15-YEAR GAINS FROM PARENTAL AND EARLY FAMILY SELECTION IN LONGLEAF PINE

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Abstract.--Wind-pollinated families from 100 parents differed greatly in height at age 8. Selection of the tallest 10 percent produced a 43-percent gain in plot volume at age 15. Most of this gain was attributed to better survival of taller families rather than to differences in growth of survivors. Selection of the fastest growing 25 percent of the parents produced a 15-percent gain in 15-year plot volume. Progeny testing for early height growth prior to orchard establishment is advisable.

Additional keywords: Genetic gain, progeny test, height growth, survival, volume, juvenile performance, Pinus palustris.

Wide differences in early growth of longleaf pine (Pinus palustris Mill.) families were demonstrated by an 8-year progeny test (Snyder 1969). Some families averaged 10 feet tall, nearly twice the population mean, while others averaged less than 1 foot tall. The study planting was remeasured at age 15, and the gains from parental selection and from selection of 8-year-old families are reported here.

METHODS

In 1955, 100 trees were randomly selected in Harrison and two adjacent counties in Mississippi. In 1957, their open-pollinated progeny were bar-planted on a grassy site at 6- x 12-foot spacing. Eight-tree row plots were replicated six times. Brown spot was controlled by spraying. Details on planting and care were reported earlier (Snyder 1969).

In 1972, heights, d.b.h.'s, and other traits were measured and subjected to analysis of variance for randomized blocks with missing plots. Trees not tall enough to have d.b.h.'s were not measured. Survivals were transformed to arc sine sq. root of percentages. Volumes were computed according to Schmitt and Bower (1970). Statistical significance was tested for at the 0.05 level.

RESULTS

Family selection

Family differences **in** height were still significant at 15 years, but they were considerably smaller than at 8 years. Differences in diameter, volume per tree, survival, and volume per plot were also significant.

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By selecting the tallest 10 percent of the families at age 8, a 43 percent gain was obtained in 15-year plot volume (6.7 vs. 4.7 feet3) (table 1). The correlation between 8-year mean heights and 15-year mean volumes per plot was 0.76. Surprisingly, height growth is not responsible for the increased plot volumes according to the following analyses.

Table 1.--Gains realized at age 15 years from selecting the best 10 percent of the families at 8 years

Trait	Mean		Gain
	Selections	Population	
	------ Ft. or ft.^{3} ------		Percent
8-year height	8.9	5.8	
15-year height	30.7	29.3	5
15-year volume/tree	1.57	1.38	14
15-year volume/plot	6.70	4.69	43

Selecting the tallest 10 percent of the families at 8 years resulted in a 33-percent gain in survival at age 15; 8-year heights had a -0.75 correlation with relative mortality, (8-year survival minus 15-year survival) /8-year survival. Thus, gains in volume per plot were achieved mainly through survival gains, whereas the usually multiplicative effects of improved height and diameter growth were minor. Mean survival in 1965 was 59 percent but by 1972 had decreased to 39 percent. Many seedlings that were less than 1 foot tall at age 8 died. Brown-spot was not controlled between ages 8 and 15. Also, short seedlings were not tallied in 1972.

The correlation between early and later family heights was only 0.57, and selection of the tallest 10 percent of the families for height at 8 years produced only a 5-percent height gain at 15 years. Mortality and the omission of numerous slow growing individuals are responsible for the poor correlation.

Similarly, selecting the best 10 percent achieved only a 5-percent gain in diameter. This trait therefore contributed little more to variation in volume per plot than did height growth.

Parental selection

The 8-year height gain from selecting the best 25 percent of the parents was previously reported as 12 percent (Snyder 1969). By 15 years the gain was only 3 percent (table 2). Thus, the height gains from parental selection

Advisability of postponing orchard establishment until parents are progeny tested depends partly on the length of time required for reliable testing. In this and the previous report (Snyder 1969) progeny tests were evaluated at 8 years because by that age within-plot heights are more uniform (h^2 = 0.53) than at 5 years (h^2 = 0.12). For practical selection, however, 5-year plot means would serve equally well. The best families had exactly the same rank, and the correlation between family means in the two years was 0.78. Planting described here were on an infertile, grassy site. Where competition is controlled or sites are fertile, reliable results might be obtained in less than 5 years (Goddard, et al. 1973).

Would it pay to limit progeny testing to parents rated plus for growth? Though the current experiment contained no plus trees, the random sample of 100 parents provided a range in parental height/age ratios of from 1.1 to 2.6 feet per year. Based on 8-year results, I recommended relaxing parental selection for height/age to 70 percent, i.e., discarding only 30 percent and progeny testing the rest (Snyder 1969). To further decrease the proportion selected would have decreased the chances for obtaining rare, superior growing families. This recommendation also holds for current 15-year plot volumes. Because superior genotypes often could not be recognized from parental performance, reducing parental selection from 25 percent to 10 percent reduced gains from 15 to 2 percent instead of increasing them (table 2). Moreover, Goddard, et al. (1973) found little difference in the likelihood of fast-growing families whether parents were plus trees or merely good-quality trees. Thus, there is no evidence that intensive parental selection of longleaf for growth rate in wild stands would pay.

Although brown spot was chemically controlled in these plantings, a similar pattern of variation in height growth has been observed where the disease was not controlled (Snyder and Derr 1972). The findings therefore should apply whether brown spot is a problem or not.

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