Project Number: 83-C7

ANNUAL REPORT - 1983

INTEGRATED PEST MANAGEMENT FOR ALMONDS

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11TH ANNUAL ALMOND RESEARCH CONFERENCE, DECEMBER 6, 1983, FRESNO, CALIFORNIA

Project No. 83-C7 - Navel Orangeworm, Mite and Insect Research
Integrated Pest Management

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Objectives: (1) Continued education efforts on insect pests of almonds. (2) Cooperate in the production of an "Integrated Pest Management in Almonds" manual to be coordinated by the IPM Manuals Group of the UC Statewide IPM Project. (3) Validate a presence-absence sampling scheme for spider mites in almonds. (4) Determine control action guidelines for ants in Kern County.

Interpretive Summary: As part of this project, traps and other supplies were provided to cooperating Farm Advisors and Area IPM Specialists for use in validating and extending phenology models for the navel orangeworm, the San Jose scale, the peach twig borer, and the oriental fruit moth.

Progress on a manual for "Integrated Pest Management in Almonds" being coordinated by the IPM Manuals Group of the UC/IPM Project is continuing. Present funding for the production of this manual comes entirely from the UC Statewide IPM Project.

A presence-absence sampling plan for spider mites in almonds developed in cooperation with Dr. Marjorie Hoy was tested intensively in the Durham and Fresno areas with considerable success. The plan allows *Tetranychus* mite and predator population densities to be determined without actually counting the number of mites per leaf, but rather by counting the proportion of infested leaves.

Ant damage threshold studies were concluded this year in Kern County. Counting ant colonies per given area and days post shaking will provide an estimate of ant damaged nuts that might be expected.

1983 was the third full year of my association with this project. The objectives for 1983 were:

1) Continued education efforts on insect pests of almonds.
2) Cooperate in the production of an 'Integrated Pest Management in Almonds' manual.
3) Validation of a presence-absence sampling scheme for spider mites in almonds.
4) Conclusion of research to develop control action guidelines for the southern fire ant.

Objective 1, Educational Efforts.

Traps and other supplies were provided to cooperating Farm Advisors and Area IPM Specialists for use in validating and extending phenology models for the navel orangeworm, the San Jose scale, the peach twig borer, and the oriental fruit moth. These individuals used the materials in their ongoing educational progams, providing growers and pest control advisors an opportunity to compare their observations to those of UC staff.

Information about sampling and monitoring for the oriental fruit moth has drawn together into a UC publications by Craig Weakley, Dick Rice, and Frank Zalom (Appendix I) similar to those already published for peach twig borers, and San Jose scales.

Data obtained from prior year's validation of winter sanitation procedures was summarized in both a grower publication (Appendix II) and a California Agriculture article now in press (Appendix III).

Objective 2, IPM Manual

Progress on a manual for "Integrated Pest Management in Almonds" is being made by its coordinator, Ms. Barbara Peterson. The Almond Board contributed support in FY 1982-83 to initiate writing of the manual. Present funding for its production comes entirely from the UC Statewide IPM Project. Most of the photographs have been taken, and a second draft of many of the chapters is now being reviewed. We hope to have a manual in print by the next research conference.

Objective 3, Spider Mite Monitoring.

During the summers of 1977 and 1978, Marjorie Hoy conducted a survey of almond orchards to determine the regional and within tree distribution of predatory and plant-feeding mites in almond orchards throughout the Central Valley. Much of this data has been used in developing her pesticide resistant strains of the predator *Metaseiulus occidentalis*, and then conducting a field implementation program of predator introductions and mite management. Several orchards were sampled with sufficient intensity and detail as to permit an analysis of within-tree distribution and clumbing patterns of predatory and web-spinning mites. This information was adapted to a presence-absence type of sequential sampling, and validation was initiated in 1982 and continued in 1983. Adaptive research was also conducted to address several areas essential to a monitoring program.

During the summer of 1983, two orchards were monitored 1) to determine the rate of increase of spider mite populations exposed to different insecticide treatments, 2) to determine predator-prey ratios that would cause a spider mite population to decline at different densities, 3) to determine the effect of different spider mite insecticides on native *M. occidentalis* populations, and 4) to validate provisional treatment thresholds. The orchards chosen were in Durham, Butte County, and in Fresno County. Cooperators were Bill Barnett, Craig Weakley, and Joe Connell. Applications of azinphosmethyl, carbaryl, and perimethrin were timed to the normal May spray and in a different block to the July hull-split spray. Each treatment was monitored weekly using the presence-absence technique for both *Tetranychus* spp. and *M. occidentalis*. Our results are presented on Figres 1, 2, 3, and 4.

Our results indicate that some natural resistance to azinphosmethyl was present in the Durham orchard. This was likely due to greater amounts of that insecticide used in that area than in the Fresno County area where all three insecticides caused greater mite build-ups than the control plots.

Preliminary analysis of our data show that there is no difference in the rate of Tetranychus increase after the trees reached 5% infested between any of the carbaryl, permethrin, or the Fresno County azinphosmethyl plots. Likewise,there was no difference between the control or Durham azinphosmethyl plots. However, the two groups were significantly different from one another. The same general trend held for the effect of the different treatments on M occidentalis populations, with the control plots and the Durham azinphosmethyl plots being much lower than the others.

Data on the analysis of predator-prey ratios at different spider mite densities has yet to be analyzed.

Information on using the presence-absence sampling plan for Tetranychus spp. mites was presented at several meetings, and a handout describing the program including a sampling form was available at the research conference in Fresno (Appendix IV). Much of our initial work has been prepared in manuscript form, and has been submitted to California Agriculture (Appendix V - In press), and Hilgardia (Appendix VI and VII).

Objective 4, Ant Thresholds.

During 1982 and 1983, research was conducted with Walt Bentley in Kern County to determine damage thresholds for southern fire ants in almond, and to improve monitoring and control actions. Much of this data was presented in a handout describing the program presented at the research conference in Fresno (Appendix VIII).

The easiest time of the year to find ant hills is in the spring or shortly after an irrigation because the soil on top of the mound is of a different color and texture to the surrounding soil. A general orchard floor survey should be conducted at this time to locate areas of significant ant activity within each block.

At least 14 days prior to harvest, the infested areas should be re-examined more critically to determine the average number of colonies per square feet. It is different to determine where one colony begins and another ends. We have observed that most ant colonies shift their entrances during the season. Colony entrances with ant activity have been observed to move more than three feet, so we assume that colony entrances separated by less than three feet are all part of the same colony. Ant activity was observed to peak in the morning and again just before sunset, and these are the best times to count colony entrances.

Damage levels at different colony abundance though time is presented on Figure 5. The three lines are significantly different from one another by a multiway analysis of variance. The fit of each regression line to the data is significant ($p<0.05$). Note that damage increases with the number of days that nuts remain on the ground. Table 1 shows the same relationship in terms of average number of colonies per 5000 square foot sampling area.

The design for obtaining the damage levels presented in this report was as follows. Ten replicates were created. The number of ant colonies per replicate was reduced to one by poisoning all colonies other than a marked central colony. The area was re-examined several times to insure that only one colony persisted in the area. All other colonies were poisoned. Just prior to infestation, circles were marked with radii of 3', 6', and 10' from the central colony. Remaining colonies for 20' beyond the central colony were poisoned by spot-treatment. The entire area was infested with a density of 10-15 nuts per square foot to simulate a normal nut density at harvest. One hundred of the nuts placed in each replicate were hand-cracked to determine any previous damage from ants present in those samples. The colonies were covered with bird netting suspended above the ground on 3' stakes. At each distance at intervals of approximately 2 days, 4 days, 7 days, 14 days and 21 days, 100 nuts were removed from each area (0-3', 3'-6', 6' to 10') surrounding the center colony. These nuts were hand cracked and the proportion of nuts with ant damage recorded. To maintain uniform nut densities in each area, nuts removed were replaced with marked nuts from the same load that was used for the initial infestation.

A trial conducted by Walt Bentley to show the effect on ant activity of watering granular Diazinon provided evidence that watering after applying the granular material will increase the effectiveness of the material, and will extend its effective period. Results of this study are shown on Table 2.

Table 1

SOUTHERN FIRE ANT DAMAGE IN ALMONDS

Mean No. of colonies per 5000 Ft^2	Percent Nut Damage (Days Post Harvest) 4	7	10	14	21
15	0.9	1.6	2.1	3.1	4.9
45	1.4	2.3	3.2	4.7	7.0
185	2.0	3.6	5.0	7.0	11.1

Table 2.

ALMONDS 1983

Effect of Watered and Unwatered Granular Applications On Ant Activity

Treatment[1.]/	Average Activity Rating Per Replicate[2.]/			
	Pretreatment	June 20 (4 days)	June 24 (8 days)	June 29 (13 days)
Untreated	1	1 A*	1 A**	.889 A*
Diazinon 14G @ 5.6 lbs. a.i./ac No watering	1	.50 B	.44 B	.778 AB
Diazinon 14G @ 5.6 lbs. a.i./ac Watered immediately	1	.39 B	.22 B	.333 C
Diazinon 14G @ 5.6 lbs. a.i./ac Water 8 days post application	1	--	watered	.50 BC

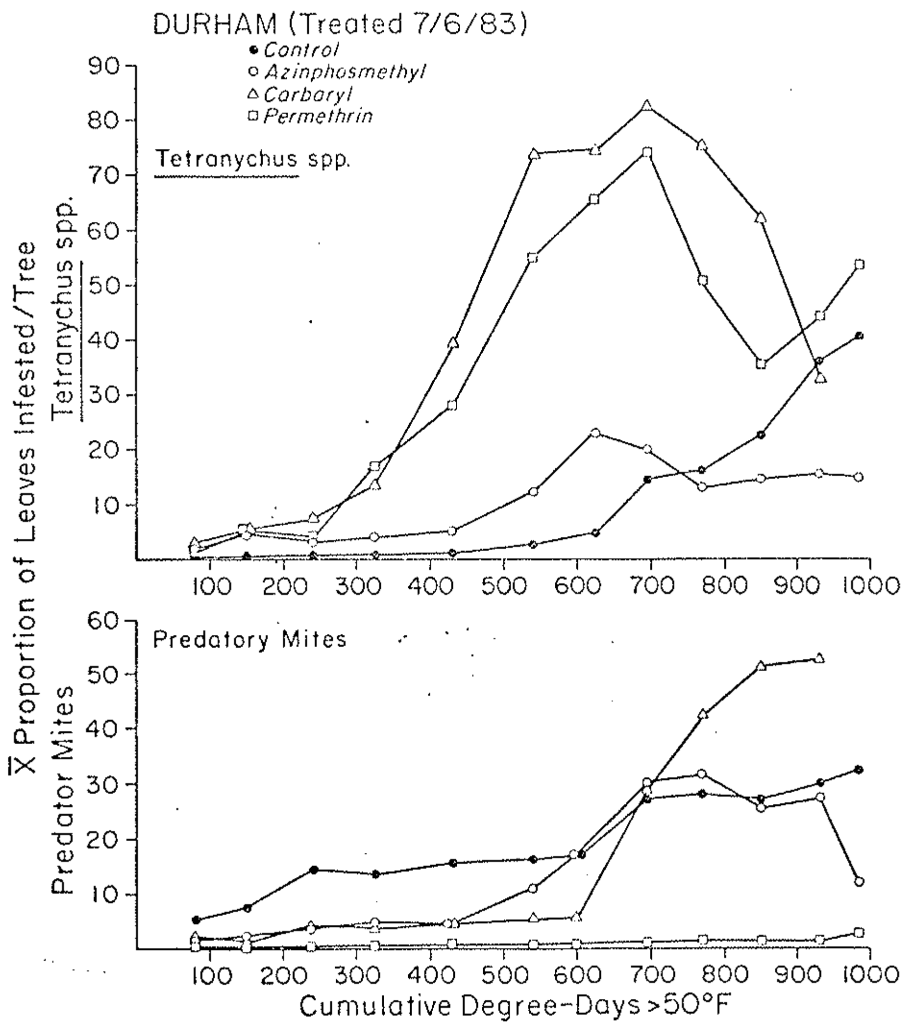
1./ Granular treatments applied on single ant colony located at center of 4 sq. ft. area on June 16, 1983. Watered plots received 1 gallon applied with a Hudson sprayer, Kern County.

2./ Visual colony ratings based on average of 9 reps each with a single colony. Ratings are on a scale of 0 to 1: 0 = no activity, 0.5 = weak colony; 1 = strong colony.

* Treatments followed by the same letter not significant at the 5% level using Duncan's Multiple Range test.

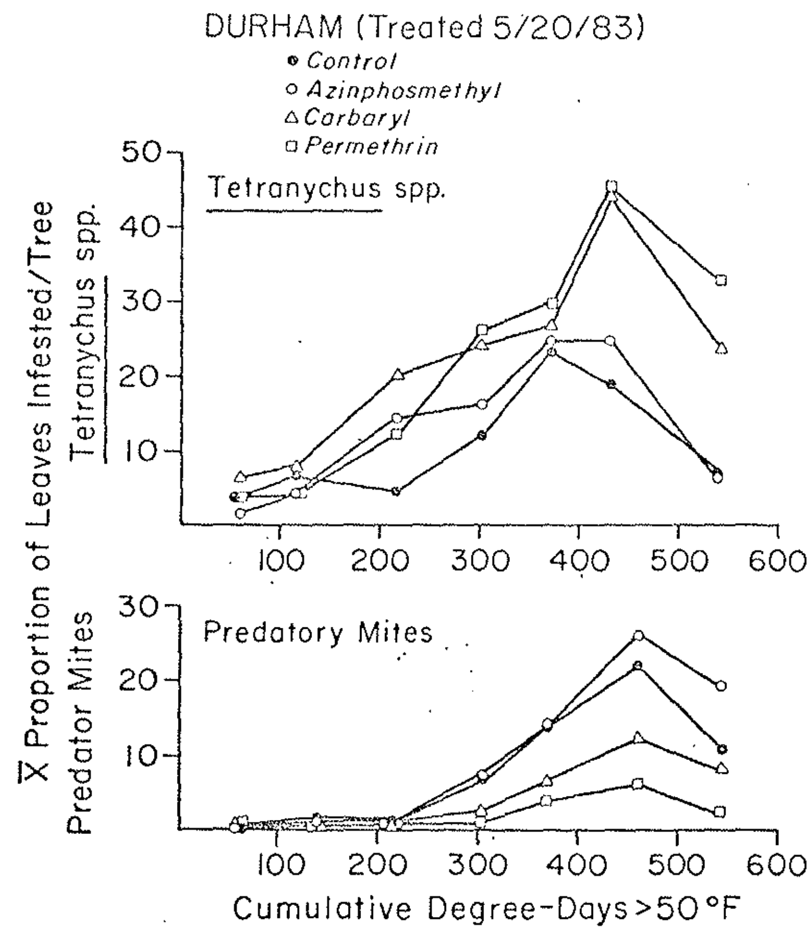
** Treatments followed by the same letter not significant at the 1% level using Duncan's Multiple Range test.

Figure 1

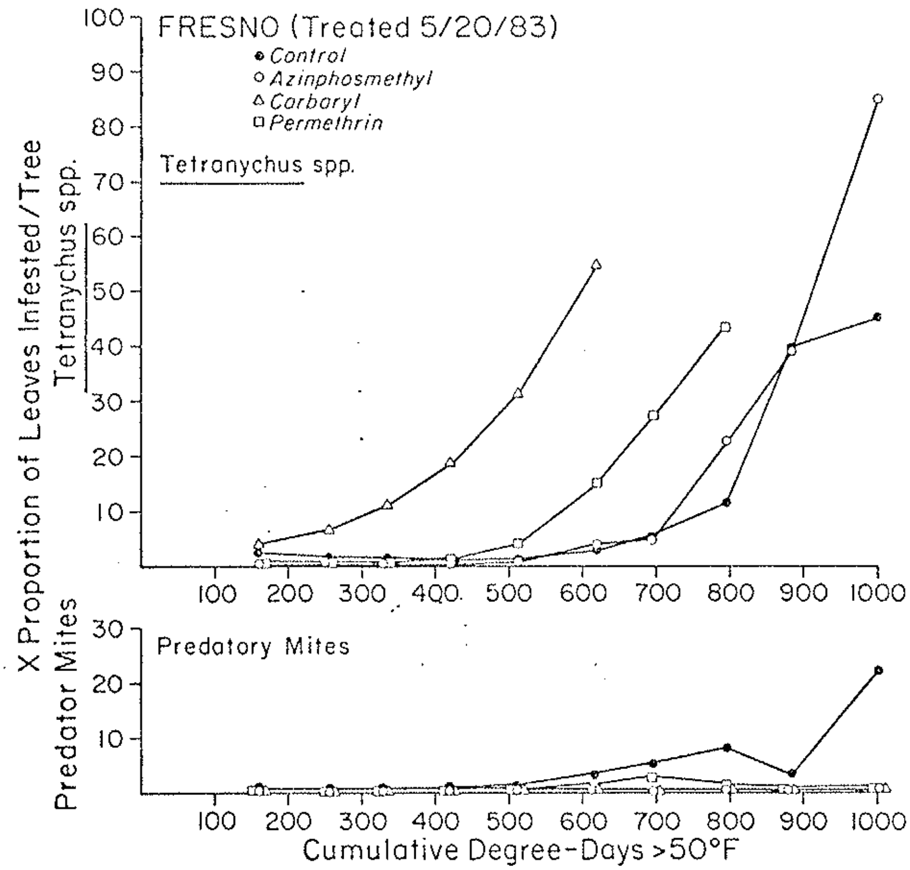


DURHAM (Treated 7/6/83)
• Control
○ Azinphosmethyl
△ Carbaryl
□ Permethrin
Tetranychus spp.
X̄ Proportion of Leaves Infested/Tree
Tetranychus spp.
Predatory Mites
Predator Mites
90
80
70
60
50
40
30
20
10
60
50
40
30
20
10
100 200 300 400 500 600 700 800 900 1000
Cumulative Degree-Days >50°F

Figure 2



DURHAM (Treated 5/20/83)
Control
Azinphosmethyl
Carbaryl
Permethrin
Tetranychus spp.
Predatory Mites
X̄ Proportion of Leaves Infested/Tree
Tetranychus spp.
Predator Mites
Cumulative Degree-Days >50 °F
50
40
30
20
10
30
20
10
100 200 300 400 500 600
100 200 300 400 500 600



FRESNO (Treated 5/20/83)
Control
Azinphosmethyl
Carbaryl
Permethrin
Tetranychus spp.
X Proportion of Leaves Infested/Tree
Tetranychus spp.
100
90
80
70
60
50
40
30
20
10
100 200 300 400 500 600 700 800 900 1000
Predatory Mites
Predator Mites
30
20
10
100 200 300 400 500 600 700 800 900 1000
Cumulative Degree-Days >50°F

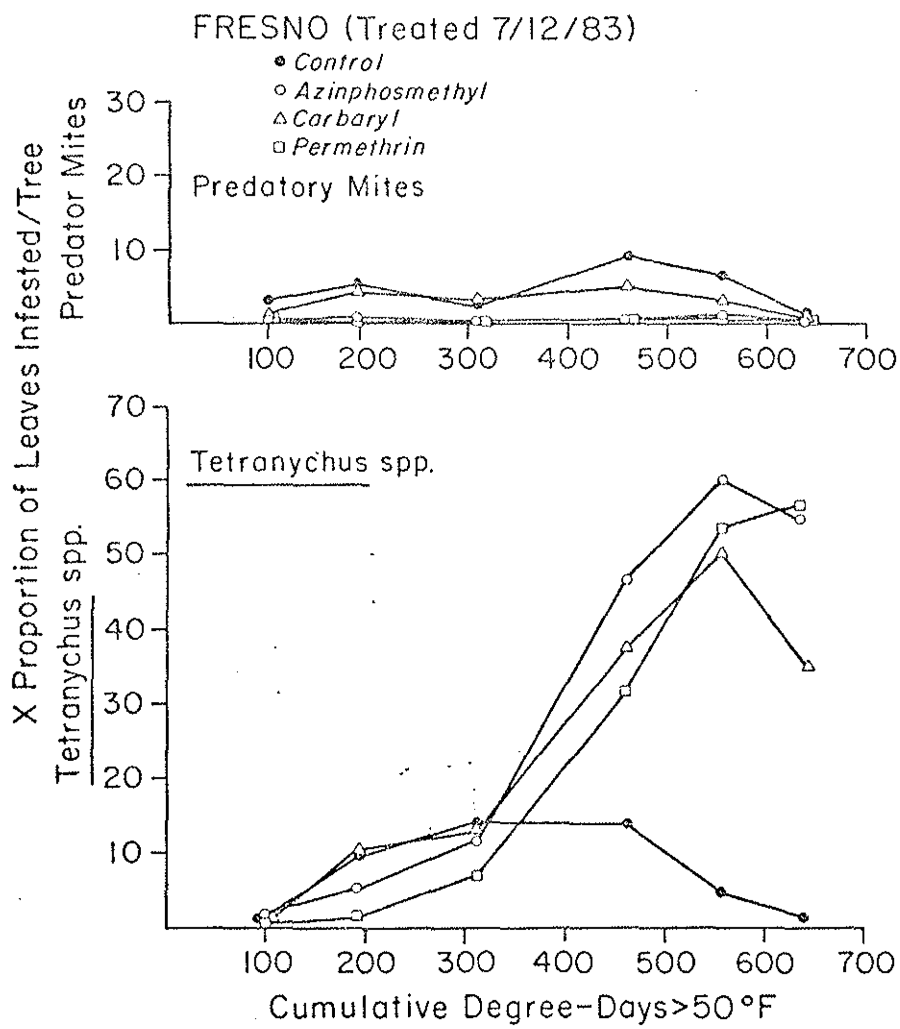
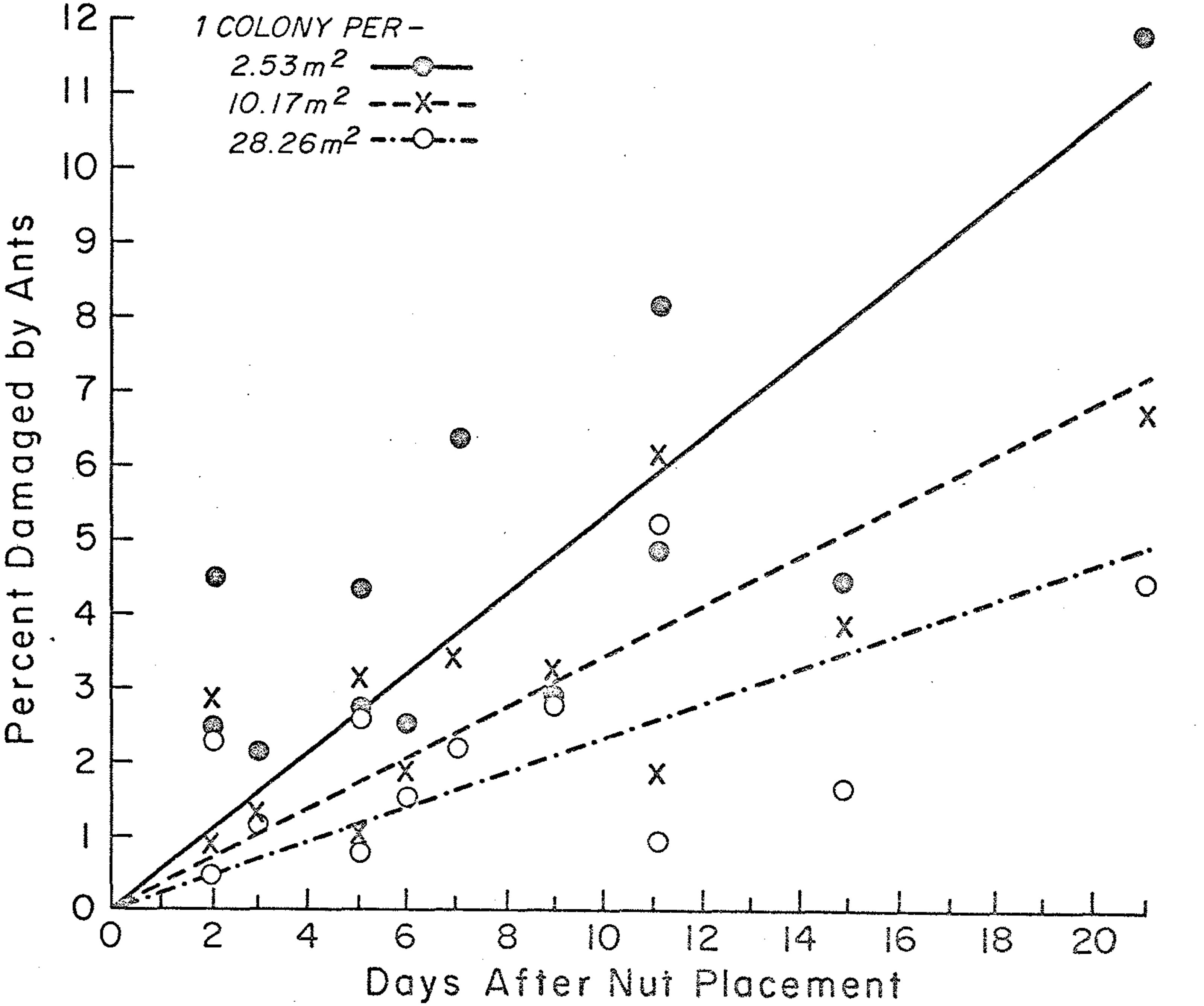

FRESNO (Treated 7/12/83)
Control
Azinphosmethyl
Carbaryl
Permethrin
Predatory Mites
Predator Mites
X Proportion of Leaves Infested/Tree
Tetranychus spp.
Cumulative Degree-Days>50°F
30
20
10
70
60
50
40
30
20
10
100
200
300
400
500
600
700

FIGURE 5



1 COLONY PER -
2.53 m2
10.17 m2
28.26 m2
Percent Damaged by Ants
Days After Nut Placement
0
1
2
3
4
5
6
7
8
9
10
11
12
0
2
4
6
8
10
12
14
16
18
20