IMPACTS OF RATE OF HEXAZINONE APPLICATION ON SURVIVAL AND GROWTH OF THE LOBLOLLY PINE. J. L. Michael, USDA Forest Service, Southern Forest Experiment Station, Auburn, AL 36849.

ABSTRACT

Hexazinone [3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H, 3H)-dione] in Z-cc pellets (10% active ingredient) was applied at rates of 0, 2, 4, and 8 pounds of active ingredient per acre for site preparation on clay soil in a randomized experiment in May 1980. Loblolly pine seedlings planted to the site in January 1981 were measured for diameter 3 inches above the ground, height, and survival in January 1981, December 1981 and 1982, and November 1983. Four and 8 pounds of active ingredient per acre resulted in significant growth of the treated seedlings over that of the untreated seedlings for each of the 3 years of this study. Growth responses for seedlings treated with 4 and 8 pounds of hexazinone were not significantly different. Diameter growth of the seedlings responded to the treatments to a greater degree than did height growth, although both were significant at the p=0.05 level by analysis of variance (ANOVA) and Duncan's multiple range test. Seedlings in the Z-pound treatment failed to grow significantly more than the untreated plants during the 3 years of study. Survival was not significantly affected by any of the treatments. Results of this study suggest that 2 pounds of hexazinone per acre is too low a rate for significant growth benefits to accrue from site preparation with the grid application method on clay soil.

INTRODUCTION

The use of hexazinone for site preparation and pine release has received much attention since it was introduced in the late 1970's. The results of research that characterize the activity of this compound have been discussed by Campbell (1), Gonzalez (2), Michael (3), Minogue et. al. (4), and others. In general, the compound is more effective on coarse textured soils. However, good activity can be achieved on fine textured soils at about twice the rates required on coarse textured soils, Use of the pelleted formulation, the production of which has been discontinued, for site preparation was limited by the product's label to a maximum rate of 3.0 pounds of active ingredient per acre (lb ai/acre). However, the liquid formulation applied with a "spot gun" is now being used in the same ways shown to be effective for the pellet, i.e., grid, spot, and individual stem treatment. The liquid formulation is much less expensive than the pelleted formulation was, and the label for the liquid formulation permits rates of up to 12 lb ai/acre. There have been no reports of the maximum rates of hexazinone that can be applied for site preparation without subsequent impacts on planted pine survival. This paper reports impacts of the 2-cc hexazinone pellet applied at rates of 0, 2, 4, and 8 lb ai/acre on the survival and growth of loblolly pines on heavy clay soil in the Alabama Piedmont.

METHODS

The study was installed in central Alabama on a highly eroded clay site having a gently sloping southerly exposure. The site, an abandoned pasture, was characterized by nearly 100% cover from honeysuckle (Lonicera japonica Thunberg), with scattered stems (120 to 300 stems/acre) of sweetgum (Liquidambar styraciflua L.) ranging in height from 12 to 24 feet.

Hexazinone pellets (2 cc, 10% active ingredient) were applied to 0.05-acre plots at four rates (Table 1) in a completely randomized designed study with three replications. Treatments, applied May 28-29, 1980, were activated by 2.74 inches of precipitation during the week of June 18-24. The first precipitation following application fell on June 18 and measured 1.6 inches.

Loblolly pine seedlings (l-year-old, bare root) were planted on each plot in January 1981 at a spacing of 6 ft x 6 ft. Twenty-five seedlings in each of the net plots (30 ft x 30 ft) were permanently tagged for future identification and measurement.

Measurements of height, stem diameter at 3 inches above the ground (D3), and survival were recorded immediately after planting and in December 1981, December 1982, and November 1983. The data thus collected were subjected to analysis of variance and Duncan's multiple range test at the p=0.05 level.

RESULTS AND OISCUSSION

Herbicide rates of 2 pounds and greater resulted in 100% kill for all sweetgum stems on the site. Honeysuckle control was not estimated in 1981 and 1982, but in 1983 the percentage of cover remaining was estimated in November. The 8-pound treatment averaged 25% cover, the 4-pound treatment averaged 18% cover, the 2-pound treatment averaged 52% cover, and the untreated control averaged 95% cover.

Pine Survival

Pine survival was not significantly affected by herbicide rate (Table 2). The average survival in 1981 varied over a range of 12% for each treatment except the 2-pound rate, which varied over a range of 32% (64 to 96%). This wide range of variation in the 2-pound treatment contributed to the lack of significance of the survival analysis of variance. While the arithmetic differences are not significant, there appears to be a trend toward decreasing survival with the highest rate tested.

During the 3 years after planting, survival decreased slightly for some of the treatments, but at the end of the third growing season there was no significant difference in survival among the treatments. A trend toward significance is apparent from the ANOVA F values and the probability of a greater F value for survival for each of the three growing seasons after planting (Table 2), but this is probably due to greater continuing mortality among seedlings in untreated plots,

Pine Height

At planting, no significant differences in height existed among the pine seedlings in the treatment groups (Table 3). By December 1981, only the seedlings in the 8-pound treatment were significantly taller than the untreated plants. At the end of the growing seasons in 1982 and 1983, both the 4- and a-pound-treated seedlings were significantly taller than the untreated seedlings. The Z-pound treated seedlings failed to grow significantly more than the untreated plants.

Pine Diameter

The average D3 of seedlings used in this study did not differ significantly at planting (Table 3). By the end of the first growing season after planting, seedlings in the 4- and 8-pound treatments were significantly larger than the untreated plants. Also, the average D3 of seedlings in the 8-pound treatment was greater than that of all the other treatments. At the end of the 1982 and 1983 growing seasons, the average D3 of seedlings in the 4- and 8-pound treatments remained significantly greater than that of the untreated control. Average D3 of the seedlings in the 2-pound treatment did not differ from that of the untreated control at any time during the 3 years of this study.

CONCLUSIONS

The use of pelleted hexazinone by foresters for site preparation was governed by the product's label: which permitted use of up to 3 pounds of active ingredient per acre for clay soils. Most often, however, the prescription was for the use of 2 pounds per acre. The development of the "spot gun" and the lower cost of hexazinone in the liquid formulation, coupled with the manufacturer's decision to cease production of the pelleted formulation, have resulted in the substitution of the liquid formulation for the pellet in spot or grid applications. Though the label for the liquid formulation permits application rates of up to 12 pounds of active ingredient per acre, most users who are substituting it for the pellet are still prescribing 2 pounds per acre.

The results of this study show that 2 pounds of hexazinone per acre applied in a grid pattern were inadequate on clay soil and did not result in any growth or survival benefits. The 4-pound rate did result in significant growth benefits. Rates of 4 pounds or 2 gallons per acre and higher can be used without adversely impacting survival of planted pines, but it was not possible to determine the maximum safe rate that can be applied. The highest rate applied resulted in the largest average seedling size 3 years after planting.

LITERATURE CITED

1. Campbell, T. E. 1982. Herbicide spray effects on mixed pine-hardwoods. Proc. South. Weed Sci. Soc. 35:175-180.

2. Gonzalez, F. Eugene. 1983. Southern pine release with hexazinone formulations. Proc. South. Weed Sci. Soc. 36:223-227.

3. Michael, J. L. 1980. Formulation, rate, and season of application effects of hexazinone gridball on oak topkill. Proc. South. Weed Sci. Soc. 33:110-113.

4. Minogue, P. J., D. H. Gjerstad, L. R. Nelson, G. R. Glover, and S. A. Knowe. 1982. Development of hexazinone formulations for pine release. Proc. South. Weed Sci. Soc. 35:157-160.

Table 1. Grid placement of hexazinone pellets applied May 28-29, 1980, for each of four rates to plots on a clay soil.

Treatment (lb ai/acre)	Grid (ft x ft.)
0	----------
2	4.3 x 4.3
4	3.0, x 3.0
8	2.1 x 2.1

Table 2. Loblolly pine survival (%), F values, and probability of a greater F value for the analysis of variance after application of hexazinone for the three growing seasons following planting.

Growing season	Survival at rates (lb ai/acre) of- 0	2	4	8	F	Probability > F
1981	71	81	77	69	0.99	.4465
1982	71	81	75	67	1.39	.3144
1983	68	81		63	1.89	.2092

Table 3. Growth response of loblolly pines on a clay soil site prepared with four rates of hexazinone in the pelleted formulation. [1, 2]

Treatment (lb ai/acre)	Height (ft.) on dates (mo/yr) of- 1/81	12/81	12/82	11/83	D3 (in) on date (mo/yr) of- 1/81	12/81	12/82	11/83
0	0.5a	0.9b	2.5c	4.3b	0.2a	0.2c	0.5b	0.8c
2	0.5a	1.0b	2.7bc	4.8ab	0.2a	0.2bc	0.5b	0.9bc
4	0.6a	1.1ab	3.1ab	5.5a	0.2a	0.3b	0.6ab	1.1ab
8	0.6a	1.2a	3.2a	5.7a	0.2a	0.3a	0.7a	1.2a

[1] Means followed by the same letter in the same column are not significantly different at the p=0.05 level by Duncan's multiple range test.

[2] D3 is the diameter at 3 inches above the ground.