EGYPTIAN ALFALFA WEEVIL CONTROL IN SOUTHERN CALIFORNIA

W. R. Bowen
Extension Entomologist
University of California, Riverside

The Egyptian alfalfa weevil, Hypera brunneipennis (Boheman) was first observed to be destructive to California alfalfa in 1952 in the Imperial Valley. During the late 1950's to 1960 it had spread westward into San Diego County and from there northward up the southern coastal plain into San Luis Obispo County. Since 1960 it has apparently maintained a steadily northward movement and for the past several years has threatened alfalfa hay production along the northwestern slope of the Central Valley and the upper Sacramento Valley as well as the alfalfa production area on the eastern edge of the Central Valley in Tulare County. In contrast, the alfalfa weevil, H. postica (Gyllenhal), has been a pest of alfalfa in California since the 1920's, but has confined its destruction largely to the hay-growing areas of northeastern California. H. postica reportedly has remained in its northerly domain and is not known to occur in southern California.

In the Imperial Valley, the adult weevils overwinter in field trash, brush piles or under the loose bark of trees. They emerge in January or early February and the females soon begin inserting their eggs into the stems of alfalfa. The eggs hatch in a few days and the young larvae make their way into the terminals of the alfalfa where they feed on the terminal buds and upper leaves first and then gradually move down the plant. The legless larvae complete their growth in about three to four weeks, drop to the ground and spin a cocoon and pupate. There is only one generation per year. Larval feeding damage is usually confined to the first cutting of alfalfa but sometimes persists into the second cutting.

Infestations of economic importance are often prevented by cutting the crop as soon as most of the plants are in the bud stage. Chemical control is usually considered when cutting time is more than 10 days away and the weevil larva count has reached an average of 20 per sweep of a standard insect net. However, timing of chemical treatments may also be based upon other criteria.

Frequently in southern California the Egyptian alfalfa weevil (hereinafter referred to as EAW) and the pea aphid, Acyrthosiphon pisum, occur simultaneously in damaging numbers in first-cutting alfalfa. In addition, a third pest, the spotted alfalfa aphid, Therioaphis maculata, is often present. Therefore, when ever chemical treatment becomes necessary, it is desirable to make a single treatment with a material that satisfactorily suppresses all target pest species present. In addition, because of the mild winters, southern California alfalfa fields harbor many beneficial predators and parasites that can become effective pest suppressors in subsequently planted crops in the interior valleys. Thus, it is desirable that any early-season chemical treatment be selective and allow the beneficial insects to survive. For several years now, Extension personnel have conducted trials in the Imperial Valley designed to investigate candidate materials that could produce this desired objective.

1968 Trials

Five insecticides were investigated in a screening trial conducted on alfalfa grown on the University of California Imperial Valley Field Station, El Centro, February, 1968. The insecticide and active ingredient per acre used were as follows: Diazinon, 18 ounces; Guthion, 6.7 ounces; Supracide, 14.6 ounces; Alfa-Tox (methoxychlor/Diazinon) 21/10 ounces; and Lannate at 16 and 8 ounces. The materials were applied to replicated plots, 60' x 80' each, as sprays by ground rig using 4X nozzles, 200 psi and applying 25 gallons of water per acre.

All of the treatments provided excellent kill of EAW larvae throughout the 17-day duration of the test. Tests conducted since, however, have shown that the dosage rates used in this investigation were too high, with the exception of the Guthion rate. The

treatments also sufficiently suppressed the population level of pea aphids present in the field with Diazinon, Supracide and Alfa-Tox appearing somewhat superior in residual kill to the other materials. Counts made of Bathyplectes, a wasp parasite of the weevil, and two wasp parasites of the pea aphid and spotted alfalfa aphid (Aphidius and Trioxys, respectively) indicated that the Diazinon/methoxychlor combination and the Diazinon rate was more harmful to these beneficials than the other treatments.

A separate trial in the same alfalfa field as above was conducted to test the effectiveness of Diazinon applied at 8 ounces of active ingredient per acre. The spray was applied in the same manner as described above. The results indicated that both the EAW and pea aphid could be adequately suppressed at this dosage rate.

1969 Trials

Insecticides that appeared promising in the 1968 experiments were reinvestigated in 1969, but at lower dosage rates. The insecticides were applied by ground rig as previously described. The results are shown in table 1. Furadan and Supracide at 8 ounces active ingredient per acre provided excellent EAW control while the methoxychlor/Diazinon rate of 10/5 ounces was marginal in effectiveness. Diazinon at the 8-ounce rate did not give adequate reduction of weevil larvae as it did in the 1968 trial. All of the treatments provided excellent suppression of the pea aphid.

An investigation was made of the impact of the insecticide treatments on beneficial insects inhabiting the alfalfa at time of treatment. Although the density levels of the various beneficials were low in this experiment, the level was generally reduced in nearly all treated plots two days after treatment (table 2). The data indicate that the Furadan treatment initially resulted in a greater mortality of beneficials at two and seven days than did other treatments. However, by the seventh and seventeenth day after treatment, some of the predators (Orius, Nabis, lacewings or lady beetles) and aphid parasites were beginning to reappear in most of the treated plots.

1971 Trials

Furadan and Supracide were reinvestigated in 1971 for minimal rates required for pest suppression. Diazinon was included as a standard. Low dosages of Thimet and Lannate were also included in these trials.

Ground trial

The insecticides were applied by a Kinkelder, mist-blower machine traveling at 7 mph with an air velocity of 200 mph applying 8 gallons of water per acre. There were three replicates per treatment with each replicate 1,230' by 100'. Plants were 6-8" high. Insect sampling was done with a D-Vac suction machine, sampling at random 50 sq. ft. per replicate. The resulting weevil larvae kill is shown in figure 1. The Furadan 4-ounce active ingredient per acre and Lannate 8-ounce treatments were somewhat superior in weevil kill to Thimet at 4 ounces. The Gardona treatments and low Lannate treatment resulted in less than satisfactory suppression of the damaging larvae when percent kill was averaged over the 14-day duration of the test.

Pea aphid counts showed that Furadan (4 oz.) and Thimet (4 oz.) provided an average pea aphid suppression over the 14 days of 86 and 77%, respectively. Lannate showed little control and Gardona provided no suppression. None of the materials in this trial had any effect on the small density of spotted alfalfa aphids present in the field.

Air trial

An air application of insecticides at low dosage rates was conducted concurrently with the ground application trial noted above for comparison. The 80-acre field used for the air trial was about five miles distant from the ground trial. The insecticides were applied by Aero-Commander aircraft flying 60 mph applying 5 gallons of water per acre to replicated plots each 160' by 1,200' long. The alfalfa was 6-8" tall. Plots were sampled 2, 7 and 14 days after treatment with the D-Vac sampler in the same manner as previously described. All weevil data are means of three replicates and are shown in Figure 2. In this experiment the 4-ounce rates of Furadan and Supracide provided 94-100% suppression of the EAW over the 14-day duration of the test. Thimet and Lannate at 4 ounces

gave 80-91% suppression as did Diazinon at 12 ounces. Only two of the treatments, Thimet and Diazinon, successfully suppressed both the pea aphid and spotted aphid. All aphid data are means of three replicates (expressed as percent reduction of aphids from the untreated check) and listed as follows for each of the treatments:

Material	Ounces AI/A	% Reduction	
		Pea aphid	Spotted alfalfa aphid
Diazinon	12	99	95
Thimet	4	89	89
Lannate	4	76	55
Furadan	4	72	21
Supracide	4	47	0
Supracide	8	37	0

1972 Trial

Treatment effects on beneficial insects were recorded in all previous experiments but were confined to samples taken over a short period of time, 14 to 17 days at most after treatment. Also, in early trials, data were collected from some test plots that were less than 1/4 acre in size. It is known that many beneficial insects can migrate rapidly from one area to another, especially among small experimental plots. An experiment was conducted during the 1972 weevil season to study the long-term effect of beneficial insect suppression after an EAW control application is made to an entire alfalfa field or area. In a predominantly hay-growing area of the Imperial Valley, three 80-acre alfalfa fields were selected for the study (Figure 3b). Two of these fields and adjacent fields not in the test were all about even in growth and within one year of age to each other. The one exception was the field selected as an untreated check. It was a first-year planting of alfalfa but otherwise was similar to adjacent alfalfa fields in growth stage and harvest date.

Furadan and Supracide were selected to be used in this trial because of their past performance of providing excellent EAW larva control at a low dosage rate. In addition, Supracide was found to be quite selective having little harmful effect on beneficial insects. Diazinon was again used as a standard treatment for comparison. Pretreatment insect sampling was made in the areas selected for treatment one day prior to the application of the insecticide. Post-treatment sampling was conducted 3, 13, 33 and 47 days after treatment over a time span which covered the first two cuttings. Sampling was done with the D-Vac suction machine. On each sampling date, fifty square ft. suction samples were taken in each of the four quadrants of a treatment (Figure 3b). Unfortunately, the assembly of data from the 33 and 47 day sampling has not been completed. Only the pretreatment and 3 and 13 day data are presented.

The recorded weevil larva kill in the three fields was 96, 90 and 99% for Diazinon 12 oz., Supracide 4 oz. and Furadan 4 oz., respectively, 13 days after treatment (Figure 3a). However, it should be noted that this degree of suppression was obtained from a low population density of weevil larvae (averaging 1-2/sq. ft. D-Vac sample; or 14 per sweep of a standard sweep net). In southern California, a decision for treatment should be considered when larval count reaches 15-20 per sweep, depending on the growth stage of the alfalfa. Nonetheless, weevil kill was not the primary concern in this experiment for previous tests have already shown these insecticides to be highly effective for EAW suppression. Other concerns were simultaneous aphid kill and effect on beneficial insects.

Counts of aphids indicated that the Diazinon treatment provided a longer residual pea aphid kill than did Supracide or Furadan, the latter two insecticides showing no control 13 days after treatment (Figure 3c). In contrast all three insecticide treatments provided excellent control of the spotted alfalfa aphid over the 13-day period of sampling (Figure 3d).

Effects of Treatments on Beneficial Insects

The effects of insecticide treatments on beneficial insects and spiders were noted and recorded in all EAW control trials conducted since 1968. The data indicates that most of the insecticides were harmful to beneficials, especially when applied at rates greater than 0.5 lb. active ingredient per acre. At the 0.25 lb. rate, Furadan and Supracide provided adequate control of EAW while Supracide appeared to be more selective in that it was generally less harmful to beneficial parasites and predators. For example, three days after treatments were applied in the 1972 trial, spotted alfalfa aphid mummies (resulting from parasitism by Trioxys utilis) were collected and incubated at room temperature in the laboratory. Of 117 aphid mummies collected from the Supracide 4-oz. plot, 63 yielded an adult Trioxys parasite; of 115 collected from the Furadan 4-oz. plot, only 35 emerged; and of 35 mummies from the Diazinon 12-oz. plot, no wasp emergence occurred. It was also noted that each adult wasp emerging from the Furadan-treated mummies died within a few minutes after emergence suggesting that the toxin was obtained from either contact with treated leaf surface or orally while the tiny wasp chewed its way out of the aphid mummy. On the other hand, Trioxys emerging from the mummies collected from the Supracide plot lived for several days after emergence.

In the 1972 trial where 40-acre field plots of alfalfa were treated and sampled (Figure 3b), the number of beneficial insects was recorded and several are listed in the following table. The data shows the general trend of reappearance of beneficial insects in Imperial Valley alfalfa fields 13 days after an effective, low dosage insecticide treatment for EAW.

March 1972

Number of Parasites / 150 D-Vac Samples on Days Indicated After Treatment

Treatment	Trioxys 3	Trioxys 13	Bathyplectes 3	Bathyplectes 13	Misc. Wasps 3	Misc. Wasps 13
Furadan 4 oz.	547	236	0	9	11	58
Diazinon 12 oz.	23	193	4	12	19	35
Supracide 4 oz.	2068	826	11	14	51	70
Check	5419	4120	18	5	157	233

Number of Predators / 150 D-Vac Samples on Days Indicated After Treatment

Treatment	Nabis (N) 3	Nabis (N) 13	Orius (A/N) 3	Orius (A/N) 13	Geocoris (N) 3	Geocoris (N) 13
Furadan	7	57	1/1	22/18	11	72
Diazinon	0	23	1/0	25/71	3	120
Supracide	13	41	3/0	19/15	14	64
Check	22	24	0/0	12/11	3	46

A = Adult N = Nymph

In addition, the above treatments had no effect on predatory spiders. They caused only a slight reduction of green lacewing larvae, but had a devastating effect on lady beetle larvae, causing 80 - 90% mortality three days after treatment.

Experiments will continue to be initiated next season. The search for insecticides that complement rather than suppress biological control, is a program that is a necessary part of any pest management approach, particularly against alfalfa pests in southern California. It is indisputable that there is a need to continue toward the development of an overall pest management program for alfalfa, a system not only involving chemical control and preservation of biological control, but also involving all other potential insect control measures discussed elsewhere in this symposium.

Table 1. Effect of Various Insecticides on the Egyptian Alfalfa Weevil and Pea Aphid in Alfalfa, Imperial Valley, California, 1969

Material[2/]	Actual oz./acre	Number of insects per 40 sweeps[1/] on days indicated after treatment: Egyptian Alfalfa Weevil 2 days larvae	Egyptian Alfalfa Weevil 7 days larvae	Egyptian Alfalfa Weevil 17 days larvae	Pea Aphid[3/] 2 days	Pea Aphid[3/] 7 days	Pea Aphid[3/] 17 days
Furadan	8	38	57	14	2,632	756	3,998
(% control)		(97)	(95)	(99)	(95)	(99)	(95)
Diazinon	8	546	536	551	2,308	4,948	21,937
(% control)		(50)	(49)	(60)	(96)	(92)	(75)
Supracide	8	42	85	294	1,073	3,833	15,777
(% control)		(96)	(92)	(79)	(98)	(93)	(82)
Methoxychlor/ Diazinon (Alfa-Tox)	10/5	231	261	380	3,662	4,871	19,092
(% control)		(79)	(75)	(73)	(93)	(92)	(78)
Check		1,088	1,047	1,393	55,816	58,384	88,488

1/ 10 sweeps/replicate.
2/ All materials applied as sprays by ground rig to randomized replicated plots, each 60' x 80'.
3/ Winged and apterous forms.

Table 2. Effect of Various Insecticides on Certain Beneficial Insects in Alfalfa, Imperial Valley, California, 1969

Material[2]	Actual oz./acre	Days after treatment	Orius sp.	Nabis sp.	Aphidius smithi	Bathyplectes curculionis	Trioxys utilis	Misc. predators[3]	Total beneficial insects evaluated
			Number of insects per 40 sweeps[1] on days indicated after treatment						
Furadan	8	2	0	3	1	1	9	4	18
		7	5	0	9	5	2	3	24
		17	39	3	33	4	44	8	131
Diazinon	8	2	15	2	3	16	16	0	52
		7	21	0	49	26	12	0	108
		17	23	2	42	16	9	47	139
Supracide	8	2	2	3	3	10	14	3	35
		7	15	0	78	13	2	4	112
		17	35	3	30	9	23	4	104
Methoxychlor/	10.5	2	13	5	2	8	10	1	39
Diazinon	5	7	22	0	63	20	8	2	115
(Alfa-Tox)		17	28	2	66	8	47	2	153
Check		2	29	11	8	7	27	6	88
		7	13	2	51	28	20	3	117
		17	26	14	36	15	95	69	255

1/ 10 sweeps/replicate.
2/ All materials applied as sprays by ground rig to randomized replicated plots, each 60' x 80'.
3/ Larvae and adults of Green Lacewing, Cocc.

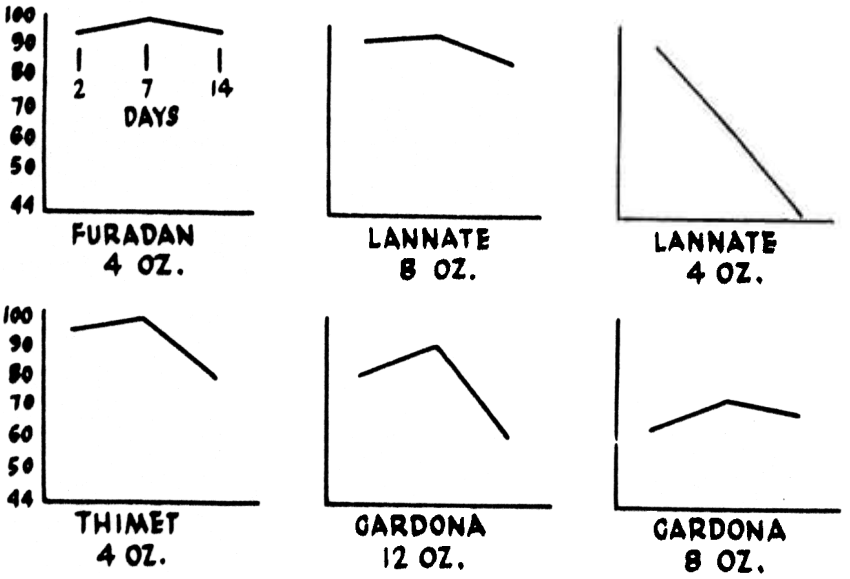


Figure 1

Effect of various insecticides on Egyptian alfalfa weevil larvae in alfalfa, Imperial Valley, California, 1971. Ground application with Kinkelder, 3 replicates. Percent reduction from untreated check is shown on days indicated after treatment. Dosage given as active ingredient per acre.

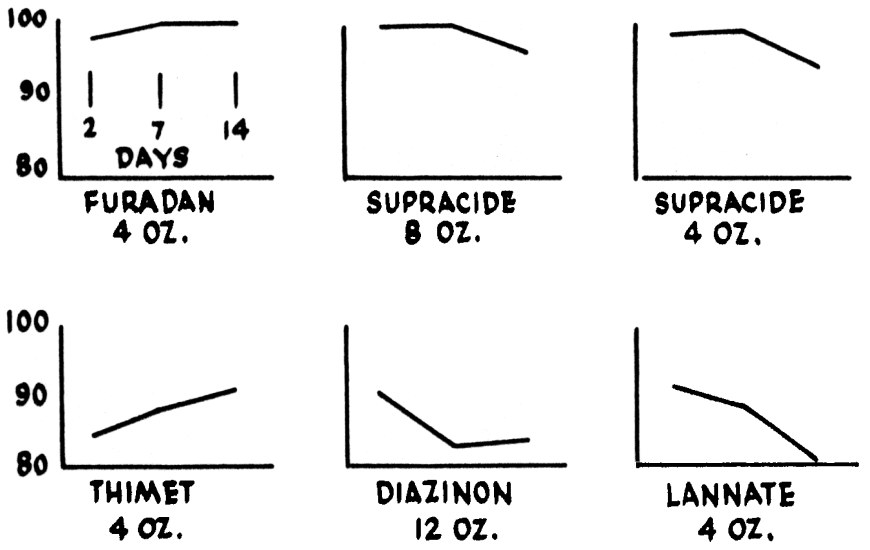


Figure 2

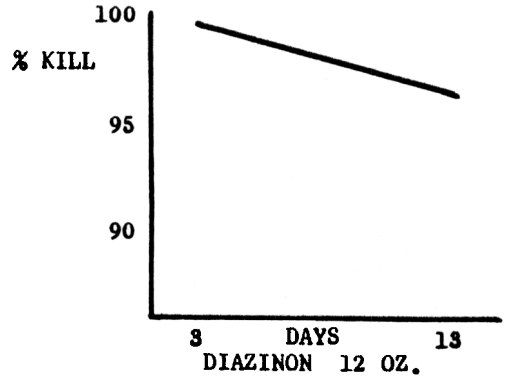
Effect of various insecticides on Egyptian alfalfa weevil larvae in alfalfa, Imperial Valley, California, 1971. Air application, 3 replicates. Percent reduction from untreated check is shown on days indicated after treatment. Dosage given as active ingredient per acre.

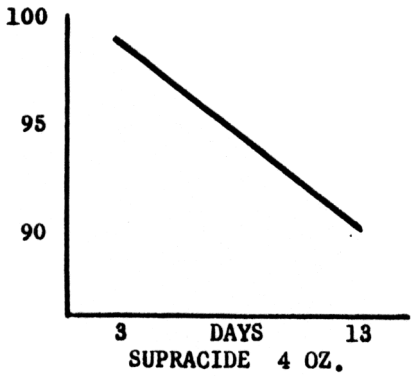
Figure 3a. Effect of various insecticides on EAW larva on days indicated after treatment by air, Imperial Valley, California, 1972.

PRETREATMENT

NO. WEEVIL LARVAE / 200 D-VAC SAMPLES

DIAZINON	394
SUPRACIDE	356
FURADAN	195





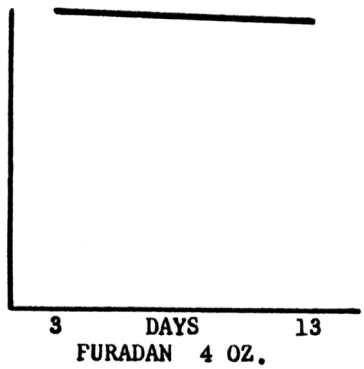


Figure 3b. Schematic drawing of alfalfa fields used in the 1972 trial showing treatments and method of sampling (50 D-Vac airsuck samples taken from each quadrant of a treatment).

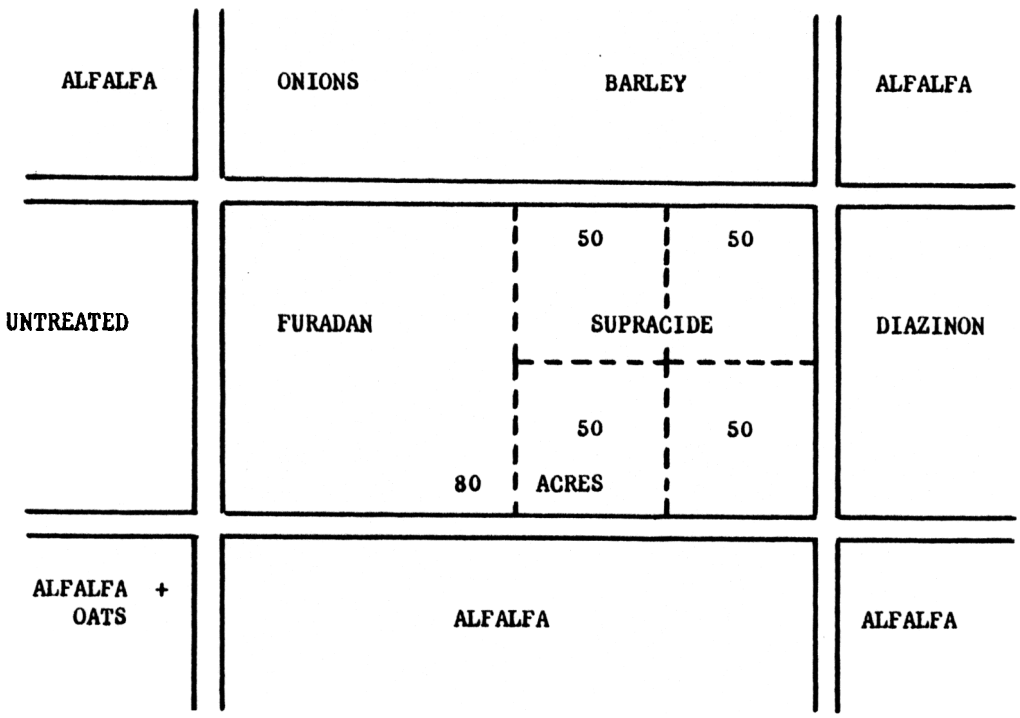


Figure 3c. Effect of various insecticides on Pea Aphid on days indicated after treatment by air, Imperial Valley, California, 1972.

PRETREATMENT

NO. PEA APHID/
200 D-VAC SAMPLES

DIAZINON	2017
SUPRACIDE	427
FURADAN	388

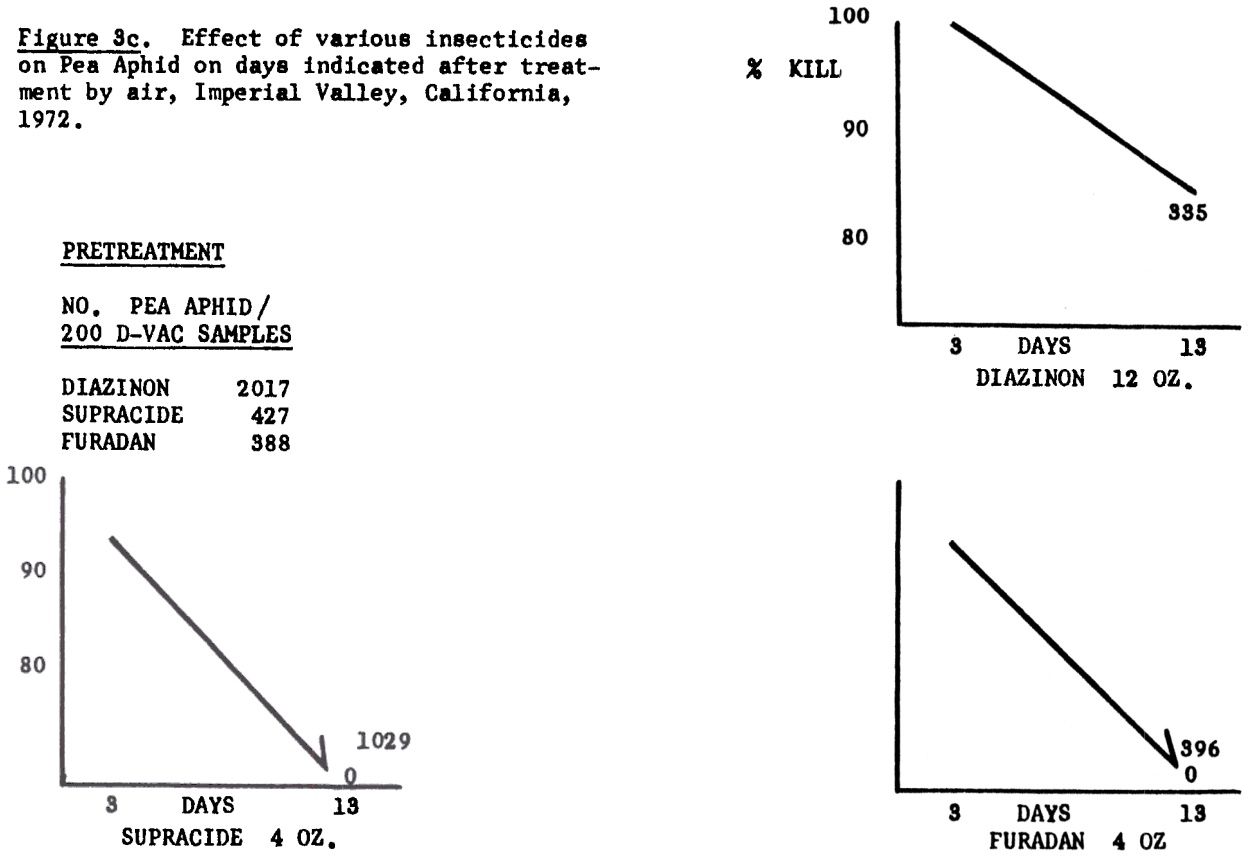


Figure 3d. Effect of various insecticides on Spotted alfalfa aphid on days indicated after treatment by air, Imperial Valley, California, 1972.

PRETREATMENT

NO. SAA/
200 D-VAC SAMPLES

DIAZINON	48,265
SUPRACIDE	268,128
FURADAN	187,703