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KUDZU ERADICATION TRIALS TESTING FIFTEEN HERBICIDES.

James H. Miller, Southern Forest Experiment Station, USDA Forest Service, Auburn University, Alabama 36849

ABSTRACT

Two studies examined herbicide treatments for controlling kudzu [Pueraria lobata (Willd.) Ohwi]. In one study, fifteen herbicides were tested at 1 or 2 rates at 5 locations. Treatments and re-treatments occurred over a 2-yr period. The most effective herbicides were picloram pellets (4.7 and 5.8 lb ai/a), tebuthiuron pellets (6 lb ai/a), and picloram + 2,4-D (1 + 4 and 1.5 + 6 lb ai/a). Eradication was achieved on plots at one or more locations with these treatments plus spot re-treatments. Kudzu was more difficult to control as patch age increased. The second study compared picloram + 2,4-D (1 + 4 lb ai/a) and dicamba (4 lb ai/a) applied with spray volumes (herbicide + water) of 40, 60, or 80 gal/a and at four timings. Control was best when treatments were applied in late May through October. Carrier volume was not a significant variable.

INTRODUCTION

Two research studies were performed to identify and refine kudzu eradication treatments. Tested first were most of the herbicides currently labeled for kudzu control on noncroplands and for forest site preparation with the objective of identifying the most effective treatments. To further define effective prescriptions, a second study compared the two most effective liquid formulations identified in the first study by applying these on four application dates and at three carrier volumes.

Unlike other forest competition, kudzu must be completely eradicated from an area or it will recover from a few surviving rootstocks to engulf tree seedlings. Thus, zero-percent kudzu cover is the uncompromising goal of any herbicide treatment program for this pest vine.

The cooperative support of the Georgia Forestry Commission in the planning and performance of this research is gratefully acknowledged.

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.

Use of trade names is for the reader's information and convenience and does not constitute official endorsement or approval by the U.S. Department of Agriculture to the exclusion of any other suitable product.

METHODS

In the first study, five kudzu patches having no forest canopy served as study areas (Table 1). Three locations were in Georgia and two in Alabama. Locations served as blocks in this randomized complete-block study design, with 1 replication per block. Fifteen herbicides were applied at 1 or 2 rates to 20 plots at each location (Tables 2 and 3). Plots measured 40 x 40 ft and were separated by 5-ft buffer strips. Liquid formulations were applied with a CO_2 boom-sprayer equipped with Raindrop™ nozzles. The equivalent of 80 gal/a spray volume in water was used with perpendicular spray passes to assure complete and uniform coverage. Spraying was usually performed in the early morning hours during high relative humidity and low wind. Pelleted herbicides were applied uniformly by hand by subsectioning the plots and the herbicide amounts. Between-plot buffers were maintained by periodic application of picloram + 2,4-D (Tordon 101).

All herbicides were applied in late May and early June, except glyphosate, fosamine, and the triclopyrs, which were applied in August according to manufacturers' recommendations. Plot re-treatments were performed for 1 or 2 yr. Herbicides applied in early summer the first year were also reapplied in August if regrowth warranted. Plot assessments were made by estimating the ground cover of kudzu plants on the interior 20 x 20 ft. Assessments were made twice a year, and re-treatments were applied according to these assessments and recommended application times. When coverage of kudzu was greater than 5%, a broadcast re-treatment was applied; if less, then a spot re-treatment was used. A final assessment of all plots was made in June of the growing season following the last re-treatments. Cover percentages from this assessment were analyzed by analysis of variance (ANOVA) and Duncan's multiple range test after arcsine transformations.

In the second study, the two most effective liquid formulations -- Tordon 101 and Banvel were tested at one rate each, at four application times, and at three spray volumes. Both were applied at 2 gal/a, or picloram + 2,4-D (1 + 4 lb ai/a) and dicamba (4 lb ai/a). Untreated check plots were included. The application times were May 5, May 26, August 23, and October 2, 1983. Total spray volumes tested were 40, 60, and 80 gal/a, with water as the carrier. An additional treatment applied the dicamba rate with Cide-Kick™, a nonionic spray adjuvant, as a 0.625% solution at the four timings and with only 80 gal/a of total mix. Applications were with a CO_2 boom-sprayer using flat-fan nozzles and perpendicular swaths. Plots, 20 x 20 ft, were separated by 5-ft buffer strips, which were kept clear with Tordon 101. A completely randomized design was used with 3 replications. The study site was a kudzu patch over 20 yr old on a Piedmont site near Auburn, Alabama. The soil was Gwinnett sandy loam (clayey, kaolinitic, thermic typic Rhodudult).

Plot assessments were conducted in March 1985, after the surviving kudzu had sprouted. Thus, a complete growing season without treatments had past. All sprouting rootstocks were counted on the interior 10 x 10 ft of both treated and check plots. These data were analyzed with ANOVA's, linear contrasts (gallons of spray), and Duncan's multiple range test (time).

RESULTS AND DISCUSSION

The most effective of the 15 herbicides tested were picloram pellets, tebuthiuron pellets, and the mixture of picloram + 2,4-D (Table 3). Differences in locations (blocks) were significant at the 0.01 level. Picloram pellets at the 5-lb ai rate gave eradication at three of the five locations and tebuthiuron pellets at four locations. Picloram + 2,4-D provided plot eradication at only one location. Complete control was achieved mostly on the two younger patches, where kudzu had been growing for about 10 years. Average control was least on the the oldest patch. Dicamba and amitrole, at 4-lb ai rates, provided greater than 90% control on the four youngest patches. The relative effectiveness of the other herbicides tested can be judged from the 2-yr results presented in Table 3.

On Tordon-treated plots kudzu rootstocks continued to sprout over the 2-yr observation period. Most of these sprouts originated from partially controlled rootstocks, because spot treatments with sprays of both picloram + 2,4-D and dicamba were 100% effective. Spot treatments with tebuthiuron pellets in August of the first year were probably not needed at the four locations where eradication eventually occurred. Tebuthiuron is a slow acting, residual herbicide that causes plants to yellow in the first year and progress to necrosis in the second year. Except for one location, tebuthiuron appears to be a one-time treatment. Loblolly pine seedlings (1-0 stock) were planted on tebuthiuron-treated plots at three locations in the third planting season after initial treatments. After one growing season, seedling survival averaged 50% under droughty summer conditions.

In the second study, herbicides and timing of application were both significantly different at the 0.01 level, but varying carrier volume, as tested by linear contrasts, did not yield significant differences, even at the 0.1 level. Thus, the lowest gallonage would be operationally the most practical to use. Carrier volume is averaged in the results shown in Figure 1. Control with one application of picloram + 2,4-D was about twice as effective as dicamba. The effectiveness of control was significantly (0.05 level) improved when treatment was applied in late May or later. October applications, although most effective for both herbicides, did not differ significantly from August or late May applications.

Dicamba applied with Cide-Kick was not significantly different from dicamba alone when analyzed by an ANOVA across all times (Fig. 2). Timing differences were significant (0.01 level) only with the dicamba plus Cide-Kick. Again, applications beginning in late May through October were more effective than those beginning in early May. This difference with Cide-Kick appears to warrant further testing at the later application dates.

Table 1. Approximate age of kudzu and soil properties at each study location.

Location	Patch age	pH	Organic matter	Sand	Silt	Clay
	Years		----------Percent----------			
Georgia:						
Carrollton	10	5.1	2.9	55	25	20
Newnan	30	6.0	1.4	58	22	20
Buena Vista	20	5.2	2.2	75	15	10
Alabama:						
Dadeville	10	5.0	1.6	53	27	20
Opelika	40	4.9	2.7	52	27	21

Table 2. Description of the test herbicides.

Common name	Active ingredient	Trade name	Manufacturer
	Percent		
Picloram (pellet)	11.6	Tordon 10K	Dow
Picloram + 2,4-D	10.2 + 39.6	Tordon 101	Dow
Tebuthiuron (pellet)	40.0	Spike 40P	Elanco
Dicamba	48.2	Banvel	Velsicol
Amitrole	21.6	Amitrol T	Union Carbide
Fosamine	41.5	Krenite	DuPont
Triclopyr ester	61.6	Garlon 4	Dow
Triclopyr amine	44.4	Garlon 3A	Dow
Glyphosate	41.0	Roundup	Monsanto
Sulfometuron methyl	75.0	Oust	DuPont
2,4,5-T ester	69.2	Esteron 245*	Dow
2,4-D ester	68.6	Esteron 99*	Dow
2,4-D ester + 2,4-DP ester + dicamba	32.5 + 30.7 + 5.4	Super Brush Killer	P.B.I. Gordon
Chlorflurenol	12.5	Maintain CF125	Uniroyal
2,4-DP ester	59.1	Weedone 2,4-DP	Union Carbide

*No longer sold.

Table 3. Rate of herbicide treatments and re-treatments, with the percentage of cover reduction 2 yr after initial treatments.

Herbicide	Initial Rate	Re-treatment[1] Type	No.	Rate	Kudzu control[2]
	lb ai/a				Percent
Picloram	5.8	s	2	0.4 oz prod. per crown	99.9a
Tebuthiuron	6.0	s	1	5 pellets per crown	99.6a
Picloram	4.7	s	2	0.4 oz prod. per crown	99.2a
Picloram + 2,4-D	1.5 + 6.0	s	2	4% mixture	99.0a
Picloram + 2,4-D	1.0 + 4.0	s	2	4% mixture	99.0a
Dicamba[3]	8.0	sb	2	4% mix. or 4 lb ai/a	95.0a
Amitrole[3]	4.0	sb	3	same as initial	87.0ab
Fosamine	12.0	b	1	4 lb ai/a	71.0abc
Triclopyr ester	4.0	b	1	2 lb ai/a	66.0abc
Triclopyr amine	4.5	b	1	2.25 lb ai/a	65.0abc
Glyphosate[3]	4.0	b	1	2 lb ai/a	64.0abc
Sulfometuron methyl[3]	1.0	sb	2	same as initial	63.0abcd
Amitrole[3]	2.0	sb	2	same as initial	61.0abcd
2,4,5-T ester	4.0	sb	1	same as initial	51.0 bcd
Sulfometuron methyl[3]	0.6	sb	2	same as initial	47.0 bcde
2,4-D ester	8.0	b	2	same as initial	43.0 cde
2,4-D + 2,4-DP + dicamba	2+2+0.5	b	2	same as initial	36.0 cde
Chlorflurenol	1.0	b	2	same as initial	17.0 efg
2,4-DP	3.7	b	2	same as initial	8.0 fg
Check	--	-	-		0.0 g

[1]Re-treatment: s=spot; b=broadcast; sb=plots required either spot or broadcast re-treatment.

[2]Means in a column followed by the same letter are not significantly different at the 0.05 level.

[3]Surfactant was added to the spray mixture.

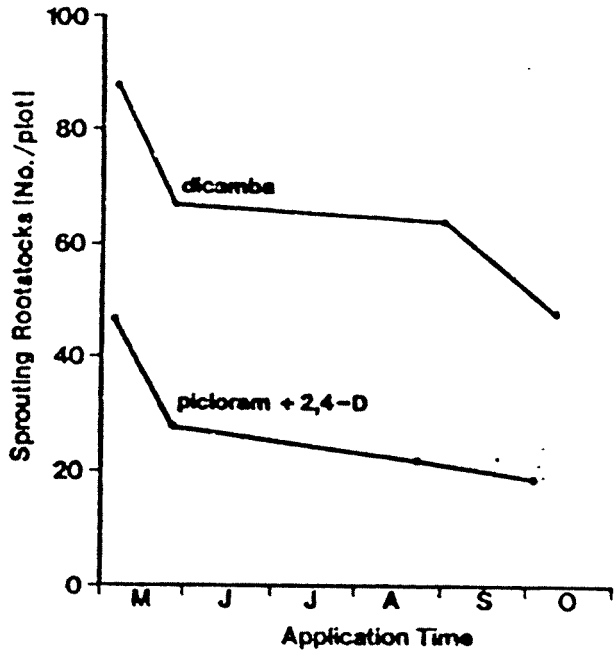

Figure 1. Number of kudzu rootstocks observed sprouting in plots treated with picloram + 2,4-D at 1 + 4 lb ai/a (1 gal/a Tordon 101) or dicamba at 8 lb ai/a (2 gal/a Banvel). Treatments occurred on May 5, May 26, August 23, and October 2, 1983; and sprouting rootstocks were counted on March 9, 1985. Check plots averaged 101 rootstocks.

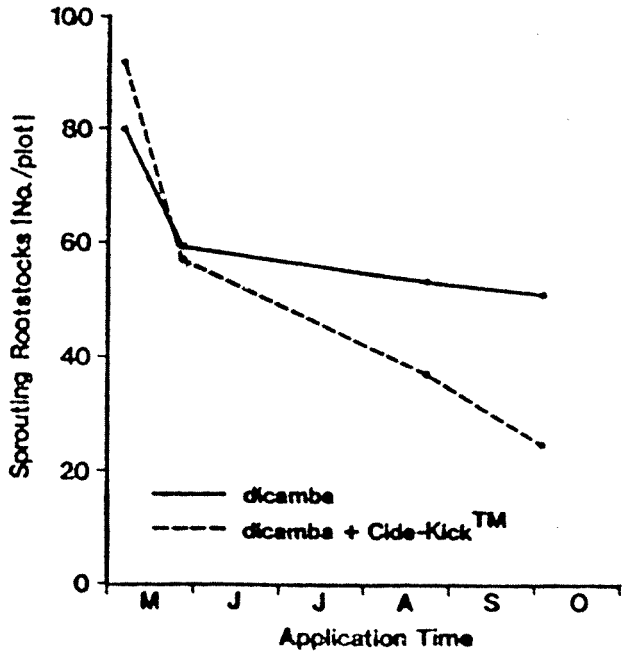

Figure 2. Number of kudzu rootstocks observed sprouting in plots treated with dicamba at 8 lb ai/a in 80 gal/a spray volume, with and without Cide-Kick. Treatments occurred on May 5, May 26, August 23, and October 2, 1983; and sprouting rootstocks were counted on March 9, 1985. Check plots averaged 101 rootstocks.