1974
USDA FOREST SERVICE RESEARCH PAPER PNW-176

BUDBREAK SPRAYS FOR SITE PREPARATION AND RELEASE FROM SIX COASTAL BRUSH SPECIES

R.E. Stewart

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
FOREST SERVICE
PORTLAND, OREGON
U.S. DEPARTMENT OF AGRICULTURE

CONTENTS

ABSTRACT

Ten herbicides or combinations of herbicides were applied at budbreak on red alder, salmonberry, western thimbleberry, vine maple, California hazel, and salal. Results show that red alder, vine maple, and California hazel can be adequately controlled for conifer release by budbreak sprays of 2,4,5-T applied in diesel oil. Sprays containing 2,4,5-T are promising for control of salal, but additional tests are necessary. Budbreak sprays should not be used to control salmonberry or western thimbleberry shrubs. Aerial spray tests indicate that combinations of dicamba with 2,4,5-T may be useful for site preparation. Herbicidal treatments for conifer release and site preparation are recommended for each species.

KEYWORDS: Herbicides, brush control, Coniferae.

New burns and cuttings in the Oregon and Washington Coast Ranges are rapidly occupied by aggressive shrubs and weed trees that may dominate the site and reduce survival and growth of more desirable conifers (Ruth 1956, 1957). Field trials of herbicidal sprays during the last 20 years have led to several useful treatments to control this competing vegetation and allow conifer establishment. As a result, herbicides have become a valuable silvicultural tool in management of Pacific Northwest forests.

Herbicides may be applied at budbreak, during the growing season or after growth has ceased, to control shrubs and weed trees in the Coast Ranges. Budbreak sprays are often preferred by silviculturists for releasing Douglas-firs because many brush species are susceptible while conifers are resistant. These sprays are applied during budbreak of undesirable species but before conifer growth begins. However, pine species are susceptible to herbicides at this time and cannot be safely released by budbreak sprays. Because most coastal brush species are leafless during this period, herbicides must be applied in diesel- or fuel-oil carriers to penetrate the bark of stems and branches.

Budbreak sprays of 2,4-D and 2,4,5-T are recommended for releasing Douglas-firs from red alder; 2,4,5-T is used to release Douglas-firs from vine maple (Lauterbach 1961). Unfortunately, many other coastal brush species are resistant to budbreak applications of 2,4-D or 2,4,5-T. Effects of other herbicides or combinations of herbicides on these species are unknown.

To properly prescribe treatments, silviculturists must know response of associated brush species to various herbicidal sprays. The screening tests reported here will provide this information for budbreak applications of several herbicides and combinations of herbicides. Results of this study and of an earlier test of foliage sprays on the same species (Stewart 1974) provide a sound basis for development of treatments for site preparation and conifer release.

METHODS

Screening tests were conducted during late winter and early spring of 1971 to determine the effect of various herbicides and combinations of herbicides applied as stem or foliage sprays on six brush species found in the Coast Ranges of Oregon and Washington. Vigorous plants located in recent clearcuts near Coos Bay, Oregon, or in nonstocked brushfields near Vancouver, Washington, were selected for treatment. The species selected were:

Red alder	*Alnus rubra*
Salmonberry	*Rubus spectabilis*
Western thimbleberry	*Rubus parviflorus*
Vine maple	*Acer circinatum*
California hazel	*Corylus cornuta californica*
Salal	*Gaultheria shallon*

Each treatment was applied by knapsack sprayer to thoroughly wet the stems of 10 individual plants of each species except salal. Salal foliage was sprayed on an area basis by applying treatments in a carrier volume equivalent to 200 gallons per acre on ten 1/1,000-acre plots.

Ten herbicides or combination of herbicides were selected for study. Similar treatments were applied to commonly associated species such as salmonberry and western thimbleberry or vine maple and California hazel. All sprays were applied in a black diesel oil carrier at budbreak for each species. Herbicides and combinations tested were:

Common name [chemical name]	Formulation
(1) 2,4-D [(2,4-dichlorophenoxy) acetic acid]	Propylene glycol butyl ether ester (PGBE)1/
(2) Dichlorprop [2-(2,4-dichloro-phenoxy) propionic acid]	Butoxyethanol ester (BEE)2/
(3) 2,4,5-T [(2,4,5-trichloro-phenoxy) acetic acid]	PGBE ester1/
(4) Silvex [2-(2,4,5-trichloro-phenoxy) propionic acid]	PGBE ester1/
(5) Dicamba [3,6-dichloro-*o*-anisic acid]	Solubilized acid3/
(6) Dicamba + 2,4-D	(5) + (1)
(7) Dicamba + dichlorprop	(5) + (2)
(8) Dicamba + 2,4,5-T	(5) + (3)
(9) Dicamba + silvex	(5) + (4)
(10) 2,4-D + dichlorprop	BEE esters2/

Test samples provided by:

1/ The Dow Chemical Company
2/ Amchem Products, Inc.
3/ Velsicol Chemical Company

All herbicides were applied in diesel oil carriers at 2 lbs ae (acid equivalent) per acre on salal and at 1 lb aehg (acid equivalent per 100 gallons) on the other five species. Herbicides such as 2,4-D, dichlorprop, 2,4,5-T, and silvex are known to be selective at certain dosages and stages of plant development. These were tested for use as conifer release sprays. Less selective sprays containing dicamba were tested for use in site preparation.

Plants were examined during September of 1971, 18 months after sprays were applied. Topkill, number and size of basal sprouts, and number of dead plants (complete topkill with no resprouting) were recorded.

EFFECTS OF HERBICIDES ON SPECIFIC SPECIES

In this section, topkill, plant kill, and number and size of basal and root sprouts are tabulated for each species. Results of selected treatments are briefly discussed.

Red Alder

Red alder plants, 9- to 12-foot-high, were treated on March 15, when buds were swelling but not open.

Herbicidal effects developed slowly during the first growing season, and many trees produced leaves after treatment. By the end of the second growing season, sprays containing 2,4,5-T, dicamba, and combinations of dicamba with 2,4-D, dichlorprop, or silvex killed all of the treated red alder trees (table 1). Other herbicides and combinations were less effective.

Budbreak sprays of 1 lb ae per acre each of 2,4-D and 2,4,5-T are presently recommended for aerial application to release conifers from red alder (Lauterbach 1961). Results of this study show that 2,4-D alone is less effective than 2,4,5-T. However, 2,4-D is less expensive than 2,4,5-T; when used in combination with 2,4,5-T, 2,4-D may substitute for higher rates of the more expensive herbicide. Further, field experience has proven the effectiveness of combinations of 2,4-D and 2,4,5-T as budbreak sprays for control of red alder.

At the rates tested, dicamba and combinations of dicamba with phenoxy herbicides were about as effective as 2,4-D or 2,4,5-T applied alone. However, dicamba sprays are more expensive and less selective than phenoxy herbicide sprays. Combinations of dicamba and 2,4-D or 2,4,5-T may prove useful for site preparation in mixed brush communities containing species resistant to budbreak sprays of phenoxy herbicides.

At present, budbreak sprays containing 1 lb ae per acre each of 2,4-D and 2,4,5-T or 2 lb ae per acre of 2,4,5-T applied in a diesel oil carrier should be used for site preparation and conifer release in pure red alder types. For maximum control, sprays should be applied before red alder trees attain a height of 15 feet. Field experience indicates that repeated sprays will be required to produce the same degree of control in larger red alder stands.

Table 1.--*Effects of herbicides applied in diesel oil at budbreak on red alder*

Herbicide	Rate	Topkill	Plant kill
	lb aehg	--------*Percent*--------	
2,4-D	1	92	90
Dichlorprop	1	70	70
2,4,5-T	1	100	100
Silvex	1	50	50
Dicamba	1	100	100
Dicamba + 2,4-D	1 + 1	100	100
Dicamba + dichlorprop	1 + 1	100	100
Dicamba + 2,4,5-T	1 + 1	90	90
Dicamba + silvex	1 + 1	100	100
2,4-D + dichlorprop	1 + 1	80	80

Salmonberry

Salmonberry clumps, 4- to 6-foot high, were treated on March 8, when flower petals and new leaves were beginning to emerge from the bud scales.

Dichlorprop, 2,4,5-T, silvex, and combinations of these herbicides with dicamba as well as dicamba alone produced nearly complete topkill of salmonberry shrubs by the end of the first growing season. Herbicidal effects changed very little during the second growing season. Few shrubs were killed by phenoxy herbicides applied alone, but dichlorprop was more effective than either 2,4,5-T or silvex (table 2). Addition of dicamba to phenoxy herbicides increased plant-kill and slightly reduced vigor of basal and root sprouts.

Results from this study and from aerial sprays reported by Lauterbach (1961) show that budbreak applications are less effective than foliage applications for salmonberry control (Gratkowski 1971, Stewart 1974). Observations from stem and aerial sprays are in contrast to those reported for basal sprays. For example, Madison and Freed (1962) found mixtures of 2,4-D and 2,4,5-T to be very effective when applied as budbreak basal sprays. However, basal applications concentrate herbicides near the root collar of shrubs and produce better rootkill than stem or aerial sprays.

Dichlorprop is more damaging to conifers than 2,4,5-T and should not be used for release sprays until additional tests are completed. Budbreak sprays of 2,4,5-T may produce sufficient topkill of salmonberry shrubs to release well-established conifers, but foliage sprays are preferred for most situations. For site preparation, budbreak sprays of dicamba with dichlorprop or 2,4,5-T will produce good salmonberry control. Because herbicidal effects are fully developed by the end of the first growing season, these treatments are especially promising for preburn desiccation.

Table 2.--*Effects of herbicides applied in diesel oil at budbreak on salmonberry*

Herbicide	Rate	Topkill	Plant kill	Average number and height of basal sprouts	
	lb aehg	------*Percent*-------		*Number*	*Inches*
Dichlorprop	1	100	40	5	28
2,4,5-T	1	99	10	5	34
Silvex	1	100	20	4	28
Dicamba	1	92	10	4	33
Dicamba + 2,4-D	1 + 1	83	20	5	38
Dicamba + dichlorprop	1 + 1	99	60	2	22
Dicamba + 2,4,5-T	1 + 1	96	60	4	24
Dicamba + silvex	1 + 1	90	20	6	26
2,4-D + dichlorprop	1 + 1	100	30	3	25

Western Thimbleberry

Western thimbleberry clumps were treated on February 23, when vegetative buds were swelling and bud scales were closed.

All treatments produced complete topkill of original stems, but no herbicidal spray controlled root sprouting (table 3). All resprouting shrubs returned to pretreatment size and vigor by the end of the second growing season.

Budbreak sprays of phenoxy herbicides or dicamba will not adequately control western thimbleberry. Fortunately, western thimbleberry shrubs are more susceptible to foliage sprays of 2,4,5-T (Gratkowski 1971, Stewart 1974). Such sprays will also control salmonberry, a common associate of western thimbleberry.

Table 3.--*Effects of herbicides applied in diesel oil at budbreak on western thimbleberry*

Herbicide	Rate	Topkill	Plant kill	Average number and height of basal sprouts	
	lb aehg	------*Percent*	--------	*Number*	*Inches*
Dichlorprop	1	100	0	8	46
2,4,5-T	1	100	10	5	39
Silvex	1	100	10	5	38
Dicamba	1	100	0	4	36
Dicamba + 2,4-D	1 + 1	100	0	10	45
Dicamba + dichlorprop	1 + 1	100	10	8	43
Dicamba + 2,4,5-T	1 + 1	100	10	4	27
Dicamba + silvex	1 + 1	100	20	5	40
2,4-D + dichlorprop	1 + 1	100	0	7	37

Vine Maple

Vine maple clumps, 5- to 8-foot high, were treated on March 17, when vegetative buds were swelling and bud scales were closed.

Vine maple shrubs were very susceptible to budbreak sprays of 2,4,5-T and silvex (table 4 and fig. 1). Although silvex was slightly more effective, it is more expensive, less selective, and more erratic on species often associated with vine maple than is 2,4,5-T. Lauterbach (1961) recommends aerial sprays of 2 lb ae of 2,4,5-T per acre applied in a diesel-oil carrier at budbreak to release conifers from vine maple. Foliage sprays (Stewart 1974) or budbreak sprays containing dichlorprop, dicamba, or combinations of phenoxy herbicides with dicamba are less effective than the recommended treatment. Therefore, budbreak sprays of 2,4,5-T should continue to be used for control of vine maple shrubs.

Figure 1.--A budbreak spray of 2,4,5-T in diesel oil killed this vine maple shrub.

Table 4.--*Effects of herbicides applied in diesel oil at budbreak on vine maple*

Herbicide	Rate	Topkill	Plant kill	Average number and height of basal sprouts	
	lb aehg	------*Percent*-------		*Number*	*Inches*
Dichlorprop	1	46	30	2	14
2,4,5-T	1	100	80	8	12
Silvex	1	100	90	1	11
Dicamba	1	68	40	10	17
Dicamba + 2,4-D	1 + 1	38	10	10	19
Dicamba + dichlorprop	1 + 1	90	40	7	18
Dicamba + 2,4,5-T	1 + 1	90	80	16	14
Dicamba + silvex	1 + 1	100	60	8	16
2,4-D + dichlorprop	1 + 1	30	10	4	19

California Hazel

California hazel clumps, 6- to 9-foot high, were treated on March 17, when vegetative buds were swelling but closed. Catkins were fully expanded and unopened.

Most herbicidal sprays produced good topkill but limited control of resprouting of California hazel shrubs (table 5). However, basal sprouts were less than one-third of the original plant height after two growing seasons. Only 2,4,5-T killed any of the test plants when applied alone. Addition of dicamba to the phenoxy herbicides increased plant kill. This effect was most pronounced for sprays containing silvex (fig. 2).

Previous research shows that California hazel shrubs are slightly more susceptible to late spring foliage sprays of 2,4,5-T than to budbreak sprays (Stewart 1974). However, control with budbreak sprays of 1 lb ae each of 2,4-D and 2,4,5-T or 2 lb of 2,4,5-T are adequate for release of established conifers, and herbicidal damage to conifers will be less than with foliage sprays. Combinations of dicamba with 2,4,5-T or silvex may be useful for site preparation and preburn desiccation sprays. However, these combinations must be evaluated in small-scale trials before they can be recommended.

Figure 2.--Budbreak sprays of dicamba with silvex produced good topkill of California hazel shrubs.

Table 5.--*Effects of herbicides applied in diesel oil at budbreak on California hazel*

Herbicide	Rate	Topkill	Plant kill	Average number and height of basal sprouts	
	lb aehg	------*Percent*-------		*Number*	*Inches*
Dichlorprop	1	98	0	9	32
2,4,5-T	1	100	40	5	22
Silvex	1	98	0	6	27
Dicamba	1	94	0	7	30
Dicamba + 2,4-D	1 + 1	100	30	6	23
Dicamba + dichlorprop	1 + 1	94	10	8	32
Dicamba + 2,4,5-T	1 + 1	100	50	5	28
Dicamba + silvex	1 + 1	100	70	8	18
2,4-D + dichlorprop	1 + 1	100	20	6	31

Salal

Salal plots were sprayed on April 1, when flower buds were swelling and vegetative buds were dormant.

Salal, an evergreen species, was susceptible to foliage sprays applied in diesel-oil carriers at budbreak (table 6 and fig. 3). Silvex, dichlorprop, 2,4,5-T, and dicamba produced at least 80-percent topkill and 50-percent reduction in salal cover. Silvex was best, and addition of dicamba did not increase degree of control enough to justify the added cost.

Salal is resistant to many of these same herbicides applied in water or oil-in-water emulsion carriers later in the growing season (Gratkowski 1970, Stewart 1974). The greater control obtained with budbreak sprays in the present study may be due to differences in timing of application or type of carrier. Salal may be more susceptible to herbicidal sprays earlier in the growing season, or herbicides applied in diesel oil may penetrate the thick, waxy salal leaves more readily than sprays in water or oil-in-water emulsion carriers.

Few plants were killed by budbreak sprays, and salal cover will be quickly reestablished from root and basal sprouting. However, silvex sprays may produce sufficient control of salal for conifer release. Silvex should be evaluated in small-scale aerial spray tests before specific treatments can be recommended. For site preparation, sprayed plants should be removed by scarification or burning to avoid planting in the dense mat of salal stems and roots. Because of the dense, compact growth habit of salal, low volume aerial sprays will not produce results equivalent to those obtained with high volume ground sprays. Therefore, carrier volumes between 15 and 30 gallons per acre should be evaluated in aerial spray tests.

Figure 3.--Budbreak sprays of dicamba plus 2,4,5-T produced good control of salal on small plots.

Table 6.--*Effects of herbicides applied in diesel oil at budbreak on salal*

Herbicide	Rate	Live salal cover	Topkill	Average number of sprouts per square foot
	lb ae/acre	-----*Percent*------		*Number*
Untreated	--	85	0	--
2,4-D	2	66	37	2
Dichlorprop	2	30	84	2
2,4,5-T	2	38	90	3
Silvex	2	12	100	1
Dicamba	2	24	98	3
Dicamba + 2,4-D	2 + 2	42	94	2
Dicamba + dichlorprop	2 + 2	16	98	1
Dicamba + 2,4,5-T	2 + 2	20	98	2
Dicamba + silvex	2 + 2	10	100	1
2,4-D + dichlorprop	2 + 2	24	96	2

EFFECTS OF AERIAL SPRAYS OF DICAMBA PLUS 2,4,5-T

Aerial sprays of dicamba plus 2,4,5-T were evaluated for site preparation in brush communities on the Siuslaw National Forest and the Tillamook State Forest. Two 5-acre portions of a recent clearcut on the Siuslaw National Forest were sprayed at budbreak during March of 1972 with either one-half lb ae dicamba (oil-soluble acid) plus 2 lb ae 2,4,5-T (isooctyl ester) or 1 lb ae dicamba plus 2 lb ae 2,4,5-T in 10 gallons of diesel oil per acre. Treated areas were then examined in August of 1973, 17 months after the sprays were applied.

Except for vine maple, results of budbreak aerial sprays were similar to those obtained with the high volume stem sprays described earlier in this publication (table 7). Although vine maple shrubs were more susceptible to stem sprays than aerial sprays, defoliation of live stems was excellent two growing seasons after aerial spraying. Small, exposed Douglas-firs received only minor herbicidal damage even at the highest application rate. However, studies by Ryker (1970) show that conifers are susceptible to dicamba. Therefore, sprays containing dicamba should not be used to release conifers.

A mature red alder stand on the Tillamook State Forest was treated in late November of 1972 with 1-1/2 gallons of Banvel 510[4/] in 20 gallons of diesel oil per acre. Results were observed in August of 1973, 9 months after the sprays were applied (table 8). Crowns of large red alder trees killed by the spray were already breaking apart. Control of western thimbleberry was inadequate; shrubs were resprouting vigorously. However, effects on other understory shrubs were sufficient to allow planting of conifers. Existing Douglas-fir saplings were moderately to severely damaged by the spray, and previous tests with summer applications suggest that damaged trees will not readily recover (Ryker 1970).

Results from both aerial spray tests suggest that dormant or budbreak applications of dicamba plus 2,4,5-T will be useful for preparing planting sites in coastal brush communities. However, these sprays should not be used if western thimbleberry forms a significant portion of the brush cover. Additional aerial spray tests will be necessary to evaluate the potential of oil-soluble formulations of dicamba with 2,4,5-T. Such tests should use 1 to 1-1/2 lb ae of dicamba with 2 lb ae of 2,4,5-T in 10 or 15 gallons of diesel oil per acre. The higher carrier volume should be used in dense, well-established brushfields.

Results of tests on individual species reported earlier in this publication were very similar to those found with broadcast aerial sprays. Therefore, response of individual plants should provide a reliable indicator of aerial spray results.

[4/] Banvel 510 is a commercial formulation manufactured by the Velsicol Chemical Corporation. It contains 1 lb ae oil-soluble acid of dicamba plus 2 lb ae isooctyl esters of 2,4,5-T per gallon.

Table 7.--*Effect of budbreak aerial sprays of dicamba and 2,4,5-T on the Siuslaw National Forest 17 months after treatment*

Species	½ lb dicamba + 2 lb 2,4,5-T per acre					1 lb dicamba + 2 lb 2,4,5-T per acre				
	Number of plants	Topkill	Plant kill	Average number and height of basal sprouts		Number of plants	Topkill	Plant kill	Average number and height of basal sprouts	
		-----*Percent*------		*Number*	*Feet*		------*Percent*------		*Number*	*Feet*
Douglas-fir	21	1	0	--	--	15	2	0	--	--
Red alder	21	87	86	0	0	27	92	92	0	0
Salmonberry	30	70	27	4	2.4	30	68	47	5	1.8
Vine maple[1/]	30	77	3	6	2.4	30	60	10	4	1.0
Red elder	3	100	66	2	2.0	8	75	62	1	3.0

1/ Average defoliation of vine maple shrubs for the 2 treatments was 96 and 91 percent, respectively.

Table 8.--*Effect of a November aerial spray of 1½ gallons of Banvel 510 per acre on the Tillamook State Forest 9 months after treatment*

Species	Number of plants	Defoliation	Topkill	Average number and height of basal sprouts	
		------*Percent*-------		*Number*	*Feet*
Douglas-fir	18	29	13	--	--
Red alder[1/]	40	86	66	2	1.5
Salmonberry	40	75	60	3	2.8
Western thimbleberry	40	82	78	6	3.0
Vine maple	40	87	15	4	1.6

1/ 60 percent of the red alder trees were dead.

SUMMARY AND RECOMMENDATIONS

Ten herbicides or combinations of herbicides were tested on red alder, salmonberry, western thimbleberry, vine maple, California hazel, and salal as high volume stem sprays. Results show that red alder, vine maple, and California hazel can be adequately controlled for release of Douglas-firs by budbreak sprays of 2,4,5-T applied in diesel oil. Silvex was slightly more effective than 2,4,5-T on vine maple and salal but less effective on red alder and California hazel. Salmonberry and western thimbleberry cannot be adequately controlled with budbreak sprays; foliage sprays are best on these two species (Gratkowski 1971, Stewart 1974). Budbreak sprays for control of salal must be further evaluated before they can be recommended.

Addition of dicamba to phenoxy herbicides generally increased degree of control, especially on salmonberry and California hazel. However, increased control was not sufficient for most species to justify the added cost.

Aerial spray tests suggest that dormant and budbreak applications of 1 to 1-1/2 lb ae dicamba plus 2 to 2-1/2 lb ae 2,4,5-T per acre can be useful for site preparation and preburn desiccation on areas dominated by red alder, salmonberry, and vine maple; this treatment should not be used on areas dominated by western thimbleberry. Combinations of dicamba and phenoxy herbicides should not be used in operational spraying until they have been further evaluated in aerial spray tests.

Effects of the 10 herbicides and combinations of herbicides are compared in table 9. This table can be used to estimate degree of control produced by selected treatments in pure- or mixed-species brush communities. Budbreak sprays must be applied after brush species show signs of growth (bud swelling or flowering) but before conifer growth begins in late winter or early spring. New leaves are readily killed by herbicidal sprays applied in diesel-oil carriers. Leaves also shield the stem and branches from direct application. Therefore, budbreak spraying should stop before one-fifth of the leaves of brush species are fully developed.

Table 9.--*Degree of control of budbreak sprays on six coastal brush species*

Herbicide[1/]	Estimated degree of control of:					
	Red alder[2/]	Salmonberry[2/]	Western thimbleberry[2/]	Vine maple[2/]	California hazel[2/]	Salal[3/]
2,4-D	92/90	--	--	--	--	19
Dichlorprop	70/70	100/40	100/0	46/30	98/0	55
2,4,5-T	100/100	99/10	100/10	100/80	100/40	47
Silvex	50/50	100/20	100/10	100/90	98/0	73
Dicamba	100/100	92/10	100/0	68/40	94/0	61
Dicamba + 2,4-D	100/100	83/20	100/0	38/10	100/30	43
Dicamba + dichlorprop	100/100	99/60	100/10	90/40	94/10	69
Dicamba + 2,4,5-T	90/90	96/60	100/10	100/90	100/50	65
Dicamba + silvex	100/100	90/20	100/20	100/60	100/70	75
2,4-D + dichlorprop	80/80	100/30	100/0	30/10	100/20	61

[1/] All herbicides applied at 1 lb aehg of diesel oil except on salal. Salal was treated at 2 lb ae in 200 gallons of diesel oil per acre.

[2/] Percentage topkill per percentage of plants dead.

[3/] Percent reduction in salal cover.

LITERATURE CITED

Gratkowski, H.
1970. Foliage sprays fail on salal. West. Soc. Weed Sci. Res. Prog. Rep. 1970: 18.

____
1971. Midsummer foliage sprays on salmonberry and thimbleberry. USDA For. Serv. Res. Note PNW-171, 5 p., illus. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

Lauterbach, P. G.
1961. Herbicides and their use in forest management in west side forests. *In* Herbicides and their use in forestry, p. 57-63. Oreg. State Univ., Corvallis.

Madison, Robert W., and Virgil H. Freed
1962. Basal treatments for control of salmonberry. Weeds 10(3): 247-248.

Ruth, Robert H.
1956. Plantation survival and growth in two brush-threat areas in coastal Oregon. USDA For. Serv. Pac. Northwest For. & Range Exp. Stn., Res. Pap. 17, 14 p. Portland, Oreg.

____
1957. Ten-year history of an Oregon coastal plantation. USDA For. Serv. Pac. Northwest For. & Range Exp. Stn. Res. Pap. 21, 15 p. Portland, Oreg.

Ryker, Russell A.
1970. Effects of dicamba and picloram on some northern Idaho shrubs and trees. USDA For. Serv. Res. Note INT-114, 6 p. Intermt. For. & Range Exp. Stn., Ogden, Utah.

Stewart, R. E.
1974. Foliage sprays for site preparation and release from six coastal brush species. USDA For. Serv. Res. Pap. PNW-172, 18 p., illus. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

Stewart, R. E.
1974. Budbreak sprays for site preparation and release from six coastal brush species. USDA For. Serv. Res. Pap. PNW-176, 20 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

For conifer release, budbreak sprays of 2,4,5-T applied in diesel oil carriers were effective on red alder, vine maple, and California hazel. Mixtures of dicamba with 2,4,5-T or 2,4,5-T alone are promising treatments for site preparation.

Keywords: Herbicides, brush control, Coniferae.

Stewart, R. E.
1974. Budbreak sprays for site preparation and release from six coastal brush species. USDA For. Serv. Res. Pap. PNW-176, 20 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

For conifer release, budbreak sprays of 2,4,5-T applied in diesel oil carriers were effective on red alder, vine maple, and California hazel. Mixtures of dicamba with 2,4,5-T or 2,4,5-T alone are promising treatments for site preparation.

Keywords: Herbicides, brush control, Coniferae.

Stewart, R. E.
1974. Budbreak sprays for site preparation and release from six coastal brush species. USDA For. Serv. Res. Pap. PNW-176, 20 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

For conifer release, budbreak sprays of 2,4,5-T applied in diesel oil carriers were effective on red alder, vine maple, and California hazel. Mixtures of dicamba with 2,4,5-T or 2,4,5-T alone are promising treatments for site preparation.

Keywords: Herbicides, brush control, Coniferae.

Stewart, R. E.
1974. Budbreak sprays for site preparation and release from six coastal brush species. USDA For. Serv. Res. Pap. PNW-176, 20 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

For conifer release, budbreak sprays of 2,4,5-T applied in diesel oil carriers were effective on red alder, vine maple, and California hazel. Mixtures of dicamba with 2,4,5-T or 2,4,5-T alone are promising treatments for site preparation.

Keywords: Herbicides, brush control, Coniferae.

PESTICIDE PRECAUTIONARY STATEMENT

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.

PROTECT

Use Pesticides Safely

FOLLOW THE LABEL

U.S. DEPARTMENT OF AGRICULTURE

GPO 990-615

The FOREST SERVICE of the U. S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.