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ABSTRACT: Ohia trees less than 6 inches d.b.h. on the island of Hawaii were killed by injection of undiluted 2,4,5-T ester. This chemical was less effective on larger trees. Injections applied in September and January were more effective than the May applications. Injections of 2,4-D were relatively ineffective, any season of the year, even for small trees. Tordon 22K proved 100 percent effective in a single, unreplicated trial.

Controlling Cull Ohia Trees by Injecting Herbicides

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Ohia (*Metrosideros collina* [Forst.] Gray) is the most abundant native tree species in Hawaii both in terms of volume and acreage (Degener 1930). Found throughout Polynesia, it occurs to some extent on all of the Hawaiian Islands at elevations from 100 to 9,000 feet (Margolin 1910). Nelson and Wheeler (1963) found that the ohia forest type[1] occupies about three-fourths of Hawaii's commercial forest land. Unfortunately, cull trees account for about one-half of the net wood volume. The poor form of ohia is largely responsible for this high proportion of cull timber.

Injecting undiluted herbicides into tree trunks is an effective and efficient technique for eliminating cull trees or other undesirable hardwoods (Peevy 1963; Starr 1963). Season of treatment is an important consideration. Shipman (1958) reported that treatments applied during the growing season killed more hardwood species than at any other time. Other species can be controlled more effectively if treated during fall or winter (Leonard 1955). The degree of control is apparently closely related to tree size. Large trees are usually more difficult to kill than small trees (Brinkman 1960).

In a study near Laupahoehoe on the island of Hawaii, I found that stem injection of undiluted 2,4,5-T can help control ohia trees up to 6 inches d.b.h., at any season of the year. Better control of trees 6 to 12 inches in diameter was achieved with injections of 2,4,5-T in September or January. Treatments in May were less successful. Injection of trees larger than 12 inches in diameter resulted in less than 75 percent crown kill, which may not be satisfactory. Undiluted Tordon 22K was more effective on ohia trees than was 2,4,5-T. Injection of 2,4-D resulted in less than 35 percent crown kill, which is probably not effective enough.

Further tests will be required to determine the most efficient means of eliminating cull ohia trees by stem injection. Other herbicides may be effective with fewer and more widely spaced injections. And other methods of individual stem treatment, such as basal spraying and frilling, deserve investigation.

Methods

The study site is situated on the northeastern slopes of Mauna Kea at an

[1] Native forests in which ohia is predominant and comprises 25 percent or more of the stand, and koa (*Acacia koa*) less than 25 percent.

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elevation of 2,500 feet. Annual precipitation is about 140 inches. Average temperature is 70°F. Ages of the study trees are not known.

The trees were divided into three diameter classes:

Diameter class	Actual d.b.h. range
Small < 6 inches	1 - 5 inches
Medium 6 - 12 inches	6 - 12 inches
Large >12 inches	12 - 43 inches

In September 1964 and in January and May 1965, five randomly chosen trees in each diameter class were injected with undiluted 2,4-D[2]; five with undiluted 2,4,5-T[3] and five left untreated as controls, making a total of 135 trees in the study.

The herbicides were applied with a Jim-Gem[4] tree injector calibrated to dispense 0.5 milliliters of herbicide per injection. The poor basal form of most ohia made it difficult to use evenly spaced injection cuts. For this reason we based the number of injection cuts per tree on its diameter, breast height, averaging one cut per 1.5 inches of tree diameter. The injections were spaced around each tree as evenly and as close to the ground as possible.

A smaller trial was made in the Waiakea Forest Reserve on the east slope of Mauna Loa, in October 1964. Elevation of this study area is about 2,800 feet. Precipitation and temperature are similar to that at the Laupahoehoe site. Age of this ohia stand is not known. We designated two size classes based on tree diameter: small (< 12 inches d.b.h.) and large (12 inches d.b.h. and greater). A total of 16 trees were treated. In each size class, two trees were injected with 2,4-D amine, 2,4,5-T ester, and undiluted Tordon 22K[5], respectively; and two untreated trees served as controls.

Study trees were observed at 6-month intervals after treatment. Other periodic observations were made to determine the immediate response of ohia trees to herbicide injection. Observations taken included the percent of crown kill achieved to the nearest 10 percent and the presence or absence of sprouting.

Results

Herbicide

The herbicide 2,4,5-T was effective at both study sites (fig. 1). Its effects were visible on ohia within 1 month of treatment, and most crown kill occurred within 6 months. Most of the crown kill that occurred was complete 1 year after treatment. 2,4,5-T caused an average crown kill of 74 percent at Laupahoehoe (table 1) and 100 percent crown kill at the Waiakea site (table 2).

The 2,4-D treatment was not effective. An average crown kill of only 33 percent was achieved at Laupahoehoe, while no crown kill was recorded at Waiakea.

The Tordon 22K injections, although unreplicated in time or place, produced noteworthy results. Within 6 months there was 100-percent crown kill of tested trees at the Waiakea study site. One large tree died in less than 30 days.

[2]Amine form of 2,4-Dichlorophenoxyacetic acid at 4 pounds of acid equivalent per gallon.

[3]Butoxy ethanol ester form of 2,4,5-Trichlorophenoxyacetic acid at 4 pounds of acid equivalent per gallon.

[4]Mention of trade names and commercial products is solely for necessary information. No endorsement by the U.S. Department of Agriculture is implied.

[5]4-Amino-3,5,6-trichloropicolinic acid at 2 pounds of acid equivalent per gallon.

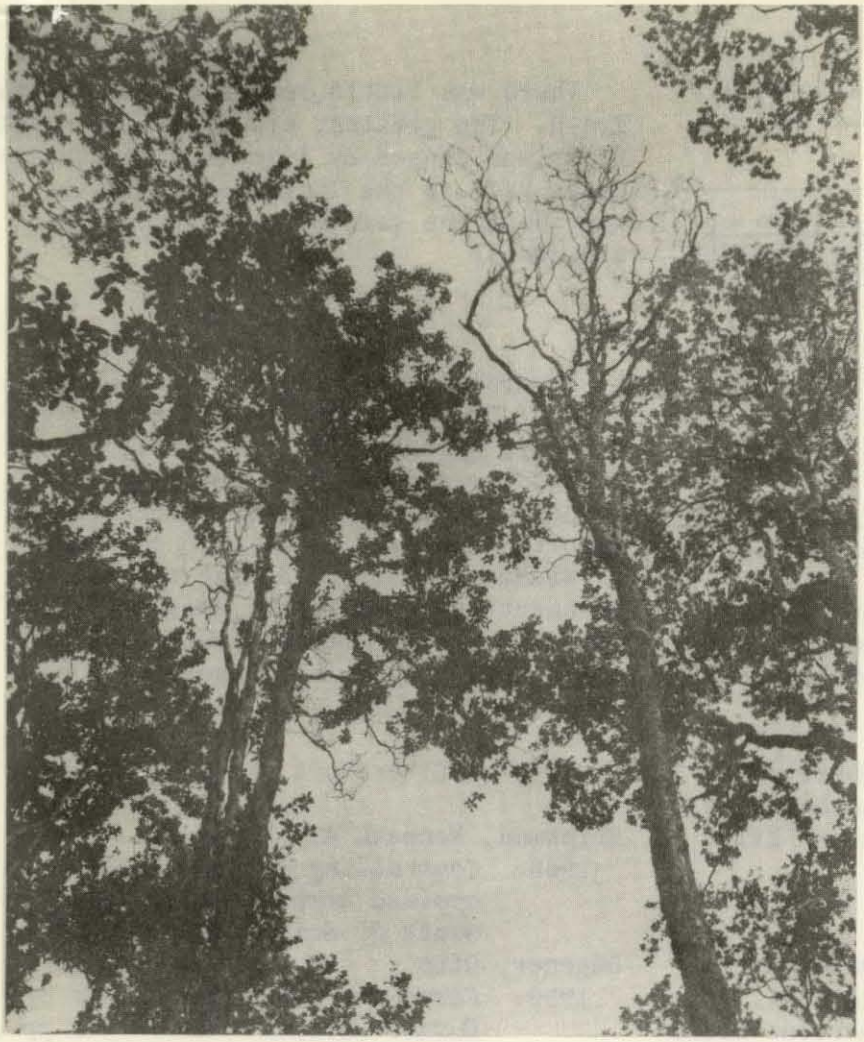

Figure 1.--The herbicide 2,4,5-T has completely killed the tree on the right. The tree on the left was treated with 2,4-D at the same time.

Table 1.--*Effect of 2,4,5-T and 2,4-D injections on ohia after 1 year, by size classes and season of treatment, Laupahoehoe, Hawaii, 1964 (basis: 135 trees)*

Herbicide	Tree size	Degree of crown kill[1]						All
		September		January		May		
		Average	Range	Average	Range	Average	Range	av.
	In.	*Percent*						
2,4,5-T ester	< 6	100	--	100	--	80	50-100	93
2,4,5-T ester	6-12	86	50-100	98	90-100	46	10- 90	77
2,4,5-T ester	> 12	72	20-100	76	40-100	12	0- 60	53
	All	86		91		46		74
2,4-D Amine	< 6	52	20-100	76	20-100	56	20-100	61
2,4-D Amine	6-12	34	0-100	16	0- 80	36	10- 70	29
2,4-D Amine	> 12	0	--	16	0- 70	10	0- 40	9
	All	29		36		34		33
Control	< 6	0	--	0	--	0	--	0
Control	6-12	0	--	0	--	0	--	0
Control	> 12	0	--	0	--	0	--	0
	All	0		0		0		0

[1]Summary of individual tree observations.

Table 2.--*Response of ohia trees to herbicide injection, Waiakea Forest Reserve, 1964, (basis: 16 trees)*

Herbicide	Tree size	Degree of crown kill[1]	
		6 months	12 months
	Inches	*Percent*	
2,4,5-T	< 12	80	100
2,4,5-T	12+	90	100
Tordon 22K	< 12	100	100
Tordon 22K	12+	100	100
2,4-D	< 12	0	0
2,4-D	12+	0	0
Control	< 12	0	0
Control	12+	0	0

[1]Summary of individual tree observations.

Untreated trees showed no signs of injury or defoliation throughout the duration of the study at either location.

No sprouting has been observed on any of the study trees, whether with complete or only partial crown kill.

Tree size

The herbicide 2,4,5-T was most effective on small trees (table 1). An average crown kill of 93 percent occurred in trees less than 6 inches d.b.h. Crown kill of medium and large trees was proportionately less.

The degree of crown kill achieved by 2,4-D was also related to tree size. The greatest crown kill occurred in the small-size class. Less crown kill occurred in the medium- and large-size classes.

Tordon 22K, in an unreplicated test, appeared equally effective on both large and small trees (table 2).

Season

Good control of ohia trees up to 6 inches d.b.h. was achieved with 2,4,5-T at all seasons of treatment (table 1). But better control of larger trees occurred from injections in September and January.

There was little seasonal effect with 2,4-D. The greatest crown kill of small trees was caused by injection in January. Crown kill in the larger size classes was about the same from treatments at all dates.

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Literature Cited

Brinkman, Kenneth A.
1960. *Controlling oaks with stem-applied herbicides.* Iowa State J. Sci. 34(4): 613-622.

Degener, Otto.
1930. *Ferns and flowering plants of Hawaii National Park.* 312 pp., illus. Honolulu: Honolulu Star Bulletin, Ltd.

Leonard, O. A.
1955. *Some observations on new chemicals for woody plant control and some factors influencing success with cut-surface treatments for killing trees.* Calif. Weed Conf. Proc. 7: 94-100.

Margolin, Louis.
1910. *The closer utilization of ohia lumber.* The Hawaiian Forester & Agr. 7(4): 118-126.

Nelson, Robert E., and Wheeler, Philip R.
1963. *Forest resources of Hawaii-1961.* Hawaii Dep. Land & Natural Resources, and U.S. Forest Serv. Pacific SW. Forest & Range Exp. Sta., Honolulu, Hawaii, 48 pp., illus.

Peevy, Fred A.
1963. *Injecting undiluted 2,4-D amine to control woody plants.* Southern

Weed Conf. Proc. 16: 257-262.

Shipman, R. D.
1958. *Effect of season of treatment on girdling and chemical control of oak and sweetgum.* J. Forestry 56: 33-35.

Starr, John W.
1963. *The use of undiluted herbicides for control of undesirable woody plants.* Northeast. Weed Conf Proc. 17: 502-507.

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