

6. FIVE YEAR RESULTS OF LOBLOLLY PINE GEOGRAPHIC SEED SOURCE TESTS

E. G. Wiesehuegel, Chief
Forestry Investigations Branch, Division of Forestry Relations,
Tennessee Valley Authority, Norris, Tennessee

Foresters have long been interested in extending the use of rapid growing southern pines northward as a means of achieving increased growth in volume and quality. They have also been interested in seeking within the range of loblolly pine those races which would achieve similar objectives. Little information was available on this subject when Tennessee Valley Authority in 1950 decided to experiment with some of the many seedlots planted in its nurseries from widely separated collection points. It seemed like a good opportunity to initiate tests that would provide more specific information on significant variations of plantings of different seed sources in different locations and in the same location.

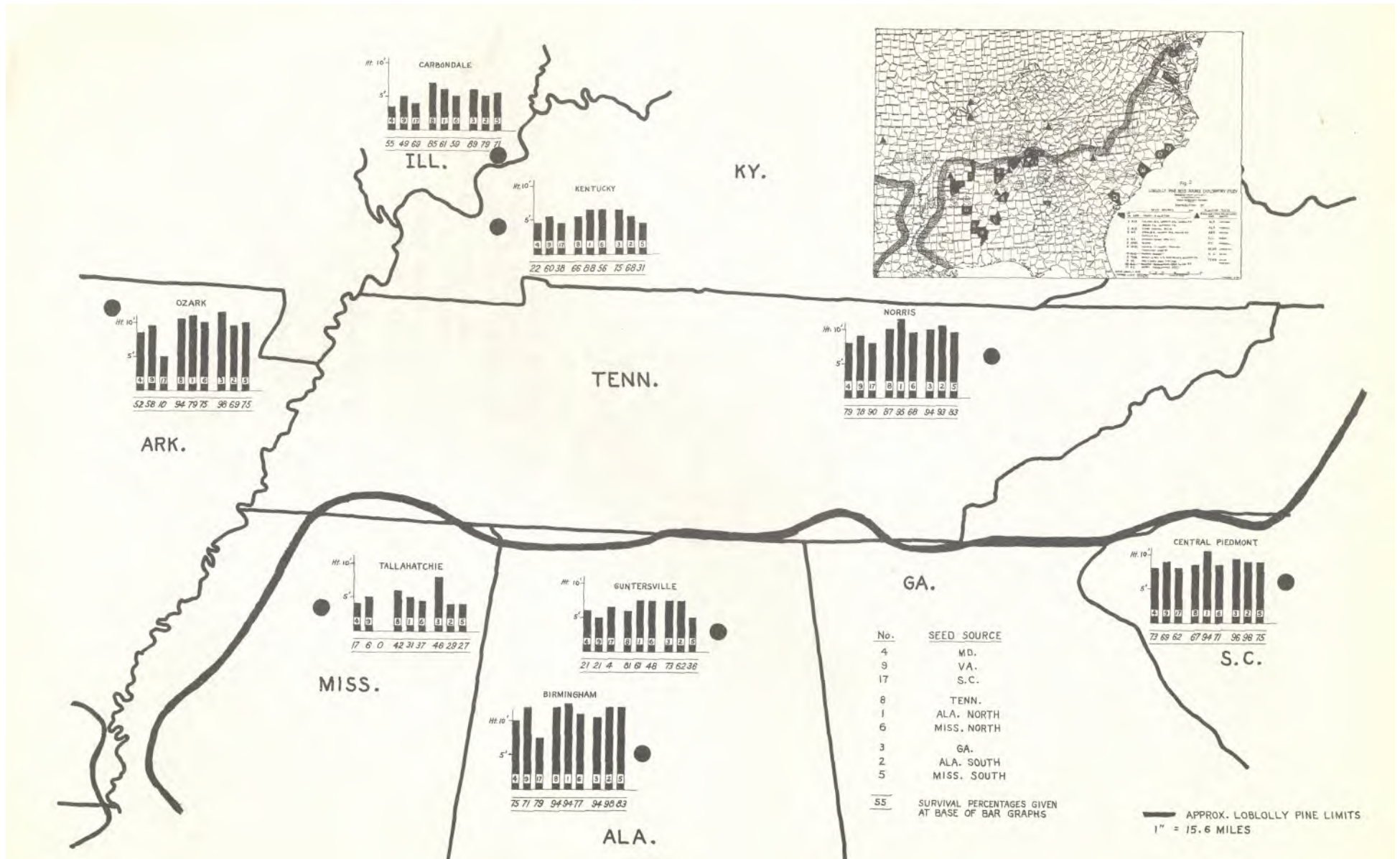
The test is fully described in the Appendix of TVA Technical Note 14, which was developed as a project of the Southern Forest Tree Improvement Committee on Testing Tree Progeny (4). Essentially, the plan called for testing nine seed sources at eight locations, ranging from central Alabama to Illinois and from Arkansas to the South Carolina Piedmont, as shown in Figure 1. Three blocks were established in each locality, representing complete replications. Within each block, seedlings from the various sources were assigned at random to nine plots.

A project as extensive as this one required a great deal of cooperation. And for that cooperation, recognition and thanks are due to the members of the Central States Forest Experiment Station at the Carbondale Research Center, the Southern Forest Experiment Station at the Ozark, Tallahatchie and Birmingham Research Centers, the Southeastern Forest Experiment Station at the Central Piedmont Research Center, and to cooperating divisions of the Tennessee Valley Authority at Guntersville, Alabama, and Paris, Tennessee, and last but not least, to Mr. W. H. Cummings, who organized and helped establish the investigation. With the assistance of the above, experimental plots were established at the eight localities shown, in Illinois, Arkansas, South Carolina, Alabama and Mississippi. TVA established three in Tennessee, Kentucky and Alabama. Four of these locations lie outside the natural range of loblolly pine and four inside. The seed sources are equally divided among the Atlantic Coastal Plain, the north fringe of the loblolly pine type, and southern sources.

At the end of the second year results began to appear and were published in the Journal of Forestry (3). Seedlings from the North Carolina seed source failed generally the first year. They were replaced with new seedlings from a South Carolina source and these failed. A third South Carolina source gave mediocre success, as will be discussed later. Two year height growth showed Alabama trees best and those from Maryland and Virginia sources poorest, on the average.

We are now in a position to begin an evaluation of the fifth-year results of this study. Although no disasters have hit any of the plots, all but one of the three replications in the Tallahatchie plantings in Mississippi were lost because of the extremely dry weather. Pine tip moth damage has occurred on most of the plantings but has not been evaluated as to seed source and location. The measurements reported here were taken in October and November 1954 and represent an up-to-date analysis of the survival and height growth of the various seed sources in the eight localities.

Fig. 1 TVA SEED SOURCE STUDY



The average survival by seed sources is shown in Table 1, and by planting locations in Table 2. Only the Atlantic Coastal Plain seed sources ran lower than the overall average survival of 57 percent. The difference is significant and is reinforced by the complete failure of two selections from the Coastal Plain of North and South Carolina. Survival from seed originating outside the Coastal Plain averaged 71 percent as compared with 49 percent for the Atlantic Coastal Plain seed. Thus it would seem that from the standpoint of survival the inland sources are one and one-half times better than the Coastal Plain seed sources.

If the unusual situation caused by the drouth in Mississippi is disregarded, there is little difference in average survival between plantings inside and outside the natural range of loblolly pine. Insofar as these studies are concerned, it is my opinion that the extension of loblolly pine from a given seed source to points outside its natural range should not affect initial survival. Unquestionably, it may have a great effect on later survival. But for the first five years of this study, the principal differences were found in height growth as related to seed source.

With respect to height growth, trees originating from Atlantic Coastal Plain sources grew more slowly on the average than trees from other sources. Differences among individual seed sources were found to be statistically significant. There is a very real difference between such sources as Maryland and South Carblina, which average 6.9 feet and 6.5 feet respectively, as compared with north Alabama, Georgia, and Tennessee sources, with averages of 9.3, 8.8, and 8.4 feet. This is obvious from an inspection of Figure 1.

Trees planted inside the natural range of loblolly pine tend to grow faster than those planted outside. However, this is only a tendency and is not invariably true. Of the four plantings averaging best in height growth, two are inside the natural range and two outside. Also, of the four plantings showing the poorest height growth, two are inside the natural range and two outside. However, as will be noted in Table 2, the average heights vary only by .8 of a foot in five years and this may not be statistically significant. Also, if results are examined carefully, it is obvious that the poorest growing plots were at the north extension of the tests in Illinois and Kentucky while the best growth was obtained in Alabama, probably due to a climatic or soil factor. Exploration of climatic factors such as maximum temperature, rainfall distribution and amount, soil or other factors, may further becloud or clear up the real facts. These factors will be further analyzed.

A further analysis shows that plots with the highest survivals generally contain the tallest trees. This relationship was found significant by statistical tests. As can be seen from Table 2, for plantings in Jefferson County, Alabama, and in Anderson and Union Counties, Tennessee, survivals of 85 percent have average 5-year

heights of 11.2 and 9.5 feet respectively, while the lowest survivals found in Mississippi and Kentucky, (26 percent and 52 percent survival) had average heights of 5.2 and 5.5 feet respectively. This indicates that seedlings showing good survival the first year or two can, as a general rule, be expected to make good height growth, and that poor survival is indicative of a poorly adapted seed source.

In an effort to check the effect of distance between the point of seed collection and planting locality, an analysis proved that distance was a significant factor in survival but not in height growth. Table 4 will bear some study from this standpoint. You will note that the plantations are arranged according to good, satisfactory and poor height growth. This shows that poor survival and poor growth go together; also that seed brought from long distances does not do as well generally as seed collected within a few hundred miles of the planting site. However, there are so many exceptions to this that no definite conclusion can be drawn. No rules can be established. For instance, good plantings were obtained from Georgia seed as far as 820 miles from the seed source and with Tennessee seed as far as 500 miles from the seed source. On the other hand, a poor planting showing poor growth in north Mississippi resulted from seed collected only 40 miles away. Other factors must therefore be studied in order to determine the locality from which loblolly pine seed may be collected for best results in any given area. To say that seed should be collected only within 50, 75, or 100 miles, or any given number of miles from the seed source is not sufficient. Later experience with these plantations and further study will, we hope, give us more significant information on this important rule of thumb.

In summary, certain tentative conclusions subject to further verification can be drawn:

1. It is highly probable that seed from Atlantic Coastal Plain sources will result in poor survival and poor growth if used for reforestation outside the natural range of loblolly pine. Present indications are that this is also true for north Mississippi. Tennessee, Arkansas, Kentucky, and Illinois should avoid seed from Atlantic Coastal Plain sources.

2. High juvenile survival and good height growth of loblolly pine go together and show a significant correlation. Good loblolly plantings can be expected to attain a height in excess of 10 feet in five years.

3. The survival and growth of loblolly pine for all seed sources is progressively better in plantings progressing from north to south. There is probably a definite northern limit beyond which other pine species can be expected to do better with less risk. Further analysis of climatic factors should assist greatly in establishing the zone within which loblolly pine can be expected to be successfully established as an economic venture.

4. There is a definite lowering of early survival with increasing distance from seed source, but the many exceptions make it obvious that we do not have all of the facts and further study is necessary.

Future plans call for the remeasurement of these plots at age 10 years. However, we hope that the agencies responsible for each set of plots will report regularly any unusual circumstances that cause undue mortality or reduction in height growth. It is obvious that at the end of 10 years it would be of little value to know that differences exist unless we know the reasons for those differences.

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

Origin of seed	Survival, percent	Height, feet
Atlantic coast:		
Maryland	51	6.9
South Carolina, lot 2 ^{1/}	44	6.5
Virginia	51	7.9
Average	49	7.2
North inland:		
Alabama	74	9.3
Mississippi	60	8.0
Tennessee	75	8.4
Average	70	8.5
South inland:		
Alabama	74	8.0
Georgia	83	8.8
Mississippi	61	7.9
Average	73	8.1
All, average	57	8.0

1/ Third year survival, total height adjusted to five-year basis (actual 3-year height, 3.9 feet). 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 and Height of Five-Year
Old Loblolly Pine by Planting Locations

Planting Location	Survival, percent	Height, feet
Inside natural range:		
Alabama, Jefferson Co.	85	11.2
Alabama, Marshall Co.	45	7.0
Mississippi, Lafayette Co.	26	5.2
South Carolina, Union Co.	76	8.8
Average	58	8.4
Outside natural range:		
Arkansas, Newton Co.	68	9.4
Illinois, Hardin Co.	69	5.2
Kentucky, Marshall Co.	52	5.5
Tennessee, Anderson & Union Cos.	85	9.5
Average	70	7.6
All locations, average	64	8.0

Table 3. Average Survival and Height of Five-Year Loblolly Pine by Seed Origin and Planting Locations

Origin of seed	Planted within native range				Planted outside native range			
	Alabama, Jefferson County	Alabama, Marshall County	Mississippi, Lafayette County	S. Carolina, Union County	Arkansas, Newton County	Illinois, Hardin County	Kentucky, Marshall County	Tennessee, Anderson & Union Counties
<u>Survival, percent</u>								
Atlantic coast:								
Maryland	75	21	17	73	52	55	22	79
S. Carolina, Lot 2 ^{1/}	79	4	0	62	10	69	38	90
Virginia	71	21	6	69	58	49	60	78
North inland:								
Alabama	94	61	31	94	79	61	88	95
Mississippi	77	48	37	71	75	59	56	68
Tennessee	94	81	42	67	94	85	66	87
South inland:								
Alabama	98	62	29	96	69	79	68	93
Georgia	94	73	46	96	98	89	75	94
Mississippi	83	36	27	75	75	71	31	83
<u>Average height, feet</u>								
Atlantic coast:								
Maryland	10.2	6.2	4.1	8.2	8.4	3.4	4.3	8.0
S. Carolina, Lot 2 ^{2/}	7.6	6.6	-	7.9	5.0	4.0	4.6	8.1
Virginia	12.0	4.8	5.1	8.8	9.3	5.0	5.7	8.8
North inland:								
Alabama	12.6	7.4	6.6	10.7	11.1	6.0	6.4	11.7
Mississippi	11.3	7.4	4.7	8.3	10.2	5.2	6.6	9.5
Tennessee	12.2	6.1	6.2	8.3	10.6	7.3	5.4	9.8
South inland:								
Alabama	12.1	7.3	4.1	8.9	9.4	5.1	5.4	10.4
Georgia	10.7	7.7	7.9	9.3	11.5	5.9	6.4	10.2
Mississippi	11.8	7.9	4.1	9.0	9.9	5.4	4.6	9.2

1/ Third year survival. 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 the winter 1951-1952.

2/ Adjusted to 5-year heights; average 3-year heights were 3/5 of the values shown above.

Table 4. Loblolly Pine Seed Source Plantings
Grouped by Survival and Height Class 1/

Survival	Seed source plantings grouped by height classes and accompanied by distances in miles between each seed collection and planting location		
	Good (over 10 feet)	Satisfactory (5 to 10 feet)	Poor (under 5 feet)
Good (over 70 percent)	N. Ala.--50, 230, 320, 400 S. Ala.--140, 410 Ga. --140, 150, 820 Md. --740 N.Miss.--140, 290 S.Miss.--120, 360 Tenn. --100, 180, 500 Va. --700	N. Ala.--220 S. Ala.--440, 440, 450 Ga. --80, 210, 260, 290 Md. --440, 480 N.Miss.--470 S.Miss.--370, 400, 460 S.C. --340, 500 Tenn. --100, 200, 260 Va. --420	
Satisfactory (40 to 70 percent)		N. Ala.--30, 260 S. Ala.--220, 390 Ga. --290 Md. --990 N.Miss.--180, 240, 290, 360 S.C. --160, 880 Tenn. --240, 280 Va. --370, 660, 670, 970	Md. --690 S.C. --620
Poor (under 40 percent)		N. Ala.--170 Md. --680 S.Miss.--200 S.C. --460 Va. --620, 800	S. Ala.--220 Md. --700, 850 N.Miss.--40 S.Miss.--130, 320 S.C. --610, 640

1/ Five-year height measurements in all cases except the South Carolina seed source which was three-year old; these height values, however, were projected to a five-year basis for purposes of comparison.

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