CONCLUSION

Hexazinone and atrazine application resulted in the most consistent control of all the seed species examined. Sulfometuron resulted in good to excellent control of all species tested with the exception of both broom species. However, the highest rates of sulfometuron resulted in less dry weight of both broom species. Under less ideal conditions the combination of other environmental stresses along with herbicide stress may have resulted in greater scotch and Portuguese broom mortality. This is likely true for all the species examined and it is suspected that if the seeds in this trial had been subjected to even minor moisture stress many of those treated with herbicides would have perished. Growth of true leaves and of extensive root systems was dramatically reduced for most germinants exposed to any of the herbicides (with a few exceptions) which would have strongly limited their ability to successfully establish under field conditions.

Table 3. Mean percent germination and average seedling weight for each species and rate tested.[a]

		Deerbrush		Snowbrush		Black cottonwood		Scotch broom		Portuguese broom		Trailing blackberry		Thimbleberry		Salmonberry	
Treatment	Rate	germ.	wt	germ.	wt	germ.	wt	germ.	wt	germ.	wt	germ.	wt	germ.	wt	germ.	wt
	oz/A	%	mg	%	mg	%	mg	%	mg	%	mg	%	mg	%	mg	%	mg
Hexazinone	0	51 a	210 a	69 a	14 a	7.5 a	4 a	52 a	40 a	52 a	70 a	33 b	60 a	62.3 a	11 a	.	.
Hexazinone	8	26 b	9 b	10 b	3 b	0 b	0 b	30 b	30 ab	50 a	30 a	60 a	4 ab	29 b	2 b	.	.
Hexazinone	16	6 cd	3 cd	0 c	0 c	0 b	0 b	0 c	0 c	0 b	0 c	20 bc	4 ab	6.4 cd	1 b	.	.
Hexazinone	24	14 c	6 c	5 bc	1 c	0 b	0 b	10 c	10 bc	35 a	30 b	22 bc	2 bc	15 c	2 b	.	.
Hexazinone	32	4 cd	1 d	3 bc	1 c	0 b	0 b	5 c	6 c	7.5 b	10 c	8 cd	1 c	4 cd	1 b	.	.
Hexazinone	48	0 d	1d	0 c	0 c	0 b	0 b	3 c	2 c	2.5 b	0.1 c	2 d	1 c	0 d	0 b	.	.
Sulfometuron	0	40 a	24 a	46 a	16 a	13.7 a	14 a	42 a	40 a	60 a	70 a	31 a	7 a	41 a	11 a	57 a	13 a
Sulfometuron	0.75	45 a	11 b	10 b	2 b	5 b	1 b	50 a	30 ab	50 a	40 b	31 a	4 b	31 ab	1 b	39 ab	5 a
Sulfometuron	1.5	36 a	7 bc	8 b	2 b	7.5 ab	2 b	60 a	30 ab	58 a	30 b	15 ab	3 b	8 b	0.1 b	22 b	2 c
Sulfometuron	2.25	35 a	9 bc	5 b	1 b	5 b	1 b	58 a	30 ab	38 a	40 b	29 ab	3 b	19 ab	2 b	45 ab	3 c
Sulfometuron	3	29 a	7 bc	6 b	1 b	1.3 b	1 b	·32 a	20 ab	45 a	30 b	13 b	1 b	19 ab	1 b	42 ab	3 c
Sulfometuron	4.5	20 a	6 c	4 b	1 b	1.3 b	1 b	45 a	10 b	55 a	30 b	27 ab	2 b	35 a	2 b	59 a	2 c
Metsulfuron	0	43 a	16 ab	46 a	14 a	18.8 a	6 a	37.5 abc	50 a	10 a	10 a	.	.	.	.	.	.
Metsulfuron	0.15	38 a	19 a	24 b	5 b	16.3 a	2 b	40 ab	40 a	12.5 a	40 a	.	.	.	.	.	.
Metsulfuron	0.3	51 a	12 b	33 ab	4 bc	11.3 a	1 b	52 a	20 b	0 a	0 b	.	.	.	.	.	.
Metsulfuron	0.45	45 a	15 ab	26 b	4 bc	10 a	2 b	25 bc	20 b	7.5 a	10 ab	.	.	.	.	.	.
Metsulfuron	0.6	39 a	13 ab	18 b	4 bc	6.3 a	1 b	32 bc	30 ab	7.5 a	4 b	.	.	.	.	.	.
Metsulfuron	1.2	48 a	11 b	14 b	2 c	5 a	1 b	20 c	20 b	12.5 a	23 ab	.	.	.	.	.	.
Atrazine	0	48 a	17 ac	51 a	17 a	18.8 a	5 a	22 a	21 a	.	.	.	.	.	.	.	.
Atrazine	16	12.5 bc	5 b	1.3 b	1 b	0 b	0 b	8 bc	5 b	.	.	.	.	.	.	.	.
Atrazine	32	0 c	0 c	0 b	0 b	0 b	0 b	0 c	0 b	.	.	.	.	.	.	.	.
Atrazine	48	17.5 b	3 bc	3 b	1 b	0 b	0 b	20 ab	6 b	.	.	.	.	.	.	.	.
Atrazine	64	0 c	0 c	0b	0 b	0 b	0 b	2.5 c	2 b	.	.	.	.	.	.	.	.
Atrazine	80	1.2 c	1 c	1.3 b	1 b	0 b	0 b	5 c	2 b	.	.	.	.	.	.	.	.

[a] Means within a column for each herbicide and species interaction associated with the same letter are not significantly different $p \leq 0.05$.

EARLY RESULTS OF THE 'HERB II' STUDY: EVALUATING THE INFLUENCE VEGETATION CONTROL HAS ON FERTILIZATION AT THE TIME OF PLANTING. Robin Rose and J. Scott Ketchum, Associate Professor and Faculty Research Assistant, Department of Forest Science, Oregon State University, Corvallis, OR 97331-7501.

INTRODUCTION

Fertilization in forest nurseries is a common practice to enhance growth rate and vigor of conifer seedlings. Fertilization has also been tried in the field at the time of planting as a means to enhance reforestation efforts. Early fertilization results have been mixed with positive responses in some trials (Woods et al. 1993, Powers and Ferrel 1996) and poor to negative responses in others (Sutton 1995, Roth and Newton 1996). The purpose of this study was to assess the interactive effects among increasing levels of vegetation control and fertilizer treatments over an array of conifer species on a variety of Pacific Northwest regional sites from northern California to eastern Washington.

MATERIALS AND METHODS

The basic study design was a completely randomized design with the plot being the treatment unit. The study design has been repeated five times with four species of crop trees: Douglas-fir, ponderosa pine, western hemlock, and coastal redwood (Table 1). Each of the five study sites consisted of four replications of six separate treatment plots. Treatments were: no vegetation control, no vegetation control and fertilization, 2 feet tree centered radius of vegetation control, 2 feet radius and fertilization, 3 feet tree centered radius of vegetation control, and 3 feet radius and fertilization Each plot consists of 36 conifer seedlings planted at a 10 by10 feet spacing.

Table 1. Study sites locations and crop trees used in the five repetitions of the Herb II study.

Study site	Established	Crop species	Location
Vernonia	spring 1995	Douglas-fir	Northwestern Oregon Coast Range
Klickitat	spring 1995	Ponderosa pine	East of Mt. Adams in WA
Drain	spring 1996	Douglas-fir	Oregon Coast Range a few miles N. of Roseburg
Seaside	spring 1996	Western hemlock	5 miles inland from the coastal town of Seaside OR
Korbel	spring 1996	Coastal redwood	10 miles inland from the N. CA coastal town of Arcata

The fertilization treatment consisted of two slow release (1 to 2 year) fertilizer briquettes with formulations of 14:3:3 (N:P:K) and 9:9:4. Both briquettes also contained micro-nutrients. The briquettes were added to the bottom of the hole at the time of planting. Either hexazinone or sulfometuron were used to create the vegetation control treatments and were applied in April the year of planting and again the following April using a backpack applicator. The herbicide used and rate varied with site. The goal of the herbicide treatments was not to test the activity of the herbicide or rate used but to achieve the desired radii of vegetation control and maintain it for a period of two growing seasons.

Seedlings were measured for stem diameter at 15 cm above the ground line and height each growing season in late fall after growth had ceased. Stem volume was calculated as the volume of a cone ((stem diameter)^2*height*p/12) and is used as the best measure of seedling response to the six treatments applied.

Analysis of variance was used to test for differences in stem volume by treatment for each site using initial stem caliper as a covariate. To meet the ANOVA assumptions means for stem volume were linear transformed and reported means have been backtransformed.

RESULTS AND DISCUSSION

Response to fertilization and vegetation management was surprisingly similar across the five study sites. At all but the Seaside site, the 3 feet radius of vegetation control with or without fertilization resulted in greater volume than both check treatments. At Seaside only the fertilized 3 feet radius treatment was significantly greater than the unfertilized check treatment. Fertilization did not result in a significant increase in volume at any site when compared between the same level of vegetation control treatments. Although not significantly different, means for the fertilized 3 feet radius treatments resulted in consistently greater volume than the unfertilized 3 feet treatments across all five sites. Similarly, the fertilized 2 feet treatments resulted in means that were larger than the unfertilized 2 feet treatments across all sites. There were no constant responses between the fertilized and unfertilized check treatments across the 5 study sites.

Prior to harvest the Seaside site was dominated by a dense mature stand of western hemlock (Figure 1a). After harvest vegetation invaded the site slowly taking more than two years to completely invade the site. Because of this, the vegetation control treatments had less influence on the competition faced by planted seedlings than on other sites. This explains in part the lack of a strong trend of increasing growth with increased radius of vegetation control. Means for the fertilized treatments although not significant were much larger than the unfertilized treatments.

Ponderosa pine stem volume responded nearly identical to the treatments as the Douglas-fir Vernonia site (Figure 1b). All radius control treatments resulted in significantly greater stem volume than the untreated check treatments. The fertilized 3 feet radius treatment resulted in the greatest stem volume, significantly greater than the 2 feet unfertilized treatment. A trend of increased response to fertilization with increased radius of control was observed although fertilization did not result in increased stem volume between any two similar radius treatments.

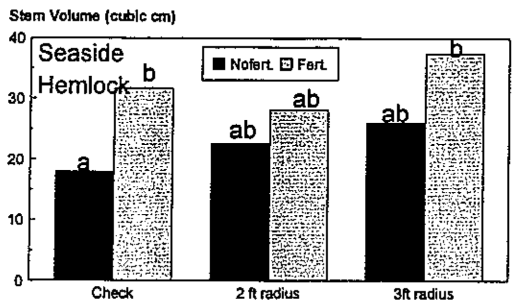
Douglas-fir stem volume increased with increased radius of vegetation control at the Vernonia site (Figure 1c). All the radius treatments of 2 feet or greater had significantly greater third year stem volume than the untreated check treatments. Only the 3 feet radius fertilized treatment had a significantly greater stem volume than the 2 feet radius unfertilized treatment. A trend of increasing response to fertilization with increased radius of control was observed Fertilization did not result in significantly larger stem volume among similar radius of control treatments.

No significant differences were observed among any of the six fertilizer and vegetation control treatments tested at the drain site (Figure 1d). However, the same trend of increasing stem volume with increased radius as seen at Vernonia and Klickitat was observed. This trend was not as pronounced as on the other two sites.

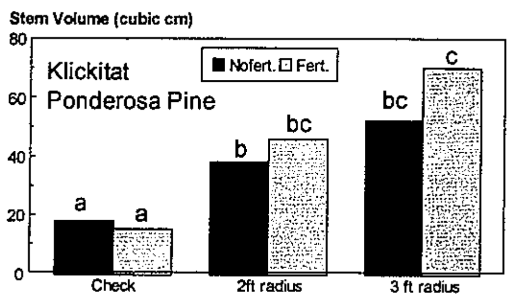
The fertilized 3 feet radius treatment resulted in second year coastal redwood stem volume significantly greater than all other treatments except the unfertilized 3 feet radius treatment at Korbel (Figure 1e). The fertilized check treatment was significantly smaller than both 2 feet treatments and both 3 feet treatments. Fertilization did not result in significantly greater stem volume between any two similar radius treatments.

CONCLUSION

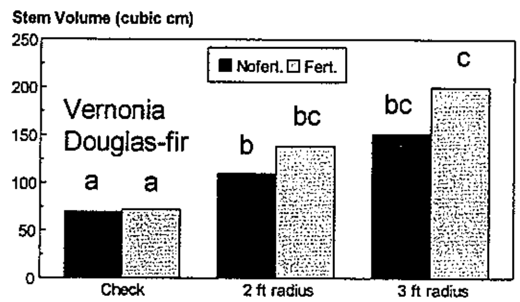
Without adequate vegetation control a positive response to fertilization is unlikely on most reforestation settings in the Pacific Northwest. Weed control results in increased levels of soil moisture and thus increased nutrient availability (Nambiar and Sands 1993). Plants require moisture to absorb soil nutrients. Although not directly measured, the increase in soil moisture resulting from the vegetation control treatments in our study is likely responsible for the growth responses observed in fertilized and control treatments. Similar findings have been reported by other investigators (Woods et al. 1993, Powers and Ferrel 1996). Placement of the fertilizer briquettes in the planting hole and the use of a complete fertilizer are also suspected of aiding in the positive fertilizer response measured. Fertilizer in the planting hole insures that the seedling targeted benefits from the added nutrients and not competing vegetation, which has been the case in other reported literature (Roth and Newton 1996). Variability was high at each site and, although there were differences in the overall plot means, many individual seedlings failed to respond to fertilization. More research is needed to find which combinations of application technique, weed control and fertilizer formulation will illicit the best response for different tree species on differing sites.



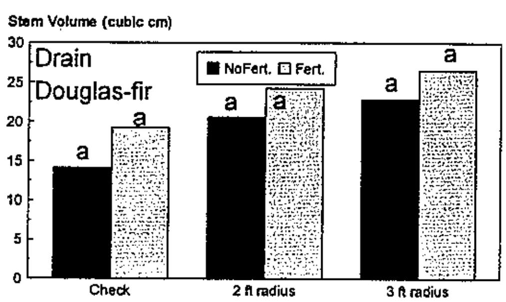
a. Seaside



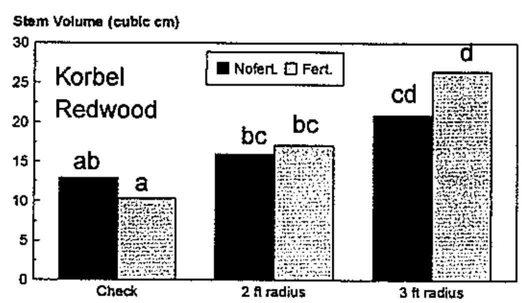
b. Klickitat



c. Vernonia



d. Drain



e. Korbel

Figure 1. Stem volume means for all five sites across all six treatments. Bars associated with similar letters within a graph are not significantly different ($p \leq .05$).

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DIFLUFENZOPYR INCREASES PERENNIAL WEED CONTROL WITH AUXIN HERBICIDES. Rodney G. Lym and Katheryn M. Christianson, Professor and Research Specialist, Department of Plant Sciences, North Dakota State University, Fargo, ND 58105.

INTRODUCTION

BAS-662 (formally known as SAN-1269) is a combination of dicamba plus diflufenzopyr (SAN-836) in a ratio of 2.5:1 dicamba:diflufenzopyr. Diflufenzopyr is an auxin transport inhibitor (ATI), which suppresses the transport of naturally occurring IAA and synthetic auxin-like compounds in plants. In general, diflufenzopyr interferes with the auxin balance needed for plant growth. The purpose of this research was to evaluate diflufenzopyr alone and in combination with dicamba and other auxin herbicides for perennial weed control in a series of greenhouse and field studies.

MATERIALS AND METHODS

Greenhouse. Initially diflufenzopyr was only available for research as a tank-mix with dicamba (BAS-662) and was evaluated in two greenhouse studies. BAS-662 was applied to 12-week-old leafy spurge plants to achieve dicamba rates of 0.5 to 4 oz/A. The treatments were compared to dicamba applied alone. The plants were evaluated for top growth injury 1 and 2 WAT (weeks after treatment) Then all top growth was removed and the plants were allowed to regrow for 4 weeks (6 WAT), at which time the leafy spurge regrowth was harvested, oven dried, and weighed.

In a second greenhouse study, BAS-662 was applied in combination with other auxin and non-auxin herbicides. The ratio of the new auxin herbicide to ATI was 2.5:1. Since BAS-662 also contained dicamba, the treatments were in effect 3-way tankmixes.

Field. Diflufenzopyr in combination with auxin herbicides was evaluated in a series of field trials following the promising results observed in the greenhouse trials. Diflufenzopyr alone was available when these trials began. Auxin herbicides were applied with diflufenzopyr at a ratio of 2.5:1 to Canada thistle, leafy spurge, and spotted knapweed on June 12, 1997. The air temperature and dew point were in the mid-80s and mid-60s, respectively. Treatments were applied using a hand-held sprayer delivering 8.5 gpa. Each species was a separate trial. Treatments were visually evaluated for foliage injury 1.5 MAT (months after treatment) and control 3 MAT.

BAS-662 will likely be marketed for cropland use in 1998 and would be the first herbicide with diflufenzopyr available for pasture and rangeland use. Thus, a second leafy spurge experiment to compare dicamba alone and applied with the ATI was established near Fargo on July 22, 1997. The air temperature was 73 and the dew point was 66. The experimental area had been flooded in April 1997 which delayed the leafy spurge maturity. Leafy spurge was beginning seed-set (25%) but 50 to 75% were still flowering.