PROJECT No. 99-RC-o0 FINAL REPORT

ANT MANAGEMENT IN ALMONDS, 1999: SAN JOAQUIN VALLEY

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INTRODUCTION AND OBJECTIVES

Southern fire ant, *Solenopsis xyloni* McCook, has become one of the major pests damaging almonds in the last two decades throughout the San Joaquin Valley (SJV). The pavement ant, *Tetramorium caespitum* (Linnaeus) is also damaging, but damage is limited to the northern SJV and Sacramento Valley. The major damage is from ants foraging on the nuts after the nuts are dropped on the ground during harvest, however, significant ant feeding can occur on nuts still hanging in the tree. Damage on the nuts can range from small nicks and holes, which downgrade the crop, to removal of the entire nutmeat, which reduces crop size. Downgrading of the crop, which reduces the premium paid to the grower, is the more important damage. Crop damage of over 25% has been reported from some orchards in 1998.

Until the summer of 1999, Lorsban® (chlorpyrifos) and Pounce® (permethrin) were the only registered insecticides for ant control in almonds. Data from previous trials have shown Pounce to be only marginally effective. Lorsban is one of many organophosphate pesticides which are under scrutiny as part of the Food Quality Protection Act and may not be available to growers in a few years. In 1998 trials was undertaken throughout the San Joaquin Valley to evaluate several new materials for ant control in comparison to Lorsban and to provide efficacy data for registration of alternatives. In 1999 one of the evaluated materials, Clinch® bait, received registration in California. The primary objective in this year's project was to optimize the use of Clinch. Of primary importance was to determine the optimum application timing prior to harvest. A secondary objective was to continue the evaluation of another promising material from last year's experiment. Pyriproxifen bait (Esteem®, Distance®) performed well in 1998 and we wanted to reexamine it.

METHODS AND MATERIALS

The project was established in four locations in the San Joaquin Valley: Kern County, Fresno County, Merced County and San Joaquin County. This was done in order to test the materials over a wide geographic region and also, in the case of San Joaquin Co., to test the materials against the pavement ant which is not a problem in central and southern SJV. Non-bearing orchards were used in Kern, Merced and one of the San Joaquin County locations where unregistered materials were used in order to minimize the necessity for crop destruction. Bearing orchards were used in Fresno and the other San Joaquin County location in which only Clinch, Lorsban and/or Pounce were used.

General Experimental Procedures

The individual experiments were laid out as a randomized complete blocks with multiple factors. The factors were the various insecticides, treatment timing, and baits applied in piles vs. broadcast in two of the locations. Individual plots were approximately 0.25 to 0.33 acres in size. Chemicals evaluated in the trial included chlorpyrifos (Lorsban®), pyriproxyfen (Esteem®, Distance®), abamectin (Clinch®), permethrin (Pounce®), phosmet (Imidan®), bifenthrin (Brigade®, Talstar®) and thiamethoxam (Platinum®).

Tables 1-6. show the treatments, rates, nominal application timing and dates for all locations. All spray treatments were applied at 100 GPA and covered all of the orchard floor within each plot. The broadcast treatments of the granular materials were applied with a Herd electric powered spreader or a handheld "whirlybird" type spreader. The pile applications were placed 80-84 piles per plot in the Kern and San Joaquin locations and 36 piles per plot (one pile per tree) in the Fresno site. The Fresno site also included a treatment where Clinch bait was enclosed in small PVC pipe bait stations which allowed the ants to enter and retrieve bait but did not allow bait to contact the ground or fallen nuts.

The effects of the treatments were evaluated by measuring ant activity during the course of the experiment and measuring nut damage at harvest. Ant activity was measured by "hot-dogging". Small pieces of hotdog were place in plastic snap-cap vials. The vials were placed on the ground 8 or 10 per plot for two hours after which the vials were retrieved and the ants counted and identified. Except in the Fresno site, nut damage at harvest was measured by placing 10 shelled kernels each in PVC pipe bait stations and placed on the ground for from 24 to 96 hours depending on apparent ant activity. From 5 to 8 bait stations per plot were used. The stations were retrieved and the kernels examined for the number and amount of nuts damaged. In the bearing orchards samples were taken from the commercially harvested nuts just prior to picking up. The nuts were cooled down to prevent further feeding and then cracked out and examined for ant damage.

RESULTS AND DISCUSSION

The effects of the treatments on nut damage at harvest are shown in tables 7 – 12. In general, most treatments at least numerically reduced ant damage compared to the untreated check. None of the materials performed as well this year as they did last year including Lorsban. Lorsban was clearly superior in ant damage reduction at all locations except Kern County in 1998, however this year it performed well only in the Merced non-bearing and San Joaquin bearing orchards (Tables 9, 11 and 12). At the Kern Co. location Clinch was not as effective as it was in 1998. Clinch performed better at the longer pre-harvest intervals of 5 to 7 weeks. This is most clearly shown in the Fresno and Merced sites (Tables 8 and 9). It appears that application of Clinch 3 weeks before harvest does not allow sufficient time for foraging ants to be reduced significantly. There is some suggestion in the data that 7 weeks is about the maximum amount of time to apply Clinch before harvest in order to prevent its losing effectiveness before harvest of pollinator varieties.

The material that performed best overall was Esteem bait. This material is not registered at present and was tested in the non-bearing orchards only (Tables 7, 9 – 10). This was also one of the better performing materials in 1998. Esteem is an insect growth regulator that affects the queen's reproductive ability but does not have any significant toxicity to foraging ants. Therefore it must be applied well in advance of harvest in order to allow natural mortality to decimate the foraging portion of the population. This is most clearly shown in the Kern and Merced Co. sites (Tables 7 and 9) where the 7 week pre-harvest timing was the most effective. Data from the 1998 trials indicated that Esteem can remain effective for up to 12 weeks.

Data from the Kern Co. trial in 1998 showed a small improvement in performance of the bait where it was applied in small piles rather than broadcast. The influence of this method of bait application was investigated in two locations this year: Kern and Fresno Counties. The results (Table 13) show no significant difference between application methods. This indicates that the ants can forage well enough to allow flexibility in applying the material to compensate for varying orchard situations.

Other materials in the trial included permethrin (Pounce®) which once again demonstrated its ineffectiveness (Table 11, 12). Bifenthrin (Capture, Brigade, Talstar) was marginally effective in controlling southern fire ants (Tables 9,10) but by some as yet unexplained mechanism provoked a strong increase in the number of pavement ants (Table 10). Thiamethoxam (Platinum, Actara) also showed the same effect on pavement ants.

SUMMARY
The newly registered insecticide Clinch bait was as effective as Lorsban in reducing damage to almonds in most of the trial locations this year. However, neither one performed as well as in previous trials. It is clear that Clinch must be applied between 5 and 7 weeks before harvest to allow adequate ant population reduction for acceptable control. Potential improvements in effectiveness by sequential or multiple applications need to be evaluated. Other factors that still need to be evaluated to improve performance are the interactions of weeds and cover crops and the effects of temperatures on the rate of foraging on the bait by the ants. Conceivably, cool temperatures during and immediately after application could slow bait uptake and consequently reduce efficacy.

The IGR Esteem/Distance bait continues to show promise as an effective ant control material.

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Table 1. Chemicals and tradenames of insecticides used in project.

Common Name	Trade Names(s)	Chemical Category	Company
Abamectin	Clinch	Fermentation product	Novartis, Inc
Pyriproxifen	Esteem, Distance	Insect Growth Regulator	Valent, Inc
Chlorpyrifos	Lorsban	Organophosphate	Dow Agrosciences
Phosmet	Imidan	Organophosphate	Gowan Corp.
Bifenthrin	Brigade, Capture, Talstar	Pyrethroid	FMC Corp.
Permethrin	Pounce	Pyrethroid	FMC Corp.
Thiamethoxam	Platinum	Neo-nicotinoid	Novartis, Inc.

Table 2. Chemicals, rates, seasonal timing and treatment dates for ant control evaluation in Kern Co. non-bearing orchard.

Material	Rate (Product/Acre)	Date Treated
Lorsban 4E	4 pt.	14-June
Lorsban 4E	4 pt.	9-Aug
Clinch 0.01G	1 lb.	14-June
Clinch 0.01G	1 lb.	27-July
Esteem 0.5G	2 lbs.	14-June
Esteem 0.5G	2 lbs.	20-July
Chlorpyrifos 75WG	2.67 lbs.	15-June
Chlorpyrifos 75WG	2.67 lbs.	10-Aug
Untreated Control		

Table 3. Chemicals, rates, seasonal timing and treatment dates for ant control evaluation in Fresno Co. bearing orchard.

Material	Rate (Product/Acre)	Nominal Timing	Application Method	Date Treated
Clinch 0.01G	1 lb.	3 weeks phi	Piles	4-Aug
Clinch 0.01G	1 lb.	3 weeks phi	Broadcast	4-Aug

Clinch 0.01G	1 lb.	5 weeks phi	Piles	26-Jul
Clinch 0.01G	1 lb.	5 weeks phi	Broadcast	26-Jul
Clinch 0.01G	1 lb.	7 weeks phi	Piles	12-Jul
Clinch 0.01G	1 lb.	7 weeks phi	Broadcast	12-Jul
Clinch 0.01G	1 lb.	3 weeks phi	Bait station	4-Aug
Lorsban 4E	4 qt.	2 weeks phi	Brdcst Spray	9-Aug
Untreated Control				

Table 4. Chemicals, rates, seasonal timing and treatment dates for ant control evaluation in Merced Co. non-bearing orchard.

Material	Rate (Product/Acre)	Nominal Timing	Date Treated
Clinch 0.01G	1 lb.	7 weeks phi	6-July
Clinch 0.01G	1 lb.	5 weeks phi	20-July
Clinch 0.01G	1 lb.	3 weeks phi	3-Aug
Distance 0.5G	2 lb.	7 weeks phi	6-July
Distance 0.5G	2 lb.	5 weeks phi	20-July
Distance 0.5G	2 lb.	3 weeks phi	3-Aug
Lorsban 75W	2.7 lb.	5 weeks phi	20-July
Lorsban 75W	2.7 lb.	3 weeks phi	3-Aug
Lorsban 4E	4 pt.	3 weeks phi	3-Aug
Imidan 70W	5.7 lb.	5 weeks phi	20-July
Brigade 10%	1 lb.	3 weeks phi	3-Aug
Untreated Control			

Table 5. Chemicals, rates, seasonal timing and treatment dates for ant control evaluation in San Joaquin Co. bearing orchard.

Material	Rate (Product/Acre)	Nominal Timing	Date Treated
Clinch	1 lb.	7 weeks phi	14-July
Clinch	1 lb.	4 weeks phi	4-Aug
Clinch	1 lb.	3 weeks phi	13-Aug
Clinch	1 lb.	"Spring"	28-May
Followed by Lorsban EC	4 pt.	3 weeks phi	13-Aug
Lorsban WP	2 lb.	"Spring"+ preharvst	31-May & 13-Aug
Lorsban EC	4 pt.	"Spring"+ preharvst	31-May & 13-Aug
Lorsban EC	4 pt.	3 weeks phi	13-Aug
Pounce 3.2EC	1 pt.	3 weeks phi	13-Aug
Untreated Control			

Table 6. Chemicals, rates, seasonal timing and treatment dates for ant control evaluation in San Joaquin Co. non-bearing orchard.

Material	Rate (Product/Acre)	Application Method	Date Treated
Esteem 0.5G	1.0 lb.	Broadcast	23-June
Esteem 0.5G	1.5 lb.	Broadcast	23-June
Esteem 0.5G	2 lb.	Broadcast	23-June
Esteem 0.5G	1.0 lb.	piles	23-June
Talstar 10WP	2.0 lb.	Broadcast spray	30-Aug
Capture 2EC	13 oz.	Broadcast spray	30-Aug
Platinum 2SC	1 ml/1000 water	Liquid bait station*	23-June
Lorsban 4E	2.0 lb.	Broadcast spray	30-Aug
Untreated Control			

* Platinum 2SC was mixed with 25% wt/wt sugar water at the rate of 1 ml Platinum to 1000 ml water. The solution was held in small vials and placed 8 per replication. Vials were refilled 3 times in the course of the experiment.

Table 7. Nut damage in PVC pipe almond bait stations placed prior to harvest, Kern Co. non-bearing orchard.

Treatment	Application Method	Mean No. Damaged Nuts
Clinch - 6/14	Broadcast	4.167 cd
Clinch - 6/14	Piles	4.367 cd
Clinch - 7/27	Broadcast	4.400 cd
Clinch - 7/27	Piles	5.200 d
Esteem - 6/14	Broadcast	3.000abc
Esteem - 6/14	Piles	2.600ab
Esteem - 7/20	Broadcast	2.433a
Esteem - 7/20	Piles	4.033 bcd
Chlorpyrifos 75W- 8/10		3.633abcd
Lorsban 4E- 8/9		4.667 d
Untreated Control		6.833 e

Means within a column followed by the same letter(s) are not significantly different (DMRT,P=0.05).

Table 8. Ant damage in nut samples from commercial harvest, Fresno Co. bearing orchard.

Treatment	Timing	Application Method	% Damaged Nuts
Clinch 0.01G	3wk phi	Piles	20.84ab
Clinch 0.01G	3wk phi	Broadcast	13.95ab
Clinch 0.01G	3wk phi	Bait Station	9.83a
Clinch 0.01G	5 wk phi	Piles	6.60a
Clinch 0.01G	5wh phi	Broadcast	11.94a
Clinch 0.01G	7wk phi	Piles	10.41a
Clinch 0.01G	7wh phi	Broadcast	9.96a
Lorsban 4E	2 wk phi	Brdcst Spray	10.66a
Untreated			27.80 b

Means within a column followed by the same letter(s) are not significantly different (DMRT,P=0.05).

Table 9. Nut damage in PVC pipe almond bait stations placed prior to harvest, Merced Co. non-bearing orchard.

Treatment	Nominal Timing	Mean No. Culls/10 Nuts
Clinch 7/6	7 weeks phi	2.50 bcd
Clinch 7/20	5 weeks phi	3.24abcd
Clinch 8/3	3 weeks phi	4.72abc
Distance 7/6	7 weeks phi	1.84 cd
Distance 7/20	5 weeks phi	5.32abc
Distance 8/3	3 weeks phi	5.56ab
Lorsban 75W 7/20	5 weeks phi	2.40 bcd
Lorsban 75W 8/3	3 weeks phi	0.52 d
Lorsban 4E 8/3	3 weeks phi	0.40 d
Imidan 7/20	5 weeks phi	2.92abcd
Brigade 8/3	3 weeks phi	4.64abc
Untreated Control		6.44a

Means within a column followed by the same letter(s) are not significantly different (DMRT,P=0.05).

Table 10. Nut damage in PVC pipe almond bait stations placed prior to harvest, San Joaquin Co. non-bearing orchard.

		Fire Ants			Pavement Ants		
Treatment	Appl. Date	Mean No. Ants/pipe	Mean % Consumed	Mean No. Damaged	Mean No. Ants/pipe	Mean % Consumed	Mean No. Damaged
Esteem 1 lb. Broadcast	Jun 23	54.4a	22.8ab	3.7ab	5.2ab	0.5a	0.3a
Esteem 1.5 lb. Broadcast	Jun 23	49.9a	13.5a	2.6a	2.3ab	0.3a	0.4a
Esteem 2 lb. Broadcast	Jun 23	28.5a	16.7a	3.6ab	0.6ab	0.0a	0.0a
Talstar 10 WP .2 lb	Aug 30	69.3a	29.3ab	3.5ab	38.2bc	4.4ab	1.1ab
Capture 2 EC 13 oz	Aug 30	22.6a	16.1a	2.6a	30.6abc	5.2ab	1.7b
Platinum 5 ml	Jun 23	69.7a	15.2a	3.2ab	53.1c	7.9b	2.3b
Esteem 1.0 lb in piles	Jun 23	76.1a	27.8ab	4.9abc	1.8ab	0.0a	0.0a
Lorsban 4E 1 qt.	Aug 30	70.7a	42.7bc	5.5bc	0.2a	0.2a	0.3a
UTC	---------	156.1b	51.1c	7.3c	0.0a	0.0a	0.0a

Means within a column followed by the same letter(s) are not significantly different (DMRT,P=0.05).

Table 11. Nut damage in PVC pipe almond bait stations placed prior to harvest, San Joaquin Co. bearing orchard.

Treatment	Timing	Mean No. Culls/10 Nuts	Mean % Consumed	Mean No. Fire Ants/Station
Clinch 1 lb.	7 wk. PHI	3.1cd	5.7a	34.3a
Clinch 1 lb.	4 wk. PHI	4.8de	21.1b	202.0bc
Clinch 1 lb.	3 wk. PHI	2.3bc	6.5a	90.9ab
Clinch 1 lb +Lorsban WP 2lb	Early +3 wk PHI	0.0a	0.0a	0.0a
Lorsban WP 2 lb.	Early+3 wk PHI	0.0a	0.0a	0.0a
Lorsban EC 2 lb.	Early+3 wk PHI	0.0a	0.0a	0.0a
Lorsban EC 2 lb.	3 wk PHI	0.5ab	4.9a	31.6a
Pounce EC 0.4 lb.	3 wk PHI	6.7e	35.4c	220.5c
UTC	----------	5.0de	30.6bc	237.5c

Means within a column followed by the same letter(s) are not significantly different (DMRT,P=0.05).
PVC Bait stations placed in orchard on 17- August and retrieved on 21-August.

Table 12. Ant damage in 100 nut samples from commercial harvest, San Joaquin Co. bearing orchard.

Treatment	Timing	Mean No. Culls/100 Nuts
Clinch 1 lb.	7 wk. PHI	0.25ab
Clinch 1 lb.	4 wk. PHI	0.0a
Clinch 1 lb.	3 wk. PHI	0.75ab
Clinch 1 lb +Lorsban WP 2lb	Early +3wk PHI	0.0a
Lorsban WP 2 lb.	Early+3wk PHI	0.0a
Lorsban EC 2 lb.	Early+3wk PHI	0.0a
Lorsban EC 2 lb.	3 wk PHI	0.0a
Pounce EC 0.4 lb.	3 wk PHI	1.0ab
UTC	----------	1.25 b

Means within a column followed by the same letter(s) are not significantly different (DMRT,P=0.05).
Harvest on 8=Sept, sampled on 13-Sept.

Table 13. Mean percent ant damage at two locations comparing method of application.

Treatment	Kern Co	Fresno Co.
Bait broadcast	35.0	13.7
Bait in piles	40.5	14.1
Bait in pvc bait stations	——	11.0
	NS	NS

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Clinch 0.01G	1 lb.	5 weeks phi	Broadcast	26-Jul
Clinch 0.01G	1 lb.	7 weeks phi	Piles	12-Jul
Clinch 0.01G	1 lb.	7 weeks phi	Broadcast	12-Jul
Clinch 0.01G	1 lb.	3 weeks phi	Bait station	4-Aug
Lorsban 4E	4 qt.	2 weeks phi	Brdcst Spray	9-Aug
Untreated Control				

Table 4. Chemicals, rates, seasonal timing and treatment dates for ant control evaluation in Merced Co. non-bearing orchard.

Material	Rate (Product/Acre)	Nominal Timing	Date Treated
Clinch 0.01G	1 lb.	7 weeks phi	6-July
Clinch 0.01G	1 lb.	5 weeks phi	20-July
Clinch 0.01G	1 lb.	3 weeks phi	3-Aug
Distance 0.5G	2 lb.	7 weeks phi	6-July
Distance 0.5G	2 lb.	5 weeks phi	20-July
Distance 0.5G	2 lb.	3 weeks phi	3-Aug
Lorsban 75W	2.7 lb.	5 weeks phi	20-July
Lorsban 75W	2.7 lb.	3 weeks phi	3-Aug
Lorsban 4E	4 pt.	3 weeks phi	3-Aug
Imidan 70W	5.7 lb.	5 weeks phi	20-July
Brigade 10%	1 lb.	3 weeks phi	3-Aug
Untreated Control			

Table 5. Chemicals, rates, seasonal timing and treatment dates for ant control evaluation in San Joaquin Co. bearing orchard.

Material	Rate (Product/Acre)	Nominal Timing	Date Treated
Clinch	1 lb.	7 weeks phi	14-July
Clinch	1 lb.	4 weeks phi	4-Aug
Clinch	1 lb.	3 weeks phi	13-Aug
Clinch	1 lb.	"Spring"	28-May
Followed by Lorsban EC	4 pt.	3 weeks phi	13-Aug
Lorsban WP	2 lb.	"Spring"+ preharvst	31-May & 13-Aug
Lorsban EC	4 pt.	"Spring"+ preharvst	31-May & 13-Aug
Lorsban EC	4 pt.	3 weeks phi	13-Aug
Pounce 3.2EC	1 pt.	3 weeks phi	13-Aug
Untreated Control			

Table 6. Chemicals, rates, seasonal timing and treatment dates for ant control evaluation in San Joaquin Co. non-bearing orchard.

Material	Rate (Product/Acre)	Application Method	Date Treated
Esteem 0.5G	1.0 lb.	Broadcast	23-June
Esteem 0.5G	1.5 lb.	Broadcast	23-June
Esteem 0.5G	2 lb.	Broadcast	23-June
Esteem 0.5G	1.0 lb.	piles	23-June
Talstar 10WP	2.0 lb.	Broadcast spray	30-Aug
Capture 2EC	13 oz.	Broadcast spray	30-Aug
Platinum 2SC	1 ml/1000 water	Liquid bait station*	23-June
Lorsban 4E	2.0 lb.	Broadcast spray	30-Aug
Untreated Control			

* Platinum 2SC was mixed with 25% wt/wt sugar water at the rate of 1 ml Platinum to 1000 ml water. The solution was held in small vials and placed 8 per replication. Vials were refilled 3 times in the course of the experiment.

Table 7. Nut damage in PVC pipe almond bait stations placed prior to harvest, Kern Co. non-bearing orchard.

Treatment	Application Method	Mean No. Damaged Nuts
Clinch - 6/14	Broadcast	4.167 cd
Clinch - 6/14	Piles	4.367 cd
Clinch - 7/27	Broadcast	4.400 cd
Clinch - 7/27	Piles	5.200 d
Esteem - 6/14	Broadcast	3.000abc
Esteem - 6/14	Piles	2.600ab
Esteem - 7/20	Broadcast	2.433a
Esteem - 7/20	Piles	4.033 bcd
Chlorpyrifos 75W- 8/10		3.633abcd
Lorsban 4E- 8/9		4.667 d
Untreated Control		6.833 e

Means within a column followed by the same letter(s) are not significantly different (DMRT,P=0.05).

Table 8. Ant damage in nut samples from commercial harvest, Fresno Co. bearing orchard.

Treatment	Timing	Application Method	% Damaged Nuts
Clinch 0.01G	3wk phi	Piles	20.84ab
Clinch 0.01G	3wk phi	Broadcast	13.95ab
Clinch 0.01G	3wk phi	Bait Station	9.83a
Clinch 0.01G	5 wk phi	Piles	6.60a
Clinch 0.01G	5wh phi	Broadcast	11.94a
Clinch 0.01G	7wk phi	Piles	10.41a
Clinch 0.01G	7wh phi	Broadcast	9.96a
Lorsban 4E	2 wk phi	Brdcst Spray	10.66a
Untreated			27.80 b

Means within a column followed by the same letter(s) are not significantly different (DMRT,P=0.05).

Table 9. Nut damage in PVC pipe almond bait stations placed prior to harvest, Merced Co. non-bearing orchard.

Treatment	Nominal Timing	Mean No. Culls/10 Nuts
Clinch 7/6	7 weeks phi	2.50 bcd
Clinch 7/20	5 weeks phi	3.24abcd
Clinch 8/3	3 weeks phi	4.72abc
Distance 7/6	7 weeks phi	1.84 cd
Distance 7/20	5 weeks phi	5.32abc
Distance 8/3	3 weeks phi	5.56ab
Lorsban 75W 7/20	5 weeks phi	2.40 bcd
Lorsban 75W 8/3	3 weeks phi	0.52 d
Lorsban 4E 8/3	3 weeks phi	0.40 d
Imidan 7/20	5 weeks phi	2.92abcd
Brigade 8/3	3 weeks phi	4.64abc
Untreated Control		6.44a

Means within a column followed by the same letter(s) are not significantly different (DMRT,P=0.05).

Table 10. Nut damage in PVC pipe almond bait stations placed prior to harvest, San Joaquin Co. non-bearing orchard.

		Fire Ants			Pavement Ants		
Treatment	Appl. Date	Mean No. Ants/pipe	Mean % Consumed	Mean No. Damaged	Mean No. Ants/pipe	Mean % Consumed	Mean No. Damaged
Esteem 1 lb. Broadcast	Jun 23	54.4a	22.8ab	3.7ab	5.2ab	0.5a	0.3a
Esteem 1.5 lb. Broadcast	Jun 23	49.9a	13.5a	2.6a	2.3ab	0.3a	0.4a
Esteem 2 lb. Broadcast	Jun 23	28.5a	16.7a	3.6ab	0.6ab	0.0a	0.0a
Talstar 10 WP .2 lb	Aug 30	69.3a	29.3ab	3.5ab	38.2bc	4.4ab	1.1ab
Capture 2 EC 13 oz	Aug 30	22.6a	16.1a	2.6a	30.6abc	5.2ab	1.7b
Platinum 5 ml	Jun 23	69.7a	15.2a	3.2ab	53.1c	7.9b	2.3b
Esteem 1.0 lb in piles	Jun 23	76.1a	27.8ab	4.9abc	1.8ab	0.0a	0.0a
Lorsban 4E 1 qt.	Aug 30	70.7a	42.7bc	5.5bc	0.2a	0.2a	0.3a
UTC	---------	156.1b	51.1c	7.3c	0.0a	0.0a	0.0a

Means within a column followed by the same letter(s) are not significantly different (DMRT,P=0.05).

Table 11. Nut damage in PVC pipe almond bait stations placed prior to harvest, San Joaquin Co. bearing orchard.

Treatment	Timing	Mean No. Culls/10 Nuts	Mean % Consumed	Mean No. Fire Ants/Station
Clinch 1 lb.	7 wk. PHI	3.1cd	5.7a	34.3a
Clinch 1 lb.	4 wk. PHI	4.8de	21.1b	202.0bc
Clinch 1 lb.	3 wk. PHI	2.3bc	6.5a	90.9ab
Clinch 1 lb +Lorsban WP 2lb	Early +3 wk PHI	0.0a	0.0a	0.0a
Lorsban WP 2 lb.	Early+3 wk PHI	0.0a	0.0a	0.0a
Lorsban EC 2 lb.	Early+3 wk PHI	0.0a	0.0a	0.0a
Lorsban EC 2 lb.	3 wk PHI	0.5ab	4.9a	31.6a
Pounce EC 0.4 lb.	3 wk PHI	6.7e	35.4c	220.5c
UTC	----------	5.0de	30.6bc	237.5c

Means within a column followed by the same letter(s) are not significantly different (DMRT,P=0.05).
PVC Bait stations placed in orchard on 17- August and retrieved on 21-August.

Table 12. Ant damage in 100 nut samples from commercial harvest, San Joaquin Co. bearing orchard.

Treatment	Timing	Mean No. Culls/100 Nuts
Clinch 1 lb.	7 wk. PHI	0.25ab
Clinch 1 lb.	4 wk. PHI	0.0a
Clinch 1 lb.	3 wk. PHI	0.75ab
Clinch 1 lb +Lorsban WP 2lb	Early +3wk PHI	0.0a
Lorsban WP 2 lb.	Early+3wk PHI	0.0a
Lorsban EC 2 lb.	Early+3wk PHI	0.0a
Lorsban EC 2 lb.	3 wk PHI	0.0a
Pounce EC 0.4 lb.	3 wk PHI	1.0ab
UTC	----------	1.25 b

Means within a column followed by the same letter(s) are not significantly different (DMRT,P=0.05).
Harvest on 8=Sept, sampled on 13-Sept.

Table 13. Mean percent ant damage at two locations comparing method of application.

Treatment	Kern Co	Fresno Co.
Bait broadcast	35.0	13.7
Bait in piles	40.5	14.1
Bait in pvc bait stations	——	11.0
	NS	NS