Field tests for control of

Grape Leafhoppers

resistant to insecticides

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The grape leafhopper in San Joaquin Valley vineyards has developed resistance to DDT, to malathion, and to Sevin. Resistance problems are most severe in the Orange Cove area, and extend beyond Orosi and Dinuba in Tulare County and beyond Reedley in Fresno County.

The standard value for satisfactory control in field tests is at least 98% reduction of grape leafhoppers in the nymphal stage. Neither Trithion nor Sevin gave satisfactory control at Orange Cove in 1959. Control of adult leafhoppers was less satisfactory than control of nymphs. In laboratory tests with field-collected adult leafhoppers, it took about seven times as great a concentration of Sevin to kill adult leafhoppers from Orange Cove as to kill a comparable percentage of those from Sanger.

Nymphs collected in the spring of 1961 from Orange Cove and others from a Kings County vineyard, where little or no insecticide had been applied for several years, were maintained separately on caged vines in the greenhouse at Davis. The second broods of adults produced were used in laboratory tests. From 20 to 60 insects from each source were treated with five different concentrations of Sevin. At each concentration tested, the leafhoppers from Orange Cove showed the lower percentage of kill 24 hours after treatment. The various treatments killed 1.9% to 32.7% of the insects from Orange Cove and 15.8% to 73.8% of those from Kings County. These results give a strong indication that resistance may account for the poor control in the field at Orange Cove.

The table gives details of those 1960 treatments in the Orange Cove area that gave 98% or greater reduction of grape leafhopper nymphs within 5–14 days after application.

A Sevin-Trithion-DDT spray, applied on May 14, gave 100% reduction of nymphs and a Sevin-Trithion spray gave more than 99.9% reduction. At the concentrations used, Trithion alone was better than Sevin alone. Delnav and Diazinon emulsifiable concentrates and Diazinon wettable powder gave less than 98% control. In dust form, neither Trithion nor Sevin-Trithion was satisfactory, but Sevin-Trithion-DDT dust gave 99.7% control.

Of the sprays applied on May 16–17, ethion, Thiodan, dimethoate—1 pint in

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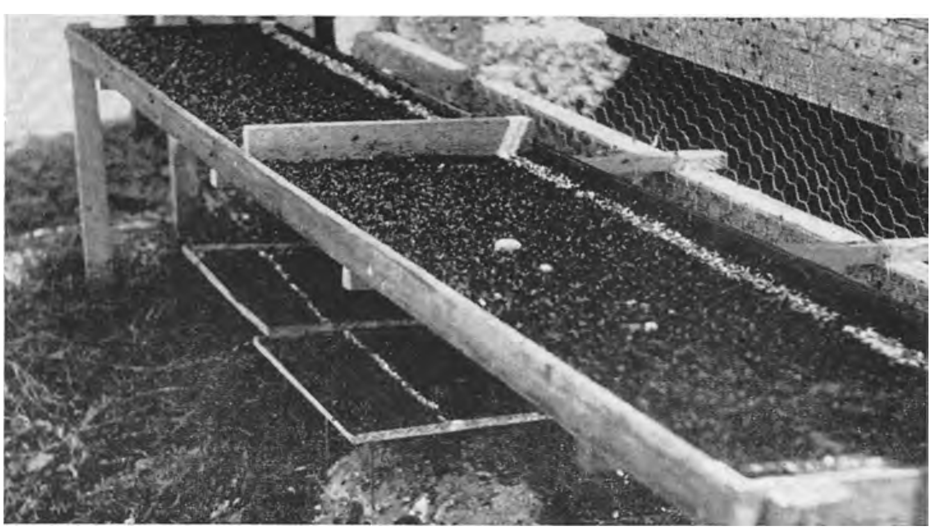
the reduction of larvae was greatest, the numbers of lesser house fly larvae recovered ranged from 7% to 21% of the numbers recovered from unsprayed droppings. Larvae of the common house fly were found in the unsprayed droppings, but they were less numerous than larvae of the lesser house fly. No live house fly larvae were found in the sprayed droppings.

A drainage ditch from the watering troughs of the poultry buildings, used for drinking purposes by the flies, was heavily infested with mosquito larvae and pupae. This ditch was sprayed with Dibrom 4 E at the same concentration as was used in the chicken buildings. Adult mosquitoes and flies flying above the water or resting in clumps of tumbleweed were knocked down in seconds after spraying, and none revived. The water surface of the ditch was covered with dead flies, and the water in the ditch was completely free from mosquito larvae and pupae 18 hours after the water surface was sprayed. In addition, thousands of dead rat-tail maggots were found on the surface of the water.

Federal registration permits using Dibrom 4 E as a space spray and as a wet or dry sugar bait for control of house flies, lesser house flies, mosquitoes, gnats, and fruit flies in and around dairy and livestock barns, pig pens, poultry houses, cider mills, wineries and other processing plants.

Dead house flies in sugar-Dibrom baited trays placed opposite a molasses barrel at one end of a corral. *Upper trays*—wet bait; *lower trays*—dry bait. Chicken wire on fence is to prevent cattle from reaching bait.



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100 gallons of water—and Sevin, with or without piperonyl butoxide, gave commercially acceptable control. Bayer 29493 and Trithion gave reductions of 96% to 91%. DDT, parathion, malathion, dimethoate—½ pint—and Guthion all gave poor control.

Among sprays applied May 19, only Thiodan gave good control. Sprays of Dibrom, Sevin plus Trithion, and Sevin plus piperonyl butoxide showed nymph reductions of from 96.9% to 95.6%. Less effective were sprays of Bayer 29493, Systox, dimethoate, Diazinon, Sevin, Guthion, and Sevin plus Tedion. The numbers of nymphs in untreated plots increased more than 70%.

Of the dusts applied on May 20, only Thiodan gave acceptable control, but 5% Sevin dust was nearly as effective. Dusts of Phosdrin, Diazinon, and Diazinon plus DDT were much less effective. Nymphs increased 78% in the check plot.

The dusts applied on June 1 did not receive a critical test, because most unkilled nymphs were turning into adults during the period between treatment and observation. All dusted plots showed more than 96% reduction of nymphs. Only three of the dusts—Sevin plus malathion, Sevin plus parathion, and Sevin 3% plus Trithion 2%—failed to give good control.

Control of second- or third-brood nymphs was attempted in three tests. None of the materials or combinations applied on July 7 gave satisfactory control. A Trithion-Sevin combination caused the greatest reduction. The short residual materials Phosdrin and Dibrom gave good initial reductions but failed to control the nymphs that hatched during the six days between the treatment and the first count.

A larger number of insecticides were tested as dusts on July 14, and the nymphs were counted only once—five days after treatment. The control probably appeared much better than a later count would have indicated. The count on July 19 showed 98% control or better following dimethoate, Phosdrin with Trithion, Dibrom with Trithion, Trithion-Sevin-DDT, and ethion-Sevin. Treatments giving 90% to 95% reduction were: Phosdrin, Dibrom, Sevin, and pyrethrin plus Sevin plus piperonyl butoxide. Still less effective were Diazinon, pyrethrin plus piperonyl butoxide, and Diazinon plus DDT.

Of the dust treatments applied on August 18, only a Trithion-Sevin combination gave good control. Dibrom-Sevin, Sevin-pyrethrum-piperonyl butoxide, Phosdrin-Sevin, and ethion-Sevin showed 96%–100% reductions one week after treatment, but the reductions dropped to 73%–93% after the second week.

Treatments Showing 98%–100% Reduction of Grape Leafhopper Nymphs
Orange Cove area, 1960

Date applied	No. of days before count	Materials applied per 100 gallons of water, for sprays, or % in dust	Active material per acre, pounds	No. of nymphs per leaf	Reduction of nymphs %*
May 14	7	Sevin 50W, 1 lb.; Trithion 4 Fl.**, ½ pt.; DDT 50W, 2 lbs. Spray	3.9	0.00	100.0
		Sevin 50W, 1 lb.; Trithion 4 Fl., ½ pt. Spray	1.7	0.07	99.9+
		Trithion 4 Fl., ¾ pt. Spray	0.9	0.38	99.8
		Sevin 50W, 1½ lbs. Spray	1.7	2.00	99.0
May 14	12	Sevin 5%; Trithion 3%; DDT 10%. Dust	4.5	0.01	99.7
May 16–17	14–15	Ethion 25W, 2 lbs. Spray	1.1	0.00	100.0
		Sevin 50W, 1 lb.; Piperonyl butoxide, 2½ lbs. Spray	6.5	0.35	99.0
		Thiodan 2 EC, 1 qt. Spray	1.1	1.20	98.0
		Dimethoate 4 EC, 1 pt. Spray	1.1	1.20	97.7
		Sevin 50W, 1 lb. Spray	1.1	1.30	98.0
May 19	6	Thiodan 2 EC, 1 qt. Spray	1.0	1.30	98.4
May 20	6	Thiodan 3%. Dust	0.8	0.38	97.9
June 1	7	Sevin 5%; Trithion 3%. Dust	2.2	0.00	100.0
		Sevin 3%; Ethion 2%. Dust	1.1	0.05	99.9
		Sevin 3%; Piperonyl butoxide 2%. Dust	2.7	0.45	99.2
		Sevin 5%; Trithion 3%; DDT 10%. Dust	4.5	0.15	99.7
July 14	5	Phosdrin 2%; Trithion 3%. Dust	1.6	0.02	99.8
		Sevin 2.5%; Trithion 1.5%; DDT 5%. Dust	3.2	0.05	99.6
		Dibrom 2%; Trithion 3%. Dust	1.6	0.08	99.3
		Ethion 2%; Sevin 3%. Dust	1.5	0.10	99.1
		Dimethoate 2%. Dust	0.7	0.25	97.8
Aug. 18	14	Sevin .5%; Trithion 3%. Dust	2.4	0.03	99.9+
Sept. 23	7	Guthion 5%. Dust	1.0	0.90	98.0
		Sevin 5%; Trithion 3%. Dust	2.7	0.37	98.8

* Reduction from untreated check leaves.
** Trithion flowable emulsion, 4 lbs. per gallon.

In the last trial of the season, September 23, Sevin-Trithion dust was compared to Guthion dust. Although Guthion gave poor control when applied as a spray against first brood nymphs, it did nearly as well as Sevin-Trithion in the September dust test.

In the 1960 field tests, application of a single insecticide—with the possible exception of Ethion spray and Thiodan spray or dust—failed to give commercial control.

Phosdrin and Dibrom, which have short residual action, did not give outstanding control. In these trials, it required two applications to reduce the leafhopper population, because eggs continued hatching almost immediately after treatment.

The best of the combinations tested were those containing more than one of the most effective residual materials. Addition of a material such as Phosdrin or Dibrom, with short residual action, to materials like Sevin or Trithion, with long residual action, enhanced the immediate kill but did not control leafhoppers that hatched later. Combinations of such materials as DDT and Diazinon failed to increase control very much.

The comparative effectiveness of different insecticides depends on many factors, including formulation, dosage, method and time of application. The most favorable time to apply insecticides for leafhopper control in the Fresno area is late May or early June, after all eggs have hatched but before any of the newly matured adults have laid eggs. Many of the materials or combinations of materials are not registered for commercial use on grapes.

Because of severe resistance problems in the Orange Cove area, the performance of insecticides was unpredictable. Even the most effective materials—if they were tested several times—failed at least once to give good commercial control.

The resistance problems with leafhoppers and the increasingly serious pest infestations in grapes are due partly, at least, to the extensive use of chemicals for control of the various grape pests. Investigations on other possible methods of control are planned for 1961.

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