Northern California Walnuts

environmental resistance a factor in the control of codling moth populations shown in tests at Linden

A. E. Michelbacher, W. W. Middlekauff and Donald Davis

Control of the codling moth on susceptible varieties of walnuts usually requires spray applications each year.

Because sprays are necessary some growers hold the opinion that natural environmental factors are not important in regulating the codling moth population.

Codling moth population shows considerable fluctuation over a period of years, and evidence obtained at Linden, indicates that the environment exerts an important regulating influence upon the pest. Under an effective spray control program, it is usually difficult to detect the effect of these natural controlling factors, because of the suppressed population.

When the codling moth investigation was started at Linden in 1942, the infestation was of serious proportions. The number of infested nuts in the harvested crop from check trees exceeded 25%. With subsequent years, the control program was greatly improved and the seriousness of the infestations as measured by the amount of infested nuts in the check trees declined so that by 1945 it was 6.8% and in 1946 it was 7.0%.

These data indicate that the reduction in the seriousness of the problem was due to the effectiveness of the codling moth spray control program. However, this probably was not the case because—although the same program was continued—the infestation in the harvested crop in the check trees reached 44% in 1948 and was 22% in 1949.

These increases in infestations could not be attributed to the insect becoming resistant to standard lead arsenate as—in spite of the heavy infestation—excellent control was obtained where sprays were properly timed and carefully applied. Further, there was a general increase in the infestation even in orchards or areas where no sprays were applied.

There can be but little question that climatic and biological factors were important in influencing the size of the codling moth population.

It appears that when these factors afford a high environmental resistance, the codling moth population is reduced and spray control programs benefit. When these factors favor the codling moth, spray programs are put to a severe test and satisfactory control can be obtained only where they are properly timed and thoroughly applied.

The action of natural controlling fac-

Continued on page 10

Parasitism of Second Brood Codling Moth Eggs by *Trichogramma embryophagum* Hartig in the Experimental Orchard at Linden, California, 1949

Date	Total number of eggs	Condition of Eggs											
		With dead larvae		Hatched		Not hatched		Parasitized					
								Not emerged		Emerged		Total	
		number	per cent	number	per cent	number	per cent	number	per cent	number	per cent	number	per cent
July 26	210	.	..	57	27.1	39	18.6	51	24.3	63	30.0	114	54.3
Aug. 1	208	9	4.3	55	26.4	21	10.1	49	23.6	74	35.6	123	59.1
Aug. 3	214	9	4.2	75	35.0	5	2.3	51	23.8	74	34.6	125	58.4
Aug. 11*	144	5	3.5	109	75.7	1	0.7	19	13.2	10	6.9	29	20.1
Aug. 25*	203	4	2.0	117	57.6	0	0.0	16	7.9	66	32.5	82	40.4

* Survey conducted in a portion of the orchard one half mile from the previous survey area.

CEREAL

Continued from page 5

Davis were essentially the same as those observed at other experiment stations in the western region.

The awned plants exceeded awnless plants in yield, kernel weight, and test weight per bushel.

Two new varietal types were also produced by backcrossing the hybrid strain obtained by crossing Baart with Onas.

This method of breeding permits recovery of practically all of the characters from one of the parents. One of the new varieties, resulting from eleven successive backcrosses to Baart, is like Baart in every characteristic except that it lacks awns. The other variety which was the result of 10 generations of backcrossing to Onas, is essentially an awned Onas.

Thus, with awned and awnless stocks of Baart and Onas, it was possible to determine the effect of awns in two different varieties.

Awnless Baart was of value only for experimentation. If grown commercially, it would certainly yield less and weigh less per bushel than the awned Baart now grown. It will not be released.

The Onas wheat and the bunt resistant Onas 41, which are grown in California are awnless. Though they already yield more than Baart, under some conditions, their low weight per bushel is a universal handicap in marketing. This difficulty can largely be overcome by use of the new awned form of Onas.

Wheat breeders at the California Experiment Station move through a succession of gains in production efficiency or security. These gains are exemplified by the new awned and bunt resistant Onas 49, obtained from the union of Awned Onas and Onas 41.

Onas 49 was tested in more than 10 county nurseries in 1950 and foundation seed will be available for 1951.

Growers in rust-hazard areas should recognize that Onas 49 does not have rust resistance. In 1953 Onas 49 will have been combined with an Onas which has a new type of rust resistance—from Kenya. The variety Hope has provided the resistance for all previous breeding. Kenya and Hope have different genes and protect against different races of rust. The new stock should replace all previous releases of Onas and even some other varieties.

This combination of characters illustrates how one improvement after another is built into a basic variety chassis to make the variety better and better.

They show that plant breeders, using genetic laws as tools, can provide basic information for other fields of science. Furthermore the mysticism which has long shrouded plant breeding is being unmasked by use of genetic principles in breeding. These permit both prediction and reproduction of results.

Progress in the future will probably be slowed more by time requirements and capacity than from lack of know how.

Coit A. Suneson is Associate in Agronomy in the University of California College of Agriculture Experiment Station, Davis and Agronomist, United States Department of Agriculture.

Downy Mildew Control

new chemicals greatly reduce damage from downy mildews of leafy garden vegetables

C. E. Yarwood

Zineb spray is the best fungicide yet tried for the control of the downy mildews of spinach, beets, lettuce, and hops.

Zineb is the compound zinc ethylene bisdithiocarbamate.

Studies have been underway on spinach downy mildew for 15 years. No method of fungicidal control of the disease was known in 1939.

The studies were made because downy mildew occurs each year in places where spinach is grown. It is also frequent on beets and lettuce. Sometimes it causes great loss to these crops in California.

Downy mildew appears as pale spots on the upper side of leaves and as fuzzy, gray-looking spots on the lower side. It occurs chiefly on the older but still vigorous leaves and slowly kills them.

In 1946, greenhouse trials showed that several spray and dust fungicides control downy mildew under conditions of heavy inoculation. Sulfur dust was apparently more effective than copperlime dust.

Trial Conditions at Milpitas

Four trials under natural conditions were undertaken at Milpitas in 1947–49. In two trials the incidence of disease was too low to yield dependable results.

In the 1947 plot, two varieties—Bloomsdale and Viroflay—were seeded in raised double rows on January 24th. The area was divided into treatment plots four feet long with a two-foot row of buffer plants between each treatment.

Plants in the buffer areas were inoculated by spraying them with downy mildew sporangia collected in another field.

On March 3d, and weekly thereafter until April 8th, duplicate randomized plots were sprayed or dusted with a variety of fungicides. Seven randomized plots were left untreated. On April 11th incidence of disease and yield of plants were recorded.

Spinach Test Results

All fungicides tested reduced significantly the amount of disease as compared with the untreated plots.

Sprays used included 0.1% phygon with spreader, 0.2% zineb with spreader, and 0.2% bismuth subsalicylate with spreader. Also tried were 0.3% bordeaux with spreader, 0.3% bordeaux with 0.3% cottonseed oil, 0.5% resin soap with 0.5% lime sulfur, and 1% lime sulfur with 0.1% zinc sulfate.

The dusts used were sulfur, 5% spergon with 95% sulfur, and 6% zerlate with 94% inert material.

Zineb was the most effective spray. Bismuth subsalicylate was the spray next most effective. This compound must be finely divided for best results.

Of the three dusts tested, a mixture of 5% spergon—tetrachloroquinone—and 95% dusting sulfur was the best. Sulfur alone gave significant control.

In the 1949 test at Milpitas, 10 plots of spinach 16 feet long were marked out. Five alternate plots were treated April 1st, 7th, and 14th with 0.2% zineb plus spreader. There was a slight but uncounted amount of mildew in the field when the test was started.

On April 21st, the mildew lesions on seven random leaves per plot averaged 11 for the untreated areas. None was found on treated areas.

Tests on Beets and Lettuce

The same treatments with sprays and dusts were used in 1947 for the control of beet downy mildew and lettuce downy mildew.

On the highly susceptible beet variety, Asgrow Canner, downy mildew was more severe and fungicidal control was less successful than with spinach mildew. On the untreated plots, 84% of the plants became systemically infected.

Zineb spray reduced systemic infections to 29%, while spergon-sulfur dust reduced them to 61%. Only these two treatments gave good control.

On Imperial No. 615 lettuce the con-

Continued on page 16

WALNUTS

Continued from page 7

tors becomes more apparent with an increase in population. This is particularly true in regards to predators and parasites, which often occur in large numbers when their host becomes very abundant. To some extent this happened with the codling moth during the 1949 season. There was a very large second brood of codling moths, and in the experimental orchard at Linden there was a heavy deposition of eggs. The average number of eggs per nut was something more than 1.75, which was considerably higher than usually encountered. The eggs were heavily parasitized by *Trichogramma embryophagum* Hartig. Parasitized eggs usually contained three parasites.

A number of surveys were made to determine the degree of parasitism and the information obtained is given in the accompanying table. It should be noted that approximately 50% of the eggs laid were parasitized.

Although the amount of parasitism was insufficient to successfully control the codling moth, the data show that the large codling moth population created conditions favorable for a rapid rise in a parasite population.

The conflict between the codling moth and its natural controlling factors is always present, but the value derived is seldom clearly seen. A more thorough knowledge concerning the relations that exist between the two is certainly deserving of intensive investigations.

Environmental resistance appears to play an important role in the success of a codling moth spray control program on walnuts. Apparently satisfactory control is easily obtained when environmental resistance is at a high level, but when it is low, timely and thorough applications are necessary for successful control.

Because of the powerful natural environmental factors that tend to regulate codling moth population efforts should be made to avoid practices that might shift them to favor the codling moth.

Control measures should be used with discrimination, applied only when needed, and the insecticide used at a rate no higher than necessary to insure satisfactory control.

A. E. Michelbacher is Assistant Professor of Entomology and Associate Entomologist in the Experiment Station, Berkeley.

W. W. Middlekauff is Assistant Professor of Entomology and Assistant Entomologist in the Experiment Station, Berkeley.

Donald Davis is Research Assistant in Entomology in the Experiment Station, Berkeley.

The authors are staff members of the University of California College of Agriculture.