Soft Brown Scale on Citrus

abnormal increase of scale population in groves treated with parathion investigated in survey

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Not all commercial groves treated with parathion develop abnormally high populations of soft brown scale but where populations do increase they usually are extensive and have definite characteristics in comparison to populations found in groves not treated with parathion.

Following experimental applications of parathion for the control of yellow scale and citricola scale in certain groves in the San Joaquin Valley, the soft brown scale became a major pest in 1947. Since then abnormally high populations have been observed in other groves treated with parathion in the San Joaquin Valley, in the Sacramento Valley, and in southern California.

Resistance to Parathion

Preliminary investigations indicated that these increases were the result of a striking resistance of this species to parathion, coupled with the susceptibility of its parasites to this compound and their consequent elimination from treated groves for relatively long periods.

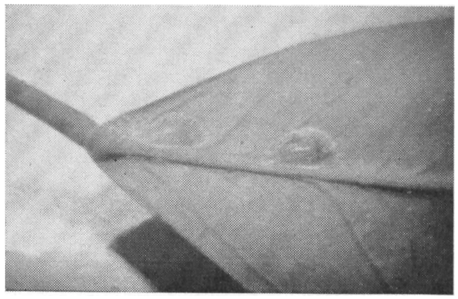
In untreated groves the soft brown scale is normally found in colonies restricted to occasional branches which are almost always attended by ants. In parathion-treated groves soft brown scale is found throughout the trees on the leaves and small branches largely unattended by ants.

Soft brown scale is found throughout the commercial citrus producing areas of California, but has normally been a minor pest because of very effective parasites and predators.

Heavy populations of this scale weaken the trees by removing large quantities of plant sap and leaving large deposits of honeydew, which become blackened with sooty mold fungus and interfere with the normal functions of the leaves. This type of injury is similar to that caused by citricola scale or black scale.

Survey

To develop information on the relation between parathion treatments and increases in soft brown scale populations, a survey was made in 1949 and 1950 in approximately 100 experimental plots and in 22 commercially treated groves in which parathion had been applied for the control of citricola scale, black scale, California red scale, or yellow scale.



Photograph by Metta McD. Johnson

Appearance of soft brown scale on an orange leaf. Darker scale at right is an older specimen.

This survey disclosed a great amount of variability in soft brown scale populations in different plots and groves following parathion treatments. In certain groves, however, there was a relationship between the size of the population and the dosage or number and timing of parathion treatments.

In one grove, plots had been treated in 1947 with dosages of 1, 1½, 2, 2½, and 3 pounds of 25% parathion wettable powder per 100 gallons of water applied at the rate of 3,000 gallons per acre. One year later the soft brown scale population in these plots averaged 0.3, 1.2, 2.8, 6.1 and 3.1 scales per leaf, respectively. The plots treated with the higher dosages of parathion were not entirely cleared up by parasites one year and four months after treatment.

Three plots in another grove were treated in 1949 with 1, 1½, and 2 pounds of 25% parathion wettable powder per 100 gallons applied at the rate of 3,000 gallons per acre had an average of 0.2, 0.1 and 0.4 scales per leaf, respectively, two months after treatment. The populations were entirely cleaned up in all three plots four months after treatment by parasites and predators that were able to move back into the grove.

Other plots and groves showing similar abnormal populations of soft brown scale failed to clean up only when additional treatments of parathion were applied before the parasite and predator populations had a chance to move back into the grove.

One plot treated six times over a period of two years—in 1948 and 1949—had an extremely high population count of 23.9 scales per leaf seven months after the last treatment of parathion. However, 14 months after the last treatment parasites and predators had eliminated the soft brown scale population in this particular grove.

Test Treatments

Spray applications of parathion at the rate of 100 to 200 gallons per acre with spray duster equipment for the control of citricola scale also caused an increase in soft brown scale populations. These populations, however, generally were less extensive than those in groves treated with thorough coverage applications.

Larger populations of soft brown scale occurred in and persisted longer in plots treated with parathion without oil than in plots treated with petroleum oil sprays to which parathion had been added. There were, however, usually more soft brown scales in plots treated with parathion-petroleum oil sprays than in untreated plots or plots treated with oil alone.

Plots treated with experimental insecticides other than parathion were closely watched throughout the survey for any abnormal increases of this scale.

Other organic phosphate compounds that caused increases in populations of soft brown scale were O,O-dimethyl S-(2-oxo-2-uredioethyl) dithiophosphate—Compound 3901; S-carbamylmethyl O,O-dimethyl dithiophosphate—Compound 3869; para-oxon; and ethyl *p*-nitrophenyl thionobenzenephosphonate—EPN.

Para-oxon-treated plots, in one grove, had higher populations of this scale than did plots treated with similar dosages of the other organic phosphates, including parathion. Parathion ranked second, followed in order by EPN, Compound 3901, and Compound 3869. These last two compounds showed but slight increases in the population over untreated plots. Dieldrin, aldrin, rotenone, DDT, TDE, methoxychlor, and DFDT treated plots in this grove had no significant increases in the population of soft brown scale.

The survey was continued into 1951 and differences were observed when compared with the 1949 and 1950 survey. Groves treated with high dosages of parathion in 1951 did develop high populations of soft brown scale immediately

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SPRAY

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6. Spray chemical. Fumigant types such as TEPP and parathion may require less gallonage per acre in aphid control. Oil emulsions and lime sulphur must be applied at lower concentrations and gallonage to avoid excess deposits.

7. Condition of bark at time of application. Dry bark absorbs more spray liquid and requires a higher gallonage.

8. Atmospheric conditions. Warm, dry air increases evaporation and requires larger gallonages to wet the trees adequately.

9. Amount of wind. An increased gallonage is generally required even if a light wind is blowing.

10. Insects to be controlled. Bark infestations of scale insects are more satisfactorily controlled by bulk sprays or increased applied gallonage.

In general, the applied gallonage per acre required for fruit trees with the semiconcentrate and concentrate methods of application may be expressed as the following fractions of what is required in the bulk application method:

	Concentration (in multiples of standard dosage 1X)	Gallonage required (in fractions of requirements by the bulk application method)
Semiconcentrate applications	1X	4/5
	2X	2/5
	3X	3/10
	4X	1/5
Concentrate applications	6X	1/8
	8X	1/10
	10X	1/12

The table on page 12 gives the gallonage and amount of material to be applied per acre with the various concentrations of spray chemicals, as used in bulk, semiconcentrate and concentrate methods of application.

The gallonage as applied by the bulk method—being most familiar to growers—is used as a base in determining the data.

The variance in planting and number of trees per acre is covered in column one.

The variance in tree size is indicated in column two by the number of applied gallons per tree in the bulk method.

The variance in concentration of the three methods is indicated in columns three to 10 by the multiples of 1X, the standard dosage.

The reduction in the amount of material applied per acre by the semiconcentrate and concentrate methods of application does not exceed 20% of that as applied by the bulk method.

The amounts of material applied by the semiconcentrate and concentrate methods of application are comparable or equal.

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The above progress report is based on Research Project No. 806.

TOMATO

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earworm, tomato pinworm, and the larvae of the potato tuber moth. In Central California it is seldom necessary to initiate control against these pests before early July. In the warmer portions of the San Joaquin Valley, it may be necessary to start treatments in May or June.

Sulfur is the principal material used to control the tomato mite, while DDD and DDT are the chief insecticides used against the several species of caterpillars. Sulfur for the control of the tomato mite can be used in combination with the insecticide selected for the control of caterpillars. In such cases the concentration of sulfur should not be less than 50% and—for the first application—best control of the mite will be insured if the sulfur content is 75%. In most cases, where it appears that there is poor control, it is because applications were made too late; poor coverage was obtained especially in the vicinity of aerial obstructions such as buildings, trees, or power lines; insufficient material; or faulty equipment. To the present time there has been no positive indications that a strain of mite resistant to sulfur is being selected from the population.

In general if the control of the mites has been satisfactory and no evidence of them can be found by the first part of September, sulfur can be omitted from later applications of insecticides intended for caterpillar control.

DDT is not nearly so effective as DDD for the control of the tomato hornworm, *Protoparce sexta.* Therefore, in the warmer interior valleys where this caterpillar is likely to be present in destructive numbers, DDD is the recommended insecticide for the first two applications. However, DDD is not effective against flea beetles. A switch to DDT for a final application is frequently desirable as flea beetles may appear in destructive numbers in tomato fields in late summer and early fall. By this time hornworms no longer present a problem, and the important caterpillars likely to be present include the corn earworm, beet armyworm, tomato pinworm and the potato tuber moth. Against these pests both DDT and DDD are highly effective.

For an effective control of the tomato mite and the several species of caterpillars, usually two to three applications of insecticides are necessary, applied at intervals of from four to six weeks. The concentration of DDD or DDT in the dust should be 5% and the dusts applied at the rate of from 30 to 35 pounds per acre per application. Best results are assured where the dusts are evenly and thoroughly applied. Where obstacles—such as trees, buildings, power lines, oil derricks—interfere with airplane applications, supplemental measures should be used to treat any areas missed, If this is not done, the harvested crop may contain annoying amounts of infested fruit, particularly in the late shipping crop from the southern San Joaquin Valley. Failure to obtain highly satisfactory control should not be blamed at present upon the insecticide but upon the application.

In recent years a leafminer occasionally has caused serious defoliation of tomato plants. At first, some of the newer insecticides—such as DDD and DDT—were held responsible for an increase in the population of the leafminer. After investigation it appears that serious infestations by the leafminer are more dependent upon natural surroundings and conditions than upon insecticides used.

The insecticides used in the tomato insect control program will not result in a residue problem if used as recommended and if the fruit is washed or wiped carefully before being marketed.

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SCALE

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after the application but such populations did not persist so long as in the previous two years.

Multiple applications of parathion in 1951 were no more serious in this respect than single treatments were in 1949 and 1950. One possible explanation is that the increased populations of this scale in 1948 and 1949 because of parathion treatments followed unusually cold winters which may have reduced the number of parasites to much lower levels than the milder winter in 1950–51.

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The above progress report is based on Research Project No. 1416.