Grape Bud Mite Tests

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THE GRAPE BUD MITE, *Eriophes vitis* Pgst. causes greatly shortened basal internodes on grape shoots. Often the berry clusters are reduced or absent.

In severe cases the overwintering buds are killed and the vines respond with a vigorous growth of suckers. Before the vines lose their leaves in the fall bud mites are generally prevalent in all vineyards and may be found in from 60% to 90% of the buds. Overwinter mortality is great, however, so that injury in the spring can not be predicted from prevalence of bud mites in the fall.

A series of preliminary tests were made on Carignane grapes in the University vineyard at Davis on September 20, 1947. Single vines were sprayed using a hand-sprayer before the leaves had fallen. Cane samples were collected on September 23 and again from a few of the treated vines on October 22. From 25 to 50 buds were examined from each treatment. The results are summarized in table 1.

On October 1, 1947, a series of sprays were applied to plots of Thompson Seedless vines of 0.7 acres each. Using a power driven sprayer at 500 pounds pressure, sprays were applied at the rate of 1.3 gallons per vine. Each row of vines was sprayed from both sides by two operators each using a single nozzle spray gun. One rode on top of the spray rig while the other walked behind at a distance of some 15 feet. At the time of application the leaves were still green and the canes had not fully matured.

An examination of 50 buds from each treatment was made on October 15 and again on October 27. The results are tabulated in table 2.

While examining buds under the binocular microscope many dead bud mites were observed on all treated plots. Often dead mites were seen beneath the outer portion of a bud scale while live mites were found at the base of the scale. It appeared that nearly all treatments reduced the per cent of buds having live bud mites to some extent. On the whole, the addition of kerosene to the spray increased its efficiency slightly.

It may be that immediate control of grape bud mites depended more on penetration of the spray beneath the bud scales than on the amount of toxic agent used. Because of the slow action of parathion it may take until spring of 1948 to evaluate these experimental sprays.

TABLE 1—Results of Hand-Spray Tests to Control Grape Bud Mite

Treatment per 100 gallons September 20, 1947	Per cent buds with live mites	
	September 23	October 22
Parathion 15% wettable, 1 lb.	61.5	....
Parathion 15% wettable, 2 lbs.	46.8	....
Parathion 15% wettable, 4 lbs.	38.5	....
Parathion 15% wettable, 6 lbs.	33.3	34.4
Parathion 15% wettable, 1 lb.; di 2-ethyl hexyl phthalate, 1 qt.	52.6	....
Parathion 15% wettable, 2 lbs.; di 2-ethyl hexyl phthalate, 1 qt.	31.8	....
Parathion 15% wettable, 4 lbs.; di 2-ethyl hexyl phthalate, 9 qt.	44.4	....
Parathion 15% wettable, 6 lbs.; di 2-ethyl hexyl phthalate. 1 qt.	36.2	56.2
Parathion 15% wettable, 1 lb.; di 2-ethyl hexyl phthalate, 1 qt.; kerosene, 2 gals.	50.0	....
Parathion 15% wettable, 2 lbs.; di 2-ethyl hexyl phthalate, 1 qt.; kerosene 2 gals.	38.6	....
Parathion 15% wettable, 4 lbs.; di 2-ethyl hexyl phthalate, 1 qt.; kerosene, 2 gals.	38.9	....
Parathion 15% wettable 6 lbs.; di 2-ethyl hexyl phthalate, 1 qt.; kerosene, 2 gals.	36.0	19.2
Unsprayed	59.9	60.0

TABLE 2—Results of Sprays to Control Grape Bud Mites on Thompson Grapes

Treatment per 100 gallons October 1, 1947	Per cent buds with live mites	
	October 15	October 27
Parathion 15% wettable, 3 lbs.	46	36
Parathion 15% wettable, 3 lbs.; di 2-ethyl hexyl phthalate, 1 qt.	50	42
Parathion 15% wettable, 3 lbs.; di 2-ethyl hexyl phthalate, 1 qt.; kerosene, 2 gals.	30	40
Unsprayed	72	60

Red Spiders on Grapes

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THE PACIFIC MITE, *Tetranychus pacificus* McG. is a serious pest on nearly all varieties of grapes grown in northern and central California, as far south as Fresno. In the vineyards around Fresno and south the Willamette Mite, *Tetranychus willamettei* McG. predominates. Tests on this latter species are reported on page 13.

In view of the phenominal success obtained with HETP in 1946, it was decided to conduct a timing experiment in 1947 to determine the most advantageous time to apply this material. Since DDT is normally applied to grapes in the spring to control the grape leafhopper, tests were designed to study the efficiency of DDT plus HETP in combination. The efficiency of single applications of HETP was contrasted with double applications, both with and without DDT.

An experiment was conducted in 1947 on a commercial Zinfandel vineyard (No. 1) at Woodbridge and repeated on a commercial Zinfandel and Alicante vineyard

(No. 2) at Escalon. Both of these vineyards were known to suffer severe red spider damage each year. Each plot was ten by ten vines, included one hundred vines or nearly one quarter of an acre.

TABLE 1—Vineyard No. 1 Red Spider Control

Date sprayed 1947	Ave. colonies per ½ vine*		Ave. per cent leaves yellow†		Ave. per cent leaves red†	
	HETP	HETP+DDT	HETP	HETP+DDT	HETP	HETP+DDT
Single applications						
March 5	14.0	....	81.7	....	2.5	....
April 5	11.6	....	48.1	....	6.8	....
April 15	4.5	15.3	34.8	24.4	4.6	7.1
April 22	3.0	0.8	24.2	0.27	2.6	0.0
April 30	1.0	0.6	5.9	2.8	0.92	0.47
Douple applications						
Apr. 5 and Apr. 15	4.5	....	24.4	....	2.08	....
Apr. 15 and Apr. 22	0.1	0.06	0.14	0.17	0.003	0.0
Apr. 22 and Apr. 30	0.01	0.19	0.33	4.7	0.0	9.5
Checks, not sprayed						
1	19.1		71.6		22.6	
2	16.3		61.1		10.9	

* Counted May 20, 1947. † Counted June 4, 1947.

The materials used were a 50% hexaethyl tetraphosphate, and a commercial fabrication of 50% DDT as a wettable powder. The HETP fabrication was used at one pint per hundred gallons and the DDT fabrication was added at a rate calculated to deposit one pound of actual DDT per acre. Sprays were applied with a 400 gallon Bean spray rig, using a pressure of 400 pounds per square inch. Applicators walked around each vine, spraying it from all sides with single nozzle hand guns using number six disks. The rate of application varied from 0.5 to 0.9 gallons per vine, depending on the size of the vine.

Each plot was a square, ten vines on a side. The outer perimeter row was regarded as a guard row and no counts were made on these vines. This left the central area of the plot eight vines on a side, or 64 vines per plot. All of these vines were counted in the following counts. Counts were made first by collecting leaves and counting the number of red spiders under a binocular microscope. Later, the number of colonies per one-half vine were counted by field examination, based on discolored leaves. As the season advanced, the colonies fused together and a count was made of yellowed leaves, expressed as per cent of yellowed leaves on each vine, then averaged per plot. Still later, the yellow leaves turn red, a symptom of advanced red spider damage, and a count of red leaves per vine was made.

The earliest application was March 5 on vineyard number one. This application differed from all subsequent applications in that the spiders had not yet emerged from their hibernation quarters beneath the grape bark. It was estimated that only 5% of the overwintered mites had emerged. To yield a successful control at this time of year, the spray material would need to penetrate the grape bark. Consequently, the 50% HETP was used at two pints per 100 gallons, whereas one pint was used in all subsequent applications. On March 5 the grape buds were swollen but the first leaf had not separated from the bud.

During cool spring weather the life cycle of the Pacific mite requires from 15 to 20 days for completion. Double applications were spaced five to ten days apart so that spiders which hatched from eggs after the first application, would not have time to mature and lay eggs before the second application was made. The counts are presented in tables 1 and 2.

The data in tables 1 and 2 show that: (1) HETP at two pints per 100 gallons did not satisfactorily control red spiders in hibernation under the grape bark. The slight control demonstrated was of negligible value from the commercial standpoint. (2) Two applications of HETP were far more effective than one. It has previously been demonstrated that HETP does not markedly affect the red spider eggs, and a second application, properly timed, controls larvae and protonymphs which hatch after the first application. (3) Later applications were more effective than earlier applications. This held throughout the scope of the experiment. The last application was made on May 1 and no later applications were made because of the possibility of injuring the grape flowers. However, small scale tests, reported below, indicate that later applications are feasible. (4) The addition of DDT to HETP increased the initial efficiency of the spray, but after 35 days the population on vines sprayed with this combination, had increased markedly over that on vines sprayed with HETP alone.

In order to study the effect of DDT on the red spider populations in these experimental plots, the data in tables 1 and 2 have been analyzed on the basis of elapsed time between spraying and counting and are presented in table 3.

TABLE 2—Vineyard No. 2. Red Spider Control

Date sprayed 1947	Ave. colonies per ½ vine*		Ave. per cent leaves yellow†		Ave. per cent leaves red†	
	HETP	HETP+DDT	HETP	HETP+DDT	HETP	HETP+DDT
Single applications						
April 16	0.05	2.51	5.7	58.0	1.1	13.0
April 23	0.10	0.68	1.0	11.4	0.08	1.7
May 1	0.10	0.30	1.0	0.9	0.42	0.0
Douple applications						
Apr. 16 and Apr. 23	0.02	0.27	0.0	6.8	0.0	0.10
Apr. 23 and May 1	0.02	0.0	0.0	0.72	0.0	0.16
Checks, not sprayed						
1	5.7		25.6		9.4	
2	74.8		33.1		11.7	
3	1.7		15.2		3.7	
4	11.4		50.4		27.6	
5	1.2		9.4		2.1	

* Counted May 21, 1947. † Counted June 5, 1947.

This table indicates that the number of colonies per vine and the amount of leaf damage was at first smaller in the HETP plus DDT plots, but at the end of 35 days the number of colonies had increased markedly in the DDT plot and at the end of 50 days the amount of damaged foliage was considerably greater in these plots than in the plots treated with HETP alone.

TABLE 3

Effect of DDT on Red Spider Populations

Vineyard	Days After Spraying	HETP		Counted as
		Alone	With DDT	
1	20	1.0	0.6	Colonies per vine
	28	3.0	0.8	
	35	4.5	15.3	
2	20	0.1	0.3	Colonies per vine
	28	0.1	0.7	
	35	0.1	2.5	
2	35	1.0	0.9	Per cent yellow leaves
	43	1.0	11.4	
	50	5.7	58.0	
2	35	0.4	0.0	Per cent red leaves
	43	0.1	1.7	
	50	1.1	13.0	

The data on leaf damage on vineyard No. 1 is somewhat inconsistent and hence not included in table 3. The data in table 3 should be considered as preliminary, and not indicative of what will infallibly happen. The balance between red spiders and their natural enemies is very complex and contains such a variety of factors that any local condition is probably rarely duplicated in nature. The writer has studied spider populations in vineyards which were treated commercially with DDT for the control of grape leafhopper, and no build-up of the red spider population was found.

Since better red spider control was obtained by later sprays, approaching blooming time of the grapes, it seemed desirable to study the effect of HETP on grape flowers. A 50% formulation of HETP was sprayed onto grape forms in bloom at 1, 2, 4, and 8 pints per 100 gallons. A 100% HETP was similarly applied at ½, 1, 2, and 4 pints per 100 gallons. These sprays were applied on Carignane, May 14 and 15, 1947. On May 31 the 50% formulation showed no damage to flowers at the one pint concentration, slight injury at two pints; and severe injury at four and eight pints per 100 gallons. The 100% HETP did not injure the forms at ½ and one pint concentrations; slight damage occurred at two pints and serious damage was caused by the four pint application.

The injury consisted in killing of the flowers, causing them to drop, thereby thinning the bunch, and caused brown scarring on the stem of the bunch. Both HETP types produced the same type of injury but more injury was produced by the 50% formulation per unit of HETP, than by the 100% HETP.

At harvest, the damage which was visible on May 31, had been overcome to a considerable degree by the natural tendencies of the vine. Thus, if the flowers are thinned and the number of berries per bunch are reduced, the weight of the individual berries which remain will be greater. The data at harvest are given in table 4.

TABLE 4

Phytotoxicity of HETP to Grape Flowers

Material	Pints per 100 gallons	Ave. weight per bunch, grams	Ave. no. berries per bunch	Ave. weight per berry, grams
None, check	none	302.5	195.5	1.549
50 per cent formulation	1	274.3	202.1	1.450
	2	211.3	130.1	1.675
	4	243.4	138.8	1.720
	8	119.7	76.6	1.633
100 per cent	½	276.4	188.5	1.455
	1	332.6	196.3	1.704
	2	229.1	134.3	1.669
	4	219.0	115.5	1.914

Parathion was used as a 15% wettable powder and the tetraethyl pyrophosphate, TEPP, was supplied as 100%. They were tested in conjunction with the following adjuncts: di 2-ethyl hexyl phthalate, a powder containing 33.3% of dioctyl sodium sulfosuccinate, glyceryl phthallic alkyd resin, and 2-thiazolinyl lauryl sulfide IN4200. Tests in 1946 showed that di 2-ethyl hexyl phthallate (899) gave a good control of red spiders on grapes when emulsified with Vatsol K and used at the rate of two quarts per 100 gallons. Moreover, it is regarded as a good solvent for parathion. When these were combined, the spray tank was half filled with water, then two ounces of Vatsol K added with the agitator running, then the 899, and finally the 15% parathion wettable powder.

The glyceryl phthallic alkyd resin (B1956) had been shown previously to possess considerable acaricidal properties. It was added as an emulsifying agent, as a wetting agent, and as a possible synergist. The 2-thiazolinyl lauryl sulfide has been reported to have an ovicidal action on mite eggs. It was therefore used in conjunction with TEPP which has a low ovicidal action. It was usually emulsified with a proprietary emulsifying agent—Duponol OS. Three per cent of this material was dissolved in 97% of the 2-thiazolinyl lauryl sulfide.

These materials were applied to two vineyards of Zinfandel grapes near Modesto on July 9 and 10, 1947. A 100 gallon Hardie rig, with 250 pounds pressure and number 5 disk in the gun, was used. On vineyard No. 3 single plots were used and on vineyard No. 4 the plots were duplicated. Only July 18 leaf samples were picked from all plots and placed in refrigeration for later counting with a binocular microscope. Only mature leaves showing the first signs of yellow spotting were selected for counting. Thirty leaves from each plot were examined and the number of live mites, not counting eggs was recorded. This data is presented in table 5 on page 5.

The data in table 5 indicate that parathion was outstanding in its effect on Pacific mite. The addition of the solvent, 899, increased the efficiency to 100% which is very desirable in red spider control. A control of 95% or less, under most conditions, is of little value. Emulsified 899 by itself again demonstrated considerable toxicity, substantiating the results obtained in 1946. Emulsified IN4200 by itself showed some toxicity but not enough to yield a good commercial control in one application. When this material was used in conjunction with HETP and TEPP the efficiency was greater than when these phosphates were used alone (see also table 6). The addition of the wetting agent B1956 to the mixture of TEPP and IN4200 increased the efficiency considerably.

TABLE 5

Phosphate Compounds on Pacific Mite on Grapes

Material	Amount per 100 gallons	Ave. no. of live mites per leaf	Per cent reduction
Parathion 899 Vatsol K	2 lb. of 15% 2 quarts 2 oz.	0.0	100.0
Parathion	2 lb. of 15%	0.2	99.95
TEPP B 1956 IN4200	4 oz. 4 oz. 1 pint	4.8	99.06
TEPP IN4200 Duponol OS	2.6 oz. 1 pint .03 pint	7.4	98.56
899 Vatsol K	2 quarts 2 oz.	8.5	98.35
Parathion	1 lb. of 15%	14.7	97.14
HETP 100% IN4200 Duponol OS	½ pint 1 pint .03 pint	27.2	94.71
IN4200 Duponol OS	1 pint .03 pint	38.0	92.62
HETP 50%	1 pint	40.8	92.07
Check	none	514.6	.....

No plant injury occurred in any of these plots except the one sprayed with 899 at two quarts per 100 on vineyard No. 3. This vineyard was suffering from lack of water. This material at the same concentration did not injure the vines in vineyard No. 4 which had sufficient moisture. When two pounds of 15% wettable parathion powder were used with two quarts of 899 on vineyard No. 3, no damage to the vines occurred. The powder may have absorbed the 899 and prevented it from penetrating the leaves in toxic quantities.

It is known that ethyl phosphate sprays are relatively nontoxic to red spider eggs. Consequently, two applications are necessary to effect a satisfactory control. The second application must be timed to kill the young mites which hatch after the first spray and they must be killed before they become adults and in their turn produce eggs. Under normal summer weather conditions the egg stage lasts about three days and the immature (nymphal) stages last about nine days. Therefore the second application should be from four to nine days later than the first.

TEPP and HETP were tested in double applications on vineyard No. 4 and counts were made as described earlier. Leaves from check vines averaged 588.3 mites per leaf at the time of the count of the first application. The results are given in table 6.

The data in table 6 show that when

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Aphids, Mites on Pears, Prunes

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POST HARVEST APPLICATIONS were applied October 14 in an experimental plot of large Smith Cider apple trees heavily infested with woolly apple aphid, using the following materials and dosages. Counts of living aphids on ten sucker growth shoots from each plot were made seven days after spraying.

Parathion gave the most remarkable control of woolly apple aphid yet observed and is most promising for the solution of this problem.

TABLE 1

Control of Woolly Apple Aphid

Materials	Dosage per 100 gals.	Number living aphids on 10 twigs
HETP 90% emulsion	¾ pint	278
Parathion 15% wettable	¼ pound	185
Parathion 15% wettable	½ pound	7
Parathion 15% wettable	¾ pound	0
Parathion 15% wettable	1½ pounds	0
Check unsprayed		5,840

In a randomized experimental plot of Bartlett pears on the Sacramento River in which nine of the most promising miticides were employed, HETP and parathion were included in the control of European red mite and the two-spotted mite. The complete program included spray applications on June 9, June 27, July 15, and August 15.

HETP (50%) at a dosage of one pint per 100 gallons was used in the June 9 application but the resulting injury to foliage and fruit precluded its further use in the program. Counts of adult mites on 100 leaves before and after the June 9 application on trees sprayed with HETP, are given in table 2.

The build up in the population of Eu-

TABLE 2—Control of Mites with HETP

	June 9 spray		
	June 5	June 12	June 26
European Red Mite	150	0	224
Two-spotted Mite	90	4	31

TABLE 3—Counts of Adult Mites on 100 Leaves from Trees Sprayed with One Pound of 15% Wettable Parathion per 100 Gallons

	July 15 spray	
	July 14	July 18
European Red Mite	172	18
Two-spotted Mite	62	0
	August 15 spray	
	Aug. 14	Aug. 22
European Red Mite	78	3
Two-spotted Mite	175	13

Hexaethyl Tetraphosphate Thermal Aerosol Fog Effective Against Grape Leafhopper

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DURING SEPTEMBER, 1947, observations were made of hexaethyl tetraphosphate applied as a thermal aerosol fog for control of the grape leafhopper, *Erythroneura elegantula* Osb., on grapes. A commercial operator of a Tifa machine (Todd Insecticide Fog Applicator) coöperated in tests and the results of several commercial applications were evaluated.

For all treatments a commercial preparation containing 50% of HETP—Vapotone—was mixed with a commercial light medium spray oil—Greenol—and applied in Emperor variety vineyards in Tulare County. The Tifa machine was mounted on a jeep, with the outlet nozzle so adjusted that the fog was directed to the ground at a point about 10 feet to the rear and midway between the rows. Controls were set to deliver particles of 20 to 30 microns in size.

Three vineyards were treated, two at sundown and the third at sunrise, with a mixture of one part of 50% HETP and three parts of oil applied at one gallon per acre in alternate middles. No actual counts were made of leafhoppers killed but both evening treatments resulted in a very good commercial reduction of populations. The early morning test showed no observable effect.

Two additional evening tests were made. In one vineyard a mixture of one part of 50% HETP and three parts of oil was applied at two gallons per acre in every middle. This resulted in a reduction of the average population per leaf on 10 leaves from 64.4% to 0.9% or 98.6%. In the second vineyard a mixture of equal parts of 50% HETP and oil was applied at one gallon per acre in alternate middles. The average population per leaf on 10 leaves was reduced from 123.8 to 1.6 or 98.7%. In both cases pretreatment population samples were taken the day of treatment and post-treatment samples counted the day following application.

An application was then made over a 100-acre vineyard in which equal parts of HETP and oil were applied at night in alternate middles at one gallon per acre. This resulted in a very excellent kill of leafhoppers. In spots where averages of 398, 141, 168, and 139 leafhoppers per leaf had been counted prior to treatment the population had apparently been reduced by 100%. It was difficult to find a live adult or nymph anywhere in the treated area the day after treatment.

No discernable injury developed on the vines as a result of any treatment.

Further use and tests of this method will be necessary to determine its relative merits as a means of controlling the grape leafhopper.

RED SPIDER

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four ounces of TEPP was fortified with B 1956 and IN4200 the combination was more effective than eight ounces of HETP (i.e. one pint of 50%). But in the second application the HETP was more effective than TEPP when used alone. By comparing with the data in table 5, it can be seen that the double applications of ethyl phosphates in table 6 were not as effective as single applications of parathion at two pounds of 15% per 100 gallons.

TABLE 6—Double Applications of Ethyl Phosphates on Pacific Mite on Grapes

Plot	Sprayed, 1947	Material	Amount per 100 gallons	Ave. live mites per leaf
No. 1	July 10	TEPP B1956 IN4200	4 oz. 4 oz. 1 pint	4.8
	July 17	TEPP	4 oz.	11.4
No. 2	July 10	HETP 50%	1 pint	40.8
	July 17	HETP 50%	1 pint	8.1

FIG SCALE

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parathion near the start of hatching had evidently retarded the establishment of the summer forms until late in the hatching period of eggs from the overwintered females.

At harvest, August 7, 1947, 100 figs from the sprayed and unsprayed tree were examined for numbers of scale present (table 2). All the figs from the unsprayed tree and 78% of those from the sprayed tree were infested. The high percentage of infestation on fruit from the sprayed tree was expected since observations in 1944 and 1945 had indicated that unless the infestation in late June was substantially less than 1 per leaf, an appreciable fruit infestation could be expected on the mature figs. Table 2 shows that 72% of the figs from the sprayed tree had five or fewer scales each while 72% of those from the unsprayed tree had 26 or more scales.

This preliminary test indicates that parathion may be very effective in control of fig scale. Information on dosage, timing, residue, etc., must be obtained. The possibility of controlling spider mites and other pests makes the possible use of parathion even more interesting.