Increased insecticide use in cotton may cause secondary pest outbreaks

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Pink bollworm, *Pectinophora gossypiella* (Saunders), invaded southern California's lower desert valleys during the 1966 cotton growing season. Because of the widespread, damaging infestation levels, multiple applications of broad-spectrum insecticides have been used to reduce losses. These insecticides have proved extremely toxic to beneficial insect populations and are suspected of inducing outbreaks of other cotton pests.

Several insect predators have been found to consume a large number of eggs and larvae of the bollworm-budworm complex, *Heliothis zea* and *H. virescens.* These predators are destroyed with repeated applications of the highly toxic insecticides used to suppress pink bollworm; consequently, bollworm-budworm may reach an economic infestation level. In 1974, field investigations were conducted on the effect of various insecticide treatment regimes on beneficial predators and on the subsequent bollworm-budworm population.

Methods and materials

Eleven commercial cotton fields in the Imperial Valley and 12 fields in the Palo Verde Valley were monitored weekly from July 9 through September 3, 1974, for predators and bollworm-budworm eggs and larvae.

The beneficial predators were sampled with a backpack vacuum sampler. A 25 row-foot sample was taken from each quadrant of a field. The samples from each field were combined, processed through modified Berlese funnels, and counted. On the same day that the predators were sampled, bollworm-budworm eggs and larvae were sampled by inspecting 25 random cotton terminals per quadrant per field.

The beneficial predators recorded were adult and nymph big-eyed bugs, adult and nymph minute pirate bugs, adult and nymph damsel bugs, adult and nymph assassin bugs, adult and larval green lacewings, adult collops beetles, adult and larval convergent lady beetles, and adult and immature spiders.

The decision to treat for pink bollworm was made by each grower or his pest control advisor and was based on Hexalure trap catches or automatic spray schedule. The decision to treat for other cotton pests, the choice of insecticide, and the application rate were also made by each grower or pest control advisor. The insecticides used, singly or in combination, during the study were monocrotophos, methomyl, Dicrotophos, chlordimeform, methyl parathion, and azinphos-methyl. All applications were made by airplane.

For the purpose of analyzing the data, the 23 fields were divided into four regimes based on the number of insecticide treatments applied during the study. The regimes and the number of fields in each were: regime 1—three fields with 0 to 3 insecticide treatments; regime 2—seven fields with 4 to 5 insecticide treatments; regime 3—six fields with 6 to 7 insecticide treatments; and regime 4—seven fields with 8 to 9 insecticide treatments.

Results and discussion

The most abundant beneficial predators were big-eyed bugs, minute pirate bugs, and spiders. The other predators were low in all treatment regimes, and convergent lady beetle larvae were never observed. Green lacewings and collops beetles were not adversely affected by increased insecticide usage.

The mean number of beneficial predators was inversely related to the

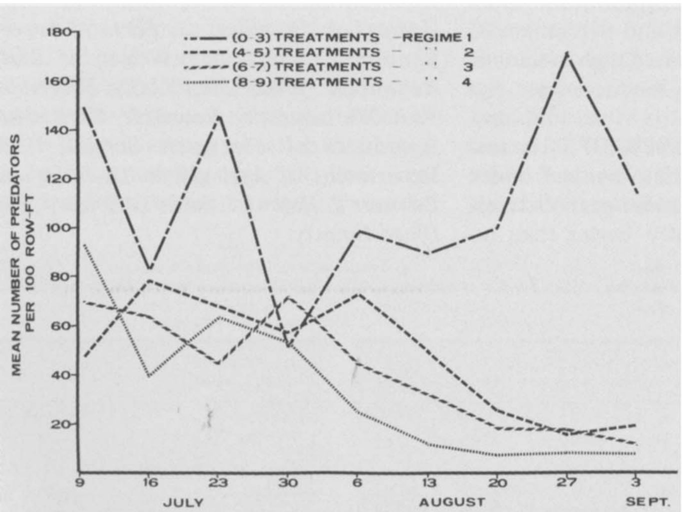

Fig. 1. Mean numbers of predators per 100 row-feet per week under four treatment regimes of insecticides used for pink bollworm control in southern California.

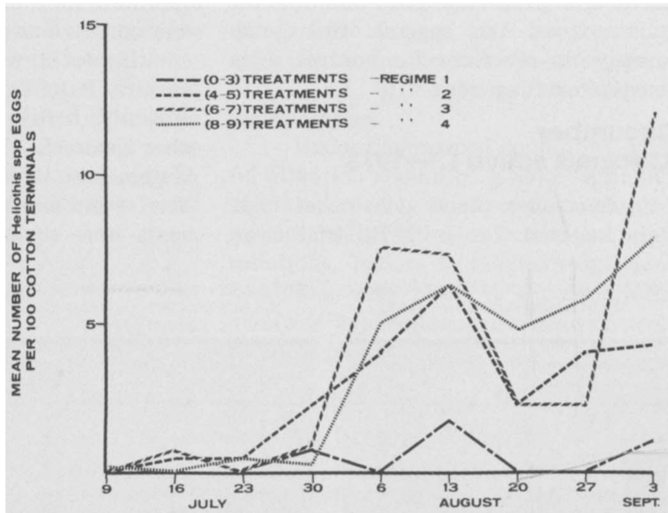

Fig. 2. Mean numbers of bollworm-budworm (Heliothis spp.) eggs per 100 cotton terminals per week under four treatment regimes of insecticides used for pink bollworm control in southern California.

number of insecticide treatments applied. Regime 1 showed a significantly higher number of predators than the other three treatment regimes, which did not differ significantly.

Mean numbers of beneficial predators per week (fig. 1) in regimes 2, 3, and 4 were about equal from July 9 to July 30 and then rapidly declined. The number of predators in regime 1 remained high throughout the season, with the high point occurring on August 25. The reduction in number of predators between July 23 and July 30 is attributed to insecticide applications between the two sampling dates. In individual fields, beneficial predators declined dramatically after application of an insecticide. Predator populations resurged rapidly, if there was not a second application within one week. When the number of insecticide applications was increased, predators were largely eliminated.

The mean number of bollworm-budworm eggs was significantly lower in treatment regime 1, compared with the other regimes, while mean number of larvae was significantly higher in regime 3, compared with the other treatment regimes. Since the mean number of bollworm-budworm eggs and larvae increased progressively from regime 1 to regime 3 and then decreased in regime 4, while the mean number of beneficial predators decreased with increased numbers of insecticide treatments, it appears that bollworm-budworm was suppressed by the combined action of both predators and insecticide treatments, with the predators having the greatest effect.

The mean number of bollworm-budworm eggs per week (fig. 2) shows a generation peak about August 11 in all treatment regimes and the apparent beginning of a second generation on the last sampling date. All four treatment regimes were approximately equal from July 9 to July 30. After this date the bollworm-budworm eggs in treatment regimes 2, 3, and 4 increased rapidly while in regime 1 they remained low throughout the season.

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Carrot foliage with powdery mildew (left), as compared with healthy foliage (right). Note white spots of fungal growth on diseased leaves.

Powdery mildew on carrots—a new disease

Demetrios G. Kontaxis

Powdery mildew has been reported for the first time on carrots grown in the Imperial Valley.

California's third largest carrot-producing county is Imperial County, with more than 6,000 acres of carrots. Fields are planted to carrots during September to November and harvested from December to June. More than 90 percent of the acreage is planted to the Imperator 57 cultivar.

In April, Pest Control Advisor Ralph Pedley of Stoker Company showed the author a carrot disorder in one field. Field and laboratory examination revealed that the disorder was powdery mildew.

Symptoms

The leaves of many plants were covered with small white-grayish spots on both sides and on their petioles. In advanced infections, the whole foliage was covered with fungal growth (see photo). Such plants looked as if they had been dusted with a white powder. Shaded leaves showed a higher incidence and a more severe infection than did leaves well exposed to the sun. Older, infected leaves turned brown and died.

The disease was widespread in the field with several local spots of higher incidence.

Causal agent

Laboratory examination indicated that the causal agent was a fungus, the hyphal and spore structure of which resembled that of powdery mildew commonly found on local sugar beets. C. E. Yarwood, Professor of Plant Pathology, U.C., Berkeley, identified the pathogen as *Erysiphe polygoni* DC.

This is the first recorded incidence of powdery mildew on carrots in the Imperial Valley. Furthermore, it is the second recorded incidence of the disease on carrots in the United States (in 1975 the same disease was observed in Santa Maria, California—C. E. Yarwood, personal communication).

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