Codling Moth Investigations

severe infestations in northern California walnut orchards in 1958 followed conditions favorable to the second brood

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The attack on walnuts by the first brood of codling moth in 1958 was light but favorable environmental conditions during the development of the second brood resulted in a marked upward surge in the number of nuts infested by harvest time.

Extensive control measures investigated at Linden, Walnut Creek, and San Jose included the insecticides: DDT, Sevin, ethion, Guthion, Delnav and lead arsenate. Treatments were applied with air carrier sprayers in 200 gallons of water per acre.

The experimental orchard at Linden was divided into heavily infested and lightly infested portions. The unequal distribution of codling moth population is believed to be the result of developing resistance to DDT. A single treatment of DDT, at the rate of eight pounds of 50% wettable powder per acre, in the lightly infested area gave better control of the codling moth than did two such treatments in the heavily infested section. However, a single application of 12 pounds of DDT 50% wettable powder per acre resulted in nearly as good control in the heavily infested area as did two applications at eight pounds per acre for each treatment. The addition of Trithion in two applications for aphid control, to the 12 pound treatment of DDT 50% wettable powder, improved the control of the codling moth.

Of the new materials tested, both Sevin and Guthion, in two treatments, compared favorably with the best DDT programs and gave excellent control of the codling moth. Ethion at high dosages failed to give as good control as did DDT, and even poorer results were obtained with Delnav.

Usually during June many of the nuts infested by the first brood of codling moth drop to the ground. On June 6, infested nuts—fallen from 10 trees in each plot at Linden—were counted. The drop count quite accurately forecast the results actually obtained in the harvested crop.

The best results at Walnut Creek were obtained where the trees received two applications of Guthion. It further appeared that both Trithion and ethion aided in suppressing the codling moth where a single application of DDT was made. Where Trithion and ethion were not used, infestation by the second brood of codling moth increased to a point where a second application of DDT was necessary on August 8. Applied at that late date, DDT killed many of the small caterpillars that had recently entered the nuts.

The residual action of Guthion is apparently less than that of DDT. By July 9—when the second Guthion treatment was applied at Walnut Creek—a number of caterpillars had entered the nuts and some of the larvae were well along in their development. Sizeable mounds of frass had been ejected from the burrows, and penetrations to the shell of the nuts by caterpillars were not uncommon. However, the protection afforded by the husks was not sufficient to save the caterpillars from the Guthion.

All treatments at San Jose gave satisfactory control of the codling moth. However, because the Sevin treatment was the only one that was duplicated, comparison of results was difficult.

An accurate evaluation of the damage caused by the codling moth may be complicated by an infestation of either or both the navel orangeworm and the filbertworm. The codling moth may be blamed for damage inflicted by the other two insects because the damage done is similar. However, the codling moth is the only caterpillar that is able to penetrate the sound husk of walnut and therefore, staining of the nut shell is limited to attack by codling moth. Further, the codling moth is the only one of the three pests that is able to infest and feed on sound nuts before the husks have cracked and the kernels have reached maturity.

Control measures directed against the codling moth are not effective against the filbertworm. However, control of the codling moth is important in reducing damage by the navel orangeworm, because the navel orangeworm—which is a scavenger—develops in nuts attacked by the codling moth, and may be present in numbers to infest the crop when the husks crack.

On early varieties, such as Payne, treatment to control codling moth should be applied when the average cross-sectional diameter of developing walnuts reaches 3/8" to 1/2". For late varieties, such as Franquette, the application should be made about the middle of June. Timing and thoroughness of application are most important.

In many parts of northern California a single, well timed application of DDT 50% wettable powder, at eight pounds per acre has given sufficient control for the entire season. However, there are areas where such a treatment will not give adequate control, which may be because a strain of codling moth resistant to DDT is developing. In cases, where difficulty has been experienced in controlling the codling moth, effective treatment has been achieved by using DDT 50% wettable, at 12 pounds per acre, or by a second application at eight pounds during the last half of June.

Of the new materials tested both Guthion and Sevin—neither released for commercial use on walnuts—showed promise in two applications. Guthion at six pounds of 25% wettable powder per

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Percent of Infested Walnuts in Harvested Crop in the Experimental Plots at Linden, 1958

Treatment/acre[a]	Dates applied	Infested nuts, %
Check	.....	16.90
DDT, 50% WP; 8 lbs	May 3 June 24	1.42
DDT, 50% WP; 12 lbs	May 5	1.95
DDT, 50% WP; 12 lbs	May 7	
Trithion; 1 lb[b]	Apr. 25 June 25	0.80
Ethion, 25% WP; 15 lbs 20 lbs	May 5 June 24	2.55
Sevin, 50% WP; 8 lbs	May 5 June 23	1.35
Guthion, 25% WP; 6 lbs	May 7 June 23	0.87
Delnav, 4 lbs/gal; 2 qts	May 5 June 24	4.70

[a] Except where noted, applied with an air carrier sprayer in 200 gallons of water per acre. (1.2 gallons of light summer oil emulsion incorporated with mixtures containing wettable powders.)

[b] Applied in 100 gallons of water per acre.

Average Number of Infested Drops per Tree on June 6, 1958 in the Experimental Plots at Linden

Treatment/acre	Date applied	No. of drops/tree
Check	.....	19.55
DDT, 50% WP; 8 lbs	May 3	1.15
DDT, 50% WP; 12 lbs	May 5	2.00
DDT, 50% WP; 12 lbs	May 5	
Trithion; 1 lb	April 25	0.50
Ethion, 25% WP; 15 lbs	May 5	3.85
Sevin, 50% WP; 8 lbs.	May 5	0.10
Guthion, 25% WP; 6 lbs	May 7	1.10
Delnav, 4 lbs/gal; 2 qts	May 5	7.50

CELERY

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and harvested in June escaped damage and showed only a trace of virus infection. In contrast, celery set out during April and May and harvested in July showed a definite increase in the percentage of plants infected. Severe damage was first noted in late June and became progressively more severe in July, August and September. Celery planted following the last week of July and harvested during the latter part of October, in November and December usually showed only a low percentage of infected plants.

The leafhopper populations in celery usually decreased during July and August. Because no reproduction of the aster leafhopper has been noted on celery, the spread of aster yellows virus appears to be entirely dependent on the insects that move into celery from other locations.

The percentage of leafhoppers naturally infective with the aster yellows virus was determined by monthly collections in the natural breeding areas. Leafhoppers were collected and fed in groups of 10 on healthy test plants to determine the percentage actually carrying virus. Seasonal infectivity of the leafhoppers would indicate when and from what habitats the insects were potentially the most likely to spread the virus.

The percentage of aster leafhoppers found to be naturally infective varied with habitat, season, and the predominant host plant in the area. Usually about 2% were naturally infective during April. As the season progressed, the percentage of infective individuals increased to 12% in June, 22% in August and reached a peak of 36% in September of one year.

It is evident that the period of highest disease incidence in celery does not coincide with the presence of the highest number of leafhoppers in the celery fields. This is true because it takes 2–3 weeks for the disease symptoms to develop on the celery plants and also because the percentage of leafhoppers carrying virus increases as the season progresses.

Control Program

A spray program—designed to control the leafhoppers in their natural breeding sites—was initiated in the spring of 1955, soon after leafhopper populations were noted in the creek area. DDT oil sprays were applied by a fixed wing airplane at approximately two week intervals beginning April 16 and continuing until the final application on July 21.

The spray program was repeated in 1956 and 1957 with applications made by helicopter. In 1956 applications were made on May 10–11, May 21–23, June 6–7, June 20–21, and on July 3–8. In 1957 only three applications were made —on April 19, May 6, and June 25.

In 1958, because of the late and heavy spring rains, the creek carried a heavy flow of water over an extended period of time. This resulted in conditions unfavorable for the development of a leafhopper population until July when only a single application of insecticide was necessary.

Losses due to aster yellows infection of celery in the Arroyo Grande Valley have been light—less than 5%—during the past four years. The logical conclusion to be drawn is that the DDT reduced the leafhopper population at the source and was responsible for the reduction in the amount of aster yellows infection of celery. However, what the disease situation would have been if no insecticides had been applied to the creek can not be determined because it was not possible to leave untreated checks without jeopardizing the whole program.

The cost of the control program has been nominal to the cooperating growers who contributed each year an amount equal to the cost of making one application of DDT to each acre of celery they grew.

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acre for each application has tended to give better control than obtained with DDT. Further, Guthion has a suppressing action on spider mites and the walnut aphid. Sevin at eight pounds of 50% wettable powder per acre for each application has resulted in control equal to that obtained with DDT. Although Sevin tends to suppress the walnut aphid population it may—as DDT does—induce an increase in the spider mite population.

Trithion at one pound per acre has not given adequate control of the codling moth when used alone. However, in combination with DDT, to control the walnut aphid and spider mites, Trithion has a tendency to improve the control of the codling moth.

Ethion at high dosages has shown promise in controlling the codling moth, but has not equaled DDT. Delnav also has resulted in insufficient control.

A careful examination of the young developing walnuts usually indicates whether the codling moth control program is adequate. When boring into the green husks the caterpillars leave piles of brown frass at the entrance of the burrow. At first, the piles of frass are tiny and can be overlooked easily. Late first brood and second brood caterpillars usually penetrate the nuts at the side or the base. The brown frass produced shows up rather distinctly on the green husks. If 1.5% or more of the nuts are being attacked a treatment is probably justified.

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CUT FLOWERS

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Los Angeles and San Francisco market areas and, particularly, for cut flowers and foliages sold in the state. For out-of-state shipments, consignment selling is greater, especially when the deals are with central-market wholesale dealers who are primary distributors for smaller wholesalers and jobbers.

Specialization appears to be growing in the cut flower trade, as is evidenced by the growth in the number of special buyers in the Los Angeles metropolitan and other markets. The buying specialists have the job of selecting products in the wholesale markets and delivering or holding them for their retailers, for a commission. Such an arrangement provides the retailer with a skilled buyer who recognizes and can select flowers of the desired quality characteristics. In an industry that largely depends on sale by inspection, buying specialists could provide a very beneficial service to the retail trade.

Wholesalers attempt to establish and maintain long-time business relations with both growers and retailers. Central market wholesalers are often very solicitous of near-by grower interest. They assure such growers a regular outlet and advise with them on market conditions and prices as a means of assuring themselves a source of supply and minimizing the likelihood of direct sales to retailers.

Wholesalers are equally solicitous of their retailers. Generally, they follow rigidly a policy of adhering to the established grower-wholesaler-retailer market channel, introducing whatever commission men and jobbers may be needed to facilitate sales.

To be continued

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