Purple Scale Control

imported parasites give promise of ultimate biological control

Paul DeBach

Successful biological control of the purple scale in California may be proven in experiments underway in citrus groves in Orange County.

The purple scale—*Lepidosaphes beckii*—is the only major orange tree pest that has evaded biological control in untreated test plots in the coastal areas of southern California.

In one Orange County grove, the purple scale is being held in check by one of two recently imported species of parasitic wasps—*Aphytis* "X"—which is established in several colonies in that county and as far north as Santa Barbara County. The second wasp—*Physcus* sp.—is known to be established in San Diego County only although it was colonized in Orange and Santa Barbara counties.

Aphytis "X" was imported in December, 1948, in purple scale from China. During 1949, small colonies were released in several plots in Orange and San Diego counties. The extremely cold winter of 1949–50 apparently seriously reduced the small overwintering parasite population because early in 1950 very few live parasites could be found. In 1950, 1951, and 1952, more colonizations were made in purple scale.

The oldest case history and the most promising progress are represented by a grove near El Toro, Orange County. In 1949 several hundred parasites were colonized on two purple scale infested trees in a 10-acre block in the grove.

The progeny of these parasites were virtually eliminated by the cold winter of 1949–50. During March, April, and May of 1950, 4,000 insectary-reared *Aphytis* "X" were released on another tree in the 10-acre block—one not colonized previously. No evidence of reproduction was readily evident until July, but in September, the wasps were common on the new release tree and by December they had dispersed to, at least, six tree rows from the original tree.

At the time of colonization the new tree had purple scale damage to such an extent that large areas were defoliated. Scale-encrusted areas on fruit, leaves, and wood were general. During the second half of 1950 much parasite-caused mortality occurred and the live purple scale was reduced from 84% to 10%.

The parasites successfully passed through the winter of 1950–51 and became extremely abundant on the release tree.

In April and May, 1951, considerable new tree growth appeared for the first time since 1949. By August, the tree had outgrown much of the previous damage, and in December, the purple scale population was estimated at only 1% of the original. By the end of 1951, the parasites had dispersed from the original 1950 release tree and were common on all infested trees throughout the 10-acre test block. Maximum dispersal in one direction during this period was at least 60 tree rows. In 1952, no commercial damage occurred in the 10 acres. Trees originally heavily infested generally showed good reduction in scale infestations.

Other test plots also have shown good results from the colonization of *Aphytis* "X."

A tree in an abandoned grove near Carpinteria, Santa Barbara County, was colonized with 100 *Aphytis* "X" in March, 1949. Although their progeny carried through the cold winter of 1949–50, another 100 parasites were released on the same tree in April, 1950. Purple scales on the originally heavily infested tree were greatly reduced by the end of 1951. During 1952 they continued very light. All evidence indicates that the parasitic wasp was responsible for this reduction. However, dispersal from the colonized tree in this small plot was poor, probably because of a heavy Argentine ant infestation.

In another case, parasites were released on one tree in an untreated, two-acre plot near Irvine, Orange Coutny, in September, 1950, and on several more trees in early 1951. Many very heavily infested trees were present. By the end of 1951 the parasites were common on and around the release trees and had dispersed considerably throughout the plot. During 1952 the parasites became extremely abundant in the two acres and caused high mortality of purple scale.

In other cases of colonization with the parasite *Aphytis* "X" results were less favorable.

The wasp was released in an untreated six-tree plot near Yorba Linda, Orange County, in small numbers in the fall of 1950 and in large numbers in the spring of 1951. No reproduction was evident until July, 1951, and then only on one tree. Establishment on all six trees was not general until late in 1951 despite an abundance of purple scale. Although a large proportion of the adult purple scales was dead, by October, 1952 enough hatch was present to cause a heavy reinfestation—two years after the initial small colonization.

In October, 1952, a survey was made of 30 purple scale infested plots in which *Aphytis* "X" had been colonized at some one time from 1949 to 1952. In five of the 30 plots no parasites were recovered.

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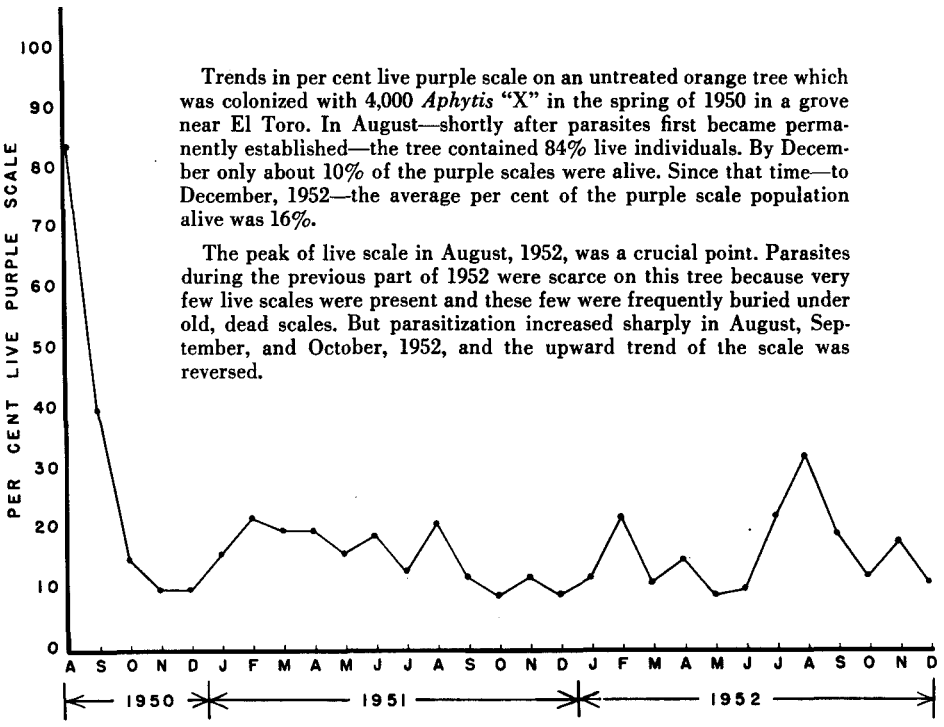

Trends in per cent live purple scale on an untreated orange tree which was colonized with 4,000 *Aphytis* "X" in the spring of 1950 in a grove near El Toro. In August—shortly after parasites first became permanently established—the tree contained 84% live individuals. By December only about 10% of the purple scales were alive. Since that time—to December, 1952—the average per cent of the purple scale population alive was 16%.

The peak of live scale in August, 1952, was a crucial point. Parasites during the previous part of 1952 were scarce on this tree because very few live scales were present and these few were frequently buried under old, dead scales. But parasitization increased sharply in August, September, and October, 1952, and the upward trend of the scale was reversed.

Vinegar Fly in Tomato Fields

series of experimental tests indicates solution of control problem may be in field treatments

A. E. Michelbacher, O. G. Bacon, and W. W. Middlekauff

DDT and dieldrin have shown the most promise in experiments to control the vinegar fly—*Drosophila melanogaster* Meig.—on tomatoes. However, field investigations with insecticides have not progressed to a point where treatment recommendations can be made.

Shortly after the middle of September, 1952, troublesome populations of the vinegar fly developed in tomato fields in the Linden area of San Joaquin County. Prior to that time flies were found in abundance in harvested peach orchards where they were breeding in rotting fruit on the ground. The delayed start in tomatoes may have been due to the late maturity of this crop or the dusting program conducted to control caterpillars attacking tomato may have had a suppressing effect upon the vinegar fly population in the fields.

A series of experiments was conducted in the Linden and Tracy areas to determine whether tomatoes in boxes could be protected against the flies.

Because none of the first four experimental treatments showed promise, a fifth test was conducted in which the concentration of the materials used was increased to at least twice the concentration applied in any of the preceding experiments.

All the treatments in the fifth test were replicated twice and were applied by hand to plots of 0.2 acre on November 4, 1952.

The treatments and the approximate amounts of insecticides applied per acre are given below:

1. Check—untreated
2. 10% DDT dust 30 pounds
3. DDT emulsion spray 3 pounds actual DDT
4. DDT emulsion spray 3 pounds actual DDT, plus malathon wettable powder, 1 pound actual
5. Dieldrin, emulsion spray, 1 pound actual
6. Dieldrin emulsion spray, 1 pound actual; malathon wettable powder, 1 pound actual
7. Malathon wettable powder, 1 pound actual

Relative populations were determined by using slit tomatoes and counting the eggs deposited on the fleshy portion of the fruits. Each count was based on 10 tomatoes, five from each replicate.

Of these treatments the 10% DDT dust and the dieldrin spray showed the most promise.

The adult vinegar flies were most active in the morning and in late afternoon. Of the physical factors, temperature and light intensity appeared to be very important. Little activity occurred at temperatures below 55° F, and flies became quiet at temperatures higher than 95° F. Light intensity and temperature were closely interrelated. The flies preferred light of low intensity, and were not active during midday even when temperature conditions were favorable. Optimum temperatures appeared to range between 60° F and 77° F. In general there was more activity and flight in the afternoon than in the morning, probably because in the morning—when light intensity was best for maximum activity—temperatures were too low. In the evening highly satisfactory temperatures almost always coincided with proper light intensities. The flies remained inactive in the dark and strong winds tended to keep them quiet even when other conditions were favorable.

During periods of flight, adult flies entered the boxes by the thousands, and under severe conditions the fruit was almost covered with them.

During the swarming period eggs were laid on any tomatoes that had been recently cracked or crushed. From observations made during the past season it appears that the vinegar fly problem must be stopped in the field although experiments to control the flies in the field with insecticides have not proved very successful.

Fly abundance in tomato fields is associated to a large extent with the amount of crushed and cull fruit to be found. As a result they are most abundant along box rows, or portions of the field where equipment has run over the vines.

Although large populations may be encountered in tomato fields, the largest infestations have been found in melons. It is certain that melon fields and certain fruit orchards are sources of infestation for tomatoes that grow adjacent to them.

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Of those five, two had been colonized with a few parasites in 1949 when heavily ant-infested. A combination of the effects from the 1949–50 freeze and from ants may have eliminated the incipient colonies. The third of the five plots was oil sprayed twice following colonization. The fourth plot was colonized in January and the fifth in March, 1952.

The 25 plots which showed parasite establishment were rated as to progress of the parasite in relation to the length of time the parasites had been out, abundance of the parasites, and mortality to the purple scale. Progress was poor in seven plots, fair in seven, good in five, and very good in six. Ants were associated with poor progress in three and dust in one of the seven poor plots. Ants were associated with two and spray treatment with one of the seven plots showing only fair progress. Of the five plots showing good progress, a few ants were present in one. No ants were present in the six plots showing very good progress. These and other observations indicate that ants have a depressing effect on *Aphytis* "X" population increase. However, in about half of the plots rated as poor some other factors were responsible for unfavorable parasite increases.

The parasite's preference for adult scales on which to lay its eggs reduces its efficiency when the majority of scales present are young but the fact that it lays its eggs—to a certain extent—on male scales helps to bridge this gap.

Aphytis "X" is slow to increase and disperse but demonstrates good efficiency at low scale densities—a prime requisite for a successful parasite.

It appears hopeful from these studies that under favorable environmental conditions, biological control of purple scale ultimately may be achieved as it has been for certain other citrus pests.

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