and 14 days after treatment. The results are presented in table 6.

Nymphs were just starting to hatch on July 24, so that all nymphs counted were in the first or rarely the second instar. It is clearly evident from the table that all treatments were very effective against nymphs up to four days after treatment. At the same time the parathion and DDT dust applications resulted in from 83.4% to 99% reduction of adult populations. During the same interval from July 24 to 30, adult populations in five untreated plots had decreased by 28.6%, due possibly, to some drift of dusts into the small plots and also perhaps to flight activity which causes an increase in adult population in favorable areas, and a decrease in less favorable spots. Continued hatching increased the nymph populations in untreated plots by 33.3%. By August 9, populations of nymphs in untreated plots had again increased by nearly six-fold from July 30, whereas in all treated plots the numbers of nymphs had increased very slightly or, in the DDT plot, not at all. On August 9, the adult population exhibited a further decrease in the control plots. No change of adult population occurred in the DDT plot which indicates an effective persistant toxicity, but marked increases took place in all parathion plots, which indicates no effective residual toxicity.

Parathion appears to be safe to use on grapevines. Only very slight foliage injury developed as a result of extremely heavy applications of 5% dust by hand duster during April to tender young shoots. Areas of immature leaves over which the dust had caked or covered solidly often appeared glassy due possibly to injury to epidermal cells. Leaf margins would sometimes appear abnormally ruffled. No injury was observed at any time with dusts of lower concentration nor as a result of heavy applications of 5% dust when it was used on several later occasions during the season and results studied.

Provided factors such as possible harmful residue or deleterious effects on beneficial insects do not develop, parathion appears to offer good promise of affording satisfactory control not only of most San Joaquin Valley grape pests but of combinations of such pests where they are present together. It is probable that more than one application of parathion dusts would be required for control.

Preliminary field tests with dust mixtures containing 0.25%, 1%, 2%, 3%, or 5% concentrations of parathion with or without sulfur applied by hand or power dusters have shown parathion to be effective against the following pests of grapes in the San Joaquin Valley: *Pocalta ursina, Hoplia callipyge, Pseudococcus maritimus, Desmia funeralis, Tetranychus willamettei, Erythroneura elegantula,* and *Draeculacephala minerva.* No significant injury to vines was observed.

TABLE 6

Effect of Parathion and DDT Dusts on Draeculacephala Minerva in Summer Grass Vineyard Cover Applied by Hand Duster Near Woodlake, July, 1947

Treatments	Numbers of sharpshooters per 20 sweeps per plot on sampling dates											
	July 24			July 30			Per cent differences of populations			August 9		
	Adults	Nymphs	Total	Adults	Nymphs	Total	Adults	Nymphs	Total	Adults	Nymphs	Total
July 26												
0.25% parathion, 55% sulfur	36	14	50	6	1	7	−83.4	−92.9	−86.0	29	4	33
1% parathion, 55% sulfur	62	12	74	1	0	1	−98.4	−100.	−98.6	16	2	17
2% parathion	104	0	104	1	0	1	−99.0	−0.	−99.0	32	1	34
5% DDT, 50% sulfur	46	4	50	3	0	3	−93.5	−100.	−94.0	3	0	3
Av. 5 untreated plots	33.6	3.6	37.2	24	5.4	29.4	−28.6	+33.3	−21.0	18.4	30.8	49.2

California Cotton Insects

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THE CONTROL OF THE COTTON OR MELON aphid, *Aphis gossypii* Glover, on cotton with HETP in liquid preparations only was considered practical since this insecticide in dusts had given such poor control in most trials, and proprietary dust mixtures were not being readily supplied. HETP was tried in "vapo-oil" applications by airplane but resulted in much foliage injury. One to two quarts of 50% HETP per five gallons of water applied per acre by airplane were effective in some applications, but in more than half of the applications these failed to give good control. When good control was obtained on young cotton plants, it was difficult to find a live aphid within the treated area. When control was poor, it was so nearly ineffective that no exact measurements were necessary. The applications tried were all made in the morning and temperature differences were not found to account for the variations in control. Two proprietary compounds—Vapotone and Blade—only were used, and these were apparently quite comparable.

The method for making counts consisted of fastening a merchandising tag on the petiole of a leaf and marking the tag with the number of aphids present on the leaf. When aphids were very numerous late in the season, the closest estimates of the number were used.

HETP was used in one application with an emulsifiable DDT concentrate and gave good control of the cotton aphid in the upper part of large cotton plants, without injury to the foliage. This airplane application applied 10 gallons per acre of a mixture containing one half gallon of 25% DDT plus 1½ quarts of 50% HETP.

BHC was unreliable in control of cotton aphids during 1947. Several proprietary dusts applied by row crop duster and airplane and sprays by airplane failed in the control of the cotton aphid. Few applications of BHC gave as good control of any cotton insect pest as were obtained with other insecticides.

In May, parathion was found very ef-

fective in small field tests for the control of cotton aphids and red spider mites. Dusts containing 0.25%, 0.5%, 0.75%, and 1.0% parathion; some with 55% sulfur were used. While the kill of aphids and red spider was more rapid with the 1% parathion, at the end of 10 days, the 0.5% and 0.75% dusts gave comparable results.

For the control of *Lygus hesperus* Knight, dusts were applied with a 4-row Master Fan row-crop duster, with a single outlet per row. Fifty pounds of each insecticide shown in table 2 were applied at the rate of 20 pounds per acre. The infestation on July 10, two days before dusting, was determined by 31 samples, each consisting of the Lygus bugs swept from 50 cotton tops with a standard insect net. The average was 4.1 adults and 1.4 nymphs per sample. The dusts were applied July 12.

About July 20, the entire field, including all experimental plots were dusted by airplane with a 5% DDT and sulfur mixture. Usually a good application will leave an average of 0.0–0.5 adults and no nymphs per sample. Evidently a poor proprietary insecticide, poor application, or combination gave poor control.

The field dusting tests with parathion show the initial kill was good but the residual action was not sufficient to kill adults migrating in. The residue may or may not control the nymphs that hatch from eggs within the stems. The DDT and sulfur mixture accidentally applied, prevented the determination of the effect of the parathion residue on young nymphs.

Parathion was applied as ½%, 1%, and 2% dusts by row-crop duster for the control of a heavy infestation of aphids and some spotted infestations of red spiders at 10 to 40 pounds per acre. The heavier applications and the higher concentrations were more rapid in effect but not ultimately more effective. Good control of aphids and red spiders resulted within two weeks. The larvae of red spiders were killed soon after hatching.

Late in the season red spider mites became numerous and injurious in a few fields which had been dusted with 5% DDT and 75% sulfur. This indicated that an unusual species of mite was present. It was identified as *Tetranychus pacificus* McG. *T. atlanticus* McG. is the species common on cotton and is controlled with 10 pounds or more of sulfur per acre.

In one of the fields heavily infested with the Pacific red spider with considerable webbing present, airplane applications of 30 pounds per acre of ½% and 3% parathion dusts were applied on 10-acre blocks. Two other such blocks were dusted, one with sulfur and the other with DN-D8 dust. The ½% parathion dust applied by airplane gave poor control but was more effective than either DN-D8 or sulfur. Mites near the surface of webbing were killed, but beneath the webbing there were live mites for the remainder of the season. The 3% parathion gave almost complete control after two weeks but was much slower in control than 1% and 2% parathion dusts were in lighter infestations and with considerably less webbing.

Some small-scale cage tests were made to test the toxicity of parathion to false chinch bugs, *Nysius minutus* Uhl. Parathion 0.25% and 1%, chlordan 5%, and benzene hexachloride (1.5% gamma) dusts all gave 100% kill in 48 hours. Sabadilla, 10%, was not effective.

TABLE 1—Hexaethyl Tetraphosphate Compared with Benzene Hexachloride for Cotton Aphid

Location of leaves on plants	HETP plus DDT* Aphids per leaf		Benzene hexachloride† Aphids per leaf		Benzene hexachloride‡ Aphids per leaf	
	Pretreatment	Post-treatment 3 days	Pretreatment	Post-treatment 3 days	Pretreatment	Post-treatment 3 days
Upper leaves	100	0	50	5	100	50
	300	2	100	40	60	60
	500	4	400	8	125	125
Lower leaves	800	3	250	250	250	250
	500	3	350	350	100	100
	100	10	...	...	...	...
	70	2	...	...	...	...

* 10 gallons per acre of a mixture containing ½ gallon of 25 per cent DDT plus 1½ quarts of 50 per cent HETP in 10 gallons.
† 10 gallons per acre of a water suspension of benzene hexachloride to apply a 0.21 lbs. gamma isomer per acre.
‡ 6 gallons per acre of Vapo oil and benzene hexachloride to apply 0.8 pounds of gamma isomer per acre.

TABLE 2—Control of Lygus with Various Dusts

Materials, applied July 12	Average Lygus per sample, 24 hours later		July 17, average Lygus per sample		July 28, average Lygus per sample	
	Adults	Nymphs	Adults	Nymphs	Adults	Nymphs
Parathion 0.5%	2.0	0.3	6.0	0.1	2.0	0.0
Parathion 1.0%	0.5	0.0	4.5	0.0	1.7	0.0
Parathion 2.0%	0.0	0.0	5.8	0.0	2.1	0.0
BHC 1.5% gamma plus DDT 2.5% plus 50% sulfur	0.0	0.0	0.5	0.0	1.5	0.0
Toxaphene 12.5% plus 50% sulfur	0.5	0.0	1.3	0.0	2.0	0.0
Chlordan 5%	4.6	0.6	6.8	0.3	3.3	0.7
Control N of plots	...	...	4.2	0.6	3.3	0.0
Control S of plots	...	...	7.0	2.2	4.2	0.7

Greenhouse Plants

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IN CONTRAST TO THE GENERAL CONTROL of insects on a large agricultural acreage, the control of pests occurring under greenhouse conditions is aimed at complete elimination. The newer insecticides, more than ever before, are judged by nurserymen for their ability to effect one hundred per cent control. In this report a summary is presented of the preliminary investigations of the use of parathion for the control of mite and insect pests of ornamental plants grown under greenhouse conditions in the San Francisco Bay Region. Wettable powder preparations were used in water, and the rate of application was such as to ensure complete coverage of the plants. An effort was made to determine the minimum dosage necessary for 100% control of various pests by a single application, and to determine apparent limits of plant tolerance.

Although in some instances complete control of the common spider mite, *Tetranychus telarius* (Linnaeus), was accomplished with 0.15 pound parathion per 100 gallons, there was generally sufficient survival from hatching eggs to allow a rapid return of destructive populations. Complete control was effected with 0.3 pound per 100 gallons, with the larvae developing within the eggs and dying before or soon after hatching. Complete control was accomplished of a heavy infestation in two greenhouses of carnations with 0.15 pound to 100 gallons when six ounces to 100 gallons of adjuvant—Du-