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Survival of pines on droughty soils: two-year results

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SURVIVAL OF PINES ON DROUGHTY SOILS:

TWO YEAR RESULTS [1/]

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Abstract.--Three species of pines (loblolly, slash and longleaf) were planted with four treatments (loblolly and slash = bareroot, clay dip slurry and Terrasorb®; longleaf = containerized) to test survival on droughty, typic quartzipsamments soils. At the end of the first season, survival was significantly better for the containerized longleaf and Terrasorb® treated loblolly pine (81 and 85%) followed by untreated loblolly pine (51%), clay-treated loblolly (50%), then Terrasorb® treated slash (48%), untreated slash (41%) and clay-treated slash (36%). At the end of the second growing season, longleaf had 56% survival, Terrasorb® treated loblolly (51%), clay-dip slurry loblolly (31.9%), Terrasorb® treated slash (21%), untreated loblolly pine (20%) and clay-treated slash and untreated slash (17%). Pest management recommendations and management considerations are presented.

INTRODUCTION

During the last twenty years clear-cutting, followed by intensive site preparation and planting with genetically improved seedlings, has become a widely used method for southern pine regeneration. Such techniques, when applied on a broad scale, "one-size-fits-all" manner often produce less than satisfactory results. This is particularly the case when ecologically sensitive sites are involved. We encountered one such problem while attempting to regenerate pines on droughty soils (=Tonkawa Series) near Nacogdoches, TX.

Tonkawa soils are Typic Quartzipsamments, characterized by low fertility and high permeability, especially in uplands. These soils make up approximately 23,000 acres in Nacogdoches, Panola, Rusk and San Augustine counties. Tonkawa soils are formed in sandy deposits, with slopes ranging from 0-20 percent. Typical site index is 55 (base 50 years). The original forest cover type was probably dominated by shortleaf pine (Pinus echinata Mill.) with some longleaf pine (P. palustris Mill.) intermixed. Dominant hardwood species were sandjack (bluejack) oak (Quercus incana Bart.).

From 1973 to 1975, approximately 5,200 acres were clearcut, followed by either chopping, burning and/or shearing and windrowing with V-blades. In some areas a whole-tree chipper was used for hardwood removal. Essentially, this was removing organic matter from the surface and exposing bare mineral soil to the sun and wind, greatly decreasing the moisture holding capacity of the soil, as well as, increasing surface temperature. Subsequently, several attempts were made to reforest the area (1974-1981), using both machine planting and hand planting methods. Planting stock was generally slash 1-0 seedlings, with some drought hardy loblolly also being planted. Sources of seedlings included Texas Superior seedlings from the Texas Forest Service and seedlings from Florida and Oklahoma. All of

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these plantings were failures (i.e., less than 10 percent survival) due primarily to droughty conditions. Other factors included rabbit and town ant damage. Town ant predation is common on such sites (Moser 1984).

This study was initiated in 1983 in order to ascertain the fate of pine seedlings given various root treatments, planted on Tonkawa soils. Results reported herein represent two years of survival data.

METHODS AND MATERIALS

Study plots were established on Tonkawa (Typic quartzipsamments) soils (Dolezel 1980) 6 miles west of Garrison, Nacogdoches Co., TX. Seven treatments with eight replications (Fig. 1) each were established. Within each replicate, 48 seedlings were planted on an 8 x 8 foot spacing in four rows of 12 seedlings each. A buffer zone, equal in size to the replicates was planted with bare rooted loblolly pine seedlings between replicates. Replicates were 208 by 104 ft., each containing the same seven treatments randomly arranged (e.g., Replicate 5, Fig. 1).

The seven treatments were:

1. bare rooted loblolly pine,
2. Terrasorb® treated loblolly pine,
3. clay-slurry treated loblolly pine,
4. bare rooted slash pine,
5. Terrasorb® treated slash, and
6. containerized longleaf pine.

Terrasorb® is an organic compound which, when mixed with water, forms a hydroscopic substance used as a root dip to increase moisture holding capacity. Clay-slurry is a similar but inorganic compound that also forms a hydroscopic substance when mixed with water. Planting stock was 1-0 seedlings. Replicates were hand-planted using standard methods in January 1983. The study was replicated in January 1984, but failed due to excessively low winter temperatures, followed by high rabbit predation.

Survival counts were taken at approximately three month intervals throughout the year. At each count, surviving seedlings were flagged for ease of relocation. Data for all replicates were grouped by treatment to compare the effects of each treatment on survival and growth. We are in the process of taking height and diameter measurements on surviving seedlings for comparison of growth rates for each treatment.

RESULTS

First Year Survival.--First year data (Fig. 2) indicated a drastic decrease in survival between the period June-October, reflecting the below normal rainfall during that period (H. Reeves, pers.

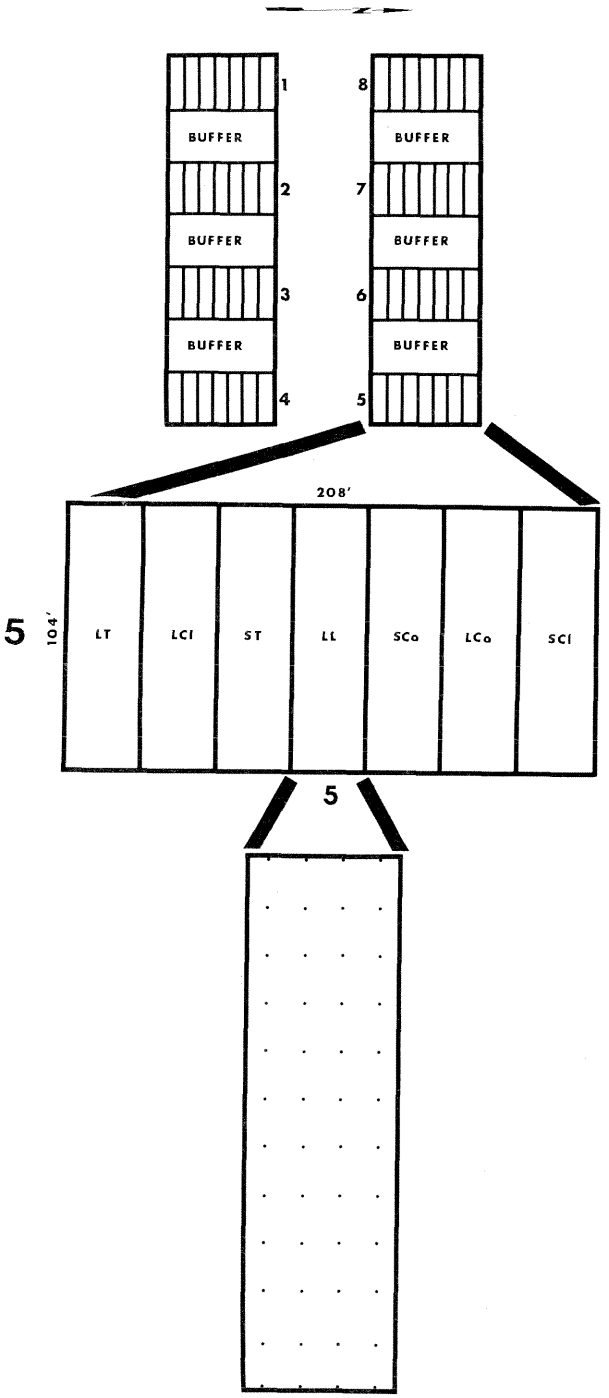

Figure 1. Experimental design for the Tonkawa pine seedling survival study. Each of the 8 replicate plots were randomly assigned 7 treatments. Abbreviations for treatments are those given in Fig. 2.

comm.). For the remainder of the year, both the longleaf and loblolly Terrasorb® treatments showed much higher survival rates (greater than 80%) than the other five treatments (50% or less). The entire study was repeated in December 1983, but due to extremely low temperatures (8°F.) for an extended period of time, that planting was a total loss.

Second Year Survival.--Second year data (Fig. 2) indicated another drastic decrease in survival between August and October, reflecting another severe drought. At last count (October, 1984), the longleaf and loblolly Terrasorb® treatments still showed significantly higher survival rates (56.6 and 50.8%, respectively), while the other five treatments showed unacceptable levels of survival (32% or less). The slash treatments all had very low survival, which indicates that this species is unsuitable for growing on droughty sites. Within some replicates, there was often less than 10% survival of the slash treatments.

DISCUSSION

Containerized longleaf and Terrasorb® treated loblolly pines had better survival than the other treatments. Management considerations for these deep sandy soils include:

1) minimizing clearcutting (followed by intensive site preparation as these methods

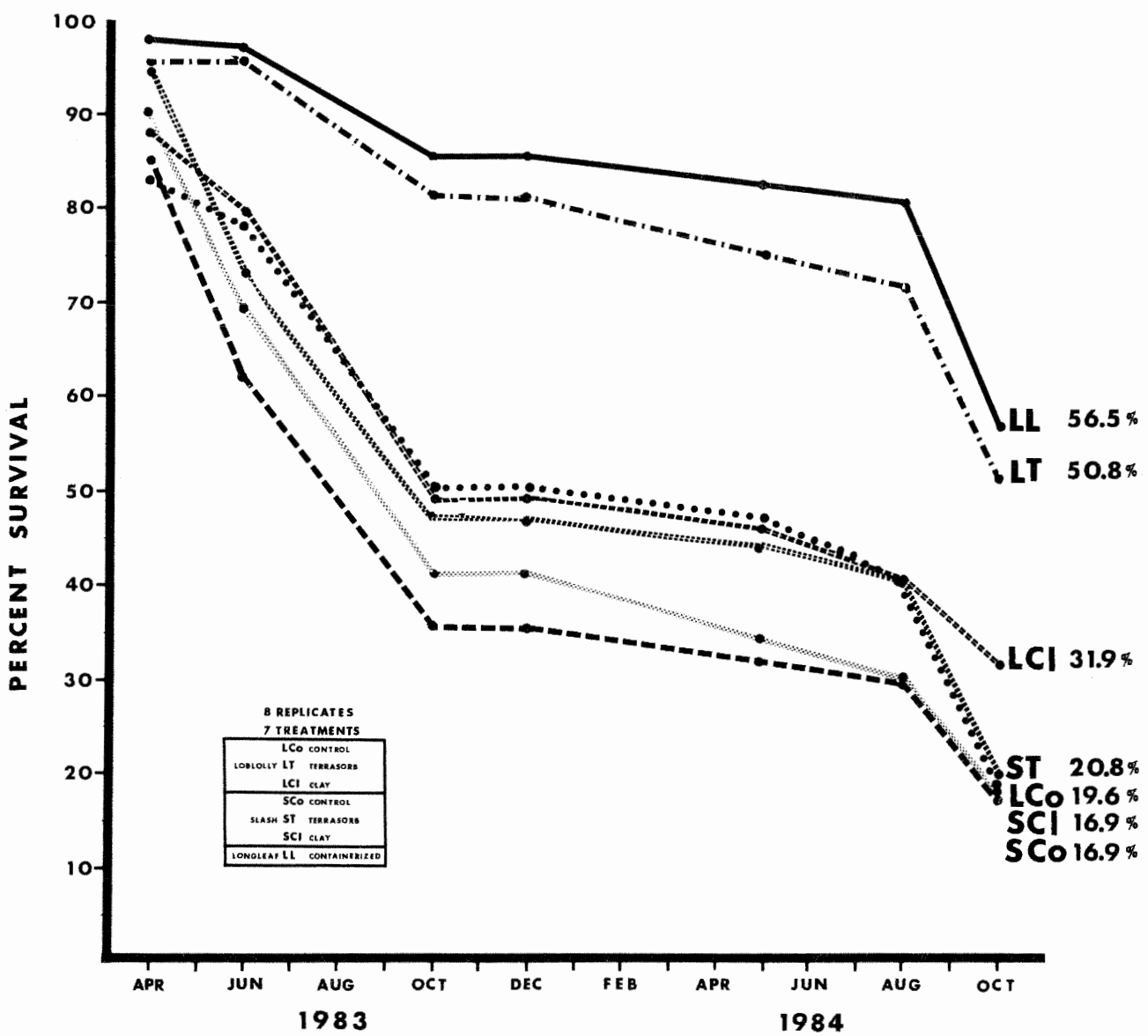

Figure 2. Survivorship curves for the 7 seedling treatment types during the period April, 1983 to October 1984. Plotted values represent means of 8 replicates.

cannot be economically justified due to the low productivity of the site;

2) considering underplanting with delayed hardwood removal, as this method leaves cover and shade for the seedlings. The key idea is to leave some cover and organic matter on the site to prevent exposure to the sun and wind.

The USDA Soil Conservation Service (Nacogdoches, TX) reports excellent success in regenerating sites on droughty soils by underplanting followed by injection. The problem of regeneration on deep sandy soils emphasizes the importance of root treatments for loblolly pine and the consideration of longleaf pine for planting.

Future project plans include:

1) continued monitoring of the existing replicates;
2) field operation tests of containerized longleaf, barerooted loblolly and shortleaf pine with and without Terrasorb®;
3) soil tests for moisture holding capacity and temperature combined with monitoring of wind speed;
4) monitoring of precipitation including amount and periodicity;
5) examination of survival in relation to topographic position, slope and aspect; and
6) study of mortality through time to ascertain cause and degree of each mortality factor (i.e., summer drought, winter low temperatures, pests, including town ants and rabbits).

In conclusion, we feel that Terrasorb® treatments and longleaf pine should be considered when planting seedlings on exposed droughty soils.

LITERATURE CITED

Dolezel, Raymond.
1980. Soil survey of Nacogdoches County, Texas. U.S. Dept. Agr. Soil Conservation Serv. and Forest Service. 146 p. plus 53 plates.

Moser, John C.
1984. Town ant. In: History, status, and future needs for entomology research in southern forests, pp 47-52, T. L. Payne, R. F. Billings, R. N. Coulson and D. L. Kulhavey, eds. Proc. 10th Anniversary East Texas Forest Entomology Seminar, 1983. Tex. Agr. Exp. Sta. MP 1553. 72 p.