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Nursery Selection of Loblolly Pine

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SUMMARY

Selecting exceptionally tall loblolly pine seedlings from nursery beds is a promising and low-cost means of tree improvement, according to this 10-year study.

From 1962 to 1971, 2,800 outstandingly tall seedlings were chosen from a nursery in south Mississippi and outplanted. Selected seedlings were about twice as tall as average-height controls. When the trees were measured, the 10 plantings were 3 to 10 years old.

Selected seedlings generally survived as well as controls and had better height and volume growth. Height growth superiority declined somewhat with age, but superiority in volume growth remained fairly high. Thus, in the three 10-year-old plantings, selects were only 4 to 7 percent taller than controls, but they produced 20 to 46 percent more volume.

Fusiform rust infections were somewhat more prevalent among selects than controls, possibly because fast-growing selects reveal the weakness better than slower-growing seedlings. Nevertheless, for every 1,000 seedlings initially chosen, there were at least 10 rust-free plus trees with twice the volume of controls.

Costs of nursery selections are small compared to most tree improvement ventures. The tree breeder needs only a three-man crew for 1 week to select and plant up to 500 trees—50 controls and 450 selects. Documentation, measurement, and analyses will require less than an additional week.

This test involved more selections and plantations than had been tried in the past. The next step in evaluating nursery selection is to compare progeny from selects with those of controls to see how much of the phenotypic gain is truely genetic.

Additional keywords: Survival, *Cronartium fusiforme*, volume growth, height growth, *Pinus taeda*.

Analysis of benefits from selecting exceptionally tall seedlings from nursery beds have generally led investigators to recommend this method of tree improvement (Barber and Van-Haverbeke 1961). Others (e.g., Foulger 1960) contend that height growth advantages are too small to recommend nursery selection. Before the method is routinely adopted, therefore, conflicting findings must be weighed, and the efficiency of the method must be evaluated. This experiment, in which selections of loblolly pine (*Pinus taeda* L.) were made annually for 10 years, supplements information from previous work involving fewer selections and plantations.

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METHODS

From 1962 to 1971, 2,800 outstandingly tall seedlings were selected from a Forest Service nursery in south Mississippi. The selected proportion was 1:50,000 (one per nursery bed). Average-sized neighboring seedlings lifted with

every 10th selection served as controls. Selected seedlings were about twice as tall as controls. Seedlings were planted in a completely randomized design at 1.8 by 3.6 m spacing. Plantings were mowed periodically for weed control.

Survival, seedling size, and incidence of fusiform rust were observed in the first three plantings at age 10 years and in subsequent plantings, at younger ages (table 1). Heights were measured to the nearest 0.03 m, and diameters, to the nearest 0.25 cm. For trees 6 years and older, individual tree volumes were calculated according to Schmitt and Bower (1970). For quantitative traits, differences between treatments were tested by the t-test; for qualitative traits the chi-square contingency test with correction for discontinuity was used. All tests were at the 0.05 probability level.

RESULTS AND DISCUSSIONS

Survival was generally excellent, and selected seedlings tended to survive as well as controls—in two cases significantly better (table 1). In one 5-year-old planting 99 percent of the selected trees survived. In only the 1964 and 1966 plantings was survival of selects appreciably (but not significantly) lower than that of controls.

Heights and individual tree volumes of selected trees were significantly greater than those of controls in all but two of the plantings measured. These results confirm previous findings by Hatchell et al. (1972). Height growth superiority declined somewhat with age as it did for Grigsby (1975), but superiority in volume growth remained fairly high. Thus, in the three 10-year-old plantings selects were only 4 to 7 percent taller than controls, but they produced 20 to 46 percent more volume.

Fusiform rust infections were almost always more prevalent among selects than controls, and in three plantings the differences were striking (though not always statistically significant): 52 vs. 29, 62 vs. 20, and 22 vs. 8 percent (table 1). Other researchers have suspected a higher incidence of rust in selected seedlings than in controls but have been unable to consistently demonstrate this (Wakeley 1969).

Variability among the annual plantings was large. Survival varied from 53 to 93 percent, and infection, from 1 to 46 percent. Such variation implies that results of an individual test

Table 1. *Nursery selections compared with controls*

Year planted	Age (yrs)	No. selects	Survival			Rust			Height			Tree volume		
			Control mean	Select mean	Difference as proportion of control	Control mean	Select mean	Difference as proportion of control	Control mean	Select mean	Difference as proportion of control	Control mean	Select mean	Difference as proportion of control
			Percent						*Meter*			*$M^3 \times 100$*		*Percent*
1962	10	697	71	90	+27s	29	52	+ 79s	10.4	11.1	+ 7s	5.5	8.1	+46s
1963	10	483	73	70	− 4	42	50	+ 18	11.2	11.9	+ 6s	8.0	10.7	+33s
1964	10	151	59	47	−20	30	62	+107	9.8	10.2	+ 4s	6.6	7.9	+20
1965	9	288	68	64	− 6	0	14	+ ∞	9.0	9.4	+ 5	4.8	6.0	+26
1966	8	285	86	71	−17	12	19	+ 58s	6.3	8.0	+26s	1.8	3.1	+69s
1967	7	359	90	87	− 3	8	22	+175	7.1	7.9	+11s	1.9	2.8	+50s
1968	6	132	93	92	− 1	0	2	+ ∞	4.6	5.2	+12s	0.5	0.8	+68s
1969	5	111	85	99	+16s	3	3	− 1	3.2	4.2	+31s	...	...	...
1970	4	104	91	95	+ 4	38	39	+ 1	3.6	4.3	+18s	...	...	...
1971	3	144	62	74	+19	43	44	+ 1	2.7	3.3	+23s	...	...	...

NOTE: s indicates that the difference was significant at the 0.05 probability level.

are inconclusive. Only when the series of years is considered do strong trends emerge.

Although the results of the present experiment are valuable, the breeder contemplating nursery selection must ponder as well the cost per breed tree produced. He needs only a three-man crew for 1 week to select and plant up to 500 trees—50 controls and 450 selects. Documentation, measurement, and analyses will require less than an additional week. Thus, costs are small compared to most tree improvement ventures.

Admittedly, such a program yields only a small number of final plus-tree candidates. C. R. Gansel[1] selected for further breeding only two candidates from 1,000 original selections and pronounced the method inefficient for his dry, flatwood site in Florida. On our sites, however, for every 1,000 seedlings initially chosen, there were at least 10 rust-free trees with twice the volume of controls. Perhaps fast growth of selects exaggerates and reveals weaknesses present in the general population. If so, this exaggeration should be considered a benefit. Our final decision as to efficiency of nursery selection awaits comparison of progeny from chosen selects with those from similarly chosen controls to see how much of the phenotypic gain is truly genetic.

[1] Gansel, C. R., Southeastern Forest Experiment Station. Personal communication, 1972.

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