Soft Scales on Walnut in 1956

increase in soft scale populations on walnuts in northern California effected by several factors in complex problem

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Destructive populations of soft scales—frosted scale, *Lecanium pruinosum*, Coq.; European fruit lecanium, *L. corni* Bouché; and the calico scale, *L. cerasorum* Ckll.—occurred on walnuts in many locations in northern California during 1956.

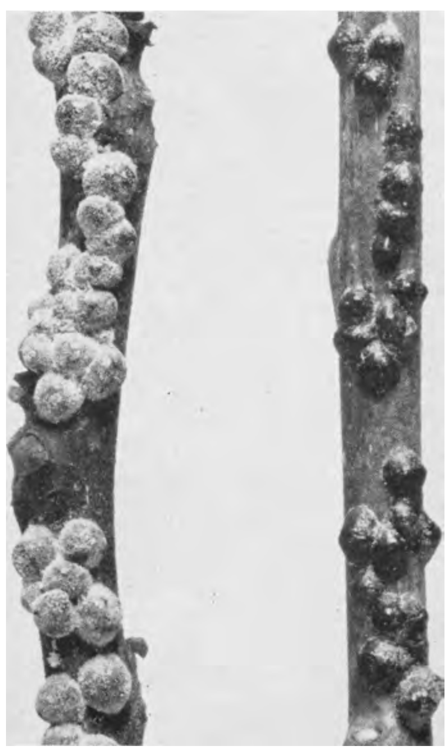
The soft scale problem is complicated by the fact that the frosted scale—seemingly the most abundant and destructive—can not be distinguished from the European fruit lecanium during the early stages of development. It is easy to confuse the two species during the period from June—when the eggs hatch—until the individual scales begin rapid growth in late March and April. At that time the frosted scale becomes densely covered with powdery wax while the European fruit lecanium remains more or less naked, except for a very fine and sparse waxy coating. However, the calico scale is rather distinctive and can be easily identified throughout the year.

Insecticides used to control pests of walnuts may induce increases in the population of soft scales. The adverse action of DDT is due to an interference with natural enemies. In cases where increases in the scale population occur with the use of systemic aphicides, the cause also may be related to an interference with the effectiveness of natural enemies or the problem may involve physiological processes, or even ones of a physical nature.

The increase in the soft scale population in many orchards can be directly associated with treatments applied to crops grown in adjacent fields. Where materials such as DDT dusts are applied to these crops and there is a drift of the dust through the orchard, induced increase in the soft scale population can be expected. Where this occurs the heaviest scale infestation is usually found on the side of the walnut orchard next to the treated field. The seriousness of the situation depends to a large extent upon the number of treatments applied, the timing, and the intensity of the dust drift.

Young of the calico scale as they appear in early November. Note the six scales on the leaf scar. (x6)

Frosted scale on walnut. *Left*—Frosted scale at time they are covered with a maximum amount of powdery wax. *Right*—European fruit lecanium.



Most harm is likely to result where walnut orchards are subjected to heavy drift of dust in June and July. Where corn fields have been dusted several times with DDT during this period, the twig growth in adjacent walnut orchards is sometimes caked with scales.

Not all of the important increases in the soft scale population can be accounted for by the treatments applied directly to the orchard or to adjacent crops. It appears that induced increases in some cases result from the drift of dust that occurs over a wide area in varying degrees morning after morning. Such conditions are believed to be responsible for some of the destructive scale populations that have developed in areas such as around Gustine.

The control problem is further complicated because the different scale species show some variation in their susceptibility to treatments directed against them. The frosted scale is easily killed with parathion treatments but parathion is not so effective against the European fruit lecanium or the calico scale. Therefore it is necessary to know the species involved before selecting control treatments.

Parathion and malathion have exhibited a marked suppressive action on soft scales when applied—during the

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Treatments and Number of Soft Scales Found on the Basal Two Inches of the Past Seasons' Twig Growth. Linden.

1955 Treatments and pounds per acre		Average number of scales Feb. 8, 1956
OMPA (actual)	0.55	38.0
	0.78	28.0
	1.17	11.5
	1.20	6.2
	1.56	10.5
Systox (actual)	0.25	56.0
	0.50	36.0
	0.75	56.0
Parathion, 25% wettable powder, 1; May 14 and July 1		4.1
Malathion, 25% wettable powder, 3; May 14 and July 1		24.0
Nicotine, 25% Dry concentrate, 5; May 14 and July 1		47.5
BHC, 12% gamma isomer, 3.75, May 14.		
Systox, 0.25 pound, July 1		23.0

Control of Frosted Scale and Number of Live Calico Scales, and European Fruit Lecanium, April 5, 1956

Treatment, and amount applied per acre. (Applied Feb. 16, 1956)	Frosted scale			Other scales	
	dead	alive	Per cent reduction	Calico scale	European fruit lecanium
Parathion, 25% wettable powder 4.4 pounds in 88 gallons of water	438	5	98.87	4	8
Parathion, 25% W.P. 5 pounds in 150 gallons of water	149	0	100.00	3	13
Parathion, 25% W.P. 5 pounds in 200 gallons of water	327	0	100.00	2	23
Malathion, 25% W.P. 15 pounds in 200 gallons of water	176	2	98.88	14	11

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summer—for the control of the walnut aphid. However, when applied in the spring, those materials are ineffective against the scales. In the spring the scales are making rapid growth or are in the egg stage protected by the bodies of their mothers.

When the systemic aphicides—Systox and OMPA—are used in the spring they exhibit some residual suppressive action. With Systox there is a high mortality of the crawlers that attempt to settle on the twig growth and the leaf petioles, but not of those that settle on the leaflets. With OMPA—not registered for commercial use—the same situation occurs but there is a reduced survival of the crawlers that move to the leaflets. With both materials the survival is greatest on the growth in the center of the trees. In these locations the crawlers may survive in large numbers on the twigs and leaf petioles. Tree vigor seems to influence the effectiveness of these materials, particularly OMPA. Scale suppression also appears to be associated with the dosage used. This again seems much more important with OMPA than with Systox. Although both materials show a tendency toward scale control, only OMPA, under certain conditions, results in effective suppression of the pest. Despite the killing action of Systox, the scale population tends to reach a destructive level, and in fact it appears as if Systox encourages this. Just why this should occur remains to be explained.

Stage of development of the frosted scale in early November. Compare size of scale with leaf scars. (x6)

On February 8, 1956, the relative scale population—after various aphid treatments applied the preceding summer—was determined in the experimental orchard at Linden. The results of the determination are shown in the table in column 1 on page 7.

Because of the high scale populations in the Systox and nicotine plots, they were treated with either parathion or malathion on February 16, 1956. Another population survey on these plots was made on April 5, 1956. Because many of the dead scales had weathered away, the actual mortality of the frosted scale in treatments where survivors were found was actually higher than indicated in the table in column 3 on page 7. The kill was nearly complete.

At the time of the February survey the calico scale but not the European fruit lecanium could be distinguished from the frosted scale and—although they represented only a small fraction of the total scale population—they were far less susceptible to the treatments than was the frosted scale. This conclusion is further substantiated by uncompleted investigations—started in the fall of 1956 —which show that the calico scale, and probably the European fruit lecanium, are not effectively controlled by parathion after late October.

The relative scale population on the leaves in the several aphid treatments at Linden was determined on October 6, 1956, and at Modesto on October 22, 1956. The results of the surveys are shown in the table on this page. Because of the chance of dead scales being dislodged, the figures on live scales as given in the table are probably of greater significance.

The low scale count for the Systox treatments at Linden is because those plots were treated with parathion during mid-February of 1956.

A relatively large number of European fruit lecanium survived the February parathion treatment and—because frosted scale and European fruit lecanium are indistinguishable in October —the figures in the table probably represent mostly the European fruit lecanium. There was a relatively low scale population in all the plots at Modesto treated with experimental OMPA with the exception of one where the dosage was 0.6 pound and a highly destructive population occurred. In previous years this plot had received Systox and the vigor of the trees was greatly reduced probably because of the obstructive scale infestation—compared to the surrounding plots —and because of their weakened condition the 0.6 pound of OMPA apparently exerted no suppressive action on the scale population.

OMPA is somewhat effective against the frosted scale and the European fruit lecanium, but it does not appear to exert any real controlling action upon the calico scale.

Soft scales attacking walnuts can not be controlled from March until about the middle of June. They are most easily controlled during the summer. In mid-fall the scales turn from yellowish to brownish in color and in that stage of development they are difficult to kill. The scales are as difficult to control the first of November as they are in mid-February.

Parathion—at the dosages used in late fall and winter—has been more effective

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1956 Aphid Treatments and Number of Scales Found on Leaf Samples in the Experimental Plots at Linden and at Modesto.[a]

Treatments, amount applied per acre in pounds and dates of application		Average number of scales per leaf sample[b]			
		Frosted scale and European fruit lecanium		Calico scale	
		alive	dead	alive	dead
Linden[c]					
OMPA (actual)	0.55, Apr. 30	1.58	1.37	0.12	0.05
	0.78, Apr. 30	0.69	0.42	0.08	0.03
	0.80, May 1	0.05	0.08	0.08	0.03
	1.17, May 1	0.07	0.11	0.19	0.14
	1.56, May 1	0.22	0.22	0.14	0.15
Systox [d]	0.25, May 2	0.04	0.01	0.06	0.02
	0.25, May 2 and Sept. 5	0.03	0.02	0.01	0.04
	0.50, May 2	0.06	0.01	0.02	0.00
Parathion 25% W.P. 1.0; Apr. 19 and June 20		0.02	0.10	0.01	0.00
Malathion 25% W.P. 3.0; Apr. 19 and June 20		0.10	0.16	0.03	0.01
BHC 12% gamma isomer 3.75; Apr. 19. Systox 0.25; June 20		1.00	0.65	0.06	0.03
Modesto[e]					
OMPA (actual)	0.43, Apr. 25	1.03	0.56	0.09	0.07
	0.60[f], Apr. 25	19.60	2.14	0.04	0.00
	1.00, Apr. 25	0.17	0.27	0.05	0.00
	2.10, Apr. 25	0.05	0.87	0.08	0.01

[a] All plots received a DDT spray directed against the codling moth.
[b] Leaf sample 15mm. in diameter.
[c] Survey conducted October 6, 1956.
[d] All Systox plots were treated for scale control on February 16, 1956.
[e] Survey conducted October 22, 1956.
[f] Treated with Systox in prior years.

NEW MATERIALS

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three materials required treatment with an acaricide on June 15.

A second series of plots was established in an abandoned Hardy pear orchard near San Jose. A high population of codling moths was present, and as the fruit would not be harvested, the plots afforded an excellent chance to test new materials which had little data available with respect to residues.

The plots consisted of four trees each replicated three times, the replicates being randomized throughout the orchard. The materials were applied with conventional ground equipment and orchard guns. The amount of spray per acre averaged 750 gallons.

The sprays were again timed by means of bait pans in the check plots.

The fruit was harvested on August 14 and examined for the presence of worms and stings. Fruit that had dropped to the ground was included with the fruit on the tree for each treatment. An attempt was made to examine 200 pears per treatment, but because of a light crop, this was not possible for all treatments.

The materials used, dosages, time of applications and harvest counts are summarized in the lower table on this page.

Several materials, including Diazinon, Trithion, Thimet, Dipterex and the spore preparation of *Bacillus thuringiensis* did not give adequate control of the codling moth. These plots all showed more than 4% damaged fruit at harvest. The one pound dosage of DDT alone was as effective as a combination of one pound of DDT with one pound of Diazinon, indicating that the Diazinon adds little to the spray. Neither of these two materials gave satisfactory control. Hercules 528 showed some promise, but was not as effective as the two-pound dosage of DDT and the Ryania, both of which gave good control considering the high populations of moths present. The most outstanding control was obtained by two new chemicals, Guthion, and Carbon and Carbide 7744, each of which had less than 1% worms at harvest.

The more promising materials from the 1956 plots will be evaluated on a larger scale during the 1957 season.

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

Summary of European Red Mite Control on 1956 Codling Moth Plots—Bartlett Pears Courtland (Mite Counts Expressed as Average Number Mites per Leaf)

Materials	Dosage per acre	Mite Count Data					
		May 1 Pre-spray	May 9 Post-spray	June 1 Pre-spray	June 6 Post-spray	June 15 Post-spray	July 23 Harvest
Diazinon	14.2 lbs. 25% wettable.	5.2	0.1	3.1	1.1	7.3*	....
Diazinon and DDT	7.1 lbs. 25% wettable. 7.1 lbs. 50% wettable.	4.8	0.1	2.5	2.1	10.4*	....
Parathion and DDT	7.1 lbs. 25% wettable. 7.1 lbs. 50% wettable.	5.4	0.08	1.5	0.2	4.6*	....
Trithion	14.2 lbs. 25% wettable.	4.3	0.1	0.02	0.05	0.0	0.0

* Resprayed with chlorobenzilate at this point. *Application Dates:* May 1, June 1, June 29.

Summary of 1956 Codling Moth Plots—Hardy Pears San Jose
Application Dates: May 1, May 28, July 9

Materials	Dosage per 100 gallons	Fruit counted	worms	Stings	% Infested Fruit
DDT	2 lbs. 50% wettable	600	2	4	1.0
DDT	1 lb. 50% wettable	600	15	8	3.6
Diazinon—DDT	1 lb. 25% wettable 1 lb. 50% wettable	564	14	7	3.7
Diazinon	2 lbs. 25% wettable	600	26	8	5.6
Thimet	1 qt. 48% emulsion	600	28	33	10.1
Hercules 528	2 lbs. 25% wettable	600	8	6	2.3
Carbon and Carbide 7744	1½ lbs. 50% wettable	553	2	1	0.6
Trithion	2 lbs. 25% wettable	600	20	6	4.3
Dipterex	4 lbs. 50% soluble powder	516	32	19	9.8
Ryania	6 lbs. 100%	586	7	4	1.8
Guthion	2 lbs. 25% wettable	600	2	1	0.5
Bacillus thuringensis	100 grams of spore preparation	600	80	18	16.3
Check No. 1		600	92	32	20.5
Check No. 2		600	115	21	22.6

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against the frosted scale than against the European fruit lecanium or the calico scale. Five pounds of parathion, 25% wettable powder per acre, applied in 100 to 200 gallons of water, with an air carrier sprayer has resulted in good control of the frosted scale.

In the full dormant season all three species of soft scales can be satisfactorily controlled by spraying with a 3% dormant oil emulsion. Control has been obtained where 15 gallons of dormant oil was applied in 100 to 200 gallons per acre by an air carrier sprayer. A dormant oil spray should never be used on dry trees or in orchards that have suffered for water during the year.

Time of Treatment

The best time to control soft scales is during the summer. The effectiveness of parathion for summer use is shown by the suppressive action it exerts when applied at a dosage of one pound of 25% wettable powder per acre for the control of the walnut aphid.

For highly satisfactory scale control, parathion should be used at the rate of two to three pounds per acre and applied with an air carrier sprayer. The amount of water needed—75 to 150 gallons—depends upon the air capacity of the equipment.

Treatment should not be applied later than three weeks before harvest nor delayed until after harvest. By the time harvest is completed, winter strength of parathion may be needed to give control.

Where winter treatment is applied, the addition of an oil emulsion—four gallons per acre—has improved the control obtained.

In the full dormant season a dormant oil emulsion has been used, but for other periods a summer oil emulsion is better.

Parathion treatments for soft scales—applied in mid-February—also result in the destruction of the overwintering walnut aphid eggs.

Malathion 25% wettable powder has given both summer and winter control of soft scales, but the dosage required was three times that of parathion.

Natural enemies of soft scales—when given an opportunity—provide effective control. This apparently happens in the case of the calico scale, regardless of chemical treatments, because effective control results from the action of an insect parasite and the feeding of the Audubon's warbler upon the scales during the winter and early spring.

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