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CONTROL OF THE WESTERN PINE SHOOT BORER, *Eucosma sonomana* Kearfott, IN SELECTED PONDEROSA PINE PLANTATIONS IN NORTHERN IDAHO AND WESTERN MONTANA

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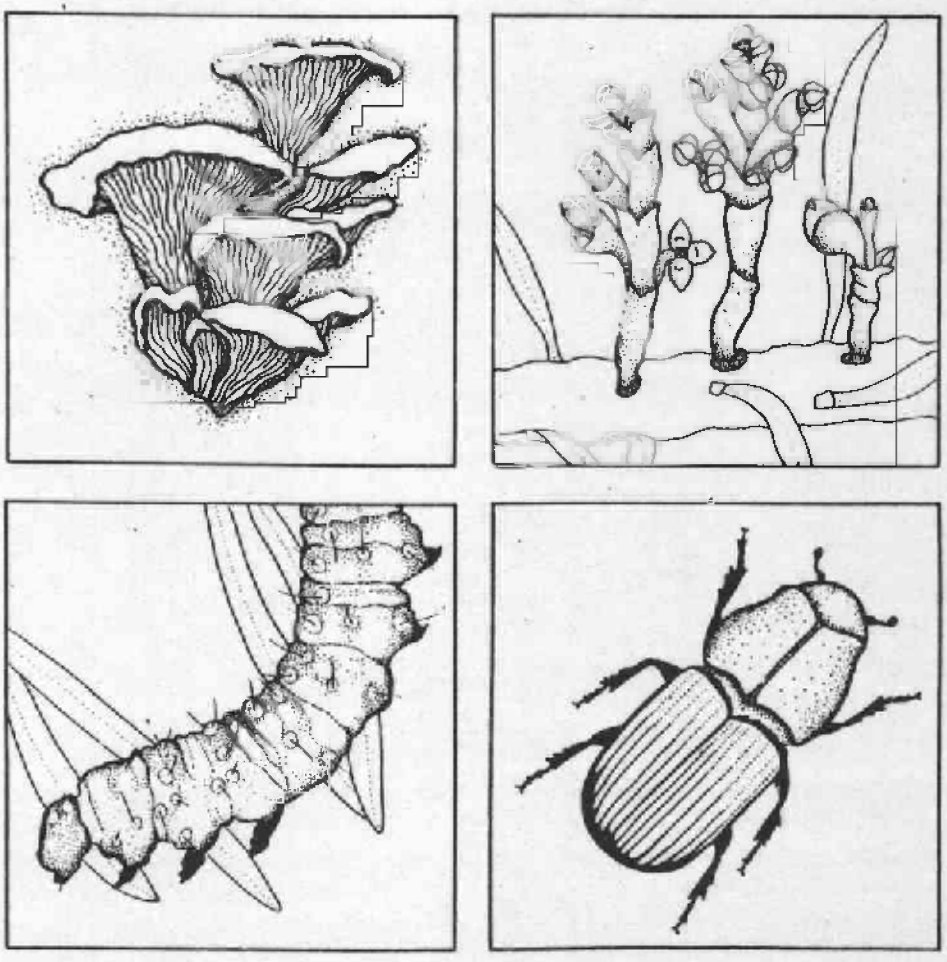

CONTROL OF THE WESTERN PINE SHOOT BORER, *EUCOSMA SONOMANA* KEARFOTT IN SELECTED PONDEROSA PINE PLANTATIONS IN NORTHERN IDAHO AND WESTERN MONTANA

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ABSTRACT

Two blends (Natural and Phillips) of the western pine shoot borer pheromone, formulated as Hercon Luretape, were applied to six ponderosa pine plantations in northern Idaho and western Montana in 1984. The treatment was approximately 21.6 grams of pheromone per hectare. Significant reductions in damage have occurred in all treated plantations. Damage has been reduced most in plantations that are not surrounded by pine stands which provide a reservoir of moths that can reinvade treated areas. The best results to date have been a reduction of infested terminals from 50.9 to 1.6 percent after 2 years of treatment. Population trends in nearby check areas were either static or increasing. Treatment effects of both the Natural and Phillips formulations were significantly different from the control at the 99 percent level. However, these treatments were not different from each other.

INTRODUCTION

Control of the western pine shoot borer[1] was initiated at three ponderosa pine plantations in Idaho and at a ponderosa pine seed orchard in Montana in 1983 (Livingston and others 1984). The Idaho plantations were a part of a tree improvement provenance test aimed at identifying tree families with superior growth characteristics. The objective of this control effort in the Idaho test plantations was to reduce shoot borer-caused injury, thus clarifying the relationships among growth potential, tree source, and heritability. The seed orchard was included to serve as a demonstration area for the control technique and to provide experience to agency personnel with this management tool.

Two formulations of the synthetic western pine shoot borer pheromone are commercially available. One material is a 4:1 mix of Z-9 to E-9 dodecenyl acetate (Natural blend) and the other is a 2:3 mixture of Z-9 to E-9 dodecenyl acetate (Phillips blend). In 1983, the Phillips blend was used because it was the less expensive formulation. While 1983 treatment results were satisfactory, they were less than striking. This report summarizes the 1984 project comparing the two pheromone blends in a "side-by-side" evaluation.

DESCRIPTION OF AREAS

Two provenance test plantations in western Montana (Condon and Lubrecht Experimental Forest) were added in 1984 bringing the total to six plantations to be treated (Table 1).

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[1] *Eucosma sonomana* Kearfott

Table 1.--Plantations included in 1984 project.

Plantation	Location	Administered by	Size (ac)	Date established	Habitat type
Condon	W. MT	USDA For. Ser.	22	1974	DF/Vac
Lone Mtn.	N. ID	USDA For. Ser.	22	1974	GF/Pach
Lubrecht Exp. For.	W. MT	State of MT	24	1974	DF/Vac
Meadow Creek	N. ID	USDA For. Ser.	23	1974	GF/Pach
Missoula Nursery	W. MT	State of MT	13	1974	-
Tensed	N. ID	State of ID	22	1974	DF/Phma

The following plantation descriptions are presented because of the influence that surrounding stands can have on treatment effect through immigration of mated moths into treated areas.

Condon: This plantation is bordered on one side by young lodgepole pine and western larch plantations. Mature and pole-sized mixed species stands of ponderosa pine, lodgepole pine, Douglas-fir, western larch, and Engelmann spruce surround the remainder of the plantation. Several ponderosa pine plantations up to 20 years of age are within a mile of the test plantation. The risk of invasion by the western pine shoot borer from surrounding stands is high.

Lone Mountain: This plantation is bordered on the east and west by western white pine plantations, on the south by an open area, and mature and pole-sized ponderosa and lodgepole pine border the north side. The risk of shoot borer invasion is quite high.

Lubrecht Experimental Forest: Second-growth ponderosa pine, western larch, and Douglas-fir entirely surround this plantation resulting in a high risk of shoot borer invasion.

Meadow Creek: A mixed species stand of pole and mature timber butts up against one side of the plantation. The remaining three sides are bordered by large plantations of approximately 15- to 25-year-old ponderosa pine. There is an extremely high risk of moths migrating into this plantation.

Missoula Nursery: This plantation is in an urban setting. Besides the beds of seedlings in the nursery, the plantation is surrounded by residences with occasional ornamental ponderosa pine. The risk of shoot borer invasion is low.

Tensed: There are no stands of trees immediately adjacent to this plantation. Mature and pole stands of ponderosa pine exist within about one-eighth mile on the north side, and one-fourth mile on the east and south sides. Agricultural land borders the west side. Risk of shoot borer invasion is quite low.

MATERIALS AND METHODS

To document if moth flight had begun prior to treatment of the plantations five pheromone-baited sticky traps were placed in each plantation about mid-March. These were examined for captured shoot borer moths later in the month when treatments were applied.

Both pheromone isomer blends (Natural and Phillips) were formulated into Hercon Corporation's Luretape® for the 1984 project. The tape is composed of several plastic layers laminated into a single strip. The Luretape used in 1983 had a permeable membrane on a single surface to regulate emission of the pheromone. However, assays revealed that by the end of the 1983 moth flight period, approximately 50 percent of the pheromone remained in the tape (Livingston and others 1984). Hence, in 1984, the Luretape was prepared with the permeable membrane on both surfaces in an attempt to reduce the pheromone remaining in the tape to about 25 percent by the conclusion of the moth flight period.

To permit comparison of the two formulations, each was applied to one half of each plantation. The treatment method was identical with that of 1983, i.e., one-fourth-inch x 24-inch strips of Luretape were hand tied to eye-level branches at 9.12-meter intervals. This resulted in 21.6 grams of pheromone per hectare.

Test plantations bordered by ponderosa pine stands were buffered with additional pheromone strips in an attempt to reduce the impact from mated moths flying into treated areas and depositing eggs. Buffering these stands consisted of going about 25 meters into the adjacent stands and tying a line of pheromone strips at approximately 10-meter intervals parallel to the plantation boundary. Additional buffer lines were established parallel to the first at a distance of about 20-25 meters. Two buffer lines were used at Condon, Lubrecht, and Meadow Creek. At Lone Mountain a total of 17 buffer lines, with Luretape strips placed every 15 meters, were established along the north boundary; another 6 lines were located on the east boundary. The test plantation at Tensed and the Missoula seed orchard were not buffered.

To measure what moth populations would have done in the absence of treatment, untreated check areas were established for each plantation except the Missoula seed orchard. Check areas were similar aged ponderosa pine plantations within a mile of each test plantation.

Treatment of the test plantations and the Missoula seed orchard occurred between March 20 and March 28.

A trained specialist determined the pretreatment infestation level at each plantation and its accompanying check area. This was done for the treated areas by rating 25 percent of the trees as "leader infested" or "leader uninfested". In the check areas, 500 trees were examined and rated. An identical survey, by the same person, was made in late summer following shoot growth to quantify posttreatment infestation levels. Trees with dead tops or multi-tops were excluded from the pre- and post-treatment counts.

The pheromone emission rate from the Luretape was again determined with reference strips from Missoula, Montana, by the same method as in 1983 (Livingston and others 1984).

The percent of pre- and post-treatment infested terminals was calculated. With these counts, an analysis of covariance was used to compare treatment means. Each plantation was considered a replication. The Missoula nursery was excluded from this analysis because it had no accompanying check area. Abbott's formula[2] was also used to measure treatment effects.

RESULTS

No moths were captured in the pheromone-baited traps prior to treatment of the plantations, indicating that as intended the treatments were applied prior to moth emergence.

The pre- and post-treatment infestation levels and percent change are shown in Table 2.

Table 2.--Infestation level by plantation and treatment.

		DAMAGED TERMINALS PER 100 TREES		
Plantation	Treatment	Before treatment	After treatment	Change
Condon	Natural	50.9	13.3	- 37.6
	Phillips	43.9	19.5	- 24.4
	Control	24.9	33.1	+ 8.2
Lone Mtn.	Natural	36.3	16.6	- 19.7
	Phillips	35.2	15.5	- 19.7
	Control	29.2	40.8	+ 11.6
Lubrecht Exp. For.	Natural	14.7	2.6	- 12.1
	Phillips	21.5	2.1	- 19.4
	Control	20.9	18.8	- 2.1
Meadow Cr.	Natural	35.1	22.7	- 12.4
	Phillips	35.7	31.5	- 4.2
	Control	45.6	48.2	+ 2.6
Missoula Nurs.	Natural	25.8	5.4	- 20.4
	Phillips	21.8	6.5	- 15.3
Tensed	Natural	10.0	1.6	- 8.4
	Phillips	11.3	1.6	- 9.7
	Control	21.8	23.6	+ 1.8

2/ $X = 100 \left(1 - \frac{T^1 C}{T C^1}\right)$

X = percent control
T_1 = treatment mean before control
T^1 = treatment mean following control
C_1 = check mean before control
C^1 = check mean following control

Results of the covariance analysis showed that both "Natural" and "Phillips" were significantly different at the 99 percent level from the control, but the two treatments were not different from each other (Table 3).

Table 3.--ANOCOV table and adjusted means.

	DF	SSX	SP	SSY	DF	SSY	SMY	F
Treatment	2	4.9	- 69.2	1369.1	2	1456.6	728.3	12.2
Error	12	2152.4	1366.2	1522.4	11	655.2	59.5	
TOTAL		2157.3	1297.0	2891.6		2111.8		

Treatment	Actual mean	Adjusted mean
Natural	11.4	11.3
Phillips	14.4	13.9
Control	33.0*	33.9

*Tukey's multiple range test showed that the control was the only mean different from the others.

Percent control using Abbott's formula with the adjusted means is shown in Table 4.

Table 4.--Percent control by treatment.

	Percent control	
Treatment	Abbott's formula	Corvariance test
Natural	67.1	66.6
Phillips	58.7	59.0

The amount of residual pheromone in the Luretape reference strips over time is shown in Table 5. In 1984, the Phillips blend initially had E-9 and Z-9 in a proportion of about 1:1 (51 percent E-9). The E:Z ratio shifted slightly as the season progressed, eventually reaching a 55:45 ratio. The Natural blend was about 1:5 E to Z at the beginning and did not change appreciably over the season.

Table 5.--Retention of two blends of behavioral chemicals in Hercon Luretape releasers by length of field exposure, Missoula, MT 1984.

Days exposed	Phillips	Natural
	Percent remaining	
0	100	100
14	73	69
28	65	60
45	43	43
57	31	29

CONCLUSIONS AND DISCUSSION

There was no significant difference in the effectiveness of the two formulations assessed using the methods described in our 1984 project. Hence, recommendations for future use will be for the less expensive material.

Based on 1983 and 1984 results, the treatment appears to be very successful in plantations that are not in close proximity to extensive pine stands where invasion of mated moths is expected to occur, i.e., Missoula seed orchard and Tensed plantation. At these sites infestation levels have declined from 50.9 percent to 1.6 percent and from 35.0 percent to 6.0 percent, respectively, in the 2-year period, while an increasing pattern occurred at the Tensed check area.

While less striking results have occurred to date at Condon, Lone Mountain, and Meadow Creek (i.e., 47.4 to 16.4 percent; 58.8 to 16.1 percent; and 36.5 to 27.1 percent, respectively), shoot borer populations are being reduced by the treatment even though populations are continuing to rise in nearby check areas. The poorer results in these areas are attributed primarily to their proximity to neighboring untreated pine stands. Also, the Condon plantation has only been treated a single year.

The Lubrecht plantation is an interesting case in that despite its being completely surrounded by pine stands, the 1984 treatment decreased the infestation level from 18.1 to 2.4 percent. Tensed, in 1984, is the only plantation with a lower pretreatment infestation level, and it too experienced an excellent reduction in infestation for pre- to post-treatment. Treatment effect might be more pronounced on populations of this magnitude.

REFERENCES CITED

Livingston, R. Ladd, Jerald E. Dewey, Steve Kohler, and Charles Sartwell. 1984. Control of the western pine shoot borer Eucosma sonomana Kearfott in selected ponderosa pine plantations in northern Idaho and western Montana. Progress Report No. 1. Idaho Dept. of Lands, Coeur d'Alene, Idaho. Report No. 84-5.