SUMMARY OF 1978 ALMOND INTEGRATED PEST MANAGEMENT TRIALS

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The Almond IPM Project was started in 1978 to develop and demonstrate guidelines for improved orchard management of pests. Specifically, the program was directed at better Navel orangeworm (NOW) control and the effects of NOW chemical control upon predators and mites. Seven cooperators in various almond growing districts participated in the trials this past season. Each grower provided an eighty to one-hundred acre orchard where specific chemicals and cultural practices were used during the growing season. Populations of NOW, Peach twig borer, Oriental fruit moth and phytophagous (spider) mites were monitored weekly.

This summary describes each trial conducted during 1978 separately. No attempt has been made to correlate data into a statewide recommendation at the present time because of only having a single year's data. Several of the concepts, ideas and problems are unique to each individual ranch and some of the ideas have developed following the growing season after careful analysis of the data.

The increased egg deposition on traps by NOW following the application of Sevin occurred in most orchards and is an intriguing phenomenon. Whether it is due to a change in insect physiology, plant physiology, surface attraction, or whether it is causing a distraction from egg laying on mummy nuts, research is needed to define the problem. Recent work by Nick Toscano indicates other Lepidopterous insects might be stimulated by one of the above ideas.

In all orchards NOW egg traps indicated the amount of moth pressure and periods of egg deposition throughout the growing season. If trap counts are similar in future trials, criteria could be used to predict NOW pressure on the crop throughout the season and to correlate populations with harvest damage.

Some experience was gained this past year on beneficial insects present in the orchards. Guidelines need to be established on criteria to evaluate beneficials and on what role biological control might have in almond orchards. Cooperation with Marjorie Hoy on predator mites will continue. Additional work on lacewing populations will be attempted in 1979.

A cooperative project with John Labavitch on harvest maturity, time of knocking, time of harvest and worm infestation will also be included as a trial in 1979.

Chico Almond IPM Plot

The Chico almond IPM orchard is located approximately 5 miles south of Chico on level ground and is 80 acres of uniform sized, 12-year-old trees. Sprinkler irrigation is accomplished through the use of a solid-set sprinkling system and non-tillage orchard management is practiced. Pollenizers are Mission, Ne Plus and Thompson with 1 row of 1 pollenizer variety between 2 rows of Nonpareils.

The 80-acre block was divided into 8, 10-acre plots, 40 acres of which would be cleaned (orchard sanitation including knocking mummies, sweeping and chopping left-over nuts on the ground) and the other 40 acres would be left uncleaned. These clean and unclean blocks had check plots and spray treatment plots of 10 acres each, the treatments consisting of Guthion® (spring), Sevin® (summer) and Guthion® plus Sevin®. Because of the late start into the program and the severe winds and rain which knocked many of the overwintering mummies during January and February, this orchard was not cleaned; thus, the clean vs. unclean treatments could not be compared.

Monitoring Insects

Monitoring of Navel orangeworm (NOW), Peach twig borer (PTB) and Oriental fruit moth (OFM) began April 10, 1978 and concluded October 9, 1978. NOW traps were monitored at least once a week, usually twice a week.

NOW. The overwintering generation of NOW was observed from NOW egg traps for a 2 month period beginning April 14 and ending June 15 with a peak average of over 2 eggs per trap per day occurring between May 11 and May 15. First generation egg deposition began July 3 and continued to August 4 with a peak average of over 5 eggs per trap per day occurring between July 10 and 21. Egg deposition from the second generation began around August 10, peaked at over 18 eggs per trap per day on August 18 and concluded by October 9. The effect of the Guthion® treatment alone (June 1 and 2) on the first NOW generation reduced egg deposition compared to the check, as did the Sevin® treatment alone (July 20 and 21) and Guthion® plus Sevin®. In the second generation NOW egg deposition was greatest with the Guthion® plus Sevin®, Sevin®, and then the Guthion® treatments, in that order. The lowest egg deposition occurred in the check where no chemical treatment was applied. A possible explanation for this might be that there were more infested nuts in the check area that were in competition with the egg bait traps, and therefore, less eggs were deposited on the egg traps.

PTB. Traps containing PTB pheromone caps were used to attract male PTB moths. The PTB overwintering brood May flight began approximately April 28 and ended around June 9. Since there was an interruption of the flight by a 4-day cold period between May 22-26, 2 peaks occurred, one between May 8-15, and the other between June 5-9, each with an average of 6 PTB moths per trap per day. The July flight (June 29-July 31) also had a split peak, one between July 7-10 with an average of 5.5 moths per trap per day and another on July 21-24 with an average of 3 moths per trap per day. The last flight that was monitored occurred on August 18-September 28, peaking between September 1 and September 14 with an average of 17 moths per trap per day. Treatment with Guthion® (June 1 and 2) had an effect only on

the July PTB moths in that there seemed to be a reduction in the counts as compared to the plots which had not been treated (checks and Sevin® treatments). The Sevin® treatment (July 20 and 21) did not seem to have any effect on the PTB moths.

OFM. Oriental fruit moths were also monitored with a pheromone attractant cap. Although somewhat less distinct than PTB or NOW, there were 4 broods of OFM throughout the monitoring season. The first brood (April 18-May 5) peaked between April 25 and May 2 with an average of 3 moths per trap per day. The second brood (May 15-June 12) had a peak around May 22 with an average of 9 moths per trap per day. The brood between June 19 and July 24 had a peak around June 29 with an average of 21 moths per trap per day. The last brood (July 28-September 28) peaked around August 18 with an average of 22 moths per trap per day. There seemed to be a reduction in moth counts in only the brood following Guthion® treatment (June 1 and 2) compared to the plots which had not been treated (checks and Sevin® treatments).

Monitoring Mites and Predators

Leaf samples were collected biweekly beginning June 12 with the last sample collected on August 21. Thirty leaves per sample from 6 replicate trees from each of 4 plots (Guthion®, Sevin®, Guthion® plus Sevin®, and check) were taken to the lab, brushed through a mite brushing machine onto a glass plate; and then mites and predators were counted. The findings are in Table 1. European red mites and Pacific mites were the major pest mites found in significant numbers. The 3 kinds of predators found were nymphs of lacewing and six-spotted thrips and predator mites. Spray treatments with a miticide were applied on July 20 and 21 (Omite®) at the same time and only with the Sevin®-treated plots and on August 2 (Plictran®) in which the entire block was treated. The Plictran® application reduced Pacific mites and also European red mites except in the Sevin® plot where the number of European red mite eggs increased in the sample taken 5 days after treatment. Later samples showed a reduction. There was also a reduction in the predators, especially the predator mite, after both miticide applications.

Preharvest and Harvest Results

Preharvest Nonpareil nut samples were collected at 4 different dates - 30, 23, 19 and 13 days - before harvest. Composite samples of 200 nuts from 2 adjacent Nonpareil trees in the middle of each 10-acre plot were collected and from this, 100 nut subsamples were opened and examined for NOW, PTB and any other insect damage that might occur in the hull and nut.

Harvest samples were collected at harvest on September 15, 18 and 20 for Nonpareil and on September 30 and October 9 for Thompson and Mission, respectively. Although NePlus had been harvested by September 30 before samples could be taken, a 100 nut sample throughout the block was taken. For the Nonpareils harvest sampling consisted of a composite of 200 nuts from 2 adjacent trees, making up 1 replicate; and 11 other replicates were selected from the middle of the same 10-acre plot. This sampling procedure was repeated for each of the remaining 7, 10-acre plots. One-hundred nut subsamples from each of the 12 replicates from the 8 plots were cracked and examined for NOW,

PTB and other nut damage. A similar sampling procedure was used for the pollenizers except there were only 2 replicates from each of the 8, 10-acre plots.

The results are found on Graph 6. As was stated previously, the clean and unclean plots were disregarded and the respective 2, 10-acre plots (clean and unclean) were averaged together. In a period of 17 days from August 21 to September 7 NOW damage in the check plots rose from 5% to 19.5% which amounts to nearly 0.9% increase per day. From September 7 to harvest on September 20 NOW damage in the check plots increased 23%, nearly 1.8% per day. Whereas, in the period from August 21 to September 7 increases of NOW damage on the treatments were 0.6%, 0.6% and 0.2% for Sevin®, Guthion® and Guthion® plus Sevin®, respectively. Also, in the Guthion®, Sevin® and Guthion® plus Sevin® plots, the increase in NOW damage from September 7 to harvest was 1.4%, 1.2%, and 1.2%, respectively. All chemical treatments reduced NOW damage at harvest. The check had 42.5% damage, whereas Guthion®, Sevin®, and Guthion® and Sevin® sustained damage of 28.5%, 27.0% and 21.0%, respectively. Statistically, all the chemical treatment plots were significantly different at the 5% level from the check plots.

Presence of PTB frass or pupae in the hull or evidence of PTB feeding damage was greatest in the check of the preharvest samples. If the harvest samples were damaged by PTB, it was masked by the NOW damage. There were also some feeding damages made by ants in all the plots except for the Guthion® treatments on at least one of the preharvest sampling dates.

The results of the Thompson pollenizer treatments significantly reduced NOW damage from the check at the 5% level, but were not significantly different from each other. The averages of the NOW damage for Guthion®, Sevin®, Guthion® plus Sevin®, and check were 16.3%, 20.5%, 15.5%, and 33.8%, respectively. For the Mission pollenizers no difference was found except that there was no NOW damage in the Guthion® plus Sevin® treatment. The percent damages were 0.8, 0.5, 0, 0.8 for Guthion®, Sevin®, Guthion® plus Sevin , and check, respectively. A 24% NOW damage was found in the 100 NePlus nuts sampled throughout the block after all the NePlus nuts had been harvested.

On September 21 Diazinon® was applied by air in an adjacent block. Although this was late in the season after the Nonpareils but before the pollenizers were harvested and when NOW egg deposition was low, the Diazinon® treatment showed a trend in reducing NOW damage in Thompson nuts. Thompsons with the Diazinon® treatment had an average of 25.5% NOW damage, whereas, the Thompson check had 32% damage.

Conclusions and Recommendations

1. The orchard is one of the most uniform and probably the highest potential producing orchard within our trials.

2. Although the first two flights of NOW were moderate, an extremely high population developed during late August and September causing heavy damage to the crop.

3. Timing of both the Guthion® and Sevin® sprays were too late. The timing needs to be advanced to egg hatch for both flights.

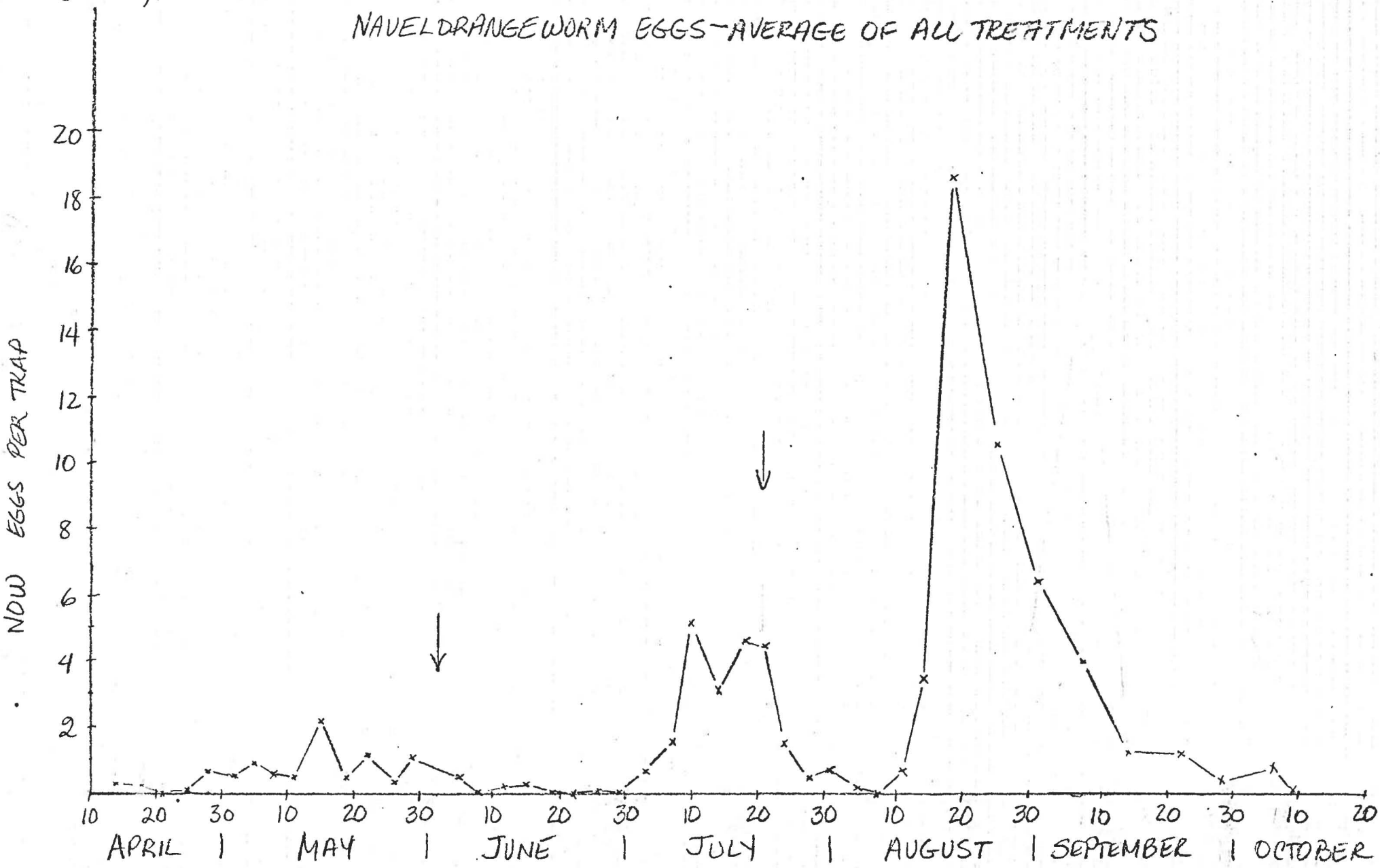
4. Earlier harvest if at all possible would have been very beneficial in 1978.

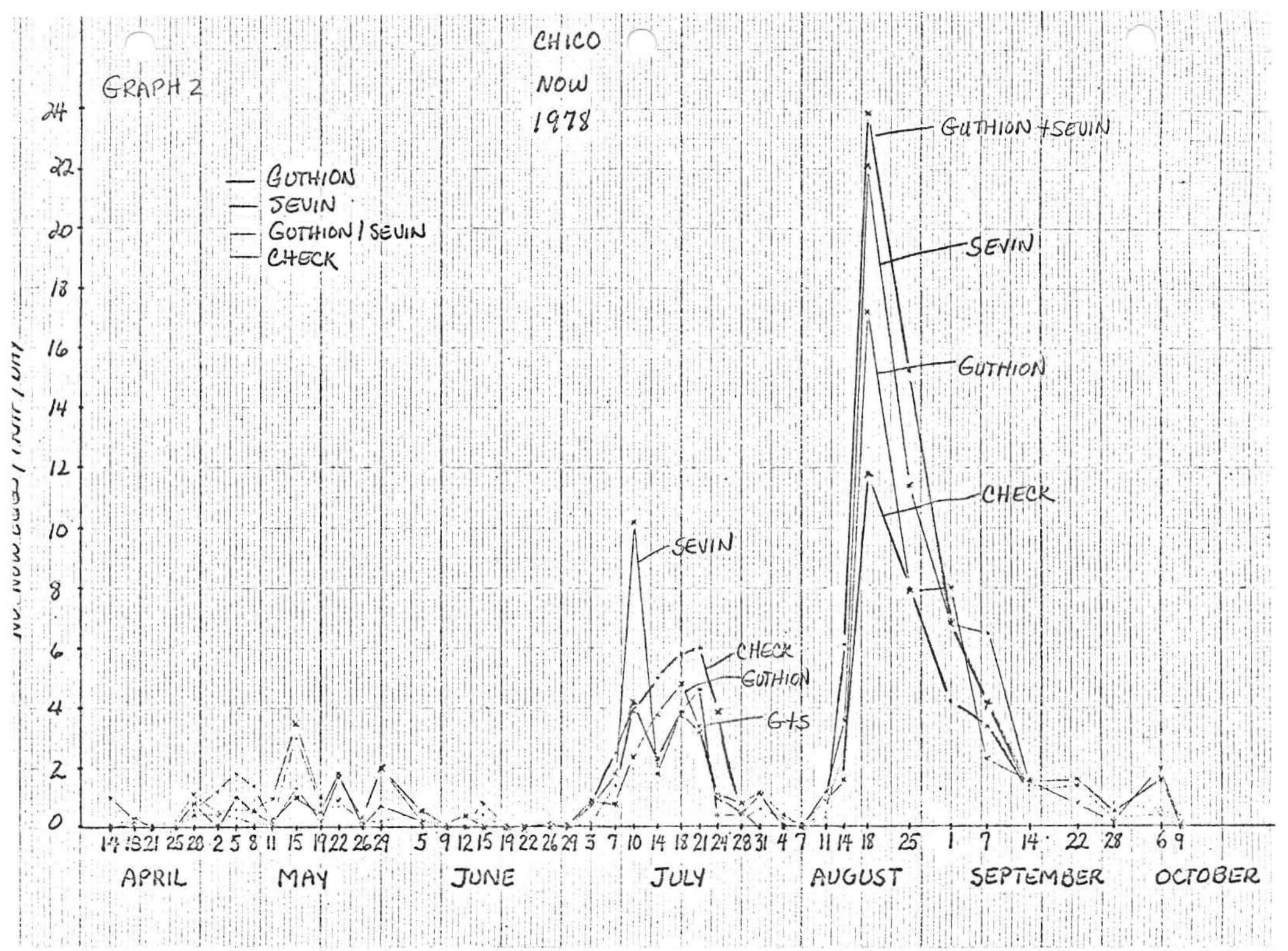
5. The orchard was never stressed for water throughout the season. Although some mite buildup was observed, no severe flare-ups and hotspots occurred, indicating good soil moisture will reduce mite potential.

6. Diazinon® applied to pollenizer rows showed a reduction of NOW damage from 32% to 25.5% in this limited trial. Additional trials need to be applied to determine feasibility of reducing the NOW population at harvest time.

GRAPH 1

CHICO, 1978

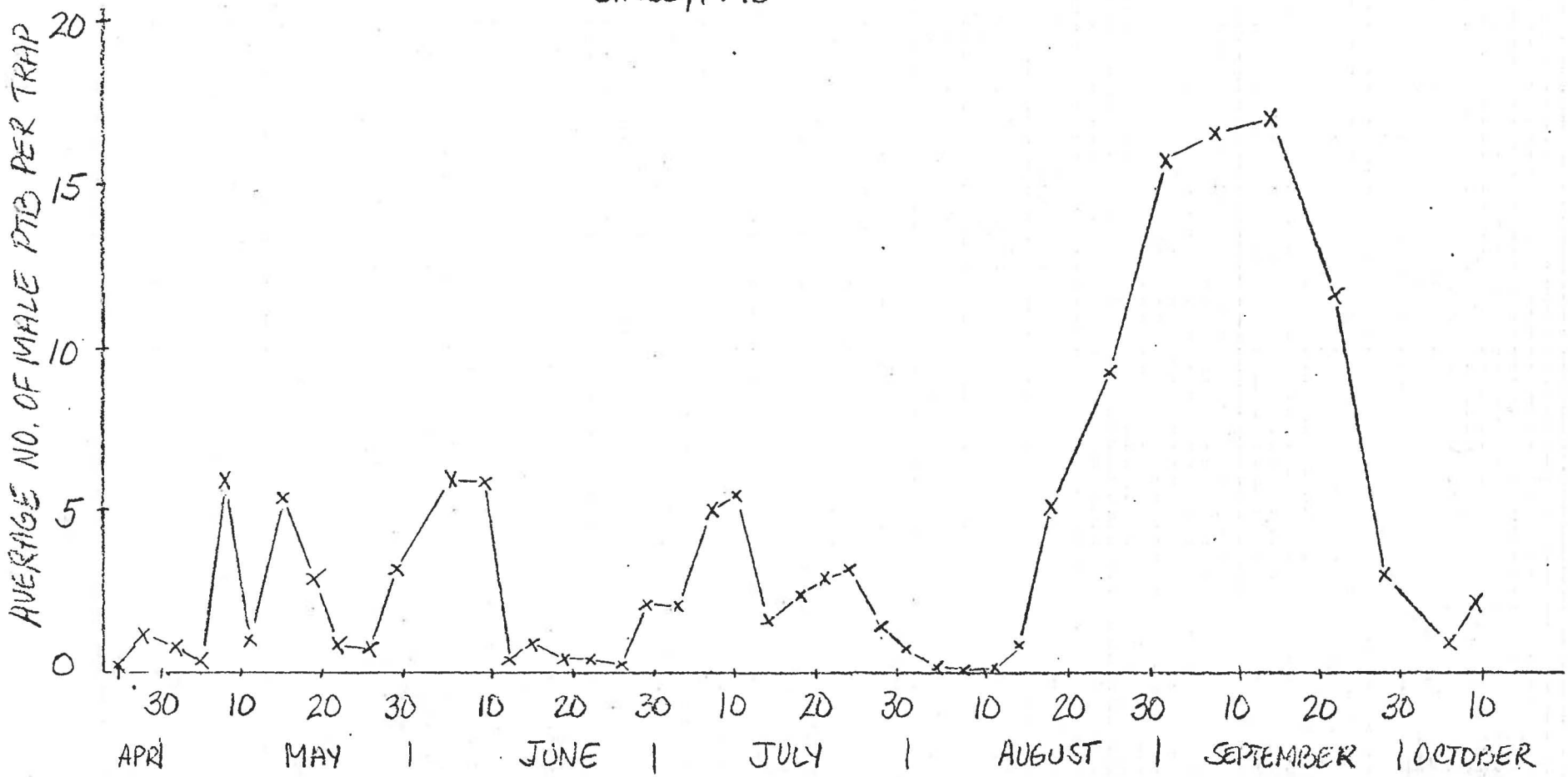


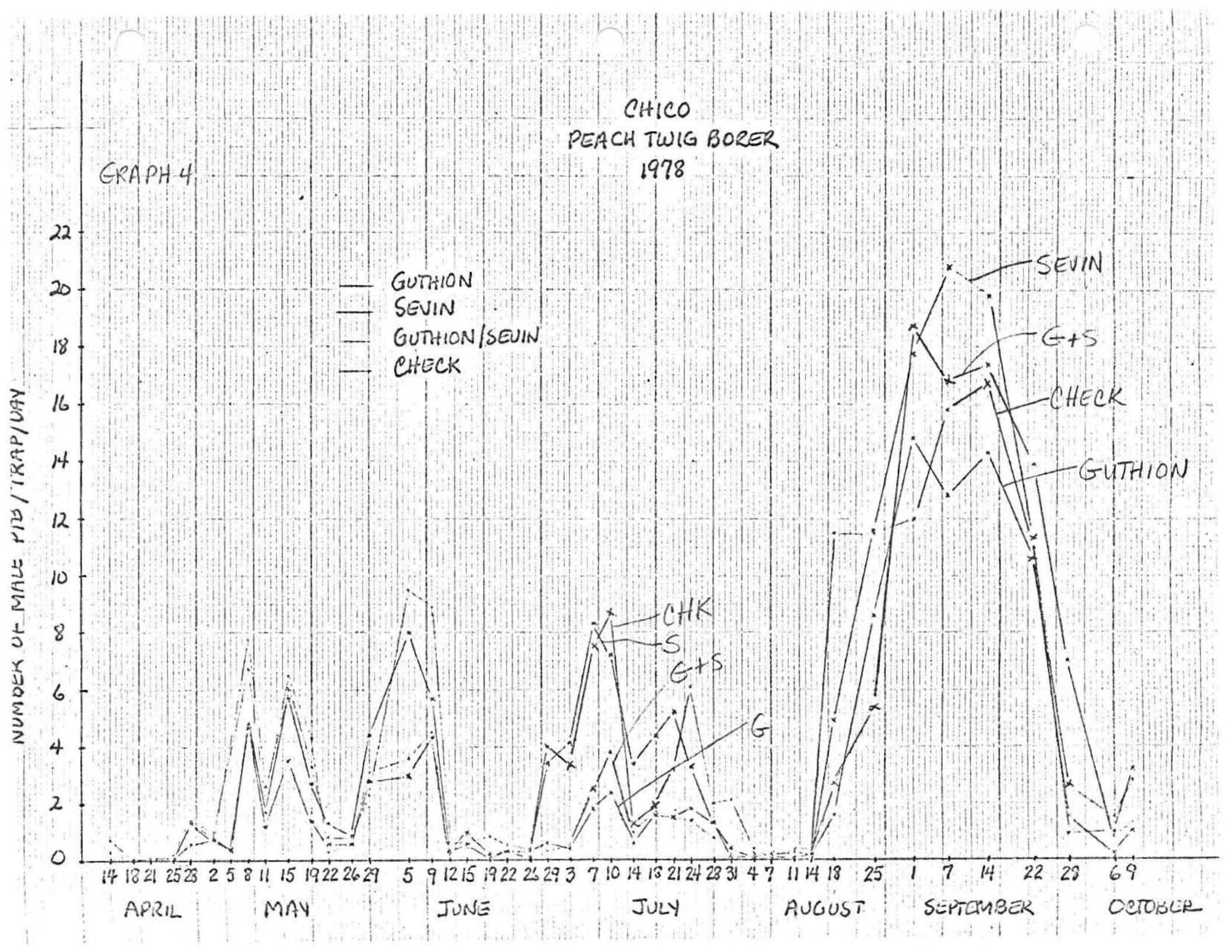

CHICO
NOW
1978
GRAPH 2
GUTHION
SEVIN
GUTHION / SEVIN
CHECK
GUTHION + SEVIN
SEVIN
GUTHION
CHECK
SEVIN
CHECK
GUTHION
G+S
INSECTS / UNIT / DAY
0
2
4
6
8
10
12
14
16
18
20
22
24
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER

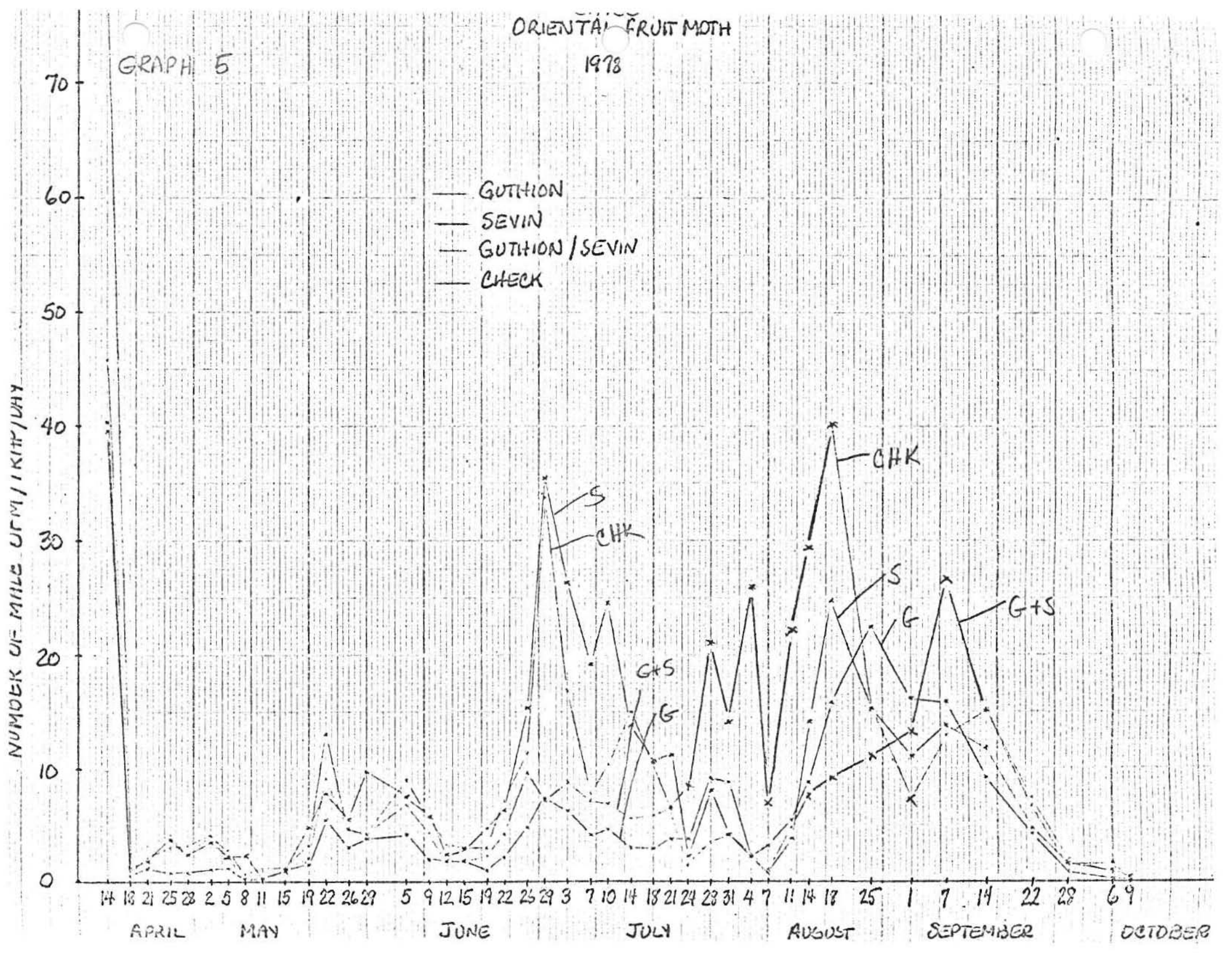
GRAPH 3

PEACH TWIG BORER AVERAGE OF ALL TREATMENTS

CHICO, 1978




CHICO
PEACH TWIG BORER
1978
GRAPH 4
GUTHION
SEVIN
GUTHION/SEVIN
CHECK
SEVIN
G+S
CHECK
GUTHION
CHK
S
G+S
G
NUMBER OF MALE PTB / TRAP / DAY
0
2
4
6
8
10
12
14
16
18
20
22
14 18 21 25 28 2 5 8 11 15 19 22 26 29 5 9 12 15 19 22 25 29 3 7 10 14 18 21 24 28 31 4 7 11 14 18 25 1 7 14 22 28 6 9
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER


ORIENTAL FRUIT MOTH
1978
GRAPH 5
GUTHION
SEVIN
GUTHION / SEVIN
CHECK
NUMBER OF MALE OFM / TRAP / DAY
0
10
20
30
40
50
60
70
S
CHK
G+S
G
CHK
S
G
G+S
14 18 21 25 28 2 5 8 11 15 19 22 26 29 5 9 12 15 19 22 25 29 3 7 10 14 18 21 24 28 31 4 7 11 14 17 25 1 7 14 22 28 6 9
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER

GRAPH 6

NONPAREIL NUTS INFESTED WITH NAVEL ORANGEWORM

CHICO, 1978

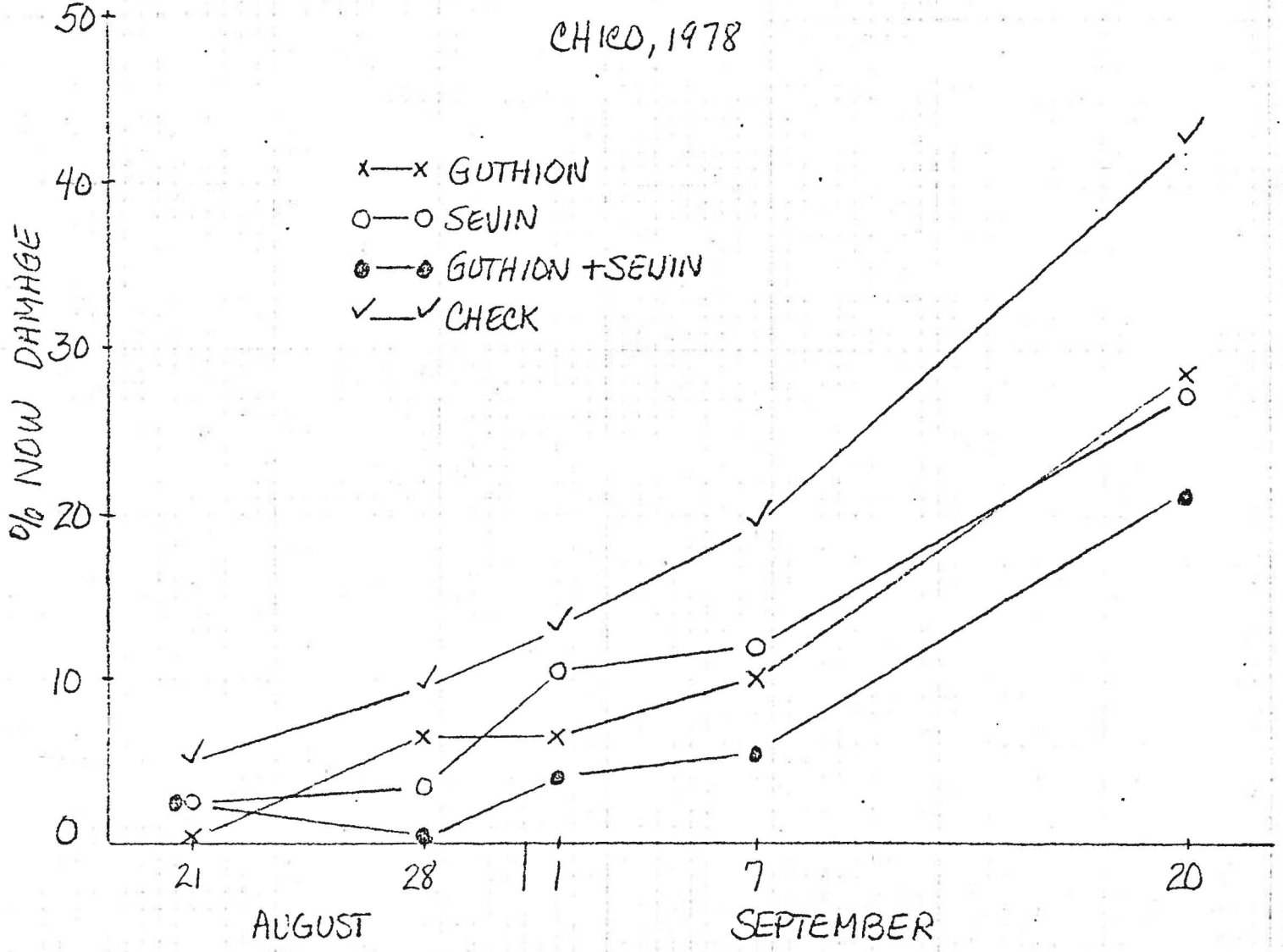


Table 1
CHICO - 1978
MITES AND PREDATORS IN AN ALMOND ORCHARD*

Treatment	June 12		June 26		July 10		July 24		August 7		August 21	
	Adult	Egg	Adult	Egg	Adult	Egg	Adult	Egg	Adult	Egg	Adult	Egg
GUTHION®												
Pacific Mite	0.23	0	0.14	0.01	0.93	0.19	0.20	0.24	0	0.03	0	0.03
European Red Mite	0.01	0.51	0.01	0.28	0.69	7.06	1.66	31.81	0.03	2.98	0	1.02
Predators**	0.01(m)	0	0	0.02(m)	0.01(m)	0	0.16(m)	0.22(m)	0.02(m)	0	0.01(m)	0
	0.01(lw)	0										
SEVIN®												
Pacific Mite	0.44	0.38	0.19	0.01	0.35	0.01	0.02	0.02	0	0.03	0	0
European Red Mite	0.04	2.89	0.03	0.89	0.33	1.22	0.13	1.04	0.04	7.58	0.06	1.90
Brown Almond Mite	0	0	0	0	0.02	0	0	0	0	0	0	0
Predators	0.04(m)	0	0.02(m)	0.01	0.05(m)	0.01(m)	0	0	0	0	0.01(m)	0
					0.02(lw)	0						
CHECK												
Pacific Mite	0.24	0	0.07	0	0.20	0.22	0.04	0.02	0	0	0.01	0
European Red Mite	0.02	1.50	0	0.57	0.10	1.55	0.10	3.18	0.06	1.86	0	0.34
Predators	0	0	0.03(t)	0	0.07(m)	0	0.08(m)	0	0	0	0.01(t)	0
GUTHION® + SEVIN®												
Pacific Mite	-	-	-	-	-	-	0.10	0.01	0	0	0.03	0
European Red Mite	-	-	-	-	-	-	0.26	7.99	0	2.50	0.01	0.61
Predators	-	-	-	-	-	-	0	0.02(m)	0	0	0.01(t)	0

* Average number of six replicates, 30 leaves/rep. using a mite brushing machine. Counts per leaf.

** lw = Lacewing nymph; m = predator mite; and t = six-spotted thrips nymph.

Guthion® treatment - June 1 & 2; Sevin® treatment - July 20 & 21.

Treatment with Omite® in Sevin® and Guthion® + Sevin® on July 20 & 21.

All plots treated with Plictran® on August 2.

TABLE 2

Chico

Nonpareil Harvest - Sept. 18, 1978

Treatment	% Damage		
	PTB	NOW	ANT
Guthion c	0	30.8 d	0
Guthion u	0	26.4 bc	0
Sevin c	0	29.6 cd	0
Sevin u	0.2	24.8 b	0.1
G + S c	0	18.7 a	0
G + S u	0	24.4 b	0
Check c	0	46.8 f	0.1
Check u	0	39.0 e	0

Preharvest Samples - Single Samples

	Date											
	8-21			8-28			9-1			9-7		
	PTB	NOW	ANT	PTB	NOW	ANT	PTB	NOW	ANT	PTB	NOW	ANT
Guthion c	0	1	0	0	8	0	0	7	0	0	10	0
Guthion u	0	0	0	0	5	0	1	6	0	0	10	0
Sevin c	0	2	0	2	4	0	1	7	0	0	11	0
Sevin u	2	3	2	0	3	8	0	14	3	1	13	0
G + S c	0	1	0	0	0	2	0	4	2	0	6	0
G + S u	0	4	0	2	1	0	0	4	0	0	3	0
Check c	5	5	0	1	9	3	2	14	2	0	18	5
Check u	12	5	1	3	10	0	3	12	1	0	21	1

Table 3

Chico

Pollenizer Harvest

Date

	Oct. 9, 1978 Mission			Sept. 30, 1978 Thompson	
	% Damage				
	PTB	NOW		PTB	NOW
Guthion c	0	1.0		0.3	17.5
Guthion u	0	0.5		0	18.5
Sevin c	0	1.0		0	23.0
Sevin u	0	0		0	18.0
G & S c	0	0		0	13.5
G & S u	0	0		0	17.5
Check c	0	0.5		1.0	32.0
Check u	0	1.0		0	35.5

MANTECA ALMOND IPM PLOT

The Manteca almond IPM orchard is located about 4 miles south of Manteca and consists of 80 acres of a uniform sized, 14-year old rectangular block of trees on level ground. Cultivation is by strip weed control with discing between rows. The orchard is flood irrigated. Pollenizers consist of Merced and Thompson with 1 row alternating between 2 rows of Nonpareils.

The 80-acre block was divided into 8, 10-acre plots consisting of 2, 10-acres of checks and chemical treatments of 2, 10-acre each of Guthion (spring), Sevin (summer), and a combination of Guthion plus Sevin. Half of the treatments was intended for cleaning (proper orchard sanitation including knocking mummies off trees and discing them under) and the other half to be left uncleaned. Due to the late start into the program, the only sanitation procedures used on the clean plots were sweeping of the tree row area. The nuts on the ground in the tree rows were blown toward the center between the trees where they were disced under in late March. There were considerable overwintering mummies left on the trees, especially on the pollenizers. The Nonpareils had an average of 15.9 mummy nuts per tree, whereas, Thompson and Merced had 25.6 and 29.2, respectively. Due to such high mummy counts in the entire orchard and the lateness in sweeping the clean plots, the clean vs. unclean treatments could not be compared this year.

Monitoring Insects

Monitoring of Navel orangeworm (NOW), Peach twig borer (PTB), and Oriental fruit moth (OFM) began on April 12, 1978 and concluded October 9, 1978. Traps were monitored at least once a week, usually twice a week.

NOW. The overwintering generation of NOW was observed from NOW egg bait traps on April 20 to June 19 with a peak around May 4 and a peak average of 3.8 eggs per trap. The rest of the season was more sporadic with low egg counts in most of the traps. The first generation, July 14 to August 11, averaged 0.5 eggs per trap at its peak on July 20. Egg deposition from the second generation (August 18 to October 2) had a peak average of 0.8 eggs per trap on September 5.

The Guthion treatments were applied on June 22 and 23, while the Sevin treatments were applied on July 17. It is difficult to describe the effects of the chemicals on the first NOW generation because all the egg counts were considerably low. But, there is more of a separation of peak counts in the second NOW generation with the Guthion plus Sevin having the highest counts of 1.9 eggs per trap. This is followed by the Sevin treatment, Guthion treatment, and then the check plot with 1.0, 0.7, and 0.3 eggs per trap, respectively.

PTB. Peach twig borer pheromone caps were used to attract male PTB moths to traps. The flight of the overwintering brood began April 17 and

concluded June 9. During this period 3 sharp peaks were noted, the highest having an average of 14.5 moths per trap per day on May 4, another with 8.0 moths on May 14, and the last one on May 30 with 8.5 moths per trap. The second brood, June 19-August 18, had a peak of 10.5 moths per trap on July 7, while the last brood from August 18-mid-October, had a peak average of 12.0 moths per trap on September 11.

The effect of Guthion (June 22 and 23) was seen in a reduction of moths in the peak in the second brood, where the untreated plots (checks and Sevin treatments) had 18.7 and 14.5 moths per trap per day, respectively, while the Guthion plus Sevin plot and Guthion plot had 5.9 and 3.7 moths, respectively. There did seem to be a reduction by the Sevin treatment (July 17) for a short while compared to the check plot. In the last recorded brood Guthion and Sevin treatments had the highest numbers of PTB with 14.3 and 13.5 moths per trap per day, respectively, whereas, the Guthion plus Sevin and check plots had 11.9 and 9.2 PTB moths, respectively.

OFM. Oriental fruit moth pheromone caps were also used to attract male OFM adults. There seemed to be 4 broods of OFM throughout the monitoring season. The first brood (April 17-May 8) had a peak average of 4.0 moths per trap on April 20, while the second brood (May 10-June 9) peaked on June 2 with 11.3 moths per trap. The brood between June 16 and mid-July had a peak average of 20.5 moths per trap on July 10. The last brood's (mid-July - October 2) peaks were scattered depending on the treatments, but if calculated from the check plot peak, was 15.6 on August 18.

The Guthion treatment on June 22 and 23 reduced the numbers of OFM found during the third brood flight compared to the untreated plots (checks and Sevin treatments). The Sevin treatment on July 17 reduced OFM moths in the fourth brood flight and for the most part the counts remained consistently below the counts of the Guthion and check plots.

Monitoring Mites and Predators

Leaves were sampled biweekly beginning June 9 through August 18. Thirty leaves per sample from 6 replicate trees from each of 4 plots (Guthion, Sevin, Guthion plus Sevin, and check) were taken to the lab and put through a mite brushing machine. The mites and predators were collected on a glass plate and counted under a dissecting scope. The findings are in Table 1. Pacific and/or Two-spotted mites and European red mites were the major mite pests found in significant numbers. Predators present were nymphs of lady beetles, lacewings, and six-spotted thrips, and predator mites. There was an increase of both European red and Pacific and/or Two-spotted mites throughout the monitoring season in the Guthion treatment. In the check plot predators were present throughout the season and had less mite pests than the Guthion treatment.

No miticide was applied to the orchard except in the areas treated with Sevin or Guthion plus Sevin where Omite was included in the spray treatment. The plots receiving Guthion had considerable European Red Mite buildup in July and August with Pacific and Two-spotted Mites occurring in August. Considerable defoliation occurred at harvest in the 20 acres treated with Guthion.

Mites were not a problem in the check areas throughout the season. Considerable predators (mainly M. occidentalis-predator mite) occurred in the check area throughout the season. The orchard was allowed to become dry in late June during a hot spell and some defoliation occurred from stress throughout the block.

A small area of 5 rows on one side of the Sevin-treated plot was not treated with Omite on July 17. By August 4 both European Red and Pacific mite populations were increasing rapidly with defoliation and webbing of trees occurring at harvest. Treatment with Omite® along with the Sevin treatment on July 17 resulted in a decrease in pest mites in those plots.

Preharvest and Harvest Results

Preharvest Nonpareil nut samples were taken 21, 18, 11 and 6 days before harvest. Composite samples of 200 nuts from 2 adjacent Nonpareil trees in the middle of each 10-acre plot were collected and from this, 100 nut subsamples were opened and examined for NOW, PTB, and any other insect damage that might occur in the hull and nut.

Nonpareil harvest samples were collected on September 19 and 20 and the Merced and Thompson pollenizers on October 3. For the Nonpareil harvest sampling consisted of a composite of 200 nuts from 2 adjacent trees, making up 1 replicate; and 11 other replicates were selected from the middle of the same 10-acre plot. This sampling procedure was repeated for each of the remaining 7, 10-acre plots. One hundred nut subsamples from each of the 12 replicates from the 8 plots were then cracked and examined for NOW, PTB, and other insect damage. A similar sampling procedure was used for the pollenizers except only 2 replicates from each of the 8, 10-acre plots were taken.

The results are found on Graph 6. As was previously stated, the clean and unclean plots were disregarded this year and the respective 2, 10-acre plots (clean and unclean) were averaged. There was considerable variation in the preharvest sample counts which could have been due to the small sample size that was taken. In spite of this, the preharvest samples seemed to show a trend toward increasing NOW damage in all of the plots as the season progressed, with the check plots having the highest percentage of NOW damage and the Sevin, Guthion, and Guthion plus Sevin treatments having lower percentages than the check. The Nonpareil harvest results showed that the chemical treatments reduced NOW damage and was significantly different at the 5% level from the check plot but not from each other. The percent NOW damage for the Sevin, Guthion, and Guthion plus Sevin treatments was 9.8, 5.6 and 4.9, respectively, whereas, the check plot NOW damage was 13%. PTB frass or pupae in the hull was present throughout all the plots at the preharvest sampling time. Presence of PTB in the nut at the earlier preharvest dates was higher in the check and Sevin plots, with the check plot having from 1-2.5% more PTB damage than the Sevin plot. At harvest PTB nut damage, when it was not masked by NOW damage, was 1.9% in the check, 1.2% in the Sevin plot, 0.2% in the Guthion plot and 0% in the Guthion plus Sevin plots.

The chemical treatments significantly reduced NOW damage in the Merced pollenizers from the check at the 5% level, but were not significantly different from each other. The percentages of NOW damage were 4.8, 3.5, 3.0

and 9.5 for the Guthion, Sevin, Guthion plus Sevin, and check plots, respectively. Presence of PTB was found in all but the Guthion treatment and evidence of a small amount of ant feeding was present in the check plot. The Thompson pollenizer harvest results showed a similar trend as the Merced, but was statistically significant at the 10% level. The NOW damages found for the Guthion, Sevin, Guthion plus Sevin, and check plots were 1.0%, 0.3%, 0.5% and 2.8%, respectively. The check plot was the only plot which had evidence of PTB damage or ant feeding.

Conclusions and Recommendations

1. The Guthion sprays went on too late this year. Sprays should have gone on at egg hatch which was 10 days earlier.

2. Presence of predators are able to keep mite pests down in population. Chemicals (Guthion) will reduce predators to where there is a severe flare-up of mite pests.

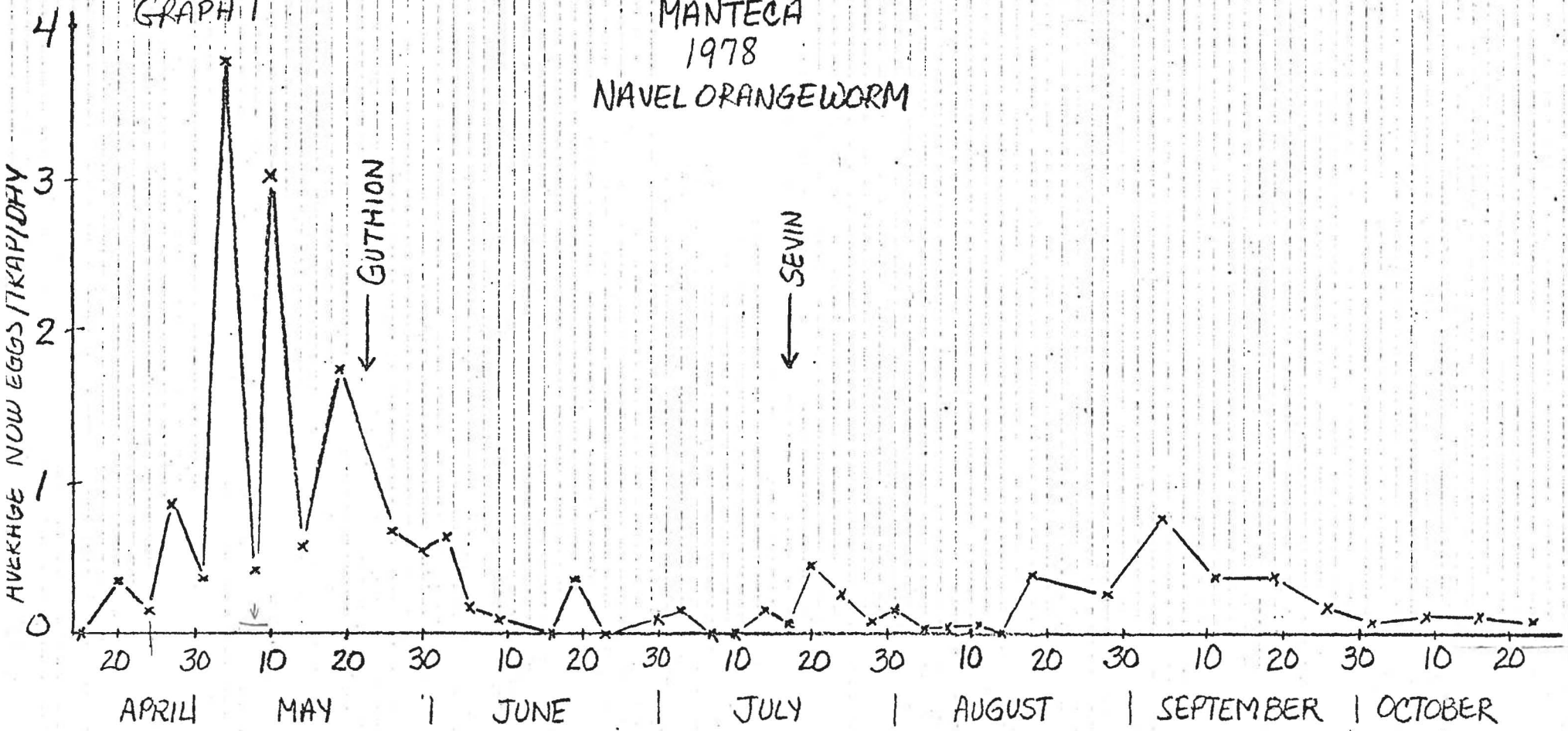
3. Sevin treatments were not as effective as Guthion treatments probably because of the low NOW egg deposition occurring in July.

4. The Sevin spray was applied at approximately 5% hull split. Manteca is the coolest district in which we have plots and therefore, possibly the July flight of NOW might have been later, more closely correlated with hull split than other areas. That does not mean the relation to hull split will be the same in future years but only that it coincided in 1978.

5. Very low egg deposition occurred in late August and September on the egg traps. Only a slight increase in NOW in nut samples also occurred during this period. A correlation between egg trap counts in August and September and worm pressure on the nuts might be possible. Further work needs to be done to develop a possible correlation.

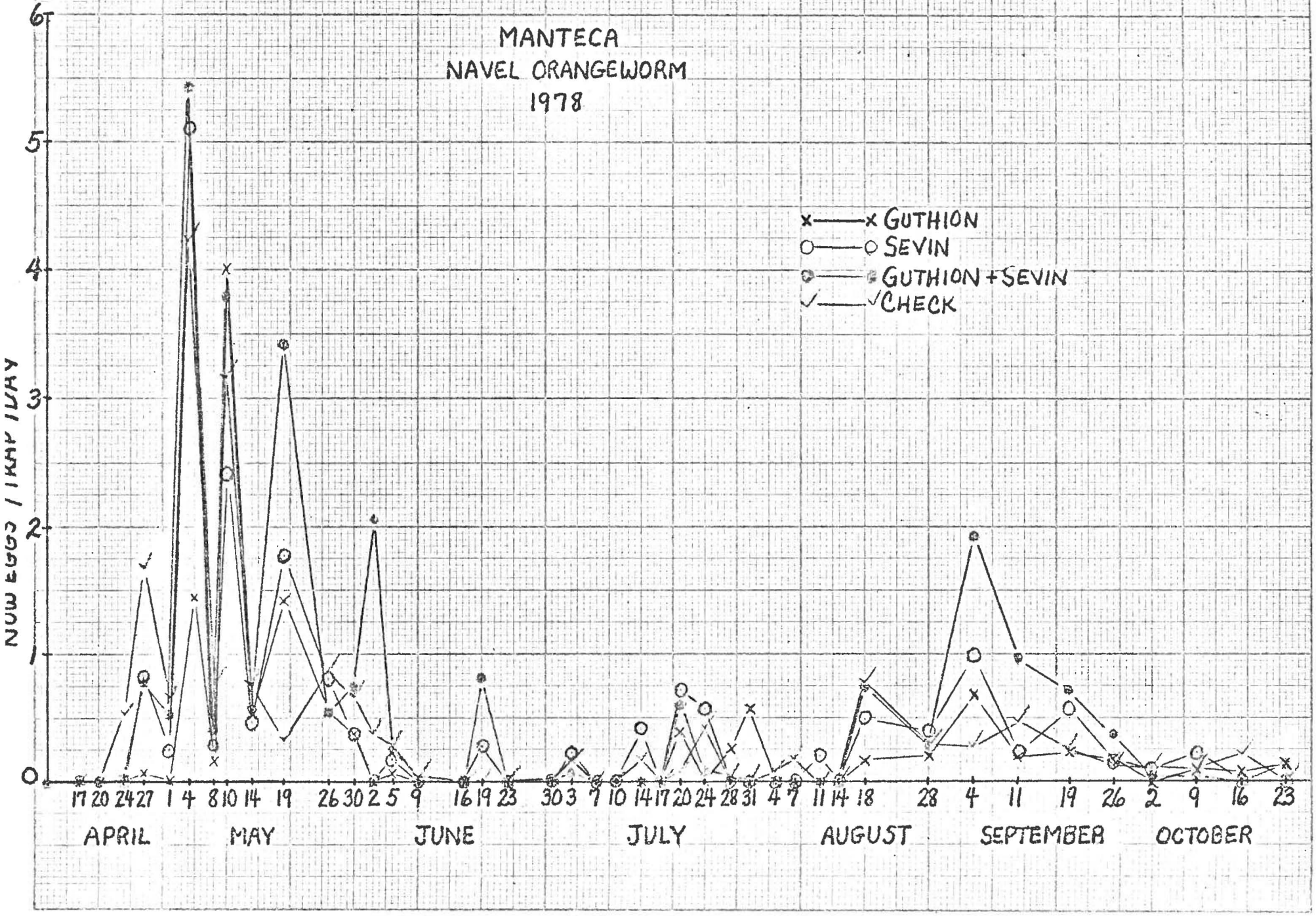
GRAPH 1

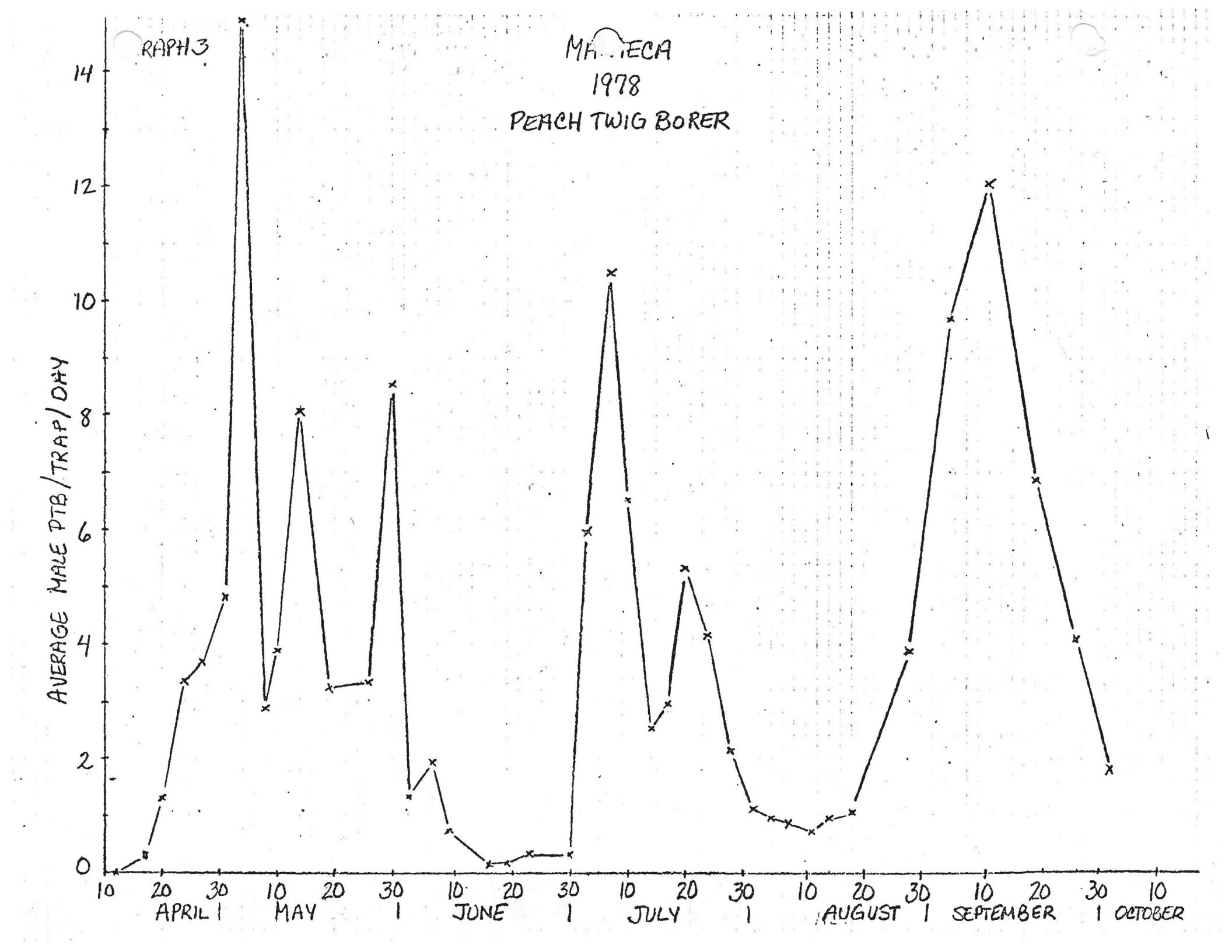
MANTECA
1978
NAVEL ORANGEWORM

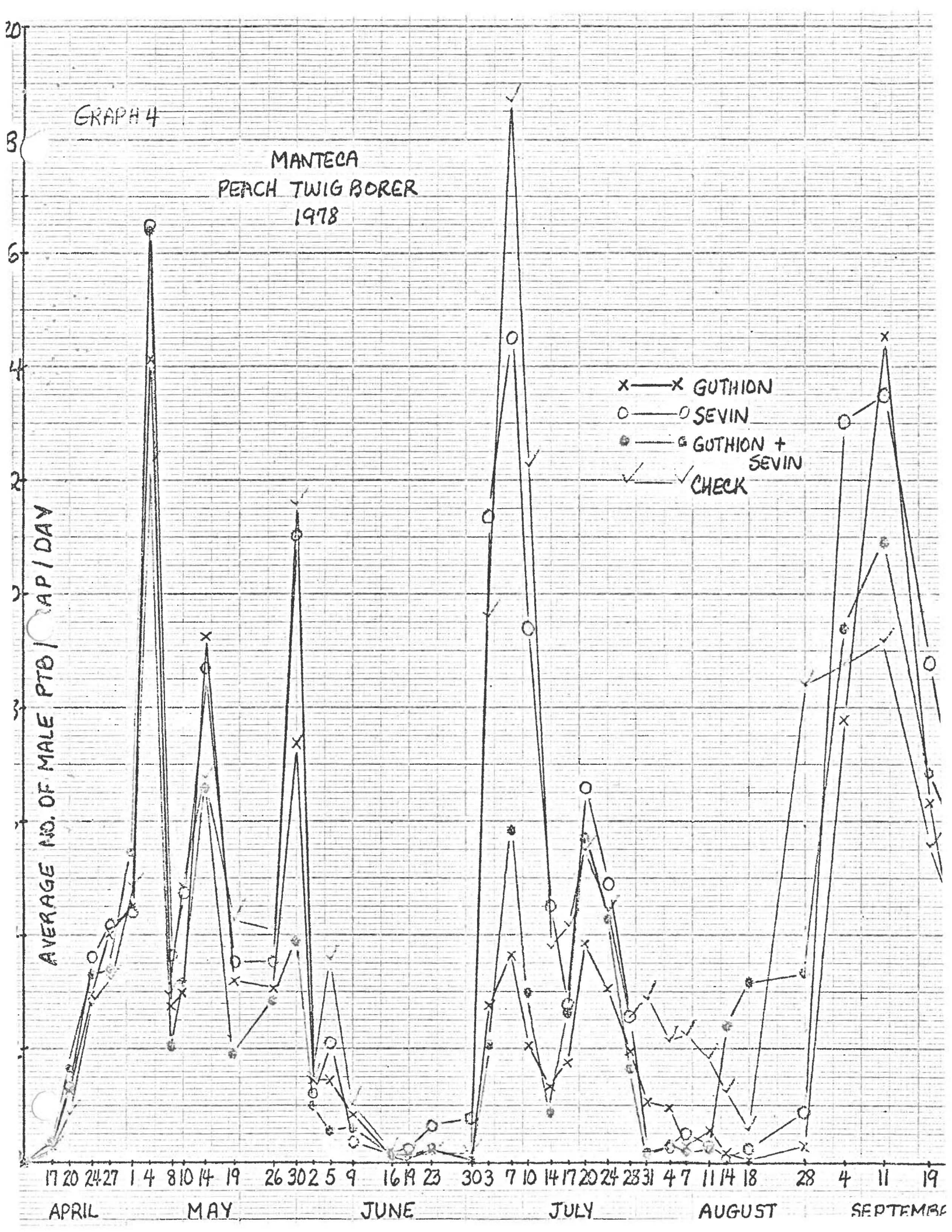


GRAPH 2

MANTECA
NAVEL ORANGEWORM
1978

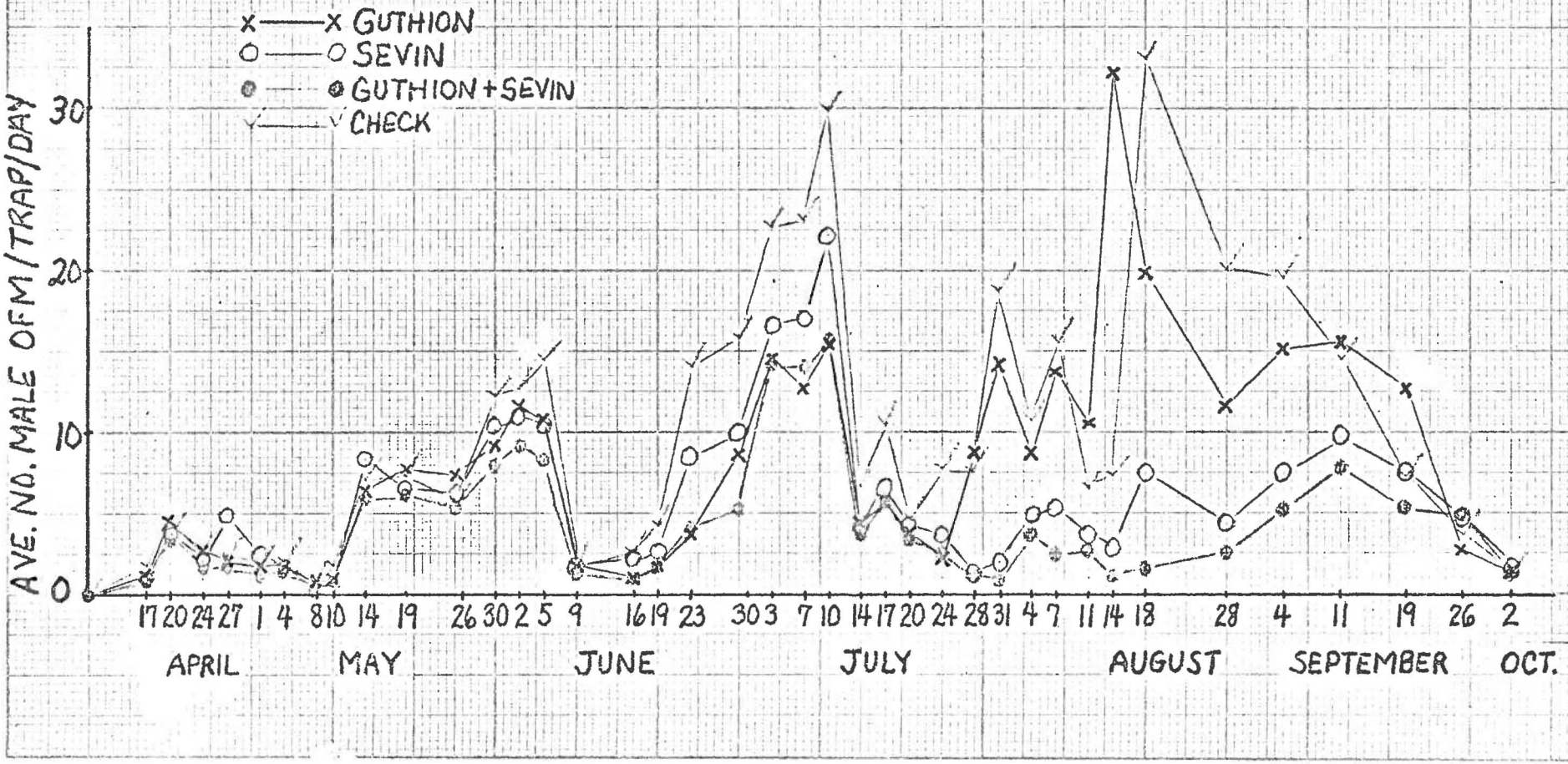



RAPH 3
MA..ECA
1978
PEACH TWIG BORER
AVERAGE MALE PTB/TRAP/DAY
0
2
4
6
8
10
12
14
10 20 30 10 20 30 10 20 30 10 20 30 10 20 30 10 20 30 10
APRIL 1 MAY 1 JUNE 1 JULY 1 AUGUST 1 SEPTEMBER 1 OCTOBER


GRAPH 4
MANTECA
PEACH TWIG BORER
1978
GUTHION
SEVIN
GUTHION + SEVIN
CHECK
AVERAGE NO. OF MALE PTB / TRAP / DAY
17 20 24 27 1 4 8 10 14 19 26 30 2 5 9 16 19 23 30 3 7 10 14 17 20 24 28 31 4 7 11 14 18 28 4 11 19
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER

GRAPH 5

MANTECA
ORIENTAL FRUIT MOTH
1978



GRAPH 6

NONPAREIL NUTS INFESTED WITH NAVELORANGEWORM

MANTECA, 1978

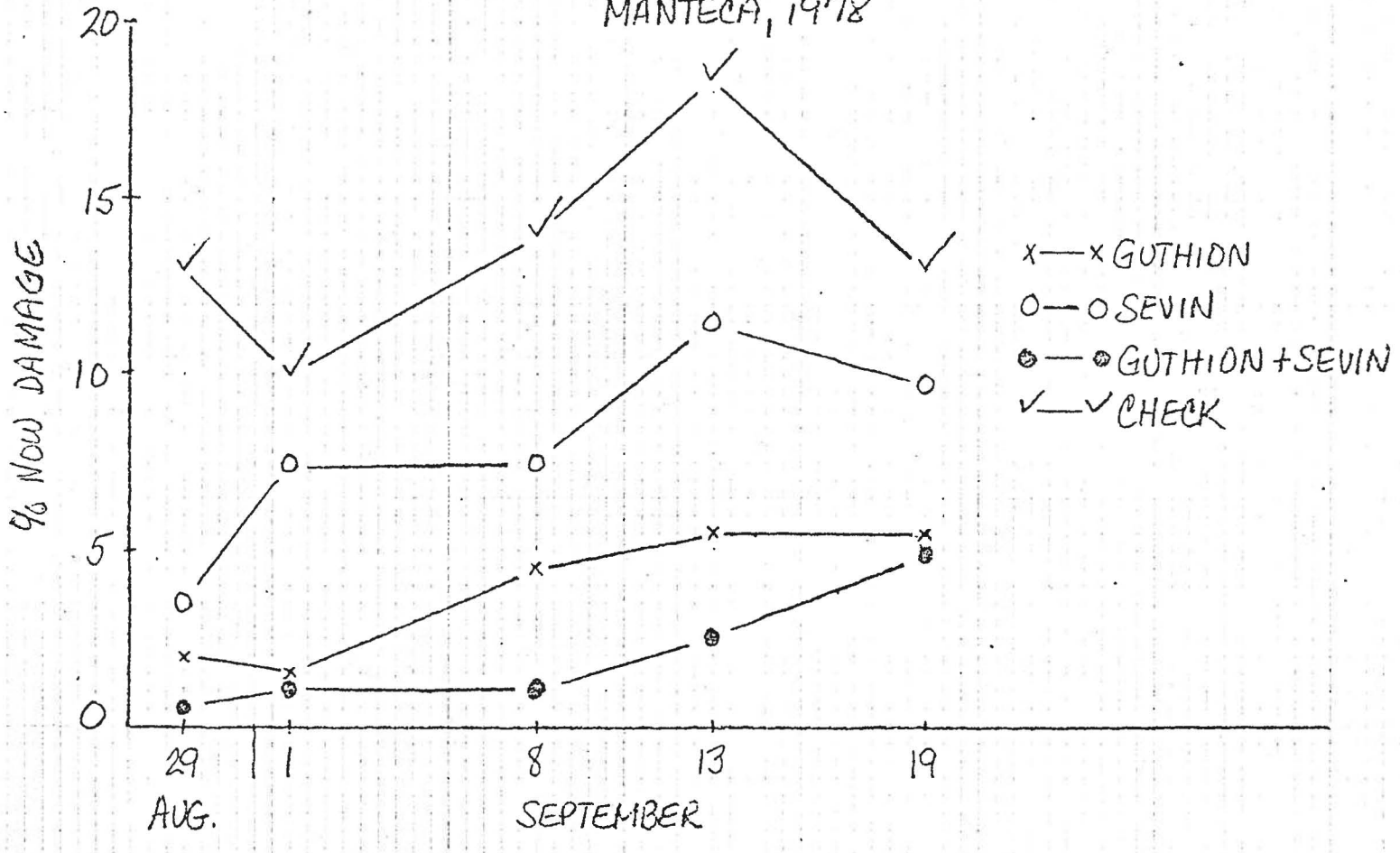


Table 1

M[illegible]eca - 1978

Mites and Predators in an Almond Orchard*

Treatment	June 9		June 23		July 7		July 20		Aug. 4		Aug. 18	
	Adult	Egg	Adult	Egg	Adult	Egg	Adult	Egg	Adult	Egg	Adult	Egg
Guthion®												
Pacific + Two-Spotted Mites	0	0	0.23	0	1.04	0.05	0.70	0.10	4.20	3.43	10.10	18.27
European Red Mite	0.10	1.3	0.06	1.6	0.75	7.67	8.08	38.63	19.13	54.77	5.03	31.97
Brown Almond Mite	0	0	0	0	0.02	0	0	0	0	0	0	0
Predators**	0	0	0	0	0.02(t)	0	0	0	0	0	0.07(m)	0.03(m
Sevin®												
Pacific + Two-Spotted Mites	0	0	0	0	0	0	0.09	0	0	0	0.06	0.16
European Red Mite	0	0.06	0	0.06	0	0.03	0	0.33	0	0.19	0.01	0.21
Predators	0	0	0	0.01(m)	0.02(m)	0	0.01(m)	0	0	0	0	0
					0.01(lw)	0						
					0.03(t)	0						
Check												
Pacific + Two-Spotted Mites	0	0	0	0	0	0	0.09	0.02	0.71	0.92	0.51	0.24
European Red Mite	0	0.02	0	0	0.01	0.09	0	0.03	0	0.09	0.04	0.66
Brown Almond Mite	0	0	0	0	0	0	0	0	0.02	0	0	0
Predators	0.01(m)	0	0.03(m)	0	0.03(m)	0.01(m)	0.07(m)	0	0.13(m)	0	0.04(m)	0
	0.01(lb)	0			0.02(lw)	0			0.02(t)			
	0.07(t)	0										
Guthion® + Sevin®												
Pacific + Two-Spotted Mites	-	-	-	-	-	-	0.74	0.58	0	0	0.08	0.07
European Red Mite	-	-	-	-	-	-	0.01	0.05	0.01	0.02	0.01	0.06
Predators	-	-	-	-	-	-	0	0.01(lw)	0	0.01(m)	0	0
Sevin® W/O Omite®												
Pacific + Two-Spotted Mites	-	-	-	-	-	-	-	-	0.93	1.07	5.23	6.08
European Red Mite	-	-	-	-	-	-	-	-	1.30	15.69	4.77	54.61
Predators	-	-	-	-	-	-	-	-	0	0	0.23(m)	0.30(m

*Average number of six replicates, 30 leaves/rep. using a mite brushing machine. Counts per leaf.

**lb = lady beetle nymph; lw = lacewing nymph; m = predator mite; t = six-spotted thrips nymph.

Guthion® treatment - May 22 & 23; Sevin® treatment - July 17 (Omite® included except for 5 rows).

TABLE 2

MANTECA

Nonpareil Harvest - September 20, 1978

Treatment		% Damage PTB	NOW	ANT
Guthion	c	0.3	8.1c	0
Guthion	u	0	3.0a	0
Sevin	c	1.3	7.9c	0
Sevin	u	1.2	11.7d	0.2
G&S	c	0	5.6b	0
G&S	u	0	4.3ab	0
Check	c	1.8	13.8e	0
Check	u	1.9	12.2d	0

Preharvest Samples - Single Samples

		Date 8-29			9-1		9-8		9-13	
		PTB	NOW	ANT	PTB	NOW	PTB	NOW	PTB	NOW
Guthion	c	0	3	2	0	3	0	5	0	10
Guthion	u	0	1	0	0	0	0	4	0	1
Sevin	c	8	3	0	6	4	0	5	0	6
Sevin	u	3	4	0	6	11	6	10	0	17
G&S	c	1	1	0	0	2	0	2	0	3
G&S	u	0	0	0	0	0	0	0	0	2
Check	c	7	14	0	7	9	5	20	1	24
Check	u	8	12	0	10	11	3	8	1	13

Table 3

Manteca

Pollenizer Harvest - Oct. 3, 1978

	% Damage					
	Merced			Thompson		
	PTB	NOW	ANT	PTB	NOW	ANT
Guthion c	0	5	0	0	2	0
Guthion u	0	4.5	0	0	0	0
Sevin c	0	1.5	0	0	0	0
Sevin u	2	5.5	0	0	0.5	0
G & S c	2.5	3	0	0	1	0
G & S u	0	3	0	0	0	0
Check c	2.5	6	1.3	1.3	2.5	0.3
Check u	1	13	0	0	3	0

The Hughson Almond IPM Plot

The Hughson almond IPM plot is composed of an orchard approximately 120 acres. Originally, the plot was designed to cover approximately 90 acres but was redesigned to the larger size because of air applications. The terrain is rolling foothills about 7 miles east of Hughson and the orchard floor is strip-sprayed with the areas between rows disced. The orchard is irrigated by a hose pull irrigation system. The varieties present are 2 rows of Nonpareil alternated by a pollenizer row. The pollenizers are Merced in one row, then 2 rows of Nonpareil, and then a row with 2 trees of Mission alternating with 2 trees of NePlus down the row. Due to the extremely wet winter and spring this past year, shothole disease was very severe in the orchard with no fungicides applied during spring time. Shothole was most severe in all 3 of the pollenizers present - Merced, NePlus, and Mission-taking most of the crop. The Nonpareil trees were not quite as heavily damaged, but the crop was severely limited by the disease.

The Navel orangeworm traps indicated a very low egg deposition during the May flight starting approximately May 8 and terminating May 22. Only a maximum of 10 of the 24 traps showed any egg deposition for any one week period of time during this May flight. Therefore, due to the extremely low population of Navel orangeworm, the Guthion spray which was designed to be put on at this time was not applied. The grower chose to apply a Guthion spray to the rest of the orchard. Therefore, 90 acres was left untreated with the rest of the orchard treated with Guthion at this time. Sprays were applied between May 25 and June 1 on the rest of the orchard. During early July, considerable peach twig borer was found in the hulls of nuts on the trees. At that time, we wanted to apply Sevin and Imidan treatments in the areas that were originally designated for treatments. The grower had floated the orchard preceding this period of time and did not want to spray by ground rig. He wanted us only to apply any treatment by air with fixed-wing aircraft. At that time, we redesigned the plot so that we could sample the Guthion treatment plus fly on various treatments to compare. The treatments were Sevin, Imidan, and Diazinon and an unsprayed check. The Diazinon treatment was a triangular corner which was not a full 30 acres, but was approximately 30 acres in size. Sprays were applied by fixed-wing aircraft at 10 gallons per acre on July 21 to the Sevin, Imidan, and Diazinon plots. Considerable damage was seen from the Peach twig borer at this time and the worms present in the hull continued to work and entered the nuts causing considerable damage to the kernels.

Peach twig borer pheromone trap counts showed a peak period of flight occurring approximately May 4; another flight occurred between May 22 and June 12; a flight occurred between July 3 and July 25 and then sporadic amounts of PTB catches in August and September. It is interesting to note that the late April-May flight was interrupted by a period of approximately three weeks when very little male PTB were caught in traps. This occurs during the traditional mid-May period when normal PTB flight usually occurs. The data indicates a definite need to monitor PTB and time sprays according to trap counts rather than according to the calendar. If sprays had been applied in Mid-May, most of the brood would not have been affected by the spray and the spray would have been worthless. The grower's treatment of Guthion, which was apllied on May 25 to June 1, controlled the second part of this first May brood.

Damage caused by NOW on the final sample date (September 16) showed that Guthion had completely controlled the PTB, and NOW caused 29% damage. The Sevin, Imidan, and Diazinon treatments had 46% to 49% NOW damage and 7% to 9% PTB damage. Very little difference occurred between any of the three treatments. The check area showed 63% damage from NOW and approximately 6% from peach twig borer. Peach twig borer damage in the check was slightly lower than in the Sevin, Imidan and Diazinon treatment, probably due to the masking of the Navel orangeworm over the Peach twig borer. If any of the nuts had both PTB and NOW damage, they were counted as NOW damage. Early season samples in the last two weeks of August showed that the Guthion had no Navel orangeworm in the early samples, whereas, the other plots had appoximately 10 to 20 percent damage in early August. Had the nuts been harvested at this early date, they would have shown considerably less damage than at the final harvesting date, again indicating the benefits from early harvesting of nuts.

The predominate mite present in the orchard was European red mite with some Pacific mite also present. The Guthion blocks caused a buildup of both European red mite and Pacific mite in July. A treatment of Plictran was applied on July 18 by fixed-wing aircraft to the entire orchard. There were a few mites in different trees within the orchard and along the edge of the plot, although no treatment had been applied before then. After the orchard was treated, samples were taken from the various treatments on July 27 and August 10. The check, Sevin, Imidan, and Diazinon, did not have a mite buildup on the two sample dates, July 27 and August 10. Some defoliation, though, was noted and had occurred by harvest time during mid-September. The Guthion, Sevin, and Imidan treatments had more defoliation than either the check or Diazinon treatment. The Guthion treatment showed a high population of both European red mite and Pacific mite on the sample date of July 27 and August 10, even though Plictran had been applied by air on July 18 preceding those sample dates. The population was higher in the area before the air application, but the air application did not give control in those areas treated with Guthion.

Some observations concerning the Hughson plot are:

1. Very high popluations of peach twig borer occurring during the growing season can cause appreciable damage to the nuts at harvest if left uncontrolled throughout the season. Average moth counts of 20 to 30 male PTB caught in pheromone traps were quite high in May and average counts from 40 to 60 PTB per day caught in July can cause appreciable damage to the crop at harvest.

2. Peach twig borer and Navel orangeworm can cause a high percentage of damage in very light crop years. The crop at Hughson was very light this past year with a high percentage of nuts infested. One question which has been raised is, "Will the damage from both peach twig borer and Navel orangeworm be an equal percentage regardless of crop load?" Based on the appearance of damage at the Hughson plot , it is believed that damage is greater in

those years when a light crop is present in the orchard. A higher percentage of a light crop can be damaged from Navel orangeworm than when there is a heavy crop.

3. Navel orangeworm trap counts of approximately 1/2 the traps receiving egg deposition in any one week period appears to be very near the critical level to recommend spray treatments for control of Navel orangeworm.

4. Applications of both organic phosphate insecticides and Plictran during the summer time by fixed-wing aircraft appear to be inferior to ground applications, and appear to be inadequate in controlling medium to high infestations of either PTB or mites.

5. Applications of Imidan, Sevin and Diazinon applied by air during July gave equal control of Navel orangeworm for the season. The treatment was not as effective, though, as a Guthion spray in May by ground rig.

6. Very few Navel orangeworm eggs deposited on any of the egg bait traps during the June and July period. A reason might be that the high incidence of peach twig borer damage within the hulls made the traps unattractive for egg deposition. During late August and September egg deposition occurred on the traps. This flight caused the increase in Navel orangeworm damage to the nuts at harvest time.

7. European red mite was present within the orchard throughout the summer. Following the treatments of Guthion ERM built up to high numbers. There was no suppression of European red mite due to any hot spells occurring during the summer. Considerable stippling and defoliation occurred in the Guthion plot. Some defoliation and stippling also occurred in the Sevin and Imidan plot during the late season because of both European red mite and Pacific mite feeding.

8. Several problems which occurred during 1978 need to be worked out before continuing the plot. These are:

   a. Application of a good peach twig borer spray during the dormant time.

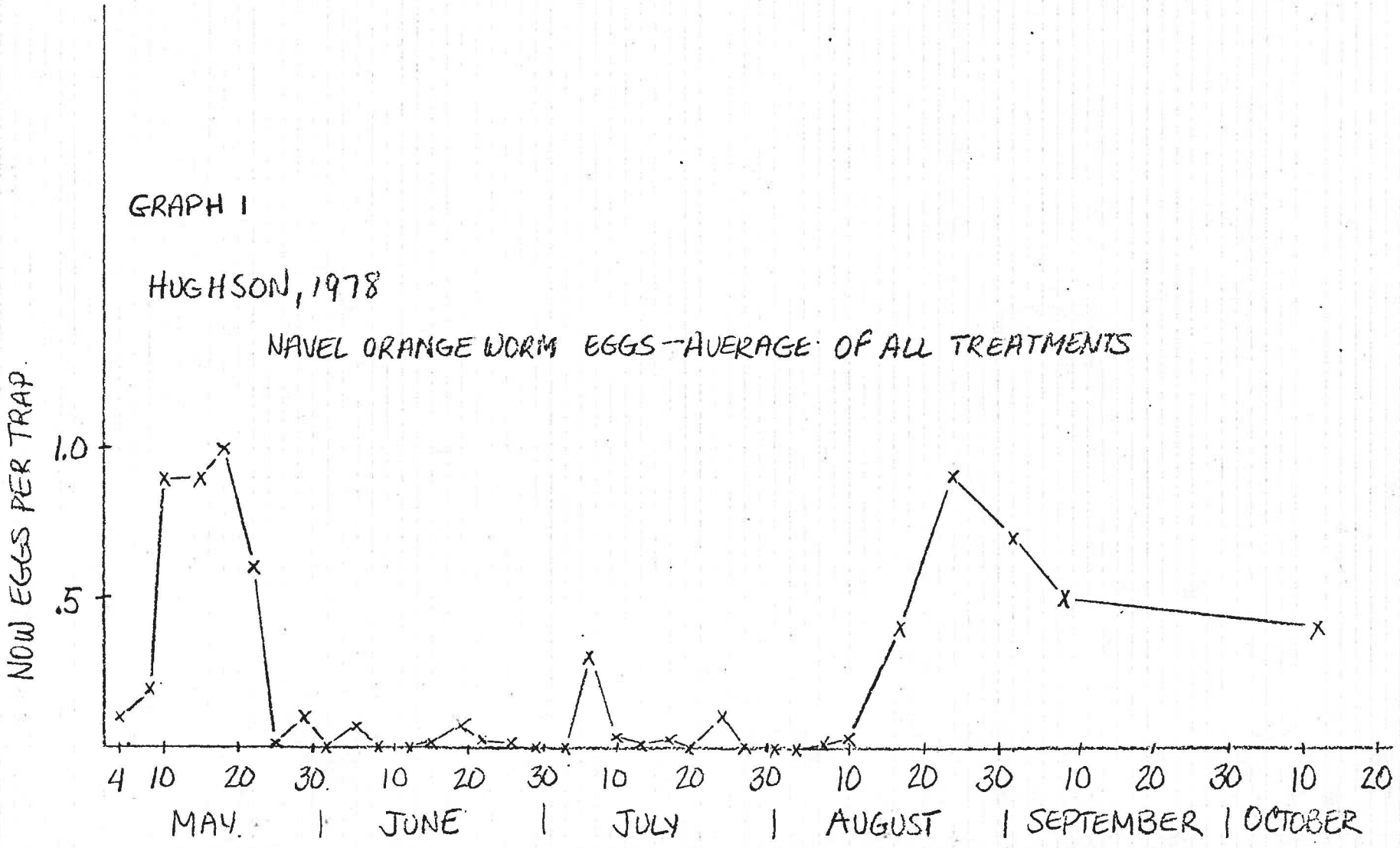
   b. The application of the various treatments designed in the plot be applied by ground rig at the appropriate time.

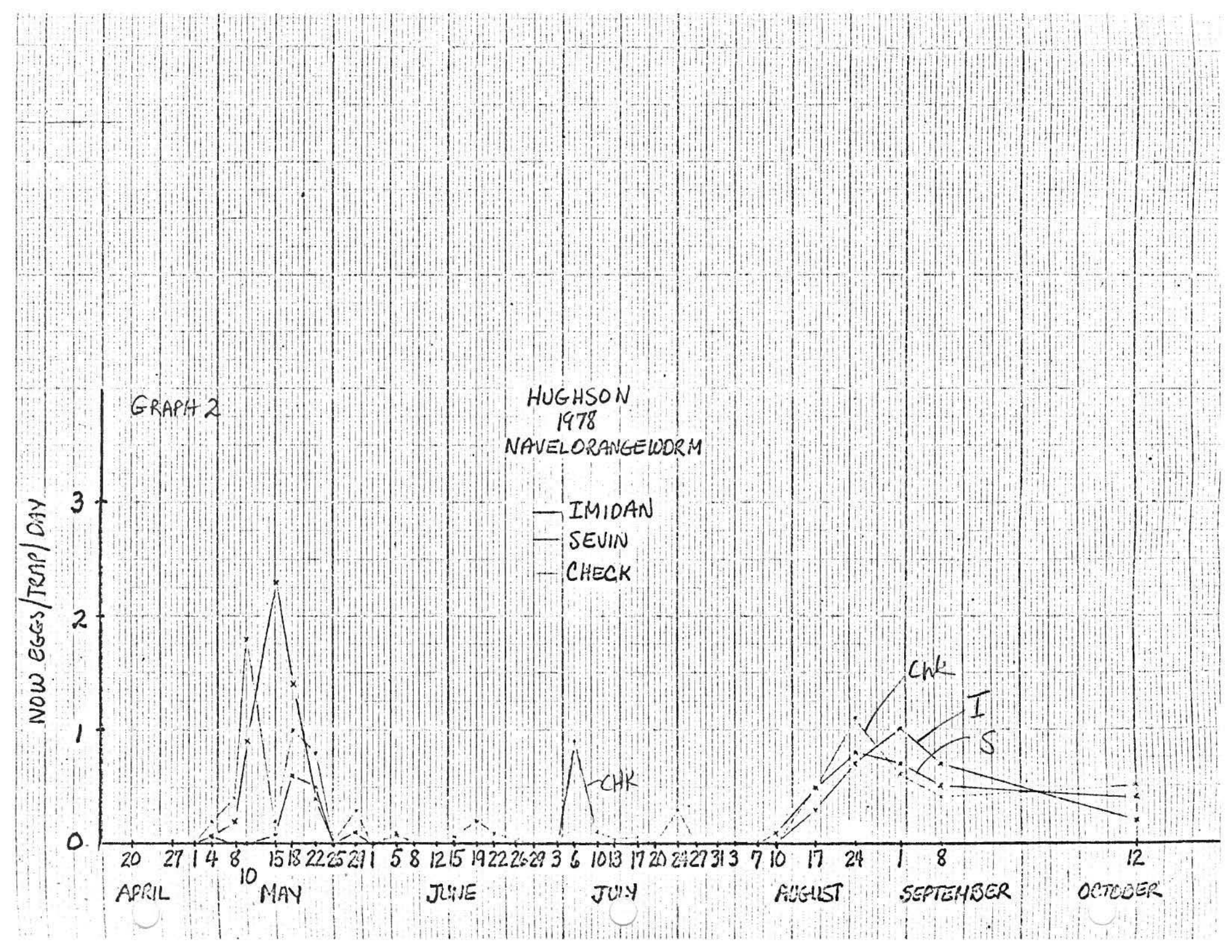
   c. Application of a good shothole or shothole, brown rot treatment program be initiated this season.

GRAPH 1

HUGHSON, 1978

NAVEL ORANGE WORM EGGS - AVERAGE OF ALL TREATMENTS

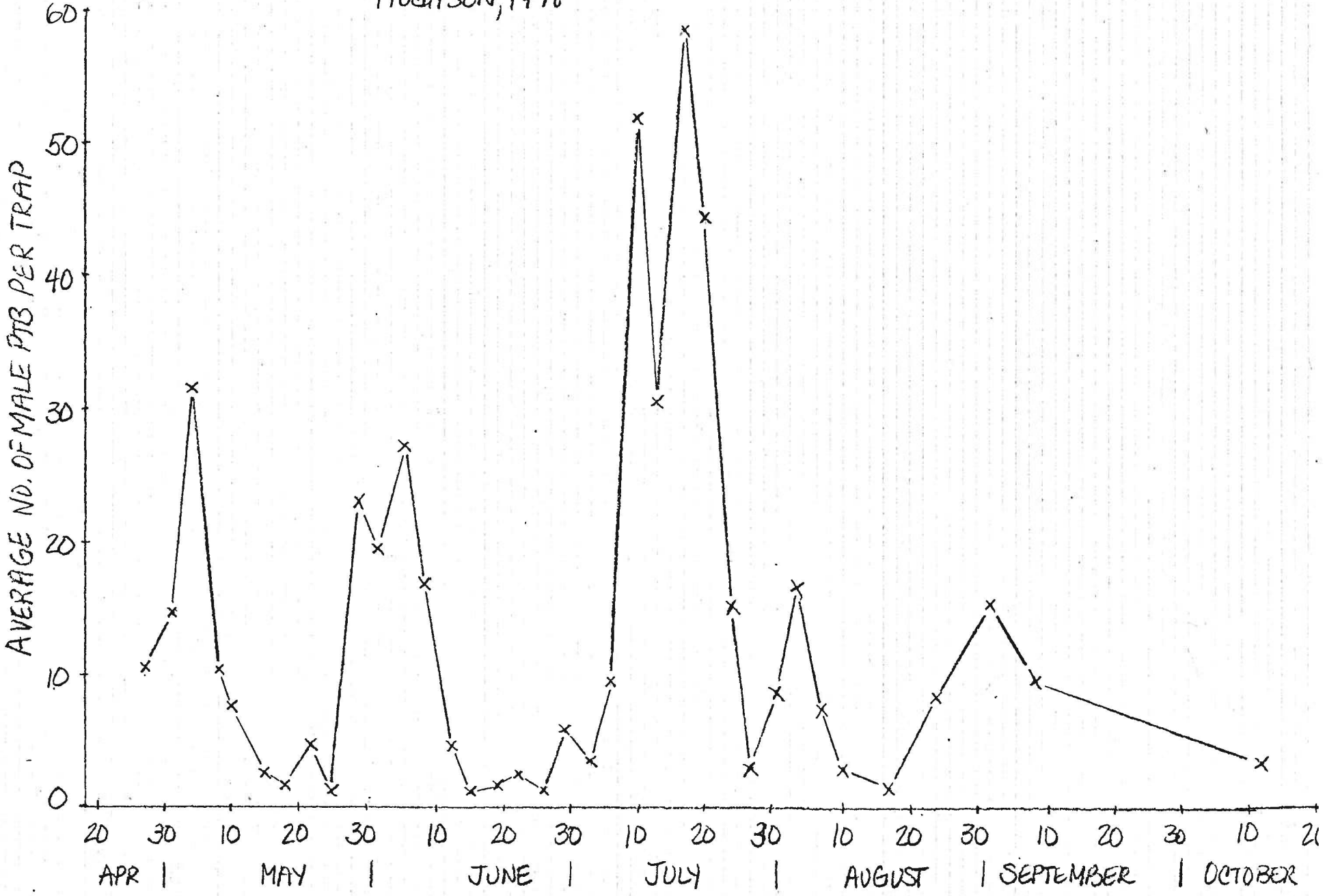


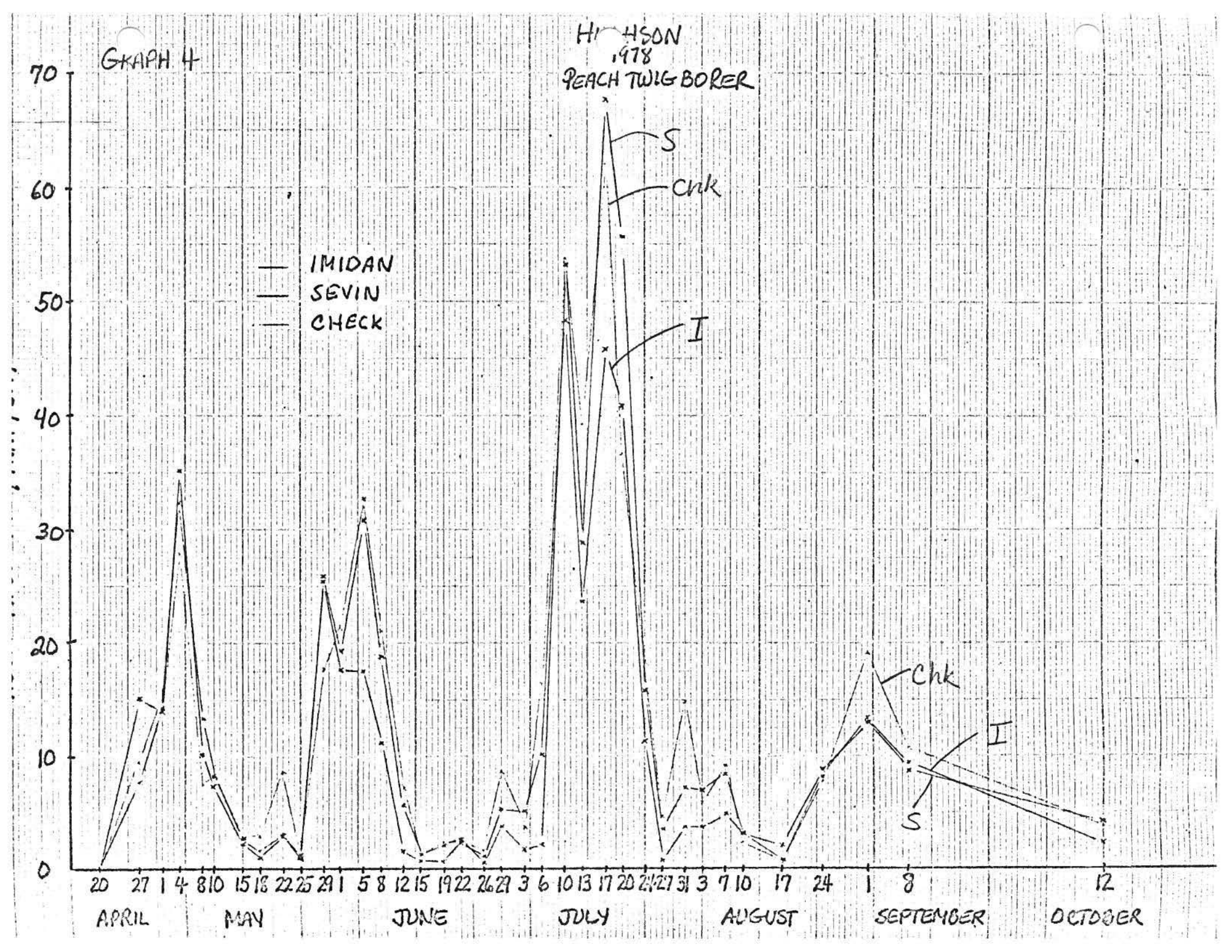

GRAPH 2
HUGHSON
1978
NAVELORANGEWORM
IMIDAN
SEVIN
CHECK
MOW EGGS/TRAP/DAY
0
1
2
3
CHK
CHK
I
S
20 27 1 4 8 10 15 18 22 25 28 1 5 8 12 15 19 22 26 29 3 6 10 13 17 20 24 27 31 3 7 10 17 24 1 8 12
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER

GRAPH 3

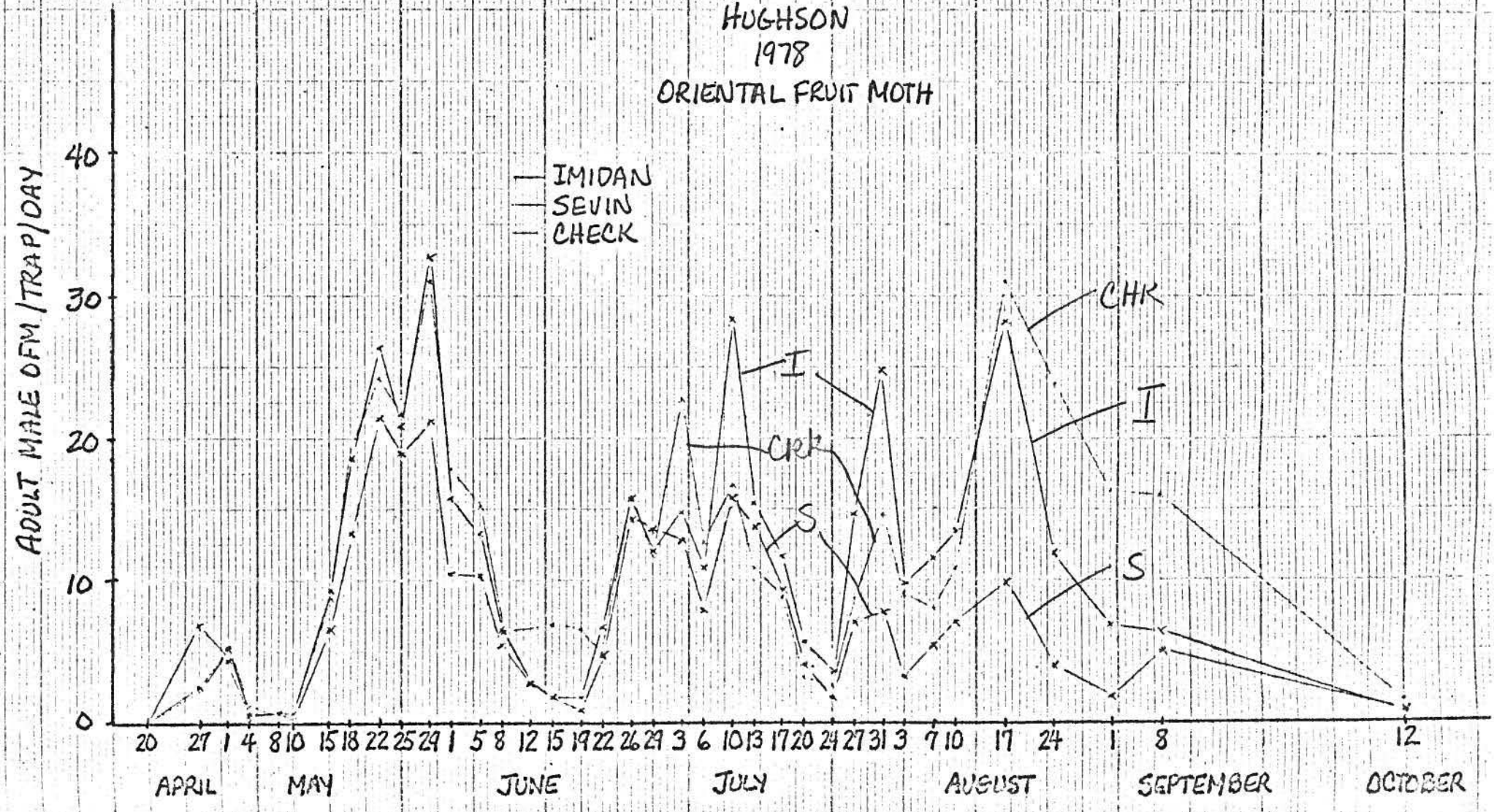
PEACH TWIG BORER AVERAGE OF ALL TREATMENTS

HUGHSON, 1978

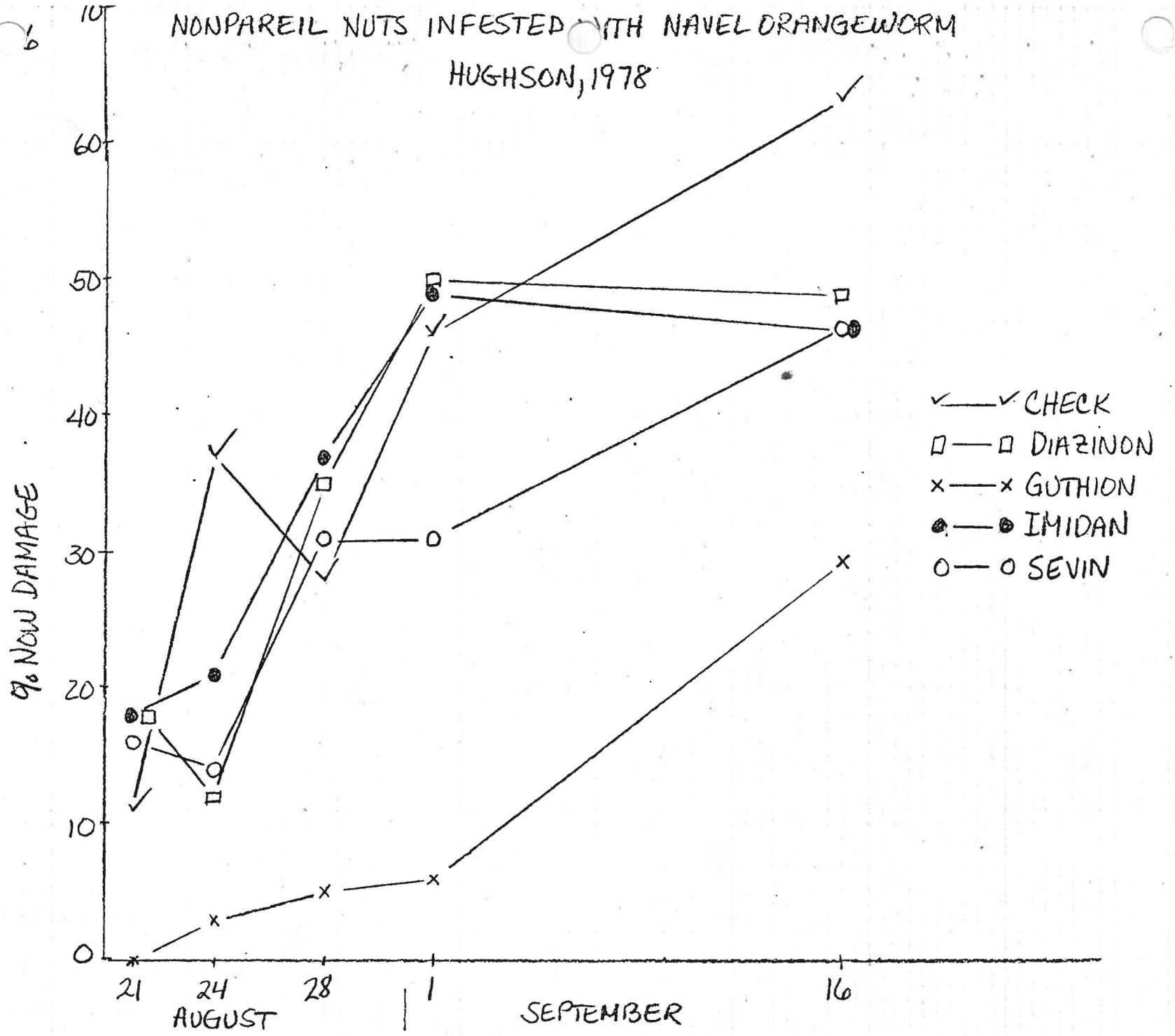



GRAPH 4
HI HSON
1978
PEACH TWIG BORER
70
60
50
40
30
20
10
0
IMIDAN
SEVIN
CHECK
S
Chk
I
Chk
I
S
20 27 1 4 8 10 15 18 22 25 29 1 5 8 12 15 19 22 26 29 3 6 10 13 17 20 24 27 31 3 7 10 17 24 1 8 12
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER

GRAPH 5


HUGHSON
1978
ORIENTAL FRUIT MOTH
IMIDAN
SEVIN
CHECK
ADULT MALE OFM / TRAP / DAY
0
10
20
30
40
I
CHK
S
CHK
I
S
20 27 1 4 8 10 15 18 22 25 29 1 5 8 12 15 19 22 26 29 3 6 10 13 17 20 24 27 31 3 7 10 17 24 1 8 12
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER

GRAF 6


NONPAREIL NUTS INFESTED WITH NAVEL ORANGEWORM
HUGHSON, 1978
% NOW DAMAGE
0
10
20
30
40
50
60
21
24
28
1
16
AUGUST
SEPTEMBER
CHECK
DIAZINON
GUTHION
IMIDAN
SEVIN

Hughson 1978

Mites and Predators in an Almond Orchard*

Treatment	June 15		June 29		July 13		July 27		August 10	
	Adult	Egg	Adult	Egg	Adult	Egg	Adult	Egg	Adult	Egg
Sevin®										
Pacific Mite	0.17	0.02	0	0	0.12	0	0.01	0	0	0
European Red Mite	0.17	3.57	0.02	0.52	0.01	0.64	0.04	0.83	0	0.23
Brown Almond Mite	0.06	0	0	0	0.01	0	0	0	0	0
Predators**	0.01(lw)	0	0.01(lw)	0.01(m)	0	0	0	0	0	0
Check										
Pacific Mite	0.25	0	0.16	0	0.65	0.06	0.02	0	0.14	0.07
European Red Mite	0.13	3.51	0.18	5.43	0.35	5.70	0.10	0.21	0.02	0.04
Brown Almond Mite	0.03	0	0.05	0	0.08	0	0	0	0	0
Eriophyid Mite	0	0	4.43	0	0	0	0	0	0	0
Predators	0.01(m)	0	0.06(m)	0	0.09(m)	0.02(m)	0.01(m)	0	0	0
	0.1(lw)	0	0.01(lw)	0	0.01(lw)	0				
	0.1(t)	0								
Guthion®										
Pacific Mite	-	-	-	-	-	-	3.63	0.49	3.93	1.94
European Red Mite	-	-	-	-	-	-	6.41	76.24	3.42	33.32
Predators	-	-	-	-	-	-	0.06(m)	0.11	0.17(m)	0.14(m
Imidan®										
Pacific Mite	-	-	-	-	-	-	0.24	0.06	0.21	0.07
European Red Mite	-	-	-	-	-	-	0.29	2.26	0.06	0.36
Predators	-	-	-	-	-	-	0.02(m)	0	0.01(m)	0
Diazinon®										
Pacific Mite	-	-	-	-	-	-	0.03	0	0	0
European Red Mite	-	-	-	-	-	-	0.12	0.38	0.03	0.11
Predators	-	-	-	-	-	-	0.01(m)	0	0	0

* Average number per leaf of six replicates (except check which on 6/15, 6/29 & 7/13 had 12 reps.), 30 leaves/rep. using a mite brushing machine. Counts per leaf.

** lw= Lacewing nymph; m=predator mite; and t= six-spotted thrips nymph.

Guthion®treatment by grower - May 25 - June 1; Diazinon®, Imidan®and Sevin®treatment by air - July 21.

Plictran®applied by air - July 18.

Effects of Chemical Sprays on Navel Orangeworm Damage
to Nonpareil Almonds
Hughson - 1978

Treatment	Navel Orangeworm	Peach Twig Borer[Δ]	Total
Guthion[*]	29.2	0	29.2
Sevin[+]	46.2	7.9	54.1
Imidan[+]	46.2	8.9	55.1
Diazinon[+]	48.9	6.8	55.7
Check	63.1	5.7	68.8

[*]Applied by ground spray rig 5/25/78.

[+]Applied by fixed wing aircraft 7/21/78.

[Δ]If nut showed both ptb and NOW damage it was counted in the NOW column. Probably the reason for check ptb percentage being below some treatments.

Hughson
Preharvest Samples - Single Samples

	Date - % Damage											
	8-21			8-24			8-28			9-1		
	PTB	NOW	ANT	PTB	NOW	ANT	PTB	NOW	ANT	PTB	NOW	ANT
Guthion	0	0	0	1	3	0	0	5	0	0	6	0
Sevin	50	16	2	42	14	0	32	31	0	21	31	2
Imidan	53	18	0	31	21	1	26	37	0	14	49	0
Diazinon	44	18	0	42	12	1	21	35	0	13	50	0
Check	54	11	1	29	37	0	37	28	0	22	46	3

Chowchilla Almond IPM Plot

The Chowchilla almond IPM plot is a 100-acre orchard approximately 5 miles east of Chowchilla. The 11-year old orchard consists of a rectangular block of uniform-sized trees on fairly level ground. The cultivation practice used is strip weed control with discing in between rows. Sprinkler irrigation is accomplished with a solid-set sprinkling system. Ne Plus is the pollenizer variety which is planted 1 row between 3 rows of Nonpareil. The middle row of the Nonpareil rows contain Nonpareil trees that have limbs grafted with Milow to also aid in pollenizing.

The 100-acre orchard was divided into 8, 12.5-acre plots, 50 acres of which would be cleaned (proper orchard sanitation including knocking overwintering mummies off trees and discing them under) and the other half to be left unclean. These clean and unclean blocks had check plots and chemical treatment plots of 12.5 acres each, the treatments consisting of Guthion (spring), Sevin (summer), and Guthion plus Sevin. Due to the late start in the IPM program the only orchard sanitation procedures used this year was sweeping the tree rows in the clean plots. The mummy nuts on the ground were raked toward the center between the trees where they were disced under in mid-April. Because of the lateness in cleaning, the clean vs. unclean treatments could not be compared this year.

Monitoring Insects

Navel orangeworm (NOW), Peach twig borer (PTB), and Oriental fruit moth (OFM) monitoring began on April 19, 1978 and concluded on October 4, 1978. Traps were monitored usually twice a week and at least once a week.

NOW. The overwintering generation flight of Navel orangeworm observed from NOW egg traps began on May 5 and concluded on June 5, the peak occurring on May 11 with an average of 2.5 eggs per trap. The first generation egg deposition occurred between June 29 and July 30 with a peak average of 1.0 egg per trap on July 17. The second generation occurred between August 2 and late September with a peak average of 8.1 eggs per trap on August 18. The Guthion treatments were applied May 31 and June 5 while the Sevin treatments were applied on July 17 and 21. Egg deposition counts in the first NOW generation were very low so it is hard to discern any differences. In contrast, the second NOW generation egg deposition showed quite a puzzling separation of counts at peak time. The Guthion plus Sevin treatments had the highest number with 13 eggs per trap, whereas, the Sevin, Guthion and check plots had 9.8, 5.4, and 4.3 eggs per trap, respectively.

PTB. Peach twig borer male moths were attracted to traps containing PTB pheromone caps. There were 3 definite peaks during the monitoring season. The overwintering brood (April 27-June 15) had an average of 20 PTB moths per trap per day between May 8 and 11. The second brood between June 22 and August 10 had a peak on July 10 with an average of 21 PTB moths per trap. The last brood that was monitored occurred between August 15 and mid-October and had a peak average of 18.5 PTB moths per trap on August 31. The chemical treatment effect of Guthion (May 31 and June 5)

is readily seen in the second brood peaks where between July 6 and 20 the peak averages for the untreated plots of check and Sevin were 34.0 and 24.8 PTB moths per trap, respectively, while the Guthion and Guthion plus Sevin plots had 19.4 and 9.8 PTB moths per trap, respectively. In the Sevin treatment (July 17 and 21) PTB counts of 22.5 moths in the third brood was reduced from the check plot which was 29.3 moths per trap, but the Guthion and Guthion plus Sevin treatment counts continued to be lower (12.7 and 9.3 PTB moths, respectively) than the Sevin and check plots.

OFM. Pheromone attractant caps were also used to monitor Oriental fruit moth males. Although populations were low, there seemed to be 4 broods throughout the monitoring season. The first brood (mid-April-May 15) had a peak average of 1.3 moths per trap on April 1, while the second brood (May 19-June 15) had a peak average of 1.6 moths per trap on May 25. The third (June 22-July 20) and fourth (July 25-mid-October) flights had peak averages of 2.7 and 2.2 OFM moths per trap, respectively. The Guthion treatment on May 31 and June 5 reduced moth counts below those of the untreated plots (check and Sevin) and continued to remain below the check plot throughout the rest of the monitoring season. The Sevin treatment on July 17 and 21 reduced OFM counts below the check plots and for the most part remained below the check for the rest of the season.

Monitoring Mites and Predators

Beginning June 2 leaf samples were collected biweekly with the last sample being taken on August 10. Six replicate trees from each of 4 plots (Guthion, Sevin, Guthion plus Sevin, and check) were selected in the middle of each plot where 30 leaves per tree per sample were taken to the lab to be brushed through a mite brushing machine. The mites and predators were collected on a glass plate and counted under a dissecting scope. The results are in Table 1. Pacific mite was the only mite pest present in significant numbers throughout the monitoring season. Other mites that were present at different times during the season were European red, Brown almond and Eriophyid (peach silver) mites. Predator mites and nymphs of lacewing and six-spotted thrips were the predators that were present. Plictran was applied on June 13 to all but the check and predator release (M. Hoy - UCB project) areas. The leaf samples collected did not give a true picture of what was occurring in the orchard. There were distinct areas throughout the orchard where populations of Pacific mites "exploded" causing severe defoliation to those trees.

Preharvest and Harvest Results

Preharvest samples of Nonpareil nuts were taken on August 21, 25, and 29 which was 29, 25, and 21 days, respectively, before harvest on September 19. Composite samples of 200 nuts in the middle of each 12.5-acre plot from the 2 outer Nonpareil trees were collected and 100 nut subsamples were opened and examined for NOW, PTB, and any other insect damage that might effect the hull and nut.

For the harvest Nonpareil nut samples were collected on September 19 and the Ne Plus pollenizers on October 4. Sampling of the Nonpareils consisted of a composite collection of 200 nuts from the 2 outer Nonpareil

trees that surrounded the Nonpareil with the grafted Milow limb. This being the first replicate, 11 other replicates were taken from the middle of the same 12.5-acre plot. This procedure of sampling was repeated for each of the other 7, 12.5-acre plots. A subsample of 100 nuts from each of the 12 replicates from the 8 plots were then cracked and examined for NOW, PTB, and other insect damage. A similar sampling procedure was used for the pollenizers except only 2 replicates from each of the 8, 12.5-acre plots were collected.

The results are seen in Graph 6. This year, as was mentioned previously, the clean vs. unclean plots were disregarded and the respective 2, 12.5-acre plots (clean and unclean) were averaged. Perhaps, due to the sample size, the preharvest sample counts seemed to show considerable variation from date to date but it was obvious that percent NOW damage was greatest in the check at all preharvest dates. The check plot ranged from 17% to 27%, whereas, the Guthion, Sevin, and Guthion plus Sevin plots were 10% or under. In a period of 21 days from August 29 to September 19 (harvest) the check plot increased from 25% to 49.5% NOW damage, which is a 1.2% increase per day. Whereas, in the same period of time the increase of NOW damage of the Guthion, Sevin, and Guthion plus Sevin treatments was only 0.6%, 0.7% and 0.3% per day, respectively.

The harvest results of the Nonpareils showed that the percent NOW damage of all the chemical treatments was below that of the check. The check plot had 49.5% NOW damage, whereas, the Sevin, Guthion, and Guthion plus Sevin plots had 23.5%, 16.5%, and 10.5% NOW damage, respectively. Statistically, the chemical treatment plots were significantly different from the check plot at the 5% level, but not different from each other.

Hull and nut damage by PTB was present in the preharvest samples of the Sevin and check plots with the check having an average of 7.6% PTB nut damage higher than Sevin. The Guthion and Guthion plus Sevin treatments had no PTB nut or hull damage the first 2 sampling dates and had only 0.5% PTB nut damage on the last preharvest date. PTB damage at harvest when it was not masked by NOW damage, was 0.25%, 0.13%, 0.04%, and 0.17% for the Guthion, Sevin, Guthion plus Sevin, and check plots, respectively.

There was no significant difference among any of the plots in the Ne Plus pollenizer harvest samples although the check plots showed considerable more damage than the treatments. Percent NOW damage was 9.9, 10.7, 7.7, and 16.9 for the Guthion, Sevin, Guthion plus Sevin, and check plots, respectively. PTB damage of 0.5% was found in only the Sevin treatment.

Conclusions and Recommendations

1. If May 11 were used as the week where half of the egg traps had eggs deposited on them, and Guthion were applied at hatch of these eggs (within 7-10 days), better NOW control would have been attained.

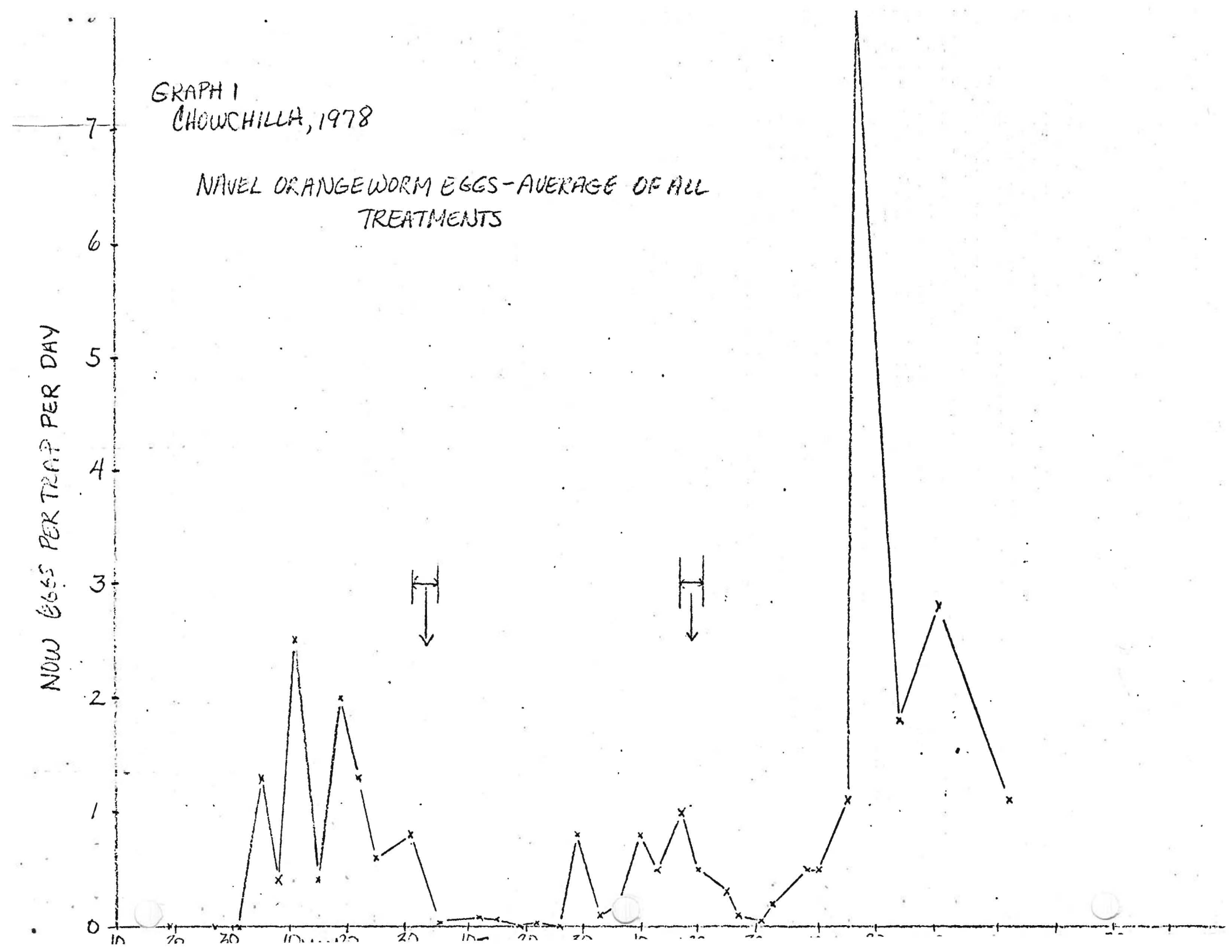
2. An earlier harvest could have resulted in a reduction in NOW damage, especially in the check areas.

3. Different parts of the orchard during the hot summer were stressed for water causing severe mite flare-ups. Serious defoliation occurred in some areas. These "hot" areas will need to be sampled next year. Better techniques need to be developed on mite sampling so that "hot" spots can be located.

4. Guthion spray applied in May controlled PTB with little damage from PTB occurring to the nuts.

GRAPH 1
CHOWCHILLA, 1978

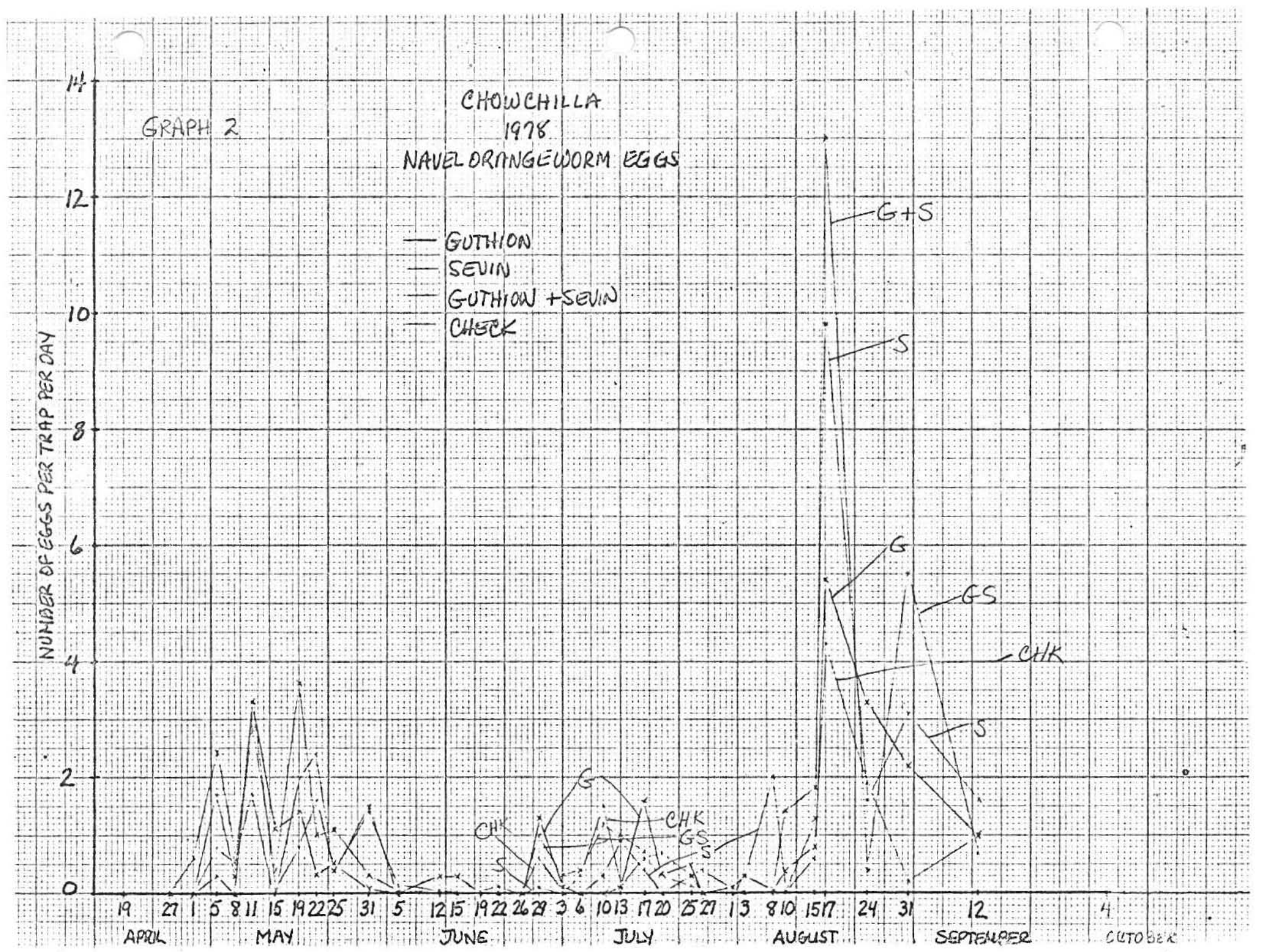
NAVEL ORANGEWORM EGGS - AVERAGE OF ALL TREATMENTS



GRAPH 2

CHOWCHILLA
1978
NAVEL ORANGEWORM EGGS

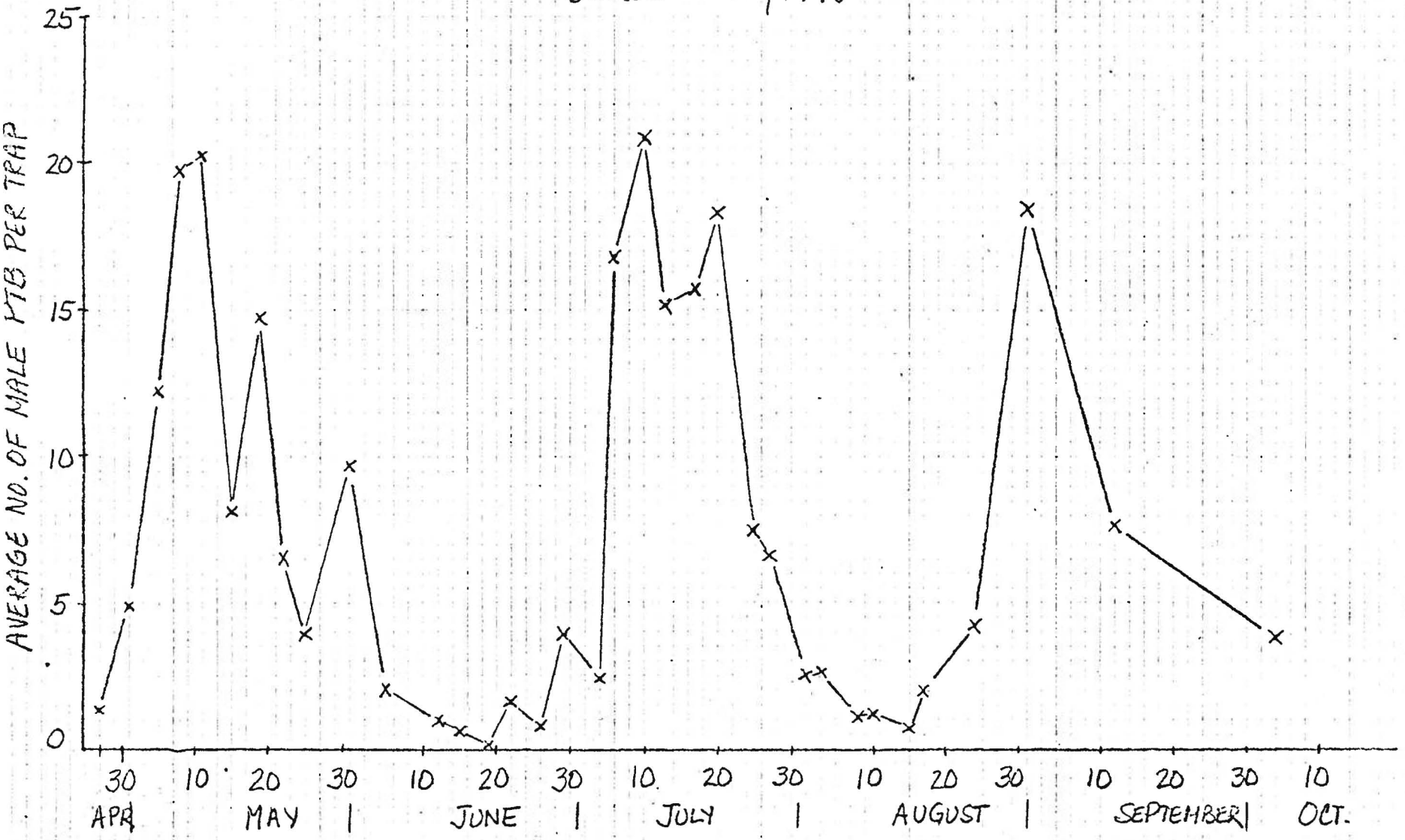
— GUTHION
— SEVIN
— GUTHION + SEVIN
— CHECK

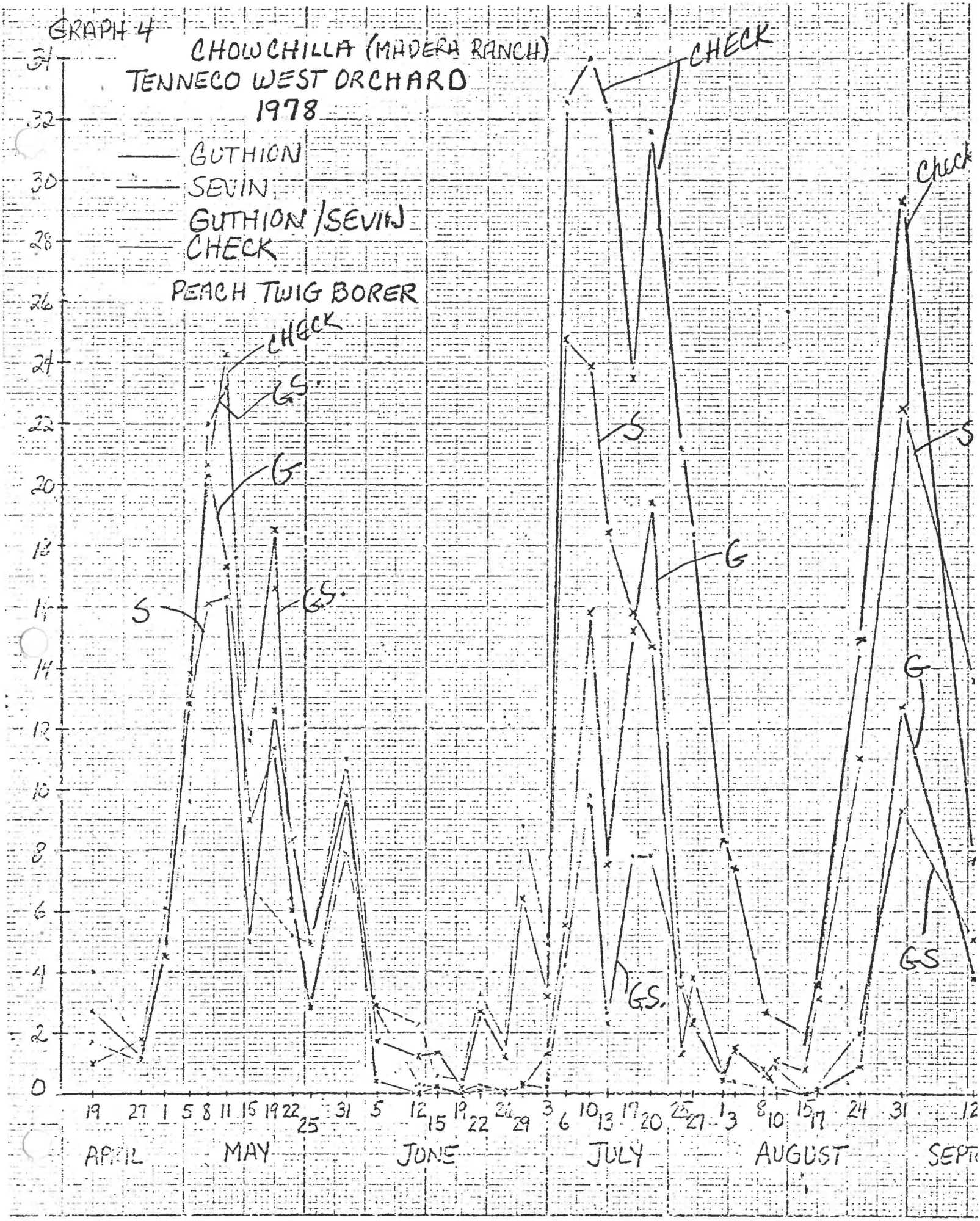


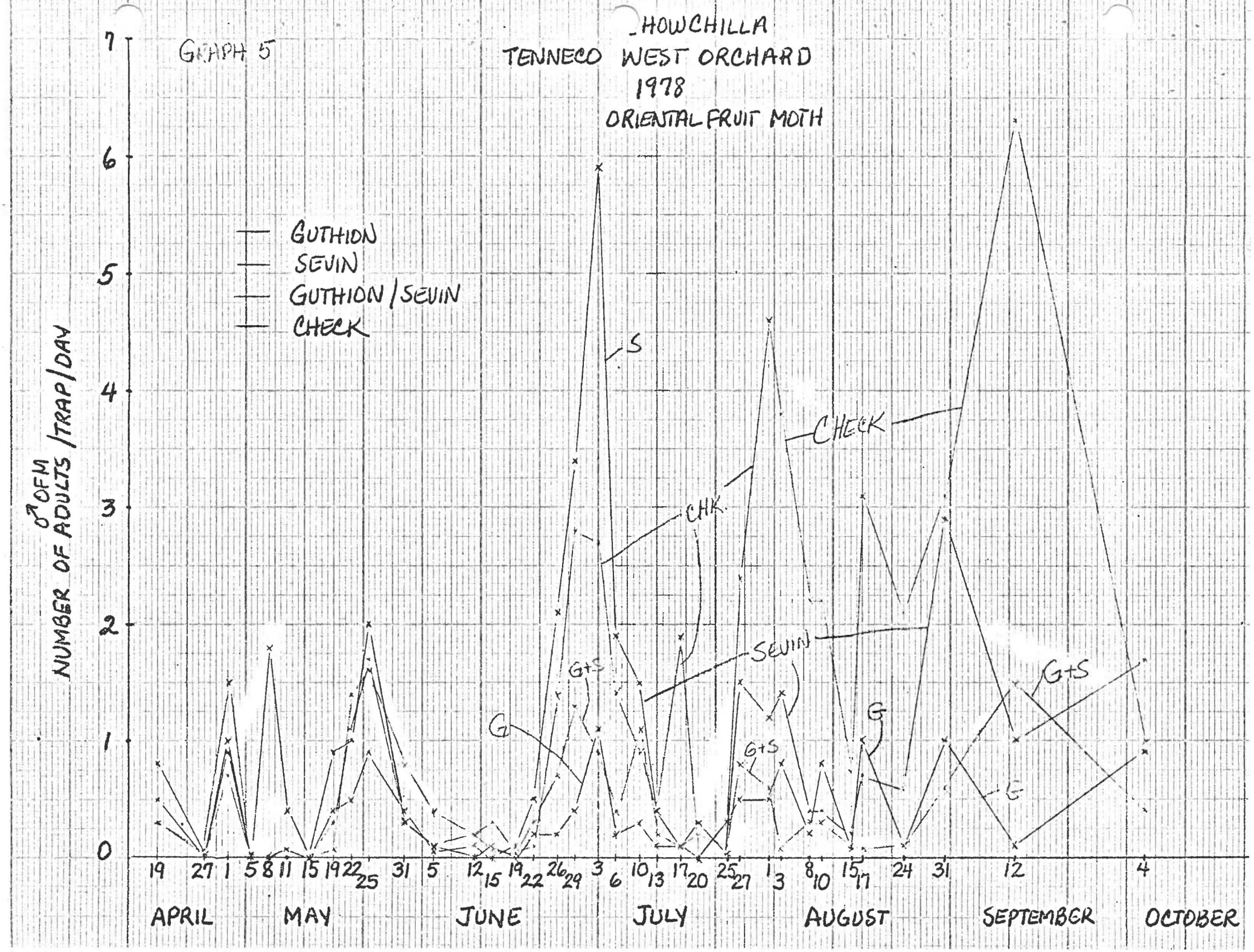
GRAPH 3

PEACH TWIG BORER AVERAGE OF ALL TREATMENTS

CHOWCHILLA, 1978




GRAPH 4
CHOWCHILLA (MADERA RANCH)
TENNECO WEST ORCHARD
1978
GUTHION
SEVIN
GUTHION / SEVIN
CHECK
PEACH TWIG BORER
CHECK
G
S
GS
APRIL
MAY
JUNE
JULY
AUGUST
SEPT


GRAPH 5
CHOWCHILLA
TENNECO WEST ORCHARD
1978
ORIENTAL FRUIT MOTH
GUTHION
SEVIN
GUTHION / SEVIN
CHECK
♂ OF M
NUMBER OF ADULTS / TRAP / DAY
0
1
2
3
4
5
6
7
S
CHECK
CHK
SEVIN
G+S
G
G+S
G
G+S
G
19 27 1 5 8 11 15 19 22 25 31 5 12 15 19 22 26 29 3 6 10 13 17 20 25 27 1 3 8 10 15 17 24 31 12 4
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER

GRAPH 6

NONPAREIL NUTS INFESTED WITH NAVEL ORANGEWORM

CHOWCHILLA, 1978

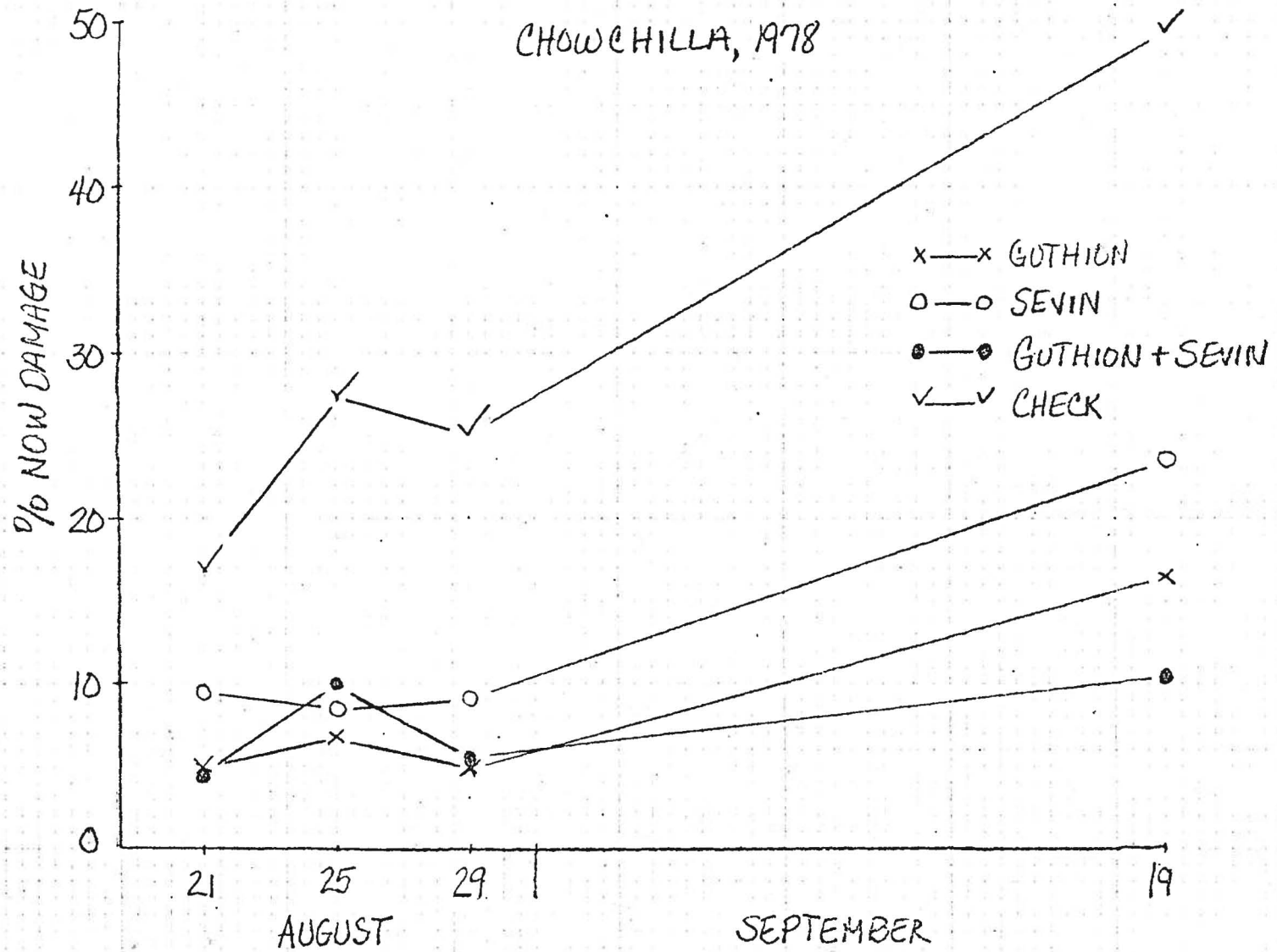


Table 1

Chowchilla - 1978

Mites and Predators in an Almond Orchard*

Treatment	June 2		June 15		June 29		July 13		July 27		August 10	
	Adult	Egg	Adult	Egg	Adult	Egg	Adult	Egg	Adult	Egg	Adult	Egg
Guthion®												
Pacific Mite	0.51	2.54	0.21	0.40	0.02	1.32	0.04	0.07	0.38	0.40	0.10	0.26
European Red Mite	0	0	0	0	0	0.19	0	0	0	0	0	0
Brown Almond Mite	0	0	0.02	0	0	0	0	0	0.04	0	0	0
Eriophyid Mite	0.12	0	0	0	0	0	0	0	0	0	0	0
Predators**	0.01(lw)	0	0.0(m)	0	0	0	0	0	0.03(m)	0.03(m)	0.17(m)	0.11(m)
Sevin®												
Pacific Mite	0.28	1.10	0.02	0.19	0	0.73	0.04	0.17	0	0.14	0.03	0.18
European Red Mite	0	0	0	0	0	0	0.01	0.01	0	0	0	0
Brown Almond Mite	0.01	0	0	0	0	0	0	0	0	0	0	0
Eriophyid Mite	0.18	0	0	0	0.05	0	0	0	0	0	0	0
Predators	0.01(m)	0	0.02(t)	0	0	0	0.01(m)	0	0	0	0	0
	0.01(lw)	0										
	0.02(t)	0										
Guthion® + Sevin®												
Pacific Mite	0.03	0.05	-	-	-	-	-	-	0	0	0	0
European Red Mite	0	0	-	-	-	-	-	-	0.01	0	0	0
Eriophyid Mite	0.01	0	-	-	-	-	-	-	0	0	0	0
Predators	0.03(t)	0.01(lw)	-	-	-	-	-	-	0.01(t)	0	0	0
Check												
Pacific Mite	0.04	0.28	0.02	0.03	0	0	0.02	0.01	0.01	0.12	0.51	1.2
Eriophyid Mite	0.01	0	0	0	0.07	0	0	0	0	0	0	0
Predators	0	0.01(m)	0.01(m)	0.02(m)	0.05(m)	0	0	0	0.01(m)	0	0.02(m)	0.02(m)
			0.08(t)	0	0.03(t)	0			0.01(t)	0		

* Average number per leaf of six replicates, 30 leaves/rep. using a mite brushing machine. Counts per leaf.

** lw = lacewing nymph oregg; m = predator mite; and t = thrips.

Guthion® treatment - 5/31 & 6/5; Sevin® treatment - 7/17 & 7/21

Treatment with Plictran® on 6/13 (except check and predator release areas) and 7/17 & 7/21 (only in Sevin® & Guthion® plus Sevin® plots).

TABLE 2

CHOWCHILLA

Nonpareil Harvest - September 19, 1978

Treatment		% damage PTB	% damage NOW
Guthion	c	0	10.8a
Guthion	u	0.5	22.2bc
Sevin	c	0.3	25.8c
Sevin	u	0	21.4b
G&S	c	0.1	9.3a
G&S	u	0	11.6a
Check	c	0.3	54.2e
Check	u	0	44.8d

Preharvest Samples - Single Samples

		Date 8-21 PTB	8-21 NOW	8-21 ANT	8-25 PTB	8-25 NOW	8-25 ANT	8-29 PTB	8-29 NOW	8-29 ANT
Guthion	c	0	3	0	0	0	0	0	0	0
Guthion	u	0	7	0	0	13	0	1	10	0
Sevin	c	12	7	0	-	-	-	7	10	0
Sevin	u	9	12	0	6	8.5	0	3	8	4
G&S	c	0	6	0	0	10	0	1	8	0
G&S	u	0	3	0	-	-	-	0	1	0
Check	c	16	16	0	12	21	0	42	32	0
Check	u	13	18	0	10.5	34	0	15	18	0

Table 3

Chowchilla

NePlus Pollenizer Harvest - Oct. 4, 1978

	% Damage	
	PTB	NOW
Guthion c	0	6.5
Guthion u	0	13.3
Sevin c	0	16.5
Sevin u	1	4.8
G & S c	0	4.0
G & S u	0	11.3
Check c	0	17.3
Check u	0	16.5

McFarland Almond IPM Plot

The Integrated Pest Management plot in McFarland is comprised of two 40-acre square blocks which join at one corner. The trees are 6 years old, planted with 2 rows of Nonpareil then a pollenizer row of Mission or alternately, Thompson. The topography is slightly rolling with differences of approximately 20 feet elevation occurring in some areas. Trees are irrigated by a sprinkler hose pull system. The orchard has a native sod cover crop which was maintained with frequent mowing. Trees appear quite uniform in size, vigor and conformation and the 1978 crop was approximately equal throughout. There is a dirt road on the east side of the field along two of the treatments. Considerable dust was created during the summer in this area, causing a flare-up of citrus red mite, which was particularly evident in the first 5-8 trees in from that edge of the orchard.

All trees were clean of holdover nuts during the winter of 1977-78. The owner of the orchard has an excellent program of shaking, followed by polling at harvest and had left less than 10 nuts per tree going into the fall of 1977. What few nuts remained after harvest were eaten by birds during the winter.

Plots were set up in a random block design; treatments and timing included Guthion, when egg traps showed a consistent population of NOW, Sevin at early hull split, Guthion and Sevin in two applications as described, an unsprayed check area was also included. Each treatment was replicated twice (8 blocks). Each block was a square 10-acre area with all samples and trapping occurring in the center 2 acres.

Treatment guidelines for consistent egg deposition was arbitrarily established at 1/2 the traps indicating egg lay during any one week. This level was never reached during the spring flight of NOW, and no Guthion treatment was made.

Application of Sevin was made on July 12 at hullsplit, although traps still indicated low populations. Imidan was also applied to the blocks originally intended for a Guthion application. The double treatment was left untreated as was the check. Omite was included in these sprays and the check area was also treated with Omite.

Peach twig borer pheromone trap counts averaged less than 2 moths per day during the May flight. Approximately 7 moths per day were caught during the July flight. PTB nut damage was very minor at harvest.

Oriental fruit moth traps indicated no OFM was present in the orchard. NOW damage at harvest showed that Sevin averaged 0.4%, Imidan- 1.05% and check - 0.78% damage. Variations between blocks showed no significant difference between any block.

Considerable ant damage occurred in the check areas in the harvest samples. Preliminary samples indicated this damage occurred during August - the last two weeks before harvest. Additional observations need to be made concerning where the damage is occurring. Average damage from ants were Sevin - 1.25%, Imidan - 1.4% and check - 5.88%.

Omite gave good control of citrus red mite when it was applied on July 12. Considerable leaf stippling occurred along the extreme eastern edge of the orchard next to a dusty roadway. Populations of citrus red mite exceeded 10 mites per leaf in this area. An average popluation of 3 mites per leaf was present in the orchard during the last part of June and early July. This population caused slight leaf-stippling and probably is approximately the economic threshold level. Hot weather during this period did not suppress citrus red mite activity.

The McFarland trials indicated several probabilities toward the IPM program.

1. With excellent sanitation (removal of overwintering nuts), NOW populations can be maintained at low levels.

2. In 1978, low egg trap counts could be used for prediction of NOW population levels and for determining whether sprays are necessary.

3. Early and rapid harvest also helped in reduction of NOW. Harvest was completed by August 17 in the McFarland plot. This was two weeks earlier than any of the other plots.

4. Monitoring techniques need to be developed for predicting possible damage from ants so that proper control can be taken.

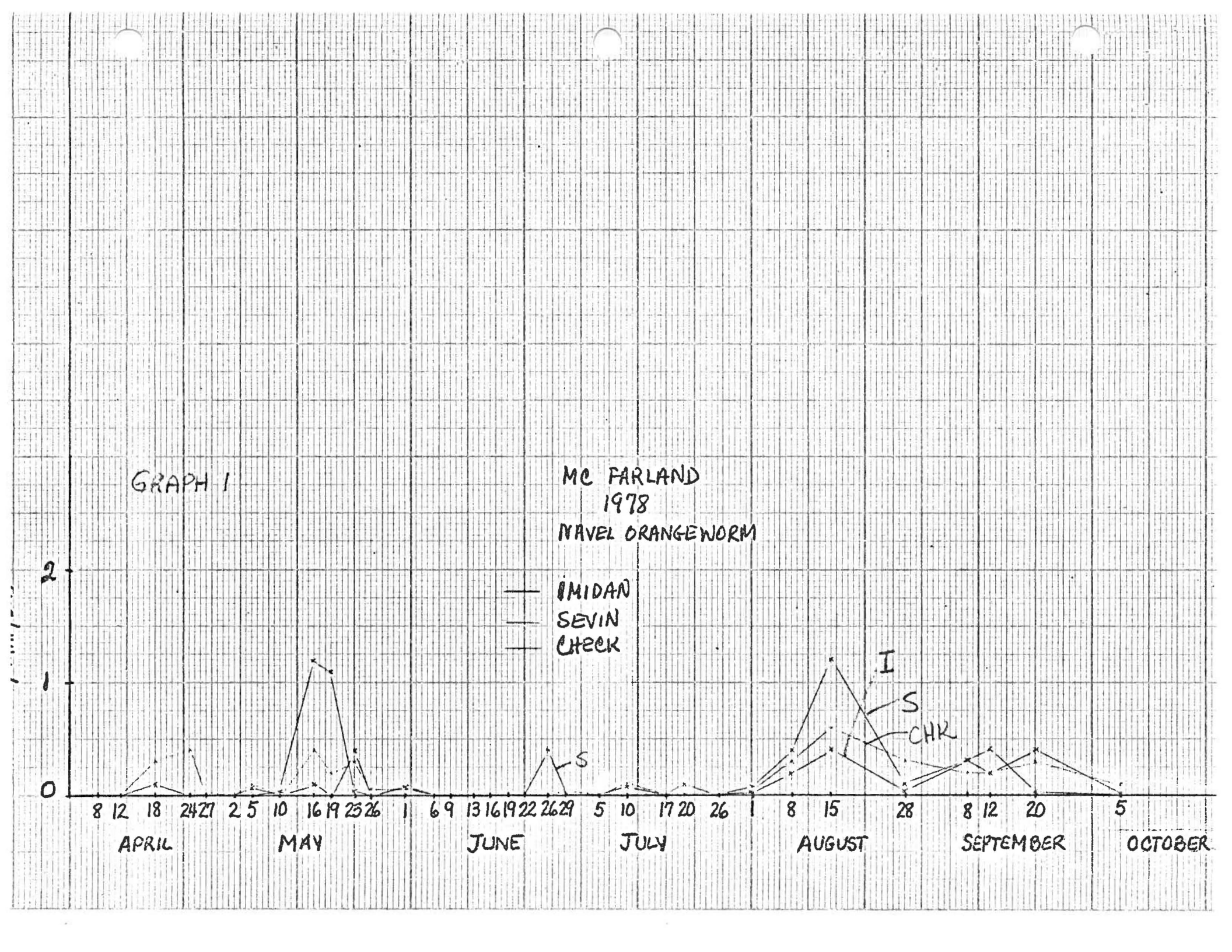
5. Ants can be controlled by a spray of either Sevin or Imidan in July.

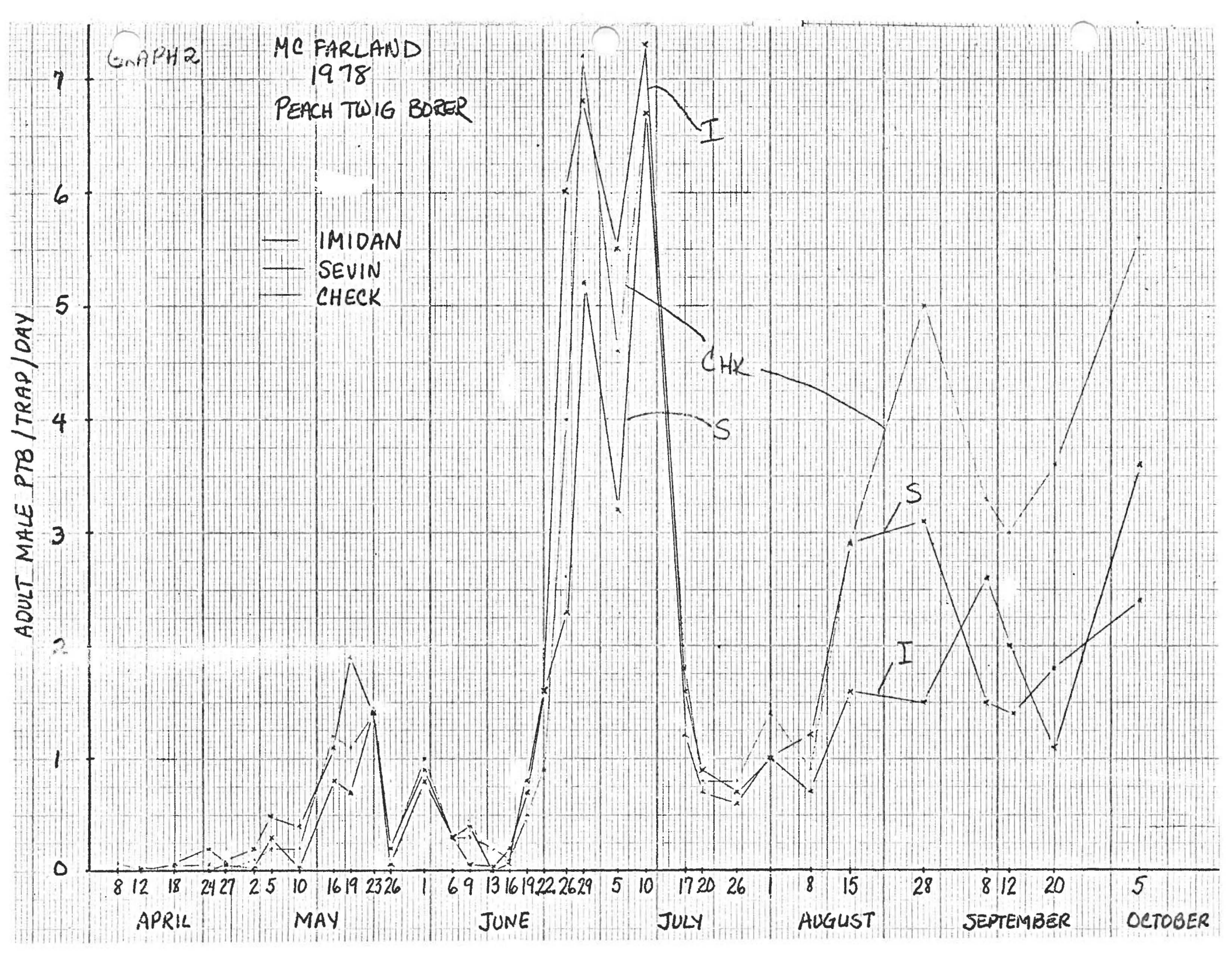
6. A level for citrus red mite in June-July of approximately 3 mites per leaf will cause some leaf stippling. Almond trees can tolerate much higher population (10 mites/leaf) without defoliation. Damage caused by extreme amount of stippling at these high populations was felt to cause considerable damage. Therefore a level of about 3-5 mites per leaf in June-July might be close to the economic threshold level for treatment.

7. Hot weather can no longer be depended upon to cause a decrease in citrus red mite levels. This observation was made in other areas and could be the result of development of a new biotype of mite.

GRAPH 1

MC FARLAND
1978
NAVEL ORANGEWORM

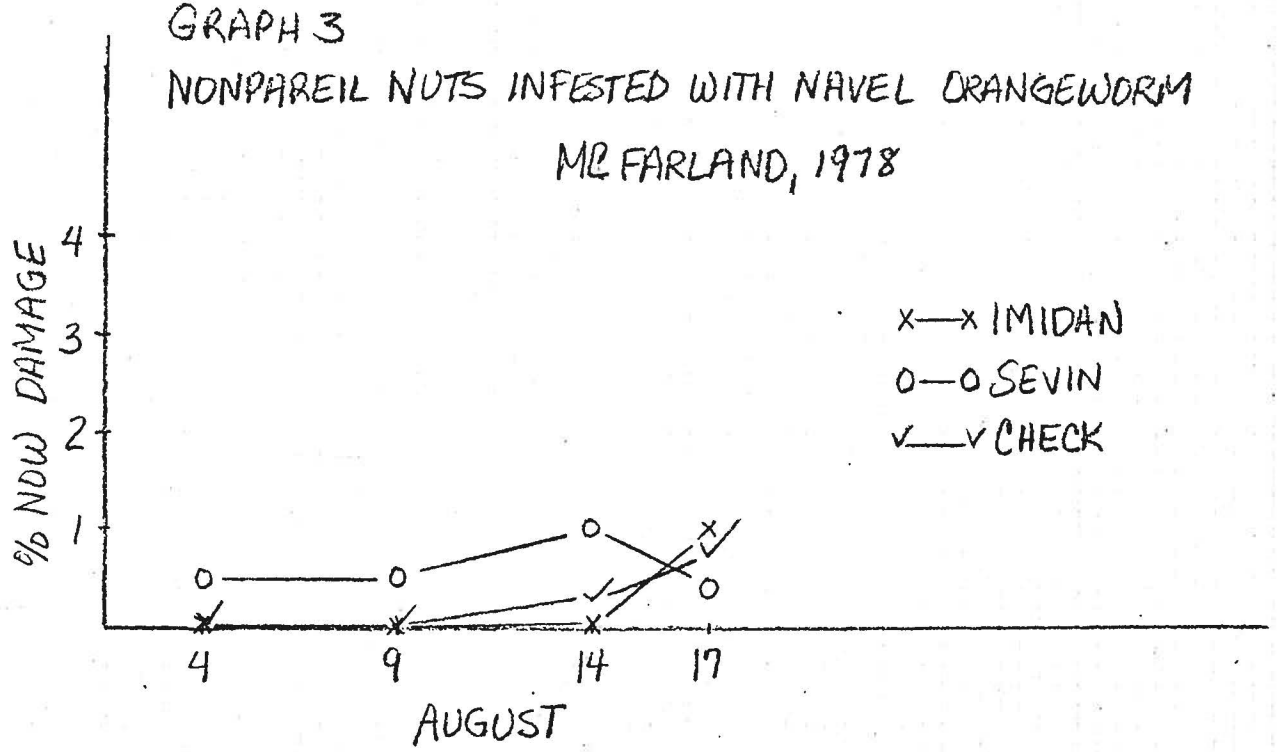



GRAPH 2
MC FARLAND
1978
PEACH TWIG BORER
IMIDAN
SEVIN
CHECK
I
CHK
S
S
I
ADULT MALE PTB / TRAP / DAY
0
1
3
4
5
6
7
8 12 18 24 27 2 5 10 16 19 23 26 1 6 9 13 16 19 22 26 29 5 10 17 20 26 1 8 15 28 8 12 20 5
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER

GRAPH 3

NONPAREIL NUTS INFESTED WITH NAVEL ORANGEWORM

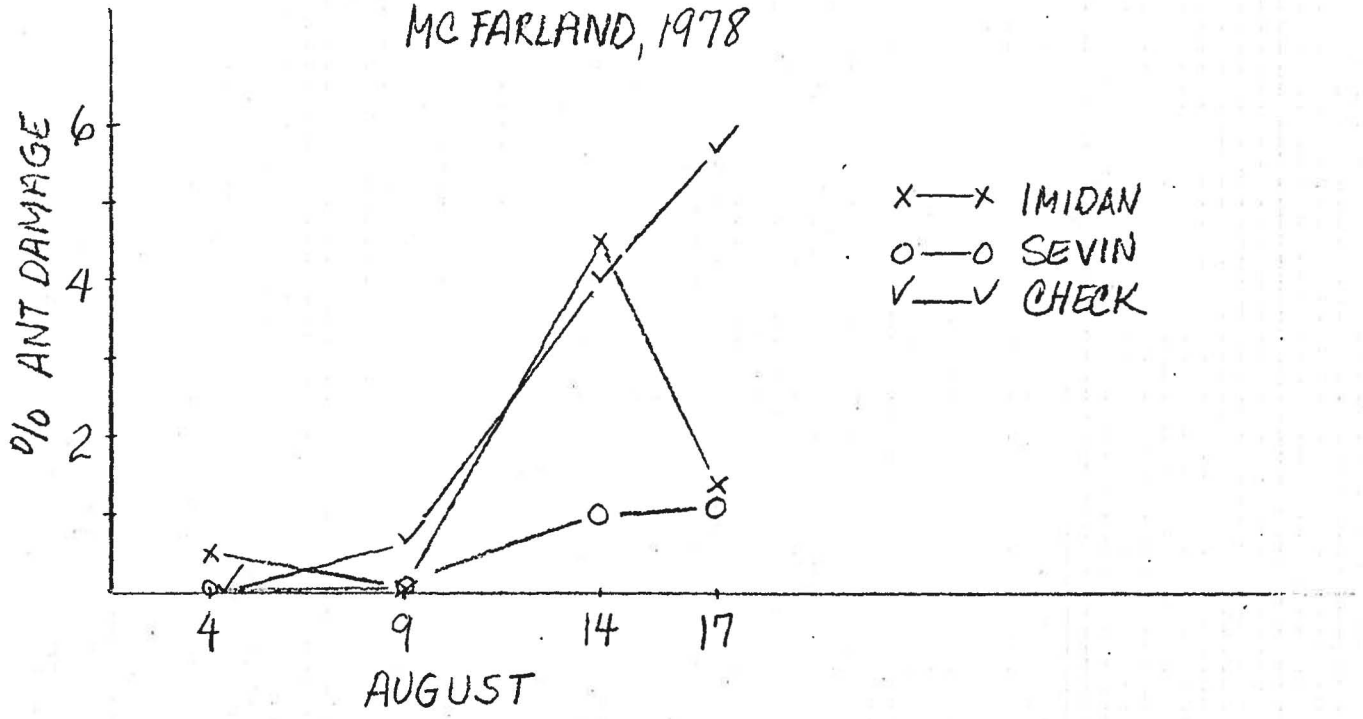
MC FARLAND, 1978



GRAPH 4

NONPAREIL NUTS AFFECTED BY ANTS

MC FARLAND, 1978



Kern Farming - McFarland

Final Nonpareil Harvest - August 17, 1978

Treatment	% Damage	
	NOW	ANT
Sevin c	0.6	1.5
Sevin u	0.2	1.0
Imidan c	0.3	1.5
Imidan u	1.8	1.3
Check c	0.6	7.2
Check u	0.2	4.4
Check c	0.9	8.1
Check u	1.4	3.8

Preharvest Samples - Single Samples

	Date								
	8-4			8-9			8-14		
	PTB	NOW	ANT	PTB	NOW	ANT	PTB	NOW	ANT
Sevin c	0	1	0	1	1	0	0	2	1
Sevin u	0	0	0	0	0	0	0	0	1
Imidan c	3	0	1	1	0	0	0	0	6
Imidan u	0	0	0	3	0	0	0	0	3
Check c	0	0	0	4	0	2	0	1	3
Check u	1	0	0	1	0	0	0	0	2
Check c	0	0	0	6	0	1	0	0	4
Check u	1	0	0	0	0	0	0	0	7

Bakersfield Almond IPM Plot

The Bakersfield almond pest management orchard is composed of 100 acres of 6-year-old almond trees planted with 2 rows of Nonpareil with a pollenizer row on each side. The pollenizers are Mission alternated with Merced. The orchard is on level, deep soil with all the trees uniform in size and shape. The trees are planted on a berm and have a flood-type irrigation system. A natural sod cover crop is maintained by close chopping. The plots were laid out in a randomized block design. Plots consisted of a Guthion treatment when traps indicated a flight of Navel orangeworm, a Sevin treatment at 10% hull split, a treatment receiving both the Guthion and Sevin applications, and a check area. These treatments were replicated in a clean area where nuts on the berms were swept off into the adjoining weed strip and destroyed, and an unclean area where this practice was not done. An average of 72, and 21 nuts per tree was present on the Nonpareil and Merced trees, respectively, in March. Samples showed approximately 21% and 77% NOW infestation present in the two varieties. Mission nuts contained no larvae in any of the samples. Crop set for the 1978 season was light to moderate with all areas about equal in the amount of nuts present.

Consistent egg deposition occurred on April 29 with egg hatch on May 8. The Guthion spray was applied 6 days later. The egg traps showed a reasonably consistent egg deposition throughout the entire orchard. The second major flight occurred June 20 until July 27. The Sevin treatments were applied on July 20 approximately 14 days after hull splits because of irrigation. An Omite spray was also included at this time on all plots except the uncleaned check area. The egg traps showed a low population of Navel orangeworm present in the orchard when Sevin was applied. In August, just before harvest, an extremely high adult population appeared to be present in the orchard, starting on August 11 and continuing through until September 7. This was also followed by a fairly high population occurring again in October. The flight occurring the latter part of August through September was the flight that caused considerable damage to the nuts at harvest time. There was no chemical protection on the nuts at this time and most of the larvae that hatched infested the nuts. The preharvest nut samples were single, non-replicated samples and were taken on August 10, 16 and 21 with the harvest sample being taken on August 23. The harvest sampling occurred before the eggs laid during the August flight had a chance to hatch and infest the crop. Had we allowed the samples to remain until September, the NOW infestation in the samples would probably have shown a marked increase. Our samples on August 23 showed very little increase in NOW damage occurring between August 10 and August 23. The plots where Guthion was applied showed an average of 10.7% NOW damage regardless of the Sevin treatment. The check showed 18.9% NOW damage and the 2 blocks with Sevin applied showed 20.6% NOW damage. The Sevin treatment gave no control in any of the plots and in fact, where Sevin was applied, a slight though not significant increase in the amount of Navel orangeworm damage occurred. The timing of Sevin sprays not applied at 10% hullsplit occurred when very few NOW were present within the orchard. In fact, it was at the low point in egg laying. This made the timing very poor and probably caused the lack of control in the plot. A high population

of green lacewing was present in the orchard throughout the summer and although counts were not made within the Sevin block, possibly there was a reduction in lacewings caused by the application of Sevin. This could account for the slight increase of Navel orangeworm experienced. Although the difference was not significant, the effects of Sevin on the lacewing predators need to be checked to see if a significant reduction in population is affecting predation on Navel Orangeworm.

Two 100 nut samples were harvested and examined from the Merced variety on September 21. Percent infestation was 40.0, 50.2, 48.0, and 39.8, respectively, from Guthion, Sevin, Guthion + Sevin, and check treatments. These samples were taken after the NOW flight in late August and show considerable more damage than occurred in the Nonpareils. All treatments where Sevin was applied were higher at that time than all other plots. The check areas had the lowest infestation.

The Guthion spray applied on May 16 gave a significant reduction in the peach twig borer population during the June flight (second generation). Very little peach twig borer damage was noted in the nuts at harvest time.

The principal mite present in the orchard was the Pacific mite, Tetranychus pacificus, although an occasional limb would show some citrus red mite present. Infestation of mites was reasonably low and we were able to keep from treating one 12-acre check area because of the low infestation of mites. The Guthion treatments gave some control of Pacific mite; this was the first year that Guthion was applied in this orchard. When Sevin was applied, we included Omite in the treatment, since past experience has been that this insecticide would cause a mite flare-up.

Some of the major observations made concerning this plot are:

1. The entire plot appears to be very uniform in tree vigor and growth, age of tree and production potential.

2. At the beginning of the trial, there was a fairly even distribution of Pacific mite throughout the entire block and it will be valuable to observe the effects of chemicals on the development of mites in future years.

3. Navel orangeworm damage was fairly high in this orchard and much of the damage appeared to be caused by the generation of Navel orangeworm which occurred in July at hull split time.

4. There was a high lacewing population within the orchard throughout the season with the Sevin treatments possibly causing considerable disruption. There was also a slight increase in the Navel orangeworm damage caused by the Navel orangeworm in the Sevin-treated areas, therefore, an experiment should be designed to study the population of lacewings and their effects upon Navel orangeworm and also upon the mites that are present within the orchard.

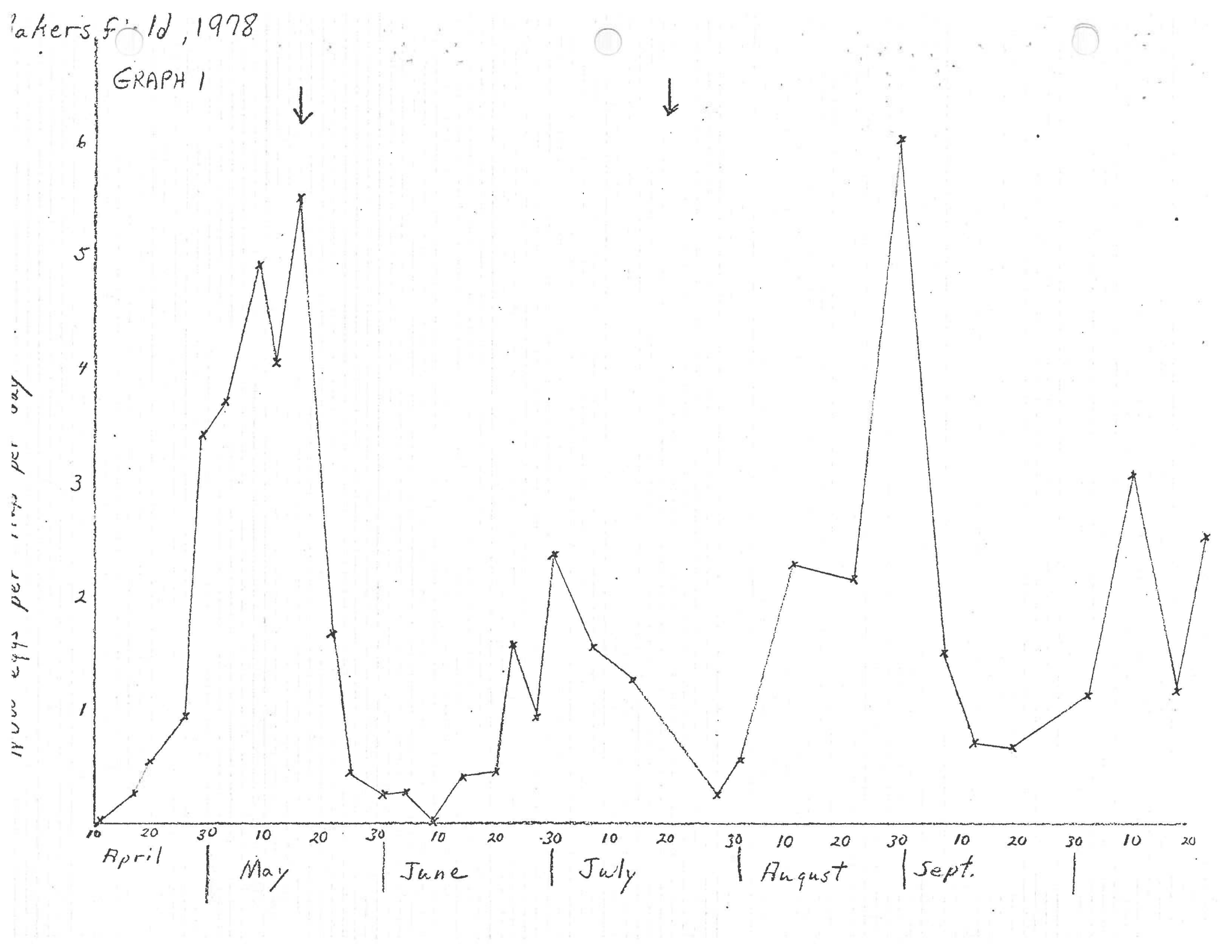
5. Guthion, applied when egg traps indicate consistent egg deposition occurring in the orchard, appeared to give good control at the Bakersfield plot this past year.

6. PTB damage was minimal even though very high moth populations were observed throughout the season. This might be due to the masking effects of NOW damage.

7. Cleaning the berms of mummy nuts while leaving large numbers in the trees did not result in any noticeable benefits.

Bakersfield, 1978

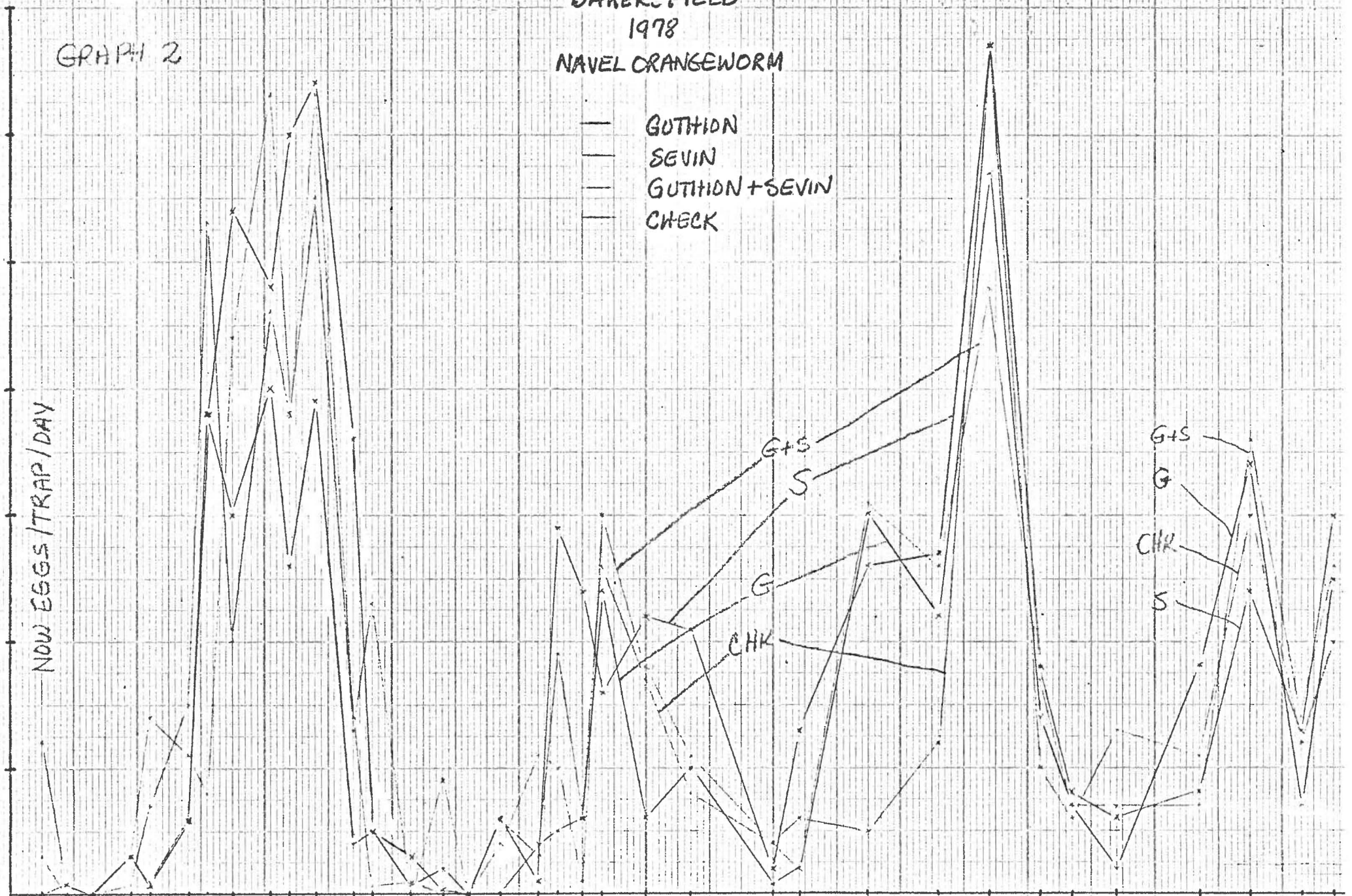
GRAPH 1

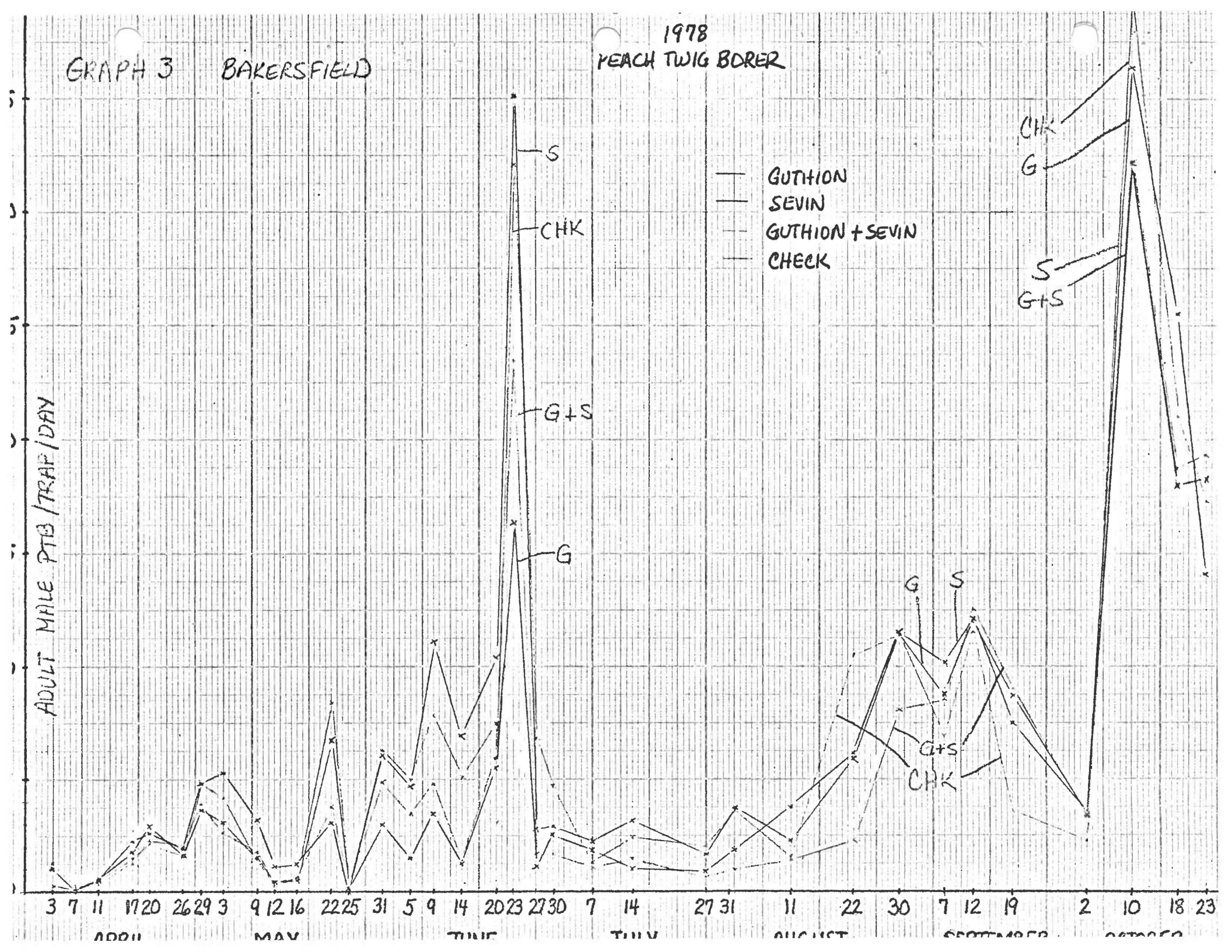


GRAPH 2

BAKERSFIELD
1978
NAVEL ORANGEWORM

— GUTHION
— SEVIN
— GUTHION + SEVIN
— CHECK

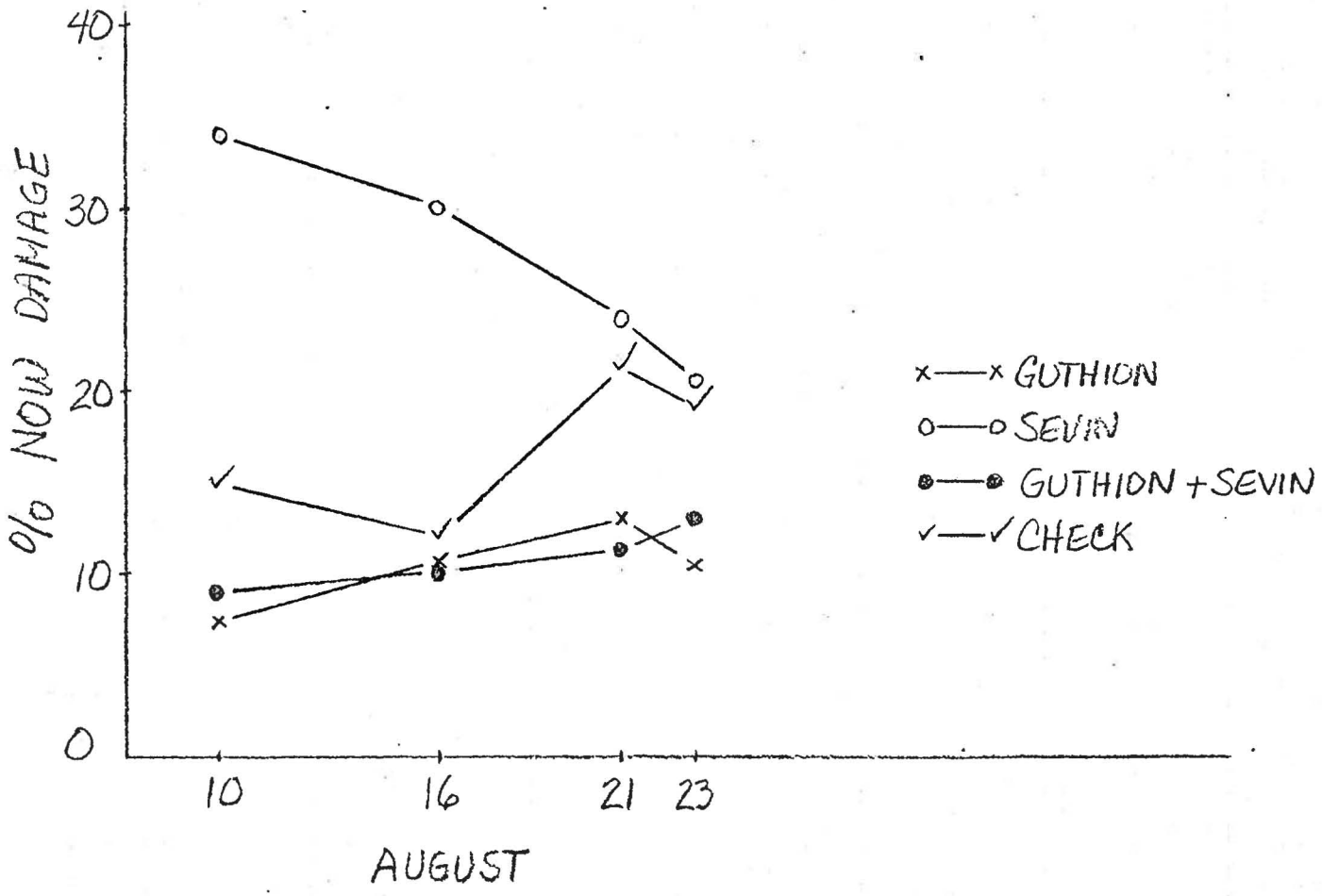



GRAPH 3 BAKERSFIELD
1978
PEACH TWIG BORER
GUTHION
SEVIN
GUTHION + SEVIN
CHECK
ADULT MALE PTB / TRAP / DAY
S
CHK
G+S
G
CHK
G
S
G+S
3 7 11 17 20 26 29 3 9 12 16 22 25 31 5 9 14 20 23 27 30 7 14 27 31 11 22 30 7 12 19 2 10 18 23
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER

GRAPH 4

NONPAREIL NUTS INFESTED WITH NAVEL ORANGEWORM

BAKERSFIELD, 1978



Bakersfield

Final Harvest - Samples, 1978

Treatment		% Damage					
		Nonpareil			Merced		Mission
		PTB	NOW	ANT	PTB	NOW	NOW
Guthion	c	.3	11.1ab	.6	0	44.5	1
Guthion	u	0	10.3a	.1	0	35.5	0
Sevin	c	0	14.5bcd	.1	0	55.5	1
Sevin	u	0	26.7f	.2	1	45.0	3
G&S	c	0	14.8cd	.6	0	47.0	0
G&S	u	.2	11.3abc	0	0	49.0	1
Check	c	.3	21.1e	.8	0	38.5	0
Check	u	0	16.7d	.1	0	41.0	2
Harvest date		August 23			September 21		October 6

Preharvest Nonpareil Samples - Single Samples

		Date						
		8-10		8-16		8-21		
		PTB	NOW	PTB	NOW	PTB	NOW	ANT
Guthion	c		7	1	9		12	1
Guthion	u		8		12		14	
Sevin	c	1	27		21		20	
Sevin	u		37		39	1	28	1
G&S	c		12	1	12		12	
G&S	u	1	6		8		11	1
Check	c		16	2	6		28	4
Check	u	2	14		18		15	1

Blackwell ALmond IPM Plot

The Blackwell almond IPM plot is composed of 80 acres in a rectangular block on slightly sloping ground. The trees are approximately 12 years old with 2 rows of Nonpareil and 1 row of Merced as the pollenizer. The trees are quite uniform in size throughout the block. Irrigation is by a solid-set sprinkler system and the ground is maintained under a natural sod culture that is closely chopped. This orchard is located in the northwestern corner of Kern County. There are no almonds surrounding the block other than 20 acres of very young trees on the west side.

The orchard was divided into eight, 10-acre plots. Treatments consisted of a Guthion spray, timed to the egg trap counts, a Sevin application at 10% hull split, a combined application of Guthion and Sevin timed to the above two treatments, and a check area. The egg traps in the Guthion plots were observed for consistent egg deposition during the first major moth flight (May). Each of the four treatments had two replications, one cleaned and one uncleaned. Due to the lateness of establishing the plots, the clean treatment consisted of sweeping nuts from the berm area between the trees into the sod area where they could be chopped up. The unclean treatment was left alone. Considerable amounts of mummies or holdover nuts remained on the trees throughout the winter, especially on the Merced variety. There were approximately 300 mummies per Merced tree, with much lower counts on the Nonpareils.

The first major egg laying period for Navel orangeworm occurred on May 4. At this time we started getting fairly consistent, high populations of eggs deposited on the traps. This period of egg laying continued until May 26. The Guthion spray was not applied until May 30 and 31 due to problems with the irrigation schedule for the block. Treatment was from 10 days to two weeks past the desired time. A second major flight and egg deposition period started approximately June 15 and lasted into the first week of July. Sevin treatments were applied on July 21 through July 25 because of the logistics problems and time involved using a dilute sprayer. Ten percent hull split occurred approximately July 15; the Sevin spray was thus delayed approximately a week from the desired time. On observing the egg deposition period, the spray was applied after egg laying of the second brood had taken place and the newly hatched larvae had already entered the nuts. The third major flight period began on August 8 and continued until September 7. During this period, both the Sevin treatment and the treatment receiving Guthion plus Sevin showed higher counts of Navel orangeworm egg deposition than was noted in either the check area or the Guthion spray plot. This corresponds with many of the other plots in which we observed this same phenomenon.

Preharvest samples were taken on August 10, 16 and 21, and the final harvest samples were take on August 29. Considerable differences in the amount of Navel orangeworm damage occurred in the August 29 sample with the highest infestations occurring near the 20-acre young planting which had not been harvested the previous year. A significant population of Navel orangeworm probably developed in the young planting, and then migrated

into the adjoining plots in the orchard. Therefore, results from the clean and unclean treatments were inconclusive. If the data from the cleaned and uncleaned areas were averaged, NOW damage was approximately 10.5% in the Guthion plot, 11.9% in the Guthion plus Sevin plot, 12.6% in the check area, and 12.5% in the Sevin area. There was slight Navel orangeworm control with the Guthion plus Sevin blocks. Damage was greater than where we applied Guthion alone, and there was virtually no difference from the Sevin blocks or the check areas. Lacewings were abundant throughout mid-season, and the effects o pesticides on natural predation possibly should be considered in explaining these results.

The peach twig borer flights peaked for the first time on May 19, again on June 30, and for a third time on August 29. The latter two flights produced high counts although very little peach twig borer damage was seen at harvest time.

The principle mite infesting the orchard was the Pacific mite, Tetranychus pacificus. Populations were fairly high by June, approaching 5 mites per leaf. Large numbers of Metaseiulus occidentalis, a predator mite, were present in the orchard at that time and were feeding on the Pacific mite population. The predator mite, 6-spotted thrips, and lacewing populations seemed to keep the Pacific mite at a low level until late June when mite numbers increased greatly, and some defoliation occurred. In early July the population of Pacific mite decreased. Therefore, the grower cancelled a scheduled miticide application, and the only chemical control for mites came with the Sevin treatment, when Plictran was included.

Major Observations Concerning the Blackwell Plot are:

1. Sprays were applied 2 to 3 weeks late. Applications of Guthion or Sevin delayed for 10 days or more are too late to be effective. The timing of either of the sprays is very critical for control of Navel orangeworm.

2. High populations of Metaseiulus occidentalis predator mite, 6-spotted thrips and lacewings can control a significant population of Pacific mite if allowed to increase their number to adequate levels.

3. Unharvested young trees adjacent to an almond orchard can cause a significant influx of Navel orangeworm into the adjoining crop.

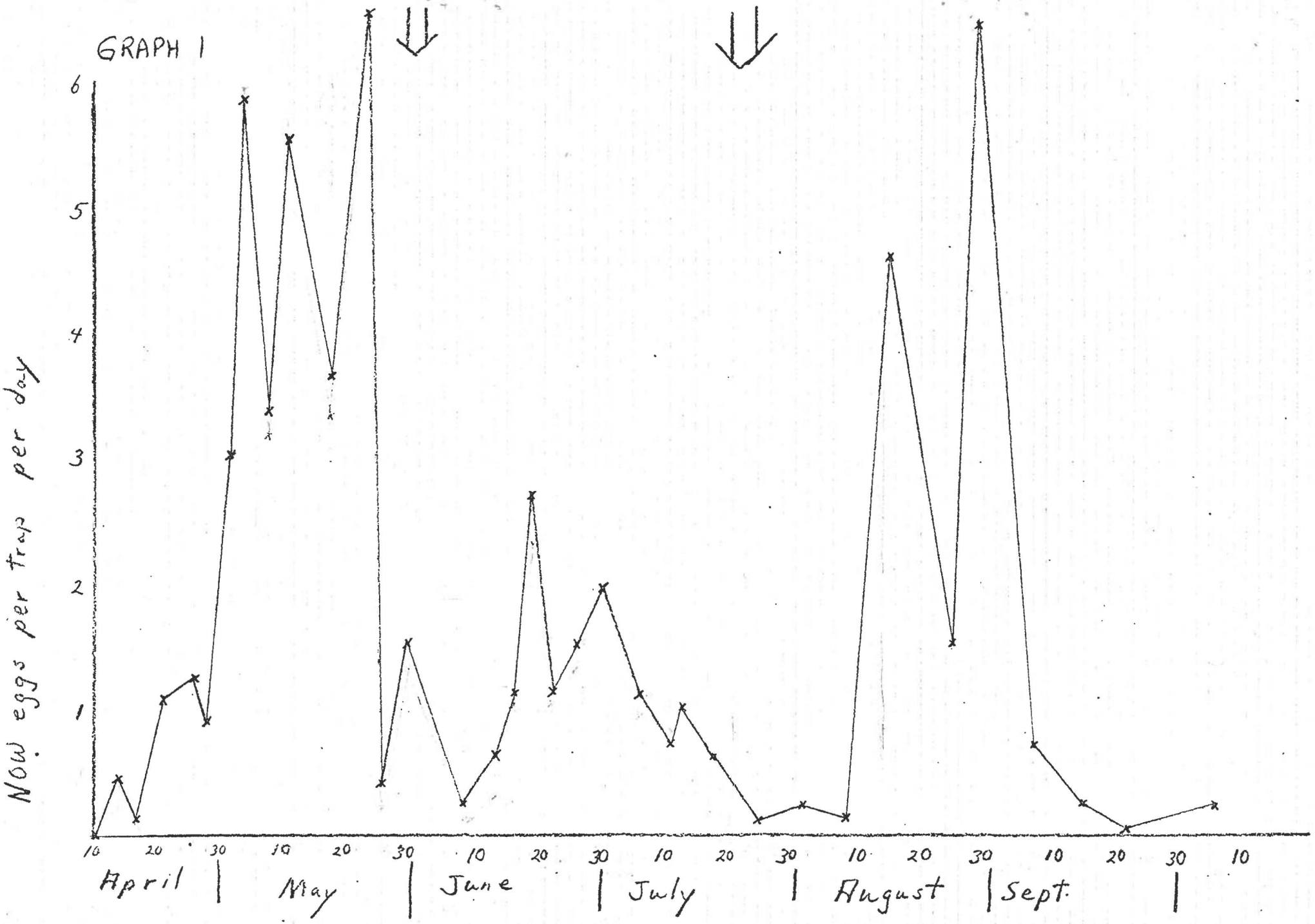
4. Large numbers of mummy nuts left on the trees will cause significant NOW pressure on the orchard.

5. For large acreage, sprays by ground rig were difficult to apply at the correct time. Helicopter applications are used on the rest of the orchard. Next year, the plots should be changed to facilitate application of chemicals by helicopter.

6. Large populations of Peach Twig Borer resulted in only limited PTB damage to the almond kernels, although hulls were commonly infested.

Blackwell, 1978

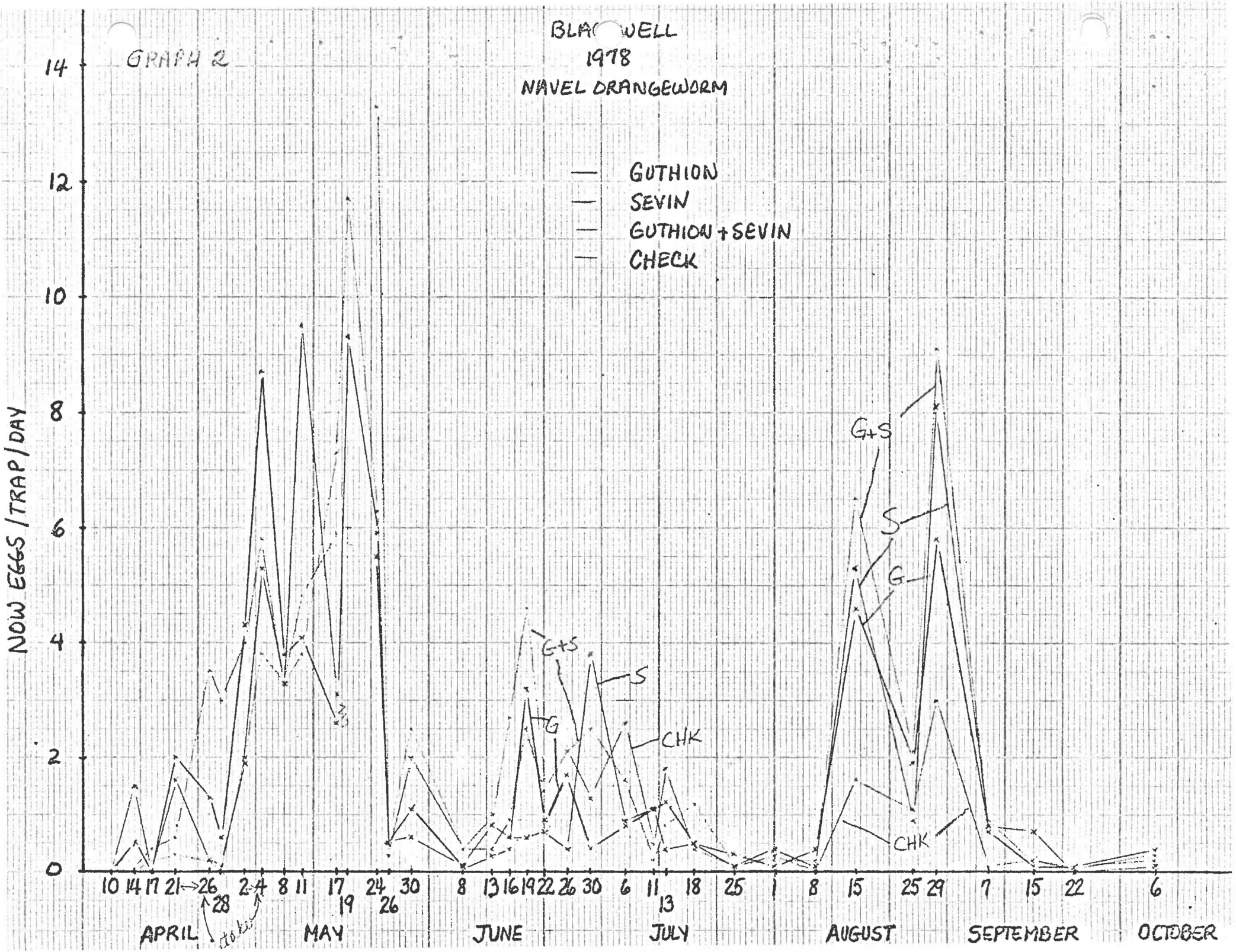
GRAPH 1

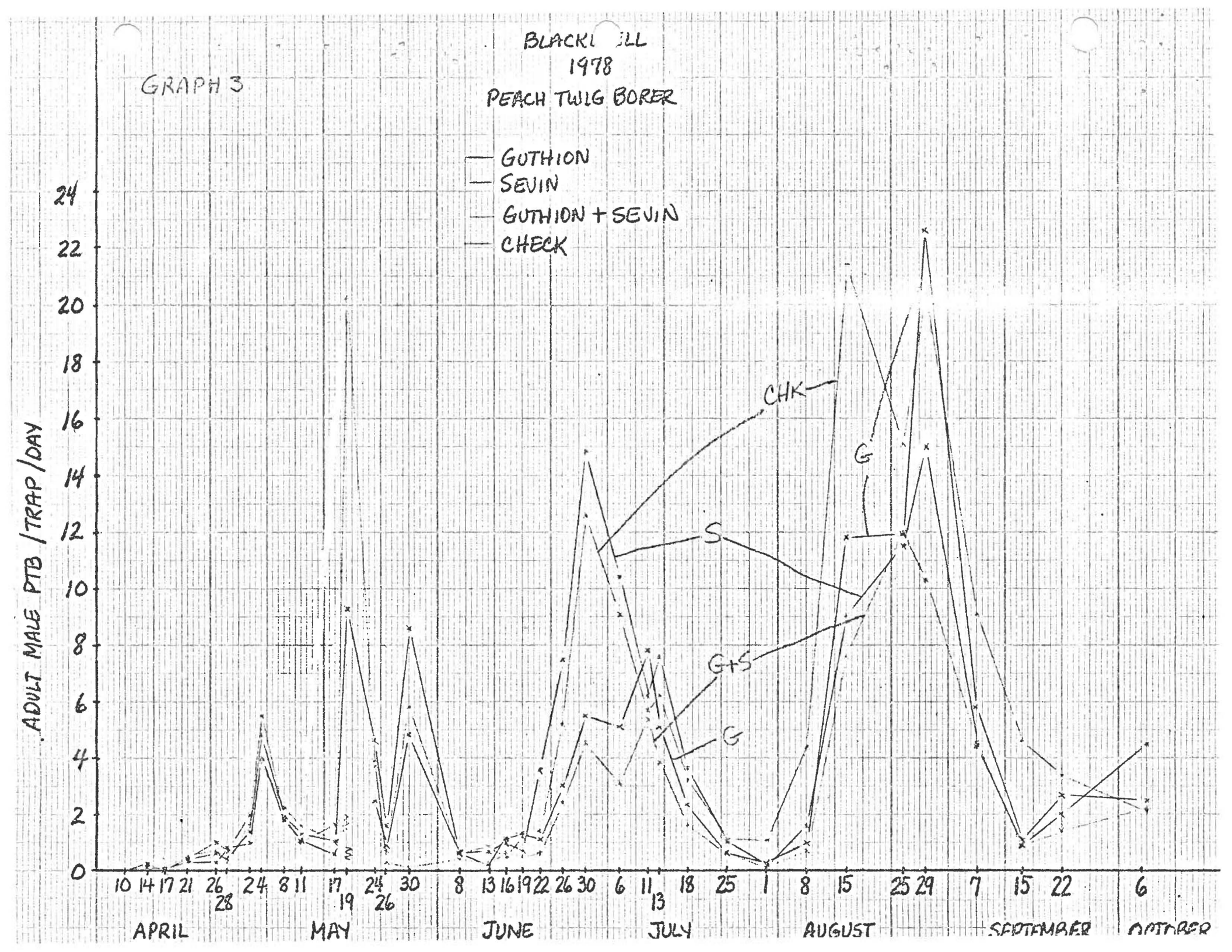


GRAPH 2

BLA[illegible]WELL
1978
NAVEL ORANGEWORM

— GUTHION
— SEVIN
— GUTHION + SEVIN
— CHECK

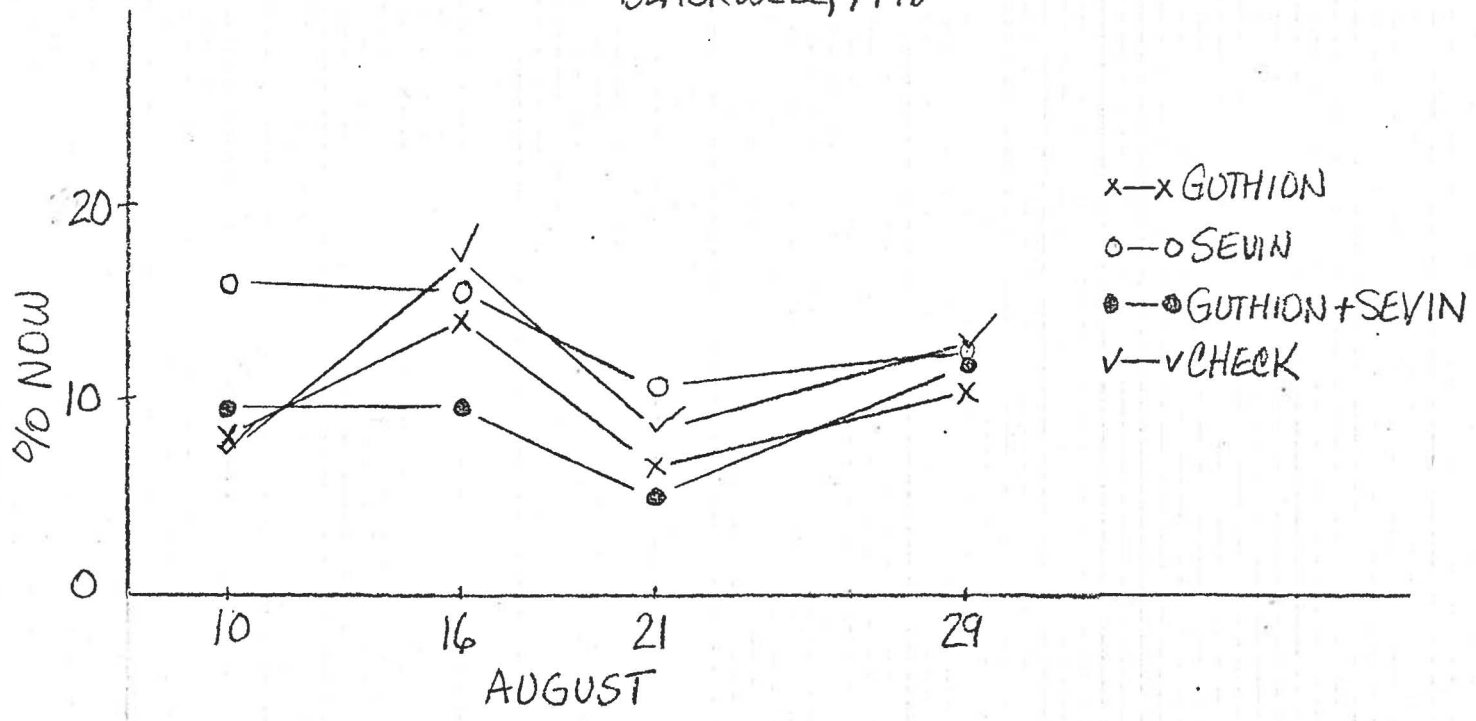



BLACKL ILL
1978
GRAPH 3
PEACH TWIG BORER
GUTHION
SEVIN
GUTHION + SEVIN
CHECK
ADULT MALE PTB / TRAP / DAY
0
2
4
6
8
10
12
14
16
18
20
22
24
CHK
G
S
G+S
G
10 14 17 21 26 28 24 8 11 17 19 24 26 30 8 13 16 19 22 26 30 6 11 13 18 25 1 8 15 25 29 7 15 22 6
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER

GRAPH 4

NONPAREIL NUTS INFESTED WITH NAVEL ORANGEWORM

BLACKWELL, 1978



BLACKWELL

Final Harvest - 1978

	% Damage	
Variety:	Nonpareil	Merced
Treatment	NOW	NOW
Guthion c	8.2	27
Guthion u	12.8	29
Sevin c	14.9	41
Sevin u	10.0	23
G + S c	7.8	28
G + S u	15.9	39
Check c	8.5	12
Check u	16.7	43
Harvest date:	August 29	October 6

Preharvest Nonpareil Samples - Single Samples

	Date					
	8-10		8-16		8-21	
	PTB	NOW	PTB	NOW	PTB	NOW
Guthion c		5		8		5
Guthion u		11		20		8
Sevin c		17	2	20	1	11
Sevin u		15		11		10
G + S c		6		5		3
G + S u		13		14		7
Check c		4	2	4		7
Check u		11		30		10