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Resistance of Lygus Bugs in Seed Alfalfa to toxicity of toxaphene

In parts of the alfalfa seed producing areas in the southern San Joaquin and Sacramento valleys, toxaphene has lost some of its original toxicity to lygus bugs. Where such toxicity loss occurs, toxaphene applied early in the year generally provides satisfactory control, but when applied late in the season control of the lygus bugs is poor.

Trials to re-evaluate toxaphene and to test a number of other insecticides for lygus bug control in seed alfalfa were conducted in Kern County during June and July, 1959.

The first experiment was designed in two parts to compare the effectiveness of toxaphene in spray and in dust applications and to evaluate repeated sprays of Dylox, Phosdrin, and toxaphene. On June 8, one half of a 40-acre field near Arvin was treated with 10% toxaphene-50% sulfur dust applied at 30 pounds per acre by aircraft and the other half treated, also by aircraft, with toxaphene at 3.0 pounds of toxicant in 10 gallons of spray per acre.

Pre-treatment counts showed that the numbers of lygus bugs in the field were low at the beginning of the experiment. Post-treatment counts revealed little difference between the toxaphene spray and dust, as both formulations controlled the pests for approximately 15 days. Beyond 15 days the toxaphene-sulfur dust lost its effectiveness more rapidly than did the spray.

After the first treatments had lost their effectiveness, the field was redivided in the opposite direction into three equal plots. Sprays of Phosdrin, toxaphene and Dylox were applied to the three plots on July 6 and on July 16. All of the sprays were applied in the late afternoon by aircraft at the rate of 10 gallons of spray per acre.

The results with Phosdrin and Dylox sprays applied on July 6 to the redivided field were similar to those of trials in 1958. These insecticides caused a rapid initial kill of both adults and nymphs but within 10 days after treating, populations of newly hatched nymphs exceeded pre-treatment levels. Second applications of Phosdrin and Dylox on July 16 gave approximately the same results as the first treatments, with nymph populations increasing rapidly 11 days after treatment. The toxaphene sprays in the July 16 test did not result in as good control as obtained in the July 6 test. At the end of 10 and 11 days the total lygus count was approximately the same as the pre-treatment count. Toxaphene did not greatly affect the adult lygus bugs, which largely accounted for the population increase. Nymphs were never eliminated from the plots, but it appeared that control of young nymphs was better than the control of the older nymphs.

In the second experiment conducted near Edison, a larger number of materials were tested alone or in combination on individual plots that were four acres in area. Toxaphene at 4.0 pounds per acre, endrin at 0.4 pound, malathion at 1.0 pound, methyl trithion at 1.0 pound, Dimethoate at 0.5 pound, and Phosphamidon at 0.5 pound were used separately. Toxaphene at 3.0 pounds per acre was combined with Dylox at 1.0 pound, with Phosdrin at 0.5 pound, and with Volck Supreme oil at 2.0 quarts per acre. A mixture of 1.0 pound DDT and 1.0 pound of Dylox was also included. The

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Comparison of Toxaphene Spray and Dust Applications by Aircraft to Control Lygus Bugs in Seed Alfalfa.
(First part of experiment 1. Arvin, 1959)

Insecticide*	Toxicant per acre lbs.	Life stage	Average number Lygus Buds per sweep								
			Pre-treat. 6/8/59	Post-treatment—Days							
				1	2	3	5	8	15	24	28
Toxaphene E.C.	3.0	Adult	0.8	0.5	0.3	0.1	0.3	0.4	0.5	2.2	3.4
		Nymph	2.1	1.0	0.6	0.3	0.5	0.3	1.1	6.4	9.9
		Total	2.9	1.5	0.9	0.4	0.8	0.7	1.6	8.6	13.3
Dust Toxaphene 10% Sulphur 50%	3.0	Adult	0.9	0.6	0.3	0.3	0.3	0.3	0.4	2.2	....
		Nymph	2.8	1.2	0.9	0.4	0.2	0.4	2.3	10.8	....
		Total	3.7	1.8	1.2	0.7	0.5	0.7	2.7	13.0	....

* E.C. applied in 10 gallons of spray per acre, dust applied at rate of 30 lbs. per acre on June 8, 1959, 6:30–7:15 p.m.

Results wth Sprays Applied by Aircraft to Control Lygus Bugs in Seed Alfalfa
(Second part of experiment 1. Arvin, 1959)

Insecticide*	Toxicant per acre lbs.	Life stage	Average number Lygus Bugs per sweep									
			Pre-treat. 7/6/59	Post-treatment—Days								
				1	2	3	4	7	10		4	11
Phosdrin E.C.	0.5	Adult	5.3	0.05	0.3	0.3	0.7	2.2	1.7		0.3	1.3
		Nymph	12.9	0.5	0.4	0.5	1.4	13.1	15.8		1.2	20.5
		Total	18.2	0.6	0.7	0.8	2.1	15.3	17.5		1.5	21.8
Toxaphene E.C.	3.0	Adult	1.9	1.1	0.7	1.1	0.8	2.6	5.9	Second Application July 16	4.0	4.1
		Nymph	8.3	6.6	3.9	5.9	6.3	6.6	4.6		2.5	2.5
		Total	10.2	7.7	4.6	7.0	7.1	9.2	10.5		6.5	6.6
Dylox Sol. Powd.	1.0	Adult	2.9	0.3	0.2	0.3	0.3	1.2	1.4		0.4	3.1
		Nymph	8.6	0.3	0.3	0.2	0.6	6.8	25.3		0.3	16.3
		Total	11.5	0.6	0.5	0.5	0.9	8.0	26.7		0.7	19.4

* Insecticides applied as sprays at 10 gallons per acre on July 6 (7:00–8:10 p.m.) and July 16 (6:30–7:30 p.m.)

LYGUS BUGS

Continued from preceding page

materials were formulated as emulsions except Dylox which was an 80% soluble powder. Treatments were applied as sprays by aircraft at the rate of 10 gallons of spray per acre and, as in the first experiment, all applications were made in the late afternoon.

Pre- and post-treatment counts of lygus bugs were made with a standard 15″ diameter insect sweeping net. On each sampling date a series of samples, each consisting of two sweeps, was made in each plot. The number of such samples ranged from five to 25 per plot, depending upon the particular experiment. Nymphs and adults were recorded separately.

Dimethoate, a new experimental insecticide that is not yet registered for use in alfalfa seed fields, appears to have a relatively long residual activity against both adults and nymphs. It is not known whether the toxicity of Dimethoate is due to systemic action or to contact effect, but it was the most effective of the materials tested in the second experiment, near Edison. Both adults and nymphs were controlled within 24 hours and the Dimethoate was still highly effective at the end of 14 days. Malathion, methyl trithion and Phosphamidon also reduced initial populations quickly but lost their effectiveness within 7–11 days. Combinations of toxaphene with Dylox and DDT with Dylox produced good initial kills but resulted in nymph increases over pretreatment levels within 11 days. The toxaphene-Phosdrin combination behaved similarly. However, it appeared to have a slightly longer residual activity against the nymphs. Endrin gave effective control for about 11 days.

The addition of Volck Supreme oil to the toxaphene spray appeared to improve initial kills, but the residual action of this combination was no better, if as good, as toxaphene alone.

The results of the third experiment, near Wheeler Ridge, indicated that 4.0 pounds of toxaphene per acre plus oil was slightly more effective than 3.0 pounds per acre with oil. Toxaphene without oil was not included in this test. Observations of straight toxaphene applied to other parts of the field indicated that the addition of oil did not greatly increase its effectiveness. There were some indications that the toxaphene with oil may have resulted in slight injury to the alfalfa.

Data obtained in all of these experiments confirm earlier observations that toxaphene does not always provide adequate control of lygus bugs in alfalfa seed fields. It is more effective in early season applications and becomes less so as the season advances. Toxaphene in combination with Phosdrin or Dylox produced initial reductions in lygus populations which were similar to those obtained with Phosdrin or Dylox alone. There were, however, indications that nymphs did not increase quite as rapidly when a toxaphene-Phosdrin combination was used. This was undoubtedly due to the longer residual activity of toxaphene against newly hatched nymphs.

Despite the fact that toxaphene tends to lose some of its effectiveness in late season applications, it is still the preferred material for lygus bug control in alfalfa seed. While toxaphene may not produce more than 50%–60% reduction of lygus populations, it tends to hold down the numbers of nymphs after it is applied. Increases in dosage from 3.0 pounds to 4.0 pounds of toxaphene per acre appear to improve control.

Certain of the organo-phosphorus compounds such as Phosdrin, Dylox, malathion, and Phosphamidon result in rapid initial kill of lygus bugs. They do not kill the eggs, nor do they remain active long enough to kill nymphs that hatch after treatment. Furthermore, these materials are highly toxic to natural enemies of lygus bugs. The latter increase rapidly in the absence of their predators.

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Comparison of Several Insecticides to Control Lygus Bugs in Seed Alfalfa
Edison, 1959

Insecticide*	Toxicant per acre lbs.	Life stage	Average number of Lygus Bugs per sweep					
			Pre-treat. 7/8/59	Post-treatment—Days				
				1	4	7	11	14
Toxaphene	4.0	Adults	0.7	0.3	0.6	1.0	0.9	1.0
		Nymphs	4.0	3.0	1.1	0.7	3.0	7.1
		Total	4.7	3.3	1.7	1.7	3.9	8.1
Toxaphene	3.0	Adults	1.8	0.0	0.8	1.4	2.3	....
Volck Supreme Oil	2 qts.	Nymphs	5.6	1.8	0.5	1.8	9.2	....
		Total	7.4	1.8	1.3	3.2	11.5	....
Endrin	0.4	Adults	2.2	0.3	0.6	0.8	0.9	1.0
		Nymphs	15.1	0.5	0.1	1.1	6.4	12.5
		Total	17.3	0.8	0.7	1.9	7.3	13.5
Toxaphene	3.0	Adults	0.6	0.1	0.6	0.8	1.2	....
Dylox	1.0	Nymphs	4.0	0.3	0.0	1.2	5.2	....
		Total	4.6	0.4	0.6	2.0	6.4	....
Toxaphene	3.0	Adults	1.5	0.0	0.3	0.9	0.9	1.8
Phosdrin	0.5	Nymphs	6.3	0.1	0.0	0.9	4.0	4.4
		Total	7.8	0.1	0.3	1.8	4.9	6.2
DDT	1.0	Adults	1.6	0.0	0.4	0.8	0.7	....
Dylox	1.0	Nymphs	4.8	0.4	0.1	3.1	20.0	....
		Total	6.4	0.4	0.5	3.9	20.7	....
Malathion	1.0	Adults	1.4	0.0	0.3	0.6	0.7	....
		Nymphs	5.1	0.0	0.2	3.4	10.7	....
		Total	6.5	0.0	0.5	4.0	11.4	....
Methyl trithion	1.0	Adults	1.3	0.0	0.6	0.2	0.4	....
		Nymphs	5.3	1.5	0.1	3.3	13.6	....
		Total	6.6	1.5	0.7	3.5	14.0	....
Dimethoate	0.5	Adults	2.3	0.0	0.1	0.0	0.3	0.2
		Nymphs	5.9	0.1	0.0	0.8	1.3	1.7
		Total	8.2	0.1	0.1	0.8	1.6	1.9
Phosphamidon	0.5	Adults	1.0	0.0	0.3	0.3	0.5	....
		Nymphs	5.2	0.6	0.0	1.9	6.8	....
		Total	6.2	0.6	0.3	2.2	7.3	....

* Insecticides applied as sprays by air at rate of 10 gallons per acre on July 9, 1959, 5:40–7:30 p.m.