Field Insecticide Tests Against the Beet Leafhopper in Sugar Beets Grown for Seed

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CURLY TOP, a virus disease transmitted by the beet leafhopper (*Eutettix tenellus* (Bak.)), has been recognized as a major problem in the production of beet seed in Arizona and New Mexico. Losses are attributable to fall movements of the leafhopper from desert breeding areas to seed-beet fields and are manifested as reductions in seed yield. These movements occur principally in late September and early October, when the beets are small and highly susceptible to curly top. In 1943 Romney (1) described methods of controlling the beet leafhopper. The control was dependent upon the use of insecticides until sufficient foliage covered the ground to create an unfavorable environment for the leafhoppers. At the time this work was published the only satisfactory insecticide known for this insect was an atomized pyrethrum-in-oil spray. This insecticide reduced leafhopper populations at the time of application but had no residual effect; therefore, if additional movements of the leafhoppers occurred after spraying, a second treatment was necessary. The pyrethrum-in-oil also had to be applied with special equipment. For these reasons DDT and other insecticides were tested in the field from 1944 to 1947 with the hope of finding one that would not only give good initial kill but would remain active in the field long enough to avoid the necessity of repeated applications with each leafhopper influx into seed beet fields.

These studies were not conducted as critical experiments but consisted of cooperative field tests in which insecticides were applied with commercial equipment to several acres on different farms. Leafhopper counts were made before and after treatment and, wherever possible, the numbers of leafhoppers remaining in the treated areas were compared with the numbers in adjacent untreated areas. The populations were determined by means of a counting cage (2), that encloses approximately 1 foot of row, the samples being taken at random. The same number of samples per treatment was taken to evaluate comparative treatments on a given date, but the number of samples taken per treatment on different dates or in different fields ranged from 20 to 100, depending upon the magnitude and distribution of the insect population. From 1944 to 1947 the beet-seed-producing district in the vicinity of Safford, Ariz., was subjected to heavier influxes of the beet leafhopper than were the other districts in the Southwest. Therefore, most of the tests were made in this district.

The pyrethrum-in-oil spray contained 0.08 percent of pyrethrins; it was prepared by diluting pyrethrum extract with a mixture of 1 part of

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white oil to 2 parts of kerosene. The pyrethrum-sulfur dust contained 0.2 percent of pyrethrins and 50 percent of sulfur. This dust was prepared by diluting a proprietary pyrethrum-extract dust (2.0 percent of pyrethrins) with pyrophyllite and sulfur. All the DDT and chlorinated camphene dusts were diluted with pyrophyllite, except where sulfur was included. The DDT-oil sprays contained a non-burning petroleum oil as the carrier. The DDT water sprays were emulsions or suspensions made from commercial emulsion concentrates or wettable powders, respectively, the contents other than DDT being unknown.

Tests in 1944

In 1944 tests involving four insecticidal dusts in addition to the recommended pyrethrum-in-oil spray were conducted in two fields in the Safford district. Field 1 consisted of approximately 40 acres, and the tests were made in strip plots of 2 to 5 acres each. All the materials were in dust or powder form, and applications were made by airplane at the rate of approximately 40 pounds of the dust mixture per acre. The materials used and the results are given in table 1. These data indicate that after 1 day no reduction in leafhopper populations could be attributed to the dithiocyanate dust. In the plot treated with sabadilla the decrease in populations was about 37 percent, whereas in the DDT plot it was approximately 87 percent. The 3-day count indicated that there were additional influxes of leafhoppers into the test fields 1 to 3 days after treatment and that only DDT was effective for as long as 3 days. From 8 to 10 days after treatment excessively heavy rains flooded the field, but even under these conditions after 13 days the DDT-treated portion of the field contained only about half as many leafhoppers per foot of row as the untreated check.

Field 2 consisted of approximately 90 acres of seed beets. DDT and sabadilla dusts were tested in different concentrations and the results compared with a pyrethrum-sulfur dust as well as with the recommended pyrethrum-in-oil spray. Except for the pyrethrum-in-oil spray, all the insecticides were applied by airplane to plots approximately 5 acres in size. An attempt was made to apply the treatments at a uniform rate per acre, but differences in the physical qualities of the dusts prevented uniform coverage. The results of these tests are given in table 2. The plots sampled 1 day after treatment showed poor results. After the 1-day count the untreated plot was treated commercially and was thus rendered unsuitable for use as a check. Since the counts after 1 and 2 days indicated that the sabadilla and pyrethrum-sulfur dusts had been ineffective, these plots were also treated commercially. Fair results were obtained with the DDT and pyrethrum-in-oil 2 days after treatment, and 1 week after treatment the mean reduction in the leafhopper population for the three DDT plots was 86 percent as compared with 74 percent for the pyrethrum-in-oil plot.

Table 1. Field tests of insecticidal dusts against the beet leafhopper in sugar beets grown for seed. Field 1, Safford, Arizona, 1944.

Treatment (Figures indicate percent)	Dosage of active ingredients (pounds per acre)	Mean number of beet leafhoppers per foot of row			
		Before treatment	After treatment		
			1 day	3 days	13 days
DDT 5	2.0	0.64	0.08	0.60	0.47
Beta, beta'-dithiocyanodiethyl ether [1]	1.2	0.68	0.64	---	---
Sabadilla 5[1]	2.0	0.60	0.38	1.32	---
Untreated check	---	0.80	0.70	1.20	0.80

[1]Proprietary product.

Table 2. Field insecticide tests against the beet leafhopper in sugar beets grown for seed. Field 2, Safford, Arizona, 1944.

Treatment (Figures indicate percent)	Dosage of active ingredients (pounds per acre)	Mean number of beet leafhoppers per foot of row			
		Before treatment	After treatment		
			1 day	3 days	13 days
Dusts:					
DDT 5	1.0	0.76	0.36	0.28	0.10
2.5	0.6	0.76	---	0.15	0.12
2.5 plus sulfur 75	0.9	0.76	---	0.15	0.10
Sabadilla 20[1]	5.7	0.76	0.46	0.90	---
10	2.0	0.76	0.80	0.85	---
5	1.7	0.76	0.50	1.00	---
Pyrethrum-sulfur (pyrethins 0.2, sulfur 50)	0.06	0.76	0.66	---	---
Spray: Pyrethrum-in-oil (pyrethrins 0.08)	0.03	0.76	---	0.16	0.20
Untreated check	---	0.76	0.70	---	---

[1]Proprietary mixture. For lower concentrations this material was diluted with pyrophyllite.

Since the DDT dusts were effective against the beet leafhopper (tables 1 and 2), a third field of approximately 15 acres was dusted commercially, by airplane, with DDT on October 9. Leafhopper-population studies in other fields in the same locality indicated that additional movements of the insects into the fields under observation had occurred from October 10 to 12. Only a 4-percent DDT dust was available, and 480 pounds were applied to this 15-acre field (1.28 pounds of actual DDT per acre). Beet leafhopper counts showed reductions of 56, 70, 42, and 80 percent of the original populations 1, 2, 3, and 9 days after treatment, respectively, in spite of the additional movements of the leafhopper into the test field.

Tests in 1945

In the spring of 1945 losses due to curly top in seed beets in the Safford district were heavy as a result of continued leafhopper movements in the fall of 1944. Growers and others interested in the problem observed that the fields treated with DDT in the fall of 1944 contained less curly top than those that had been treated with the recommended pyrethrum-in-oil spray. Therefore, in the fall of 1945 most of the fields in the Safford district were treated with a 5-percent DDT dust applied from an airplane at approximately 30 pounds (1.5 pounds of DDT) per acre. The results in most cases were fairly good, although the reductions were not so great as expected. The beet leafhopper populations in five fields considered to be representative of the Safford district remained at a comparatively low level 10 to 12 days after dusting, the mean number per foot of row ranging from 0.10 to 0.33 as compared with 0.40 to 1.13 before treatment.

In addition to this check on commercial applications of a 5-percent DDT dust, strip plots of approximately 5 acres each were laid out in one 75-acre field of seed beets for the purpose of testing the comparative effectiveness of the recommended pyrethrum-in-oil spray, two DDT-oil sprays, and a 5-percent DDT dust. Both the DDT-oil sprays and the pyrethrum-in-oil spray were applied with a tractor-mounted atomizer sprayer used commercially for leafhopper control; the DDT dust was applied by airplane. The results of these tests, which are given in table 3, show that DDT, either as a dust or as a spray, is at least as good as a pyrethrum-in-oil spray.

Table 3.—Field insecticide tests against the beet leafhopper in sugar beets grown for seed. Safford, Arizona, 1945.

Treatment (Figures indicate percent)	Dosage of active ingredient (pounds per acre)	Mean number of beet leafhopper per foot of row		
		Before treatment	After treatment	
			1 day	9-12 days
Dust: DDT 5	1.5	0.56	- -	0.15
Sprays in oil:				
DDT 2.4	1.7	0.56	0.03	0.05
	1.5	0.56	0.05	0.20
Pyrethrum (pyrethrins 0.08)	0.04	0.56	0.10	0.20

In the fall of 1945 beet leafhopper populations became high enough to justify treatment in a few fields in the Salt River Valley, Arizona. Five of these fields were dusted with 5-percent DDT by airplane at the rate of 30 pounds of dust per acre. In these fields the mean number of leafhoppers per foot of row ranged from 0.0 to 0.13 three to ten days after treatment as compared with 0.50 to 0.70 before treatment. Leafhoppers also became fairly numerous in small plots planted primarily for *Lygus* control experiments. Therefore, the same treatment was applied to these plots with hand dusters. Three to 10 days after treatment there was 0.04 leafhopper per foot of row as compared with 0.75 before treatment.

Tests in 1946

Beet leafhopper populations in the Safford district were again high during the fall of 1946, and considerable dusting was done with 5-percent DDT from airplanes at the rate of 30 pounds (1.5 pounds of DDT) per acre. Population counts were taken in a number of the fields to determine the effectiveness of the control program. In many fields the control was unsatisfactory and tests were made with heavier dosages of DDT. The results of these heavier applications were good and many fields were redusted with either 10-percent DDT at 30 pounds (3 pounds of DDT) per acre or 5-percent DDT at 40 pounds (2 pounds of DDT) per acre. Leafhopper counts were taken in representative fields 2 to 5 days after treatment. Excellent results were obtained with both treatments. The mean numbers of beet leafhoppers per foot of row were as follows:

Before treatment	After treatment
5-percent DDT	
0.81	0.05
0.60	0.20
0.60	0.00
.....	0.00
10-percent DDT	
1.20	0.00
.....	0.00
.....	0.05
1.26	0.00

Tests in 1947

Equipment for applying concentrated liquid insecticides from airplanes had been greatly improved by the fall of 1947, and tests were made against the beet leafhopper to compare the effectiveness of DDT dusts and sprays applied from airplanes and DDT dusts applied with ground equipment. Similar tests were made to compare chlorinated camphene and DDT. Strip plots ranging in size from 3 to 6 acres were marked off in five fields. Table 4 indicates that good results were obtained with all the treatments and that there was little or no difference between sprays and dusts.

Table 4.—Field insecticide tests against the beet leafhopper in sugar beets grown for seed, Safford, Arizona, 1947.

Field	Insecticide (Figures in percent)	Type of application		Dosage of active ingredients (pounds per acre)	Mean number of beet leafhoppers per foot of row			
		Form	Equipment		Before treatment	After treatment		
						1 day	3-5 days	10-15 days
1	DDT 10	Dust	Airplane	3.0	0.99	0.17	0.10	0.04
			Ground	2.0	0.99	---	0.12	0.08
	4.5	Oil spray	Airplane	2.0	0.99	0.04	0.47	0.02
	Check (untreated)	---	---	---	0.99	0.73	1.43	---
2	DDT 10	Dust	Ground	2.0	1.18	0.07	0.24	0.05
	4.5	Oil spray	Airplane	1.7	1.18	0.13	0.97	0.26
	Chlorinated camphene 5	Dust	Ground	1.0	1.18	0.03	0.86	0.12
	Check (untreated)	---	---	---	---	---	1.03	---
3	DDT 10	Dust	Airplane	3.0	0.77	---	0.24	0.04
	4	Water spray (emulsion)	Airplane	2.5	0.77	0.27	---	0.00
	Chlorinated camphene 5	Dust	Airplane	5.8	0.77	0.67	---	0.04
4	DDT 10	Dust	Airplane	3.0	---	---	0.22	0.02
	Chlorinated camphene 5	Dust	Airplane	1.0	---	---	0.24	0.12
5	DDT 4.5	Oil spray	Airplane	3.3	0.95	---	0.04	---
		Water spray (suspension)	Airplane	3.5	0.95	---	0.08	---
	Check (untreated)	---	---	---	0.95	---	0.62	---
6	Untreated	---	---	---	---	---	0.88	---
7	Untreated	---	---	---	---	---	0.97	---

In fields 1 and 2 additional influxes of leafhoppers are indicated after the 1-day population counts. Later counts, however, indicate that both DDT and chlorinated camphene remained sufficiently active to reduce leafhopper numbers to a low level. The untreated areas in fields 1 and 2 were later treated commercially with DDT dust; therefore, checks on leafhopper numbers in untreated areas in these fields were not possible. Fields 6 and 7 were curly-top-resistant varieties and were, therefore, left untreated. Comparison of leafhopper numbers in these fields with numbers in the treated plots gives further evidence of the value of the various treatments.

Summary

Field insecticide tests against the beet leafhopper (*Eutettix tenellus* (Bak.) in sugar beets grown for seed have been conducted for 4 consecutive years in Arizona. Materials tested included DDT dusts and sprays, pyrethrum dusts and sprays, chlorinated camphene dusts and sprays, sabadilla dusts, and dithiocyanate dusts. Some tests were also made to compare the efficiency of applications by airplanes with those by ground equipment. These tests indicate that DDT applied at the rate of 2 to 3 pounds per acre will give as good initial kill as the recommended pyrethrum-in-oil spray, and that the residual effect is sufficient to hold leafhopper populations at a low level for at least 1 to 2 weeks after application. The tests also indicate that good results can be obtained with either dusts or sprays containing DDT, and that applications may be made either with power-driven ground equipment or with airplanes. Limited tests in 1947 also indicated that chlorinated camphene may be an effective insecticide against the beet leafhopper.

Literature Cited

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