MIXTURES FOR WEED CONTROL IN NEWLY PLANTED LOBLOLLY PINE (*PINUS TAEDA* L.)[1/]

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ABSTRACT

Imazapyr, metsulfuron methyl, imazapyr plus metsulfuron methyl, and hexazinone plus metsulfuron methyl were aerially applied over newly planted and 1-year-old loblolly pine seedlings for the control of blackberry (*Rubus* species), composites (*Compositae*), sumac (*Rhus copallina* L.), and trumpet vine [*Campsis radicans* (L.) Seemann]. The study was installed at three locations with three replications of each treatment at each location. Imazapyr (0.375 lbs ai/A) plus metsulfuron methyl (0.063 lbs ai/A) gave the best control of sumac, blackberry, composites, and trumpet vine for 4 months after treatment. There appeared to be some synergism in the imazapyr plus metsulfuron methyl mixture against blackberry and sumac, but antagonism in the mixture of hexazinone (0.5 lbs ai/A) plus metsulfuron methyl (0.063 lbs ai/A) against blackberry. Loblolly pine seedling survival was not affected by any of the treatments tested. Minimal pine seedling damage was observed on newly planted seedlings treated with imazapyr at 0.375 lbs ai/A.

INTRODUCTION

One aspect of intensive southern pine management receiving much attention is herbaceous weed control in very young plantations. While some herbicides are available for this operation, no panaceas exist. Atrazine, hexazinone, simazine, and sulfometuron methyl have been reported to be beneficial in release of loblolly pine from herbaceous competition under some conditions, but results are variable (1,2,4,5). Some of the variability is due to experimental conditions, but some is also directly attributable to the selectivity of these compounds which makes them so useful in forestry. While selectivity permits application of herbicides over the top of pine seedlings in release operations, it also may release some weeds that are potentially as harmful to the growing seedling as weeds controlled by the treatment.

Herbicides are often used on land where the site index is very high and where competition is most likely to develop. Studies of weed control and pine

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[1/] Discussion of herbicides in this paper does not constitute recommendation of their use or imply that uses discussed here are registered. If herbicides are handled, applied, or disposed of improperly, there is potential for hazards to the applicators, off-site plants, and environment. Herbicides should be used only when needed and should be handled safely. Follow the directions and heed all precautions on the container label.

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This research was funded in part by the Santee and the Congaree Limited Partnerships.

growth along the Santee river in South Carolina have resulted in the operational use of 0.5 lbs product/A of sulfometuron methyl (4). Sulfometuron methyl controls many herbaceous weeds and is safe even when applied directly over the top of newly planted loblolly pine seedlings. Like most selective herbicides, however, some weeds are not controlled, and these weeds may become strong competitors of young pine seedlings. Early tests with sulfometuron methyl revealed that American black nightshade (Solanum americanum Miller) is resistant to sulfometuron methyl. On treated sites it often grew to 5 feet in height and formed a very dense cover over the entire plantation. This annual species did not prove to be an important pine competitor because it did not return in significantly dense populations in following years. Two weeds not controlled by sulfometuron methyl that are severe problems are trumpet vine, or cow-itch vine, and dwarf, or winged, sumac. Trumpet vine forms dense mats of vines capable of mechanically damaging young seedlings by pulling them down to the ground. Previous attempts at controlling trumpet vine with imazapyr were successful at rates of 0.5 lbs ai/A, but this rate is not recommended by the manufacturer for use on seedlings under 3 years old. In addition, imazapyr releases blackberry, which then often forms nearly impenetrable thickets. Winged sumac, a woody shrub or small tree, has been observed in young pine plantations with densities that average 3 million stems per acre over 85- to 100-acre sites. Sumac populations of this density often begin to develop during the first year of the plantation, and by the end of the first growing season forms nearly pure stands up to 6 feet in height with 120,000 to 150,000 stems of sumac per acre.

A solution to the problem of resistant or tolerant competing species observed in these young plantations in South Carolina might be to treat with sulfometuron methyl to control herbaceous weeds in the first year, treat with imazapyr in the second year to control trumpet vine and sumac, and then treat in the third year with hexazinone to control blackberry competition. Multiple treatments, however, are expensive, and logistical problems of arranging chemical treatments are increased. The ideal solution would be a single treatment to be applied in the year of planting, which would result in adequate control to permit pine seedlings to capture the site.

Efficacy and pine survival results of the following tests are reported: hexazinone plus metsulfuron methyl, imazapyr plus metsulfuron methyl, imazapyr alone, and metsulfuron methyl alone. All were tested on newly planted and 1-year-old loblolly pine seedlings for the control of blackberry, composites, trumpet vine, and winged sumac.

METHODS

The three study sites are typical lowland areas in South Carolina. The Liberty Life Tract (LLT) is located in Richland county on the flood plain of the Congaree River. Soil on the LLT is a silty clay similar to that found at the two sites located in the southwestern corner of Williamsburg County along the Santee River. The Santee sites were located on a 1-year-old sumac area (SOS) and on a new sumac area (SNS). The silty clay soils of the Santee area

belong to the Tawcaw Series and are members of the fine, kaolinitic thermic family of Fluvaquentic Dystrochrepts. These soils are characterized by slow permeability and slow runoff with a high available water capacity and 5% to 7% organic matter. Analysis of the top 6 inches of disked beds revealed an average of 16% sand, 42% silt, and 42% clay; the pH was 5.0. The average phosphorus content of the top 6 inches of soil on this site is very low (2 ppm), potassium is low (48 ppm), and magnesium is high (200 ppm).

Two of the study sites, LLT and SOS, were clearcut in 1983-84, and bedded in 1984. In April 1985, they were planted with containerized loblolly pine seedlings obtained from the state nursery and then treated with sulfometuron methyl. Because of a drought in 1985 , the sulfometuron methyl treatment on the LLT site was ineffective. Both the LLT and SOS sites were interplanted in the spring of 1986 with bare-root stock so that at treatment time for the present study they contained newly planted and 1-year-old seedlings. Herbaceous competition and trumpet vine rapidly colonized the LLT site, while sumac captured the Santee site following planting.

The Santee new sumac site (SNS) was clearcut in 1984. In 1985 sumac seedlings completely colonized the site. It was disked and bedded in the fall of 1985 and planted in the spring of 1986, and sumac again completely colonized the site.

The study, a completely randomized design with three replications, was installed on each of the three sites. Seven treatments (tables 1,2,3, and 4) were applied to the twenty-one 300- by 50-ft plots used at 2 of the sites, and 6 treatments were applied to the 18 plots used at the third site. Effective end-to-end buffer zones among plots were 200 feet long, and side-by-side buffer zones were 50 feet wide.

Treatments were applied on June 24, 1986 by helicopter equipped with raindrop nozzles. All herbicides were mixed in water to make 15 gallons of spray mixture per acre. Igepal DM-710 was added to the mixture to make a surfactant application strength of 0.25% by volume.

All plots were evaluated for weed control and seedling survival during October 22 to 23, 1986. Data were averaged for each plot and then analyzed by analysis of variance at the 0.05 probability level. Percent data were transformed to the arc sine of the square root of the percent prior to ANOVA. Significant ANOVA results were further analyzed with Duncan's multiple range test.

RESULTS AND DISCUSSION

Sumac was controlled by all chemical treatments except the hexazinone plus metsulfuron methyl combination (table 1). The metsulfuron methyl treatment initially resulted in complete defoliation of 1-year-old sumac, but nearly all were beginning to resprout 4 months after treatment. Sumac seedlings (less than one year old) treated with the same rate of metsulfuron methyl were not defoliated but were approximately 60% as tall as adjacent untreated sumac, indicating some growth inhibition. The hexazinone plus

metsulfuron methyl combination did not defoliate any of the old sumac stems, indicating antagonism for this combination. The combination was not applied to young sumac. Sumac stems treated with imazapyr and imazapyr plus metsulfuron methyl were still green 4 months after treatment, but they were more brittle than adjacent untreated stems, and sprouting was not observed on stems receiving these treatments.

Trumpet vine was controlled best with both the highest rate of imazapyr alone and the high rate of imazapyr plus metsulfuron methyl (table 2). The low rate of imazapyr and imazapyr plus metsulfuron methyl resulted in control that was about 60% as good as the higher rates. Sprouting was not observed on any of the trumpet vine, but most defoliated vines were still green and may resprout during the 1987 growing season. Metsulfuron methyl alone and in combination with hexazinone did not defoliate any of the trumpet vine.

Blackberry was controlled best with a combination of imazapyr and metsulfuron methyl (tables 1,2). Imazapyr alone did not result in any blackberry defoliation at any of the sites and metsulfuron methyl alone resulted in less defoliation than observed in combination with imazapyr. Thus synergism between imazapyr and metsulfuron methyl was observed in this study on blackberry but not on any of the other species evaluated. In addition, the combination of metsulfuron methyl with hexazinone did not result in any defoliation of blackberry and may indicate antagonism on blackberry for this combination.

Several members of the Compositae were lumped together in the group "composites" for evaluation. These species were controlled equally well by all treatments except the metsulfuron methyl treatment alone, which did not control these species at all. Imazapyr plus metsulfuron methyl combinations resulted in numerically higher average control than the other treatments, and the highest rate of imazapyr plus metsulfuron methyl gave 100% control.

Pine survival was evaluated separately for seedlings that were newly planted and 1 year old at treatment. Four months after treatment there were no significant differences in seedling survival for any of the treatments (tables 3,4), and survival of treated seedlings was not different than untreated check seedlings. Overall survival of the newly planted seedlings for the Santee and Liberty Life sites was 51%. The low survival of these seedlings was due to an extreme drought that occurred in the 1986 planting and growing season in South Carolina. Herbicide related symptomology was not observed on the dead seedlings, indicating that they probably died during the 3 months that elapsed between planting and treatment. Seedlings that were 1 year old at treatment had an overall survival rate of 94%.

Treatment with high rates of metsulfuron methyl typically results in morphological changes in the terminal growth of young pine seedlings. Aberrations include a reflexing of needles to give a pin-wheel appearance along with varying degrees of chlorosis and release of inhibited lateral buds (3,4). The ensuing development of released buds results in development of very bushy seedlings, but seedlings grow out of this damage at rates varying with herbicide dose. Damage of this type was not observed with seedlings

treated with metsulfuron methyl in this study. Similar effects were observed to a minor extent on newly planted seedlings treated with the highest rate of imazapyr (0.375 lbs ai/A). The same symptoms have been observed in other studies with imazapyr at rates exceeding 0.5 lbs ai/A, but seedlings ceased to exhibit morphological aberations in growth as early as 1 to 2 months after treatment with 0.5 lbs ai/A. Higher rates generally require longer recovery periods.

CONCLUSION

The high dosage rate of imazapyr plus metsulfuron methyl gave the best overall weed control and did not adversely affect pine survival. Failure of treatments to improve survival of newly planted seedlings is partially due to masking by the droughty conditions at each site and to the lateness of the treatments. Apparent synergism between these two herbicides was expressed against some of the species evaluated but not against pine. Apparent antagonism between hexazinone and metsulfuron methyl against blackberry and sumac was not observed for the herbaceous species evaluated. These studies are not conclusive on the question of synergism and antagonism for the mixtures tested but serve to indicate the need for extensive testing before herbicide mixtures are recommended for general use.

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