HERBICIDES FOR CONTROLLING WEEDS AT THE ALBUQUERQUE FOREST TREE NURSERY

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ABSTRACT: In 1982, a study was initiated at Albuquerque, New Mexico, to test oxyfluorfen, bifenox, and propazine for controlling grasses and forbs in ponderosa pine nursery beds. Propazine was highly toxic to pine seedlings. Oxyfluorfen at a rate of 0.5 pound ai per acre controlled vegetation without damage to tree seedlings.

INTRODUCTION

Controlling unwanted vegetation is one of the many problems associated with managing a tree nursery. Grasses and forbs (weeds) begin to invade seedbeds shortly after sowing. Weeds may be controlled mechanically or chemically. Because of the closeness of the rows, however, seedbeds are difficult to cultivate. It is also difficult to eliminate weeds growing within the rows. Mechanical weeding, therefore, is usually limited to hand-weeding. To date, this has been the weed control method used at the Albuquerque Forest Tree Nursery in New Mexico.

If herbicides could accomplish the same job, the savings in time and money would be considerable. According to McDonald and Isaacson (1974), weeding costs may be reduced as much as 75% through the use of herbicides. In addition, seedling growth may be improved. In one nursery in Louisiana, two selective herbicides, applied as postemergent treatments to grasses, resulted in a 50% increase in plantable loblolly pine (Pinus taeda L.) compared to controls, even though the controls had been hand-weeded four times (South and Gjerstad 1982).

Herbicides, however, must control unwanted weeds without damaging tree seedlings. Certain herbicides such as trifluralin (a,a,a-trifluoro-2,6dinitro-N-N-dipropyl-Q-toluidine) have produced toxic symptoms in loblolly pine seedlings at rates as low as 0.5 pound per acre (0.56 kg/ha) (Rowan 1978), although at the Norman nursery in Oklahoma trifluralin was incorporated at a rate of 0.75 pound ai per acre (0.84 kg/ha) several weeks before sowing without any harmful effects on seedlings (Abrahamson 1983). Ryker (1979a) found bifenox (methyl-S-(2,4-dichlorophenoxy)-2-nitro-benzoate) at rates of 3 to 6 pounds ai per acre (3.36 to 6.72 kg/ha) was toxic to ponderosa pine (Pinus ponderosa var. scopulorum) seedlings at the nursery in Albuquerque.

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THE STUDY AREA

The Albuquerque nursery was established in 1977, and the first beds were sown in 1978. Soils are loamy sands and sandy loams. The soil pH now averages 7.6, a drop from a pH of 8.6 at the time of nursery establishment. Calcium carbonate levels are high, ranging from 2.3% to 11.3%, and average 5.9%. Soil organic matter content now averages 1.3%.

Some of the more commonly occurring grasses are sixweeks grams (Bouteloua barbata), sand dropseed (Sporobolus cryptandrus), stinkgrass (Eragrostis cilianensis), Bermudagrass (Cynodon dactylon), and fall witchgrass (Leptoloma cognatum). Forbs include Russian thistle (Salsola kali), oakleaf datura (Datura quercifolia), prostrate pigweed (Amaranthus blitoides), puncturevine (Tribulus terrestris), and tanseymustard (Descurainia pinnata).

THE STUDY, 1982

In 1982, a study was initiated at Albuquerque to test the effectiveness of bifenox, oxyfluorfen (2chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene), and propazine (2-chloro-4,6-bis(isopropylamino)-s-triazine) in controlling weeds in ponderosa pine nursery beds. Bifenox and oxyfluorfen are registered for forest nursery use and have proven effective and safe on ponderosa pine in other western nurseries (Stewart 1977; Ryker 1979b). Heidmann (1970) found that propazine could be applied to planted ponderosa pine nursery stock on basalt-derived soils at rates up to 10 pounds ai per acre (11.20 kg/ha) without damage to the seedlings. The decision was made to test bifenox at Albuquerque again because of the changes (pH and organic matter content) in the soils since Ryker's (1979a) work was conducted.

Methods

The three herbicides--bifenox, oxyfluorfen, and propazine--were applied at various rates and times in four randomized blocks. Each block consisted of 12 plots, each 25 feet (7.62 m) by 4 feet (1.22 m). Each plot was a section of nursery bed in normal seedling production. A 10-foot (3-m) buffer was left between plots within the same nursery bed. Each plot was randomly assigned one of the treatments listed in table 1. Treatments

Table 1.--Effects of herbicide treatments applied to study plots at Albuquerque Forest Tree Nursery in 1982

Treatment	Time of application[1]	Rate		Tree density[2]	Mean oven-dry weights[3]	
					Tops	Roots
		pounds ai/acre	(kg/ha)	Mean no./ft	- - - - - gram - - - - -	
1. Untreated (control)				14.6 c[4]	0.1846 bcd[4]	0.1397 de[4]
2. Bifenox	ps	1.5	(1.68)	11.3 b	.1297 ab	.1103 c
3. Bifenox	ps +	1.5	(1.68)	9.9 b	.1662 abc	.1264 cd
	pg (6 weeks)	1.5	(1.68)			
4. Propazine	ps	1.5	(1.68)	0.0	.0000	.0000
5. Propazine	ps +	1.5	(1.68)	0.0	.0000	.0000
	pg (6 weeks)	1.5	(1.68)			
6. Oxyfluorfen	ps	0.5	(0.56)	9.0 b	.1301 ab	.0851 ab
7. Oxyfluorfen	ps	1.0	(1.12)	2.8 a	.1159 ab	.0658 a
8. Oxyfluorfen	ps	1.5	(1.68)	2.4 a	.1005 a	.0893 b
9. Oxyfluorfen	pg (6 weeks)	0.5	(0.56)	15.7 cd	.1733 abc	.1623 f
10. Oxyfluorfen	pg (6 weeks)	1.0	(1.12)	16.1 cd	.2475 d	.1683 f
11. Oxyfluorfen	pg (6 weeks)	1.5	(1.68)	16.5 d	.2239 cd	.1469 ef
12. Oxyfluorfen	ps +	0.5	(0.56)	10.0 b	.1577 abc	.1110 c
	pg (6 weeks) +	0.5	(0.56)			
	pg (12 weeks)	0.5	(0.56)			

Treatments 3, 5, and 12 were applied both after seeding and after germination at the indicated rates and times.

[1]Key to applications:
ps--herbicide was applied at the rate indicated within 48 hours after beds were sown.
pg--herbicide was applied at the rate indicated 6 weeks or 12 weeks after beds were sown, i.e., after germination.

[2]Mean number of trees in 36 sample rows, 1 foot in length.

[3]Means based on 12 samples of 10 trees.

[4]Means with the same letter are not significantly different at the 0.05 level as determined by Waller-Duncan multiple comparison test.

were applied within 48 hours of seeding (postseeding), 6 and 12 weeks after seeding (postgermination), or as a combination of both (table 1). The postseeding and postgermination treatments were selected to compare effectiveness of one treatment at time of sowing with one or two followup treatments. Oxyfluorfen was used more often for postgermination treatments because of its effectiveness as a postemergence treatment. The beds were sown with ponderosa pine seeds on May 26. Herbicides were applied in water at a rate of 40 gallons (151.4 1) of solution per acre, using a 3-gallon (11.36 1) hand-powered backpack sprayer. After application, beds were watered for 20 minutes, three times a day, until germination started.

Measurements

Grass and Forbs.--Within each plot, five permanent sample plots, 1 foot (0.30 m) square, were located down the center of each plot. Each of the five plots was randomly located within a 5-foot (1.52-m) section of the main plot and marked with wire flags. In each of the sample plots, the number of grasses and forbs was counted 6, 12, and 20 weeks after sowing of pine seed.

Phytotoxicity.--Herbicide damage to pine seedlings was determined in three sample plots, (1 by 4 feet) (0.30 by 1.22 m) randomly located across the beds in each treatment plot. Vigor of pine seedlings was estimated at 6, 12, and 20 weeks using a system proposed by Anderson (1963). In addition, all seedlings in three randomly selected rows within the tree vigor sample plot were counted. The two outside rows were used as a buffer and were excluded from the count. In the fall. 30 seedlings, 10 from each sample plot, were lifted for determining oven-dry (OD) weights of the tops and roots. Appropriate means were obtained by analysis of variance, and differences were determined by using Waller-Duncan's multiple comparison test.

Results

In 1982, weed control measurements were compromised when nursery personnel inadvertently weeded the study plots. However, information on seedling toxicity was collected. It became evident soon after seedlings began to germinate that the propazine treatments were toxic. Most of the propazine plots had no live trees a few weeks after treatment. Therefore, all propazine treatments were excluded from analysis. It was also difficult to assign vigor ratings to seedlings since general chlorosis of seedlings at Albuquerque is a common problem. Because of this, only number of trees per linear foot and OD weights of tops and roots were analyzed.

A significant loss of seedlings was caused also by oxyfluorfen applied postseeding at all rates

(?=0.05). There were less than three seedlings per linear foot for two of these treatments, compared to 14.6 for controls (table 1). The other treatments, except postgermination applications of oxyfluorfen, had similar results. Oxyfluorfen applied after seeding at 1.5 pounds ai per acre (1.68 kg/ha) produced top OD weights significantly lower than the control (table 1, P-0.05). Root OD weights were not different from the control for bifenox applied postseeding plus postgermination and for oxyfluorfen at 1.5 pounds ai per acre (1.68 kg/ha) applied postgermination. Postseeding application of oxyfluorfen and the remaining bifenox treatment reduced root OD weights significantly. Postgermination application of oxyfluorfen at 0.5 and 1.0 pound ai per acre (0.56 and 1.12 kg/ha) increased root OD weight (table 1).

THE STUDY, 1983

The study was repeated in 1983 because no weed control information could be collected in 1982. Since propazine and postseeding rates of oxyfluorfen resulted in significant reduction of seedling numbers, these treatments, except for the lowest rate of oxyfluorfen, were eliminated. The treatments listed in table 2 were applied in the same manner as in 1982, and the experiment was conducted in the same way, except that the five sample plots in each main plot on which grasses and forbs were counted were increased in size from 1 square foot (0.09 m^2) to 4 square feet (0.37 m --0.30 by 1.22 m, across the bed).

Results

In general, postseeding application of herbicides provided the greatest control (table 2). A11 treatments, except oxyfluorfen applied after germination, reduced grass and forb cover significantly (P=0.05). There was no vegetation present on plots treated with oxyfluorfen postseeding plus postgermination, while the postseeding rate of 0.5 pound ai per acre (0.56 kg/ha) had only 0.05 plant per sample plot. Both of these treatments completely controlled grasses. Bifenox at 1.5 pounds ai per acre (1.68 kg/ha) and oxyfluorfen, applied after germination, were not effective in reducing grasses. All treatments had significantly fewer forbs than the control.

There were no toxic effects of the herbicides noted in 1983. The number of trees per linear foot did not differ by treatment (table 2). Ovendry weights of seedling tops, however, were significantly different (table 2, P=0.05). Oxyfluorfen applied postseeding and postseeding plus postgermination at 0.5 pound ai per acre (0.56 kg/ha) and bifenox applied postseeding at all rates produced tops heavier than the control. Root weights for these treatments and for oxyfluorfen applied postgermination at 1.5 pounds ai per acre (1.68 kg/ha) were also significantly heavier than the control (table 2, P-0.05).

Table 2.--Effects of herbicide treatments applied to study plots at Albuquerque Forest Tree Nursery in 1983

Treatment	Time of application[1]	Rate		Tree density[2]	Vegetation[3]			Mean oven-dry weights[4]	
					Forbs	Grass	Total	Tops	Roots
		pounds ai/acre	(kg/ha)	Mean no./ft	gram				
1. Untreated (control)				19.2	1.7 e[5]	6.60 de[5]	8.30 e[5]	0.0753 a[5]	0.0490 a[5]
2. Bifenox	ps	0.5	(0.56)	21.9	0.05 ab	0.45 a	0.50 a	.1190 bc	.0857 cd
3. Bifenox	ps	1.0	(1.12)	27.0	0.05 ab	0.10 a	0.15 a	.1637 de	.1096 e
4. Bifenox	ps	1.5	(1.68)	23.0	0.25 b	0.05 a	0.30 a	.1543 cde	.1043 de
5. Bifenox	pg (6 weeks)	0.5	(0.56)	22.2	0.95 d	4.05 bc	5.00 bc	.0814 a	.0583 ab
6. Bifenox	pg (6 weeks)	1.0	(1.12)	22.8	0.65 c	4.05 b	4.70 b	.0816 a	.0653 abc
7. Bifenox	pg (6 weeks)	1.5	(1.68)	20.2	0.25 b	5.30 cd	5.50 bcd	.0859 ab	.0594 ab
8. Oxyfluorfen	ps	0.5	(0.56)	27.8	0.05 ab	0.00 a	0.05 a	.1371 cd	.1040 de
9. Oxyfluorfen	pg (6 weeks)	0.5	(0.56)	22.6	0.00 a	8.15 e	8.15 e	.0655 a	.0479 a
10. Oxyfluorfen	pg (6 weeks)	1.0	(1.12)	23.4	0.00 a	6.50 de	6.50 cde	.0784 a	.0481 a
11. Oxyfluorfen	pg (6 weeks)	1.5	(1.68)	21.0	0.10 ab	7.35 e	7.45 de	.1003 ab	.0752 bc
12. Oxyfluorfen	ps + pg (6 weeks)	0.5	(0.56)	23.9	0.00 a	0.00 a	0.00 a	.1793 e	.1154 e
		0.5	(0.56)						

Treatment 12, oxyfluorfen, was applied after seeding and after germination at the indicated rates and times.

[1]Key to applications;
ps--herbicide was applied at the rate indicated within 48 hours after beds were sown.
pg--herbicide was applied at the rate indicated 6 weeks after beds were sown; i.e., after germination.

[2]Mean number of trees in 36 sample rows, 1 foot in length.

[3]Numbers are means of 20 sample plots, 1 by 4 feet.

[4]Mean based on 12 samples of 10 trees.

[5]Means with the same letter are not significantly different at the 0.05 level as determined by Waller-Duncan multiple comparison test.

DISCUSSION AND CONCLUSIONS

Oxyfluorfen and bifenox at fairly low rates effectively controlled grasses and forbs in tests at the Albuquerque Forest Tree Nursery when applied after seeding. Oxyfluorfen applied postseeding plus postgermination gave the best results. None of the herbicides at rates tested in 1983 was toxic to ponderosa pine seedlings. In 1982, however, all treatments except oxyfluorfen applied postgermination significantly reduced seedling numbers. Treatments that obviously controlled competing vegetation generally produced larger pine seedlings, presumably because of more available moisture.

Because in this study oxyfluorfen gave variable results, a fact also observed by Ryker (1984), it is suggested that this herbicide be used on a limited basis at the Albuquerque nursery until more definitive results are obtained. Bifenox at postseeding rates up to 1.5 pounds ai per acre (1.68 kg/ha) might also be tested.

REFERENCES

Abrahamson, Lawrence P. Herbicides, an important component of the weed control program at Oklahoma State (Norman) Nursery. In: Proceedings, 1982 Southern Nursery Conference. U.S. Department of Agriculture, Forest Service, Southern Region, Technical Publication R8-TP4; 1983: 171-191.

Anderson, H. W. A system for evaluating effective weed control in forest nurseries. Tree Planters' Notes 61; 19-23; 1963.

Heidmann, L. J. Preemergent herbicides for preparing ponderosa pine planting sites in the Southwest. Res. Note RM-164. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station; 1970. 4 p.

McDonald, S. W.; Isaacson, J. A. Using diphenamid herbicide for seedbed control cuts hand weeding labor 75 percent. Tree Planters' Notes 25(3): 15-27; 1974.

Rowan, S. J. Treflan injury of loblolly pine seedlings. Tree Planters' Notes 29(3): 25-26; 1978.

Ryker, Russell A. Western forest tree nursery herbicide study, Rocky Mountain-Great Basin segment, progress report for 1978. Boise, ID: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1979a. Unpublished report.

Ryker, Russell A. Western nursery herbicide study-1979 update. Proceedings, 1979 Intermountain Nurserymen's Association Meeting; 1623; 1979b.

Ryker, Russell A. Personal communication. Boise, ID: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1984.

South, David B.; Gjerstad, Dean H. Postemergence control of grasses with selective herbicides in pine and hardwood seedbeds. Tree Planters' Notes 33(1): 24-28; 1982.

Stewart, R. E. Herbicides for weed control in western forest nurseries. Proceedings, Western Society of Weed Science 30: 78-89; 1977.