or concentrate sprays of Thuricide were comparable with dilute carbaryl sprays except for the late Thuricide treatment applied on September 7, eight days after the comparable earlier spray. The S.S. Thuricide was a special preparation with potency comparable to Thuricide 90 T.S., but supposedly more stable to heat and ultraviolet light.

Dust trials

Two dust trials in 1967 (tables 2 and 3) showed no significant differences in control between carbaryl or the two *Bacillus* preparations, Thuricide 2.5 B or Biotrol 2.5 D. A spray treatment that year (table 4) shows significant differences among carbaryl, the two *Bacillus* preparations, and the untreated check after both the second and third brood.

The 1968 spray trial, established in the first brood and carried through all three broods, shows no significant differences among the three treatments, with all treatments significantly different from the untreated check. Populations remained at extremely low levels in both the second and third brood in this test.

Currently, *Bacillus* preparations are available for sprays as Thuricide 90 T.S. or Biotrol 25 W, or in dust form as Biotrol 2.5 D. Where growers are concerned about the possible deleterious effects of carbaryl on beneficial insects, these *Bacillus* preparations can be expected to give comparable control in most cases. However, applications of *Bacillus* must be carefully timed to coincide with the period when the bulk of the brood makes its first leaf rolls—a period of perhaps not more than four or five days. Carbaryl will perform satisfactorily over the much longer period of at least 10 days and will reduce large larvae in leaf rolls, where *Bacillus* is ineffective.

The carbaryl, standard lead arsenate, or *Bacillus* treatments do not show significant differences in carry-over effect, that is, the reduction of a subsequent brood from an application made in a prior brood.

The *Bacillus thuringiensis* formulations and carbaryl are recommended in the University of California grape schedule for use against any of the three broods. Standard lead arsenate may be used only for first brood treatment, before the edible portions have formed.

Frederik L. Jensen is Farm Advisor, Tulare County.

Rolled grape leaf in photo resulted from infestation by grape leaf folder. The rolls are formed from webbing as the larva develops within.

INTEGRATED CONTROL

Newer for grape spider mite

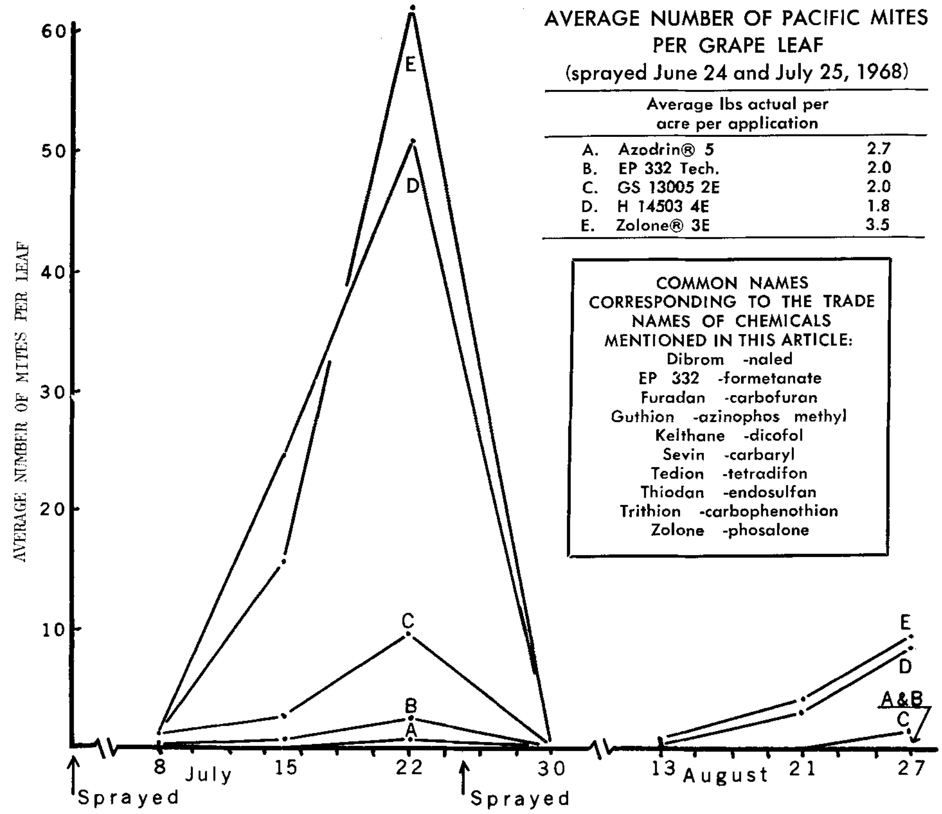
THE RESISTANCE of insect and spider mite pests of grapevines in many areas of the San Joaquin Valley to insecticides has led to the use of combinations of insecticides and often to more frequent applications for control. In view of the history of the use of combinations of chemicals for control of insecticide-resistant pests, these insects and spider mites may soon become resistant to the combinations now in use. Although a great many combinations may be tried and some new ones may be found effective, grape growers need additional and more effective acaricides. To this end, many newer chemicals (not registered for use on grapes) have been tested in the field for the past several years. Some of these are nearing registration and general use; however, the University of California does not have sufficient information to recommend any of these new materials for use on grapevines at the present time.

Pacific mite

Most of the tests have been made to investigate control of the Pacific mite. All the sprays for control of Pacific mite and omnivorous leaf roller were applied with a power sprayer with an "over-the-row" boom. The results of tests made near Caruthers in 1968 show the average number of mites per leaf for nine weekly counts (July 1 to August 27) of mites on 15 leaves per plot and three replicate

E. M. STAFFORD · H. KIDO

insecticides the control of insect and pests



AVERAGE NUMBER OF PACIFIC MITES PER GRAPE LEAF
(sprayed June 24 and July 25, 1968)

		Average lbs actual per acre per application
A.	Azodrin® 5	2.7
B.	EP 332 Tech.	2.0
C.	GS 13005 2E	2.0
D.	H 14503 4E	1.8
E.	Zolone® 3E	3.5

COMMON NAMES CORRESPONDING TO THE TRADE NAMES OF CHEMICALS MENTIONED IN THIS ARTICLE:

Dibrom -naled
EP 332 -formetanate
Furadan -carbofuran
Guthion -azinophos methyl
Kelthane -dicofol
Sevin -carbaryl
Tedion -tetradifon
Thiodan -endosulfan
Trithion -carbophenothion
Zolone -phosalone

TABLE 1. RESULTS OF SPRAYS TO CONTROL PACIFIC MITE AND OMNIVOROUS LEAF ROLLER ON THOMPSON SEEDLESS GRAPEVINES, CARUTHERS, 1968

Materials per 100 gallons*		Application rate per acre*	Mites per leaf	Bunches infested†
	Oz.	Lbs actual per acre	Ave. no.	Ave. %
Azodrin®5	16	2.5		
	17.5	2.9	0.3 a ‡	9 a ‡
Azodrin®5	8	1.2		
	8.7	1.3	0.5 a	27 ab
EP 332 Tech.	8	1.8		
	8	2.2	0.6 a	88 d
EP 332 Tech.	6	1.3		
	6	1.5	1.5 ab	99 e
GS 13005—2 E	32	1.8		
	64	4.0	1.9 ab	9 a
Azodrin®5	6	0.8		
	6.5	1.0	5.0 ab	26 ab
EP 332 Tech.	4	0.8		
	4	1.0	3.1 b	63 c
GS 13005—2 E	16	0.9		
	32	1.6	9.9 b	12 a
H 14503—4 E	12.8	1.5		
	16.0	2.0	9.9 b	15 a
H 14503—4 E	6.4	0.9		
	8.0	1.0	10.4 b	21 ab
Zolone®—3 E	44	3.3		
	44	3.8	10.5 b	9 a
Zolone®—3 E§	22	2.0		
	22	2.4	16.8 –	39 b
Dimethoate—25 W	32	1.9		
	32	1.6	1.3 –	66 –
Dimethoate—25 W	64	3.9		
	64	3.0	1.4	57 —
Dimethoate—25 W	16			
	16	1.0	11.9	59 —

* Materials and rates per acre listed first were applied June 24 and those listed second were applied July 25.

† 50 bunches per plot examined on September 25.

‡ Averages followed by the same letter are not significantly different. The last three treatments contained only two plots and were not analyzed statistically.

§ One of the plots of this treatment was sprayed on July 15 instead of June 24. This plot was omitted in calculating the average number of mites per leaf. The treatment was not included in the statistical analysis of the Pacific mite data.

plots for each treatment, except for the last three treatments in which two plots per treatment were used (see table 1). Table 1 also gives a summary of a statistical analysis of the data. The results of the last four treatments are omitted from analysis of the mite data. In most cases the numbers of mite eggs per leaf were greater than the numbers of mites, but because the numbers of eggs followed the same general trend as the numbers of mites, the data for eggs are not shown. Efforts to use the same number of gallons of spray per acre were not successful. The result was that, though the same material was used at the same rate per 100 gallons, the number of pounds of actual acaricide per acre varied between the two applications.

TABLE 2. RESULTS OF ACARICIDES TO CONTROL PACIFIC MITES ON THOMPSON SEEDLESS GRAPEVINES, SELMA, 1968. SPRAYS APPLIED JULY 16, 1968.

Materials per 100 gallons*		Application rate	Pretreatment	Post treatment
		Lbs. actual per acre	Ave. no. mites per leaf	
Dibrom® 1E and	1 qt	1.1		
Tedion® ¾ E		0.8	253	2.0†
Ethion 4M	6 oz	0.8	322	6.7‡
Kelthane® MF	12 oz	1.4	275	98.3‡
Trithion® 4F	8 oz	0.9	228	4.4‡
Trithion® 4F	8 oz	0.8		
+ Tedion® 1E	24 oz	0.6	330	0.7†
Guthion® 25W	1 lb	0.9	175	0.3†
Guthion® 25W	1 lb	0.9		
+ Sevin 50W	1 lb	1.7	168	1.4†
Ethion 4M	8 oz	0.9		
+ Moyer 796 oil	1 gal	1.7	393	0.9†
Ethion 4M	8 oz	1.0		
+ Tedion® 1E	24 oz	0.8	305	1.1†

* Two plots per treatment. Pretreatment counts made on July 11.

† Average of counts per leaf on five dates (weekly) after treatment.

‡ Average of counts of first two weeks after treatment.

Greatest dosages

The results from the greatest dosages of five of the treatments are shown in the graph. The graph illustrates only the higher counts of the mite populations after spraying. The average number of mites per leaf in any treatment, on all dates *not* shown, was less than three. The second spray application was more effective than the first in holding the populations in check. After the second spray, the less effective treatments showed a second resurgence of mites and some slight damage occurred to new leaves in September. The owner of the vineyard did not consider it worthwhile to respray any of the test plots after August. This greater effectiveness of the second spray (applied on July 25) had been observed in previous years and is perhaps characteristic of results with Pacific mite populations in this area. It is doubtful that one spray application will be sufficient wherever Pacific mite is a serious recurring problem. A limiting factor in the reduction of the June population explosion of Pacific mites may be the impossibility of obtaining thorough spray coverage. An attempt was made to reduce the influence of this factor in the tests by using a ground speed of about 2 miles per hour and from 350 to 400 gallons of spray per acre. While this is not in accord with most commercial practices, it may become necessary to improve coverage methods to avoid an excessive number of applications.

New chemicals

In less extensive tests the following new (unregistered) chemicals appeared promising for Pacific mite control: UC 34096, Plictran, Chemagro 58733, and Chemagro 45432. In replicated tests in 1967 the acaricides Galecron and Omite were promising though not as effective as some of the chemicals listed in table 1. The acute toxicity of these two chemicals to mammals is lower than that of many of the chemicals now used for Pacific mite control. Omite, a comparatively safe acaricide, was used commercially to a very limited extent under an experimental registration in 1968. Of all the newer acaricides tested, Omite appears closest to registration for use on grapevines.

Spray materials

A test of several spray materials in common use for control of Pacific mite was made on July 16, 1968. The vines used were previously sprayed with oil in early season (last sprays applied on April 19) or with an experimental fungicide (last sprays applied June 20). The vines were heavily infested when the acaricides were applied. The results are summarized in table 2. The poor results with Kelthane confirmed both the grower's and the University's experiences in previous years. The decision to respray the vines treated with ethion or Trithion alone was based on counts made from leaves collected eight days after spraying. The second collection of leaves had not been examined before plots of these treatments had been resprayed on August 1. Later, an examination of the counts taken the day before these plots were resprayed showed that there had been a marked reduction in numbers of mites below the first counts. It is probable that the average counts would have been much lower if five weekly leaf samples had been collected rather than only two. Since some treatments tend to act more slowly than others, it appeared that all of the treatments except Kelthane were effective under the conditions of this test.

Omnivorous leaf roller

As shown in table 1, the plots treated with acaricides (except EP 332 and dimethoate) for control of Pacific mite also showed considerable control of the omnivorous leaf roller, *Platynota stultana*. In another vineyard about 4 miles away, the flight activity of the leaf roller moths was followed by recording the numbers of moths captured nightly in a "black light" trap. Periods during which more than 30 moths per night were caught occurred from June 14 to 28 and from July 17 to August 4. The treatments listed in table 1 were applied well after the beginning of these periods of high moth activity. Although considerable control was obtained with certain chemicals in this vineyard near Caruthers, the optimum time for application of these insecticides in relation to the catching of moths in light-traps has not been satisfactorily defined.

TABLE 3. RESULTS OF SPRAYS TO CONTROL OMNIVOROUS LEAF ROLLERS ON THOMPSON SEEDLESS GRAPEVINES, 1968

Materials per 100 gallons and date sprayed		Application rate	Dates sampled 6/21	7/3	7/16–18	7/26
		Lbs. actual per acre	No. live larvae/40 vines			
Lead arsenate 4/8/68	4 lb	6.1	13	2	374	461
Lead arsenate 5/10/68	4 lb	8.4	18	2	16	112
Lead arsenate 4/8/68	4 lb	6.1				
+ Guthion® 25W	1 lb	0.4				
+ Sevin® 80W 5/10/68	10 oz	0.7	..	0	21	18
Trithion® 4F	5.5 oz	0.5				
+ Sevin® 80W 6/25/68	11.0 oz	1.3	2	0	14	43
Sevin® 44%		2.0				
+ Methyl parathion 11% 7/18/68	1.5 lb	0.5	..	.	345*	139

* Pretreatment count.

TABLE 4. RESULTS OF SPRAYS TO CONTROL GRAPE LEAFHOPPERS NEAR REEDLEY IN 1967 (RIBIER GRAPEVINES) AND IN 1968 (EMPEROR GRAPEVINES). SPRAYS APPLIED JULY 26, 1967 AND JULY 17, 1968.

Materials per 100 gallons		Application rate	Nymphs per leaf*	Reduction from pretreatment count
		Lbs actual per acre	Results in 1967† Ave. no.	Ave %
GS 13005—3.67 EC	36 oz	4.1	0.9	88
Furadan® 50W	8 oz	1.0	0.1	99
Furadan® 50W	16 oz	2.0	0.1	99
GC 6506—4 EC	1 pt	2.0	0.3	99
Azodrin® 5	6.4 oz	2.0	1.0	98
Azodrin® 5	3.2 oz	1.0	2.0	91
EP 332 Tech.	7.7 oz	2.0	1.0	94
Galecron® 4E	1 pt	2.0	2.9	71
Thiodan® 50W	1 lb	2.0	2.6	81
			Results in 1968‡	
Azodrin® 5	51.2 oz	1.0	0.2	98
GS 13005 2 EC	1 qt	1.0	0.9	92
H 14503—4 EC	1 pt	1.0	0.3	94
H 17413—4 EC	1 pt	1.0	1.9	95
Velsicol 506 3 EC	27.7 oz	1.3	0.4	99
Furadan® 4F	4 oz	0.25	1.5	93
Furadan 4F	6.1 oz	0.38	2.1	89
Furadan® 4F	8.2 oz	0.51	0.8	98
EP 332 Tech.	11.6 oz	2.4	0.6	99
Dimethoate 25W	4 lb	2.0	0.1	99

* 10 leaves per treatment per week for 6 weeks after treatment.
† Sprays applied with hand-held guns—400 gallons per acre.
‡ Sprays applied with hand-held guns—200 gallons per acre.

Short-term effects

In another Thompson Seedless vineyard in the Monmouth-Caruthers area a series of tests was made to determine the short-term effects of different dates of application. The results are summarized in table 3. The first spray of lead arsenate appeared to have been applied too early for good control (April 8). The second spray applied May 10 was much more effective. There were relatively few larvae found in early April, and the rapid vine growth soon produced untreated leaves and inflorescences that could easily be infested. Lead arsenate may be applied to grapevines until the small berries are visible but later sprays are prohibited by federal regulations. The combinations of Sevin plus Guthion (sprayed on vines previously sprayed with lead arsenate on April 8) and Sevin plus Trithion (applied to untreated vines) on June 25 gave appreciable control up to July 26. The Sevin-Trithion spray was applied near the end of the June 14 to 28 moth flight period. A spray of Sevin plus methyl parathion applied on July 18 reduced a heavy population of leaf roller larvae but there were still many larvae present in this plot on July 26. The July 18 application, occurring near the beginning of the July 17 to August 4 moth flight period, was perhaps too early for maximum effectiveness.

Grape leafhopper

Tests to control grape leafhoppers were made in a locality where these insects are resistant to most insecticides registered for use on grapevines. Thiodan, the most commonly used insecticide, is no longer effective in this locality. As in the case of resistant Pacific mite, combinations of insecticides are used in this area for leafhopper control. The results of tests made in 1967 and 1968 are summarized in table 4. Several newer chemicals appear promising for leafhopper control including Furadan, Azodrin, GC 6506, Velsicol 506, and dimethoate. Geigy GS 13005, Hercules 14503, and Hercules 17413 are also effective.

E. M. Stafford is Professor of Entomology and H. Kido is Laboratory Technician, University of California, Davis.