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File No. 414

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FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION
BERKELEY - CALIFORNIA

RESEARCH NOTE

No. 152 July 1959

TESTS WITH DDT FOLIAR SPRAYS TO CONTROL THE CALIFORNIA FLATHEADED BORER

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The California flatheaded borer (Melanophila californica Van Dyke) kills an estimated 30 million board-feet of pine timber in California each year. The insect is especially troublesome on ponderosa and Jeffrey pines growing on dry sites, and it has caused serious losses in Jeffrey pine stands on valuable watershed and recreational lands of southern California. An effective control is needed to prevent such losses. This paper presents the results of tests in which the potential of DDT applied as a foliar spray against the adult borers was studied. The tests showed that control with DDT is possible but not practical because very large amounts of DDT need to be applied to get satisfactory control.

Present Chemical Control

Chemical control of the California flatheaded borer is done with penetrating sprays of ethylene dibromide in diesel oil. 1/ The aim is to kill the insect while it is still feeding beneath the bark in the tree. Success depends on getting enough spray on the bark to soak it thoroughly. The tree must be felled and limbed for this purpose. Total treating costs usually range from 10 to 50 dollars per tree and average about 20 dollars.

1/ Stevens, R. E. Ethylene dibromide sprays for controlling bark beetles in California. U. S. Forest Serv. Calif. Forest and Range Expt. Sta. Res. Note 147. 6 pp. illus. 1959.

Will an Aerial Spray Work?

The high cost of treating each infested tree with penetrating sprays makes it desirable to seek new and cheaper control methods. New control methods often suggest themselves when a so-called "weak link" is found in the habits of the insect. It has long been known that the California flatheaded borer adult must feed on the foliage of its host before it can mature sexually and lay eggs. Furthermore, it feeds at the periphery of the tree on the exposed current foliage, thereby being subject to control by a broadcast spray.

Some time ago it was suggested 2/ that a cheaper control might be had by aerial spraying of an insecticide. The aim would be to cover the pine needles with an insecticide deposit having long-lasting toxic properties. Such an approach to control looks good to the land manager. Wide areas could be treated rapidly and cheaply by air and the adults could be killed before eggs were laid.

The potential of an aerial spray was tested on a small pilot basis at the Miami Field Base, near Oakhurst, California, with the assistance of W. D. Bedard. 3/ 4/

Testing Procedure

Ponderosa pine saplings, about 4 feet tall, were hand sprayed with DDT-diesel oil solutions and then enclosed by cages (fig. 1). DDT was selected as the insecticide because of its extremely long-lasting toxic properties. Additional trees were left unsprayed to serve as checks on natural mortality.

2/ Downing, G. L. Emergence of Melanophila californica Van Dyke from infested Jeffrey pine Mt. Laguna, California, May-August, 1954. U. S. Forest Serv. Calif. Forest and Range Expt. Sta. 6 pp., illus. 1955 (Processed.)

3/ Lyon, R. L. Tests with DDT in diesel oil as a foliage spray to control the California flatheaded borer (Melanophila californica Van Dyke). U. S. Forest Serv. Calif. Forest and Range Expt. Sta. 10 pp. illus. 1955 (Processed.)

4/ Lyon, R. L. Residual tests of DDT in diesel oil as a foliage spray to control the California flatheaded borer (Melanophila californica Van Dyke). U. S. Forest Serv. Calif. Forest and Range Expt. Sta. 9 pp. illus. 1957 (Processed.)

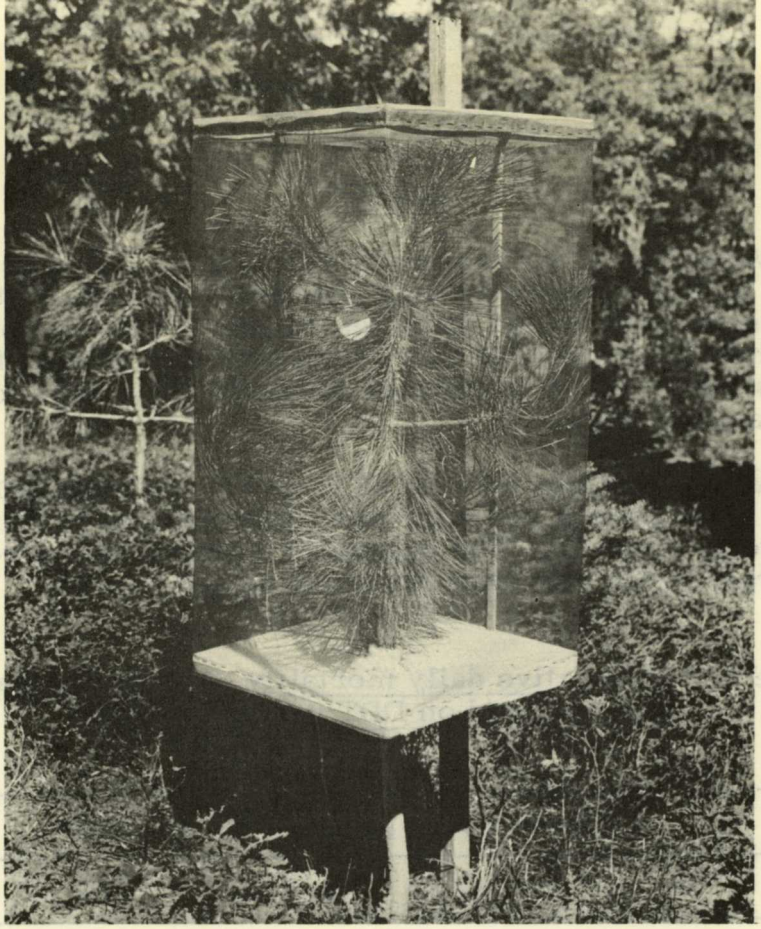

Figure 1. --Wire-screen cage used in tests of DDT foliar sprays for flathead control.

Fifty adult flatheads were introduced into each cage and allowed to feed. The cages were checked each day to keep a running account of mortality. The effectiveness of the spray was gauged by comparisons of mortality in the treated and untreated cages.

The effectiveness of an insecticide deposit is determined in part by two important factors: (1) the amount of the deposit occurring on a unit area, called dose, and (2) the age of the deposit. Both of these factors were studied because it is important to know how much insecticide is needed to get control, and also, how long the insecticide will provide control (residual toxicity).

Dose was tested by spraying 2 trees each at the rate of 1/4, 1/2, 1, and 2 pounds of DDT in 1 gallon of diesel oil per acre, leaving 2 trees unsprayed to serve as checks.

Tests were made on the effect of age of the deposit on toxicity of DDT when applied at the rate of 2 and 4 pounds per acre. Two trees each were sprayed at the rate of 2 and 4 pounds of DDT in 1 gallon of diesel oil per acre, and 2 trees were left untreated as checks. The total of 6 trees was divided into 2 groups, each group having the 3 treatments. One set of 3 trees was caged and tested 1 week after the insecticide was applied and the other set of 3 trees was caged and tested after 5 weeks.

Results

Mortality of the flatheads climbed to 100 percent in cages where 1/2, 1, and 2 pounds of DDT per acre were used (table 1), but only 75 percent were killed in cages where 1/4 pound of DDT was used. 5/ The 1/2-pound dose was not as effective (9 days for 100 percent kill) as the 1- and 2-pound dose levels (5 and 4 days for 100 percent kill, respectively).

As for residual toxicity of 1- and 5-week-old DDT deposits, the deposit of 4 pounds per acre was little changed in toxicity after 5 weeks of ageing (table 2). The deposit of 2 pounds per acre, however, fell off sharply in toxicity after the same ageing period.

Table 1.--Cumulative daily mortality of adult flatheaded borers caged on DDT-treated foliage

Period of exposure	Treatment in pounds DDT per acre				
	2	1	1/2	1/4	0
Days	- - - - - - Percent - - - - - - -				
1	15	21	6	5	6
2	54	72	30	17	12
3	95	95	61	34	16
4	100	99	75	49	22
5		100	86	59	24
6			93	67	24
7			96	72	25
8			98	77	25
9			100	77	26
10				78	27
11				78	27
12				78	27

5/ In all tests, mortality observations were discontinued when daily increments in treatment mortality equaled control mortality. This equilibrium meant that no further toxic action was taking place.

Table 2. --Cumulative daily mortality of adult flatheaded borers caged on DDT-treated foliage

Period of exposure	1-week-old deposits			5-week-old deposits		
	4 lbs. 1/	2 lbs.	0 lbs.	4 lbs.	2 lbs.	0 lbs.
Days	Percent					
1	30	2	4	4	8	0
2	64	54	4	34	22	0
3	98	86	8	66	30	10
4	100	96	10	94	48	18
5		100	10	98	68	24
6				100	76	32
7					78	38
8					82	44
9					86	44
10					88	46
11					92	48
12					94	50
13					94	50

1/ Dose in pounds of DDT per acre.

Discussion

A toxic insecticide residue must be maintained on the host foliage for the full period that flathead adults are in flight to get control. The flight period in southern California lasts for 2 to 3 months.

Assuming a direct relationship between dose and residual life, then the lower the dose, the higher the number of applications needed, and consequently, the higher the cost of control. For this reason, and because the toxicity of the 2-pound dose dropped sharply after 5 weeks of ageing, the choice of an adequate dose level narrows to 2 pounds or more.

If we accept something around 95 percent kill as adequate control, the 2-pound dose might be effective for roughly 3 to 6 weeks (table 2). If we accept a 3-month flight period, 2 to 4 applications at 2 pounds per acre would be needed to keep the foliage toxic. This totals 4 to 8 pounds of actual DDT applied to each acre in one season.

There is little evidence to suggest how long the 4-pound dose will remain adequately toxic. Certainly it will be toxic for 5 weeks (table 2). If we assume effectiveness for roughly 6 to 12 weeks, we still come out with a total DDT deposit of 4 to 8 pounds per acre; and it does seem better to assume that toxic life and dose are directly related in the absence of contrary evidence.

Doses in the range of 4 to 8 pounds per acre are far in excess of what has been generally considered acceptable for forest spraying.

In practice, the insecticide may need to be applied even more often than 2 to 4 times, since the current foliage, on which the adults feed, is not fully developed in the early flight period. As the foliage develops, new needle surface is produced free of insecticide at the needle bases. And the basal part of the needle is most fed on by the flatheaded borer. So new needle growth creates a non-toxic surface which may call for more frequent spraying.

The results of these tests show that DDT sprays will kill California flatheaded borer adults if applied to the foliage in large enough amounts. The quantity necessary to provide a satisfactory level of control far exceeds the standard one-pound-per-acre dose commonly used in forest insect sprays. For this reason, aerial spraying with DDT cannot be recommended for general use against the flatheaded borer. It is premature to say whether an aerial spray will or will not work. DDT itself shows little promise but there are many new insecticides that may be effective. The real potential of an aerial spray for flathead control cannot be appraised until the problem receives more study.