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-

pont's "Sticker and Spreader"—was also included, although control with this strength was ineffective in another carnation infestation where no adjuvant was used. It was indicated that physical differences in the leaf surfaces of different varieties or species of ornamental plants was associated with apparent differences in resistance of the same species of mite when on different hosts subjected to the same insecticidal treatment.

Complete control was obtained of a light infestation of Luden's spider mite, *Tetranychus ludeni* Zacher, on lantana with 0.15 pound to 100 gallons. Similarly, complete control was obtained of moderate to heavy infestations of the palm spider mite, *Septanychus tumidus* (Banks), on kentia and phoenix palms and maranta with 0.15 pound to 100 gallons. Hatching was observed for as long as ten days following treatment, indicating that the insecticide retarded development within the egg.

No apparent control of Trichadenid mites was obtained of moderate infestations of the privet mite, *Brevipalpus inornatus* (Banks), on aspidistra, campanula, or lycaste orchids, with one to three applications of .25 or .3 pound to 100 gallons.

The cyclamen mite—Tarsonemid mites, *Tarsonemus pallidus* Banks, feeds on many plants of which some develop new leaflets individually or in rosettes. On such plants the mite may be controlled with parathion. Laboratory tests indicated that complete control may be obtained with 0.15 pound to 100 gallons, the greatest mortality occurring in three or four days. Under greenhouse conditions severe infestations on crops including saintpaulia, English ivy, pepper plant, and *Aralia belforiana* were not entirely controlled with 0.15 pound to 100 gallons, although complete control was generally obtained with 0.25 pound or 0.3 pound to 100 gallons. Complete control was similarly obtained with a moderate infestation in fibrous begonia buds with 0.3 pound to 100 gallons, live mites being found for ten days following treatment. No apparent control was obtained with infestations in azalea buds with an application as high as 1.0 pound to 100 gallons nor with four successive treatments of various concentrations at 10 to 14 day intervals.

Complete control was obtained of a severe infestation of the broad mite, *Hemitarsonemus latus* (Banks), on azaleas with a single application of 0.15 pound to 100 gallons.

Complete control was obtained of a heavy infestation of the greenhouse thrips, *Heliothrips haemorrhoidalis* (Bouché), on azaleas with a single application of 0.15 pound to 100 gallons.

A heavy infestation of the latania aphis, *Cerataphis lataniae* (Boisduval), on kentia palms was completely controlled with a single application of 0.15 pound to 100 gallons. Complete control was similarly obtained of the ivy aphis, *Aphis hederae* Kaltenbach, on English ivy with a single application of 0.15 pound to 100 gallons.

A heavy infestation of the greenhouse whitefly *Trialurodes vaporariorum* Westwood, on coleus and light infestations on several other crops were completely controlled with a single application of 0.15 pound to 100 gallons.

Single applications of 0.15 pound to 100 gallons on light to heavy infestations of Baker's mealybug, *Pseudococcus maritimus* (Ehrhorn), on fuchsia, pelargonium, croton, acalypha, fern, and miscellaneous potted plants generally gave incomplete control, particularly because of subsequent hatching. With an application of 0.3 pound to 100 gallons, control was usually complete, and incomplete coverage was believed to be responsible where a second spraying was indicated. Mortality was generally slow, and both adults and hatching larvae died over a period of two to three weeks following treatment. Similar experience was obtained with a heavy infestation of the citrus mealybug, *Pseudococcus citri* (Risso), on coleus and a heavy infestation of the citrophilus mealybug, *Pseudococcus gahani* Green, on lantana.

A single application of 0.15 pound to 100 gallons gave complete control of a heavy infestation of the palm mealybug, *Pseudococcus nipae* Maskell, on philodendron and of light to heavy infestations of the long-tailed mealybug, *Pseudococcus longispinus* (Targioni), on miscellaneous potted plants.

Very little control was obtained with 0.3 pound to 100 gallons for the soft brown scale, *Coccus hesperidum* Linnaeus, on ferns and other plants. Poor control was also experienced for the black scale, *Sassetia oleae* (Bernard), on aralia and other plants, and the hemispherical scale, *Sassetia hemipherica* (Targioni), on ferns. The "rubber" stage of these species was particularly resistant, and hatching within the large egg masses was observed several weeks after treatment.

Complete control was accomplished with a single application of 0.3 pound to 100 gallons to heavy infestations of the Florida red scale, *Chrysomphalus ficus* Ashmead, on kentia palms and the aspidistra scale, *Pinnaspis aspidistrae* (Signoret), on Boston ferns. The larger females seemed alive two weeks after spraying, but all were dead in four weeks.

Only 60% control was effected for the larvae of the carnation bud moth, *Platynota stultana* Walsingham, within the terminal shoots and flower buds of carnations which were sprayed with 0.15 pound to 100 gallons.

No control was apparent of the larvae and pupae of the chrysanthemum midge, *Diarthronomyia chrysanthemi* Ahlberg, in a heavy infestation on chrysanthemums sprayed with 0.3 pound to 100 gallons.

A very large variety of flowering and other ornamental plants were sprayed with concentrations of from 0.25 pound to 0.3 pound to 100 gallons. In general there was no apparent damage noted to delicate blooms (including several cattleya and epidendrum orchids), foliage, or to propagation cuttings. In the case of Boston and Maidenhair ferns, however, there was possibly a slight marginal burn of some leaflets, although tender shoots appeared unaffected. Where additional spreader was used to avoid unsightly residue of the weaker wettable powder, some marginal burn was noted on flowers of saintpaulia and a small amount of lower leaf drop (possibly due to other causes) was observed on poinsettias. No greenhouse roses were sprayed. A concentration of .45 pound to 100 gallons was also sprayed on a large variety of plants, although no extensive crops were treated. No ill effects were observed after these applications. No evidence was obtained of accumulative effects on plants sprayed several times at two-week intervals.

At a concentration of 0.75 pound to 100 gallons, severe leaf burn was noted on ferns and some tip burn, leaf curl, or lower leaf drop were observed on pothos, coleus, gynura, aralia, aglaonema, syngonium, and phoenix palm seedlings. The flowers of azaleas were severely injured and accompanied by considerable leaf drop. Effects on the plants were evident within several days, and subsequent observations revealed no further injury. No damage was apparent on a few plants each of dracaena, cattleya, sansevieria, English ivy, bougainvillea, pepperonia, grape ivy, ceresa, philodendron, sheffelaria, kentia palm, and selaginella. In the case of azaleas sprayed with 1.0 pound to 100 gallons, no difference in amount of injury was noted between plants under hothouse or under cool lath-house conditions.

Parathion, as a wettable powder used at the rate of 0.15 pound actual material to 100 gallons, proved to be effective for the control of all stages of the aphids, thrips, whiteflies, the broad mite, and some of the spider mites and mealybugs tested. At the rate of 0.25 pound to 0.3 pound to 100 gallons, it gave complete control of all spider mites, mealybugs and certain armored scales tested as well as the cyclamen mite under exposed conditions. It was found at these concentrations to give at most partial control of the privet mite; the protected immature stages of the carnation bud moth and chrysanthemum midge, and the soft scales tested. Significant plant injury was not noted with concentrations of 0.25 pound to 0.3 pound to 100 gallons, and observations indicated that, except for ferns, many plants may be tolerant to 0.5 pound to 100 gallons. Concentrations above this are very apt to produce immediate injury.