SELECTING DROUTH RESISTANT LOBLOLLY PINE IN TEXAS

by

Franklin C. Cech and R. E. Goddard
Assistant silviculturists, Texas Forest Service

Because weather conditions the last several years have been such that pine plantation establishment has been poor or a complete failure due to low amounts of rainfall, the Texas Forest Service started a program to investigate drouth resistance in loblolly pine. This investigation was initiated by Dr. Bruce Zabel and his associates.

Earlier workers (Meuli, 1936 and Meuli and Shirley 1937) had shown that drouth resistance does occur in green ash depending on seed origin. There was no reason to believe that such a situation did not exist in pine trees. In fact, there was very good evidence that drouth resistance probably did exist in the "Lost Pines" of East Central Texas. These "Lost Pines" consist of several islands of loblolly pine growing between 100 and 130 miles west of the western edge of the pine belt, on a dry, sandy, often rocky soil under conditions of low rainfall. The trees in this area presented ideal material for the study since natural selection had obviously been active in favor of drouth hardy types during the establishment and existence of these isolated loblolly pine stands. The stands have all ages represented and are reproducing themselves, making it apparent that the newly established seedlings must be somewhat drouth resistant.

Three different stands were selected to represent this area in the study; one in Bastrop County near Bastrop State Park, the second *in* Fayette County near Warda, and the third in Caldwell County near MacMahon. The trees in Bastroup and Caldwell county are typically loblolly, while those in the Fayette county group are loblolly with a semblance of shortleaf characters.

To round out the study, a typical coastal plain flatwoods type,area was chosen in Tyler County, and two areas of the drier upland sites of the western edge of the pine region were selected in Leon and Angelina county. In addition, seed from two Louisiana areas and from one area each in Florida and North Carolina were used. The Tyler county and eastern states representing high rainfall areas were used as checks.

For testing purposes, six areas *were* located in widely separated parts of East Central Texas and a seventh at the A. J. Hodges Research Area near Many, Louisiana was selected. Replicated plantings were made on these test areas, representing each of the sources. These areas are all on deep sand with &minimum depth of 20 inches. Most of them are on old abandoned fields. The Lavaca County area *is* the most southerly, the Caldwell County area the farthest west and most drouthy, the Robertson

County area is in the center of the Post Oak region, the Navarro County area is the furthest north and located on a high gravelly hill. The Cherokee County site is located on the Temple Research Area near Alto, Texas, (the main test area for Texas Forest Service genetics program) and is very drouthy due to the deep sand there. The last Texas area is in Trinity County near Groveton, Texas, an area that is too wet in the winter and too dry in the summer, being especially dry after a prolonged drought, The Many, Louisiana site is on a dry sand ridge. Thus all areas present extreme conditions after a prolonged dry period.

In this study at leaf four of the phenotypically best trees were selected from each seed source area as seed trees. Selection was made on this basis to insure getting a representative sample of seed from the best trees in the area.

The original plan was to repeat plantings from each seed source at each test area for three successive years. A fairly good quantity of seed was obtained from most sources in 1951 but since that time we have had some difficulty due to poor seed years. The 1955 collection was the first where we got seed from every source being tested.

Seedlings were grown at the Indian Mound Nursery near Alto, Texas and handled generally speaking, in the same manner as commercial seedlings. Lots were planted randomly in the seed beds and were tested identically. All lots were lifted the same day and planted on the subsequent day.

Both row and block plantings have been used in the test area but due to the special aims of the project, it is now felt that rows are better than blocks, The row design enables us to have more replications with fewer seedlings hence a better cross section of site variation (better sampling), makes inventory easier, and is applicable to statistical analysis with more accuracy due to the greater numbers of replications. It is true that for the study of form, edge effect will give some bias, but this again is minimized by the greater number of replications; further this project is primarily short term and edge effects are not detrimental for several years.

Results of the study have become apparent sooner than had been hoped due to the drouths of 1954 and 1956. It would seem that first year survival would be most critical and that plantations established for one year would not be as greatly affected by drouth. This has not been the case since as much of the mortality has occurred during the second year as the first. For example, in 1953, the first year the plantations were established, survival in Robertson County averaged 95%, except for the North Carolina source which averaged 75%. The second year i.e. 1954, a definite pattern was established as follows. The survival of the Bastrop source was highest (73%), the Fayette source was next (66%), Western edge (Leon and Angelina Counties) was third (54%), the Louisiana source fourth (51%), while the North Carolina and Florida sources ranked fifth and sixth (17%) and (8%) respectively.

This situation was repeated in the plantation at Fastrill established in 1954. In this case the North Carolina source had the best survival at the

end of the first year, 837 with no drought, followed by the Bastrop source 67% and Fayette source 63%. At the end of the growing season of [4]1:66, following a severe drought, this had changed so that the Bastrop source survival was highest, being 45%, the Fayette source with 43$ was second, and North Carolina source fifth at 27%.

On an overall basis, summarizing the seven plantations, the Fayette County source is best followed by Bastrop County source, Western edge source, Texas coastal plain source, Louisiana source, North Carolina source and Florida source. This same pattern is not followed exactly in each test area, so that the results of each area would have to be presented to see the whole picture. However, in every case but one, at the end of two years the Bastrop or Payette sources had the highest survival. And, at Many, Louisiana, the Western edge source had the highest survival followed by the Fayette, coastal plains, and Bastrop sources. Notable was the fact that both Louisiana sources were inferior on this test area.

The growth rate of the seedlings from the "Lost Pines" source compares favorably to all others up to date. In fact at Many, the Fayette source is outstanding in height. Diameter differences are so small as to be negligable.

We feel that we have demonstrated the superior drouth hardiness of the "Lost Pines" sources, up to this time at least. Complete plantings, having all sources, have been made this year and should give additional confirmation if the established pattern is followed. The next step will be to examine the drouth hardiness of trees from all sources which have survived the past drouth years. For example, at the Temple Research Area, from the 352 planting, two trees of the North Carolina lot are still alive and two Louisiana trees are alive. Generally speaking, both of these sources are non-drouth resistant, but these trees are vigorous and apparently drouth resistant. These trees should be reproduced vegetatively and studied on a clonal basis to test them for drouth resistance and hardiness.

In closing, it must be mentioned that several avenues are being explored by the Texas forest Service as well as other agencies to ascertain the physiological reasons for drouth hardiness. Holger Brix, a graduate student at Texas A. and M. is studying root development with reference to the drouth hardiness. Socrates Kaloyereas at L. S. U. has developed tests for bound water contents and chlorophyll degradation in connection with drouth resistance. A. R. Gilmore at Alabama Polytechnic Institute is working on the relationship of root constituents to drouth resistance and E. Stone at the University of California at Berkeley, California, is studying drouth resistance in reference to "inverse transpiration."

On the basis of the field tests, a seed orchard has bean established from grafted clones of the most drouth hardy material. Thus, in the future seed will be produced which we expect to lesson the hazard of establishing plantations on drouthy sites in years of low rainfall. Planting may therefore be done successfully even under adverse climatological conditions.