

BIOLOGICAL CONTROL OF AVOCADO PESTS

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(Based on an address given at the annual meeting of the California Avocado Society, June 6, 1953.)

Fortunately for California growers, avocado trees in this state seldom need pest control treatment. This relative freedom from pests is not mere happenstance. There are many potential pests in our groves at the present time. Numerous other pests occur on avocado trees throughout the foreign avocado growing regions of the world. California growers are protected from the pest species which are present in foreign countries by effective quarantine measures. The many potential pest species which are in our groves at the present time are generally kept under satisfactory natural balance by beneficial insects. Some of these beneficial insects were introduced into California by the Department of Biological Control, University of California; others are native to California.

In order to facilitate establishment of newly introduced beneficial insects and to obtain the maximum efficiency from established species, it is essential to maintain satisfactory environmental conditions for them in the groves. For this reason, proper grove condition is an important part of the biological control program. Therefore, considerable attention has been given to the investigations of environmental factors which influence the activities of beneficial insects.

During the years between approximately 1928 and 1940 the latania scale *Heiniberlesia lataniae* (Sign.) was the most serious pest of avocados in California. Groves were sprayed or fumigated for control of this pest. Today due to the effective work of natural enemies this insect is a minor pest. Artificial control is no longer practiced. The small yellow parasitic wasps *Aphytis diaspidis* (Howard) is the most important parasite of the latania scale.

Perhaps the most effective predator of this scale is the twice-stabbed lady beetle *Chilocorus stigma* (Say). This beetle is shiny black except for a red spot on each wing cover. The larvae are black and covered with long branched spines. They also feed on latania scale.

Blaisdell's ladybird *Lindorus lophanthae* (Blaisdell) from Australia is also an important predator of the latania scale. It is small, about 1/12 of an inch long, the wing covers are black and the head area is reddish brown.

The parasitic mite *Heinisarcoptes malus* Banks and the predatory mites *Cheletomimus berleseii* (Oud.) and *Cheletogenes ornatus* (C. & F.) are also important enemies of

latania scale.

During the past year a number of species of newly introduced parasites and predators of latania scales have been colonized in avocado orchards throughout southern California. Sufficient time has not elapsed as yet to determine the success which may be achieved by these various species of beneficial insects in our California groves. They will be reported on fully at a later date.

Several other armored scales which often attack avocados are sometimes mistaken for latania scale. They are greedy scale, ivy scale, California red scale, and dictyospermum scale. These pests have natural enemies similar to those of the latania scale.

Prior to 1942, the long-tailed mealybug *Pseudococcus adonidum* (Linn.) was a serious pest of avocado in San Diego County. As a cooperative project between Mr. Dean Palmer, Agricultural Commissioner of San Diego County, and Dr. S. E. Flanders, Department of Biological Control, University of California, the parasitic wasps *Anarhopus sydneyensis* Timb. and *Tetracnemus peregrinus* Comp. were released in avocado groves in San Diego County in the spring of 1941. These parasites, originally from Australia, were collected from other areas in California where they had been established by the Department of Biological Control, University of California. Two years after the release of these parasites no commercial damage to avocado trees could be found in groves previously heavily infested with mealybugs.

Several other species of mealybugs found on avocados are also kept under satisfactory biological control by beneficial insects. Among these are the Citrophilus mealybug *Pseudococcus gahani* Green, Baker's mealybug *Pseudococcus maritimus* (Ehrh.), and the citrus mealybug *Pseudococcus citri* (Risso).

The Citrophilus mealybug is controlled primarily by the parasitic wasps *Coccophagus gurneyi* Comp. and *Tetracnemus pretiosus* Timb. These parasites were introduced into California from Australia in 1928 by Harold Compere of the Department of Biological Control, University of California, Citrus Experiment Station. One of the most important parasites of the citrus mealybug is the small wasp *Leptomastidea abnormis* (Girault) which was introduced from Sicily. *Chrysoplastycerus splendens* (How.) a small native wasp is the most common parasite of Baker's mealybug. The parasites mentioned here are only some of the more important ones. In addition, there are a number of others, some introduced, some native, which attack these mealybugs.

Although these mealybugs initially attracted attention as citrus pests, it is very likely that in the absence of natural enemies they would also be serious pests of avocado trees.

Predators as well as parasites are important in maintaining the natural balance of mealybugs. The well known mealybug Destroyer *Cryptolaemus montrouzieri* Muls was introduced from Australia. Some of the more important native predators are the brown lacewings *Hemerobius pacificus* Banks, *Symphorobius barberi* Banks, *S. californicus* Banks; the green lacewing *Chrysopa californica* Coq.; the predatory flies *Leucopis bella* Loew and *Diplosis* sp. ; and the small lady beetles *Hyperaspis lateralis* Muls. and *Scymnus* spp.

All of the unarmored scales attacking the avocado are effectively controlled by parasites. The most common of these scales are the black scale *Saissetia oleae*

(Bern.), the hemispherical scale *S. hemisphaerica* (Targ.), and the soft (brown) scale *Coccus hesperidum* Linn.

Although many species of parasites of the black scale have been introduced into California, it is controlled mainly by *Metaphycus helvolus* (Comp.). This parasite is one of 28 species shipped to California from South Africa by Harold Compere in 1937. The black scale frequently flares up in avocado groves but it is promptly controlled by natural enemies. No chemical treatment is necessary.

The most effective parasite of the soft (brown) scale is *Metaphycus luteolus* (Timb.). This scale is also attacked by some of the parasites introduced for black scale control as well as other native parasites and predators.

The hemispherical scale is controlled mainly by the same natural enemies that control the black scale. Here again, as in the case of the mealybug, there is a rather large complex of parasites and predators preying on these pests; only the most important of them have been mentioned here.

In the absence of their natural enemies these unarmored scale insects could be very serious pests of avocados.

The most notorious of the foliage feeders on avocados is the omnivorous looper *Sabulodes caberata* Gn. This caterpillar is usually held under control by beneficial insects and disease. The most important of the natural enemies are the parasitic wasps *Habrobracon xanthonotus* (Ash) and *Trichogramma minutum* Riley. The first of these attacks the caterpillars, the latter parasitises the eggs. When populations of the omnivorous looper become heavy they are almost invariably wiped out by the virus disease *Bergoldia nosodes* Hughes and Thompson.

A concentrated infectious material has been prepared from pulverized virus infected bodies of looper caterpillars. At the present time Dr. I. M. Hall of the Department of Biological Control, University of California Citrus Experiment Station, has a limited amount of this material available for experimental use during the 1954 season. The infectious virus material suspended in water may be applied to the trees in a spray application. As this disease is specific for caterpillars it would not kill any of the beneficial insects in the grove. Therefore, its use for looper control would in no way interfere with the natural balance of other pest species present. Should a disease material such as this prove effective in controlling the looper it would be ideal for use in the biological control program.

The greenhouse thrips *Hemiothrips haemorrhoidalis* (Bouche) has in the past decade become a pest of economic importance on avocados in restricted areas. It has a number of natural enemies such as the egg parasite *Mega-phragma mymaripennis* (Timb.), green lacewing larvae and predaceous thrips. A careful study should be made of the factors influencing the natural balance of this pest. Orchard management and prevention of build-up is probably the best method of control. Such measures as the removal of weeds and ornamental shrubs that are favorable hosts for the thrips, replacement of avocado varieties which are severely susceptible to thrips and pruning trees to admit sunlight help in preventing the build-up of this pest. Insecticides should be used only as a last resort.

Plant-feeding mites are at present the most serious pests of avocado in California. The six-spotted mite *Eotetranychus sexmaculatus* (Riley) and the avocado brown mite *Paratetranychus coiti* (McGregor) are the most common of these mites.

The six-spotted mite first became abundant on avocados in the spring of 1950. Throughout that year it caused severe damage by defoliating trees in certain orchards in the Carlsbad and Encinitas areas of San Diego County.

Considerable evidence shows that the six-spotted mite became a pest on avocados as a result of the elimination of natural enemies caused by the widespread use of DDT in control of greenhouse thrips.

Recent investigations by the Department of Biological Control, Citrus Experiment Station, have disclosed that the most effective of the natural enemies of the six-spotted mite is a group of predatory mites belonging to the genus *Typhlodromus*. These predatory mites, in general, maintain the six-spotted mites at such a low population that they are seldom seen by growers.

Stethorus picipes Casey, a tiny black lady beetle, is the most important predator of six-spotted mites when for various reasons the six-spotted mites become numerous. Under such conditions *Stethorus* generally moves in and cleans up the infestation.

Other important natural enemies of the six-spotted mite are the larvae of the green lacewing; dusty wings (several genera) ; the tiny black Staphylinid beetle *Oligota oviformis* (Casey) ; the larvae of the predatory fly *Arthrocnodax occidentalis* Felt; the pirate bug *Onus tristicolor* (White) and predatory thrips.

Field experiments in coastal areas have shown that when these natural enemies—especially the predatory mites—are removed from the trees by the use of DDT, the six-spotted mites soon become numerous enough to cause serious damage. Experiments have also shown that fresh deposits of inert dusts, such as road-dust, are almost as harmful as DDT to these natural enemies.

The avocado brown mite *Paratetranychus coiti* McGregor has been known to infest avocado trees in California for over twenty years. Although the brown mite is found in all avocado growing regions of California, it is generally kept under satisfactory control by natural enemies. High populations of brown mites may develop in any area, however, if the natural enemies are destroyed by insecticides or dust deposits.

The same species of natural enemies that control the six-spotted mites are also responsible for the natural control of the avocado brown mites.

During the past year three new mite predators have been introduced from Africa: one *Stethorus* and one *Somatium* from Asmara, and one *Stethorus* from Morocco. These predators are now being reared in the insectary of the Department of Biological Control, University of California, Citrus Experiment Station, and will be released in avocado and citrus groves this year.

Although a number of pest species have been mentioned in this report, it must be remembered that most of them are under satisfactory biological control in all avocado growing areas in California. Furthermore, the few species that have developed, at times, to pest proportions have done so only in limited areas involving a very small percentage

of the total avocado acreage. Beneficial insects and mites are largely responsible for this excellent degree of pest control.

Thus the most economic and logical approach to the pest control problem on avocados is obviously the protection and improvement of the biological balance that exists in our avocado groves.

Three important phases to be considered in protecting and improving the biological balance are quarantine measures, effective use of natural enemies, and cultural practices.

Rigid quarantine regulations must be maintained in order to prevent introduction of numerous pest species of avocado which occur in other states or other countries.

To obtain more effective use of natural enemies, more beneficial species should, as practicable, be introduced and established; research should be continued to determine factors which influence the natural balance under grove conditions, and research should be continued on the mass production and periodic release of beneficial insects and disease organisms as a means of preventing or controlling outbreaks of pest species.

Cultural practices which are known to be aids to beneficial insects are the prevention or elimination of deposits of inert dusts, such as road dust, field dust or industrial dusts; control of ants which destroy the beneficial insects; and in so far as possible avoidance of the use of insecticides.

Above all, remember that there are myriads of beneficial insects and mites constantly working in your avocado groves. Give them every possible chance to succeed in maintaining a satisfactory natural balance.