, and one final measurement between the ages of 12 and 17, referred to as age 15 for convenience. At age 15, height was measured on only a subset of dominant and co-dominant trees, while DBH was measured on all trees. Growth and genetic parameter results were compared to estimates for height growth in the US (Balocchi et al. 1993, and unpublished data from Bin Xiang of the NC State University-Industry Tree Improvement Program) and Zimbabwe (Gwaze et al. 1997).

Survival in the Brazilian trials was excellent, exceeding 90% at age 15. Mean height was 3.88 m at age 3 years, 11.87 m at age 8 years, and 19.7 m at age 15 years. Mean DBH was 6.1 cm at age 3, 18.8 at age 8 years, and 23.8 cm at age 15 years. At age 8 height and DBH in these Brazilian trials was approximately 25% greater than in a large progeny study in Bainbridge GA (Balocchi et al. 1993).

All genetic parameter estimates for the three different growth traits (height, DBH, and volume) were quite similar at ages 3 and 8, thus results for DBH at age 15 were used as proxies for height at age 15. Heritability estimates for height growth were very high, with $h^2 = 0.28$ at age 3, 0.46 at age 9, and 0.35 at age 15. These values correspond nicely to estimates from Zimbabwe based on tests with similar growth rates, but were 2 to 4 times as large as h^2 estimates from the US where growth rates were lower. However, even when comparing heritability estimates for populations of the same mean height, h2 estimates from Brazil were substantially higher. The increase in heritability appears to be due both to increased additive genetic variance and a reduction in variance due to all other sources of variation. The

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three data sets with data from ages 15 years and older showed a decrease in h^2 at the oldest measurement. Heritability for height growth appears to be maximum when the mean height is around 15 m (50 ft).

Dominance variance in the Brazilian tests was high at age 3 ($d^2 = 0.27$) but decreased with age and was unimportant relative to additive variance. A similar pattern was observed in the southern US by Balocchi et al. (1993), while dominance was low at all ages in Zimbabwe. In the Brazilian data there was very little genotype x environment interaction, and juvenile-mature genetic correlations are high. Combined with high heritability, there is tremendous opportunity to make genetic gain.

Juvenile-mature genetic correlations in the four data sets were examined. In one of the data sets, there was no variation in the juvenile-mature correlation, with all values greater than 0.8. For the other three of the data sets, the juvenile-mature correlation was predicted nicely using a linear regression on the natural log of the age ratio (LAR), as suggested by Lambeth (1980). However, there was substantial variation in both intercept and slope for the three data sets. In contrast, if log of the height ratio (LHR) is used as the independent variable, intercept and slope for the three data sets were very similar.

LITERATURE CITED

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