Beet Leafhopper Control With DDT Vapor Sprays

L. G. SMITH[1, 2]

VAPOR SPRAYS have been in use for several years (1)[3]. However, their use until recently, was confined to the control of a relatively few insects and it appears desirable at this time to give a brief description of vapor sprays as referred to in this paper. First of all, they are concentrated sprays, inasmuch as they are applied at only a few gallons per acre. The insecticide or fungicide is dissolved or suspended in a highly refined petroleum oil or in admixture with water. Application is made by means of special vaporizers which break up the material into fine droplets and then project these droplets into a stream of air moving at high velocity. This stream of rapidly moving air, in which the droplets are suspended, swirls about the plants and deposits the toxicant on insects, foliage and stems. As the droplets contact the plants they spread out forming an even film over the surface.

Vapor sprays have received their greatest impetus during the past 2 years from the improvement of airplane application equipment and the development of new chemicals which are effective at low concentrations. A number of advantages may be claimed for vapor sprays: First, because of their concentrated form, considerably less material is handled than when highly diluted liquid sprays are employed. Second, when applied by airplane the droplets settle more rapidly than dusts, thus confining the insecticide application to the field treated. Third, because of their density, applications can be made during periods when moderate winds prevail, a factor which greatly restricts dust application.

Vapor sprays are now used commercially for control of certain insects and plant diseases on practically every crop. They are also used for pre-emergence and selective weedling of a number of crops and in the control of pre-harvest fruit drop on apples and pears. When DDT was made available for field testing in 1945, Shell Oil Company, Incorporated, carried out extensive experiments with DDT vapor sprays for the control of grape leafhopper in the San Joaquin Valley of California. The residual toxicity of DDT vapor sprays was clearly demonstrated by the fact that one application of vapor spray containing 2.4 percent DDT at 5 gallons per acre, applied before blossoming, resulted in outstanding control of grape leafhopper, *Erythroneura elegantula* (Osborn), for an entire season (3).

[1]Entomologist, Shell Oil Company, Incorporated, San Francisco, California.

[2]The writer acknowledges with thanks the assistance given by G. P. Wright, Spreckels Sugar Company; William Lewis, Agricultural Commissioners Office, Monterey County; E. A. Schwing, Entomologist, California Sugar Beet Processors.

[3]Numbers in parentheses refer to literature cited.

Tests in 1946

Among the first projects undertaken by the Shell Agricultural Laboratory at Modesto, California, following its opening in 1946, was one on control of insect vectors which transmit virus diseases of plants. Under this project, preliminary field experiments on control of the beet leafhopper, *Eutettix tenellus* (Bak.), were carried out and it was found that an extra light, highly refined petroleum oil containing 2.4 percent DDT by weight (Shell Vapona 1D) applied at the rate of 5 gallons per acre with a Johnston vapor machine gave a high initial kill, but the residual toxicity could not be depended upon for more than 1 week. Approximately 200 acres were also treated commercially by airplane with similar results.

An additional test was made with the same base oil (Vapona 1) containing 4.5 percent DDT by weight[4] on one-half of a 25-acre field of curly-top resistant sugar beets at Five Points, California. Treatments were applied on May 8 with the Shell experimental vaporizer which covers 6 rows with 3 nozzles per row. Beet leafhopper population counts were made with the Hills' sampler cage (3) which covers an area of 1 square foot but because of the size and spacing of the beets each sample consisted of one plant. Pre-treatment counts made on May 7 showed an average population of 20 leafhoppers per plant. Post-treatment counts on May 10 and May 24 showed remaining leafhopper populations of only 0.7 and to 0.9 leafhopper per plant respectively. This test demonstrated residual control for 16 days as the plots were subject to reinfestation from the untreated portion of the field.

Tests and Commercial Applications in 1947

According to investigators, the potential beet leafhopper population in the Salinas and San Joaquin Valleys of California in 1947, was comparable to that of 1919 when a severe outbreak occurred. Following the initial migration on March 25, many fields were dusted with a dust containing 5 percent DDT, 50 percent sulfur and a diluent at the rate of 30 pounds per acre. On April 14, another general flight took place which necessitated additional treatments. Because of the extended period of migration into the fields and the need for maximum residual toxicity, field trials of DDT vapor sprays by airplane were undertaken. The trials and subsequent commercial applications in the King City and Salinas areas in California were carried out under the direct supervision of William Lewis, Chief Deputy Agricultural Commissioner, Monterey County.

Field trials were made April 28, 1947, with Vapona 1D-045 applied at the rate of 4 gallons per acre by airplane. These trials resulted in an average reduction of beet leafhoppers per foot of row from 3 on April 28 (just prior to treatment) to .003 on May 2 and to .03 on May 17. Because the plots were subjected to continual readjustments in population during the period May 2 to May 17, it was concluded that Vapona 1D-045 applied

[4]Now sold by the Shell Oil Company, Incorporated, under the trademark Vapona 1D-045.

at 4 gallons per acre provided residual toxicity in this area for at least 19 days. Slight injury to beet foliage resulted in some instances where the vapor spray was applied within a few days after a DDT sulfur dust.

Following the 1947 field tests, several thousand acres of beets were treated in various areas of California with Vapona 1D-045 by airplane at 4 gallons per acre during 1947 and results were comparable to those obtained in the trials at King City. In areas where high temperatures occurred following treatment there was some reduction in residual toxicity. To obtain adequate residual toxicity in these areas, a dosage of at least 6 gallons per acre was found advisable, with application directed toward maximum coverage of the undersurfaces of the foliage.

Observations made on the incidence of curly top in treated and untreated fields of resistant varieties in the San Joaquin Valley showed an average of 1 to 3 percent of the plants infected on the treated fields with an estimated yield of 20 tons of beets per acre compared with 60 to 80 percent of plants infected on untreated fields with an estimated yield of 5 tons of beets per acre. In Kern County, California, one field treated with Vapona 1D-045 showed no appreciable damage from curly-top virus and yielded an average of 30 tons of beets per acre. In an untreated field in the same area, 42 acres were abandoned because of damage from the disease and the balance of the field yielded an average of only 8.5 tons of beets per acre. This represented a loss of approximately 50 percent of the potential production of the field. A further comparison of the influence of beet leafhopper outbreaks on the yield of sugar beets during years when commercial control was not available and 1947 is presented in table 1.

Table 1.—Production of sugar beets during years of severe beet leafhopper outbreaks, Salinas-King City area, California—Spreckels Sugar Co.

Year	Acreage harvested	Total yield (tons)	Yield per acre (tons)	Remarks Leafhopper infestation
1919	29,300	211,895	7.23	Severe outbreak
1922	11,715	91,000	7.43	Severe outbreak
1925	15,793	106,267	6.73	Severe outbreak
1947	29,880	614,000	20.6	Potential same as 1919

Improvements in cultural practices since 1925 have resulted in an increase in the average yield per acre from 15 to 20 tons in the Salinas Valley. Development of resistant seed has also been a factor in minimizing crop losses as resistant seed is almost immune to curly-top virus after the plants reach the 10-leaf stage. Even with these developments, leafhopper outbreaks still cause serious losses when uncontrolled in beet fields. The result of the 1947 control program demonstrated that the use of DDT vapor sprays in sugar beet fields, supplemented by foothill control, will give maximum protection to assure normal crop yields in severe leafhopper years.

Tests on Beets Grown for Seed

Sugar beets grown for seed in the Safford, Arizona, area are subject to beet leafhopper infestations which has necessitated control in order to minimize curly-top virus infection. In recent years, control has been accomplished by use of DDT dust applied both by airplane and ground equipment. This area is also subject to prevailing winds of such velocity as to often cause considerable delay in the dusting operations. Therefore, field tests were conducted during the fall of 1947 to compare the efficacy of vapor sprays applied by airplane with dusts applied by airplane and ground equipment. These tests were carried out in cooperation with the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Field Station at Phoenix, Arizona, The Western Seed Production Corporation, Phoenix, Arizona, and Marsh Aircraft Company, Inc., Phoenix, Arizona.

Approximately 5 acre plots were used, the total amount of material required for 5 acres being measured and the dosage applied per acre calculated from the area covered. Vapor sprays on fields 1, 2 and 3 were applied by airplane equipped with rotor brushes; on field 4 with an airplane equipped with a spray boom. Dust applications were made by conventional airplane and ground dusters. The beet plants were in the 6- to 8-leaf stage of development at the time of treatment and all population counts were made at random with the Hills' sampler cage covering approximately 1 foot of row. The following materials were applied: 1.—Vapona 1D-045; 2.—DDT emulsion, 1 gallon of 25 percent DDT concentrate[5] diluted with 5 gallons of water; 3.—dust containing 10 percent DDT. The reductions in leafhopper populations by these treatments are shown in table 2.

Following the original migration of leafhoppers, which occurred on or about September 27, an additional flight took place on October 2. Vapor spray applications on fields 1, 2 and 3 were applied under adverse weather conditions with prevailing winds of an estimated 5- to 10-mile per hour velocity. Because of the windy conditions and field obstructions, field 2 received an unsatisfactory spray application. Windy weather delayed the applications of dusts on fields 1 and 3 and a portion of field 2 until after the second leafhopper migration had taken place.

These field tests demonstrated that Vapona 1D-045 gave control of beet leafhoppers for at least 15 days even when applied during periods of moderate prevailing winds. DDT emulsion applied as a vapor spray gave control of leafhoppers for at least 14 days but caused moderate injury to the foliage in the form of necrotic spotting of the leaves. Dusts containing 10 percent DDT gave control of beet leafhoppers from 10 to 15 days when applied during calm weather.

[5]Marketed by the Shell Oil Company, Incorporated, under the trademark Rositox D-25.

Table 2.- Field tests of DDT vapor sprays and dusts for beet leafhopper control, Safford, Arizona, 1947.

Field	Treatment	Treatment date	September 29		September 30		October 3		October 7		October 14	
			D.A.T.	N.L.	D.A.T.	N.L.	D.A.T.	N.L.	D.A.T.	N.L.	D.A.T.	N.L.
1	Vapona 1D-045 6 gal/A-airplane	9/29			1	.09	4	.47	8	.24	15	.02
	DDT 10-% dust @ 30 lb/A-airplane	10/2					1	.17	5	.10	12	.04
	DDT 10-% dust @ 20 lb/A-ground	10/3							4	.12	11	.08
	Untreated check		0	.99	1	.73	4	1.43				
2	Vapona 1D-045 @ 5 gal/A-airplane	9/29			1	.13	4	.97	8	.32	15	.26
	DDT 10-% dust @ 18 lb/A-ground	9/29			1	.07	4	.47	8	.42	15	.10
	DDT 10-% dust @ 20 lb/A-ground	10/2							5	.10	12	.00
	Untreated check		0	1.18	1	1.03						
3	DDT emulsion @ 7½ gal/A-airplane	9/30			1/3	.47			7	.20	14	.00
	DDT 10% dust @ 30 lb/A-airplane	10/4	—						3	.24	10	.04
	Untreated check			.77								
4	Vapona 1D-045 @ 6 gal/A-airplane	10/10									4	.04
	Untreated check						Samples taken Oct. 8			.95	4	.62

D.A.T.—Number days after treatment.
N.L.—Mean number of leafhoppers per foot of row.

Summary

Vapor sprays are concentrated sprays in which a toxicant is dissolved or suspended in a refined petroleum oil or in water. Application is made by especially equipped airplane or ground vaporizers which deposit the material on the plants in form of fine droplets. Experiments on the control of the beet leafhopper were conducted by the Shell Agricultural Laboratory at Modesto, California, in 1946 with an extra light, highly refined petroleum oil containing 2.4 percent DDT (Shell Vapona, 1D). Application, made by a ground vaporizer at the rate of 5 gallons per acre, and supplemented by limited commercial airplane applications showed that a high initial kill was obtained with a residual toxicity of 7 days. Additional tests using the same base oil containing 4.5 percent DDT (Shell Vapona 1D-045) applied at a higher dosage resulted in control of beet leafhoppers for at least 16 days. Field tests conducted in 1947 near King City, California, using Vapona 1D-045 at 4 gallons per acre applied by airplane showed an average reduction of beet leafhoppers per foot of row from 3 to .003 at 4 days and .03 at 19 days after treatment. Commercial application on several thousand acres in this area gave comparable results in leafhopper control and resulted in an average yield of 20.6 tons of beets per acre. In areas subject to high temperatures, a dosage of 6 gallons per acre is required. Field tests of various insecticides on sugar beets grown for seed in Safford, Arizona, showed that Vapona 1D-045 applied at 6 gallons per acre by airplane gave control of beet leafhoppers for 15 days. Control was comparable to 10 percent DDT dust applied at 20 pounds per acre by ground duster and at 30 pounds per acre by airplane.

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