

Systemic Insecticides

control of plant feeding pests by poisoning plant juices studied

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Systemic insecticides—compounds which can be absorbed readily by plant foliage and roots and subsequently translocated throughout the plant—render the plant tissues poisonous or unpalatable to juice feeding insect pests.

Systemics have proved effective in controlling aphids and mites on annual crops—such as greenhouse plants, cotton, hops—and their possibilities for the control of juice feeding citrus insects are under study in a comprehensive research program at Riverside. The Divisions of Entomology and Plant Physiology of the University of California Citrus Experiment Station are co-operating.

Inasmuch as systemic action has been found to some degree in several organic phosphorus and fluorine compounds, it was necessary—for the citrus pest investigations—to devise a satisfactory method for the quantitative estimation of systemic action.

Such a test must demonstrate the rate of translocation of the compounds in the plant when applied in various concentrations, and must determine the toxicity of the translocated material to a variety of citrus pests.

Preliminary experiments demonstrated that the most satisfactory results could be obtained by growing five- to six-month-old lemon seedlings in water culture solutions to which were added known concentrations of solutions or emulsions of the test compounds.

Screening Tests

At definite intervals after the beginning of the experiment, leaves were removed from the plant and placed in plastic modified Munger cells where they could be infested with known numbers of citrus red mites, citrus aphids, greenhouse thrips, crawlers of California red, cottony-cushion, black, or other scales, or with almost any citrus pest which sucks the plant juice. Mortality data could then be recorded over a period of several days.

Such tests reveal quite precisely the movement of the toxicant through the intact roots, up the stem and into the leaves, and demonstrates the concentrations in the water culture solution necessary for systemic action.

The use of closed cells—such as the modified Munger cell—is perhaps objec-

tionable on the grounds of possible fumigation effects, but no other practical way of confining the tiny pests has been devised, and no difficulty from fumigant action has occurred in practice.

When the results from the initial screening appeared promising, the compound was tested further by watering it into the soil of potted citrus seedlings and by spraying it on the foliage of similar seedlings.

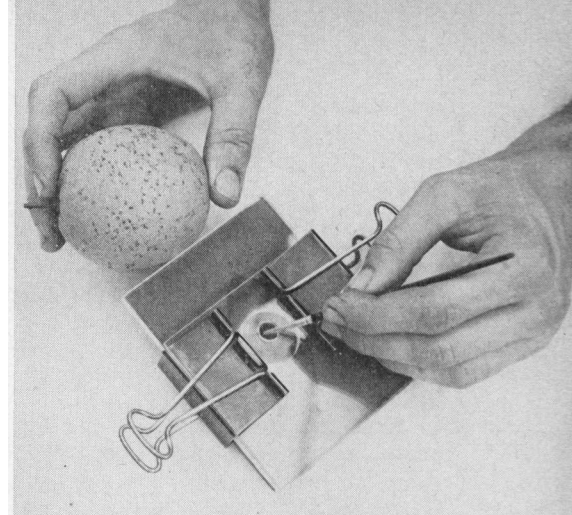
Plants treated in these ways were then tested by the Munger cell methods and by mass infestation—by numbers of adult mites, aphids, thrips, or by scale crawlers—followed by observation to determine whether the populations declined or increased.

Tests were carried out over a period of several months to determine the duration of toxic action. These tests closely approximate actual field conditions where the systemic material would be applied in irrigation water, or by spraying.

When a compound such as octamethyl pyrophosphoramidate — OMPA — gave highly promising results in laboratory tests, it was applied to one or more full-sized citrus trees on the Experiment Station grounds. This was done to assess the

Comparison of Contact and Systemic Toxicity to Adult Female Citrus Red Mite, *Paratetranychus citri* (McG.)

Compound	Conc. in per cent	24-hour per cent mortality contact with residue	48-hour per cent mortality systemic action	
			Days after treatment 2	7
Para-thion ..	0.01	91	0	0
	0.005	81
	0.0025	25
	0.001	9
Para-oxon ..	0.01	100	10	80
	0.001	23	0	0
Octa-methyl .	0.1	77
Pyro-phospho-ramide .	0.03	..	0	100
	0.01	..	0	100
	0.001	..	0	5



Applying greenhouse thrips to leaf from systemically treated citrus to determine toxic effect, using a Munger cell of isobutyl methacrylate polymer. After insects are placed on leaf, cell is closed by sliding top plate.

effects on natural insect populations of California red scale, citrus thrips, citrus aphids, black scale, cottony-cushion scale, citricola scale, citrus red mite and other pests.

The intensity and duration of the toxic action was further observed by removing leaves and fruit at regular intervals for bio-assay by the use of the Munger cells and similar methods developed for testing toxicity of treated citrus fruits.

Preliminary Results

The data obtained indicate some of the properties of several organic phosphate insecticides, both as residual toxicants and as systemic insecticides.

Parathion, very highly toxic by direct contact, has little or no systemic action, while its close relative, para-oxon, has considerable systemic action.

OMPA is very weakly toxic to insects by direct action, but is quite effective as a systemic. This lack of toxicity of direct contact is of considerable importance as it prevents destruction of beneficial parasites and predators. This factor should largely eliminate the destructive increases of resistant insects sometimes observed following the use of DDT or parathion. Certain of the newer organic phosphate compounds such as E-1059 and 20/58 show even greater systemic action than OMPA.

OMPA applied to soil about citrus seedlings at 0.1% of the weight of the soil in pots, has given complete kill of citrus red mites for five months. When applied to large citrus trees by spraying at one to two pounds per 100 gallons of water, OMPA treatment has resulted in complete cleanup of natural mite populations for periods of at least three to four months, although adjacent trees are heavily infested. The toxicity to greenhouse thrips and red scale crawlers is of considerably shorter duration.

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