Citricola Scale Control

tests find parathion a control agent of outstanding promise in commercial navel and Valencia orange groves

W. H. Ewart and H. S. Elmer

Commercial navel and Valencia orange groves in the San Joaquin Valley were used in experimental applications of parathion for citricola scale control in field tests during the period from 1947 to 1950.

Promising results were obtained with sprays containing 25% parathion wettable powder suspended in water, or with dusts composed of 1% and 2% parathion mixed with an inert diluent or with sulfur.

Three types of applications were evaluated: *1*, thorough-coverage sprays applied at the rate of 25 to 35 gallons per tree with conventional high-pressure spray equipment, using manually operated guns from the ground or—in groves with large trees—from a tower; *2*, outside coverage sprays applied with spray-duster equipment at the rate of 100 to 200 gallons per acre; and *3*, dusts applied with spray-duster equipment at the rate of 100 pounds per acre.

To conform with standard commercial practices, applications were made three times a year: *1*, from late July to late October when the hatching period was terminated and the scales were translucent and small in size; *2*, in February and early March when the scales were dark in color and slightly larger than in late summer and fall; and *3*, during the early part of the hatching period—late April to early June—when adult and newly hatched scales were present on the trees.

Summer and Fall Treatments

Late summer and fall treatments were applied from late July to late October.

With thorough-coverage sprays, excellent control was obtained with a dosage of one-quarter pound of 25% parathion wettable powder per 100 gallons of spray.

With outside-coverage sprays applied with a spray duster, good control was obtained with application of three pounds of 25% parathion wettable powder per acre and excellent control with application of six pounds per acre.

Dust treatments of 2% parathion applied at the rate of 100 pounds per acre gave good commercial control but were generally less effective than the thorough-coverage or outside-coverage sprays.

Residues of parathion recovered in the peel of ripe navel and Valencia orange fruits, based on fresh weight of peel, averaged less than 0.5 ppm—part per million—with dosages that controlled citricola scale.

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Resistance to Fumigation

studies of outbreak in southern California reveal resistance to hydrogen cyanide fumigation persists

Paul D. Gerhardt and David L. Lindgren

Citricola scale—*Coccus pseudomagnoliarum* (Kuw.)—in citrus growing areas of California is still resistant to hydrogen cyanide—HCN—fumigation.

For 15 years the population of citricola scale in southern California was so low that control treatments were rarely needed. In the summer of 1949 the scale reappeared in large numbers and it became evident that treatment would be necessary in certain groves.

Many growers and pest control operators accepted the belief that citricola scale was as resistant to HCN fumigation in 1949 as it had been prior to 1934. Within three or four years after resistance to HCN fumigation showed up in the Riverside area in 1925 it had spread to the Riverside-Highgrove and Redlands-Cucamonga areas or most of the areas where citricola scale occurred in southern California.

To ascertain the present status of the resistance of citricola scale to HCN fumigation in southern California, a series of experiments was conducted during the fall of 1949, some in groves which were fumigated by commercial operators, and others in groves in which a few trees were fumigated experimentally.

Groves used in the experiments were located in three areas in southern California—Temescal Canyon, Arlington Heights, and Redlands. Dosage schedules used were 20 cc. and 22 cc.

To compare the resistance of citricola scale to HCN fumigation in different areas, heavily infested twigs were collected from four groves in central California; two, at Ivanhoe; one, at Terra Bella; and one, at Edison. Twigs from one grove in the Highgrove area in southern California were tested also.

All twigs were brought into the laboratory, placed in small bottles of water, and fumigated in a 100 cubic foot fumigation chamber. A dosage of 6.0 cc. per 100 cubic feet was used, which is equivalent to a 20 cc. dosage field schedule.

After fumigation the twigs were held for four days in a room in which the relative humidity was 80% before the citricola scales were counted.

The results of the laboratory tests showed that the lowest mortality of citricola scale—49.9%—was obtained on scale from the Highgrove area. Higher mortality—from 87.4% to 94.7%—was obtained with the scale from central California.

Citricola scale insects from some of the areas in central California are considered resistant but they do not appear to be so resistant under laboratory conditions as do those from southern California. How-

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STATIONS

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sorghums and some varieties of melons have shown promise. All these crops can be grown with less than half the amount of water commonly used on alfalfa.

Tulelake

The Tulelake Field Station, started in 1946, is located on 18 acres in the Tulelake basin at an elevation of 4,000 feet and only four miles from the Oregon border. The growing season is short and the winters extremely cold. Killing frosts may occur in any month of the year. The two major crops of the region are potaties and two-row barley.

Because of climatic conditions the area is limited to cool climate crops. Experiments are being carried on with varieties and species of truck crops, and field and seed crops. Special attention is being given to potato diseases and storage problems as potatoes probably will continue to be a major crop in this area.

The climate conditions and the isolation of the area probably will greatly limit the number of crops which can be grown profitably.

San Jose

The Deciduous Fruit Field Station at San Jose has been in existence for about 25 years. It is a small station of 15 acres and until recently was operated by the Division of Plant Pathology, and used primarily for investigation on fruit tree diseases. Because of its strategic location in the coastal fruit belt, it will continue to be used for the same purpose, as well as a place for developing and testing deciduous fruit varieties for that area.

Hopland

The latest addition to the system of field stations is the Hopland Field Station consisting of 4,637 acres in southern Mendocino County.

This station was acquired in July 1951. The area will be used for the study of range improvement, the handling and management of livestock on the range and other problems incident to range land utilization. It will provide excellent facilities for the long-time study of range investigation and management problems.

Co-operative Work

In addition to these five field stations co-operative work is carried on at two stations operated by the United States Department of Agriculture—the United States Cotton Field Station at Shafter, and the United States Rice Station at Biggs.

The Shafter area is an important potato and vegetable growing region. Here the Division of Truck Crops investigates various potato and vegetable production problems, and the Division of Agricultural Engineering co-operates on cotton mechanization studies.

At the Rice Station, the Division of Agronomy experiments mainly with crops other than rice, which are adapted to the area.

Because of California's great variations in soil and climate the field stations can contribute materially to the solution of many of the state's agricultural problems. While emphasis will probably always be placed on problems of the immediate area, the stations also provide outdoor laboratories for trial and verification of fundamental research.

B. A. Madson is Professor of Agronomy, University of California College of Agriculture, Davis.

CONTROL

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Late winter and early spring treatments were applied in February and early March.

Thorough-coverage sprays, outside-coverage sprays, and dusts all reduced the scale populations in comparison to untreated check plots.

Good control was obtained with thorough-coverage sprays using a dosage of one-quarter pound of 25% parathion wettable powder per 100 gallons of spray. Increasing the dosage to one-half or one pound per 100 gallons did not increase the effectiveness of this type of application.

Outside-coverage sprays applied with a spray duster at the rate of 100 to 200 gallons per acre did not give commercial control with application of eight pounds of 25% parathion wettable powder per acre. Nor were dust applications of 2% parathion applied at the rate of 100 pounds per acre commercially effective.

No residue determinations for navel oranges were made following winter treatments since the applications came after the harvest period. On Valencia oranges, an average of 0.4 ppm of parathion was recovered in the peel following thorough-coverage application of one-quarter pound of 25% parathion wettable powder per 100 gallons of spray.

Treatments for the early part of the hatching period were applied from late April through early June.

All three types of application reduced the scale population in comparison to untreated check plots but only the thorough-coverage sprays gave commercial control.

The effectiveness of thorough-coverage sprays improved as the dosage was increased from one-half pound to two pounds of 25% parathion wettable powder per 100 gallons of spray. Increasing the dosage beyond the two-pound level was of no benefit. The control obtained with dosages less than one pound of 25% parathion wettable powder was not satisfactory from a commercial standpoint.

Single treatments of sprays applied at the rate of 100 to 200 gallons per acre with spray-duster equipment at the beginning of the hatching period did not give commercial control with dosages up to 12 pounds of 25% parathion wettable powder per acre. In a two-treatment program with spray-duster applications in which the first application was made at the beginning of the hatching period followed by the second application two to four weeks later, promising control was obtained with a dosage of six pounds of 25% parathion wettable powder per acre per application.

Single treatments at the beginning of the hatching period with 2% parathion dust in which parathion was combined with an inert diluent or with sulfur did not give satisfactory commercial control.

Double treatments of 2% parathion dusts—the first at the beginning of the hatching period with the second two to four weeks later—were more effective than the single treatments but still not so effective as single thorough-coverage sprays applied with conventional high-pressure spray equipment.

Parathion dusts in which sulfur was included to the extent of 85% were more effective than parathion dusts having an inert diluent in place of the sulfur.

Parathion residues recovered in the peel of navel oranges at time of harvest averaged less than 0.5 ppm from commercially effective treatment applied at this time of year.

Abnormally high populations of soft brown scale, *Coccus hesperidum* L., have occurred with some applications of parathion in citrus groves—apparently because parasites of this species were eliminated. In most cases with dosages of parathion that have controlled citricola scale, high populations of soft scale have not been extensive or of long duration. However, any application of parathion carries a possibility that soft scale populations may increase substantially.

W. H. Ewart is Assistant Entomologist, University of California College of Agriculture, Riverside.

H. S. Elmer is Assistant Specialist in Entomology, University of California College of Agriculture, Riverside.

Parathion is extremely toxic to humans and the most serious hazard relating to its use is danger to personnel who may come in contact with the compound while making applications or working in newly treated groves. Precautions recommended by the manufacturer should be followed carefully.