SOUTHERN FOREST EXPERIMENT STATION

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PINE SEEDLING SURVIVAL UNDER SIMULATED DROUGHT

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SOUTHERN FOREST EXPERIMENT STATION

In east Texas, the high probability of drought during the growing season makes it advisable to prepare pine planting sites by eliminating vegetation that competes with the seedlings for soil moisture (*4*). The seedlings are especially vulnerable during spring terminal elongation. At this time soil moisture stress retards their height growth considerably (*8*), while ample moisture often produces initial growth advantages that the young trees maintain for many years (*6*).

Field testing for drought endurance is often hampered by weather vagaries (*3*). In the study reported here, seedlings of three pine species were planted under a shelter that withheld rain from the test plots without otherwise altering their environment (*7*).

MATERIALS AND METHODS

The study was installed on the Stephen F. Austin Experimental Forest near Nacogdoches, Texas. Soil belonged to the Cahaba (fine sandy loam) series and was uniform as to texture and color. The site was level and densely covered with Bermuda and other grasses, together with a variety of broadleaved weeds.

Eight plots 10 feet square were laid out in a single east-west row. The plots at each end formed the isolation. The six interior plots were paired into three blocks. One randomly selected plot of each pair was scalped; i.e., its plant cover was removed along with 2 to 3 inches of surface soil. On the other three plots the sod remained undisturbed.

As soon as site preparation was completed (February 9, 1961), eight seedlings each of three pine species—loblolly (*Pinus taeda* L.), shortleaf (*P. echinata* Mill.), and slash (*P. elliottii* Engelm.)—were planted on each plot at 2- by 2-foot spacing. Species were randomly assigned to individual planting spots. A twenty-fifth seedling was planted in the plot center to ensure uniform use of soil moisture throughout the plot. The plants, grown at a nearby State nursery, were selected for uniform height (about 1 foot), well-developed tops and roots, and dormant apical buds.

The shelter's framework was erected over the test plots in January 1961, and its transparent plastic cover applied on May 2. To prevent seed-

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ling mortality prior to covering, all plots were irrigated once with uniform amounts of water. The shelter withheld rain but did not greatly alter the temperature and humidity of the seedling environment (7).

Gravimetric soil moisture samples (to depths of 24 inches) were taken twice a week from April 26 to early July and then at monthly intervals until December. Texture classes at the various sampling depths were determined by Bouyoucos' hydrometer method (*1*). From the hydrometer data, the 15-atmosphere moisture (permanent wilting) percentages were estimated by the procedure of Nielsen and Shaw (*2*).

Seedling survival was recorded from biweekly needle moisture samples. A plant was termed dead if its needle moisture content, expressed on a dry-weight basis, dropped below 60 percent (*5*). Height measurements were taken soon after planting, then on May 3, June 26, September 21, and December 5, 1961.

RESULTS AND DISCUSSION

After 7 months under the shelter, survival on scalped plots averaged 99 percent for the three species, significantly (0.01 level) more than on sod plots, which averaged 30 percent.

Without sod competition, shortleaf and loblolly survived equally well (100 percent), followed by slash pine (96 percent). With competition, shortleaf survival was 63 percent, loblolly 19, and slash 8. Survival differences between shortleaf pine and the other two species were significantly different (0.01 level).

Mortality of slash and loblolly on sod plots began soon after the cover was put up, but shortleaf endured for almost 3 months without severe loss (fig. 1). This performance seems to corroborate the greater drought resistance attributed to shortleaf on the basis of field observations.

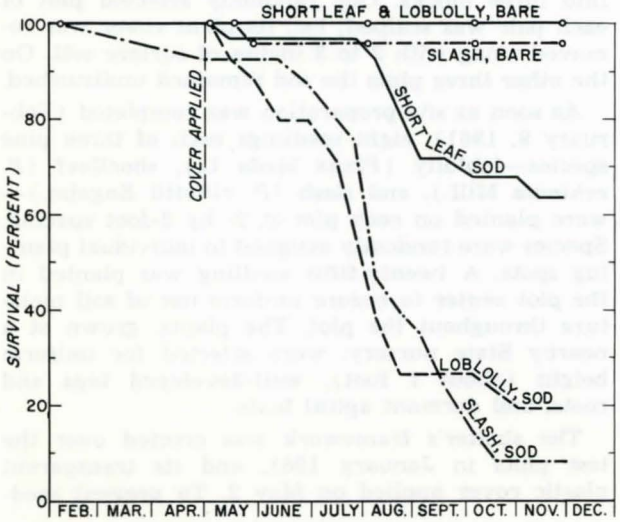

FIGURE 1.—*Seedling survival.*

Average height on bare and sod plots combined was the same for all three species (1.2 feet). Plants without competition made significantly (0.05 level) better height growth (1.3 feet) than those with competition (1.1 feet).

Loblolly made its height growth chiefly before the onset of drought. Shortleaf and slash pine initiated height growth somewhat later, and made most of it after the cover was applied. On sod plots, height growth of loblolly and slash pine slackened soon after the cover was applied, but shortleaf continued to grow at the initial high rate for about 6 weeks and made slight gains thereafter.

Immediately after the cover was installed, moisture depletion rates were greatest in the upper soil layers and decreased with increasing soil depth. Depletion was obviously faster in sod plots, where by May or June the soil moisture content dropped below the estimated 15-atmosphere wilting point at all depths. On scalped plots, soil moisture dropped below the wilting point only in the surface 6 inches.

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