EVALUATION OF HERBICIDES FOR WEED CONTROL IN ROCKY MOUNTAIN-GREAT BASIN NURSERIES[1]

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ABSTRACT

lie tested four herbicides (bifenox, DCPA, napropamide, and diphenamid) for effectiveness in reducing the hand-weeding time required for weed control in nursery seedbeds. landweeding was reduced from 50 to 80 percent depending on herbicide and nursery. Tolerance of these herbicides by five species of pine, Engelmann and blue spruces, and Douglas-fir are summarized.

INTRODUCTION

The western nursery herbicide study is a broad-based study installed at many nurseries under a variety of conditions. The study objectives were to identify promising herbicides, develop data for product registration, and demonstrate safe and effective weed control practices for nursery seedbeds.

To conduct the study, the western United States was divided into three study areas: Pacific Coast, Rocky Mountain-Great Basin, and Great Plains. In each area a minimum of three years of work was planned. The first year was primarily a screening of 18 selected herbicides for weed control effectiveness, and tolerance by tree species. The second year, herbicides showing promise during first-year tests were tested further at different rates and time of application. Third-year tests were designed for assessing reduction in handweeding costs by each herbicide surviving the first two years of tests. For more detailed description see Ryker (1979). This report summarizes the results of third-year tests at the Rocky Mountain-Great Basin nurseries.

In addition to the planned third-year tests, at five of the nurseries we also screened oxyfluorfen (Goal 2E) for weed control and toxicity to several conifer and hardwood species. This was the first year we tested oxyfluorfen in Rocky MountainGreat Basin nurseries.

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METHODS

Weed Control

The third-year weed control tests were installed at six nurseries:

Nursery	Location
Coeur d'Alene	Coeur d'Alene, Idaho
Lucky Peak	Boise, Idaho
Montana State	Missoula, Montana
Mountain Home	DeBorgia, Montana
Mt. Sopris	Carbondale, Colorado
Utah State	Salt Lake City, Utah

We tested four herbicides for weed control effectiveness: bifenox (Modown 80 WP), DCPA (Dacthal W-75), napropamide (Devrinol 50 WP), and diphenamid (Enide 50 WP). The treatments are described in table 1.

The post-seeding and post-seeding plus post-germination sprays were applied to 4- by 100-foot plots with three replications. Because most nurseries did not have sufficient bed space sown to one seed source or species, different replications were usually sown to different species.

The herbicides were applied in water at a volume equivalent to 50 gallons per acre using tractor-mounted nursery spray equipment adjusted to deliver a 4.5 foot swath. The plots were irrigated to move the herbicide into the soil soon after spraying was completed.

At each nursery all plots were handweeded when needed in the most weedy plot. Crew size, total weeding time per 100-foot plot, and weeding date were recorded each time. In every case the first weeding was done just before the post-germination spray was applied. For the remainder of the season there were one or more subsequent weedings depending on the nursery.

At three nurseries (Lucky Peak, Utah, and Mt. Sopris) we counted the number of individual weeds of each species on five sample plots per 100-foot plot. The sample plots were 20 x 50 centimeters and were systematically located in the middle of the bed at 0, 20, 40, 60 and 80 feet distances within each plot. The counts were made just before the first weeding on all plots. Because only the post-seeding sprays had been applied, they reflect only the effectiveness of the post-seeding treatments.

Phytotoxicity

The 1979 study was designed primarily to determine potential savings in handweeding costs at each of the nurseries, but we also collected data on phytotoxicity. At most nurseries each replication was sown to a different species, so we do not have the opportunity to test the data for statistical significance of toxic effects. However, the averages are good and would indicate any serious damage from the herbicides.

The phytotoxicity data were obtained from bed-width by I-foot sample plots located at 20, 40, 60 and 80 feet from the start of each treatment plot. We estimated a damage rating using the system proposed by Anderson (1963). The system is a scale from 0 (all seedlings dead) to 10 (no damage). We also counted live seedlings in three randomly selected rows within each sample plot, excluding the outside rows. We lifted 10 seedlings from each sample plot and determined top length, top dry weight, and root dry weight.

Table 1.--Herbicide treatments tested for weed control effectiveness during the third year, 1980

Herbicide	Formulation	Rate	Time of application
		lb a.i./A	
Untreated	--	--	--
Bifenox	Modown 80WP	3	Post-seeding[1]
Bifenox		3+3	Post-seeding plus post-germination[2]
DCPA	Dacthal W-75	10.5	Post-seeding
DCPA		10.5+10.5	Post-seeding plus post-germination
Napropamide	Devrinol 50WP	1.5	Post-seeding
Napropamide		1.5+1.5	Post-seeding plus post-germination
Diphenamid	Enide 50WP	4	Post-seeding
Diphenamid		4+4	Post-seeding plus post-germination
Diphenamid plus bifenox		4 3	Post-seeding plus post-germination

[1]Abbreviated Ps in subsequent tables.

[2]Abbreviated Ps+Pg.

RESULTS Handweeding Time

When data from all six nurseries were averaged, the total-season handweeding time was reduced more than 75 percent by bifenox treatments, about 60 percent by DCPA and napropamide, and about 50 percent by diphenamid.

Conditions varied greatly between some of the nurseries, particularly between nurseries that fumigated the seedbed ground and those that did not fumigate. The result was that some nurseries had very few weeds, irregularly distributed, and others had many weeds. Because of these differences, we computed separate statistical analyses for each nursery.

Statistical significance of total-season weeding times at each nursery are shown in table 2. You will notice in the table that the Modown treatments at Coeur d'Alene reduced handweeding time 85 to 90 percent, but the analysis of variance shows no significance at the 95 percent level. The difference, which is obviously real, is masked by the interaction between block and treatment. Block III had about 14 times more weeds than blocks I and II. Modown kept practically all the weeds out regardless of potential. Because there were very few weeds in blocks I and II, there was little difference between treatments in those blocks.

Table 2.--Effect[1] of herbicides on total-season handweeding time in the Rocky Mountain-Great Basin Nurseries, 1979.

Herbicide	Timing	Nursery					
		Montana	Mountain Home	Coeur d' Alene	Lucky Peak	Utah	Mt. Sopris
		Percent					
Untreated	--	100	100	100	100	100	100
Bifenox	Ps	53*	25*	15	50*	17*	7*
	Ps+Pg	23*	19*	10	36*	23*	5*
DCPA	Ps	--	45*	--	50*	32*	12*
	Ps+Pg	--	25*	--	35*	31*	12*
Napropamide	Ps	--	56*	--	63	30*	21*
	Ps+Pg	--	28*	--	92	37*	22*
Diphenamid + bifenox	Ps Pg	--	--	--	--	--	25*
Diphenamid	Ps	--	--	47	98	--	--
	Ps+Pg	--	--	46	81	--	23*

[1]Percent values shown were obtained by dividing the total-season weeding times for each treatment by the weeding time for untreated plots. The asterisk indicates that treatment mean is significantly different from the untreated mean at the 5 percent level of probability.

The weed species encountered in the sample plots at the Lucky Peak, Utah, and Mt. Sopris nurseries are listed in table 3, along with an indication of the relative degree of control by the four herbicides. Effectiveness was judged by comparing the number of seedlings per square foot on the treated and untreated plots. The data are limited and not conclusive, but may be used as an index to the relative effectiveness of the herbicides on the species encountered. For instance, bifenox was quite effective against all of these species except field bindweed, whitetop, knotweed, and some of the grasses. DCPA and napropamide were less effective against some of the other species, but effective against the grasses.

Phytotoxicity

Damage ratings, survival, height, and top and root dry weights were summarized for the five pines, two spruces, and Douglas-fir. Rather than present those rather large tables here I interpreted them in terms of the safety of the herbicide treatments for each species (table 4). All four herbicides appear safe to use on ponderosa pine, lodgepole pine, and Douglas-fir. Diphenamid, however, was the only one that did not damage Engelmann spruce. Bifenox appears safe for all the pine species tested and Douglas-fir, but not for the spruces.

Bifenox seemed to adversely affect ponderosa pine during seedling emergence at some nurseries. However, I have no measure of this and by the end of the growing season there was no significant effect on number of seedlings or seedling growth.

At the Coeur d'Alene nursery they found some of the damage [3] from dacthal reported by Pacific Coast nurseries the previous year (Callan 1979). It was limited to certain seed sources and did not occur in our plots.

[3]Personal communication with Cleve Chatterton, Assistant Nurseryman, Coeur d'Alene Nursery.

Table 3.--Relative effectiveness[1] of the four herbicides on the major weed species.

Species	Bifenox	DCPA	Napropamide	Diphenamid
Clover	+	-	-	-
Common mallow	+	-	-	*
Dandelion	+	+	+	+
Field bindweed	-	-	-	*
Filaree	+	+	-	-
Grass spp.	-	+	+	+
Jerusalem oak	+	+	+	-
Knotweed	-	-	-	-
Kochia	+	+	-	*
Lambsquarter	+	+	-	-
Mint spp.	+	+	-	-
Nightshade	+	+	-	*
Prickly lettuce	+	+	+	*
Prostrate pigweed	+	+	-	-
Purslane	+	+	+	+
Redroot pigweed	+	+	+	+
Russian thistle	+	-	-	*
Shepherdspurse	+	-	-	+
Sunflower	+	+	-	*
Tansy mustard	+	-	-	*
Thistle spp.	+	+	+	*
Whitetop	-	-	+	*

[1]A "+" indicates the herbicide was effective against that species. A "-" indicates the herbicide was less effective. An * indicates the herbicide was not tested at the nurseries where this species appeared in the plot measurements.

Table 4.--Relative safety[1] of the four herbicides tested in 1979 on eight conifer species.

Species	Bifenox		DCPA		Napropamide		Diphenamid	
	Ps	Ps+Pg	Ps	Ps+Pg	Ps	Ps+Pg	Ps	Ps+Pg
ponderosa pine	X	X	X	X	X	X	X	X
lodgepole pine	X	X	X	X	X	X	X	X
Austrian pine	X	X	X	X	No	No	-	-
mugo pine	X	X	?	?	?	?	-	-
Scotch pine	X	X	X	X	?	?	-	-
Douglas-fir	X	X	X	X	X	X	X	X
Engelmann spruce	No	No	No	No	?	?	X	X
blue spruce	?	?	No	No	No	No	-	-

[1] X--indicates those treatments that have been consistently safe to use in our study plots. No -- indicates treatments that have been too damaging. ? -results uncertain or varied between nurseries. The dashed line indicates treatments not tested against that species.

OXYFLUORFEN PHYTOTOXICITY

In addition to the planned third-year study on the large plots, we installed some phytotoxicity tests of oxyfluorfen at five nurseries (Coeur d'Alene, Idaho, Lucky Peak, Utah, and Mt. Sopris). We tested it on four species of conifers and three species of hardwoods.

No weed control data were collected but observations indicated almost complete weed control until about midsummer by the post-seeding treatment. Total season weed control appeared to be as good or better than with bifenox. If safe to use, this should be a very important herbicide for nursery weed control.

Number of seedlings and height growth of Douglas-fir and ponderosa pine were not significantly affected by oxyfluorfen. Lodgepole pine was not damaged at Lucky Peak nursery, but at Mt. Sopris the number of seedlings was reduced about 60 percent and height growth reduced about 25 percent. The reason for the difference between nurseries is not known. The effects on Engelmann spruce were highly variable within each nursery. The 2X rate was particularly damaging. All three hardwood species (Russian olive, willow, and squawbush) benefitted from the reduction in competition on treated plots.

Oxyfluorfen (Goal 2E) is now registered (EPA Reg. No. 707-145-AA) for use in conifer seedbeds. Lodgepole pine is included in the species list as is Colorado blue spruce. Our results in last year's tests indicate further phytotoxicity tests should be conducted at each nursery contemplating using this herbicide. This is particularly true for nurseries growing lodgepole pine and the spruces. The effectiveness of this herbicide for controlling weeds fully justifies further testing.

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