

Ten Year Results on a Cooperative Loblolly

Pine Seed Source Test

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Loblolly pine, although native only to a portion of the Tennessee Valley is being planted extensively in the region. Survival and growth of plantings made between 1939 and 1946 were so outstanding that by 1950 fifteen million loblolly pine seedlings were being produced in TVA nurseries (60 percent of total production that year). Much of the planting was on sites formerly planted to shortleaf and Virginia pine, and on most of these sites loblolly outgrew the native pines.

This extension naturally led to questions about the importance of seed origin on plantings outside the natural range. Therefore in 1950 the TVA Division of Forestry Relations in cooperation with five research centers of the Central, Southern, and Southeastern Forest Experiment Stations established an exploratory but extensive test of loblolly pine seed sources.

The test was designed to provide information on significant variations of plantings of different seed sources at different locations and to compare the development of plantings at a single locality. A work plan of the test may be found in the Appendix to "Testing Tree Progeny", an early report of the Southern Tree Improvement Committee. The plan called for testing nine seed sources at eight localities. The test planting at each locality was to contain three blocks, with each source planted at random within each block.

Seedlings from a variety of geographic seed sources were being grown in TVA nurseries in 1950 and stock from nine was used to establish the test. These nine include three from the Atlantic Coastal Plains of Maryland, Virginia and South Carolina; three from the northern fringe of the species range in north Alabama, north Mississippi and Tennessee; and three more from south Alabama, south Mississippi and northwest Georgia.

The eight original planting locations are shown in figure 1. Four were made inside the range: one each by the Oxford and Birmingham Research Centers of the Southern Station one by the Union Research Center of the Southeastern Station, and one by TVA near Guntersville Alabama. The four plantings outside the range include one by the Harrison Research Center of the Southern Station, one by the Carbondale Center of the Central States Station, and two by TVA--one at Norris, Tennessee, and one at Gilbertsville Kentucky.

Early Progress

The year of establishment coincided with the beginning of a prolonged drought in the region. A dry spell that began in late 1949 extended through three growing seasons and became critical by fall 1952. This caused extreme differences in survival and early height growth of several seed sources. Plantings of North Carolina Coastal Plain seedlings failed completely at all locations in 1950 and a South Carolina source failed in 1951. It was not until a third replanting in 1952 that a South Carolina seed source was finally established in the test. Effect of the drought was most noticeable at the Oxford, Mississippi, locality. Because of low over-all survival and complete loss of two out of three replications, this planting was abandoned after the fifth growing season.

Performance of plantings was reported after two and five years of development (1), (3). Significant differences in survival and height for both source of seed and planting locality showed up by the end of the second year and were still evident after five years. In general, inland sources survived better and grew more in height than Coastal Plain sources. On the average, north Alabama, northwest Georgia, and Tennessee sources performed best.

Ten-Year Results

Ten-year inspection of plantings in the fall and winter of 1959 included measurement of diameter growth at breast height. The average survival, height, and diameter by seed sources are shown in Table 1 and by planting locations in Table 2. Ten-year development of plantings at seven localities is summarized in Table 3.

Survival

As expected, the average ten-year survival of seed sources is not too different from that reported after five years. Best survival was obtained with the northwest Georgia, Tennessee and two Alabama seed sources. The superiority of inland seed sources is evident in the 75 percent average survival for inland sources as against 52 percent for Atlantic Coastal Plain seed.

Average survival of plantings inside and outside the natural range was quite similar -- 67 percent for those inside and 69 percent for those outside (Table 2).

Height

Average total height growth at ten years did not differ by seed source or region of collection (Table 1). This is in contrast to the difference in height growth that existed

at five years between inland and Atlantic Coastal Plain sources. Certain height differences showed up for plantings at different localities both inside and outside the natural range. Average height growth inside and outside the range differed by only 2 feet but the difference was enough to be significant.

Two plantings outside the natural range attained heights comparable with those inside. These were the Newton County, Arkansas, and the Anderson-Union County, Tennessee, plantings where trees averaged 27 feet after ten years. Poorest height was made by the Marshall County, Kentucky; and Hardin County, Illinois, plantings where trees averaged 18 feet and 21 feet, respectively. Of all test plantings, these were the farthest north.

Among the plantings inside the range the one in Jefferson County, Alabama, attained the best height -- 29 feet, The next best planting was in Union County, South Carolina, where trees averaged 25 feet; however, this was significantly less than growth in Jefferson County, Alabama. Poorest height growth was in the Marshall County, Alabama, planting where trees averaged 22 feet.

Diameter

There was a real difference in diameter growth between seed sources at ten years. Average diameter growth ranged from 5.0 inches for the north Alabama seed source to 4.0 inches for the South Carolina source (Table 1). Trees from the north Alabama seed grew significantly better than those from south Mississippi and the three Atlantic Coastal Plain seed sources. The Tennessee source outgrew the three Atlantic Coastal Plain sources, and the Georgia, north Mississippi and south Alabama sources outgrew the Maryland and South Carolina sources. Except for the south Mississippi source, inland sources generally were superior in diameter growth to Atlantic Coastal Plain sources.

Differences in average diameter growth between plantings inside and outside the natural range are significant after ten years. Plantings inside the range averaged 5.0 inches while those outside averaged 4.4 inches. However, the best diameter growth occurred outside the range; in the Newton County, Arkansas, planting trees averaged 5.4 inches.

Growth of plantings inside the range was relatively uniform. However, of the four outside the natural range, two grew vigorously and two grew poorly. As mentioned above the Arkansas planting averaged 5.4 inches in diameter. The one in Tennessee averaged 4.8 inches. Those in Kentucky and Illinois averaged 3.4 and 3.9 inches, respectively. These last two lie the farthest outside the natural range of loblolly pine.

Individual Localities

The Marshall County, Alabama; the Newton County, Arkansas; and the Hardin County, Illinois; plantings showed significant differences in survival between sources. Significant height differences were found in plantings at Jefferson County, Alabama; Marshall County, Alabama; Union County, South Carolina; and Anderson-Union County Tennessee. Diameter growth differed significantly in the two Alabama and the east Tennessee plantings.

Distance

At five years survival was related to distance between point of seed collection and planting locality. This relationship has continued through ten years but the variation in the pattern is still too great to draw definite conclusion. While distances up to 500 miles show less variation than distances of 500 to 1,000 miles, good performance was obtained with Georgia seed as far as 820 miles from the seed source. But poor performance was exhibited by seed planted much closer to its origin.

Neither height nor diameter growth was related to distance between origin of seed and planting locality. These measures were affected only insofar as good survival generally forecasts good height and diameter growth and vice versa. Analysis of growth and survival data by plots supports this relationship.

Relative Performance of Sources and Planting Sites

A simple index was used to express the over-all relationship of survival, height and diameter with respect to seed sources (Table 1) and planting localities (Table 2). Outside the loblolly range, the Tennessee planting showed up best, with the Arkansas planting ranking close second. The poorest planting inside the range was in Marshall County, Alabama, the poorest outside at Marshall County, Kentucky.

Relation of Ten Year Results to Earlier Findings

While final recommendations on seed sources must wait for an evaluation of wood volume and quality, ten-year data support certain inferences made after five years. General observations with respect to the better survival of inland seed sources were confirmed and sharpened. Average survival of plantings inside and outside the natural range support observations by Wieseuegel (3) that early survival of loblolly pine outside its range is affected more by available moisture than by difference in latitude or temperature. Differences in height growth after five years were less pronounced at ten years. However, those sources that were tallest five years ago are now largest in diameter. Differences in over-all development inside and

outside the range remain the same with few exceptions. It is reassuring to know that early examination of seed source plantings can give good indications of future performance.

Only quantitative measurements were taken through the first ten years. With results on survival now fairly well clarified, subsequent inspection will be concerned with basal area, volume and quality. There will also be an opportunity to evaluate storm and ice damage. Through the first ten years no appreciable damage was reported for any of the plantings. An exception was in southern Illinois where trees from deep south seed sources sustained considerably more damage than trees from Maryland, Virginia and Tennessee.

Summary

On the basis of ten-year development the performance of nine loblolly sources in plantings inside and outside the natural range can be evaluated as follows.

1. Inland seed sources survived better than Atlantic Coastal Plain sources. Of the inland sources, northwest Georgia, north and south Alabama and Tennessee sources survived best. It would appear that Atlantic Coastal Plain seed should not be planted outside the natural loblolly range until evidence to the contrary is forthcoming. The present tests also suggest a similar restriction for mississippi seed sources.
2. In contrast to results at five years, there is now no significant difference in height between seed sources. Loblolly pines planted inside the natural range grew 2 feet taller on the average than those planted outside the range.
3. Inland seed sources grew to larger diameters than Atlantic Coastal Plain sources. Of the inland sources, all but the south Mississippi seed source were generally superior in diameter growth. Trees planted inside the natural range averaged 0.6 inch more in diameter than those planted outside. However, the 5.4-inch average diameter growth of the Arkansas planting exceeded that of all other planting.
4. Distance between point of seed collection and planting site should not be used alone to evaluate the suitability of seed source. While there is a general decrease in survival with increase in distance, the wide variation in some sources suggests that other factors are involved. Neither height nor diameter growth was affected by increase in distance from seed source.

Literature Cited

1. Cummings, W. H, 1952, Loblolly Pine Shows Early Differences with Source of seed and Locality of Planting. *Journal of Forestry* 50(8) 626-627 .
2. Wiesehuegel , E, G. 1952. Testing Tree Progeny. Southern Forest Tree Improvement Committee. TVA Technical Note 14. (Appendix contains work plan for this study.)
3. 1955. Loblolly Pine Geographic Seed Source Tests -- Five Year Results. Proc., Third Southern Conf. on Forest Tree Improvement, New Orleans, Louisiana, Jan. 5-6.

Table 1.--Average Survival, Height, and Diameter of Ten-Year-Old Loblolly Pine by Sources of Seed

Origin of Seed	Survival percent	Height feet	Diameter inches	Performance index ^b
Atlantic Coast:				
Maryland	52	23	4.6	55
South Carolina, lot 2 ^c	49	24	4.0	47
Virginia	56	24	4.6	62
Average	52	24	4.4	55
North Inland:				
Alabama	82	26	5.0	107
Mississippi	63	24	4.8	73
Tennessee	80	24	4.8	92
Average	74	24	4.9	87
South Inland:				
Alabama	81	24	4.8	93
Georgia	86	24	4.9	101
Mississippi	61	23	4.5	63
Average	76	24	4.8	88
All-average	68	24	4.7	77

- a Ten-year survival percentages are generally higher than reported after five years because planting in Lafayette County, Mississippi, with an initial survival of 26 percent has since been dropped.
- b Cross product of survival percent, height in feet, and diameter in inches.
- c Eighth year survival, total height and diameter adjusted to ten-year basis. The original planting from North Carolina seed failed and was replaced the following year by South Carolina seed lot 1, which also failed. The South Carolina seed lot 2 planting was established in winter 1951-1952.

Table 2 --Average Survival , Height and Diameter of Ten-Year-Old Loblolly Pine by Planting Locations

Planting Locations	Survival Percentage	Height Feet	Diameter Inches	Performance Index ^a
Inside Natural Range:				
Alabama, Jefferson Co.	85	29	5.0	123
Alabama, Marshall Co.	39	22	5.0	43
South Carolina, Union Co.	76	25	4.9	93
Average	67	25	5.0	84
Outside Natural Range:				
Arkansas, Newton Co.	68	27	5.4	99
Illinois, Hardin Co.	69	21	3.9	57
Kentucky, Marshall Co.	54	18	3.4	33
Tennessee, Anderson and Union Co.'s	85	27	4.8	110
Average	69	23	4.4	70
All Locations--Average	68	24	4.7	77

^a Cross Product of survival percent, height in feet, and diameter in inches.