SCALPING IMPROVES GROWTH AND SURVIVAL OF LOBLOLLY PINE SEEDLINGS DURING DROUGHT

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During the spring of 1966, a tree improvement program was initiated in Oklahoma. The site chosen for the seed orchard was covered with native sod, mainly species of *Andropogon.* Initial pine grafting was to be done on 1-1 rootstock grown in the field. A test was established to help determine the best procedure for growing healthy rootstock for field grafting without extensive site preparation.

In a study using paper mulch, Hermann (3) found first-year survival significantly higher than without the mulch, especially in areas with driest summers. Using wild hay and straw, Ursic (8) determined that first-year survival was increased significantly and that height growth was also benefited. Some mulches, such as sawdust, decreased available soil nitrogen This detrimental effect of sawdust mulch can be overcome by adding nitrogen fertilizers (1, 2).

Under simulated drought conditions Stransky and Wilson (7) reported scalping to be highly beneficial to survival. Scalping was reported to be of questionable value in southeast Georgia *(11)* . On three soil types in Texas, Silker (6) reported scalping to be slightly beneficial to slash pine but not for loblolly.

Fertilization of pine seedlings where grass or forbs are abundant is questionable because the increased nutrient level stimulates the competing vegetation more than the trees, thus increasing the competition for moisture, nutrients, and light (4, 9). Fertilizers applied to natural regeneration by Walker and Leiser *(10)* did not increase survival, but where moisture was plentiful height growth was greater. In a study of the influence of soil nutrients on drought resistance in red pine, Shirley and Meuli (5) stated that increased nitrogen made seedlings more susceptible to drought, while phosphorus made them more resistant.

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Method

During March 1966 the 1-0 loblolly seedlings were planted for grafting rootstock in a clone bank. The soil is a Bowie-Ruston sandy loam. The field design was a split-plot randomized block design split over scalped spots. Eight treatments were considered:

1. Control (planted in grass).
2. Fertilizer (ammonium nitrate applied at rate of 160 pounds of N per acre, plus potash applied at rate of 60 pounds K_2O per acre).
3. Sawdust mulch (pine sawdust several years old applied 3 inches deep around each tree).
4. Fertilizer and sawdust mulch.
5. Scalped spots (removal of sod) .
6. Scalped and fertilized.
7. Scalped and sawdust mulch.
8. Scalped, fertilized, and sawdust mulch.

The treatments were applied to six replications of eight tree row plots at a 12- x 12-foot spacing. Measurements were taken for height and survival during April, June, August, and November of 1966 and at the end of the second growing season. Soil moisture was extremely good during and immediately after planting but extremely poor during the 1966 growing season. Rainfall sufficient to help survival was lacking from May 22 through July 24, about 9 weeks. Moisture stress was not a problem during the 1967 growing season.

Analyses of variance and covariance were computed for height and survival for each measurement date.

Results

Survival.-The influence of the treatments on survival was evident by the first week in June. The difference between scalped and nonscalped spots on June 10 was significant at the 5-percent level. Scalped spots had 100-percent survival whereas nonscalped had 92-percent. By August 2 after a 9-week

drought, the difference between scalped and nonscalped treatments was significant at the 1-percent level. At the same time scalped treatments had 98percent survival and nonscalped 85-percent. The differences between treatments other than scalping also became significant at the 5-percent level.

All treatments considered, survival ranged from 100-percent for the scalped spots only, to 73-percent for trees receiving fertilizer and sawdust. Survival measurements at the end of the first growing season showed both scalping and other treatments significantly different at the 1-percent level. The average survival for scalped versus nonscalped was 93-percent versus 78-percent. Survival at the end of the first growing season ranged from 98-percent for scalped spots only to 60-percent for trees treated with both fertilizer and mulch. Percent of live trees at the end of the second growing season was not different from the first-year results for four treatments. In the other treatments survival decreased from 2 to 7 percent.

Based on second-year survival, four treatments provided a higher percent of live trees than the control plots. The survival percents are given for the five measurement dates (fig. 1). The treatments are ranked according to survival percent.

There was an interaction between some of the treatments. For example, sawdust mulch was beneficial for survival while fertilizer was detrimental. Fertilizer and sawdust applied together gave no better results than fertilizer alone.

The hypothesis that the initial size of seedlings would influence survival was tested by covariance analyses. Under the conditions of this test, initial seedling size did not significantly influence survival.

Height.-Differences in height for the first year

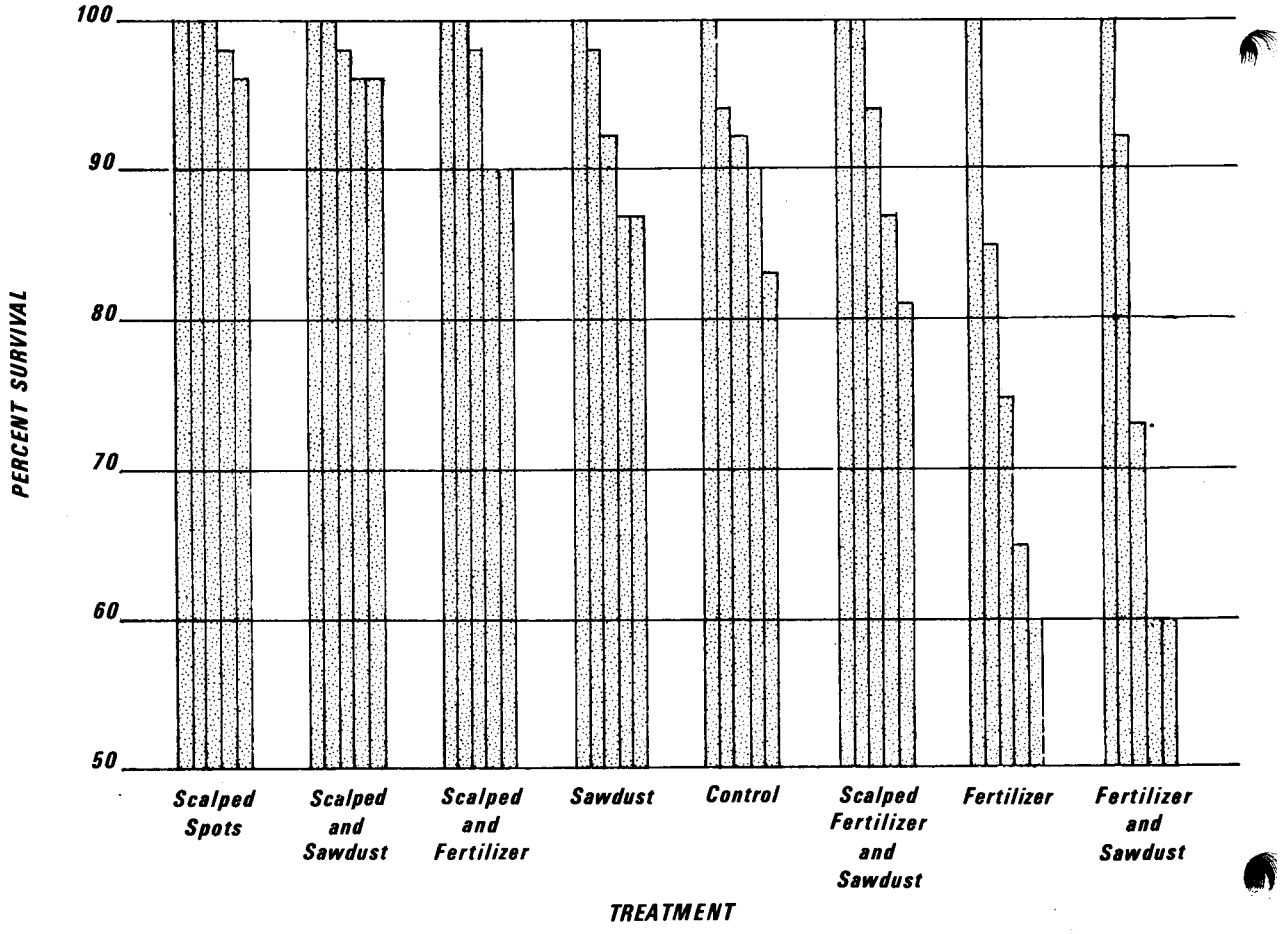

Figure 1.—Survival of loblolly pine seedlings at four measurement dates (1966 and end of growing season 1967).

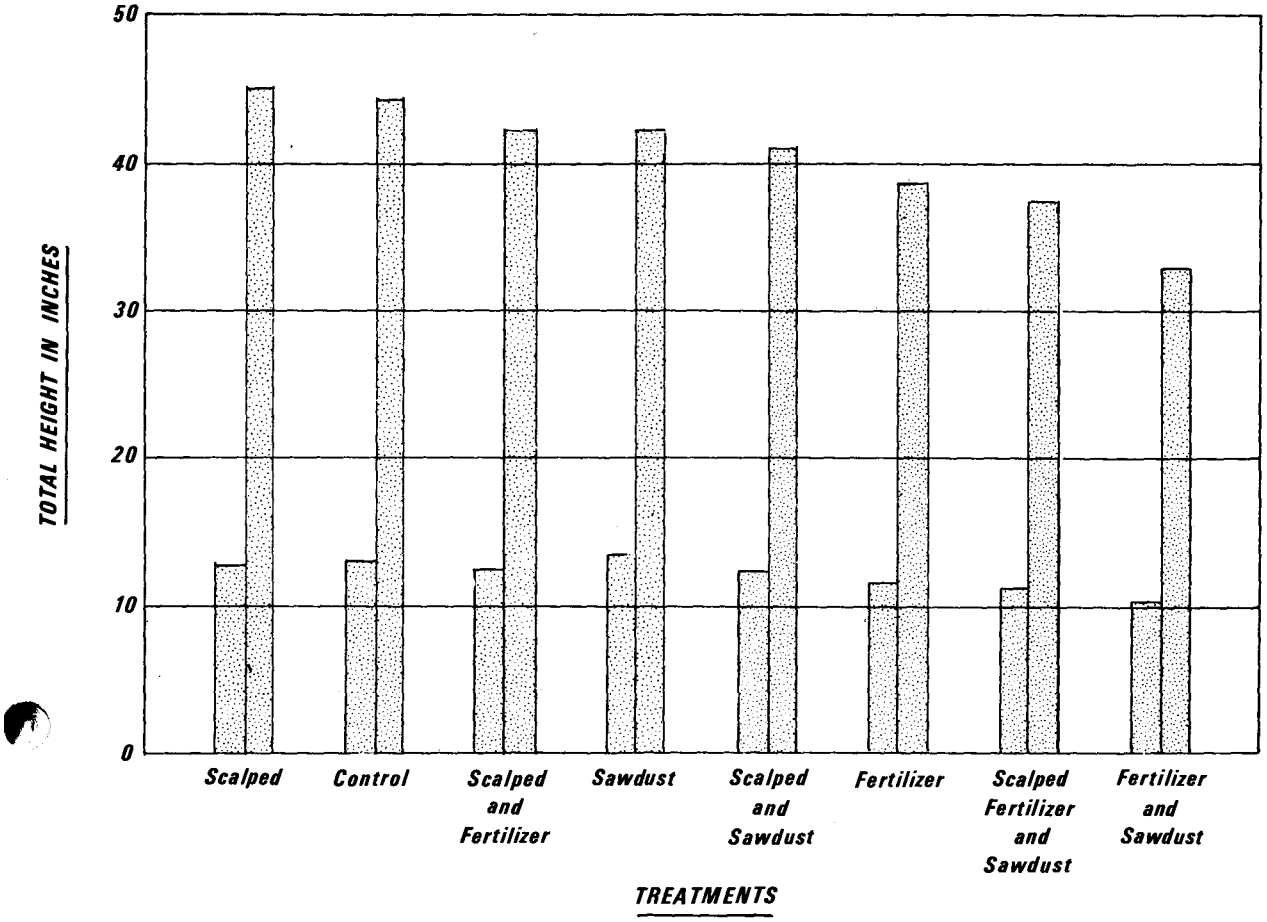

Figure 2.—Total height of loblolly seedlings at end of first and second years in the field.

ranged from approximately 10.5 to 13.5 inches. Sawdust mulch provided the conditions for best height growth the first year. During the second year when moisture was not a limiting factor, the scalped spots and the control plots provided better height growth than the sawdust mulch. The total height is given for the seedlings at the end of the first and second growing seasons (fig. 2).

The range of average height by treatments was 45 inches for trees planted on scalped spots to 33 inches for trees mulched and fertilized. After the second growing season only one treatment, scalped spots, showed greater height growth than the control. For the first year the trees that were tallest initially tended to grow faster than the shorter sees. This trend was not discernible during the second growing season.

Evaluation

Under field conditions where competition and water availability cannot be controlled, removal of competition by scalping appears to be the only treatment tested that will provide both increased survival and height. Fertilization stimulates competing vegetation more than the trees, thus causing greater stress on the tree for moisture, nutrients, and light.

Some fertilizers cause an increase in the rate of respiration. If the growing season is dry, this increased respiration when moisture is extremely limited will cause an increase in mortality. The purpose of sawdust mulch in this test was to help conserve moisture, but the sawdust after it dried during the summer actually became a moisture barrier. At least an inch of rain was required to soak

through the sawdust to become available to the tree. Trees receiving sawdust mulch suffered less from moisture stress early in the season but were under stress later than other treatments at the end of the season because of frequent light showers.

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