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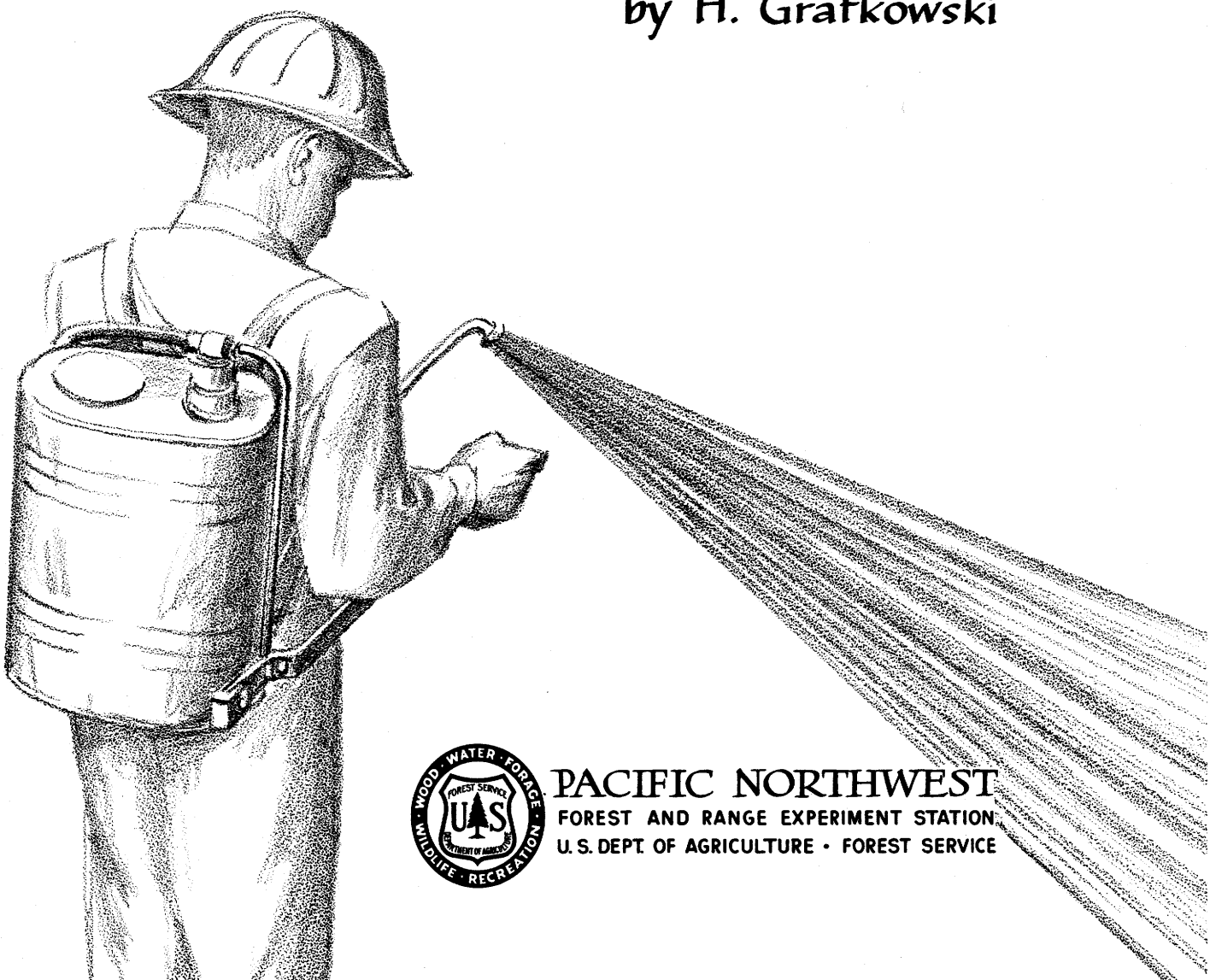
EFFECTS OF HERBICIDES on some IMPORTANT BRUSH SPECIES in SOUTHWESTERN OREGON

by H. Gratkowski



PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
U. S. DEPT. OF AGRICULTURE • FOREST SERVICE

SUMMARY

A series of screening tests were established during 1955 to determine the effects of six commercial and experimental herbicides on brush in southwestern Oregon. The herbicides were tested as foliage sprays on 13 of the most abundant species and varieties of brush on forest lands in this area. Low volatile esters of 2, 4-D and 2, 4, 5-T proved to be the most effective herbicides.

Results of the tests show that the 13 brush species and varieties can be classified into three categories on the basis of degree of susceptibility to foliage applications of herbicides: (1) highly susceptible, (2) moderately susceptible, and (3) resistant.

Highly susceptible. --Four species proved very susceptible to herbicides and were readily killed with low concentrations of 2, 4-D in water. Species in this group were hairy manzanita, hoary manzanita, Howell manzanita, and deerbrush ceanothus.

Moderately susceptible. --Aerial parts of 3 species and 1 variety were readily killed with chemicals, but relatively few of the shrubs were completely killed. Most of the treated plants resprouted the year after treatment. This group included greenleaf manzanita, snowbrush ceanothus, varnishleaf ceanothus, and mountain whitethorn ceanothus. 2, 4, 5-T was most effective on the ceanothus, whereas 2, 4-D was most effective on greenleaf manzanita.

Resistant. --Three species and two varieties proved resistant to herbicides. Only parts of the stems and branches died back after being sprayed with herbicides; none of the treated plants were killed. In the resistant group were golden chinkapin, golden evergreenchinkapin, scrub tanoak, saskatoon serviceberry, and canyon live oak. The chinkapins were most affected by 2, 4, 5-T. There was little difference, however, between the effects of 2, 4-D and 2, 4, 5-T on tanoak and serviceberry. On canyon live oak, 2, 4-D was more effective than 2, 4, 5-T.

A list of suggested spray solutions based on results of the screening tests are presented in tabular form on page 33.

Research Paper 31

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Siskiyou-Cascade Research Center

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CONTENTS

INTRODUCTION

Brushfields and brush encroachment on potentially productive sites have hampered land management in southwestern Oregon for a long time. Timber production on more than a million acres of commercial forest land in this area is reduced by dense stands of brush that exclude tree reproduction and compete with existing trees for available soil moisture and nutrients. The latest Forest Survey figures for the southwest Oregon unit classify 315,000 acres of this land as nonstocked burns and old cutovers,[1/] most of which are occupied by a dense cover of brush. Ranchers in this area are also troubled by brush, which invades and seriously reduces the grazing capacity of their pasture lands. Fire control efforts throughout southwestern Oregon are impeded by the dense brush. And, on all types of land, brush encroaches on roads, limiting their usefulness and requiring appreciable expenditures to keep them open.

In recent years, the use of herbicides for brush control has been increasing in southwestern Oregon despite a lack of adequate information to guide a choice of treatments. The herbicides are being used for roadside brush control, range and forest land reclamation, and release of conifer reproduction from competition of brush and undesirable tree species. The dearth of information concerning the effects of herbicides on native brush species, however, has seriously hampered the selection of proper treatments. The screening tests reported here may help fill this gap in existing information.

THE SCREENING TESTS

A series of tests were started in 1955 to learn the effects of six different herbicides when applied as midsummer foliage sprays on selected forest-land brush species in southwestern Oregon. The tests were an initial step in a research project attempting to develop

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[1/] Moravets, F. L. Forest statistics for southwest Oregon unit. U. S. Forest Serv. Pac. NW. Forest and Range Expt. Sta. Forest Survey Rpt. 104, 36 pp. 1951.

economical methods for reclamation of brushfields in this area. Thirteen of the most abundant brush species and varieties were selected for treatment and sprayed with various formulations of the herbicides during July and early August.

Species and Study Areas

Six of the species and varieties selected for treatment are abundant in the southern end of the Cascade Range; seven are important in the Coast Range and Siskiyou Mountains. Tests were installed in areas where the shrubs were especially abundant and vigorous. Brush species and varieties[2/] treated in the designated areas were:

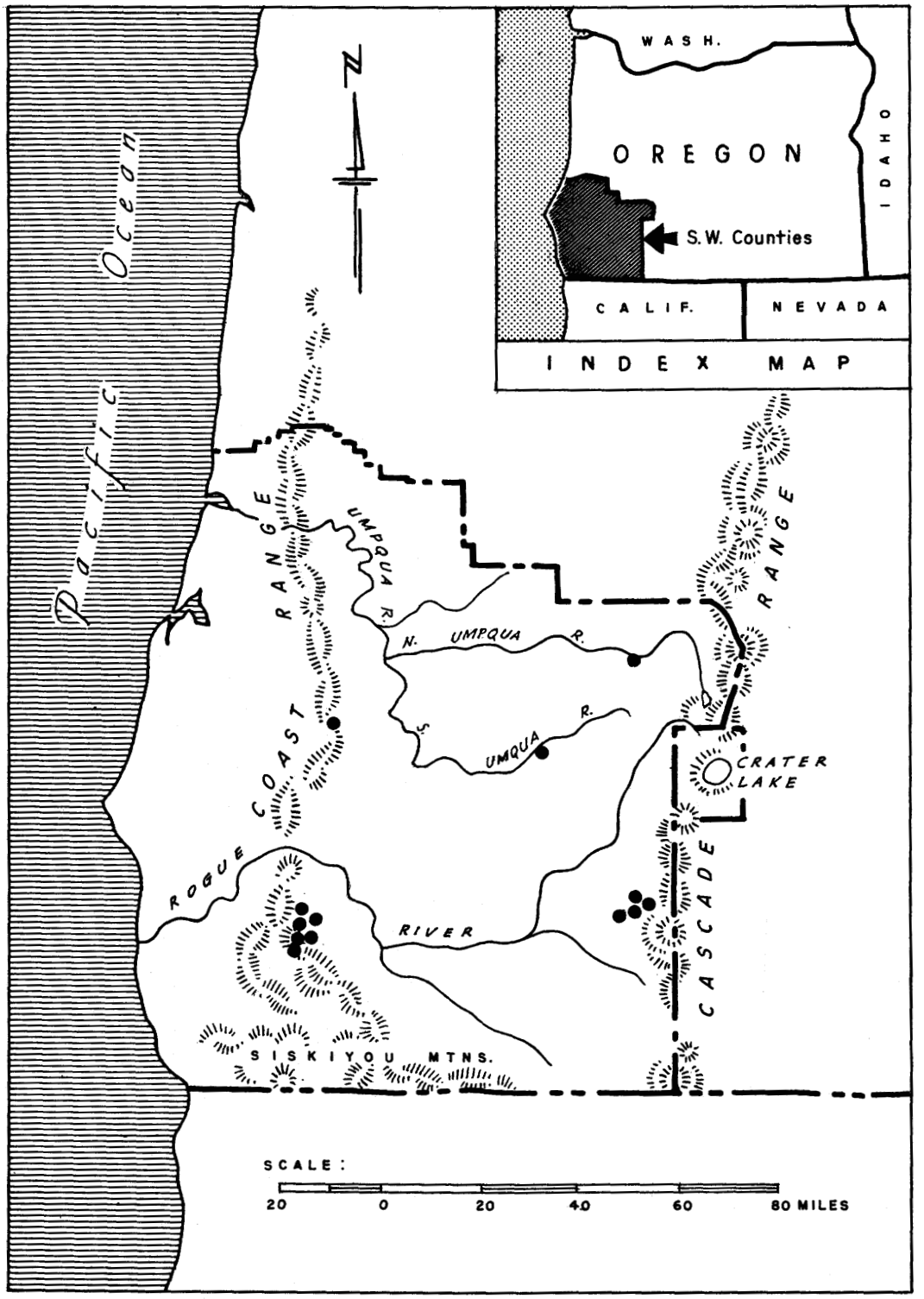
Cascade Range

1.	Howell manzanita	*Arctostaphylos hispidula*
2.	Deerbrush ceanothus	*Ceanothus integerrimus*
3.	Snowbrush ceanothus	*Ceanothus velutinus*
4.	Mountain whitethorn ceanothus	*Ceanothus cordulatus*
5.	Golden chinkapin	*Castanopsis chrysophylla*
6.	Saskatoon serviceberry	*Amelanchier alnifolia*

Coast Range and Siskiyou Mountains

7.	Hairy manzanita	*Arctostaphylos columbiana*
8.	Hoary manzanita	*Arctostaphylos canescens*
9.	Greenleaf manzanita	*Arctostaphylos patula*
10.	Varnishleaf ceanothus	*Ceanothus velutinus* var. *laevigatus*
11.	Golden evergreenchinkapin	*Castanopsis chrysophylla* var. *minor*
12.	Scrub tanoak	*Lithocarpus densiflorus* var. *montanus*
13.	Canyon live oak	*Quercus chrysolepis*

[2/] Common and scientific names are in accordance with Standardized Plant Names, 2nd ed., 1942, by Harlan P. Kelsey and William A. Dayton, except for golden chinkapin, which is in accordance with Check List of Native and Naturalized Trees of the United States (including Alaska), U. S. Dept. Agr. Handb. 41 (1953), by Elbert L. Little, Jr.



Location of herbicide test areas in southwestern Oregon.

Herbicides

Six different chemicals were included in the screening tests:

2, 4-D	2, 4-dichlorophenoxyacetic acid
2, 4, 5-T	2, 4, 5-trichlorophenoxyacetic acid
2-(2, 4-DP)	2-(2, 4-dichlorophenoxy) propionic acid
2-(2, 4, 5-TP)	2-(2, 4, 5-trichlorophenoxy) propionic acid
Amitrol	3-amino-1, 2, 4-triazole
2, 3, 6-TBA	A mixture of six isomers of trichlorobenzoic acid, mostly the 2, 3, 6-trichloro isomer

The chemicals[3/] were in several different forms. The first four listed above were low-volatile propylene glycol butyl ether esters in formulations containing 4 pounds acid equivalent per gallon. Amitrol was a fine white crystalline powder containing 50 percent active ingredient. The 2, 3, 6-TBA was a water solution of the sodium salt containing 1.5 pounds acid equivalent per gallon.

Methods

Treatments were carefully selected to suit the various brush species, and all herbicides were applied as foliage sprays to drip point.[4/] The herbicides were applied in water carriers or in oil-in-water emulsions containing 5 percent black diesel oil by volume. All solutions were applied as fine sprays with a 3-gallon knapsack-type sprayer.

2, 4-D and 2, 4, 5-T were considered the most promising herbicides and were subjected to the most intensive tests. Each formulation of 2, 4-D and 2, 4, 5-T was tested on 20 shrubs of each

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[3/] Technical advice and working samples of the four phenoxy herbicides were provided by R. N. Raynor of The Dow Chemical Co. Amitrol was furnished by the American Chemical Paint Co., and 2, 3, 6-TBA was contributed by the Heyden Chemical Corp. This cooperation is sincerely appreciated.

[4/] See "Terms and Abbreviations," inside back cover.

species or variety. Four additional chemicals were also considered potentially useful for killing brush in southwestern Oregon, and suitable formulations were prepared and tested on some species and varieties. These additional tests were exploratory in nature, and each formulation was usually sprayed on only 10 shrubs instead of 20. Nevertheless, the tests produced some useful information, and the results are included in the tables for the appropriate species or variety.

The sprayed plants were examined in September and October 1956, to determine the effects of the various herbicides; these data are presented in columns 4-8 of the tables showing effect of herbicides on each species or variety. A final examination was made in July 1957, to learn whether any additional plants had died. Column 9 shows percentage of plants dead at that time. Living plants were resprayed after the 1957 examination to determine the effect of repeated treatments.

EFFECTS OF HERBICIDES ON SPECIFIC SHRUBS

Effects of the herbicides on individual species and varieties are described in the pages that follow, and degree of susceptibility to herbicides is shown in parentheses opposite the name of each shrub. Species rated highly susceptible were readily killed with low concentrations of 2, 4-D in water. A rating of moderately susceptible indicates that aerial parts of the shrubs were readily killed with chemicals, but most of the treated plants resprouted. A rating of resistant means that only parts of the stems and branches died back after being sprayed with herbicides; none of the treated plants were killed.

Places where the various brush species and varieties have been observed are also described briefly in the following pages. Although this range data is incomplete, it may be of some assistance in identifying problem brush species in southwestern Oregon.

Several terms and abbreviations used in reporting the results of the screening tests are defined on the inside back cover.

HAIRY MANZANITA (Highly susceptible)

Hairy manzanita occurs in both the Coast and Cascade Ranges in southwestern Oregon. It is relatively common in the Coast Range in Douglas County and has been observed in both Coos and Curry Counties. Specimens have also been collected in the foothills of the Cascade Range in Douglas County. In all these areas, hairy manzanita usually occurs as scattered plants or in small groups intermixed with other brush species; it does not form extensive brushfields by itself. The species does not crown-sprout when the aerial parts are killed by fire or chemicals.

One hundred hairy manzanita shrubs near Camas Valley in the Coast Range were sprayed in mid-July. Stems were growing and new leaves were forming. Berries were full grown but not ripe.

Hairy manzanita was easily killed with a weak solution of 2, 4-D in water applied as a foliage spray. 2, 4-D proved more effective than 2, 4, 5-T on this species.

The relative value of the diesel oil emulsion as compared to a water carrier could not be determined from these tests, for all treatments killed the plants. However, a diesel oil emulsion was as effective as a water carrier with a 2-ahg solution of 2, 4-D and seemed to wet the pubescent foliage much more readily than the water carrier.

Table 1.--Effects of herbicides on hairy manzanita

Treatment			Total plants sprayed	Plants with basal sprouts	Basal sprouts per plant, by average number and average height		Percentage of kill	
Herbicide	Concentration[1/]	Carrier					Top	Complete plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Number	Percent	Number	Inches	Percent	Percent
2,4-D	1	Water	20	0	0	0	100	100
2,4-D	2	Water	20	0	0	0	100	100
2,4-D	2	5% DO	20	0	0	0	100	100
2,4,5-T	1	Water	20	0	0	0	79	90
2,4,5-T	2	Water	20	0	0	0	100	100

[1/] ahg; see "Terms and Abbreviations," inside back cover.

A hairy manzanita shrub killed with a weak solution of 2, 4-D in water.

HOARY MANZANITA (Highly susceptible)

Hoary manzanita is one of the most widespread species of manzanita in southwestern Oregon. It is an erect shrub with gray-green leaves and densely soft white-pubescent leaves and branchlets. This species is especially abundant in the high-elevation brushfields of the Siskiyou Uplands, but it is also common in the Cascade Range in eastern Douglas and Jackson Counties. Like hairy manzanita, it is usually found among other brush species as individual plants or in small clumps; no large pure stands of this species seem to develop in this area. The shrubs do not crown-sprout after fire or when the tops are killed with chemicals.

One hundred marked plants of hoary manzanita were sprayed early in July. Blossoming at this time was almost completed, some fruits were fully developed, and new leaves were beginning to unfold.

Hoary manzanita proved extremely susceptible to both 2, 4-D and 2, 4, 5-T applied as foliage sprays during the period of active growth in midsummer. Within the range of dosages tested, 2, 4-D was as effective as 2, 4, 5-T. Since 2, 4-D is less expensive than 2, 4, 5-T, the use of 2, 4-D is recommended for controlling this species.

The value of a diesel oil emulsion as compared to a water carrier could not be determined from these tests. Low concentrations of 2, 4-D in either carrier proved completely effective.

Table 2.--Effects of herbicides on hoary manzanita

Treatment			Total plants sprayed	Plants with basal sprouts	Basal sprouts per plant, by average number and average height		Percentage of kill	
Herbicide	Concentration[1/]	Carrier					Top	Complete plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Number	Percent	Number	Inches	Percent	Percent
2,4-D	1	Water	20	0	0	0	100	100
2,4-D	2	Water	20	0	0	0	100	100
2,4-D	2	5% DO	20	0	0	0	100	100
2,4,5-T	1	Water	20	0	0	0	97	85
2,4,5-T	2	Water	20	0	0	0	100	100

[1/] ahg; see "Terms and Abbreviations," inside back cover.

A typical shrub of hoary manzanita in the Siskiyou Uplands.

HOWELL MANZANITA (Highly susceptible)

A green-leaved manzanita, tentatively identified as Howell manzanita,[5/] is one of the most abundant manzanitas on the western slope of the Cascade Range in southwestern Oregon. Extensive relatively pure stands of the species have been found in eastern Jackson County, but it usually occurs in mixture with other brush species. Howell manzanita is one of the most important brush species in the 10,000-acre Cat Hill brushfield north of Mount McLoughlin. It has also been found in the Coast Range in Josephine County. Tests have shown that the shrubs do not crown-sprout when the tops are chopped off a few inches above the ground or when the aerial parts are killed with herbicides.

A series of 120 of these manzanita shrubs were sprayed in late July in the Cascade Range. New shoots on most of the plants were 2 to 3 inches long, whereas growth was just starting on others. The largest new leaves were almost full size, and the new berries were full grown.

Howell manzanita can be killed with either 2,4-D or 2,4,5-T, but 2,4-D is more effective and more economical. Although diesel oil emulsions were not pronouncedly more effective than water as a carrier for these herbicides, thorough coverage seemed more readily obtainable with the emulsions. Complete spray coverage of all foliage on the exterior of the crown is necessary, as foliage missed or sprayed too lightly remains alive for years afterward, even though the rest of the crown dies. However, flagged plants in the screening tests did not resprout from other stems or from root crowns, and competition to conifer reproduction probably was appreciably reduced. Thorough coverage will minimize or eliminate such flagging.

A small replicated minimum-dosage test was installed during 1956 to learn the least amount of 2,4-D required per acre to insure a satisfactory kill of this green-leaved manzanita. Preliminary results of the test indicate that the minimum dosage of 2,4-D is from 2 to 4 pounds acid equivalent per acre.

[5/] McMinn, Howard E. An illustrated manual of California shrubs. 663 pp. Berkeley. 1951. In the key for Arctostaphylos spp., this manzanita appears to best fit the description for Howell manzanita, Arctostaphylos hispidula Howell. Exact identity is in question.

Table 3.--Effects of herbicides on Howell manzanita

Treatment			Total plants sprayed	Plants with basal sprouts	Basal sprouts per plant, by average number and average height		Percentage of kill	
Herbicide	Concentration[1]	Carrier					Top	Complete plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Number	Percent	Number	Inches	Percent	Percent
2,4-D	1	Water	20	0	0	0	99	85
2,4-D	1	5% DO	20	0	0	0	97	80
2,4-D	2	Water	20	0	0	0	100	95
2,4-D	2	5% DO	20	0	0	0	99	100
2,4,5-T	2	Water	20	0	0	0	96	85
2,4,5-T	2	5% DO	20	0	0	0	95	95

[1] ahg; see "Terms and Abbreviations," inside back cover.

A mature shrub of Howell manzanita killed with 2, 4-D. The foliage was sprayed to drip point.

DEERBRUSH CEANOTHUS (Highly susceptible)

This deciduous species of Ceanothus with blue or white lilac-like flowers is one of the most widespread brush species in southwestern Oregon. It inhabits a variety of sites and soils in the Coast Range, the interior valleys, and the Cascade Range. Deerbrush occurs in many of the brushfields on forest lands but generally does not form extensive pure stands. The species is sometimes encountered as underbrush in lightly timbered areas. It is considered an excellent browse species.[6/] The shrubs stump-sprout after cutting[7/] and crown-sprout after the tops are killed with chemicals.

Numbered shrubs of deerbrush on the lower slopes of Mount McLoughlin in the Cascade Range were sprayed with herbicides in early August. When treated, the shrubs were in the late blossoming—early fruiting stage. Twig growth had ceased, and the new leaves were similar to the old in appearance.

Of the 4 chemicals tested on deerbrush, 2,4-D is recommended for application as a foliage spray. By the third summer after treatment, all 4 chemicals had killed 80 to 95 percent of the sprayed plants. The 2,4-D sprays, however, were the most economical and provided a degree of control equivalent to that obtained with the best of the other chemicals.

In the final examination 2 years after treatment, water proved more effective than a diesel oil emulsion as a carrier for 2,4-D on deerbrush. In earlier examinations the emulsion had appeared better.

6/ Dayton, William A. Important western browse plants. U. S. Dept. Agr. Misc. Pub. 101, 214 pp., illus. 1931.

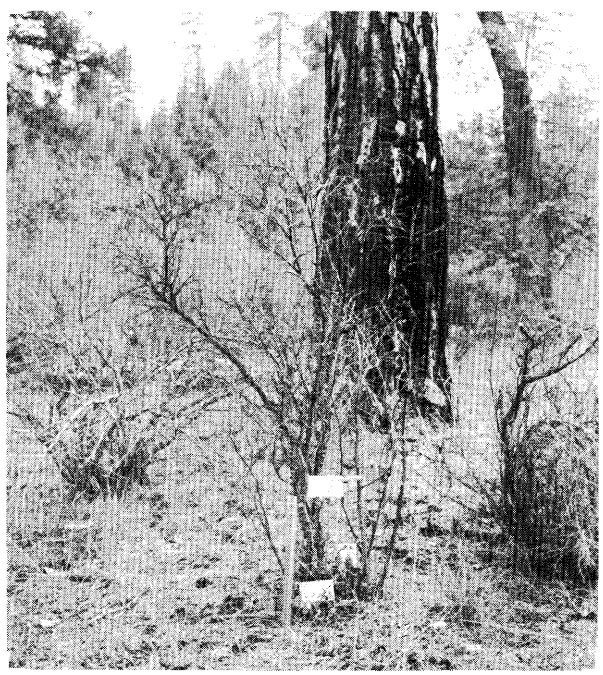
7/ McMinn, Howard E. An illustrated manual of California shrubs. 663 pp. Berkeley. 1951.

Table 4.--Effects of herbicides on deerbrush ceanothus

Treatment			Total plants sprayed	Plants with basal sprouts	Basal sprouts per plant, by average number and average height		Percentage of kill	
Herbicide	Concentration[1]	Carrier					Top	Complete plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Number	Percent	Number	Inches	Percent	Percent
2,4-D	1	Water	20	70	5	8	100	80
2,4-D	2	Water	20	60	6	10	100	90
2,4-D	2	5% DO	20	45	7	14	100	80
2,4,5-T	2	Water	20	75	4	11	100	85
Amitrol	2/4	Water	20	40	5	4	98	95
2,3,6-TBA	2	Water	10	78	5	10	95	80
2,4-D plus Amitrol	1 + 2/4	Water	10	100	7	15	100	30

[1] ahg, except for Amitrol. See footnote 2.

[2] lbs.; see "Terms and Abbreviations," inside back cover.



Although this shrub of deerbrush ceanothus produced basal sprouts a year after being sprayed with 2,4-D, it died later.

GREENLEAF MANZANITA (Moderately susceptible)

Greenleaf manzanita is by far the most important species of manzanita in the Coast Range and Siskiyou Mountains. Its importance stems not only from its widespread occurrence but also from its resistance to control. This manzanita is a major component of mixed brushfields in both areas, and extensive relatively pure stands of the species are not uncommon. It has not yet been found by the writer in the Cascade Range.

Greenleaf manzanita forms a conspicuous burl at the root crown. When the aerial parts of the shrub are killed by fire, cutting, or chemicals, new shoots develop from dormant buds in the burl.

One hundred and twenty mature shrubs were sprayed with herbicides in early July. Twig growth was in progress, the new leaves were all sizes, and the fruits were full grown but not ripe.

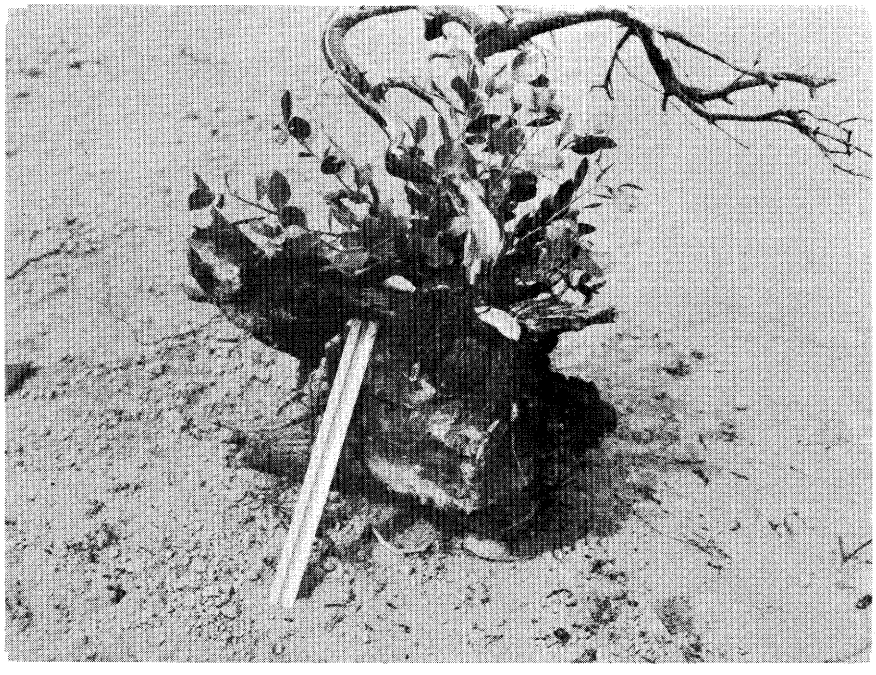
Greenleaf manzanita proved moderately resistant to foliage sprays of 2, 4-D and 2, 4, 5-T applied during this stage of development. Aerial parts of the shrubs were readily killed by the herbicides, but most of the plants resprouted from burls.

Low-volatile esters of 2, 4-D were more effective than 2, 4, 5-T on this manzanita. A water carrier was as effective as a diesel oil emulsion, but the emulsion seemed to wet the foliage more readily and completely. Since 2, 4-D is not only more effective but also costs less than 2, 4, 5-T, the use of 2, 4-D is recommended for controlling greenleaf manzanita.

Table 5.--Effects of herbicides on greenleaf manzanita

Treatment			Total plants sprayed	Plants with basal sprouts	Basal sprouts per plant, by average number and average height		Percentage of kill	
Herbicide	Concentration[1/]	Carrier					Top	Complete plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Number	Percent	Number	Inches	Percent	Percent
2,4-D	2	Water	20	70	M	5	95	15
2,4-D	4	Water	20	90	M	7	96	10
2,4-D	2	5% DO	20	75	M	2	91	20
2,4,5-T	1	Water	20	100	M	6	89	0
2,4,5-T	2	Water	20	100	M	7	84	0
2,4,5-T	1	5% DO	20	95	M	5	90	5

[1/] ahg; see "Terms and Abbreviations," inside back cover.



This greenleaf manzanita sprouted from burls at the root crown after the aerial parts were killed with herbicides.

SNOWBRUSH CEANOTHUS (Moderately susceptible)

Snowbrush ceanothus is common above elevations of 2,500 feet in the Cascade Range in southwestern Oregon, where it is sometimes called "slick-leaf ceanothus" or "sticky laurel." It is a major component of many brushfields at high elevations and is often especially abundant on clearcuts where logging slash has been burned. The shrubs stump-sprout when aerial parts are killed with chemicals.

Five herbicides were screened on snowbrush ceanothus in the Cascade Range. When sprayed in late July, a few late blossoms were still present and stems were growing. Most of the new leaves were smaller than the older leaves.

Of the commercially available herbicides, 2,4,5-T was most effective on snowbrush. Although other chemicals also killed aerial parts of the shrubs, 2,4,5-T was more effective in killing roots. In addition, crown sprouts were least abundant on the shrubs sprayed with low-volatile esters of 2,4,5-T.

Table 6.--Effects of herbicides on snowbrush ceanothus

Treatment			Total plants sprayed	Plants with basal sprouts	Basal sprouts per plant, by average number and average height		Percentage of kill	
Herbicide	Concentration[1]	Carrier					Top	Complete plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Number	Percent	Number	Inches	Percent	Percent
2,4-D	2	5% DO	20	85	M	20	96	20
2,4-D	4	5% DO	20	90	M	19	100	20
2,4,5-T	2	5% DO	19	80	F	18	100	30
2,4,5-T	4	5% DO	20	75	F	18	100	40
2-(2,4-DP)	2	5% DO	10	80	M	20	99	50
2-(2,4,5-TP)	2	5% DO	10	100	M	23	100	0
Amitrol	8[2]	Water	10	50	F	9	32	0
2-(2,4-DP) plus Amitrol	2 + 4[2]	Water	10	70	F	12	97	70

[1] ahg, except for Amitrol. See footnote 2.

[2] lbs.; see "Terms and Abbreviations," inside back cover.

Stunted, chlorotic sprouts developed on this snowbrush ceanothus sprayed with a mixture of Amitrol and 2-(2,4-DP), but the plant died the following year.

VARNISHLEAF CEANOTHUS (Moderately susceptible)

Varnishleaf ceanothus is usually considered a coastal variety of snowbrush ceanothus.[8/] From California, it extends northward in the mountains along the coast through Oregon and Washington to British Columbia. Large specimens of this ceanothus have been observed in the Siskiyou Uplands southwest of Grants Pass, where it attains heights of 10 to 15 feet with stems up to 5 inches in diameter at the base. In southwestern Oregon, varnishleaf ceanothus is also found at lower elevations in the Cascades, where its range may merge in some places with that of snowbrush ceanothus. Relatively pure stands of varnishleaf ceanothus occupy many burned-over clearcuts in the North Umpqua drainage east of Roseburg.

Like snowbrush ceanothus, varnishleaf ceanothus is often called "slick-leaf ceanothus" or "sticky laurel" in southwestern Oregon; and, generally, foresters make no distinction between the species (snowbrush) and the variety (varnishleaf). Both forms develop a large number of fast-growing stump sprouts after cutting and they crown-sprout when the tops are killed with chemicals.

Large, mature shrubs of varnishleaf ceanothus in the Siskiyou Uplands were sprayed with 8 different solutions of 5 herbicides. The shrubs were sprayed early in July when they were in full blossom, stems were growing, and some of the new leaves had attained full size.

2, 4, 5-T was by far the most effective of the herbicides tested on varnishleaf ceanothus. The 4-ahg solution of 2, 4, 5-T proved very effective; all aerial parts were killed on the 20 plants treated with this solution and 70 percent of the shrubs did not sprout again. Two years after treatment, 85 percent of the shrubs in this treatment were dead. None of the other herbicides approached the effectiveness of 2, 4, 5-T.

In spite of its large and formidable appearance, varnishleaf ceanothus in the Coast Range sprouted far less vigorously than snowbrush ceanothus in the Cascade Range after treatment with herbicides.

8/ See footnote 7, page 12.

Table 7.--Effects of herbicides on varnishleaf ceanothus

Treatment			Total plants sprayed	Plants with basal sprouts	Basal sprouts per plant, by average number and average height		Percentage of kill	
Herbicide	Concentration[1]	Carrier					Top	Complete plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Number	Percent	Number	Inches	Percent	Percent
2,4-D	2	5% DO	20	55	F	7	74	45
2,4-D	4	5% DO	20	80	F	15	88	40
2,4,5-T	2	5% DO	20	40	F	21	93	65
2,4,5-T	4	5% DO	20	30	F	14	100	85
2-(2,4-DP)	2	5% DO	10	60	F	8	60	30
2-(2,4,5-TP)	2	5% DO	10	40	F	19	88	60
Amitrol	8[2]	Water	10	70	F	7	32	0
2-(2,4-DP) plus Amitrol	2 + 4[2]	Water	10	50	F	7	72	50

[1] ahg, except for Amitrol. See footnote 2.

[2] lbs.; see "Terms and Abbreviations," inside back cover.

Varnishleaf ceanothus killed with 2, 4, 5-T in a diesel oil emulsion.

MOUNTAIN WHITETHORN CEANOTHUS

(Moderately susceptible)

Mountain whitethorn ceanothus occurs in high-elevation brushfields in the Coast Range, Cascade Range, and Siskiyou Mountains of southwestern Oregon. Small groups of a spreading, procumbent form are common in the evergreen brushfields of the Siskiyou Uplands. The seeds germinate copiously after fire; and a taller, more erect form of this spiny shrub is abundant in broadcast-burned, clear-cut settings on pumice soils near Diamond Lake in the Cascade Range. Mountain whitethorn sprouts prolifically after the tops are cut off or killed with chemicals.

Four herbicides were tested on mature mountain whitethorn bushes on pumice soil in the Cascade Range. When the shrubs were sprayed in early August, a few late flowers were still blooming, seed capsules were developing, and stems were growing on all plants.

2, 4, 5-T was the most effective herbicide tested on mountain whitethorn, but root kill was poor even with this chemical. Basal sprouts were abundant and vigorous in all treatments. A diesel oil emulsion was no better than water as a carrier for 2, 4-D on this species.

When the screening tests were installed, a series of 1/100th-acre plots were also sprayed with each of the 4 herbicides in water at a rate of 2 pounds acid equivalent per acre. In addition, two more plots were sprayed with 2, 4-D and 2, 4, 5-T in diesel oil emulsions. There was no replication of treatments.

Results of the plot tests verified the results of the individual plant tests. 2, 4, 5-T again proved more effective than the other chemicals, but sprouting occurred in all treatments. As in the tests on staked plants, a diesel oil emulsion was no more effective than water as a carrier for 2, 4-D. The emulsion was somewhat more effective than water as a carrier for 2, 4, 5-T, however.

Table 8.--Effects of herbicides on mountain whitethorn ceanothus

Treatment			Total plants sprayed	Plants with basal sprouts	Basal sprouts per plant, by average number and average height		Percentage of kill	
Herbicide	Concentration[1]	Carrier					Top	Complete plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Number	Percent	Number	Inches	Percent	Percent
2,4-D	1	Water	20	100	M	27	100	0
2,4-D	2	Water	20	95	M	28	100	5
2,4-D	1	5% DO	20	100	M	26	100	0
2,4,5-T	2	Water	20	80	M	27	100	20
Amitrol	2/4	Water	19	100	M	15	88	0
2-(2,4-DP)	2	Water	10	100	M	28	100	0
2,4-D plus Amitrol	1 + 2/1	Water	10	100	M	26	99	0

[1] ahg, except for Amitrol. See footnote 2.

[2] lbs.; see "Terms and Abbreviations," inside back cover.

Table 9.--Effects of herbicides on mountain whitethorn ceanothus in 1/100th-acre plots[1]

Treatment			Plants with basal sprouts	Basal sprouts per plant, by average number and average height		Percentage of kill	
Herbicide	Amount[2]	Carrier				Top	Complete plant
			Percent	Number	Inches	Percent	Percent
2,4-D	2	Water	100	M[3]	29	100	0
2,4-D	2	5% DO[3]	100	M	28	100	0
2,4,5-T	2	Water	100	M	24	98	0
2,4,5-T	2	5% DO	90	M	23	100	10
2-(2,4-DP)	2	Water	100	M	23	98	0
Amitrol	4/4	Water	--	-	--	(5/)	0

[1] The herbicides were applied as foliage sprays in August 1955. Results were determined by examining 10 plants on each plot in October 1956.

[2] Pounds acid equivalent per acre, except for Amitrol. See footnote 4.

[3] See "Terms and Abbreviations," inside back cover.

[4] Pounds dry commercial preparation per acre.

[5] Not effective enough to be rated.

GOLDEN CHINKAPIN (Resistant)

Golden chinkapin is common on forest lands in southwestern Oregon. The species varies greatly in habit and is often found both as a shrub and a tree in the same area. Golden chinkapin often occurs as understory brush in stands of conifers in the Cascade Range, where it assumes a habit intermediate between a shrub and a tree. In the understory it grows in a clumpwise fashion similar to vine maple, and each clump sometimes develops one or more main stems that are treelike in form. Smaller stems develop from roots near the main stems. Golden chinkapin trees of good form are found in both the Cascade Range and the Siskiyou Uplands.

Eight formulations of herbicides were tested on an understory form of chinkapin in the Cascade Range. When the shrubs were sprayed in late July, growth was still in progress and many of the new leaves were full size.

Sixteen months after spraying, responses to all treatments were similar. All treatments affected the aerial parts to some extent, but none were very effective in killing roots of the treated plants. A great variation in top kill within treatments indicates that there are no important differences between treatments. However, a few opinions concerning the relative effectiveness of the chemicals may be of some value.

The 2-ahg solution of 2, 4, 5-T is considered the most promising of the formulations tested on golden chinkapin. Increasing the concentration of 2, 4, 5-T from 2 ahg to 4 ahg did not increase its effect. Evidently the dosage of 2, 4, 5-T was near its effective practical maximum when foliage was sprayed to drip point with the milder solution.

Amitrol in mixture with the propionates shows some promise for use on this species. The mixture of Amitrol and 2-(2, 4-DP) was the most effective formulation tested. At present, however, Amitrol in combination with other chemicals is not recommended for widespread use on golden chinkapin. Additional tests must be made to determine the value of such mixtures.

Table 10.--Effects of herbicides on golden chinkapin

Treatment			Total plants sprayed	Plants with basal sprouts	Basal sprouts per plant, by average number and average height		Percentage of kill	
Herbicide	Concentration[1]	Carrier					Top	Complete plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Number	Percent	Number	Inches	Percent	Percent
2,4-D	2	5% DO	20	80	M	13	38	0
2,4-D	4	5% DO	20	100	M	13	54	0
2,4,5-T	2	5% DO	20	100	M	12	61	0
2,4,5-T	4	5% DO	20	100	M	12	61	0
2-(2,4-DP)	2	5% DO	10	90	M	11	51	0
2-(2,4,5-TP)	2	5% DO	10	90	M	14	58	0
Amitrol	[2]8	Water	10	40	M	6	42	0
2-(2,4-DP) plus Amitrol	2 + [2]4	Water	10	80	M	9	77	10

[1] ahg, except for Amitrol. See footnote 2.

[2] lbs.; see "Terms and Abbreviations," inside back cover.

GOLDEN EVERGREENCHINKAPIN (Resistant)

Castanopsis chrysophylla var. minor, a shrubby variety of golden chinkapin, is abundant in the evergreen brushfields of the Siskiyou Uplands. It is found at higher elevations and in more xerophytic habitats than golden chinkapin.[9/] This shrub is a major component of the evergreen chaparral, and relatively pure stands are found as an open cover on many of the dry slopes in the mountains of western Josephine County. The shrubs sprout from the stumps and root crowns after fire, cutting, or treatment with herbicides.

Golden evergreenchinkapin was sprayed with herbicides in mid-July while growth was in progress.

Results of the herbicide tests on this shrubby variety of golden chinkapin were unsatisfactory 16 months after spraying. Aerial parts were killed back to some extent by all treatments, but none of the treatments killed the roots of the sprayed plants. However, a few items are worth considering:

As on golden chinkapin in the Cascade Range, 2, 4, 5-T was the most effective chemical when judged on the basis of average amount of top kill at the end of the second growing season. Increasing the concentration of 2, 4, 5-T in the solution beyond 2 pounds acid equivalent per 100 gallons had no effect on amount of top or root kill. Again, as on the species in the Cascade Range, the dosage of 2, 4, 5-T was evidently near an effective maximum for practical rates of application when the shrubs were thoroughly sprayed with the 2-ahg solution.

None of the other herbicides in the test are considered as good as 2, 4, 5-T for use on golden evergreenchinkapin. Early results with Amitrol looked promising on some plants, but the shrubs recovered later. The mixture of Amitrol and 2-(2, 4-DP) which showed promise on golden chinkapin was ineffective on this shrubby variety in the Siskiyou Uplands.

[9/] See footnote 7, page 12.

Table 11.--Effects of herbicides on golden evergreenchinkapin

Treatment			Total plants sprayed	Plants with basal sprouts	Basal sprouts per plant, by average number and average height		Percentage of kill	
Herbicide	Concentration[1]	Carrier					Top	Complete plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Number	Percent	Number	Inches	Percent	Percent
2,4-D	2	5% DO	20	100	M	12	58	0
2,4-D	4	5% DO	20	100	M	11	70	0
2,4,5-T	2	5% DO	20	100	M	10	67	0
2,4,5-T	4	5% DO	20	100	M	10	68	0
2-(2,4-DP)	2	5% DO	10	100	M	8	62	0
2-(2,4,5-TP)	2	5% DO	10	80	M	7	44	0
Amitrol	8[2]	Water	10	40	F	3	61	0
2-(2,4-DP) plus Amitrol	2 + 4[2]	Water	10	100	M	11	27	0

[1] ahg, except for Amitrol. See footnote 2.

[2] lbs.; see "Terms and Abbreviations," inside back cover.

Stunted, chlorotic sprouts developed on this golden evergreenchinkapin after the aerial parts were killed with Amitrol. Two years after treatment, the sprouts had regained normal color.

SCRUB TANOAK (Resistant)

Scrub tanoak is another of the many undesirable evergreen shrubs on forest lands in southwestern Oregon. This shrub is a variety (montanus) of tanoak (Lithocarpus densiflorus), one of the better formed hardwood trees in the region. Both the species and the variety are major components of brushfields in the relatively inaccessible interior of the Oregon Coast Range. In the Siskiyou Uplands near Grants Pass, however, scrub tanoak appears to be quite tolerant and is most abundant as an understory shrub in open stands of forest trees or in the moderate shade of partially cut stands.

One hundred and twenty plants were sprayed in mid-July. The shrubs were growing, and many new leaves had attained full size. The pubescent new foliage was difficult to wet with water sprays.

Scrub tanoak proved resistant to both 2, 4-D and 2, 4, 5-T applied as foliage sprays in mid-July. Although the aerial parts died back halfway to the ground, stem sprouts developed on the living lower parts of the stems, and basal sprouts were almost invariably produced by the treated plants.

Within the range of concentrations tested, 2, 4-D was about as effective as 2, 4, 5-T. Increasing the concentration of the chemicals from 2 ahg to 4 ahg in the emulsion carrier did not appreciably change extent of top kill. Evidently the dosages of both 2, 4-D and 2, 4, 5-T were already near their effective practical maximum with the 2-ahg solutions applied to drip point.

The diesel oil emulsion was more effective than a water carrier with both 2, 4-D and 2, 4, 5-T on scrub tanoak. Top kill with a 2-ahg concentration of 2, 4-D was about 65 percent greater in an emulsion carrier than in a water carrier; the effectiveness of a similar concentration of 2, 4, 5-T increased almost 35 percent.

Table 12.--Effects of herbicides on scrub tanoak

Treatment			Total plants sprayed	Plants with basal sprouts	Basal sprouts per plant, by average number and average height		Percentage of kill	
Herbicide	Concentration[1]	Carrier					Top	Complete plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Number	Percent	Number	Inches	Percent	Percent
2,4-D	2	Water	20	95	M	10	40	0
2,4-D	2	5% DO	20	100	M	11	66	0
2,4-D	4	5% DO	20	100	M	14	55	0
2,4,5-T	2	Water	20	95	M	12	43	0
2,4,5-T	2	5% DO	20	100	M	12	58	0
2,4,5-T	4	5% DO	20	100	M	12	63	0

[1] ahg; see "Terms and Abbreviations," inside back cover.

TERMS AND ABBREVIATIONS

Several terms and abbreviations have been used in reporting the results of the screening tests. For more convenient reference and to eliminate the need for long and repetitious footnotes in text and tables, these terms and abbreviations are defined here:

	Definition
Siskiyou Uplands	Refers to upland areas of the Siskiyou Mountains and the area west of Grants Pass where the Coast Range and Siskiyou Mountains meet.
Drip point	Foliage of each shrub was sprayed with the selected solution of herbicides until all leaves had been treated and spray solution was running off and dripping from approximately one-half of the individual leaves.
ahg	Amount of liquid herbicide in pounds acid equivalent per 100 gallons of spray solution.
lbs.	Weight of dry herbicide in pounds of commercial preparation per 100 gallons of spray solution.
5% DO	An oil-in-water emulsion containing 5 percent black diesel oil by volume.
F or M--in table or column indicating average number of basal sprouts per plant (on those plants still alive at time of examination).	"F" indicates number of basal sprouts less than original number of stems originating at ground level; "M", number of basal sprouts equal to or more than original number of stems at ground. (Numerals in this column indicate actual numbers of basal sprouts.)