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CONTROL OF INSECTS IN SLASH PINE CONES WITH TRUNK IMPLANTATIONS OF BIDRIN® SYSTEMIC INSECTICIDE-FJRST-YEAR RESULTS

Abstract.—Initial experiments with the implantation of the systemic insecticide Bidrin® into the trunks of slash pines in a seed production area resulted in various degrees of control of coneworms, *Dioryctria* spp., and the pine seedworm, *Laspeyresia anaranjada* Miller, depending on dosage rates and time of application. When applied in early May, dosages as low as 3.4 grams of technical Bidrin® per inch of tree diameter resulted in a 72-percent reduction in coneworm infestation and a 92-percent reduction in seedworm infestation on second-year cones.

Two field experiments were conducted at Olustee, Florida, in 1966 to evaluate the effectiveness of implanting the systemic insecticide Bidrin®,[1] 3-hydroxy-N,N-dimethyl *cis*-crotonamide dimethyl phosphate, into the trunks of slash pines, *Pinus elliottii* Engelm., in order to control *Dioryctria* spp. coneworms and the slash pine seedwonn, *Laspeyresia anaranjada* Miller.

Experiment No. 1—Methods

This experiment was conducted in a natural seed production area of slash pine where trees averaged 12.7 inches d.b.h. and 75 feet in height. Bidrin® technical liquid (9 lb./gal.) was implanted into the tree trunks by means of Mauget injectors* placed at approximately 5-inch intervals around the trunks at breast height (fig. 1). Treatments were applied May 4, 1966, as follows: (1) five trees were injected with an average dosage of 1.5 grams of technical Bidrin® per inch of tree diameter at breast height, and (2) another five trees were injected at an average dosage rate of 3.4 grams per inch of tree diameter. Eleven trees were selected as checks and received no treatment.

Figure 1.—Top: Installing Mauget injector in trunk of slash pine tree requires safety visor and protective rubber gloves. Bottom: Plastic Mauget injector with metal feeder tuber in place on trunk.

[1]Mention of trade names or sources throughout this paper does not constitute endorsement by the U. S. Department of Agriculture to the exclusion of other equally acceptable products.

[2]Manufactured by the J. J. Mauget Company, 777 Front St., Burbank, California.

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The effectiveness of BidrinB was evaluated by comparing the incidence of coneworm and seedworm infestation on second-year cones from the treated and untreated trees. Coneworm infestation of first-year cones was not evaluated because we were unable to climb the tall study trees to make periodic observations of insect attack. The coneworm evaluation was made in mid-September, 4½ months after the BidrinB application. The entire crop of 4,751 mature cones from a]] study trees was harvested and examined, and the proportion of coneworm-infested cones on each study tree was recorded. The 2,162 cones which did not appear to have suffered coneworm damage were held in cone-drying bins for one month, until seedworms had completed their overwintering galleries in the cone axes. Then the cones were bisected with a special cone cutter, and the proportion of seedworm-infested cones from each tree was recorded. (Because *Dioryctria* larvae usually obliterate any evidence of seedworm attack, the coneworm-damaged cones were not used in the latter evaluation.)

Experiment No. l--Results

Compared with the percentage of coneworm-infested cones on the untreated trees, coneworm attack was reduced by 84 percent on the trees treated with the lower dosage (1.5 g./inch of diameter) and by 72 percent on the trees treated with the higher dosage (3.4 g./inch of diameter). The percentages of coneworm attack for the trees treated at either dosage did not differ significantly, but both percentages differed significantly (.&percent level) from that for the untreated trees (table 1) .

Seedworm attack was reduced by 55 percent on the trees treated with the lower dosage and by 92 percent on the trees treated with the higher dosage. The higher Bidrin® dosage gave significantly (5-percent level) better seedworm control than did the lower dosage, and both dosages significantly reduced the percentages of seedworm infestation in comparison with that for the untreated trees (table 1).

The effectiveness of both dosage rates of Bidrin® in the control of coneworm and seedworm infestations is also reflected by the high proportion of completely sound cones on the treated trees compared with the proportion on the check trees (table 1).

Full-seed germination tests of seed from all study trees were made by the Eastern Tree Seed Laboratory at Macon, Georgia. Differences between the percentages of full-seed germination for the treated and untreated trees were not statistically significant at the l-percent level, indicating that BidrinB as applied in this experiment was not phytotoxic. However, further study is needed to evaluate the effects of repeated Bidrin® applications on seed yields and viability.

Experiment No. 2—Methods

A small exploratory study was conducted on open-grown slash pines averaging IO inches d.b.h. and 45 feet in height. These trees had large spreading crowns more closely approximating seed orchard conditions. In this experiment, the BidrinB technical liquid (9 lb./gal.) was poured into ½- by 3-inch holes drilled into the trunks at breast height; these holes sloped downward at a 45-degree angle. Treatments were as follows: (I) on January 13, 1966, three trees were implanted with BidrinB at a dosage rate of 10 g. per inch of tree diameter at breast height; (2) on April 29, 1966, three trees were implanted with BidrinB at the same dosage rate; and (3) on April 29, 1966, three trees were implanted with BidrinB at a dosage rate of 5 g. per inch of diameter. Six trees were selected as checks and received no treatment.

Table I.--Mean percentages of sound cones and cones infested by coneworms and the slash pine seedworm following trunk injection of Bidrin® into slash pinu in a seed production area

Treatment and application date	Dosage	Second-year cones		
		Sound	Infested by—	
			Dioryctria spp.	*Laspeyresia*
	g./inch of d.b.h.	Percent[1]	Percent[2]	
Bidrin® injected on 5/4/66	3.4	94a	5a	1a
Bidrin® injected on 5/4/66	1.5	80a	3a	17b
Untreated check	0.0	44b	18b	38c

[1]In this column, any two percentages followed by the same letter are not significantly different at the I-percent level by Duncan's multiple-range test.

[2]In each column, any two percentages followed by the same letter are not statistically significant at the 5-percent level by Duncan's multiple-range test.

Coneworm attacks were evaluated by counting the sound and infested first- and second-year cones on 20 sample branches on each study tree at the time of treatment application, again on June 13, and finally at cone harvest on September 1. The 20 sample branches were tagged and numbered from a truck-mounted ladder so that repeated observations of the incidence of coneworm attack could be made.

Seedwonn infestation was evaluated by removing a 50-cone random sample of apparently sound cones from all study trees at cone harvest. These cones were held in cone-drying bins until November 15 and then bisected to expose the overwintering galleries of the seedworm larvae in the cone axes. The proportion of infested cones was then recorded.

Experiment No. 2—Results

Even though Experiment No. 2 was exploratory, results were significant and yielded considerable information for planning further research.

On June 13, coneworm infestation of first-year cones was so light that no significant differences were noted between first-year cone attack on treated and untreated trees (table 2). On this same date, however, infestation of second-year cones was significantly less on the treated than on the untreated trees. By September 1, this difference in infestation was apparent on both the first-year and the second-year cones. All three Bidrin® treatments were equally effective in controlling coneworm attack.

The two Bidrin® treatments in late April resulted in virtually complete control of the slash pine seedworm, whereas the January application did not significantly reduce seedworm infestation below that on the untreated trees (table 2). The Bidrin® applications in late April were made 2 weeks prior to the time when newly hatched larvae bore into the second-year cones.

Conclusions

From these initial experiments, it appears that good control of coneworms and seedworms on slash pines 10 inches d.b.h. and larger can be obtained with a minimum dose of 3 g. of technical Bidrin® per inch of tree diameter at breast height. Light to moderate yellowing of needles was noted at dosages of 10 g. per inch of diameter. Even though the 10-g. dose applied in mid-January (Experiment No. 2) gave good coneworm control for 8 months following application, it failed to control seedworms, whereas both the 3.4-g. dose applied in early May (Experiment No. 1) and the 5-g. dose applied in late April (Experiment No. 2) gave good seedworm control.

One of the most significant findings in Experiment No. 1 was that relatively small dosages of Bidrin® applied to large pines in late spring gave good protection to maturing cones during. their last 4½ months of development. In this experiment, the total cost of a single application was $1.68 per tree, including the cost of the insecticide, Mauget injectors, and labor. Natural seed production stands may be relatively inaccessible to ground spray equipment because of tree height, or they may be too small in area and too widely separated geographically to make aerial spraying economical. Good cone-bearing trees could be selected and injected individually with Bidrin®, thus eliminating the need for areawide spraying.

Table 2.—Mean percentages of slash pine cones infested by coneworms and the slash pine seedworm following trunk implantation of Bidrin® into open-grown trees

Treatment and application date	Dosage	*Dioryctria* spp. infestation				*Laspeyresia* infestation
		1st-yr. cones examined on—		2nd-yr. cones examined on—		2nd-yr. cones examined on—
		6/13/66	9/1/66	6/13/66	9/1/66	11/15/66
	g./inch of d.b.h.	*Percent*[1]		*Percent*[2]		*Percent*[2]
Bidrin® poured in drilled holes on 1/13/66	10	0.0a	0.3a	0.5a	0.5a	30.4a
Bidrin® poured in drilled holes on 4/29/66	10	0.5a	0.5a	0.0a	1.7a	0.0b
Bidrin® poured in drilled holes on 4/29/66	5	0.0a	0.0a	1.5a	0.8a	0.7b
Untreated check	0	4.6a	10.8b	22.8b	17.5b	42.2a

[1] In each column, any two means followed by the same letter are not significantly different at the 5-percent level by Duncan's multiple-range test.

[2] In each column, any two means followed by the same letter are not significantly different at the 1-percent level by Duncan's multiple-range test.

Even though the experiments described above were preliminary, the results are very significant. However, further research is needed (1) to determine more precisely the tolerance levels of slash pine to Bidrin®; (2) to determine the minimum dosage rates and number of applications of Bidrin® required for the control of different seed-destroying insects; (3) to determine how long Bidrin® remains toxic to cone insects in various plant tissues; (4) to evaluate the possible phytotoxic effects of repeated Bidrin® applications to seed-producing trees; and (5) to find even more practical methods of applying systemics than by trunk implantation.

WARNING

Bidrin® is an extremely toxic insecticide which should not be inhaled or come in contact with the skin at any rime. Safety goggles, a respirator (approved for use with Bidrin®) , and rubber gloves should be worn whenever the insecticide is applied. A container of water should be carried to the field so that it will be available in case the insecticide is accidentally spilled on a man's skin or clothing. When Mauget injectors are used, the plastic capsules and metal feeder tubes should be removed after the Bidrin® has been taken up by the tree and the empty injector units should be buried. When Bidrin® is applied in drilled holes, the hole should be plugged with a cork stopper after treatment. *ONLY PERSONS TRAINED IN THE USE OF TOXIC INSECTICIDES SHOULD HANDLE BIDRIN®. CAREFULLY READ THE LABEL ON THE INSECTICIDE CONTAINER. BIDRIN® IS SOLD FOR EXPERIMENTAL USE ONLY IN MOST STATES. CHECK WITH FEDERAL OR STATE PUBLIC HEALTH OFFICIALS FOR ITS REGISTERED USES. Publication of these research results does not constitute endorsement by the U. S. Department of Agriculture until and unless Bidrin® is registered for the specific purpose proposed in this study.*

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