THE SOUTH ESTABLISHES A MAJOR PINE GEOGRAPHIC

SEED SOURCE STUDY

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One tangible outcome of the January 1951 conference on Southern Forest Tree Improvement has been a South-wide co-operative study of geographic sources of southern pine seed. Prompt action by the cooperators enabled the Sub-Committee in charge to start this study with seed from the 1951 crop. This is a summary of the purpose and design of the study, and of its progress through December 1952.

Presented at the Second Conference on Southern Forest Tree Improvement, Atlanta, Georgia, January 6, 1953.

Purpose of the Cooperative Study

Previous studies have shown that numerous tree species, including at least three southern pines, consist of two or several distinct geographic races. They have shown that collecting seed at a distance may bring in a race poorly adapted to the environment of the planting site, and may greatly reduce plantation yield or result in outright failure. In a 1925 study of loblolly pine at Bogalusa, Louisiana, for example, stock from Georgia and Arkansas seed produced less than half as much pulpwood as stock from Louisiana seed. In a 1935 study, shortleaf stock from Texas and Louisiana seed, when planted in Pennsylvania, was killed by cold which left stock from Pennsylvania seed uninjured. These and similar instances impel any farsighted planter to choose seed of a geographic race adapted to the locality in which he intends to plant.

No study hitherto established, however, has shown very clearly the location or extent of the geographic races of any southern pine. We want to use seed of the right source, but have little experimental evidence as to where to get it. It is begging the question to say "Use local seed" unless we know how far the suitable local race extends in various directions from the planting site.

What we need are maps of the zones or territories within which seed may safely be moved from collecting ground to planting site, but across the boundaries of which it should be moved cautiously, if at all. The purpose of the present study is to provide time data for rough but reliable maps of this kind for each of the principal southern pines.

Design of the Study

The study attempts to insure the soundness of suck data on longleaf, slash, loblolly, and shortleaf pines by:

1. Covering practically the entire range of each species.

2. Collecting seed of each species from localities representing logical contrasts in climatic conditions, geological history, and the like.

3. Getting seed, at each source, from enough trees to minimize the influence of any one particularly good or particularly poor parent tree.

4. Establishing test plantations in the vicinity of each and every seed source, instead of at one or a few places only.

5. Planting seedlings in plots large enough to permit normal development to merchantable size.

6. Replicating stocks in each test plantation to permit statistical analysis of differences in survival, growth, disease-resistance, and the like.

7. Keeping each cooperator's burden of seed collection, stock production, and planting small enough to insure correct carrying out of his share of the study.

The Subcommittee in charge feels that, with respect to these seven specifications, the present cooperative study is off to a better start than most, if not all, earlier studies of geographic sources. The means whereby the specifications have been net are given in detail in the Study Working Plan dated September 12, 1952. One problem encountered was serious enough, however, and its solution novel enough, to merit discussion here.

The natural range of slash pine in the United States is small, and can be adequately represented in the study by seed from only half a dozen sources. This species, therefore, offered no difficulty. By contrast, the ranges of longleaf, loblolly, and shortleaf pine require seed from about 15 sources per species to insure adequate coverage. At first glance, the logical procedure appeared to be to collect enough seed at each of the 15 sources to provide stock for planting at that source and at each of the other 14 sources. This involved, however, more seed than the individual cooperating collectors might be able to supply, and larger plantations than the individual cooperating planters could well put in.

The difficulty was overcome by grouping loblolly sources in two series, and longleaf and shortleaf sources in three series each. Each series was designed to test some specific hypothesis concerning the origin and present range of geographic races within the species in question. Any one series might or might not throw light on a second or even a third hypothesis; this depended on circumstances. The essential point was to have a given series show rather conclusively whether one particular hypothesis concerning geographic races was sound.

The three hypothesis subjected to test in the present study are:

1. That geographic races of southern pines are associated primarily with temperature zones and are influenced little if at all by anything else, such as rainfall zones or major soil groups.

2. That different geographic races are associated with different rainfall zones or major soil groups within one temperature zone, or even with rainfall or soil to the virtual exclusion of temperature.

3. That geograhic races are associated less with the temperature, rainfall, and major soil groups of their present ranges than with the different ancient land masses from which they spread out to the more recently uplifted coastal plains.

Of course, a complete lack of significant differences in survival, growth, etc., of southern pine stock representing different geographic sources of seed would discredit all three of these hypotheses and support a fourth, namely, that there are no geographic races within the species being tested. This fourth hypothesis, however, has already been pretty well disproved in the case of longleaf, loblolly, and shortleaf pine.

Just how the three hypotheses are being tested by means of the series of sources in the present study is illustrated most clearly by the three longleaf pine series. It should be noted in passing, though, that seed for only two of the three longleaf series was obtainable in 1951, and that the plantations for the third series will accordingly have to go in a year later than the rest. This is a minor defect in the study, and will probably make no difference by the time the trees in the test plantatons reach sawlog size.

The delayed longleaf series tests the temperature hypothesis. Seed is being obtained from the 60 F. average annual temperature zones in Virginia, the 64° zone in South Carolina, and the 67 zone in Georgia, and the 72° zone in southern Florida. Additional 67° zone lots are being obtained from southern Mississippi and western Louisiana. All lots are from coastal plain soils other than deep sands, and average annual rainfall does not differ greatly from source to source. Stock from seed from all six sources will be planted in the vicinity of each and every source. If the temperature hypothesis be sound, stock representing each temperature zone should do better, when planted in its own zone, than stock representing other zones. The three 67° zone stocks should behave about alike wherever they are planted together. To the extent that this pattern fails to develop, the temperature hypothesis is undermined.

The occurrence of longleaf pine on the Carolina and Florida sand hills and on heavier, coastal plain soils nearby provides a golden opportunity to test the major-soils-group hypothesis and retest the temperature hypothesis at the same time. Paired collections have been made from the deep sands, and nearby heavier coastal plain soils in the 62° temperature zone of North Carolina, and the 64 degrees zone of South Carolina, and the 67 degrees zone of West Florida and adjacent Alabama. Stock representing all six sources will be

planted in the vicinity of each and every source.

If sand-hill stocks do better than coastal plain stocks wherever all stocks are planted on the deep sands, regardless of the temperature zones from which the sand-hill stocks have come, the soils hypothesis will be supported at the expense of the temperature hypotheses. Sand-hill planters had then better stick to sand-hill seed, but may be able to get it at a distance if local crops fail.

If northern stock does best in the north and southern stock does best in the south, regardless of sand-hill or coastal plain sites, the temperature hypothesis will be supported at the expense of the soils hypothesis. Sand-hill planters may then- feel safe in using coastal-plain seed, provided it is from the local temperature zone.

A more complex, response may indicate that geographic races are associated with both temperature and soil, in which case sand-hill planters had better use only local sand-hill seed.

To test the ancient origin and later migration hypothesis concerning geographic races, coastal-plain longleaf seed has been collected in the 67° temperature zones of Georgia, Alabama, eastern Louisiana, western Louisiana, and eastern Texas. The last three sources named are separated one, from another by the present or former beds of the Mississippi River -- formidable barriers to pine migration. For all we know, the longleaf pine of western Louisiana may be genetically much more like the longleaf of Alaba La, or even of Georgia, than like that of adjacent eastern Texas. For possible comparison or contrast, longleaf from the 62 zone in the Talladega mountains of Alabama -- a relatively ancient land mass has been included in this series. All stocks will be planted in the vicinity of each and every, source, as in the two series previously discussed.

Each of these series would constitute a substantial racial study in itself, even if it bore no relation to the other two series. It would not, however, provide the basis for the kind of collecting-zone map at which the cooperative study is aimed. To make them useful in mapping collecting zones, the three series have had to be connected in some way.

This has been done by collecting double the usual Quantities of seed in three places -- in the South Carolina coastal plain, in the 67° zone in Alabama, and in western Louisiana. Of these three sources, the South Carolina source is represented in both the "temperature" series and the "soils" series. The Alabama source is represented in both the "soils" series and the "ancient origin" series. The Louisiana source is represented in both the "ancient origin" series and the "temperature" series. At each of these three sources, stock representing 11 different sources (instead of 6 as in other test localities) will be included in test plantations. In like manner,

stock representing the three double sources will be tested at 11 different points in the longleaf range, instead of at 6 only. In this manner it is hoped to get adequate coverage of the species range without making any one seed collection or test plantation excessively large.

The same general approach has been used with loblolly and shortleaf pine. Details are given in the study working plan.

Contributions Made and Work Accomplished

In the fall of 1951, 25 private, State and Federal agencies, in fifteen states from Pennsylvania and New Jersey south to southern Florida and west to Texas, Oklahoma, and Missouri contributed 47 separate lots of seed for the cooperative study. These represented 11 different geograpic sources of longleaf pine seed, 6 of slash, 15 of loblolly, and 15 of shortleaf. (Smaller samples contributed for supplemental studies increased the dumber of localities represented from 47 to 52, but all not be considered further in this report.) After they had been recleaned to standards of 85 or 90 percent of seed with full kernels, the 47 main lots totalled 281 pounds in weight. At 1951 market prices, their combined value was about $880, but because of unusual difficulties in and care during collection, they probably cost the contributors a total of more nearly $2,500.

The Southern Forest Experiment Station accessioned and recleaned all the seed contributed. Right here the study ran into its first snag. Several of the lots were almost too small for inclusion in the study, and a few that had been particularly desired had proved unobtainable. As a result, the series originally planned had to be modified to some extent, and those actually set up for testing are somewhat short of ideal. Furthermore, there are gaps in a few plantations being established this year which will have to be filled with stock from supplementary collections of 1952 seed. None of these modifications, however, threatens to interfere seriously with the maps of seed-collection zones which are the objective of the study.

High school students in the New Orleans Junior Academy of Sciences made germination tests of all lots of seed received by January 1, 1952. In the light of these tests and other data, the Southern Forest Experiment Station subdivided the 47 original lots into 370 sowing lots, which it sent to the 19 nursery-men cooperating in the study, with detailed instructions for sowing.

Depending upon the number of species, series, and individual seed sources assigned to him, each cooperating nursery-man sowed from 50 to 500 running feet of standard 4-foot-wide bed. The sowing in connection with the study, by all 19 nursery-men combined, totalled 3,500 running feet of standard 4-foot-bed, of almost exactly 1/3-acre. It all had to be done by hand because of the small size of the seed lots and the care requited to keep them separate.

The stock actually needed for test plantations amounted to only 500 seedlings from each of the 370 sowing lots sent to the nurseries. To provide a margin of safety, each nurseryman was requested to produce 1,000 seedlings per sowing lot— a total of 370,000 for the study as a whole.

October inventories showed that through a combination of mishaps, the nurserymen had fallen 100,000 seedlings below this goal. More than a third of them had fewer than the requisite 500 seedlings in one, several, or all of the lots assigned to them. The study had stick a second snag, far more serious than the first. The Sub-committee in charge had to make up the shortages in some nurseries from surplus stock grown elsewhere from the same original seed lots or abandon the study.

The shortages are being made up, but at a cost. Shipping directions have had to be made far more intricate and detailed than had been planned. Nurserymen with surplus stock have had to ship more stock than they had expected to, and *often* to several different planters instead of one or two. Shipments have had to be made across state lines, with attendant attention to inspection certificates. Numbers of planters have had to get their stock from three, four, or five different nurseries instead of all from one. Lifting and shipping dates have had to be assigned by a central dispatcher instead of being left to mutual agreement between nurserymen and planter. And wherever stock from more than one nursery has been routed to one plantation, initial survival— which is greatly influenced by nursery treatment--has largely lost its value as a measurement of differences between geographic seed sources.

By ingenuity, care, unflagging effort, and endless patience and good nature all around, these difficulties are being overcome. Some 194,000 trees, in *1552* individually tagged bundles of 125 seedlings each, are being or have been shipped to 23 different cooperating agencies for the establishment of 57 separate, rigor ously designed test plantations in 15 states. The total area of test plantations established this year, if everything goes according to schedule, will be 155 acres. Supplementary planting a year hence, to make good certain shortages in 1951 seed, should increase the totals to 26 or 27 cooperating planters, and to 66 test plantations totalling 181 acres in 16 states.

This is an impressive accomplishment on the part of a hundred or more cooperators with numerous other duties to perform, highly varying facilities and skills, and no obligations in the matter beyond a common professional interest in a difficult technical problem. I t well justifies the title assigned to this discussion. The South is indeed establishing a major seed-source study. If it can complete the estabiishment and carry even four-fifths of the test plantations to near-merchantable size, it should get the seed-collection maps it needs.