Lygus Bug Control in Alfalfa

increasing tolerance to insecticides complicates control of lygus bugs in state's major alfalfa seed producing areas

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Apparently lygus bugs in certain alfalfa seed producing localities have developed a tolerance to toxaphene in addition to a tolerance to DDT.

In the southern San Joaquin Valley, lygus bugs early developed a tolerance to DDT that has become general, although confined principally to lygus bugs feeding in alfalfa seed fields.

Previous studies by other workers have shown that lygus bugs feeding in California alfalfa seed fields become more difficult to control with DDT as the season advances. Studies conducted near Arvin—1953–54—in Kern County demonstrated that lygus bugs taken from seed fields became progressively harder to kill as the crop matured, while those taken from alfalfa hay fields were consistently more susceptible to DDT. At the end of the season lygus bugs in alfalfa seed fields were 3–5 times as tolerant of DDT as were lygus bugs in alfalfa hay fields. Those workers further observed that after seed fields were cut, lygus bugs taken from the succulent regrowth were more easily killed with DDT than those tested when flower heads and seed pods were available as a source of food. The exact nature of the tolerance has not been determined but it appears that nutritional factors are involved.

Toxaphene has been substituted for DDT with good results in alfalfa seed fields for several years. However, during 1958, growers in the Arvin district reported that early season applications of toxaphene were fairly successful but control with applications later in the season was generally poor. Increased dosages of toxaphene and DDT-toxaphene combinations reduced lygus bug numbers but when populations were high the materials did not provide adequate control.

Insecticides tested

The problem of lygus bug control was again investigated during the month of July, 1958 in alfalfa seed fields near Arvin. Toxaphene was re-evaluated and a number of other insecticides were tested alone and in combination with toxaphene. Materials tested alone included toxaphene, Phosdrin, Dylox, ethion, Thiodan, endrin, and Sevin. Toxaphene was combined with DDT, ethion, Delnav and Phosdrin. A Thiodan-ethion combination was also tested.

Most of the materials were formulated as emulsions. Sevin was formulated as a solid dispersion in oil containing 2.5 pounds of actual Sevin per gallon and the Dylox was a 50% soluble powder. The sprays were applied by air in early morning or late evening at the rate of 10 gallons per acre. Only one application of each material was made in each trial. Individual plots ranged from five to nine acres. Replication of the treatments within a given field was sacrificed in favor of larger treated areas to minimize the movement of insects from one plot to another.

Pre- and post-treatment counts of lygus bugs were made with a standard insect sweeping net. On each sampling date nine two-sweep counts were made in each plot. Nymphs and adults were recorded separately.

Results with Sprays Applied by Air to Control Lygus Bugs on Alfalfa Seed. Experiment 1. Arvin, 1958

Treatment[1]		Average Number of Lygus Bugs per Sweep							
		Pre-treatment		Counts on Days after Treatment					
				Adults			Nymphs		
Insecticide	Toxicant/acre lbs.	Adults	Nymphs	½ day	4½ days	9 days	½ day	4½ days	9 days
Sevin 36 M	1.0	3.5	25.8	1.8	3.4	10.2	10.7	11.1	26.7
Phosdrin	0.5	3.5	25.9	0.0	1.8	3.2	0.1	0.7	31.7
Dylox	1.0	2.6	35.2	0.2	2.3	4.6	1.2	2.3	40.2
Thiodan	1.0	3.7	32.4	1.2	3.8	8.1	12.2	8.6	17.1
Ethion	1.5	3.5	32.2	2.1	4.1	8.4	15.9	11.8	12.8
Toxaphene + Ethion	1.5 1.0	3.9	29.8	2.8	3.6	9.1	17.5	8.4	7.7
Toxaphene + Delnav	3.0 0.5	3.6	35.7	3.4	4.5	11.4	27.6	13.1	9.2
Toxaphene + DDT	2.0 1.0	4.7	30.6	2.5	6.2	7.7	12.4	13.2	7.1
Toxaphene	3.0	3.8	21.5	3.6	5.4	7.2	15.4	10.7	4.0
Toxaphene	4.0	..	..	1.1	3.6	9.9	10.2	6.5	2.7

[1] Insecticides applied in 10 gallons of spray per acre on July 16, 1958, from 6:07 p.m. to 8:01 p.m.

Results with Sprays Applied by Air for Control of Lygus Bugs on Alfalfa Seed. Experiment 2. Arvin, 1958

Treatment[1]		Average Number of Lygus Bugs per Sweep							
		Pre-treatment		Counts on Days after Treatment					
				Adults			Nymphs		
Insecticide	Toxicant/acre lbs.	Adults	Nymphs	1 day	5 days	9 days	1 day	5 days	9 days
Toxaphene + Phosdrin	3.0 0.5	12.7	3.9	0.4	2.8	3.0	0.1	1.3	12.6
Thiodan + Ethion	1.0 1.0	9.3	4.1	0.7	1.6	4.3	1.1	2.4	25.0
Phosdrin	0.5	10.3	4.5	0.1	1.8	1.9	0.0	2.7	28.6
Endrin	0.4	8.0	7.9	2.8	4.2	5.6	3.9	5.7	21.2

[1] Insecticides applied in 10 gallons of spray per acre on July 30, 1958, 5:45 to 6:50 a.m.

Effectiveness

The results substantiated growers' observations that toxaphene treatments did not provide satisfactory control of lygus bugs in alfalfa seed fields in the Arvin area. Adult lygus did not appear to be greatly affected by the insecticide. Toxaphene was more effective in controlling nymphs and appeared to control young nymphs better than old ones. Nymph populations were reduced slowly over the 9-day period that counts were made but were never eliminated from the plots.

The combining of toxaphene with DDT, ethion or Delnav did not improve the control over that of toxaphene alone. There were indications that toxaphene alone may have been slightly more effective than these combinations.

Of the materials tested, Phosdrin and Dylox resulted in the greatest initial kill of lygus bugs; however, these plots quickly became reinfested and within nine days after treating had developed populations that exceeded pre-treatment

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been reduced by as much as two full units. Liming of two soils where the pH values were acid—below pH 5—resulted in increased potato yields and in more vigorous and healthy appearing potato plants.

These studies have shown that frequent cropping to potatoes has been an important factor in depleting the exchangeable potassium of the soils, and potassium fertilization is becoming increasingly necessary to maintain high potato yields. With the current practice of applying copious quantities of ammonium fertilizers, soil pH has been dropping to dangerously low levels—in some soils—and corrective measures are necessary to restore the soil pH to safe levels.

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LYGUS BUGS

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counts and were higher than for other treatments in the experiments. Three factors were probably responsible for the high populations. *1.* The individual plots were bounded by less effective treatments from which heavy migrations of adults occurred. *2.* There appeared to be a large hatch of nymphs from eggs laid prior to treatment. Both Dylox and Phosdrin have a short residual life and thus had little effect upon the later hatching nymphs. *3.* It was observed that Phosdrin and Dylox practically eliminated beneficial insects and they did not return to the plots as quickly as the lygus bugs, which could increase at an unchecked rate. Control of nymphs was better when Phosdrin was combined with toxaphene than with Phosdrin alone. Initial reduction with the combination was about the same as with Phosdrin but nymph populations did not increase as rapidly.

Sevin, ethion, Thiodan and endrin did not appear to be especially effective in controlling lygus bugs in these experiments.

Although it appears that lygus bugs have developed a tolerance to toxaphene in certain areas, this does not mean that toxaphene will necessarily be ineffective early in the season or in other localities. Also, instances of poor control with toxaphene should not always be attributed to resistance. Other factors may be involved in cases of poor control, such as improper timing, poor penetration of dense vegetation, skips, poor lapping of swaths and migrations of adults. Toxaphene is still the preferred material for lygus bug control. Dylox at one pound actual per acre or Phosdrin at eight ounces per acre are promising alternates when circumstances indicate failures with toxaphene which can be attributed to insecticidal tolerance. Because of the longer residual effect of toxaphene against young nymphs and the rapid kill obtained with Phosdrin and Dylox, combinations of these materials also appear to be promising. It should be possible to achieve satisfactory control if treatments are started before heavy populations develop and entire fields are treated. Phosdrin and Dylox will not give the extended control formerly obtained with DDT or toxaphene. It is likely that if Phosdrin or Dylox are used alone, repeat applications will be necessary about one week thereafter in order to control hatching nymphs. To reduce the hazard to bees Phosdrin should be applied early in the morning before the bees are active or in the evening after the bees have left the field.

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PARASITES

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does not mean that the parasites are established permanently. A period of several years is usually the basis for judgment. However, the majority of introduced natural enemies fail to make a start at all in their new environments, so any recovery is encouraging.

The proportion of plots showing that the new parasites are taking hold is rather encouraging, especially in the San Joaquin Valley and the southern California interior areas. Actually, there has been considerable population increase and dispersal of parasites from some of the plots in those areas, and certainly at least *Aphytis melinus* and *A. fisheri* are now adequately started. If they find environmental conditions favorable, they could add appreciably to the field mortality of the red scale; if not, the parasites may disappear after a severe winter or summer. Laboratory studies offer some hope that the parasites will not disappear, for in several respects both *melinus* and *fisheri* show better temperature tolerances in controlled tests than do the already-established *Aphytis lingnanensis* and *A. chrysomphali.*

The fact that a much higher proportion of recoveries was obtained from the San Joaquin Valley and interior area plots than from coastal area plots does not necessarily mean that the physical environment is responsible for this. The proportion and abundance of recoveries correlate very closely with the abundance of already-established natural enemies in the colonization plots. In the coastal counties, natural enemies were rated as already being common to abundant in every colonization plot obtained; hence, competition for the new parasites was extreme. In the San Joaquin Valley counties already-established natural enemies were rated as being from absent to rare in nearly every plot obtained; hence, competition was virtually nil and the new parasites obtained a good foothold in nearly every case. In the interior areas already-established natural enemies were rated as being from scarce to common in most plots; hence, competition was frequently a factor and the proportion of recoveries reflects this. Regardless of the colonization area, if already-established natural enemies were rated as either none, rare, or scarce when the plot was started, over 85% recoveries were obtained; if, however, already-established natural enemies were rated as being common or abundant, then less than 40% recoveries were obtained.

Regardless of the proportion of recoveries from plots in the various areas, if a newly introduced species of *Aphytis* has significant biological advantages over an established species, such as a higher reproductive capacity and a better tolerance to temperature extremes, the new species should supplant the old one sooner or later and the result should be an increase in the amount of natural mortality of the red scale. If a new *Aphytis* proved to be especially well adapted, good biological control could result because *Aphytis*, of one species or another, seem to be principally responsible for the biological control of the California red scale in much of the Orient, as well as in favorable parts of southern California and other parts of the world with similar climates.

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