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Effects of Sulfometuron and Imazapyr Combinations on Johnsongrass for Pine Establishment on Old Fields

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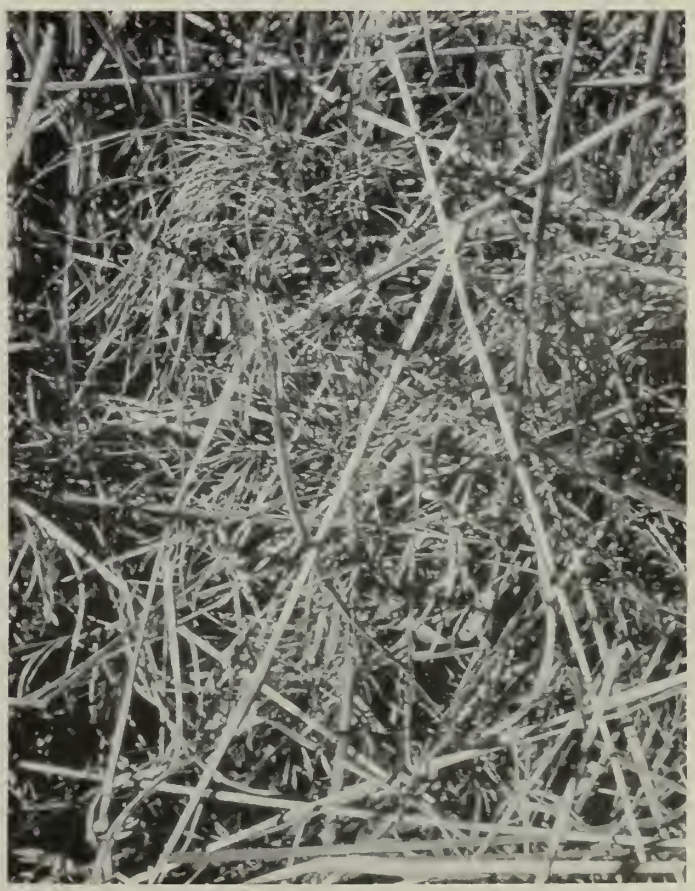
Comparison of loblolly pine seedlings (above) growing under low Johnsongrass competition versus one (at right) grown in an area with heavy Johnsongrass competition.

Under the Conservation Reserve Program (CRP), much erodible cropland is being converted to loblolly pine (Pinus taeda L). Survival of pines in old field and pasture conversion has been highly variable. This in part is believed to be due to competition from well established residual grasses such as Johnsongrass (Sorghum halepense L.), fescue (Festuca spp), bermuda (Cynodon dactylon L.), and bahiagrass (Paspalum notatum Fluegge). To determine the extent that such grasses limit pine survival and growth, and to decide what herbicide combinations are best for eliminating this problem required that herbicide tests be installed. This study was established to determine the effectiveness of Arsenal, Oust, and a mixture of Arsenal and Oust (Mix) in controlling Johnsongrass and in promoting loblolly pine survival and growth.



[1]The authors wish to acknowledge Dennis Martin and John Merrill for their assistance in setting up this study.

Study Site and Description

The study site was established on the Fleming tract in Clarke County, Georgia. The soil on this site is a Davidson sand loam which has an average site $index_{50\ year}$ of 78. Slopes on this site ranges from six to ten percent. The land was previously cultivated in wheat in 1987. The major competitor species that existed on the site at the time of treatment were Johnsongrass, sicklepod (Cassia obtusifolia L.), and fescue. The average height of the vegetative competition was 2.1 feet (0.64 meters). Subsoiling was done several weeks prior to planting in March. An improved north Georgia source of 1-0 bareroot loblolly seedlings was machine planted on the site.

Methods

Study Design and Treatment:

The study design used was a randomized complete block design. Blocking was done on the basis of topographic position. Five randomized complete blocks were established on the site. Each block consisted of four randomly assigned treatments. Treatment plots were 100 foot by 100 foot (30.6 meters by 30.6 meters) or .23 acres. The four treatments applied were:

1. Control ---------- no herbicide
2. Arsenal ---------- 8 oz product/acre (561 g/ha) (4 lb/gallon)
3. Oust ---------- 5 oz product/acre (350 g/ha)
4. Mix [2] ---------- Arsenal 3 oz product/acre (210 g/ha) + Oust @ 2 oz product/acre (140 g/ha)

Cidekick II at .025 percent was used as a surfactant in the treatments containing Arsenal. The tract was broadcast sprayed using a farm tractor with a boom of fan nozzles. The plots were broadcasted at a rate of 16.9 gallons total volume per acre (158 l/ha). Applications were made on the 15th of May, 1989.

Measurements:

Measurements of survival, percent cover, and seedling height were taken in July and October 1989. Initial height was determined for each seedling by measuring from the ground surface to where 1989 growth began. Final total height was determined in October. Seedling height growth was taken as the difference in final height and initial height measurements.

An ocular estimate of percent live cover was made for a one meter diameter circle centered around each seedling. A second set of measurements of percent cover were taken in the same manner in October of 1989.

The amount of light available to the seedlings was measured using a Decagon model number SF-80 Ceptometer. Measurements were taken in July and October. An above canopy measurement, along with a second measurement at 30 centimeters from the ground surface were taken in the control plots and in the open. Measurements were in umol $m^{-2}s^{-1}$.

Analysis:

Standard analysis of variance using a computer software program SAS GLM procedure and Duncan't multiple range test was used to determine significant differences in treatment means. All percent values were transformed using the Arcsin procedure.

Results And Discussion

Climate Trends:

Weather data was collected at the Whitehall Forest Weather Station which is approximately six miles due west of the study site. The growing season of 1989 was one of above average rainfalls and almost normal temperatures. During the months of May through November, rain amounts totalling 38.78 inches (98.5 centimeters) fell as opposed to the normal average during this period of 31.06 inches (78.89 centimeters). With this surplus of moisture and average temperatures, growth potential of these seedlings would be expected to be average or above average.

Trends in Percent Cover:

The trend in percent cover based on measurements made in July and October for percent cover are shown in Figure 1.

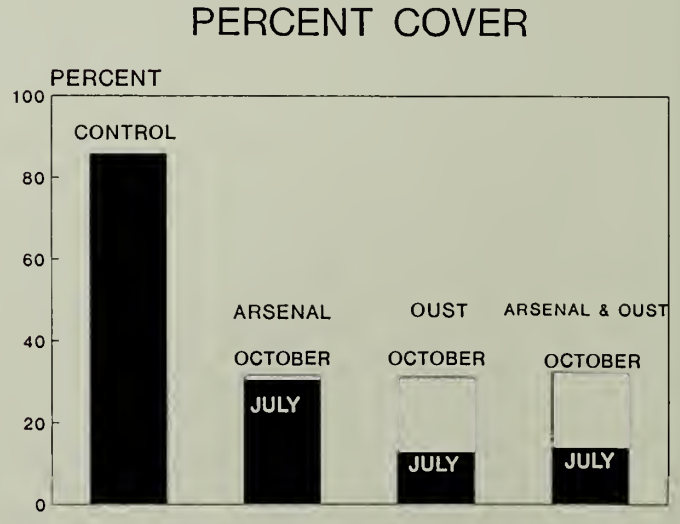


Figure 1. Average percent weed cover observed for the four herbicide treatments based on July and October assessments.

[2]Mixes of Arsenal & Oust are not currently labelled.. Labelling is currently being sought.

All herbicide treatments significantly reduced percent cover in July below that of the control. The Arsenal-Oust mix, and the Oust alone, both provided excellent control and were not significantly different from each other. Also, both treatments provided significantly better Johnsongrass control then the Arsenal alone treatment. In the October assessment, no analysis of percent cover was made. Control plots were lost due to the landowner making an early fall application of herbicides to the control plots. Percent cover was still high on the control plots; however, much of it was dead or dying at the time of the October assessment. It was observed that none of the herbicide treatments had longterm complete control of Johnsongrass.

Light Responses:

The effect of competition on reducing photosynthetically active radiation (PAR) received by the seedling was determined by measuring the incoming PAR above the competing grass and at the 30 centimeter level near the seedling in July and October. On both dates, light readings were taken between 1100 hours and 1330 hours when the sun was near its zenith. The light received near the seedling was expressed as a fraction of that received above the competing grass. In July, seedlings were on the average receiving 73 percent of the radiation received above the competition (Figure 2). By October, they were receiving only 37 percent of the incoming PAR. At other times in the day, the percent light reduction would be expected to be much greater due to the fact that incoming radiation at lower incidence angles would have to travel greater lengths through the Johnsongrass canopy before reaching the seedling. The potential effect of the light reduction observed in October on photosynthate production can be seen by comparing the potential rate of photosynthesis of seedlings that were receiving full sunlight versus those growing beneath the Johnsongrass (Figure 3). Potential photosynthesis would be expected to be reduced by as much as 27 percent due to the presence of Johnsongrass. Such differences would be expected to result in different growth rates for herbicide treated and non-treated seedlings especially in years when water supply is high.

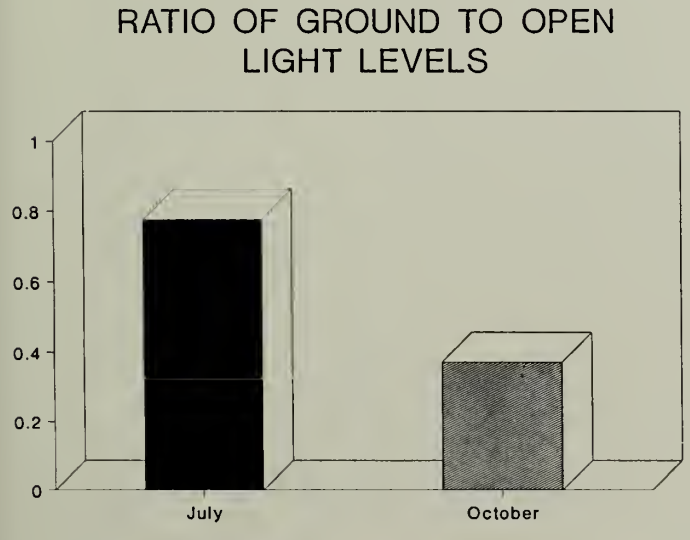


Figure 2. Ratio of photosynthetically active radiation measured at 30 centimeters to that measured above the competing vegetation based on light measurements made in July and October on the Fleming Tract.

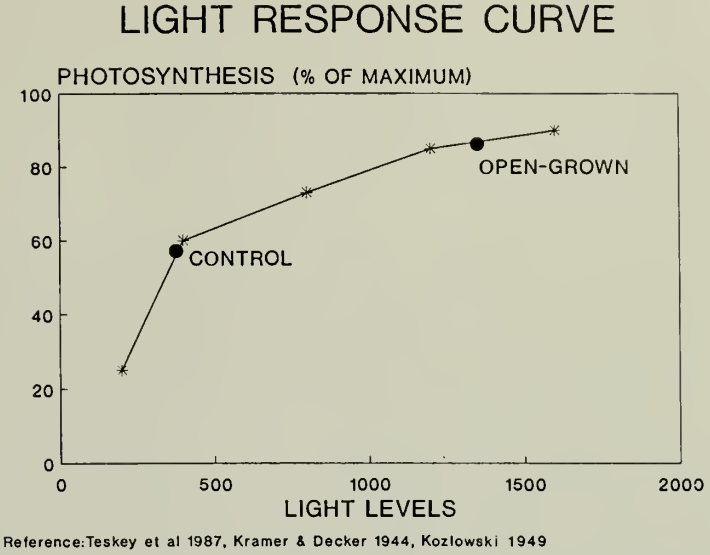


Figure 3. Average photosynthesis light response curve for Loblolly based on work by Teskey et al. 1987, Kramer & Decker 1944, and Kozlowski 1949. Also shown is the expected percent of the maximum Ps based on light levels observed for seedlings growing in the control (non-herbicided) and seedlings growing in the open in October.

Trends in Height Growth:

The trends in average height observed in July and October are shown in Table 1.

Table 1. Average height for seedlings growing in the four herbicide treatments applied to the Fleming tract. Height measurements were made at the beginning of the study (initial height), in July, and October. Means in a column with the same letter are not significantly different at the .05 level.

Treatment	Initial 1989 height (cm)	July height (cm)	October height (cm)
Control	20.67[a]	37.09[b]	35.5[c]
Arsenal	20.59[a]	33.66[c]	43.4[b]
Oust	20.42[a]	38.16[a]	54.8[a]
Mix	20.47[a]	37.63[ab]	54.3[a]

Analysis of variance of the July mean heights showed a significant difference at the .05 significance level between the Arsenal treatment and the other three treatments. While there was no significant difference between the Oust alone and the Arsenal-Oust mix treatments,there was a significant difference between the Oust treatment and the Arsenal and control plots.

In the analysis of the October final heights, there was no significant difference again at the .05 level between the Oust and Arsenal-Oust treatments. However, these two treatments were significantly different from the other two treatments, with the Arsenal being significantly different than the control. There was a decrease in the final height in the control plots due to a heavy infestation of pine tip moth (Dioryctria spp.) in these plots only. Only a few seedlings were infested in the other plots.

Survival Trends:

Survival was overall very high at the July measurements. In October, the survival rates dropped. The survival rates are shown in Table 2.

Treatment	July	October
Control	96.4[a]	81.1[b]
Arsenal	96.0[a]	83.5[b]
Oust	94.4[a]	93.0[a]
Mix	94.6[a]	92.0[a]

Table 2. Average seedling survival observed in July and October for seedlings growing in the four herbicide treatments applied to the Fleming tract. Means in a column with the same letter are not significantly different at a .05 level.

There was no significant difference in survival at the time of the July measurements. However, by October, a difference in survival was observed. Again there was no significant difference between the Oust alone and the Mix treatments. Both of these treatments had significantly higher survival than was observed for either the Arsenal or control treatments. There was no difference between seedling survival in the Arsenal and control plots.

Summary And Conclusions

The Oust alone and the Arsenal-Oust mix provided the best reduction in percent grass cover. Arsenal alone provided some competition reduction but not as much as the other two treatments. None of the treatments provided entire growing season control of Johnsongrass. By October, there was no significant difference between the three chemical treatments as far as percent grass cover. Height growth and survival were proportional to the early season reduction in percent cover (Tables 1 and 2) or the levels of photosynthetically active radiation received at the seedling height (Figure 3). For the Oust and Arsenal-Oust mix, a 12 and 11 percent increase in survival was obtained. Height growth was increased by 54 and 53 percent respectively for the Oust and Arsenal-Oust treatments over that observed for the control plots.

Further studies need to be carried out to determine if there is a level of Arsenal treatment that would be more effective and still be economically feasible. Based on this study, the Arsenal-Oust mix would be the most economical and effective treatment to apply.

Illustration of early season Johnsongrass control provided by Arsenal (foreground) versus the non-treated area (background).

Literature Cited

Kozlowski, T. T. 1949. Light and water in relation to growth and competition of Piedmont forest tree species. Ecol. Monogr. 19:207-231.

Kramer, P. J., and J. P. Decker. 1944. Relation between light intensity and rate of photosynthesis of loblolly pine and central hardwoods. Plant Physiol. 10:350-358.

Teskey, R. O., et al. 1987. Stomatal and non-stomatal limitations to net photosynthesis in Pinus taeda (L) under different environmental conditions. Tree Physiol. 2:131-142.

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