AES/CE MAR 84 Workgroup/Department Entomology, UC Riverside

University of California
Division of Agricultural Sciences

Report to the Almond Board of California
for the period ending July 31, 1998

Project title: Control of Ants in Almonds

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ABSTRACT

Our research has emphasized the development of strategies for using toxic baits, which have the advantage of minimal environmental contamination while giving greater efficacy than sprays in bringing the toxicant into contact with all inhabitants of the ant nest. The work has identified four materials which are more effective in controlling ants than is the present grower standard - Lorsban. These are the hydramethylnon-containing baits, Amdro and Tahara, and the IGR baits, Logic and Knack. Two well-timed applications of Amdro and Tahara in the spring and summer give up to 14 weeks of control of southern fire ants. A single spring application of Knack may give a similar 14 weeks of control. We consider the renewed interest of American Cyanamid Corporation in promoting US and California registrations of Tahara and Amdro to be very encouraging. This interest by American Cyanamid is spurred on by our promising research results.

OBJECTIVES

Please note that this proposal was written as a joint, 3-crop (almonds, table grapes, and citrus) study, and the objectives therefore address ant problems on all three crops.
1. For each ant species, on each crop of interest, and in each different climatic or geographic area where the ants present a problem on those crops, develop and evaluate a wide variety of formulations of each potential toxicant, to determine chemical, moisture, consistency, granule size, and other characteristics that maximize their acceptability.
2. For each ant species, on each crop of interest, and in each different climatic or geographic area where the ants present a problem on those crops, establish replicated plots of candidate ant-control chemicals, using the most effective baiting procedures found in Objective 1; determine the critical amounts and timings of application that are needed for most effective control.

3. With regard to citrus and table grapes, determine the correlation between ant control using various new chemicals and older standards (Lorsban), and infestation of the commodity with pest Homoptera (mealy bugs, scale, aphids, whitefly).
4. Develop repellents for use as bands around the bases of citrus trees or grape vines to exclude the ants from these commodities.
5. Establish relations between irrigation strategies, cover crops, and ant infestations, and manipulate irrigation strategies to lessen ant infestations.
6. Determine requirements of federal and state regulatory agencies with regard to registration of the experimental ant control chemicals and establish a practical plan for obtaining this registration.

PROCEDURES

The work during 1997 focused on the most promising ant control procedures indicated during the previous two years of research - the use of toxic baits that can be used selectively, without danger of residue on the crop or effects on non-target organisms. The baits so identified included two hydramethylnon-containing materials, Tahara and Amdro, and two insect growth regulators (IGR's), Logic and Knack. In some tests, the efficacy of these baits in controlling ants was compared to the efficacy obtained through broadcast sprays with the "grower standard" material, Lorsban.

Baits were always applied at 2 pounds of formulated material per acre. They were applied either in discrete piles of the material placed on the ground or by broadcast. When the discrete pile method was used, the applicator placed a pile of bait on the soil surface at about 3-m intervals in each direction, giving about 440 such piles per acre. Each pile was formed by the applicator dropping a measured amount of bait (about 1/2 to 1 tsp.) into a funnel attached to the top of a 1-m-long section of PVC pipe; the bait was then directed through the pipe to the ground below, where it formed a small pile. Broadcast application was made with the aid of a hand-operated fertilizer spreader which threw the granules about 3 m in all directions from the operator, as he walked back and forth through the plot in a pattern that ensured uniform overlap of treatment swaths.

When Lorsban was used as a standard for comparison, it was applied by the cooperating grower, using a commercial spray rig, as a broadcast spray in 50 to 100 gallons of water per acre. This application gave complete coverage of the soil surface.

Most plots were a square 1/4 acre in size, giving about 15 m distance from the center of each plot, where ant density evaluations were made, to the plot edges. It was feared that in plots smaller than this, ants would easily forage into the centers of treated plots from outside, untreated areas. Evaluation for ant densities in the various plots at selected intervals after materials were applied was done by a procedure called "hot-dogging". Slices of raw hot dog, about 1/2 cm thick, were placed individually in 50-ml-volume flip-top clear plastic vials. In most trials, 10 of these vials, with lids open, were laid on their sides at about 2-m intervals near the center of each experimental plot. They were placed in the plots in early morning, because southern fire ants typically cease foraging

by mid-morning during hot weather. If ants were foraging in the plots, they rapidly discovered the hot dog bait and recruited other foragers to the vials; often, the numbers of ants seen feeding on the hot-dogs in each vial totaled several hundred. Two hours after they were placed in the plots, the vials were collected and the covers were snapped shut. They were then taken to the laboratory where the ants trapped inside were identified and counted. Most of the ants were identified as either the southern fire ant, *Solenopsis xyloni*, or the field ant, *Formica petilosa*. All of this research was conducted in the southern San Joaquin Valley and the Coachella Valley.

Test 1. Evaluation of the efficacy of Lorsban, Tahara, Amdro, Logic, and Knack, with regard to duration of effectiveness in controlling southern fire ants following May applications, July applications, and double applications (at both times). Each of the following treatments was applied to 1/4-acre plots and replicated four times in a randomized complete block design:

1. Lorsban broadcast spray applied at 8 pints of 4E formulation per acre in 50 gallons of water per acre. Applied once, on May 6, 1997.
2. Same as (1), but applied twice, on May 6 and July 2, 1997.
3. Same as (1), but applied once, on July 2, 1997.
4. Tahara applied in small piles about 10 feet apart, at 2 pounds per acre. Applied once, on May 6, 1997.
5. Same as (4), but applied twice, on May 6 and July 2, 1997.
6. Same as (4), but applied once, on July 2, 1997.
7. Amdro applied in small piles about 10 feet apart, at 2 pounds per acre. Applied once, on May 6, 1997.
8. Same as (7), but applied twice, on May 6 and July 2, 1997.
9. Same as (7), but applied once, on July 2, 1997.
10. Logic applied in small piles about 10 feet apart, at 2 pounds per acre. Applied once, on May 6, 1997.
11. Knack applied in small piles about 10 feet apart, at 2 pounds per acre. Applied once, on May 6, 1997.
12. Untreated control.

On a number of dates after application of materials, and at 2- to 4-week intervals, ant activity in the plots was monitored by means of the hot-dogging procedure (Table 1).

Test 2. Comparison of the efficacy of Amdro and Tahara baits applied in August for control of southern fire ants and field ants. This experiment will provide a comparison of the efficacy of Tahara and Amdro in providing long-term, overwintering ant control. Each material was applied on August 25 in 1/4-acre, square plots by the discrete-pile method. There were three replications of each of the following treatments:

1. Tahara
2. Amdro
3. Untreated control

At 4 and 7 weeks following application, ants in the plots were sampled using the hot-dog method (Table 2).

Test 3. Comparison of the efficacy of Logic, Knack, Amdro, and Tahara baits applied on September 24, 1997 for control of southern fire ants and field ants. Each of the following treatments was applied in square 1/4-acre plots, replicated three times in a randomized complete blocks design:

1. Logic, discrete piles
2. Knack, discrete piles
3. Amdro, discrete piles
4. Tahara, discrete piles
5. Tahara, broadcast
6. Untreated control

In mid-October and November, ant activity in the plots was monitored by means of hot-dogging (Table 3).

RESULTS AND CONCLUSIONS

Southern fire ants have two main queen flights per year, in late April or May and again in September. If these bait materials can be deployed at a time that corresponds with the establishment of new nests by these queens, then whole new colonies may be destroyed, leading to relatively low ant numbers in the plots until the time of the next flight. Timing of ant bait application was addressed in the three trials discussed here.

Tahara especially, but also Amdro, gave 6 to 8 weeks of effective control of southern fire ants after a single application in early May - possibly because many new-queen nests were destroyed by application at that time - but only about 4 weeks of control after a early July application (Table 1). These two materials each had an added duration of effectiveness in plots that received two applications, in early May and again in early July; this probably will make double applications attractive, giving control of southern fire ants for about 14 weeks, longer than can be obtained by two broadcast spray applications of Lorsban. The new experimental insect growth regulator, Knack, formulated as a bait, appears very promising, giving effective control of southern fire ants for more than 14 weeks following a single application. On the other hand, the insect growth regulator, Logic, also formulated as a bait, did not provide as enduring control as Knack, although it did greatly reduce southern fire ant levels between about 30 and 60 days following application.

In Tests 2 and 3, ant control trials were initiated in a number of locations of the Coachella Valley to determine the efficacy of late summer and fall applications in reducing ant populations that might overwinter in the plots and give rise to the colonies that exist in the spring. These tests are continuing and final results will be given in the report for 1998.

We recognize that little benefit would result from this research unless products that are found to be effective in ant control can meet the approval of federal and state regulatory agencies and unless we can obtain the necessary registration for their use. We have been in close working contact with representatives from CalEPA and American Cyanamid Company. Stimulated by this research, American Cyanamid has renewed its effort to obtain early registrations for Amdro (first) and Tahara (second) on the three crops on which we concentrated this research, almonds, table grapes and citrus. In spring, 1998, Amdro received a California registration for use on nonbearing trees and vines, and the full registration for use on bearing trees could be available within 12 to 24 months.

Table 1 (Test 1). Efficacy of Amdro, Tahara, Lorsban, Logic, and Knack in providing long-duration control of southern fire ants following single or double applications during the period of May through July, 1997.

	Grand mean counts* of southern fire ants by hot-dogging (used 10 vials per plot).							
	May 20		June 3		June 18		June 30	
Trt	Vials w/ants	Ants/ vial	Vials w/ants	Ants/ vial	Vials w/ants	Ants/ vial	Vials w/ants	Ants/ vial
1	1.0	7.5b	4.3	7.1b	1.3	6.9b	3.0	19.9b
2	---		---		---		---	
3	---		---		---		---	
4	0.8	1.5a	0.3	0.5a	0.0	0.0a	1.8	1.0a
5	---		---		---		---	
6	---		---		---		---	
7	3.8	8.1b	3.5	8.4b	0.8	2.5ab	0.8	1.0a
8	---		---		---		---	
9	---		---		---		---	
10	9.0	55.5c	9.0	31.2c	2.0	6.2b	4.3	2.0a
11	8.5	38.6c	7.8	23.3c	0.5	2.7ab	1.0	0.4a
12	8.8	51.5c	6.8	35.9c	3.8	18.4c	6.0	56.3c

	July 14**		August 13		September 3	
	Vials w/ants	Ants/ vial	Vials w/ants	Ants/ vial	Vials w/ants	Ants/ vial
1	0.5	2.3a	9.4	75.1cd	9.7	66.2c
2	0.0	0.0a	4.8	21.2ab	3.8	30.3ab
3	0.0	0.0a	4.5	34.5bc	5.5	37.3ab
4	0.0	0.0a	7.3	29.4bc	7.3	44.8bc
5	0.0	0.0a	2.8	2.3a	5.8	30.3ab
6	0.0	0.0a	7.0	25.6bc	6.3	26.3ab
7	0.3	0.5a	6.3	40.5c	5.8	36.7ab
8	0.0	0.0a	4.0	5.4a	4.3	25.6ab
9	0.5	0.2a	5.8	17.7ab	6.3	28.9ab
10	1.0	6.5a	8.8	70.3cd	8.0	65.9c
11	0.0	0.0a	3.3	4.0a	5.5	17.8a
12	0.8	3.5a	8.8	106.0d	7.8	87.7c

* Data were transformed to ln(X+1) for statistical analysis. Any two means not followed by a common letter are significantly different at the 95% confidence level according to Duncan's Multiple Range Test. Means presented here have been transformed back to the original units of measurement.

** The plots were very dry on this date, and few ants were foraging.

Table 2 (Test 2). Efficacy of Amdro and Tahara in providing long-duration control of ants following applications on August 25, 1997.

		Mean numbers* on indicated date					
		September 24, 1997			October 14, 1997		
Trt		Vials w/ ants	Field ants	So. fire ants	Vials w/ ants	Field ants	So. fire ants
1	Tahara - piles	0	0.0a	0.0a	0	0.0a	0.0
2	Amdro - piles	0	0.0a	0.0a	0	0.0a	0.0
3	Untreated	4.7	6.1b	10.3b	2.0	1.2a	0.0

* Data were transformed to ln(X+1) for statistical analysis. Any two means not followed by a common letter are significantly different at the 95% confidence level according to Duncan's Multiple Range Test. Means presented here have been transformed back to the original units of measurement.

Table 3 (Test 3). Efficacy of Logic, Knack, Amdro, and Tahara in providing long duration control of ants following applications on September 24, 1997.

		Mean numbers* on indicated date					
		October 14, 1997			November 12, 1997		
Trt		Vials w/ ants	Field ants	So. fire ants	Vials w/ ants	Field ants	So. fire ants
1	Logic - piles	6.0	0.3a	46.3b	7.0	3.7bc	17.2bc
2	Knack - piles	6.7	5.4b	24.9b	6.7	3.0bc	9.6a
3	Amdro - piles	3.3	0.3a	4.8ab	5.0	2.9bc	11.0ab
4	Tahara - piles	3.0	0.4a	5.0ab	4.3	1.4ab	11.9ab
5	Tahara - broadcast	0.0	0.0a	0.0a	4.0	0.4a	10.0ab
	Untreated	6.0	0.1a	32.1b	6.7	6.9c	24.3c

* Data were transformed to ln(X+1) for statistical analysis. Any two means not followed by a common letter are significantly different at the 95% confidence level according to Duncan's Multiple Range Test. Means presented here have been transformed back to the original units of measurement.