Project Number 79-E6

INVESTIGATIONS ON CONTROL OF THE NAVEL ORANGEWORM AND MITES ON ALMONDS - 1979

Report in Acaricide Sprays

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Summary of Results of Navel Orangeworm and Mite Studies, 1979

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These investigations were conducted in Kern County.

NAVEL ORANGEWORM

(a) Permethrin (Ambush or Pounce) provides a high degree of moth mortality (86% reduction in egg laying over 18 days). Additional larvicidal action is provided. This insecticide is not registered at present.

(b) Results of the past season in a 5-acre block treated with permethrin (0.4 lbs AI/acre) were as follows: 3 applications (May, hullsplit, and hullsplit plus 16 days) gave 94% control reducing infestation from 23% to 1.3%; 2 applications (May and hullsplit) gave 84% control, 3.6% infested at harvest; and 1 application (May only) gave 66%, 7.8% infested at harvest.

(c) However, when applied in May, permethrin created such a severe mite problem that 2 treatments (one by ground and one by helicopter) failed to control them. Therefore, emphasis will be placed on its use at initiation of hullsplit and again at about 50% hullsplit. When permethrin has been used during the hullsplit period, normal applications for mite control, as used in Kern Co. have been sufficient. However, use of miticides is necessary in order to provide mite control, if this practice is not part of the usual spray program.

(d) Better results (in large plot speed sprayer trials in a heavy infestation) were obtained with Guthion when applied at the 45 days before harvest timing (46% control) as compared with a May timing (27% control). In some seasons, however, as high as 85% control has resulted from a May spray of Guthion. The difficulty with the May spray with Guthion lies in accurate timing. Improvements are being sought in this matter (see below).

(e) A heat summation model of navel orangeworm development is being developed. The threshold for egg development is 55°F. Egg hatch begins after accumulation of 99 degree-days above this threshold and is complete after 110 degree-days. Heat summation data on development from egg hatch to emergence of adults is being obtained. Matters relevant to accurate spring timing of Guthion are: (1) a substantial portion of the eggs laid during the first part of the season give rise to moths before hullsplit occurs; (2) since Guthion does not provide significant moth kill, May timing must be accurate and directed primarily against newly hatched larvae which yield moths emerging at and after hullsplit. The development of a heat summation model will aid in better timing of spring sprays.

(f) Other results of large-plot speed sprayer trials showed that Supracide applied in May (1) did not control adults and (2) failed to provide adequate larval control. Imidan applied at hullsplit provided 33% control.

(g) Comparisons of insecticides for navel orangeworm control were conducted in small plots at hullsplit timing. These trials show larvicidal action only. Fenvalerate (Pydrin) and AC222-705 head the list in the current trial followed closely by permethrin and Guthion, the latter timed at 45 days before harvest. All of these except Guthion are pyrethroids. These were followed in close order by Larvin, Imidan and Sevin.

WEBSPINNING MITES

(h) In the study of effects of mites on almond trees, readings were taken in 1979 of effects on tree growth resulting from mite infestations in 1978. Mites reduced the leaf size of the next season by 7% and terminal growth by 25% (19:1 odds). An experiment with 18 replications was initiated in 1979 using 4 different levels of mite infestation, ranging from virtually none to severe, seeking information on the relationships between these different levels and effects (which will show up next year) on tree growth and productivity. From these data we can determine the "tolerance level" of almond trees for mite infestation. Severe mite feeding reduces photosynthesis by as much as 40% and transpiration up to 45%. The relationships between degree of reduction in photosynthesis and transpiration in 1979 vs. productivity and vegetative growth in 1980 will be characterized next year. Rapid means of estimating cumulative mite damage are being investigated.

(i) Five experimental acaricides were evaluated for their effect on both spider mite and beneficial populations. Data concerning 24 hr and 72 hr mortality rates was obtained in two orchards, while residual control was evaluated for a 2-week period in a single orchard.

(j) Four dosages of granular Aldicarb 15G (Temik) were evaluated in soil applications in two experiments for efficacy in control of spider mite infestation. The orchards were flood and sprinkler irrigated, respectively. Mite mortality was evaluated for a 60-day period. In the flood irrigated orchard, mites were sufficiently controlled at 41 days after treatment, but not by 60 days. In the sprinkler irrigated orchard, mite control was successful through the season; however, mite populations declined on untreated trees after 28 days.

Investigations on the Control of Navel Orangeworm on Almonds - 1979

Insecticide Performance

Trial for the Control of Navel Orangeworm on Almonds at Hullsplit

C. E. Engle and M. M. Barnes

An experiment was conducted on a portion of a Superior Farms orchard, Kern Co., to compare the efficacy of several insecticides for controlling the navel orangeworm on almonds. This is a continuation of a series of screening trials which compare larvicidal action.

Methods and Materials

The experimental block consisted of flood-irrigated 10-year-old trees. The trees were planted in a 25 X 25-ft planting with alternating double rows of the Nonpareil variety to a single row of the Sauret variety. The experimental design consisted of 14 treatments and 1 check, replicated 10 times in randomized blocks, with single trees serving as the replicated units. Only Nonpareil trees were used.

Treatments (Table 1) were applied using a handgun with a pressure of 400 pounds, providing full coverage; check trees received no treatments.

At harvest all nuts were shaken from each tree onto canvas tarps; these nuts were then sampled, placed in mesh bags, and refrigerated at 40°F until examination. Infestation was tabulated based on a 300-nut sample per tree, totaling 3000 nuts per experimental treatment. Observations were made concerning plant phytotoxicity.

Results

Table 1 presents the average percent of infested almonds per treatment. The pyrethroid treatments, as in previous experiments, were superior in controlling the navel orangeworm; however, a single application of Ambush applied at hullsplit did not perform as well as it has in earlier experiments. In past experiments Ambush and Pydrin have performed equally well. It should be noted that when Ambush is used in a 5-acre block (see next experiment) this provides adult control as well as larvicidal action. Under this circumstance, results of treatments at hullsplit should be materially improved.

Lorsban in previous experiments has been applied at 4.0 lb active ingredient/acre; however, in this experiment, at the manufacturer's suggestion, 2.0 lb AI/A were used. This dosage did not give satisfactory control. No phytotoxicity was observed with any treatment.

Table 1.--Results of replicated experiment on control of navel orangeworm with full coverage sprays[1], Nonpareil variety, McFarland, 1979.

Treatment	Formulation	Lb AI/A	Application date[2] 6-28	7-10	7-24	Avg. % infested at harvest[3]	Average % control
Pydrin	2.4 E	0.2	-	x	-	4.9 a	75
AC 222-705	2.5 E	0.2	-	x	-	5.4 ab	72
Ambush	2 E	0.2	-	x	x	6.5 abc	66
Pounce	3.2 E	0.2	-	x	-	8.1 abc	58
Guthion	50 W	2.0	x	-	-	9.4 cde	51
Larvin	75 W	2.0	-	x	-	9.6 cde	50
Ambush	2 E	0.2	-	-	x	9.6 cde	50
Supracide	2 E	2.0	-	x	-	9.8 cde	50
Imidan	50 W	4.0	-	x	-	10.2 de	47
Ambush	2 E	0.2	-	x	-	10.3 de	47
Sevin	50 W	5.0	-	x	-	11.6 ef	40
Sevin	80 S	5.0	-	x	-	11.8 ef	39
Sevin	4 E	5.0	-	x	-	12.9 ef	33.5
Lorsban	4 E	2.0	-	x	-	14.5 f	25
Check						19.4 g	

[1] Application by handgun at 1500 gal/acre in 10 replicated blocks of single tree plots.

[2] 6-28 = 45 days prior to harvest, 7-10 = 2% hullsplit, 7-24 = 50% hullsplit.

[3] Average of 10 samples, 300 nuts each, harvest 8/20/79, treatment means in the same column followed by the same letter are not significantly different at the 95% confidence level.

Speed-Sprayer, Large Block Experiment for Navel Orangeworm Control

M. M. Barnes, C. E. Engle, and E. F. Laird

This trial was conducted through the cooperation of Superior Farming Co. Several comparisons were made in triplicated blocks of 5-6 acres each as follows: Guthion in May only, 45 days before harvest only, and both of these; Supracide in May only, Imidan at hullsplit only as compared with 3 untreated areas of 1 acre each. In addition, a single block of 5 acres was treated with Ambush in May. This provided the first data on effects of Ambush on moths. Four rows on one edge of the Ambush treated block were treated again at hullsplit. Two of these rows were treated a third time 16 days after hullsplit.

At harvest, samples were taken from each of 15 trees in the center of each 5-6 acre block. Five trees were sampled in the Ambush block in the rows treated again during the hullsplit period.

Results on moth mortality are shown in Table 1. Ambush (permethrin) at 0.4 lbs/acre provided a high degree of suppression of egg laying, an average of 86% reduction over 18 days. This feature of insecticidal action is especially useful in heavy infestations, as it has been shown that insecticides having larvicidal action only seldom provide over 50% control. Permethrin also has good larvicidal action as well. In this trial, Supracide at 2 lbs/acre showed only 34% suppression of eggs for 3 days. In previous studies, neither Guthion nor Imidan have shown reduction in egg deposition.

Results at harvest (Table 2) show that (a) Guthion performed better at the 45-day interval than when used in May; (b) Ambush (permethrin)

Table 1.--Adult mortality of navel orangeworm in treated and untreated plots, Nonpareil, McFarland, 1979.

Material	Rate[1/] AI/acre (lb)	Date of appli- cation	Eggs/trap/day[3/] Pretrt 5/15	5/18	% reduc[2/]	5/26	% reduc	6/2	% reduc
Supracide 2EC	2.0	5/15	4.11	1.26	34	4.10	21	3.49	0
Ambush 2EC	0.4	5/15	5.79	0.30	89	0.13	97	0.35	73
Untreated	--	--	7.90	3.67	--	3.05	--	1.73	--

1/ Applied by airblast sprayer in 350 gal/acre on 5/15/79. All plots were 5.5-6 acres each.

2/ % reduction calculated from Abbott's formula: % reduction = $\frac{p^o - p^c}{100 - p^c}$ X 100, where p^o = % reduction in treated as compared with pretreatment; p^c = % reduction in untreated as compared with pretreatment.

3/ Twenty egg traps per 5-acre block.

Table 2.--Comparison of speed-sprayer schedules for control of navel orangeworm, Nonpareil, McFarland, 1979.

Applications	Method of application	Rate[1/] AI/acre (lb)	Schedule[2/] May 15	June 28	July 10	July 26	% infested kernels at harvest[3/]
1. Guthion 50W	Ground	2.0	X	X ("45) (days)	(Hull-) (split)		12.0
2. Guthion 50W	Ground	2.0		X			12.4
3. Imidan 50W	Ground	4.0			X		15.4
4. Guthion 50W	Ground	2.0	X				16.8
5. Supracide 2EC	Ground	2.0	X				20.1
6. Ambush 2EC	Ground	0.4	X				7.8
7. Ambush 2EC	Ground	0.4	X		X		3.6
8. Ambush 2EC	Ground	0.4	X		X	X	1.3
9. No treatment							22.9

1/ Three replications of 6 acres each, except Ambush, see footnote no. 4. Applications by airblast sprayer in 350 gal/acre. Hullsplit 0-4% at 7/10/79, 50% at 7/29/79.

2/ All treatment plots received Omite 30W by ground application on 6/14/79 and by helicopter on 7/20/79.

3/ Harvested 8/21-22/79. Average of 15 harvest samples; 200 nuts taken at random from each tree.

4/ The Ambush block data for the May treatment (No. 6) is from a single 5-acre block. Four rows at the edge of this block were treated on 7/10 (treatments 7 and 8) and 2 of these rows were treated again on 7/26 (treatment 8).

gave the best control. However, a severe mite problem developed when it was used in May. At present, we believe its use should be confined to the hullsplit period. In past trials, this has not created an unmanageable mite problem; (c) Supracide was not satisfactory in navel orangeworm control; (d) Imidan at hullsplit was equal to Guthion in May.

Provided that an emergency exemption is given for permethrin (Ambush or Pounce), we intend to focus on its use at hullsplit and again about 15 days later. Mites must be controlled if permethrin is used.

Comparison of Ground vs. Aerial Insecticide Applications for Control of the Navel Orangeworm

C. E. Engle and M. M. Barnes

An experiment was performed in a Superior farms orchard to evaluate the efficiency of air vs. ground equipment for insecticide application for navel orangeworm control on almonds.

Methods and Materials

A 75-acre orchard consisting of Nonpareil, Texas Mission, and Merced almonds was divided into 10 plots, 10 rows or 250 ft wide and 50 trees or 1250 ft long. The two types of application were randomly replicated 5 times in a pair-wise fashion (Fig. 1). The schedule of treatments consisted of 2 applications of Guthion 50W. The first application was applied at peak spring oviposition (based on 10 oviposition traps), the second application was applied 53 days prior to harvest. The ground application was applied with an air blast speed sprayer at 350 gal/acre at 150 lbs pressure, with an average ground speed of 2.5 mph. The application by air was by helicopter applied at the same time as above, with an average air speed of 25 mph, using 35-40 gal/acre. Nut samples were taken from 15-tree plots (300 nuts/tree). Sample trees were selected from the center of each plot. The nuts from each tree were bagged, refrigerated and then examined for infestation.

Results

The average percent infestation for replications and for treatments is presented in Table 1. The infestation was light. No significant differences were found between treatment means at the 95% confidence level. However, because of the extremely low infestation level, the question of differences between the 2 application methods was not resolved.

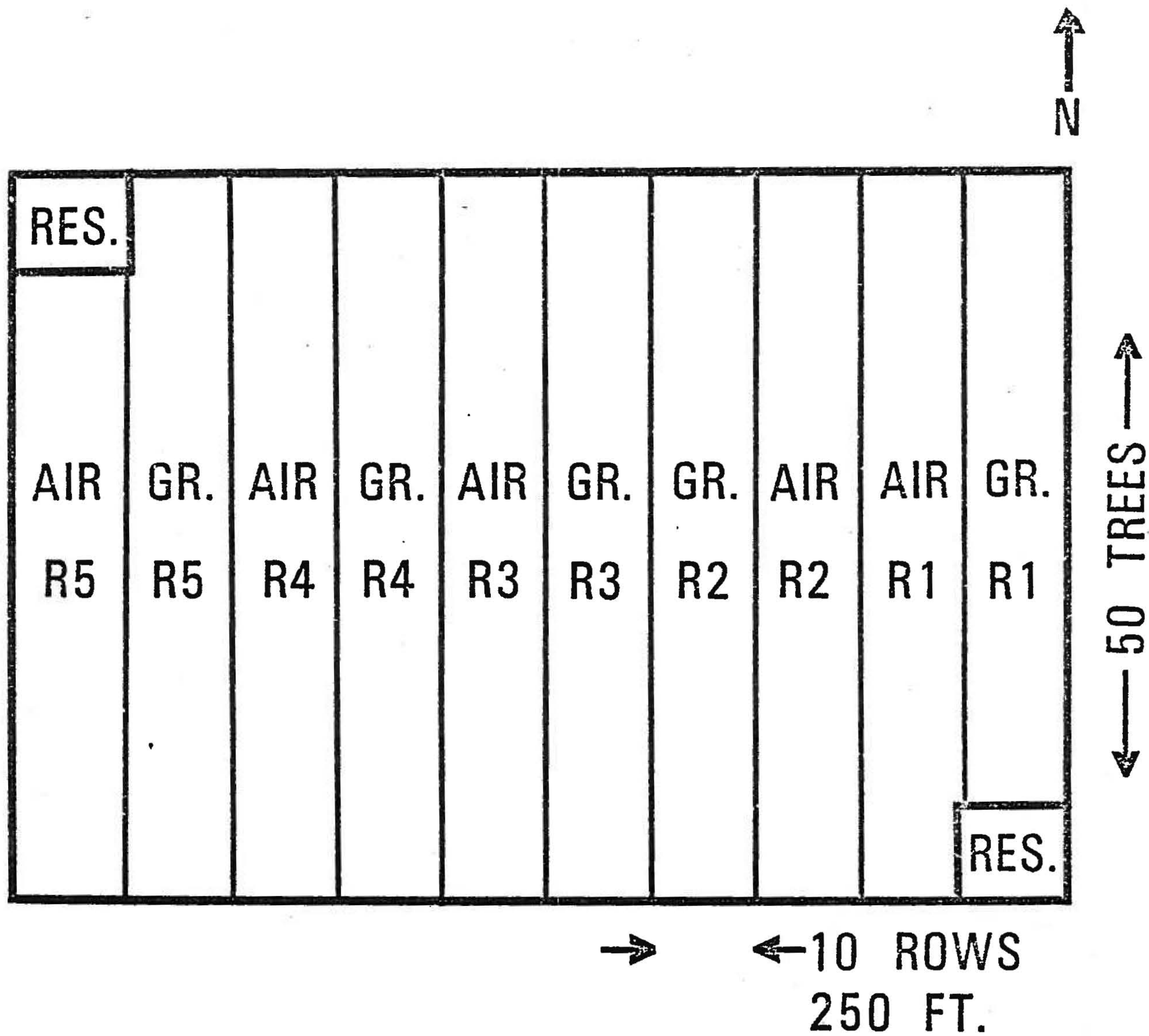

Fig. 1.--Air vs. Ground Application Block Design.

Table 1.--Comparison of treatment methods for control of navel orangeworm, Nonpareil, McFarland, 1977.

Application	Method of application	Rate/ AI/acre (lb)	Gal per acre	mph	Schedule May 17	Schedule June 27	Avg. % infest.[1] replic.	Trt %[2] infest.
Guthion 50WP	Ground (Air) (Blast)	2.0	350	2.5	X	X	I-2.8	1.7 A
							II-1.4	
							III-1.3	
							IV-1.3	
							V-1.5	
Guthion 50WP	Air Helicopter	2.0	40	25-30	X	X	I-3.6	2.2 A
							II-2.2	
							III-1.1	
							IV-1.8	
							V-2.2	

[1]Data based on replicates of 15 trees at 300 nuts per tree.

[2]Means in the same column followed by the same letter are not significantly different at the 95% confidence level.

Efficacy of Spraying Pollinators with Guthion at 45-day Interval for Nonpareil

S. C. Welter and M. M. Barnes

A preliminary study was initiated in July 1979 to evaluate the efficacy of applying Guthion to the pollinator varieties at the 45-day interval for Nonpareil. This trial was conducted in cooperation with LaBorde Farms. The current insecticide programs call for the timing of Guthion to be applied on both Nonpareil and pollinator varieties 45 days prior to harvest of the Nonpareil variety. Therefore, the timing of sprays for navel orangeworm control depends predominantly on the physiological stage of maturity exhibited by the Nonpareil trees. At this particular point in the season, pollinator varieties such as Merced, Texas Mission, etc. have failed to initiate hullsplit. The Merceds and Texas Missions continue to mature resulting in hullsplit 3-4 weeks later. The interval between the initiation of hullsplit in Nonpareil trees and their pollinators will be a function of the varieties planted, the environmental conditions and the cultural conditions of the orchard. The onset of hullsplit will be promoted by higher temperatures as well as a less frequent irrigation schedule.

The stage of nut maturity is important in determining the susceptibility of the crop to navel orangeworm infestation. Prior to hullsplit, the almond is unavailable for infestation because of the tight seal formed by the hull. Because of its impermeable shell, the Texas Mission is non-susceptible to navel orangeworm infestation the entire season.

Guthion, a common insecticide for navel orangeworm control, has been demonstrated to provide larvicidal control yet poor adulticidal action.

Therefore, any adult moths in either the Nonpareil or pollinator varieties will be essentially unaffected by the application of Guthion at hullsplit. Given the fact that certain pollinators at Nonpareil hullsplit are not susceptible to infestation and that Guthion does not provide good adult kill, we attempted to investigate the practice of complete orchard coverage, including both the Nonpareil and pollinator varieties. The alternative would be to spray only the Nonpareil variety while leaving the pollinator varieties completely unsprayed. This practice would have 3 major benefits to the almond grower. The first would be the obvious savings from the reduction in the quantity of insecticide which would be required per acre. The savings would range between 30-50% depending on the ratio of Nonpareil to pollinator varieties as determined by the orchard planting scheme. The second benefit would be the unsprayed rows acting as reservoirs for beneficial predators. The preservation of an innoculation of beneficial insects within the orchard would help avoid the lag period for the beneficial's reinvasion between the time of insecticide application and sufficient control. And, thirdly, the time required for application may be lessened with the decrease in the quantity of water applied and its necessary handling time.

Methods and Materials

Twelve pairs of Merced trees were used in a preliminary trial on LaBorde Farms 3 miles north of Shafter. One tree in each pair was treated with Guthion 50W at 0.45 lb AI/100 gal with high pressure handguns. The trees were sprayed until runoff, approximately 8 gal/tree, approximately 500 gal/acre. The other tree in each pair was left unsprayed.

The application was applied on July 18 about 7 days later than normal timing of a Nonpareil hullsplit spray.

All 12 pairs were sampled on 9/4/79 from all 4 sides of the trees, taking 300 nuts/tree. These samples were subsequently exmained in the lab for infestations of either navel orangeworm or peach twig borer.

Results

The trees treated with Guthion had a mean of 1.0% navel orangeworm infestation, while the unsprayed trees had a mean of 2.1%. While these means proved statistically different, the extremely low infestation levels tended to cloud the results. The question of whether this 1% difference represents a case of 50% control or only a 1% reduction remains unanswered.

Because of the large potential gain for almond growers that may be provided with the system of exclusively spraying the Nonpareil variety, further investigations are planned for the 1980 growing season, including use of pyrethroids.

Progress Report

Degree-Day Summation for NOW Development:

Nocturnal Behavior of NOW Moths

C. E. Engle and M. M. Barnes

We are presently involved in developing a navel orangeworm degree-day model. The ultimate goal for this system is to allow the pest manager or grower to make objective, quantitative decisions for managing the navel orangeworm infesting almonds. The decision-making will be based on having the ability to predict peak spring adult emergence, oviposition and peak egg hatch. The model should also predict following generations and their peak flights in relation to hullsplit.

In last year's report we indicated the need for several specific areas of information:

1. To determine the developmental temperature threshold and heat unit accumulation required to complete development for the NOW egg and larval stages.

2. Establishment of flight, mating and egg laying parameters with an emphasis on temperature thresholds.

3. Knowledge of the rate of development and age structure of the overwintering population prior to spring emergence.

The following are preliminary data concerning the above 3 areas of investigation.

Threshold Temperature and Degree-Hours Required for NOW Egg Hatch

Methods and Materials

Infested almonds were collected from orchards in Kern Co. periodically thru the spring, summer and fall of 1979. These were placed in

36 X 18-in. screen cages at room temperature, allowing adult NOW to emerge and mate. Approximately 50-100 moths were placed in widemouthed glass jars. The open end of the jar was covered with a paper towel and secured by a rubber band. The moths were allowed to oviposit for a 4-hr period on the paper towel covering. At the end of this period the paper toweling was removed and examined for eggs. The toweling with eggs was then cut into 1 X 3-in. sections, each section containing a variable number of eggs. The paper sections with eggs were then placed in plastic cups and sealed with a lid. The plastic cup was filled 1/4 full with potassium hydroxide to maintain humidity at 90%. The containers were placed in constant temperature cabinets ranging in temperature from 54-96°F (Table 1). Temperature and egg hatch were recorded 3-4 times daily, percent egg hatch was also tabulated. The procedure described by Arnold (1959) was utilized to determine the threshold temperature for egg development.

To validate the heat unit requirement for egg hatch, approximately 700 eggs were placed in a screen cage which was positioned in the canopy of a tree. A max-min. thermometer was placed in the cage. Temperatures and egg hatch were recorded daily.

Results

The relationship of development per hour to temperature is shown in Fig. 1. The regression equation $y = -2.297 + .041906X$ has a correlation coefficient of 0.99. The intercept of 54.8 degrees of the extrapolated regression line is the theoretical temperature for egg development. The reciprocal of the regression slope value gives an average heat unit accumulation of 2385 degree-hours. Table 1 presents the temperature at which eggs were reared, average percentage egg hatch and average degree-

Table 1.--Temperature at which NOW eggs were reared, percentage egg hatch and average degree-hours.

TEMP (°F)	% EGG HATCH	HEAT UNITS
54	0	—
56	37	755
58	61	1659
60	64	1780
65	62	2526
70	77	2502
75	83	2256
80	75	2197
86	82	2410
90	93	2445
93	61	2698
96	11.5	3677

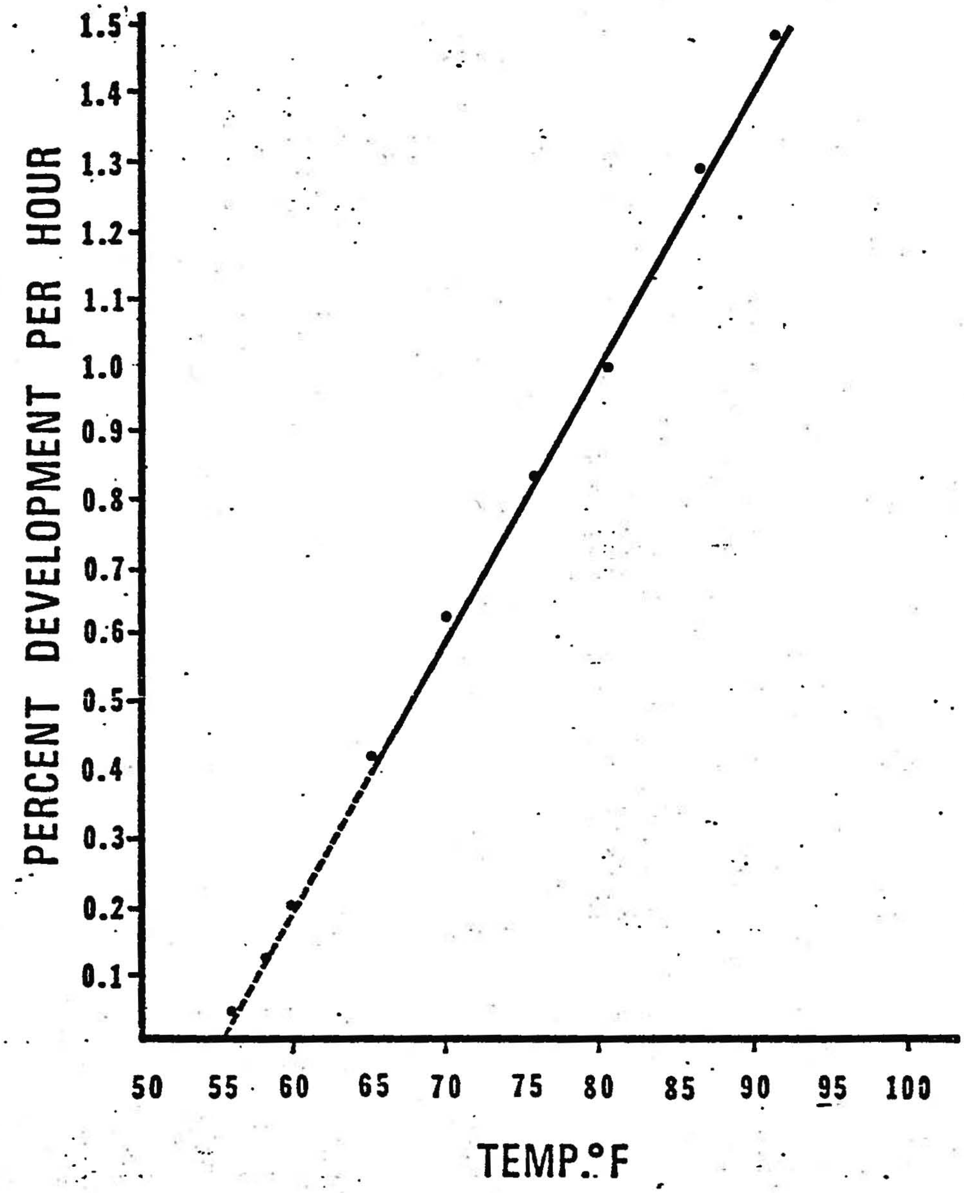

Fig. 1. RATE OF EGG DEVELOPMENT TO TEMP.

hour accumulation at each temperature regime. Egg mortality was 88.5% at 96°F and 63% at 56°F. The lowest egg mortality, 7%, occurred at 90°F.

The 700 eggs used for validating the theoretical developmental threshold were predicted to hatch at 2385 degree-hours. Hatching commenced on the 10th day after oviposition at 2376 degree-hours, 64% egg hatch occurred at 2508 and 97% egg hatch occurred at 2640 degree-hours.

<u>Scheduling Field Insecticide Application on Almonds in Relation to Spring Egg Trap Data</u>

An experiment was performed in a Kern Co. Superior Farms almond orchard to determine optimum timing for spring insecticide applications based on ovipositional traps. The experiment was performed prior to the determination of the degree-hours needed for egg hatch.

Four plots of 15 trees in a randomized block design were treated with Guthion 50W, 2.0 lbs AI at 500 gal/acre. Treatments were scheduled according to the rate of egg depositions as determined by 10 ovipositional traps placed in the orchard (Fig. 2). Treatments were applied on 4/20, 5/5, 5/14 and 5/18/79. The percent control of NOW larvae in mummy nuts and the schedule of timing is presented in Fig. 2.

Ten egg traps placed in the orchard on 4/27/79 were removed from trees 7 days later and placed in a weather shelter in the orchard to prevent any further egg deposition. These egg traps were monitored for egg hatch. Of the 1028 eggs observed at peak oviposition 75+% had hatched on 5/13/79. On the basis of thermal units, these eggs should have completed egg hatch on 5/14/79. This field-observed hatching data provides some confirmation of our predicted thermal unit value for egg hatch.

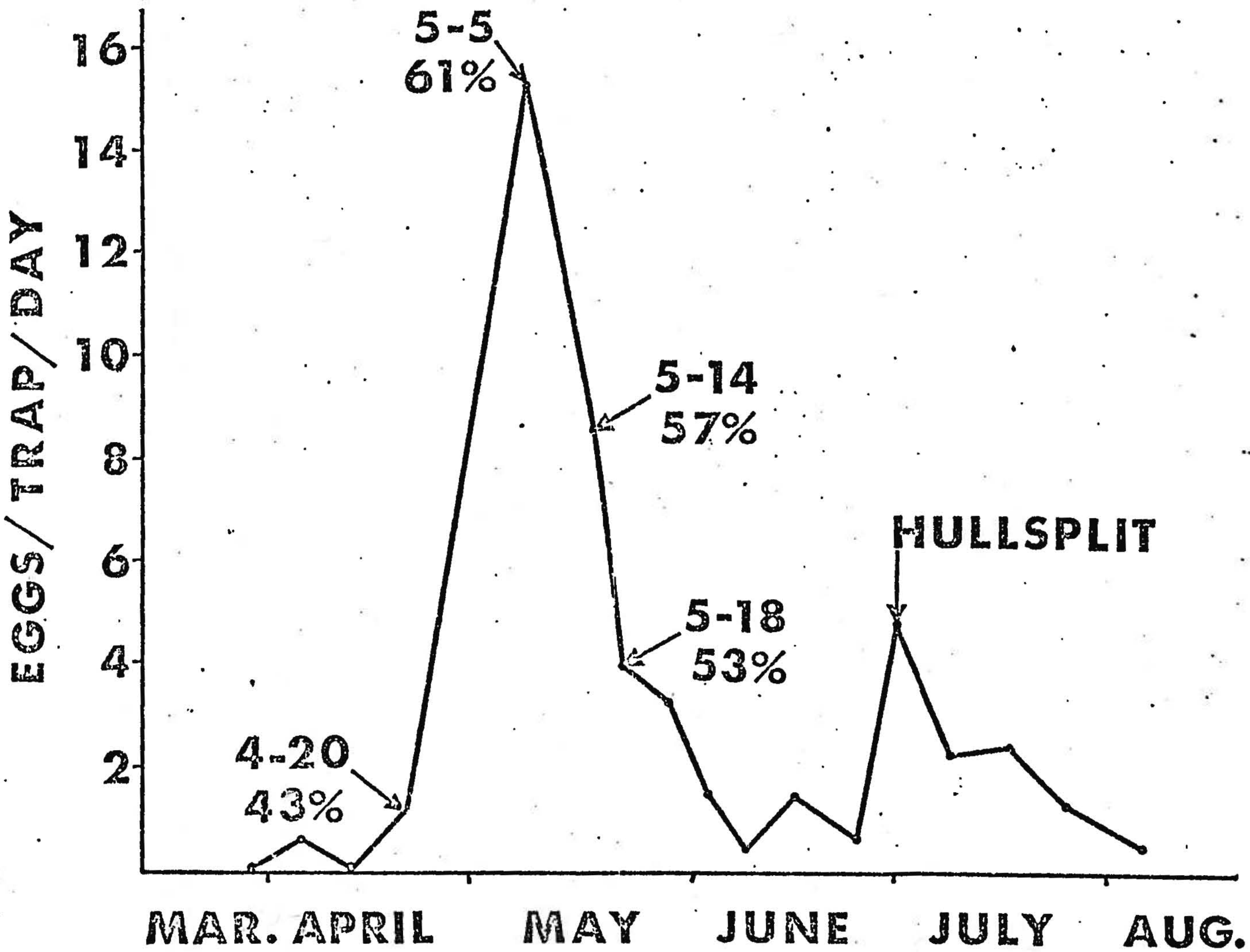

Fig. 2. Ovipositional Trap Data, Insecticide Application Dates and Percent Control of NOW on Mummy Nuts.

When examining the spring ovipositional curve compared to the theoretical egg hatching curve based on degree-hours (Fig. 3), we find that 71% of the total eggs laid hatched between 4/30 and 5/14/79. Between the interval of 4/30/79 and 5/30/79, 93.5% of the total eggs hatched. This egg hatching data suggests that 2 well-timed spring larvicide applications would theoretically control 93.5% of the hatching larvae found on mummy almonds. This would assume excellent spray coverage by an insecticide providing only larvicidal action.

Threshold Temperature and Degree-Days Required for NOW Larval Development

Presently experiments are being conducted to determine the developmental temperature threshold and degree-days required for the larval stages to become adult. Larvae are being reared at 6 different constant temperature regimes. Once the heat units are determined for the NOW to pass from 1st instar to adult, we will be able to quantify generation peaks needed for NOW control.

Our preliminary data suggest that the developmental threshold for larval stages is very close to that of the egg stage; however, we cannot assume this threshold without more data.

Field Observations of Adult Emergence Compared to Hullsplit

One goal in establishing a degree-day model for navel orangeworm is to understand adult moth emergence in relation to hullsplit of the current year's crop. This will enable the grower to optimize insecticide applications. An experiment was conducted to obtain data concerning this relationship.

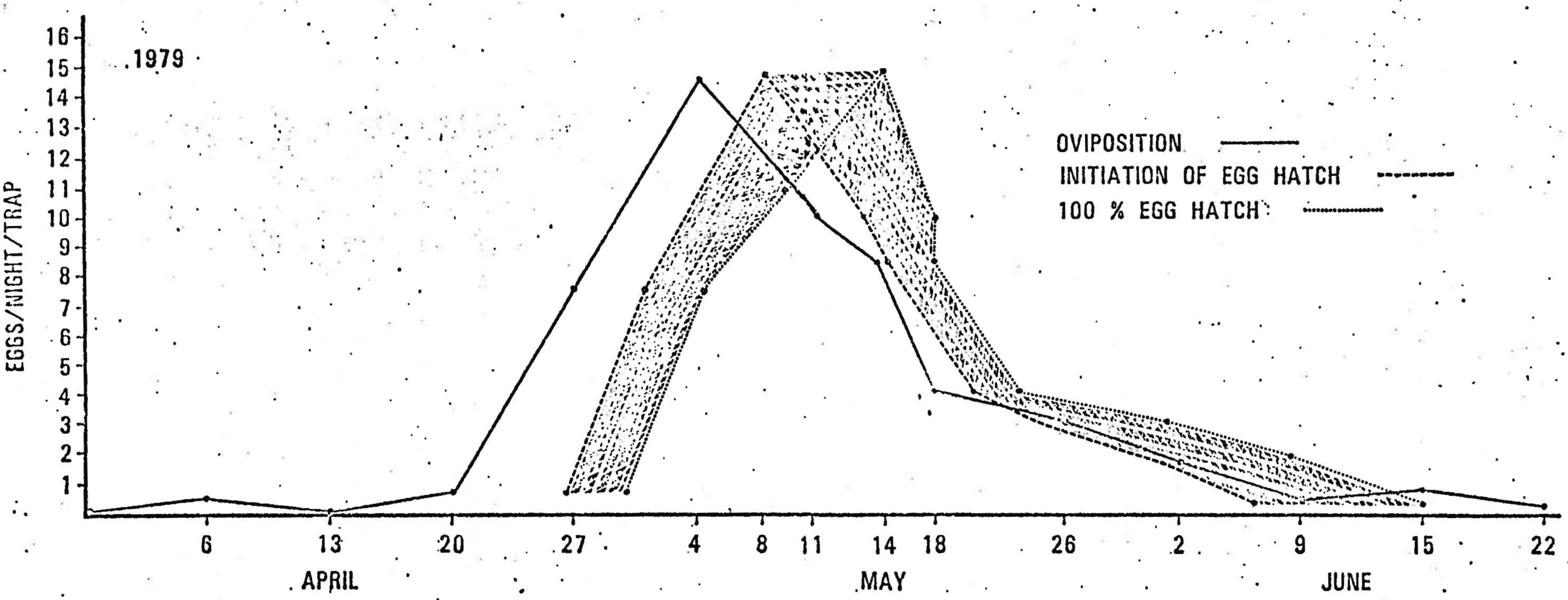

Fig. 3. Oviposition Trap Data and Theoretical Egg Hatch[1/] in Superior Farms Almond Orchard.

1/ 3-30-79 to 5-18-79 Based on 10 ovipositional traps; 5/19-79 to 6-22-79 Based on 20 ovipositional traps.

Methods and Materials

Seven screen emergence cages were placed in the canopy of almond trees in a 75-acre orchard in Kern Co. The cages were filled in the spring with approximately 200 mummy nuts per cage. Moth emergence from the caged mummy nuts was tabulated weekly.

In the same orchard 64 trees were selected for nut sampling. Ten of the 64 trees were chosen randomly for nut sampling during the hullsplit period on a weekly basis. Fifty nuts were sampled at random from each tree and from all heights. Percent hullsplit and % infestation were recorded when nut samples were taken. Fig. 4 presents the relationship between caged moth emergence, % hullsplit and % infestation. Approximately 47% of the moths emerging had done so prior to hullsplit. Because the moths emerged prior to hullsplit they should not be able to infest the non-hullsplit almonds. If this is a general pattern from season to season, spring applications may possibly be adjusted to ignore the group of larvae which provide moths emerging prior to hullsplit.

Flight and Mating Behavior of the Navel Orangeworm

Every spring the navel orangeworm begins ovipositing eggs on mummy almonds from mid-March to early April. This egg laying continues with egg deposition increasing dramatically then subsiding. We are currently involved in determining environmental conditions which account for this oviposition pattern.

An experiment was conducted in a Superior Farms, Kern Co., almond orchard to determine certain aspects of the nocturnal flight, mating and egg laying behavior of the NOW moth.

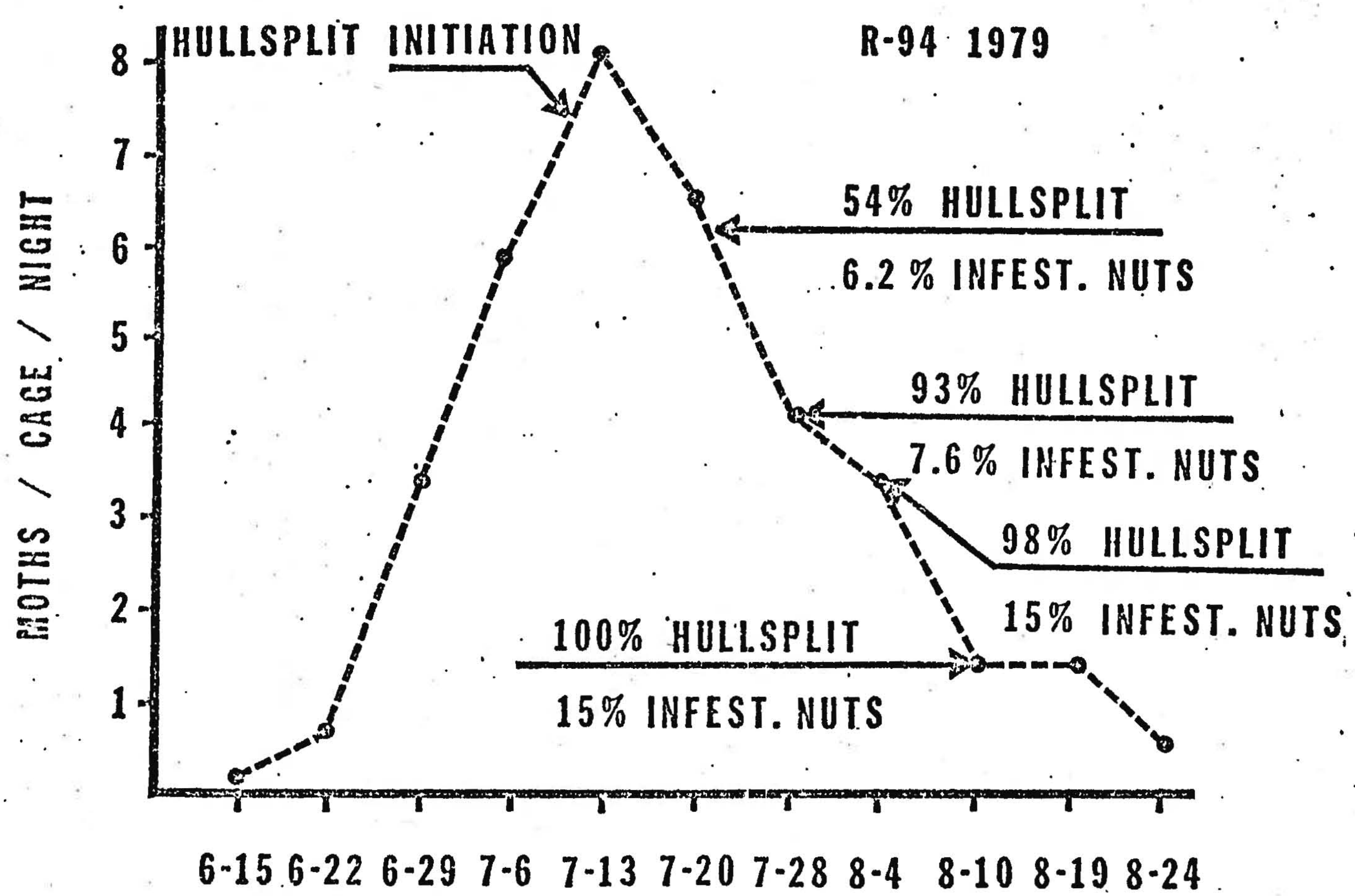

FIG. 4 ALMOND HULLSPLIT VS. CAGED MOTH EMERGENCE AND PERCENT INFESTED NUTS.

Methods and Materials

Thirty ovipositional traps were placed in the canopy of almond trees, 1 trap per tree. In the same vicinity of the almond orchard, 25 Pherocon 1C traps baited with NOW pheromone were placed in almond trees. Pheromone traps were placed 150 ft apart. Three 8-watt blacklight traps were also placed in the orchard. The blacklight traps were kept at least 400 ft from the ovipositional and pheromone traps to prevent interference. Two screen emergence cages with mummy almonds were hung in separate trees. The cages each contained from 30-50 freshly emerged NOW moths. All traps and cages were placed in the orchard 45 min. prior to sundown. Temperature was recorded on an hourly basis with a Fahrenheit thermometer placed in the orchard. Traps and caged moths were observed hourly until 30 min. after sunrise the following morning. The number of eggs and moths was tabulated, moths from blacklight traps were sexed.

Results

Fig. 5 presents the percentage of moths and eggs trapped hourly for the nights of 7/4/79 and 7/6/79. Ovipositional traps indicated that egg laying commenced between the hours of 8:30 and 9:30 PM, with 88% of all egg laying occurring in a 4-hr period from 8:30 PM to 12:30 AM. Activity (crawling and flight) of the caged moths began at twilight and ceased completely by 12:30 AM. Pheromone traps, which attract males only, caught 84% of its total moth catch between the hours of 3:30 and 5:30 AM, just prior to dawn. The blacklight trap moth catch reflected the same bimodal flight pattern as indicated by egg traps and pheromone traps, i.e. females lay eggs before midnight, mating takes place before dawn. Observations of the caged moths indicated the same activity

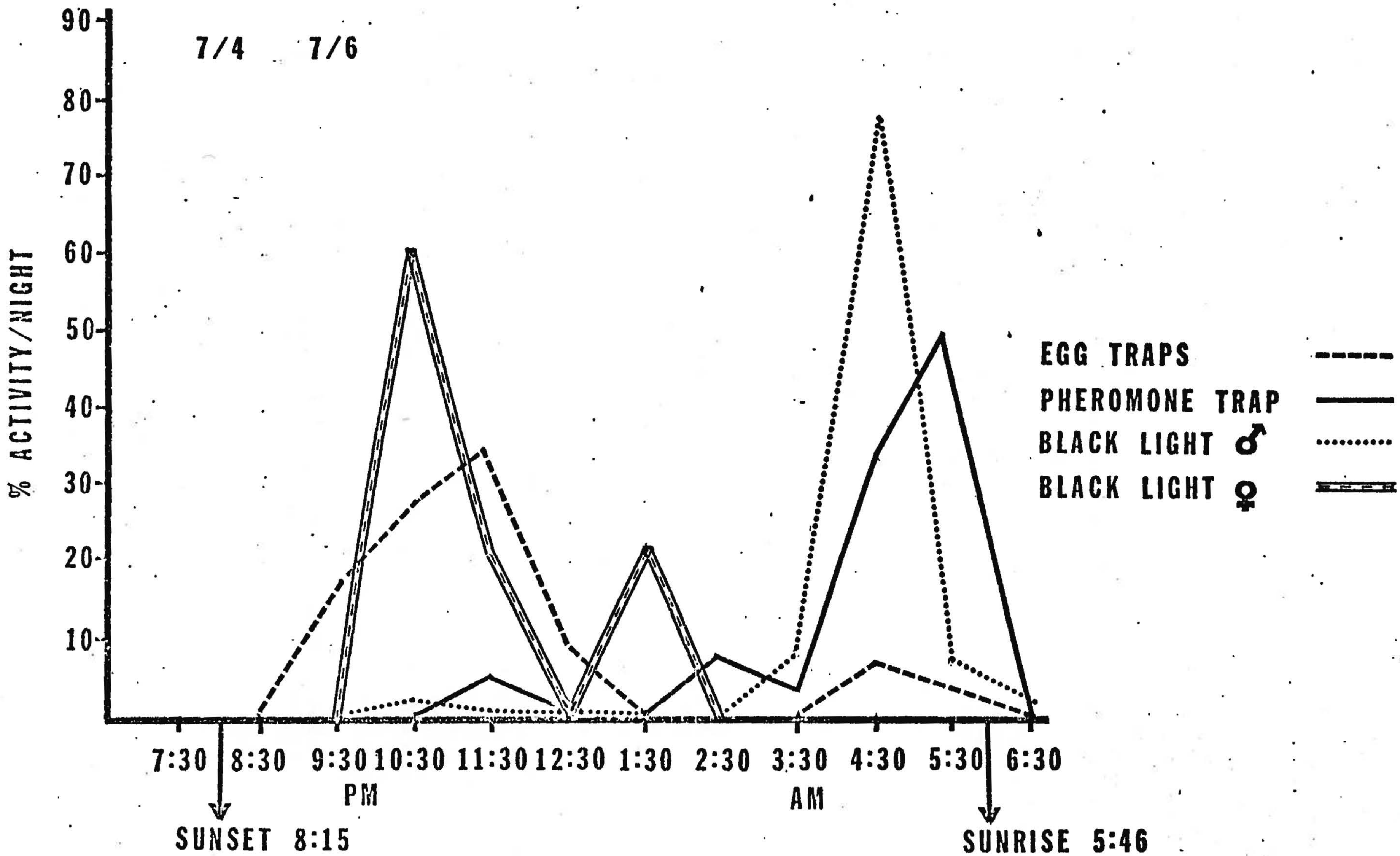

FIG. 5 . NOCTURNAL FLIGHT ACTIVITY VS TIME FOR MALE AND FEMALE NOW MOTHS

pattern as expressed by trapping. Caged moths began crawling and flying about the cages just prior to sunset with this activity gradually increasing and then subsiding to no activity at 12:30 AM. Caged moth activity began again at 2:30 AM. At this time several female moths were observed exhibiting "calling behavior," with the tip of the abdomen curled over their backs. Matings were first observed at this time and continued until dawn. Uncaged moths were also observed flying to the cages, probably in response to the calling females. Cessation of caged moth activity occurred minutes after sunrise. Temperature records indicated that moths were able to continue flying and mating at 56°F. This suggests that temperature thresholds for these functions are somewhat below this.

The above data confirm that the NOW experiences 2 nocturnal flight peaks, an egg laying flight in early evening lasting until approximately 12:30 AM. The 2nd flight peak, a mating flight, occurs just prior to dawn. These relationships will be further explored this spring.

<u>Development and Age Structure of Overwintering NOW on Mummy Almonds</u>

Thorough field sampling for two winters shows that the navel orangeworm develops throughout the winter at an extremely reduced rate. Sampling of mummy almonds indicated that NOW populations become more and more discrete in stage development as spring approaches. This discreteness becomes pronounced, with approximately 80% of the population residing in the 6th instar and pupal stage by early spring. This informa--tion was determined by classifying larvae found in mummies into their respective instars and by using egg traps. Fig. 6 indicates the frequency of occurrence of the different developmental stages of the navel orangeworm

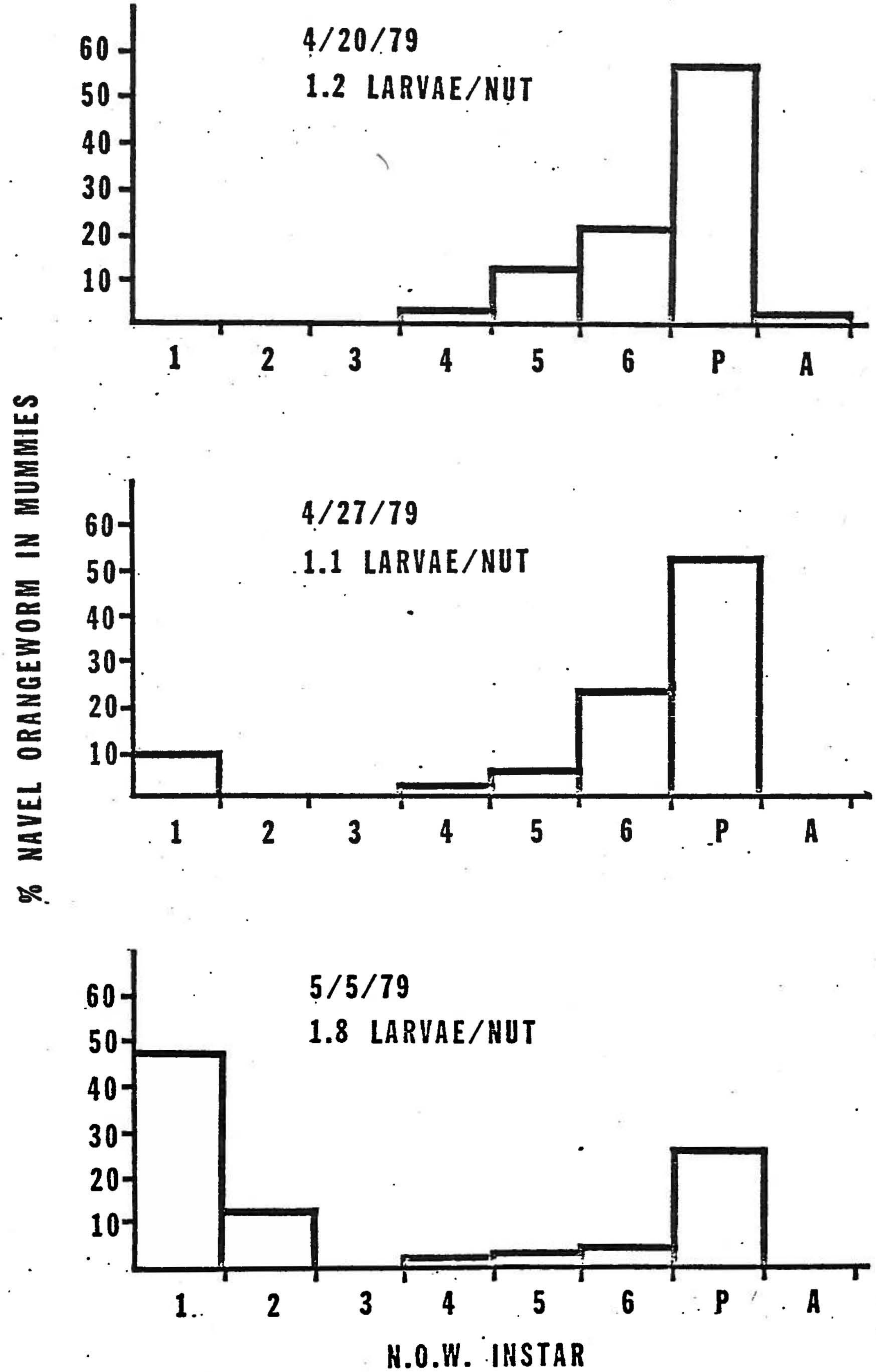

Fig. 6. Frequency of Occurrence of NOW Stages found in Mummy Almonds.

at varying sample dates. If these data are compared to egg trap data it can be seen that no adult ovipsoition has occurred as of 3/30/79 (indicated by lack of eggs), and that the majority of the population is grouped into the 6th instar and pupal stages.

Mite Investigations

Effects of Spider Mite Feeding on Almond Tree Growth and Productivity

S. C. Welter and M. M. Barnes

Research efforts were continued in 1979 to ascertain the effects of various levels of mite damage on almond tree growth. The parameters investigated included yield, terminal growth, girth and leaf size. Mite damage was quantified using "mite-days" - 1 mite-day being defined as 1 mite feeding for 1 day. The use of mite-days allows for both the duration and intensity of mite-feeding. The intensity is reflected by the number of mites feeding at 1 time interval, while duration is measured in the number of days at a particular mite-density.

While previous research has demonstrated the suppression of both yield and growth from heavy mite damage, no discrimination has been made for varying levels of mite infestation. Therefore, research is required to more critically define the relationship between mite damage and almond tree productivity and vegetative growth.

Materials and Methods

Four levels of mite damage were allowed to develop in a 4-year-old, flood-irrigated orchard in 1978. The test plot, "Test Site I", consisted of 64 Nonpareil trees on 24 X 24-ft spacing. A random block design of 16 blocks was established within the test site, all 4 levels of mite damage within every block. The orchard did not receive any pesticide applications for navel orangeworm or peach twig borer control in 1978. The mite infestations were allowed to increase until the desired level of damage had been achieved. The lowest treatment level was virtually mite-free, ranging between 0-150 mite-days. The second level of mite infestation, which ranged between 150-450 mite-days, exhibited slight stippling along the midrib. The third level of infestation, which ranged between 450-600 mite-days, demonstrated a moderate amount of stippling with slight defoliation occurring within the tree. The heaviest extent of mite damage, ranging between 600-1000 mite-days, showed 50-100% of the leaf area stippled with heavy defoliation of the tree canopy.

The trees were sprayed with Plictran 50W at 2 oz AI/100 gal on an individual basis once the desired level of damage was obtained. A high pressure handgun delivering a fine spray at approximately 450 psi was used to apply the acaricide. The trees were then kept mite-free for the duration of the season with periodic applications.

Likewise, a second orchard was established in 1979 in a 5-year-old, flood-irrigated orchard of LaBorde Farms, Kern County. The test site, Test Site II, consisted of 72 Nonpareil trees on a 25 X 25-ft spacing. Mites were also allowed to develop until the desired level of damage was obtained at which time an acaricide was applied to prevent further damage. Because of cooler temperatures, seasonally later mite buildup, and possible regulation by predators, the number of mite-days accumulated was lower than in Test Site I in 1978. Omite 30W, at .45 lb AI/100 gal, was periodically applied with a high pressure handgun to prevent additional mite damage.

Spider mite and predator populations were sampled on a weekly basis by collecting 32 leaves per tree. The tree was subdivided into 8 subunits, the divisions based on the 4 compass points and upper or lower halves of the tree. The leaves were taken into the lab and refrigerated until counts could be made under the stereoscope. The mite counts reflect the mean number of mobile Tetranychus individuals per tree. The population from Test Site I consisted of 60% T. pacificus and 40% T. urticae in 1978 as determined by the mounting of male Tetranychus on slides. The population from Test Site II consisted of 100% T. pacificus, based upon 40 slides taken throughout the season.

The yield was determined by the following formula:

$$\frac{\text{Total lbs whole nuts}}{\text{Tree}} \times \frac{\text{lbs dried sample}}{\text{lbs original subsample}} \times \frac{\text{lbs/200 nutmeats}}{\text{lbs 200 nutmeats + lbs residue}} = \text{lbs nutmeats/tree}$$

The terminal growth component was determined by measuring 9 terminals per tree with tape measures with a mean terminal growth length being established for each tree. Only the current year's growth was measured. Three terminals were measured from each scaffold branch with the most apical terminal being measured from a randomly selected cluster.

The change in girth was determined from the change in 1978 girth measurement to 1979 girth measurement at a height of 15 cm above ground level.

Because of lack of previous data, the girth data from LaBorde Farms consisted of comparisons between actual girth measurements instead of change in girth.

Leaf area for both Test Site I and Test Site II was determined in 1979 by measuring the area for 32 leaves/tree using a portable leaf area meter. The mean leaf size was determined for each test tree in both Test Sites I and II.

In addition, further studies with the chlorophyll meter were performed in 1979, as well as the further analysis of data from Test Site I in 1978. Thirty-two leaves were sampled on both upper and lower leaf surfaces with the chlorophyll meter. Sixty-four trees were sampled on 10/22/79 at Test Site I while 29 trees were sampled from Test Site II on July 31, 1979. The mean chlorophyll meter readings were regressed against mean number of mite-days per leaf which had accumulated by the sample date.

Results

The most sensitive parameter appears to be the terminal growth component. Means of 67.6, 61.4, 51.5, and 51.2 were obtained from Test Site I for treatments I, II, III, and IV, respectively. The 2 lowest levels of mite infestations did not prove to be significantly different from each other but were significantly different from either treatment III or IV at P=>0.01. Treatments III and IV, the 2 heaviest mite loads, were not significantly different from each other. These differences are the result of the mite feeding in 1978 which requires 1 year to be expressed. The decline in terminal growth between the check trees and the heaviest level of mite damage represents a 25% reduction in shoot extension.

Analysis of 10 blocks in Test Site II showed no significant differences between the check trees and the 3 levels of infestation with means of 38.0, 32.8, 33.2, and 33.8 cm, respectively.

The previously unexamined aspect of leaf size proved to be significantly different in Test Site I. Means of 17.4, 16.8, 16.3, and 16.2 were obtained from the check, I, and treatments II, III, and IV, respectively. Again the 2 highest levels of mite-days were significantly different from the check, while treatment 2 was not significantly different. These differences can be attributed to mite feeding from the previous season. The reduction in leaf size between treatments I and IV represents a 7% reduction in total photosynthetic area of the tree.

Based on ten blocks, Test Site II showed no differences in leaf size between treatments with means of 15.7, 15.2, 15.4, and 15.9 cm being obtained for treatments I, II, III, and IV, respectively.

No comparisons were made of yields from Test Site I in 1979. Yield data was obtained, however, for Test Site II with means of 10.2, 11.8, I2.0, and 11.2 being obtained for treatments I, II, III, and IV, respectively. As expected, no significant differences were found from the current year's infestation.

Girth measurements from Test Site I proved insignificantly different with a mean change in girth of 9.35, 8.89, 8.89, and 8.75 for treatments I, II, III, and IV, respectively. Likewise, girth measurements from Test Site II were not significantly different.

The use of the portable chlorophyll meter to rapidly assess mite-days appears to be possible yet requires large samples to accommodate the variation within a tree. The results from Test Site I on Fig. 1 showed a fairly reliable function with a correlation coefficient of -.82. The results from Test Site II were less favorable with the equation $y = 61.84 - .0213x$ having a correlation coefficient of -.65. While this value is highly significant, it does not indicate high predictive capabilities. If a sampling scheme can be developed which will not require such extensive sampling, the chlorophyll meter may possibly be a useful pest management tool.

Efforts will be continued in 1979 to quantify the effects of mite feeding on almond tree productivity and growth. The goal of this research is to provide some basis upon which to establish an economic threshold for spider mites.

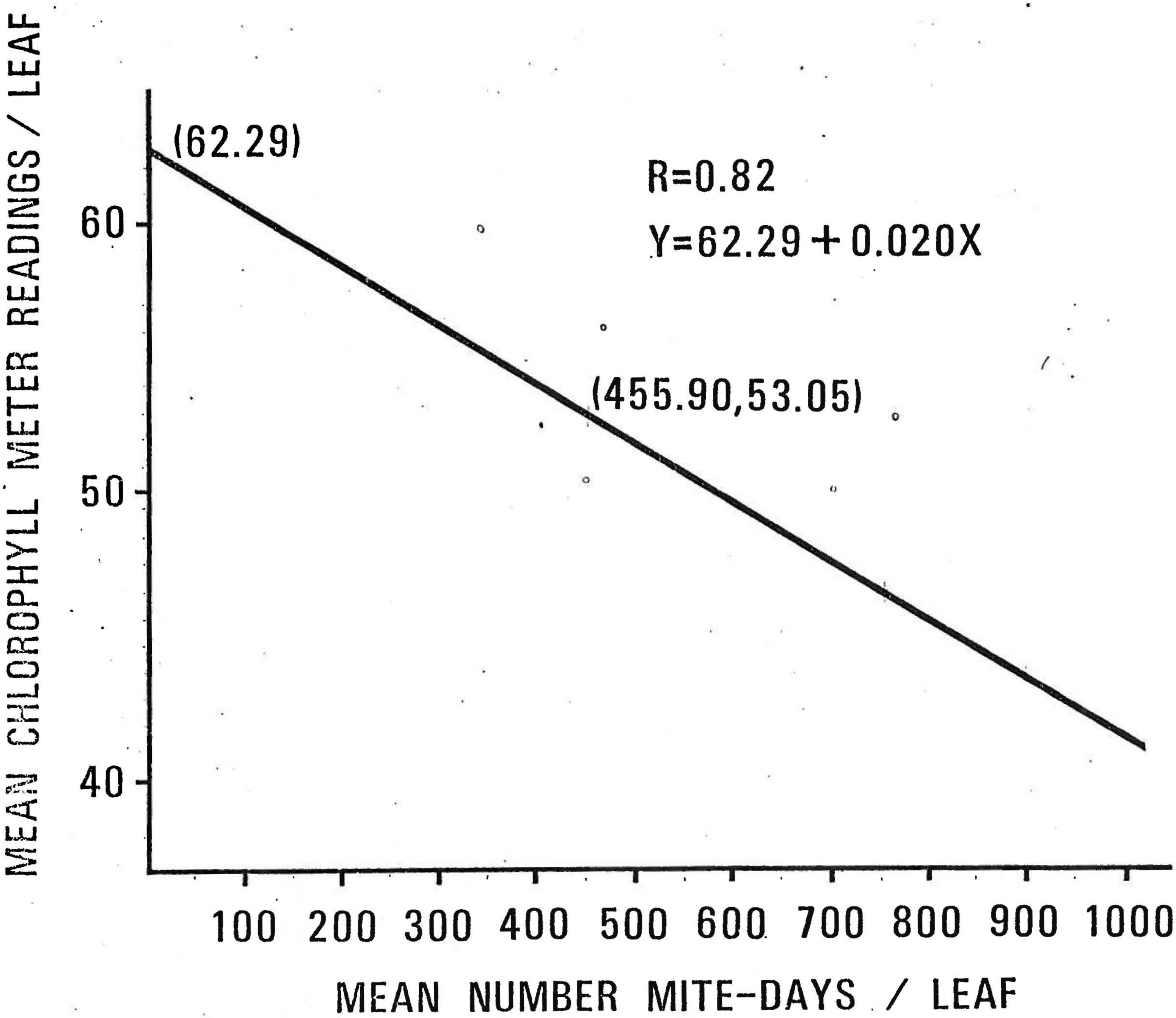

Fig. 1. Relationship between Chlorophyll Meter Readings ánd Mite-Days.

Investigations on the Relationship Between Spider Mite Feeding and Almond Tree Photosynthetic and Transpiration Rates

S.C. Welter, M. M. Barnes, and I. P. Ting

Further studies were continued in 1979 using the dual isotope porometer to measure various physiological processes within the almond tree. The dual isotope porometer can simultaneously determine an almond leaf's photosynthetic and transpiration rates. This determination is accomplished through a brief exposure to 2 isotopes, ^{14}C and tritium. The rate of uptake by the leaf of the 2 isotopes is related to the leaf's photosynthetic and transpiration rates.

Mites have been demonstrated to reduce both the photosynthetic and transpiration rates of almond trees in the field. Because of the porometer's field portability, samples can be taken from actual field infestations. A more sound decision for economic thresholds can be made through a more complete understanding of the mite-almond tree relationship.

Materials and Methods

Samples were taken on a biweekly basis from April 27, 1979 to October 27, 1979 in a 5-year-old orchard in the southern San Joaquin Valley. Sixteen Nonpareil trees were paired with the orchard, 1 tree receiving applications of an acaricide, Omite 30W, to prevent any major mite buildup. The other tree within the pair was allowed to develop mites throughout the season with no efforts made to control their numbers. The entire block was sprayed on May 24 with Omite 30W at 0.5 lb AI/100 gal to prevent any major mite outbreaks prior to beginning the experiment.

The trees were monitored both for spider mites and their predators from early May to July 1 on a biweekly schedule. The trees were sampled at 32 leaves/tree from both the upper and lower halves of the tree as well as from all 4 sides. The sampling schedule was increased to a weekly basis with the appearance of increasing mite populations in July. The spider mite species composition was 100% Pacific spider mite, *Tetranychus pacificus*, while the predator complex consisted primarily of the phytoseid mite, *Metaseiulus occidentalis*. From the sampling procedure, a mean number of mites per leaf was obtained. From the number of mites per leaf and the duration of infestation, the total number of accumulated mite-days per leaf can be determined for a tree.

The tree was sampled with the dual isotope porometer in a similar fashion with 10 sectors around the tree as well as an upper vs. lower division. One sample was taken from each sector resulting in a total of 20 leaf samples per tree at any given sample date. The trees were sampled on 4/27, 5/12, 5/24, 6/8, 6/22, 7/6, 7/21, 8/3, 8/18, and 8/31 with additional readings being taken on the check trees on 9/15 and 10/15 in order to determine the seasonal physiological rates of uninfested trees.

The water status of the orchard was determined on every porometer sample date through the use of a pressure bomb. The orchard was irrigated on a weekly basis until 3 weeks before harvest on 8/28. The cessation of irrigation prior to harvest allows the almond to dry and, as well, facilitates the actual harvest process. Irrigation was resumed about one month after harvest.

Results

Mite feeding significantly reduced both the photosynthetic and transpiration rates of the almond trees with increasing mite-damage.

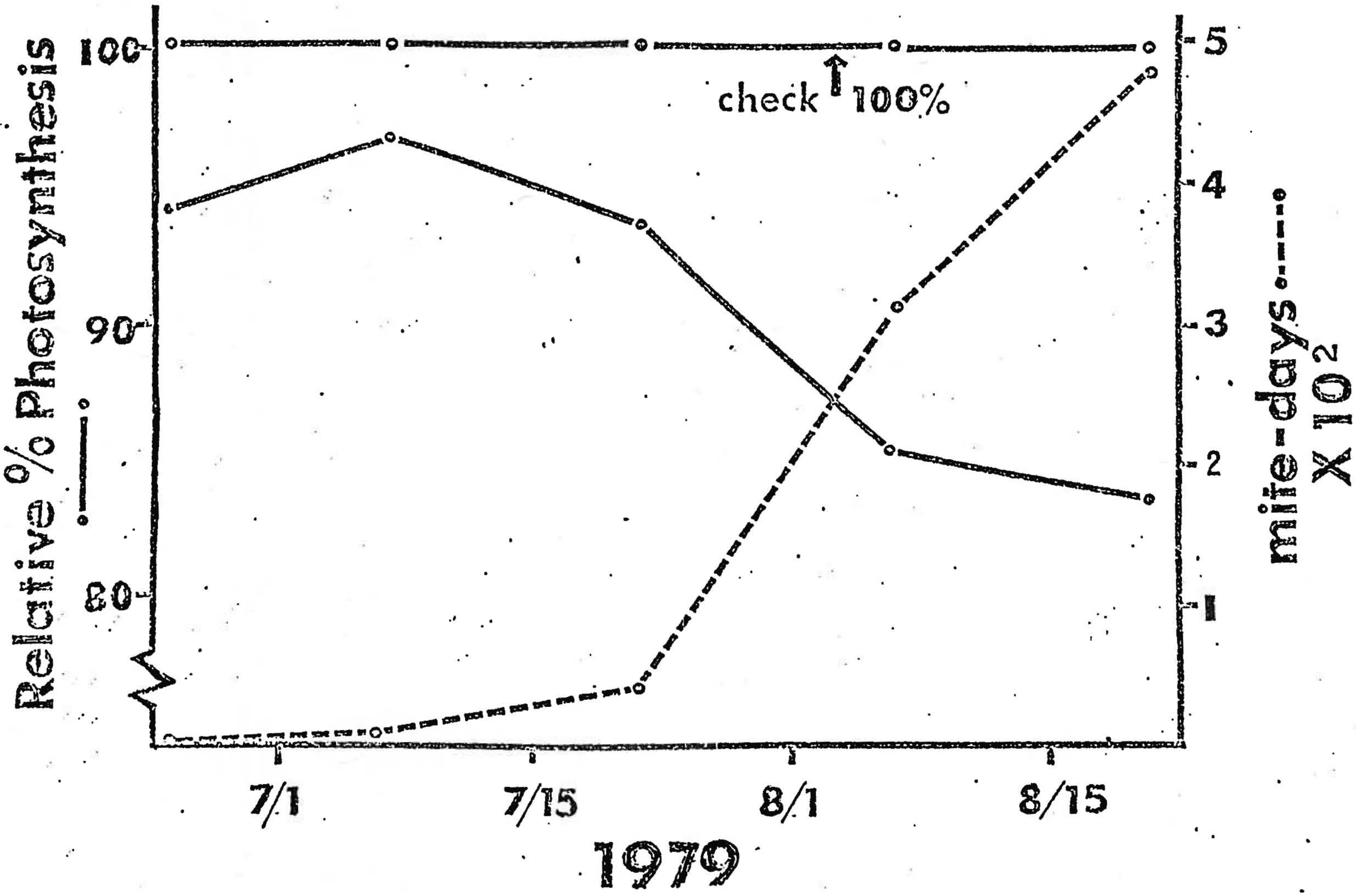

Fig. 1. Photosynthetic Rates of Mite-Infested and Non-Infested Almond Trees.

The mite-infested trees are represented as a percentage of the non-infested trees on a pair-wise basis, as shown in Fig. 1. The photosynthetic rate was not significantly different between the infested and uninfested trees from 4/27 to 7/6. On 7/21 the photosynthetic rate of the mite-infested trees was 94% of the check trees from a mean number of accumulated mite-days per leaf of 46.9. The photosynthetic rate of the mite-infested trees continued to decline to 85% of the check trees by 813. The mean number of mite-days for the infested trees was 315.5 on 8/3. By 8/18, the photosynthetic rate of the mite-infested trees with a mean number of mite-days of 477 was 84% of the check trees.

Likewise, transpiration of the mite-infested trees was expressed as a relative percentage of the check trees on a pair-wise basis. The transpiration rates of the mite-infested and non-infested trees were not significantly different from 4/27 to 7/21. The transpiration rate is shown in Fig. 2 as stomatal conductance. By using stomatal conductance instead of the actual transpiration rate, the effect of varying environmental conditions may be eliminated. If a leaf's stomatal conductance is known, the transpiration rate can be determined for any set of environmental parameters. The transpiration rate of the mite-infested trees was significantly different at the 0.1 confidence level on 8/3. The transpiration rate of the mite-infested trees with a mean of 315.5 mite-days was 90.5% of the check trees. While the percent transpiration on 8/18 proved to be significantly different from the check trees at P=0.05, there was no significant change from the previous sample date (90.5 to 89.4) despite an increase in mean number of mite-days from 315.5 to 477.3.

The results from 1979 are similar to those obtained in 1978. While the photosynthetic and transpiration rates were only reduced by 10-15%

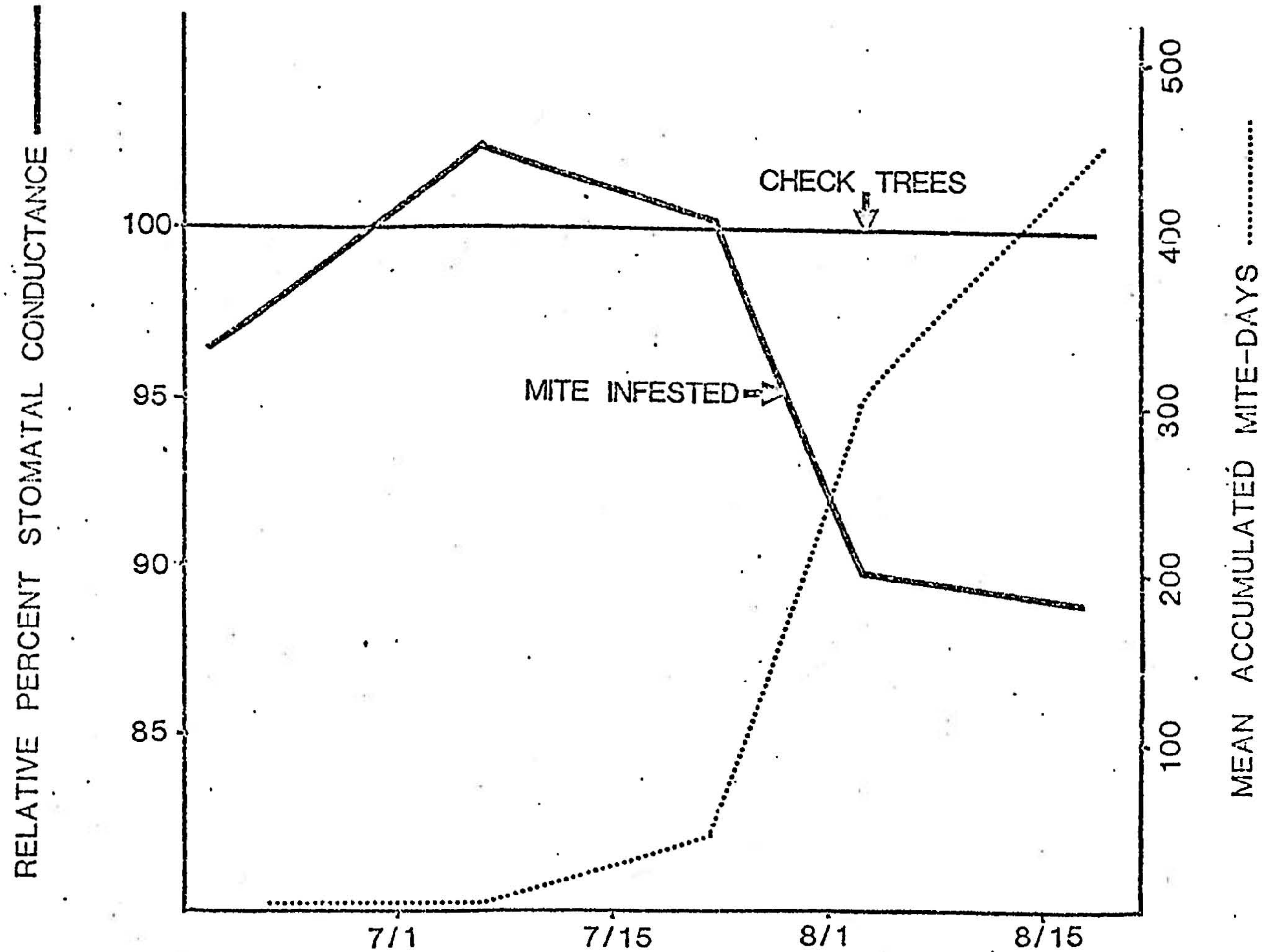

FIG. 2 STOMATAL CONDUCTANCE OF MITE-INFESTED AND NON-INFESTED TREES . 1979

as opposed to 30-40% in 1978, the mean total number of mite-days in 1979 is only 483.7, which is 41.7% of the mean total number of mite-days in 1978.

Further studies will be required to understand the relationship between mite damage, temperature, and the tree water potential.

Acaricide Sprays

S. C. Welter and M. M. Barnes

The efficacy of seven acaricides was compared in 2 trials during July and August 1979 in the southern San Joaquin Valley. This experiment was carried out through the cooperation of Minnehoma Farms. The candidate compounds included 2 formulations of Vendex, UC55248 (4EC), BUE 1452 (25WP), SLJ 0312 (50WP), Morestan (25WP), Plictran (50W), and Omite (30W). These acaricides were evaluated for their effects both on spider mite and predatory populations. Spider mite species identification was based upon the identification of slide-mounted males.

Acaricide Trial I was initiated on July 13, 1979 on the northeast corner of a 60-acre, flood-irrigated orchard approximately 1 mi south of Shafter, Kern Co. Acaricide Trial II was implemented on August 15, 1979 on a sprinkler-irrigated orchard approximately 1 mi southeast of the junction of Highways 46 and 65.

Methods and Material

Applications were made with a high pressure handgun which delivered a fine spray at 400-450 lbs per sq in. The trees were sprayed until runoff with an average of 9 gal/tree being required, approximately 680 gal/acre.

The trees were sampled for mites by collecting 28 leaves from a height of 1.5-2.5 meters. The leaves were collected from all 4 sides of the tree, an equal number from each side. The samples were placed in slightly dampened bags and brought into the lab for counting under a stereoscope.

Acaricide Trial I consisted of 6 blocks with a randomized block design, 4 of the Nonpareil variety, 2 of the Mission variety. The trees were 5 years old and on a 24 X 24-ft planting scheme.

Acaricide Trial II consisted of a randomized block design with a total of 5 blocks. Three blocks were of the Nonpareil variety while the other 2 blocks were Ne-Plus Ultra. The 6-year-old trees were planted on a 24 X 24-ft spacing. Two checks were included in each block, one treatment consisting of water only to account for losses due to hydraulic action; the second check treatment was left unsprayed.

Results

Acaricide Trial I provided data for only a 72-hr period because of an unexplained rapid decline in the check trees mite populations. Some possible explanations might be problems with drift from the surrounding orchard or the decline represents a natural decline due to exhaustion of the food reserves within the leaves. As can be noted from the pre-sample, the mite populations had achieved fairly high population levels prior to application. The only useful information from this trial was the length of time required for a significant reduction in mite numbers. While all treatments were reduced by the application method as evidenced by a similar reduction in the check trees, all the compounds except Omite and SLJ 0312 were significantly lower than the check after 1 day. After 3 days, all of the compounds tested were significantly lower than the check trees. Results are shown in Table 1.

Acaricide Trial II provided data for 15 days at which point the mite populations declined in the check trees such that no further results could be obtained. The decline in the mite numbers is characteristic for this period of the summer based upon previous field studies. All treatments provided mite control through 15 days, after which the duration of control is uncertain. Results are shown in Table 2.

Table 1.--Mean number of mobile stages of Tetranychus per leaf[1/] for Acaricide Trial I. Shafter, CA., July 197~~8~~9.

Compound	Oz. a.i. per 100 gal.	Sample: Pretreatment 7/10	Sample: 1-day 7/14	Sample: 3-day 7/16	Sample: 8-day 7/21
1. Morestan 25WP	4	45.9	0.0 B[2/]	0.0 B	0.0 A
2. Vendex 25-4W	4	21.8	0.5 B	0.3 B	0.0 A
3. Vendex 50W	4	43.2	1.1 B	0.2 B	0.0 A
4. Plictran 50W	6	22.5	0.1 B	0.0 B	0.2 A
5. Omite 30WP	7.2	51.5	3.2 AB	0.8 B	0.0 A
6. UC55248 4.0EC	4	48.1	0.8 B	0.1 B	0.0 A
7. BUE1452 25WP	8	40.3	0.0 B	0.1 B	0.0 A
8. SLJ0312 50WP	4	73.8	5.1 A	0.2 B	0.1 A
9. Water check	-	30.8	4.5 A	2.3 A	0.5 A

[1/]Based on 6 replicates of 28 leaves/tree.

[2/]Means in the same column followed by the same letter are not significantly different at the p=.05 level using Duncan's New Multiple Range Test.

Table 2.--Mean number of mobile stages of Tetranychus per leaf[1/] for Acaricide II. Shafter, CA., July 1979.

		Sample				
Compound	Oz. a.i. per 100 gal.	Pretreatment 8/14	1-day 8/16	3-day 8/19	10-day 8/25	15-day 8/30
1. Morestan 25WP	4	7.9 A	0.0 C	0.0 C	0.0 B	0.0 A
2. Vendex 25-4W	4	7.1 A	1.5 C	1.4 BC	0.0 B	0.0 A
3. Vendex 50W	4	5.0 A	1.5 C	0.5 BC	0.0 B	0.0 A
4. Plictran 50W	6	7.9 A	0.2 C	0.2 C	0.0 B	0.3 A
5. Omite 30W	7.2	7.9 A	1.2 C	2.1 BC	0.2 B	0.0 A
6. UC55248 4EC	4	9.4 A	0.5 C	0.3 C	0.2 B	0.1 A
7. BUE1452 25WP	8	5.0 A	0.4 C	0.9 BC	0.0 B	0.0 A
8. SLJ0312 50WP	4	8.8 A	2.1 BC	1.0 BC	0.3 B	0.0 A
9. Water check	-	9.1 A	4.1 B	7.5 A	2.4 A	0.7 A
10. Check (No treatment)	-	7.1 A	7.6 A	1.8 AB	2.9 A	0.9 A

[1/]Based on 5 replicates of 28 leaves/tree.

[2/]Means in the same column followed by the same letter are not significantly different at the p=.05 level using Duncan's New Multiple Range Test.

Trial of a Granular Systemic Insecticide Aldicarb 15G (Temik) Applied to the Soil for Control of Mites on Almonds, 1979

Curtis E. Engle and Martin M. Barnes

The purpose of this experiment was to test various rates of aldicarb (Temik) 15% granular formulation as an acaricide for controlling tetranychid mites on almonds. Data was evaluated for its efficacy on mites as well as its effects on mite predators and phytotoxicity. Samples were taken for residue analyses, but these data are not yet available.

Methods and Materials

The experiment was conducted on portions of two Superior Farms orchards, one located on Kimberlina Rd (R-62), the other on Wallace Rd. (R-15), Kern Co.

Orchard R-15 contained 10-year-old trees placed in a 25 X 25-foot planting, with alternating double rows of the Nonpareil variety to a single row of the Merced variety. The orchard was irrigated with a sprinkler system located in each row.

Randomized blocks were used, providing 4 replications of 4 different dosages of aldicarb as compared with untreated trees. Single trees were used as experimental units. All experimental blocks consisted of the Nonpareil variety. Various rates of granular aldicarb (see Table I) were applied by hand using a hoe and shovel. Furrows 1.5-2.0 inches deep were dug 4 feet from the base of each side of the tree. These extended 10-12 feet before each tree and stopped 10-12 feet past, with a buffer of 1 tree between each treatment. Using this design, treatments were kept at least 25 ft apart. Aldicarb was measured by wt into a container, the material was then evenly distributed along the length of each furrow and then covered with soil. The orchard was irrigated immediately after treatment.

Mites were slide-mounted from leaf samples and determined to species. The population was almost entirely twospotted mite except for an occasional citrus red mite. Leaves (25) were sampled from each tree in all blocks on 7, 14, 21, 28 and 41 days after aldicarb application. The trees were circled taking leaves randomly from 3-6 feet in height and from inside and outside the canopy. These samples were placed in labeled paper bags and immediately refrigerated in preparation for counting.

R-62 is a flood-irrigated orchard of 4-year-old trees with alternating double rows of the Nonpareil variety to a single row of Merceds placed in a 25 X 25-foot planting. The experimental design consisted of 4 randomized blocks of single trees treated with the same 4 levels of aldicarb as above and comparing with an untreated control. Aldicarb applications (Table 1) and leaf samples were the same as those of R-15. Leaf samples were taken 7, 14, 25, 41, and 60 days after treatment. Mites were slide-mounted from leaf samples and determined to species. Based on these mounts, the population was determined to be 100% Pacific spider mite.

Results

Table 1 presents the mean number of tetranychid mites per leaf for each of the 6 sampling dates in the sprinkler irrigated orchard. Satisfactory control was evident at all rates of aldicarb application 21 days after treatment. At 28 days after application, populations in the check blocks had greatly decreased to the point of showing no significant

Table 1.--Aldicarb 15 G efficacy trial, R-15. Average number of hatched mites per leaf[1/] for each of 4 treatments for 6 sampling dates.

Lbs. a.i. aldicarb/A	Sample Date: 7-13 Pretreatment	7-21 7 days	7-28 14 days	8-4 21 days	8-11 28 days	8-24 41 days
Check	6.5 a[2/]	35.8 a	57.2 a	31.0 a	7.1 a	0.3 a
.3	7.0 a	11.9 b	5.9 b	2.8 b	1.6 a	0.3 a
.625	4.2 a	11.0 b	8.0 b	1.2 b	1.1 a	0.1 a
1.25	2.5 a	2.8 b	1.5 b	0.6 b	0.9 a	0.2 a
2.50	5.1 a	5.0 b	1.1 b	0.4 b	0.7 a	1.2 a

[1/]Samples based on four replicates of 25 leaves each.

[2/]Means in the same column followed by the same letter are not significantly different at the 5% confidence level as determined by Duncan's New Multiple Range Test.

difference between that of treated blocks. There are two possible explanations for the population decrease in the check blocks. The foliage in these trees had become extremely chlorotic, indicating a depletion of mite food reserves. These trees also demonstrated a leaf drop of between 25-65% as compared to treated trees. Phytoseiid predators (Table 3 and Fig. 1) were fairly abundant, possibly adding to the mite population decrease in the untreated trees but after severe injury had occurred.

Observations concerning leaf phytotoxicity were made. There was no tip burn evident in any of the treatments.

Table 2 presents the mean number of tetranychid mites per leaf for each of the 5 sampling dates in the flood-irrigated orchard. Mites did not reach significant levels in the check blocks until 41 days after treatment. At this time all treatment rates were successfully suppressing mite population. The lowest dosage, 0.3 lb AI/acre, was showing evidence of breaking down; however, as the table indicates, this was not dramatic. By the 60th day after application no significant differences were found between treated and check blocks. Observations indicated no phytotoxicity occurred in any treated block.

Of the two orchards monitored only R-15 contained any appreciable amounts of phytoseiid predators (Table 3, Fig. 1). They were, however, unable to prevent the phytophagous mites from damaging the trees in terms of leaf chlorosis and leaf drop. It is interesting to note that the trees treated with the lower dosages of aldicarb were able to sustain a reservoir population of predacious mites throughout the duration of the experiment.

Table 2.--Aldicarb 15 G efficacy trial, R-62. Average number of hatched mites per leaf[1] for each of 4 treatments for 6 sampling dates.

Lbs. a.i. aldicarb/A	Sample Date 7-13 Pretreatment	7-21 7 days	7-28 14 days	8-11 28 days	8-24 41 days	9-12 60 days
Check	0.8 a[2]	0.0 a	0.5 a	0.4 a	8.3 a	20.6 a
.3	2.3 a	0.0 a	0.6 a	1.9 a	1.3 ab	10.3 a
.625	3.6 a	0.0 a	0.9 a	0.0 a	0.8 b	17.8 a
1.25	1.0 a	0.0 a	0.0 a	0.0 a	0.4 b	17.8 a
2.50	0.2 a	0.0 a	0.1 a	0.1 a	0.2 b	7.5 a

1/ Samples based on four replicates of 25 leaves each.

2/ Means in the same column followed by the same letter are not significantly different at the 5% confidence level as determined by Duncan's New Multiple Range Test.

Table 3.--Aldicarb 15 G efficacy trial, R-15. Total number[1/] of Phytoseiidae predacious mites for each of five treatments.

	Sample Date					
Lbs. a.i.	7-13	7-21	7-28	8-4	8-11	8-24
aldicarb/A	Pretreatment	7 days	14 days	21 days	28 days	41 days
Check	0 a[2/]	2 a	95 ab	245 a	93 a	46 a
.3	3 a	22 a	120 a	52 b	47 ab	43 a
.625	2 a	2 a	47 ab	17 b	44 ab	16 a
1.25	0 a	4 a	4 b	2 b	7 b	5 a
2.50	3 a	1 a	0 b	5 b	4 b	3 a

[1/] Samples based on four replicates of 25 leaves each.

[2/] Means in the same column followed by the same letter are not significantly different at the 5% confidence level as determined by Duncan's New Multiple Range Test.

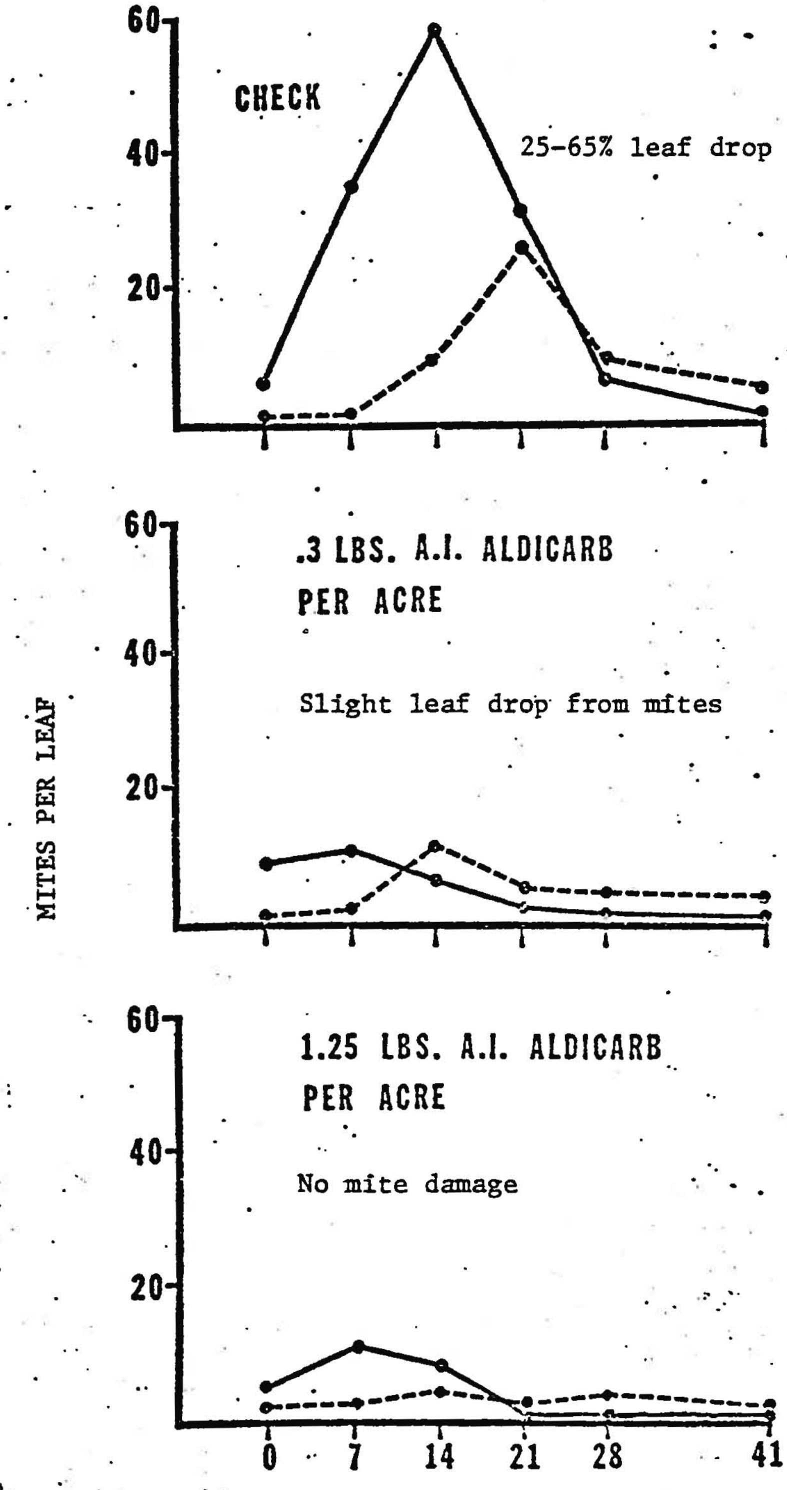

Fig. 1. Comparison of predacious mites and twospotted mites at different aldicarb dosages, R-15.

---- = predacious mites X10.
—— = twospotted mites.

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