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INVESTIGATIONS ON NAVEL ORANGEWORM EGG TRAP IMPROVEMENT, NAVEL ORANGEWORM OVIPOSITION DISRUPTION, AND AMERICAN PLUM BORER CONTROL

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I. Improvements in the Efficiency of the Navel Orangeworm Egg Trap

The navel orangeworm (NOW) is considered the key pest in almond production. The strategy developed to control navel orangeworm is based on early harvest, winter mummy nut removal, and chemical control at first generation and/or hull-split. Timing of the insecticidal application for the first generation is based on the accumulation of day-degrees beginning at the time eggs are deposited on navel orangeworm egg traps. However, the present egg trap does not indicate in all cases the beginning of egg deposition due to many influencing factors. An improvement in the efficiency of the egg trap would better indicate the true initiation of egg deposition in the spring and thus aid in improved timing of the spring treatment. An improvement in the efficiency of the egg trap might also aid in the hull-split treatment by allowing the treatment to be applied at egg-laying and not at a fixed period of time, i.e., at 10% hull-split.

Various studies were conducted on modifying the existing navel orangeworm egg trap and bait formulation in ways which might improve trap efficiency. These studies are reported here.

A. Trap Color

Various colors were tested in a preliminary study in 1982. Standard NOW egg traps baited with 15 g of ground almond press cake were painted black, dark green, blue, lime green, or yellow. Each color and a standard clear trap were replicated 5 times in a randomized complete block design in a 12-year-old Nonpareil and Carmel almond orchard. The traps were placed in the orchard on

Aug. 19 and monitored (number of eggs per trap) twice a week through Sept. 22. Once a week the bait was changed and the trap position rotated.

The results (Table 1) show that significantly more NOW eggs (3 times as many) were laid on the darker-colored (less reflective) traps than on the standard trap. We also observed that the eggs on the darker traps were more eaily seen than on the standard trap, thus reducing counting time.

Table 1. Navel orangeworm oviposition on traps of various colors - 1982

Color	Mean* number of eggs per trap per day
Black	11.4 a
Dark green	7.2 b
Blue	6.0 b
Lime green	4.7 cd
Standard (clear plastic)	3.3 de
Yellow	2.0 e

*Means followed by the same letter are not significantly different at the 5% level (DMRT).

Based on this preliminary study, a more extensive study was conducted in 1983 in which both intensity and color were varied. Standard NOW egg traps baited with 15 g of ground almond press cake were painted various colors. The paints were provided by Dr. E. D. Owens of G. T. E. Laboratories and were especially developed to give various color intensities. They were black, cadmium yellow light (CYL), CYL plus 2% black, CYL plus 0.5% black, zinc white (ZNWH), ZNWH plus 5% black, ZNWH plus 1.5% black, and blue. Each color and a standard clear trap were replicated 6 times in a randomized complete block design in a 12-year-old Nonpareil, Price, and Carmel almond orchard. The traps were placed in the orchard on April 27 and monitored twice a week through Sept. 15. Once a week the bait was changed and the trap position rotated.

The results (Table 2) again show that significantly more eggs (2 times as many) were laid on the darker-colored (less reflective) traps than on the standard and that color was less important than intensity. We again observed that eggs on the black traps were more visible. Thus, from these studies we would recommend that the standard NOW egg trap be painted black.

Table 2. Navel orangeworm oviposition on traps of various colors - 1983

Color	Mean* number of eggs per trap per day
Black	2.69 a
Cadmium yellow light plus 2% black	2.12 b
Cadmium yellow light plus 0.5% black	1.64 c
Zinc white plus 5% black	1.59 c
Standard	1.46 cd
Cadmium yellow light	1.19 de
Blue	1.15 de
Zinc white plus 1.5% black	1.11 e
Zinc white	1.03 e

*Means followed by the same letter are not significantly different at the 5% level (DMRT).

B. Bait Formulation

In 1982, a preliminary study was conducted to test various bait formulations. Standard NOW egg traps were baited with 10 g of bran formulation (bran 24: honey 2: glycerol 2: water 1), 15 g of almond press cake, 13.5 g of almond press cake plus 1.5 g of refined almond oil, 13.5 g of almond press cake plus 1.5 g of crude almond oil, 1.5 g of refined almond oil, or 1.5 g of crude almond oil. The almond oil alone was soaked into a 25 mm dental wick and suspended in the trap. Each bait formulation and an empty trap were replicated 5 times in a randomized complete block design in a 12-year-old Nonpareil and Carmel almond orchard. The traps were placed in the orchard on Aug. 19 and monitored twice a week through Sept. 22. Once a week the bait formulations were changed and the trap positions rotated.

The results (Table 3) show that the traps with almond press cake plus crude almond oil had more eggs (1.5 times as many) than the press cake without oil, although the difference was not significant. Also, crude almond oil, whether alone or combined with press cake, out-performed refined almond oil. Thus, there appears to be a constituent within the crude almond oil that increases its effectiveness. There also appears to be some synergistic activity between the oil and the press cake. Traps baited with almond oil, whether refined or crude, had very few eggs deposited on them.

Table 3. Navel orangeworm oviposition on traps containing various bait formulations - 1982

Bait formulation	Mean* number of eggs per trap per day
Press cake + crude oil	6.8 a
Press cake + refined oil	5.5 a
Press cake	4.1 ab
Bran	2.6 bc
Crude oil	0.8 c
Refined oil	0.7 c
Empty	0.6 c

*Means followed by the same letter are not significantly different at the 5% level (DMRT).

Based on the preliminary study of 1982, it appeared that changing the almond press cake bait to include crude almond oil would improve egg deposition. Since the percentage of crude almond oil was not investigated in the 1982 study, a study was conducted in 1983 in which the concentration of crude almond oil was varied in relation to almond press cake.

Standard NOW egg traps were baited with 15 g of 0, 2, 5, 10 or 25%, by weight, crude almond oil bait formulation. Each bait formulation was replicated 10 times in a randomized complete block design in a 12-year-old Nonpareil, Price, and Carmel almond orchard. The traps were placed in the orchard on April 27 and monitored twice a week through June 1. Once a week the bait formulation was changed and the trap position rotated.

The results (Table 4) show that egg deposition increased as the percentage of crude almond oil in the bait increased up to 10%, with the 10% or 25% bait formulation having ca. 1.5 times as many eggs as the almond press cake without oil. Egg deposition did not increase between 10% and 25% oil. Bait formulations which contained more than 25% crude almond oil were not considered in this study since they were very oily and difficult to handle.

Table 4. Navel orangeworm oviposition on traps containing various concentrations of crude almond oil in the press cake bait - 1983

Bait formulation as percent oil	Mean* number of eggs per trap per day
0	2.55 a
2	2.47 a
5	3.22 ab
10	4.04 b
25	3.98 b

*Means followed by the same letter are not significantly different at the 5% level (DMRT).

A bait formulation of 10% crude almond oil mixed with press cake would not be a suitable replacement for the standard press cake bait if it had only a short period of biological activity, necessitating frequent change of bait in the traps. To determine the length of biological activity of a 10% crude almond oil bait formulation, 10 traps with 15 g of the bait were added to a Nonpareil, Price, and Carmel almond orchard each week for 8 weeks. After 8 weeks the bait that been in the orchard 8 weeks was replaced with fresh bait. Traps were placed in the orchard in a randomized complete block design on June 1 and monitored twice a week through Sept. 1. For the first 8 weeks the traps traps were rerandomized once a week. After that date the trap positions were rotated once a week. We could not inspect the traps on Aug. 4 because the orchard had been irrigated in preparation for harvest. On that date we placed 10 traps containing fresh bait on the margin of the orchard. These traps were then placed in their correct position in the experiment on Aug. 11 when the orchard was dry.

The results (Table 5) show that the bait did not decrease in biological activity as it aged in the orchard for 8 weeks. Only on Aug. 17 was there some indication of decreasing egg deposition with increasing bait age. However, this trend was not consistent. Thus, a bait formulation which contains 10% crude almond oil will be effective for at least 8 weeks, but it should be changed whenever it becomes wet due to sprinkler irrigation or rain.

Table 5. Navel orangeworm oviposition on traps containing various ages of press cake plus 10% crude almond oil bait - 1983

Age of bait (weeks)	Mean* number of eggs per trap per day during period ending:												
	6/9	6/16	6/23	6/30	7/7	7/14	7/20	7/28	8/1**	8/11**	8/17	8/24	9/1
1	.33	1.14 a	.47 a	.21 a	.13 a	3.16 a	.52 a	.26 a	.15 a		1.43 ab	1.16 bc	2.94 b
2		.77 a	.06 b	.26 a	.09 a	.67 b	.50 a	.46 a	.03 a	.26 a	1.87 a	.83 c	4.91 ab
3			.09 ab	.01 b	.23 a	1.34 b	.45 a	.36 a	0 a	.08 a	1.72 ab	.83 c	4.54 ab
4				.09 ab	.03 a	1.31 b	.23 a	.36 a	.03 a	.17 a	.67 ab	.66 c	4.00 ab
5					.11 a	.66 b	.62 a	.51 a	.23 a	.25 a	.93 ab	2.06 a	4.29 ab
6						.84 b	.70 a	.11 a	.15 a	.13 a	.62 ab	1.64 ab	2.65 b
7							.28 a	.28 a	.13 a	.08 a	.97 ab	1.07 bc	5.91 a
8								.45 a	.23 a	.05 a	.52 b	1.03 bc	3.85 ab

*Means followed by the same letter in a vertical column are not significantly different at the 5% level (DMRT).

**Orchard was irrigated before harvest. Orchard monitored only once on Aug. 1 and 11.

The next study dealt with how much of the 10% crude almond oil bait formulation to place in the trap. The standard recommendation has been to fill the trap with bait up to the middle of the open window, but no experiments had been conducted to determine if this was the optimum amount. The amounts of bait tested were none (trap empty), 10 g (at the bottom of the trap window), 15 g (half-way up the window), and 30 g (at the top of the window). Traps with each amount of bait were replicated 10 times in a randomized complete block design in a 12-year-old Nonpareil, Pierce, and Carmel almond orchard. The traps were placed in the orchard on June 9 and monitored twice a week through Sept. 15. Once a week the bait formulation was changed and the trap positions rotated.

The results (Table 6) show that as the amount of bait increased, egg deposition increased. Thus, traps should be filled at least half-way up the window and preferably to the top.

Table 6. Navel orangeworm oviposition on traps containing various amounts of press cake plus 10% crude almond oil bait - 1983

Amount of bait formulation in grams	Mean* number of eggs per trap per day
30	1.32 a
15	1.08 ab
10	0.89 b
0	0.00 c

*Means followed by the same letter are not significantly different at the 5% level (DMRT).

The final study concerning bait improvement involved encapsulating crude almond oil within Albany International hollow fibers to determine if hollow fibers with their consistent release rate could be used to replace the almond press cake bait and if the fibers could be used in ovipositional disruption studies. Zero, 1, 5, 10, or 20 hollow fibers filled with crude almond oil were placed in standard NOW egg traps and compared to traps baited with 15 g of almond press cake. The fibers were taped to a piece of stiff paper so that the emitting tip was in the middle of the window. Each treatment was replicated 10 times in a randomized complete block design in a 12-year-old Nonpareil, Price, and Carmel almond orchard. The traps were placed in the orchard on Sept. 15 and monitored twice a week through Oct. 2. The almond press cake bait was changed once a week but the fibers were not. Trap positions were rotated once a week.

The results (Table 7) show that substantially fewer eggs were deposited on the traps baited with fibers than on those baited with almond press cake. The number of eggs deposited on traps increased with increasing numbers of fibers. However, fiber-containing traps had few eggs deposited on them. Thus, fibers cannot be substituted for almond press cake and they would not be useful for ovipositional disruption.

Table 7. Navel orangeworm oviposition on traps containing various numbers of hollow fibers filled with crude almond oil - 1983

Bait	Mean* number of eggs per trap per day
Almond press cake	2.19 a
20 fibers	0.28 b
10 fibers	0.28 b
5 fibers	0.26 b
1 fiber	0.09 b
0 fibers	0.03 b

*Means followed by the same letter are not significantly different at the 5% level (DMRT).

C. Trap Texture

Trap texture was considered important in improving trap design since most eggs are oviposited on the roughened surface above and below the window on standard NOW traps, while few or no eggs are oviposited on the smooth plastic. This means that much of the trap is unutilized ovipositional space. The study compared standard egg traps which had extra roughened surface above the windows to unmodified standard traps. The added roughed surface was similar to the surface around the windows and was made of Silicone Clear Household Glue and Seal - Clear G. E.-361. Each type of trap was baited with 15 g of almond press cake and replicted 10 times in alternate positions down two rows of trees in a 12-year-old Nonpareil, Price, and Carmel almond orchard. The traps were placed in the orchard on April 27 and monitored twice a week through June 9. Once a week the bait was changed and the trap position rotated.

The results (Table 8) show that more eggs (ca. 25% more) were deposited on traps with extra roughened surface than on standard traps. This increase in egg deposition appears to be the result of increasing the ovipositional sites available to the moth since the roughened area above and below the window on the standard trap was about ca. 1 cm each and the added roughened area on the modified trap was ca. 2 cm.

Table 8. Navel orangeworm oviposition on standard and roughened traps - 1983.

Trap surface	Mean* number of eggs per trap per day
Rough	3.52 a
Standard	2.80 a

*Means followed by the same letter are not significantly different at the 5% level.

D. Conclusions

The effectiveness of standard Zoecon NOW egg traps was improved when trap color, bait formulation, and texture were changed. Changing the clear plastic to black improved egg deposition ca. 2 to 3 times and made the white eggs more visible and thus easier to count. Our current recommendation is to paint all NOW egg traps black, a change which can be made quite easily and inexpensively. Changing the bait formulation from almond press cake to almond press cake plus 10% crude almond oil improved egg deposition ca. 1.5 times. This new bait formulation is effective for at least 8 weeks. Our current recommendation is to change the bait formulation to almond press cake plus 10% crude almond oil, a change which can be made quite easily and inexpensively. The crude almond oil can be purchased from Liberty Vegetable Oil Company in Santa Fe Springs, CA, for about $8.00 per gallon. The almond press cake can also be purchased from Liberty Vegetable Oil Company. Changing the trap texture to increase the amount of roughened surface increased egg deposition by 25%. A change to roughened traps is not recommended at this time since it would require significant time and expense. Perhaps the trap will need to be remanufactured. Further studies will be conducted next year to compare the improved NOW egg trap to the standard trap to determine whether egg deposition patterns will change.

II. Ovipositional Disruption of Navel Orangeworm

Ovipositional disruption is similar in concept to mating disruption in that the purpose of both is to permeate the air with the odor of an object in order to make it impossible for the insect to locate the object by flying toward its odor. To disrupt navel orangeworm oviposition, the air surrounding the almond tree could be permeated with the odor of almund nut, the ovipositional stimulant, by spraying the tree with materials such as crude almond oil or powdered almond press cake plus crude almond oil. The female then would not be able to "smell" the nut (mummy or sound-split) on which to oviposit. Such materials could be applied early in the spring during the first ovipositional period when the available ovipositional sites and populations are low to make it difficult for the navel orangeworm to reproduce. They could also be applied at hull-split to protect the sound nuts and lessen the severity of infestation.

Reported here are preliminary investigations on the phytotoxicity of almond oil to almond foliage and initial trials of ovipositional disruption using either an emulsified crude almond oil or a wettable powder formulation of powdered almond press cake and crude almond oil.

A. Phytotoxicity Trials

The phytotoxic reaction of crude almond oil to almond foliage was evaluated by spraying, to run-off, individual branches of 3-year-old Nonpareil almond trees with 20, 10, 5, 2-1/2, or 1-1/4 gal crude almond oil/100 gal water with no emulsifier added. The treatments were applied on Aug. 19, 1982. The trees were visually observed for phytotoxic reaction to the oil for the remainder of the season.

There were visible oil droplets on the leaves at all rates of oil. At the 20 and 10 gal rates, the leaves seemed to come off the trees more easily, but there were no typical phytotoxic reactions. There was intermediate effect at the 5 gal rate and no effect at the 2-1/2 and 1-1/4 gal rates. Thus, from this preliminary study, it appeared that oil did not cause an acute phytotoxic reaction.

A more thorough study on the phytotoxic reaction of almond oil was conducted in the spring of 1983. Individual Nonpareil and Carmel almond trees were sprayed to run-off with 5, 2, or 1-1/4 gal crude almond oil/100 gal water. The oil contained 2% emulsifier Triton X-363M and was applied on April 27 with a hand-held orchard sprayer operating at 300 PSI. The amount of oil/water sprayed per individual tree was 2-3/16 gal, or ca. 250 gal/ac. The trees were visually observed for phytotoxic reaction to the oil until June 1. There were visible oil droplets on the leaves at all rates of oil; however, no phytotoxic reaction was observed.

B. Ovipositional Disruption Trials

An ovipositional disruption study was conducted in a Nonpareil, Merced, and Thompson almond orchard in Chowchilla, CA. Three treatments were replicated 4 times in a randomized complete block design. The treatments were 4 gal/ac crude almond oil plus 1% emulsifier Triton X-363M, 2 lb/ac of a wettable powder formulation of 30% crude almond oil and 30% ground press cake, and an untreated control. Each replicate was 12 rows wide by 9 trees long, ca. 1.4 acres. The materials were applied on July 29 as the Nonpareils began to split and again on Aug. 30 as the Merceds and Thompsons began to split. They were applied with a Best Air blast orchard sprayer operating at 100 PSI with a delivery rate of 100 gal water/ac. Except for a dormant spray, no insecticides had been applied to the orchard.

The plots were monitored for NOW activity by inspecting 100 nuts per plot weekly after 100% hull-split (8/15 through 9/26). The nuts were collected from the center of each plot. The first two collections were from the Nonpareil variety and the last four from the Merced variety. The final harvest was 250 nuts per plot. There was no final harvest of the Nonpareil variety because the grower harvested and picked up the nuts without telling us.

Ovipositional activity of NOW was monitored by placing 3 standard NOW egg traps in each plot and inspecting the traps twice a week. The exact date the egg traps were inspected varied somewhat because of irrigation in the orchard. The grower did not want us to enter the orchard when it was wet.

The results of this study were quite interesting and a bit confusing. Ovipositional activity, as measured by the egg traps, was quite low in all plots after the initial application on July 29 (Table 9). The activity increased during August, reaching a peak of 14.6 eggs/trap/day on Aug. 29 in the oil plus press cake plots. After the second spray on Aug. 30, the trap counts decreased to a very low level, even in the untreated

Table 9. Ovipositional disruption of navel orangeworm by almond oil or almond oil plus press cake, as measured by egg traps - 1983

Treatment	Mean* number of NOW eggs per trap per day on:									
	8/8	8/17	8/22	8/25	8/29	9/7	9/12	9/16	9/19	9/23
Untreated	0 a	0.09 a	0.67 a	2.03 b	8.12 b	1.04 a	0.70 a	0.46 a	1.03 a	0.44 a
Oil	0 a	0.02 a	0.58 a	3.92 a	9.70 ab	0.63 a	0.62 a	0.27 a	0.50 a	0.52 a
Oil + press cake	0.01 a	0.08 a	1.18 a	2.97 ab	14.62 a	0.21 a	0.13 a	0.40 a	1.55 a	1.29 a

*Means followed by the same letter in a vertical column are not significantly different at the 5% level (DMRT).

plots, and remained low for the rest of the season. This rapid drop in egg deposition in the untreated check is difficult to explain and was not expected since ovipositional activity should have continued to increase. One possible explanation is that the oil or oil plus press cake treatment disrupted ovipositional activity of the moths over the entire plot. If so, our plot size was too small, a phenomenon well known in pheromone disruption studies where large plots are needed to assess the effectiveness of the pheromone. However, we did not expect this would be the case with almond oil since it should be less volatile than most pheromones.

Nut infestation (Table 10) showed a pattern similar to egg deposition on traps. Infestation in the first sample from Nonpareil trees was low and by the second sample, one month after application, the amount of infestation began to increase. The Nonpareil nuts were then harvested and nut collection from Merced trees began. The first two samples from the Merced trees again had low infestation; however by the third sample, the infestation had begun to increase and by the fourth, or final harvest sample, the infestation exploded, reaching a peak of 42% in the oil plus press cake plots. We again speculate that the oil or oil plus press cake suppressed oviposition over the entire experiment because plot size was too small. We also speculate that the oil or oil plus press cake suppressed oviposition or nut infestation for 3 weeks and that the large increase in nut infestation 4 weeks after application resulted from a large population of NOW in the orchard and the dissipation of the odor from the oil or oil plus press cake treatment.

Table 10. Ovipositional disruption of navel orangeworm by almond oil or almond oil plus press cake, as measured by nut infestation - 1983

	Mean* percent NOW-infested nuts on:					
	Nonpareil	Nonpareil	Merced	Merced	Merced	Merced
Treatment	8/15	8/22	9/7	9/12	9/19	9/26
Untreated	0 a	2.0 a	0.5 a	0.3 a	5.0 a	39.0 ab
Oil	0 a	0.5 a	1.8 a	0.8 a	2.5 a	32.3 b
Oil + press cake	1.0 a	2.5 a	0.8 a	1.0 a	4.3 a	42.0 a

*Means followed by the same letter in a vertical column are not significantly different at the 5% level (DMRT).

C. Conclusions

Crude almond oil does not appear to be phytotoxic to the almond tree at commercially acceptable rates of application. It does show some effect at higher rates (10-20 gal/100 gal water).

The disruption of NOW oviposition with crude almond oil shows some promise. The oil appears to suppress oviposition for 3 to 4 weeks after application. Although our plot design was insufficient to provide a definitive answer as to the ultimate effectiveness of crude almond oil, this appears to be a promising area of research which might provide adequate control of NOW without a disruptive effect on predators and parasites. Thus, mite problems which sometimes result from use of insecticides might be eliminated and the parasites of the NOW might become more firmly established.

III. American Plum Borer Control

American plum borer (APB) is a serious pest of young almond trees (2-4 leaf) from Merced County north. It damages the young trees by feeding in the cambium tissue at the junction of the trunk and main scaffold limbs. When APB attacks at this site, it weakens or kills the scaffold limb, causing the tree to become less productive and necessitating its removal. When trees are heavily infested, all the scaffolds may die or become weakened to such an extent that they break off the tree. We therefore initiated a research project to develop control methods for this pest. The results of this research are reported here.

A. Effect of Various Inseticides Combined with White Paint

Five insecticides, each mixed with white latex paint, and paint alone were tested. The treatments and an untreated check were replicated 10 times in a randomized complete block design in a Nonpareil, Carmel, and Price almond orchard in Merced Co. The entire trunk up to the branching of the secondary scaffolds was sprayed on March 31, May 31, and July 19. The number of frass piles or active feeding sites on the trees were counted on 9 dates. The frass piles were removed from the trees after each count so that fresh feeding sites could be determined. We did not dig into the trees to find the larvae. A second trial was conducted in the same manner in a Nonpareil, Carmel, and Peerless almond orchard.

Based on these two trials (Tables 11 and 12), it appears that any of the tested insecticides in combination with paint gave excellent control. Paint alone had some effect, but it was

Table 11. Effect of various insecticides in combination with paint on the control of American plum borer - trial 1 - 1983

	Lbs	Mean* number of frass piles per tree on:								
Material	ai/ac	5/3	5/17	5/31	6/15	6/29	7/19	8/4	8/30	9/28
Sevin + paint**	3.2	0	0 a	0 a	0.1 a	0 a	0 a	0 a	0 a	0.1 a
Lorsban + paint	1.0	0	0 a	0 a	0 a	0 a	0 a	0 a	0 a	0 a
Pounce** + paint	0.4	0	0 a	0 a	0 a	0 a	0 a	0 a	0 a	0 a
Thiodan + paint	2.5	0	0 a	0 a	0.2 a	0 a	0 a	0 a	0 a	0 a
Supracide + paint	3.0	0	0 a	0 a	0 a	0 a	0 a	0 a	0 a	0.2 a
Paint alone	-	0	0.8 b	5.2 b	1.4 a	1.5 a	0.7 b	1.1 a	0.5 a	1.8 b
Untreated	-	0	0.9 b	14.0 c	9.7 b	5.8 b	2.1 b	2.6 b	1.4 b	2/4 b

*Means followed by the same letter in a vertical column are not significantly different at the 5% level (DMRT).

**For the March 31 treatment the paint mixture was 1:3 paint:water applied at 1.6 pt/tree, or 4 gal/ac; Pounce was applied at 0.8 lb/ai/ac. For the May 31 and July 19 treatments, the paint mixture was 1:4 paint:water applied at 1.2 pt/tree, or 2.4 gal/ac.

Table 12. Effect of various insecticides in combination with paint on the control of American plum borer - trial 2 - 1983

	Lbs	Mean* number of frass piles per tree on:								
Material	ai/ac	5/3	5/17	5/31	6/15	6/29	7/19	8/4	8/30	9/21
Sevin + paint**	3.2	0	0 a	0 a	0 a	0 a	0 a	0 a	0 a	0 a
Lorsban + paint	1.0	0	0 a	0 a	0 a	0 a	0 a	0 a	0 a	0 a
Pounce + paint	0.4	0	0 a	0 a	0 a	0 a	0 a	0.1 a	0 a	0 a
Thiodan + paint	2.5	0	0 a	0 a	0 a	0 a	0.1 a	0 a	0 a	0 a
Supracide + paint	3.0	0	0 a	0 a	0 a	0 a	0 a	0 a	0 a	0 a
Paint alone		0.3 a	0.9 b	1.7 a	0.6 a	0.7 a	0.4 a	0.8 a	0.7 a	1.4 a
Untreated		0.5 a	0.4 ab	2.0 a	0.6 a	1.6 b	2.1 b	2.1 b	2.3 b	3.1 b

*Means followed by the same letter in a vertical column are not significantly different at the 5% level (DMRT).

**The paint mixture was 1:4 paint:water applied at 0.8 pt/tree, or 1.6 gal/ac.

not adequate. Thorough coverage of the trunk and main scaffold limbs is extremely important since treatments appear to be preventive and will not kill larvae present at the time of application.

B. Effect and Longevity of Sevin with and without Paint

Five treatments, including three rates of Sevin with paint, paint alone, and an untreated control, were replicated 10 times in a randomized complete block design in a Carmel almond orchard in Merced Co. The entire trunk up to the branching of the secondary scaffolds was sprayed on July 29. The number of frass piles or active feeding sites per tree were counted on 4 dates. The frass piles were removed from the trees after each count so that fresh feeding sites could be determined. We did not dig into the trees to find the larvae.

The results (Table 13) show that Sevin without paint at the high rate of application gave good control for 1 month after application, while inclusion of paint extended control for 3 months. Control with the 1/2 and 1/4 rates of Sevin with paint began to break down at 2 months after application, and paint alone provided no control.

Table 13. Effect of Sevin with and without paint on the control of American plum borer - 1983

Material	Lb ai/ac	Mean* number of frass piles per tree on: 7/19	8/4	8/30	9/21
Sevin	3.0	0.3 a	0.3 a	2.5 bcd	2.0 a
Sevin + paint**	3.0	0 a	0 a	0.1 a	0.4 a
Sevin + paint	1.5	0 a	0.3 a	1.4 abc	1.9 a
Sevin + paint	0.75	0 a	0 a	0.8 ab	1.5 a
Paint alone	-	1.9 b	2.2 b	3.8 d	4.9 b
Untreated	-	2.1 b	3.1 b	3.4 cd	5.7 b

*Means followed by the same letter in a vertical column are not significantly different at the 5% level (DMRT).

**The paint mixture was 1:4 paint:water applied at 1 pt/tree, or 1.88 gal/ac.

C. Conclusions

Control of American plum borer can be achieved with a number of insecticides when combined with paint. We recommend Sevin because it is currently registered for use on almonds, is reasonably safe to handle, is inexpensive, and provides excellent control for 3 months when combined with paint.

The timing of application is not known at this time. However, the first application should probably be made in late March or early April, with subsequent applications 2 to 3 months apart.