# Frosted Scale on Walnuts

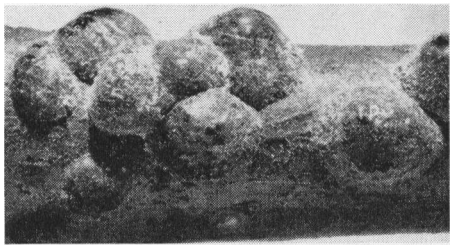
## codling moth treatment, DDT drift from adjacent crops interfere with control of the pest by natural enemies

A. E. Michelbacher and Stephen Hitchcock

**Frosted scale** *on walnuts*—held in check by natural enemies—was almost an unknown problem in northern California until after DDT was used to control the codling moth.

Soon after DDT was first used on walnuts an increase in the frosted scale population became apparent and the rate of increase was associated with the amount of DDT applied. The dividing point—between nondestructive and highly destructive DDT induced scale populations—occurred when DDT 50% wettable powder was applied in amounts exceeding five to eight pounds per acre. Some increase did occur at the five- to eight-pound dosage, but was of little importance when compared to the mass outbreaks brought about by higher applications.

Outbreaks of the frosted scale following applications of DDT result from the adverse effect the chemical has on the parasites of the scale. Any treatment that is not effective against the scale, but is harmful to its parasites—*Metaphycus californicus* (Howard) is the most important parasite—is likely to result in an increase of the scale population. Even where destructive scale populations have been allowed to develop, the parasites will reduce them to a nondestructive level if the treatments responsible for the increase are discontinued. However, a year is needed for the parasites to bring this about. Parasites have several generations each year and the scale has but one so the parasites have a number of opportunities to attack the scale and reduce its numbers.



The frosted scale produces quantities of honeydew during the period of rapid development, from mid-March through April.

All increases in the frosted scale population induced by DDT are not because of direct application of the insecticide to the trees. Some of the most serious outbreaks have resulted from the drift of DDT dust from fields adjacent to walnut orchards. In one case a destructive population developed in a walnut orchard next to a corn field that was dusted several times with DDT to control the corn earworm. Sufficient dust drifted through the orchard to play havoc with the parasites of the frosted scale. Unchecked the frosted scale developed until the twig growth was almost caked with them. The infestation was heaviest on the side of the orchard adjacent to the treated corn field.

Where walnuts are interplanted with other trees there is an opportunity for the development of a destructive frosted scale population if the interplanted trees are treated with DDT.

In some orchards the frosted scale has increased even when the amount of DDT 50% wettable powder used to control the codling moth has not exceeded eight pounds per acre. This has occurred at Linden where most of the experimental orchard has received the same codling moth treatment, but the scale population has varied considerably.

The variation in the scale population can be explained in a large measure by the different aphicides used in combination with the codling moth spray, and by aphid treatments used later in the season. The orchard is divided into plots which have received different treatments for the control of the walnut aphid. Each of the aphid treatments was replicated at least twice, permitting a study of the effect of the aphid treatments on the frosted scale population.

When the codling moth treatment is applied in late April and May, the frosted scales are reaching maturity. They are producing eggs, which are protected from the treatment by the hard body of the parent. Also, at this time the parasites are developing in the bodies of the scales and they likewise are protected from the spray. Because of these conditions, the nonsystemic aphicides exert no action upon the scale populations. On the other hand, the systemic aphicides do influence the scale crawlers when they hatch around the middle of June. However, it is believed that the systemic aphicides do not have any appreciable action upon the parasites that emerge from the old scales.

The hatching scales move to and feed on the current season's twig growth, leaf petioles and leaves where they can be found throughout the growing season. In the fall before the leaves drop many—if not most—of the scales on the petioles

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**1955 Treatments, and Frosted Scale Population on Walnut Leaves in the Experimental Plots at Linden**

| Treatment and Pounds Per Acre[a] | | Average Number of Scales Per Leaf Sample[b] | | | | | |
|---|---|---|---|---|---|---|---|
| | | July 26 | | August 8 | | Sept. 11 | |
| | | Alive | Dead | Alive | Dead | Alive | Dead |
| OMPA (total active)[c] | 0.7 | 0.81 | 0.62 | 0.98 | 0.79 | 0.69 | 0.65 |
| | 1.0 | 0.30 | 0.52 | 0.27 | 0.56 | 0.21 | 0.41 |
| | 1.5 | 0.05 | 0.12 | 0.07 | 0.19 | 0.07 | 0.09 |
| | 2.0 | 0.02 | 0.11 | 0.03 | 0.15 | 0.02 | 0.05 |
| Systox (Actual)[d] | 0.25 | 0.78 | 0.18 | 1.10 | 0.55 | 0.71 | 0.35 |
| | 0.50 | 0.96 | 0.27 | 0.90 | 0.45 | 0.61 | 0.41 |
| | 0.75 | 1.43 | 0.73 | 1.09 | 0.98 | 0.87 | 1.26 |
| Parathion, 25% W. P.[d] | 1.00 | 0.06 | 0.40 | 0.06 | 0.55 | 0.13 | 0.41 |
| Malathion, 25% W. P.[d] | 3.00 | 0.21 | 0.71 | 0.27 | 0.58 | 0.11 | 0.42 |
| Nicotine, 25% dry concentrate[d] | 5.00 | 0.53 | 0.61 | 1.08 | 0.75 | 0.72 | 0.64 |
| BHC, 12% gamma isomer[e] | 3.75 | 0.83 | 0.45 | 0.62 | 0.64 | 0.40 | 0.60 |
| Parathion, 25% W. P.[f] | 1.5 | 0.07 | 0.36 | 0.11 | 0.52 | 0.06 | 0.25 |
| Parathion, 25% W. P.[g] | 1.5 | 0.11 | 0.65 | 0.21 | 0.66 | 0.08 | 0.43 |

[a] Except as noted May application incorporated with codling moth spray (8 pounds DDT 50% wettable powder in 200 gallons of water per acre, applied with air carrier sprayer).
[b] Three impressions ½" in diameter on each of 50 leaflets.
[c] Applied May 11 to 14.
[d] Two applications: First, May 15; Second, July 1, in 50 gallons applied with an air carrier sprayer.
[e] Applied May 15; followed by 0.25 pound dosage of Systox July 1, applied in 50 gallons of water with an air carrier sprayer.
[f] Two applications: First, May 16, with conventional sprayer in 1,000 gallons of water incorporated with codling moth spray (standard lead arsenate 20 pounds, DDT 50% wettable powder 5 pounds); Second, July 1, 1 pound parathion 25% wettable powder in 50 gallons of water applied with an air carrier sprayer.
[g] Same as "e" except codling moth spray was 7.5 pounds of DDT 50% wettable powder.

## CITRUS

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ard of using 2,4-D on or near young citrus trees. In contrast, there have been numerous instances in 1955 where young interset or replant trees were sprayed, without resulting trunk damage, just before or just after the hottest weather with concentrations of 2,4-D recommended for older trees. However, it may be wise to assume that heavy applications of the material applied for weed control cause some damage to the root system of any citrus tree. The type of formulation and amount of the chemical applied, texture of the soil, and method of irrigation are important considerations. Certainly large applications on light soil under sprinkler irrigation should be avoided.

To avoid injury or death of young citrus trees from 2,4-D—and until conditions are defined and measures developed for the completely safe use of 2,4-D in citrus orchards—carelessness in application and the use of contaminated spray equipment should be avoided.

Foliage sprays for citrus trees less than six years old and for those recently topworked should not contain 2,4-D. Replants and young interplants in older orchards are frequently very sensitive to 2,4-D. Also, there is good evidence that Rough lemon and Cleopatra mandarin rootstocks are especially sensitive to 2,4-D.

If 2,4-D is inadvertently applied to vigorous young citrus trees, it is then advisable to avoid further wetting of the trunks or the soil near the trunks by additional sprinkling or other irrigation. Withholding irrigation as long as practicable may help to reduce the damage.

Injury from 2,4-D to rootstock bark opens the way for fungus invasion of the bark and wood. Lesions on the rootstock may heal better if they are exposed to the air and treated with a noninjurious fungicidal paint such as Captan 50-W in water.

Spray tanks, pumps, hoses, booms, buckets—all equipment—once used with 2,4-D must be thoroughly cleansed before using them to spray foliage of young trees. It is so difficult to remove 2,4-D residues from tanks and sprayers that—when possible — separate equipment should be maintained.

As an herbicide, 2,4-D should not be used in the nursery and it should be kept away from the root zone of young citrus trees, especially in sprinkler-irrigated orchards. Until more specific information is developed, 2,4-D herbicides should not be applied closer than two feet to the tree trunks and should be used sparingly on the soil above the root zones of young trees. Applications close to the rainy season may increase the hazard.

Herbicides containing 2,4-D should be kept off citrus trunks and branches, young or old. Bark of young trees is especially sensitive. Both accidental drift and direct applications are very dangerous.

Whenever 2,4-D is used in tree sprays, the amount and formulation used must be correct for the particular situation.

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## WALNUTS

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and leaves move back to the current season's—and adjacent—twig growth.

Most of the scale crawlers on the leaf petioles and twig growth are killed when either of the systemic aphicides—Systox or OMPA—is incorporated in the May DDT codling moth spray. However, where Systox is applied most of the scales on the leaves survive, but where OMPA is used there is a high mortality. To gain further information on the fate of the crawlers that settle on the leaves, three surveys of the experimental treatments at Linden were conducted during the summer of 1955. On all surveys, five leaflets were picked at random about the skirt of each of five trees so that a total of 25 leaflets were examined per plot or at least 50 per treatment. The average number found per impression of ½″ diameter along with the information on the treatments is given in the table on page 11.

The number of scales present in the OMPA treatments declined as the dosage increased. The largest number was found where 0.7 pound of total actives was applied per acre and the lowest where the two-pound dosage was used. The difference between 1½ pounds and two pounds treatments was not great and in both cases only a few scales were found.

Where Systox was applied, there was a large population of live scales after all the treatments. Further, there was some indication that the population increased as the amount of Systox was increased. The evidence certainly appears to show that Systox is not effective against the scale crawlers that settle on the leaves.

The findings in regards to OMPA and Systox are substantiated by a survey conducted in the experimental plots at Modesto.

OMPA is more likely to reduce the frosted scale population than is Systox. On March 23, 1955, twig samples three inches in length were examined from plots treated with OMPA or Systox in 1954. The scale population was much lower and the per cent of scales parasitized was generally higher in the OMPA treated plots than in the Systox plots.

In June, surveys were conducted to further determine the per cent of the old scales that had been parasitized. The per cent of scales parasitized in the OMPA treatments was much higher than in the Systox plots. At the time the surveys were made it took considerable searching to find scales in the OMPA plots while they were abundant in Systox treatments.

The results obtained where nonsystemic aphicides were applied show that a pound treatment of parathion wettable powder exerted a marked controlling influence upon the scale. The beneficial action resulted from the July 1 application—probably—because the scales were in the developing egg stage, protected by the body of the parent at the time of the May application.

Malathion 25% wettable powder at three pounds per acre exerted a suppressing action on the scale, but it was somewhat less than that resulting from one pound of parathion 25% wettable powder.

The nicotine treatment demonstrated no beneficial action.

The July 1 treatment of one pound parathion 25% wettable powder was also applied to plots where conventional sprayers were used to apply the May codling moth spray. One series of these plots had received five pounds of DDT 50% wettable powder, and the other 7½ pounds DDT 50% wettable powder per acre. In both series the parathion treatment reduced the scale population to a low level. The smallest population occurred in the plots that received the lowest dosage of DDT in the codling moth spray. The frosted scale can be controlled at any time of the year except for the period of rapid growth—mid-March to mid-June—until the eggs have hatched. During this time it is next to impossible to control the pest with insecticides. Also, this is the period when quantities of honeydew are produced.

The best and most economical time to control the scale is during the summer and fall after the eggs have hatched. During this period satisfactory control can be obtained where two pounds of parathion 25% wettable powder are applied per acre in 200 gallons of water with an air carrier sprayer. Malathion 25% wettable powder at a rate of six pounds per acre can be substituted for parathion in areas where the latter may be too hazardous to apply.

Parathion can also be used to control the scale during the cold part of the year.

When used during November through February, the amount of 25% wettable powder should be increased to five pounds per acre and applied in dry weather. It is difficult to immediately determine whether or not the scales have been killed by the winter treatment until 10 days to two weeks later.

Excellent control of the scale is possible with a 3% dormant oil emulsion applied as a thorough coverage spray. To avoid injury to trees this treatment can be used only in the full dormant season, from December 20 to February 15.

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## BLACKBERRY

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There was no evidence—throughout the season—of plant injury following spraying even on those plants that received four applications at 10-day intervals.

Further experimentation must be conducted before the best timing, the number of applications needed and the most effective concentration for large-scale applications can be determined.

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## PRUNES

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two to four weeks before the beginning of pit hardening. One orchard in San Benito County was sprayed with 25 ppm 2,4-5-T on May 3, about a month before the pits began to harden. About 30% of the fruit dropped before they were mature. Of the fruit that remained on the tree until mature 75% were cracked.

In a Sonoma County orchard 51 trees were sprayed with 40 ppm on May 5, about two weeks before the beginning of pit hardening. Approximately half of the sprayed prunes dropped to the ground before they were mature. This fruit and that under the check trees were disked under before harvest. The fruit from the sprayed and unsprayed trees was kept separate through harvesting, dehydrating, and grading. Of the sprayed prunes harvested 30% were offgrade compared to 10% of the unsprayed fruit. Even with the severe preharvest loss and the offgrade fruit, the increased size of fruit—62 prunes per pound compared to 98—made up for this loss. Deducting the cost of hand sorting and 2,4,5-T treatment, the return per tree after the second payment was the same for the sprayed as the unsprayed. No doubt many sprayed fruits which appeared normal may have shown some internal injury. The effect such an early application will have on the next year's crop of flower buds is not known.

Growers who may find it profitable to apply 2,4,5-T to apricots are cautioned to go easy on any trials with prunes. More work is needed to determine if a safe, effective time and concentration can be found for the French prune.

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*Farm Advisors Edward Bowles, Santa Clara; Jack Foott, Tulare; Roy McCallum, San Benito; Fred Petersen, Sutter; Wallace Schreader, Tehama; Enoch Torpen, Sonoma, cooperated with growers in their counties in testing 2,4,5-T.*

## SEED TREATMENT

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be more severe, but tend to be more uniform with most eggs hatching at about the same time.

Area differences with fungicides seem to occur. Captan in some trials was more effective in areas where cool conditions and early plantings occurred. Chloranil showed up to good advantage in certain parts of southern California. The reasons for the differences are not readily apparent.

Insecticides should always be used with adequate fungicides because insecticides used alone on seeds may increase the incidence of seed decay from *Pythium ultimum*.

The full effects of the storage of seeds treated with the several chemicals have not been determined, and for this reason only seed of high germination should be treated and then, as close as possible to date of planting. Storage of seed for periods up to three months—under conditions not adverse to viability—is considered safe.

Tests have indicated some varietal susceptibility—of different kinds of lima beans—to damage from seed treatments. Concentrated Fordhooks seem to be the most sensitive to chemical injury, Venturas more tolerant, and baby limas the least sensitive to treatments.

Seed treated with these chemicals should not be used for food for either human beings or for domestic animals.

Some of these chemicals are quite toxic to warm-blooded animals and operators handling the chemicals should follow the necessary safety precautions suggested by the manufacturers.

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## APRICOTS

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acute moisture deficiency, but six days later the foliage had completely recovered and the trees appeared normal.

Of the four growth regulators used in these tests, 2,4,5-T is superior to the others. Although 2,4,5-TP and 2,4-D brought about increases in fruit size, hastening of maturity and control of preharvest fruit drop, 2,4,5-TP significantly increased fruit cracking and 2,4-D killed the terminal portions of the shoots. NAA neither controlled fruit drop nor increased fruit weight to the extent obtained with 2,4,5-T.

The responses of the Stewart variety to 2,4,5-T are typical of those obtained with other commercial varieties produced in California. Although preharvest fruit drop of the apricot is a problem only with specific varieties or under certain environmental conditions, 2,4,5-T has proven to be an effective agent for its control. Whether or not the problem of preharvest fruit drop exists, the application of 2,4,5-T at the critical time brings about increase in fruit size and hastening of maturity.

Five years of experimentation with 2,4,5-T on the apricot has led to rather definite conclusions regarding the optimum time of application and the concentrations to use. To obtain maximum benefits from 2,4,5-T it should be applied at the beginning of pit hardening. The effectiveness of a particular concentration progressively decreases with successively later applications.

Hardening of the pits begins at the blossom end of the fruit and can be determined by cutting through the fruit from the blossom end toward the stem end. When the knife blade meets some resistance at the tip of the pit, it is time to apply the spray, generally 30 to 40 days after full bloom. The foliage should be sprayed to the point of slight drip as thorough coverage is important.

The proper concentration of 2,4,5-T to apply depends upon several factors, the primary one being the general area in which the orchard is located. In coastal valleys—where the period from pit hardening to maturity is relatively long—concentrations above 25 ppm

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