ALASKA OREGON WASHINGTON
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

USDA FOREST SERVICE RESEARCH NOTE

PNW-284 December 1976

HERBICIDES FOR CONTROL OF WESTERN SWORDFERN AND WESTERN BRACKEN

by

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ABSTRACT

Dicamba at 3 pounds acid equivalent per 100 gallons of carrier will control individual western swordfern plants when applied between mid-May and late July. A mid-July foliage spray containing 1 to 3 pounds active ingredient per acre of asulam will produce good long-term control of western bracken without significantly affecting Douglas-firs or ponderosa pines.

KEYWORDS: Herbicides, brush control, swordfern, *Polystichum munitum*, bracken fern, *Pteridium aquilinum* var. *pubescens*, Douglas-fir, ponderosa pine, dicamba, asulam.

INTRODUCTION

Western swordfern (*Polystichum munitum*) and western bracken (*Pteridium aquilinum* var. *pubescens*) are common herbaceous species on forest lands in western Oregon and Washington. The effect of competition from bracken on conifer seedling establishment is well documented (Dimock 1964, McCulloch 1942, Staebler et al. 1954, Stewart 1975, Worthington 1955) but is unknown for swordfern. Swordfern is known to be a major winter food for a tree-damaging mammal, mountain beaver (*Aplodontia rufa*) (Voth 1968). This suggests that abundance of swordfern may affect mountain beaver populations. Recent evidence shows that reclamation of red alder (*Alnus rubra* Bong.) stands with swordfern understories can be difficult (Dimock et al. 1976). Reduction or elimination of swordfern and bracken from conifer plantations may reduce their desirability as habitat for tree-damaging animals and competition for light and soil moisture.

Western swordfern is found on forest lands in limited geographic areas and has not been considered a serious competitor to seedlings. Nothing was

known about its control. In contrast, varieties of bracken are a serious problem in pastures and on forest lands throughout the world. Although information on response of western bracken to herbicides was available (Fechtig 1968, Fechtig and Furtick 1965, Homesley and Furtick 1968, Robocker 1971), satisfactory treatments for controlling this species had not been been developed.

Beginning in 1970, a series of studies were installed to develop herbicidal treatments to control western swordfern and western bracken. Since swordfern is likely to require control only in localized areas, efforts were directed toward developing individual plant treatments. Bracken is a more widespread problem requiring treatments suitable for broadcast application.

All studies were installed as completely randomized experiments and the results analyzed by analysis of variance. Comparisons of herbicide effectiveness were based on analysis of percentage of plants killed for western swordfern and percentage of ground cover for western bracken.

WESTERN SWORDFERN

During the 1970 growing season, four herbicides were tested as foliage sprays on western swordfern near Sitkum, Oregon. Each treatment was applied in a water carrier by knapsack sprayer to drip point on 10 individual plants. Herbicides were applied as early foliar sprays on May 26, when fronds were at a mid- to late-hook stage, or as midsummer sprays on July 28, when fronds were mature and sori were yellow to rust colored. Results observed in September 1971, 13 to 15 months after treatment, are shown in table 1.

Swordfern was equally susceptible to sprays applied in late spring and midsummer, but there was a significant

Table 1--*Effects of herbicides as early foliar or midsummer sprays on western swordfern, 13 to 15 months after treatment*

Herbicide	Concentration	Early foliar spray			Midsummer spray		
		Plants killed	No. of fronds per live plant	Average frond height	Plants killed	No. of fronds per live plant	Average frond height
	lb aihg[1/]	Percent		Inches	Percent		Inches
Untreated	0	0	47	26	0	47	26
Picloram	1	0	24	18	0	35	19
	2	40	24	17	20	29	21
Dicamba	4	80	20	23	30	21	17
	8	80	36	20	90	6	11
Dichlobenil	4	20	15	23	30	16	23
	8	60	10	18	50	18	23
Bromacil	12	100	0	0	90	17	19

[1/] Pounds of active ingredient per 100 gallons of water.

difference in plant kill obtained with the four herbicides. Of the herbicides and rates tested, dicamba at a maximum of 4 pounds active ingredient per 100 gallons (1b aihg) (fig. 1) and bromacil at 12 1b applied as early foliar sprays were the most effective. The most effective concentration of picloram or dichlobenil was not attained in this study.

Figure 1.--Western swordfern plant killed by an early foliar spray of 3 pounds acid equivalent of dicamba per 100 gallons of water.

A second study was installed to find the minimum effective concentration of dicamba and bromacil. During May 1972, 10 individual western swordfern plants were sprayed to drip point with each treatment when new fronds were at the early- to late-hook stage. Most sprays were applied in water carriers. However, old fronds are also present at this stage, and these seem more resistant than new fronds to herbicides applied in water carriers. Therefore, an oil-soluble dicamba formulation applied in a diesel oil carrier was also tested. Results observed in July 1973, 14 months after treatment, are shown in table 2.

All treatments reduced the vigor of surviving plants compared with untreated swordfern. Averaged over all dosages, bromacil produced better plant kill than dicamba. As shown in figure 2, the minimum effective concentration of both herbicides is approximately 3 1b aihg. However, dicamba is somewhat more effective than bromacil at this concentration. The results also suggest that the oil-soluble formulation of dicamba applied in diesel oil is better than the water-soluble formulation applied in water at equal concentrations--1 pound acid equivalent per 100 gallons (1b aehg).

Both the water-soluble and oil-soluble formulations of dicamba are registered for use as high volume ground-applied sprays on forest land; bromacil is not. Therefore, dicamba is preferred to bromacil as an early foliar application for control of western swordfern.

Dicamba and bromacil are soil- and foliage-active and may severely damage conifers, so sprays should be carefully applied on individual swordfern plants to avoid drift onto adjacent conifers. For site preparation, dicamba should be applied the year before planting.

WESTERN BRACKEN

During the 1970 growing season, the four herbicides tested on western swordfern were also applied as foliage sprays on western bracken near Blodgett, Oregon. Each treatment was applied by knapsack sprayer in a water carrier at a volume equivalent to 200 gallons per acre to ten 1/1,000-acre circular plots. Herbicides were tested as early foliar sprays on June 15, when fronds were almost fully expanded, and as midsummer sprays on August 10, when fronds were mature and sori were green.

Table 2--*Effects of various concentrations of dicamba and bromacil as early foliar sprays on western swordfern, 14 months after treatment*

Herbicide and carrier	Concentration	Plants killed	No. of fronds per live plant	Average frond height
	lb aihg[1/]	Percent		Inches
Untreated	0	0	50	36
Dicamba (oil)	1	10	16	20
(water)	1	0	34	29
(water)	2	40	14	21
(water)	3	90	6	22
Bromacil (water)	1	20	29	25
(water)	2	50	12	17
(water)	3	70	22	20
(water)	6	70	8	18

[1/] Pounds of active ingredient per 100 gallons of carrier.

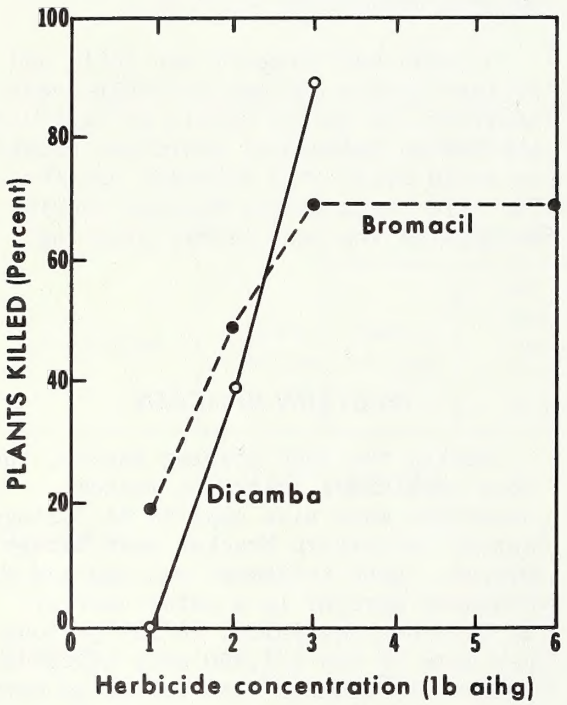

Figure 2.--Response of western swordfern to different concentrations of dicamba and bromacil.

During September 1971, 13 to 15 months after treatment, percent bracken cover and frond height and density were estimated on each plot. Height and density were obtained by measuring the average height and number of fronds in four systematically located 1-foot-square subsamples in each plot. The results of treatment are shown in table 3.

Dicamba was by far the most effective herbicide tested for reducing bracken cover, and 4 lb ai per acre was as effective as 8 lb. Early foliar sprays were less effective than midsummer sprays. This finding agrees with other studies, although Fechtig (1968) and Homesley and Furtick (1968) indicate that both picloram and dichlobenil can produce somewhat better control. Tests in Great Britain show that 4 lb ai per acre of dicamba can control bracken for up to four growing seasons on infertile sites but only for two seasons on fertile, moist sites (Forestry Commission 1969). In the present study, none of the

Table 3--*Effects of herbicides as early foliar or midsummer sprays on western bracken, 13 to 15 months after treatment*

Herbicide	Dosage	Early foliar spray			Midsummer spray		
		Cover	Stems	Average stem height	Cover	Stems	Average stem height
	lb ai/A[1/]	Percent	No./ft^2	Inches	Percent	No./ft^2	Inches
Untreated	0	87	1.8	43	87	1.8	43
Picloram	1	70	1.0	50	30	.9	43
	2	48	.9	49	16	.7	34
Dicamba	4	4	.5	43	24	.8	38
	8	2	.2	21	2	0	0
Dichlobenil	4	74	1.3	43	83	1.7	48
	8	86	1.6	48	90	1.5	47
Bromacil	12	76	1.6	46	60	1.2	53

[1/] Pounds of active ingredient per acre.

herbicides adequately controlled western bracken beyond the second season.

Dicamba is somewhat persistent, soil active, and can severely damage conifers (Ryker 1970, Stewart 1974). Asulam, a herbicide developed in Great Britain, has produced excellent control of other varieties of bracken fern at 4 to 8 lb ai per acre without damaging certain species of conifers (Holroyd et al. 1970, Martin et al. 1972, Soper 1972, Wasmuth 1973). Its effects on Douglas-fir (*Pseudotsuga menziesii*) and western bracken were unknown; therefore, a test was installed near Harlan, Oregon, to compare effectiveness of asulam and dicamba for control of western bracken.

Each treatment was applied to three 1/100-acre-square plots of western bracken in mid-July of 1972 after complete frond elongation. All sprays were applied with 0.2 percent surfactant in water at a volume equivalent to 200 gallons per acre. Bracken cover and stem density and height were observed in July--12, 24, and 36 months after treatment. Stem density and height were measured in five 1-foot-square subsamples systematically located along the diagonals in each plot. Results of the first and last examinations are shown in table 4. Change in bracken cover during the 3 years after treatment is shown in figure 3.

Asulam was more effective than dicamba in reducing bracken cover during the 3-year study. Effects of dicamba were evident by the end of the first growing season, 2 months after treatment. In contrast, asulam did not affect existing fronds but prevented emergence of new fronds the next year. Sprays containing 1 lb ai per acre of

Table 4--*Effect of dicamba and asulam as midsummer foliage sprays on western bracken*

Herbicide	Dosage	12 months after treatment			36 months after treatment		
		Cover	Stems	Average stem height	Cover	Stems	Average stem height
	lb ai/A[1/]	Percent	No./ft^2	Feet	Percent	No./ft^2	Feet
Untreated	0	90	1.33	5.1	88	1.07	4.7
Dicamba	4	57	1.20	2.4	73	1.20	4.0
Asulam	1	12	.13	2.6	27	.40	3.8
	2	8	.10	2.3	12	.08	2.1
	3	5	.03	2.0	7	.20	2.5

[1/] Pounds of active ingredient per acre.

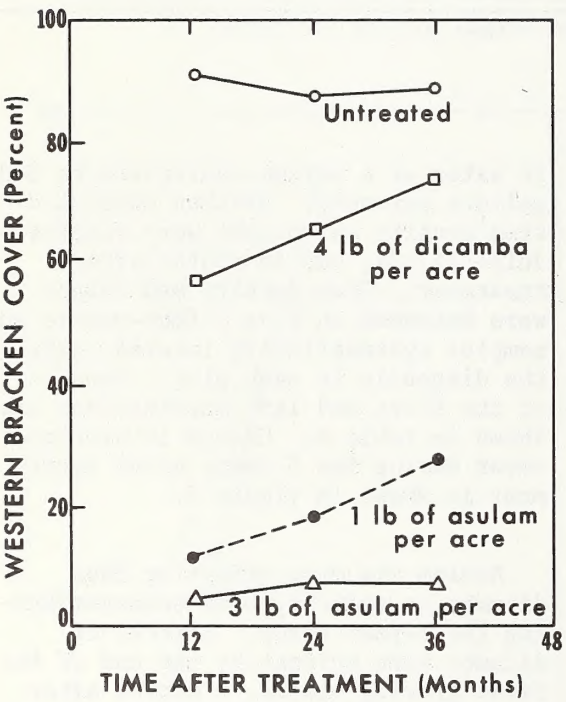

Figure 3.--Western bracken cover on untreated plots and on plots treated with dicamba or asulam.

asulam were almost as effective as sprays containing 2 or 3 lb. Bracken treated with dicamba recovered substantially by the 3d year after spraying (fig. 4). In contrast, recovery was very slow after treatment with asulam, even at the lowest dosage (fig. 5). As expected, Douglas-firs present on the plots at the time of treatments were severely damaged by dicamba (fig. 6); asulam did not damage trees at dosages up to 3 lb ai per acre (fig. 7).

Effectiveness of asulam for controlling western bracken was confirmed in a small test installed during June 1973 on the Entiat Ranger District of the Wenatchee National Forest in the Wenatchee Mountains of central Washington. Three 1/100-acre plots each were sprayed with 1 or 3 lb ai per acre of asulam with 0.2-percent surfactant in water at a carrier volume equivalent to 200 gallons per acre. Results obtained 12 months after treatment are shown in table 5.

As in tests in western Oregon, asulam produced good control of western bracken in central Washington. However, a higher

Figure 4.--Bracken fern recovered substantially by the 3d year after spraying with 4 lb aehg of dicamba.

Figure 5.--Bracken fern recovered very slowly after treatment with asulam.

Figure 6.--Dicamba severely damaged Douglas-firs such as this 3-foot-tall tree.

Figure 7.--Asulam did not damage Douglas-firs such as these two 3-foot-tall trees.

Table 5--*Effect of asulam applied as an early foliar spray on western bracken in the Wenatchee Mountains, 12 months after treatment.*

Treatment	Dosage	Cover	Stems	Stem height
	lb ai/A[1/]	Percent	No./ft^2	Feet
Untreated	0	53	1.53	1.8
Asulam	1	37	.60	1.2
	3	10	.07	1.8

[1/] Pounds of active ingredient per acre.

dosage was required to control the shorter, more open bracken on these sites than to control the taller, more dense bracken in western Oregon. Perhaps western bracken growing on drier sites is more resistant to asulam or may have a thicker waxy cuticle that reduces uptake of herbicides applied in water carriers.

To better determine the suitability of asulam for conifer release, 10 seedlings each of Douglas-fir and ponderosa pine (*Pinus ponderosa*) were sprayed to drip point with 1/2 lb aihg of asulam in a water carrier. Treatments were applied on June 19 at the beginning of active growth, on July 13 as terminal growth stopped but while new growth was succulent, and on August 14 after buds were set and new growth was woody. The concentration approximated a 2-lb-ai-per-acre application rate based on experience with phenoxy herbicides (Gratkowski 1961). Defoliation and topkill 2 years after spraying and average annual height growth before and after spraying are shown in table 6.

The data show that asulam did not affect height growth of either Douglas-fir or ponderosa pine after adjusting for differences in individual tree growth before treatment using covariance analysis. However, variation was considerable, and some small growth reduction may be possible.

Douglas-firs seemed more sensitive to asulam than ponderosa pines. Visible damage was slight in both species, but susceptibility was highest on June 19 during the period of active growth. This suggests that Douglas-fir and ponderosa pine seedlings can be safely released if sprays are applied after new growth ceases and terminal buds have set. This conclusion has been verified in a series of aerial spray tests.[1]

CONCLUSIONS

Western swordfern can be adequately controlled with sprays containing 3 lb aehg of dicamba applied in water to drip point on individual plants. Sprays can be applied anytime between the midhook and fully elongated frond stages, approximately mid-May to late July. Damage to conifers can be prevented if sprays are applied the year before planting or carefully directed away from young conifers on the site.

Western bracken can be controlled for at least 3 years with 1 to 3 lb ai per

[1]Unpublished data on file at the Forestry Sciences Laboratory, Pacific Northwest Forest and Range Experiment Station, Corvallis, Oreg.

Table 6--*Effect of asulam on Douglas-fir and ponderosa pine seedlings 2 years after treatment*

Species and application date	Initial height	Average annual height growth		Defoliation	Topkill
		Before treatment[1/]	After treatment[2/]		
	- - - - - - Meters - - - - - -			Percent	
Douglas-fir:					
Untreated	1.68	0.55	0.73	0	0
June 19	1.64	.44	.59	12	3
July 13	1.78	.58	.73	2	0
August 14	1.73	.56	.60	10	0
Ponderosa pine:					
Untreated	1.73	.59	.98	5	0
June 19	2.03	.58	.86	14	0
July 13	1.72	.64	.87	5	0
August 14	1.96	.74	.91	5	0

[1/] Total growth during the 2 years before treatment.
[2/] Total growth during the 2 years after treatment.

acre of asulam applied after frond emergence, but some recovery of bracken may occur after treatment with 1 lb of asulam. Sprays applied in mid-July or August produced good bracken control without damaging Douglas-firs or ponderosa pines. Asulam is registered for use on Christmas tree plantations, and registration for use in site preparation and conifer release on forest lands is expected soon.

Experience suggests that results from small plot tests such as those reported here often closely agree with results from operational use under similar conditions. However, as with any new technology, it is wise to begin use of new herbicides on a small scale to establish local experience. This preliminary step can save time and money later. Further, sharing your experience with others can prevent adoption of faulty technology and hasten adoption of useful technology.

METRIC CONVERSIONS

1 pound = 0.45 kilogram
1 inch = 2.54 centimeters
1 gallon = 3.78 liters
1 acre = 0.40 hectare
1 foot = 0.30 meter

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Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key--out of the reach of children and animals--and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the Federal Environmental Protection Agency, consult your county agricultural agent or State extension specialist to be sure the intended use is still registered.

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