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MANAGEMENT OF INSECT AND MITE PESTS OF AVOCADO

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Pest management can be thought of as a strategy of pest containment which seeks to maximize natural control forces and to utilize other tactics only as needed with a minimum of environmental disturbance (8). Pest management in California avocado orchards mainly involves attempts to conserve and encourage the natural enemies which, for the most part, appear to effect satisfactory biological control of most of the pest species (4, 6, 7).

A large number of pest species is known from California avocado orchards (2) but most are seldom noticed. Species which are usually present but of minor or no economic significance include the omnivorous looper, *Subulodes caberata* Guenee, the amorbia, *Amorbia essigana* Busck, the latania scale, *Hemiberlesia lataniae* Signoret, the brown soft scale *Coccus hesperidum* L., the long-tailed mealybug *Pseudococcus adonidum* L. and the greenhouse white-fly *Trialeurodes vaporariorum* Westwood. The latter 2 species increased to relatively high numbers in some orchards in San Diego County in the summer of 1975 and deposits of sooty mold were apparent on fruits and leaves. However, populations again declined to a low level in 1976. Such occasional imbalances can probably be attributed to some change in environmental conditions such as weather patterns especially favorable to the pest species or unfavorable to its natural enemies.

The greenhouse thrips, *Heliothrips haemhorroidalis* Bouch, sometimes cause fruit scarring in orchards along the coast, of southern California. Inland areas, having lower humidities and greater temperature extremes, appear to be marginal for the colonization of this tropical species. This thrips is attacked by several natural enemies (3) and large reductions in the populations also result when the fruit is picked. Some spot-spraying with malathion has been used to control greenhouse thrips in coastal areas. Spraying entire orchards with this material often induces outbreaks of mites (C. A. Fleschner and J. A. McMurtry, unpublished data). A hymenopterous parasite, *Dasyscapus parvipennis* Giard, was introduced to California from Trinidad in 1962 with the hope of achieving more effective biological control of greenhouse thrips (9). However, colonization attempts were unsuccessful.

The 6-spotted mite, *Eotetranychus sexmaculatus* Riley, is also confined to coastal areas of the state. The predaceous phytoseiid mites, *Amblyseius hibisci* Chant and *A. limonicus* Garman and McGregor, occupy the same micro-habitat (along the midrib on the undersides of leaves) and generally maintain this pest at low levels (6). Destruction of these predators by pesticides can result in a marked increase in 6-spotted mites, producing severe leaf damage or defoliation (3, 6).

The avocado brown mite, *Oligonychus punicae* Hirst, probably is the pest of greatest concern to the California growers. However, experience indicates that relatively high

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populations of this mite can be tolerated. Densities as high as 100-150 active stages per leaf do not cause defoliation (11). Two species of predators, *Amblyseium hibisci* and the coccinellid beetle, *Stethorus picipes* Casey, are the major predators of *O. punicae,* with the later species being most important at high mite densities (10). Our studies have shown that *S. picipes* can suppress rapidly increasing populations of avocado brown mite before severe leaf bronzing and defoliation occur. Occasionally, however, the increase in the *Stethorus* populations occurs too late and the mites may increase to over 300 active stages per leaf, resulting in some defoliation and possible fruit loss (10, 11). Such severe infestations usually occur only on 'Hass'.

Because severe infestations of *O. punicae* were observed in many 'Hass' orchards in the Fallbrook area for at least 3 consecutive years (1963-65), we began investigations in 1966 to determine if supplementary releases *of Stethorus* beetles would improve the degree of control of the mite. Releases of insectary-reared adult beetles were made early in the season, when mite populations were just starting to increase. Results of the experiments showed that in plots in which *Stethorus* beetles were released at the rate of 200 or 400 adults per tree, there was a faster buildup *of Stethorus* populations, lower peak populations of O. *punicae* and a lower percentage of mite-damaged leaves compared to check plots where no releases were made (11, 12).

Results of 3 years experiments were promising but the use of supplementary releases of *Stethorus* beetles still is not commercially feasible. The technology of rearing the beetles has not approached a level where they can be mass-produced commercially and sold to the growers at a realistic price. Large numbers would have to be available during the critical, narrow span of time when the initial buildup of the mite populations occurs. Also, the incidence of widespread, heavy infestations of *O. punicae* has declined during the last 8 years (1969-76). Only in 1974 were the infestations comparable to those which occurred during the years 1963-65. The reasons for the generally lower infestations are not known and perhaps another cycle of more severe infestations will occur.

Our research on avocado brown mite has since been directed mainly toward exploration for and introduction of new species of predaceous mites, with the objective of adding to the native predator complex and achieving control of this pest at lower population densities. Current insectary cultures include various species of phytoseiid mites from Mexico, Brazil, Peru, South Africa, Italy and Spain. Field colonizations are made during summer buildups of avocado brown mite. *Iphiseius degenerans* Berlese, a common phytoseiid mite in the Mediterranean region, became established at a release site in the summer of 1976.

The disadvantages of spraying for mites or other pests of avocado in California would seem to outweigh any advantages at present. Some of the potential problems of using pesticides in this particular situation are: 1) pesticides may destroy natural enemies, allowing rapid resurgence of the pests and/or outbreaks of non-target pests, 2) the pest may become tolerant or resistant to the pesticide (a common occurrence in spider mites), requiring more frequent applications or change in compounds, few of which are registered for use on avocados, 3) the difficulty of obtaining thorough coverage on large trees, especially those planted on steep slopes and 4) the expense of a pesticide application in relation to the economic loss incurred without spraying.

There are some practices which can contribute to the success of biological control or pest management programs. Ants may seriously interfere with natural enemies by killing them or driving them away from the pest colony. Therefore, ant control should be practiced by destroying nests or applying a chemical around the bases of the trees. Sources of dust deposits on the foliage should be controlled or reduced since this interferes with the searching activities of parasites and predators and may even injure or kill them (5). Severe infestations of pests are commonly observed on trees adjacent to dusty roads and oiling or paving the road eliminates the problems. Other sources sometimes responsible for dust problems include factories, poultry ranches and incinerators (5). Pesticide drift should be prevented or reduced since pesticides may eliminate biological controls. Heavy infestations of long-tailed mealybug, latania scale and avocado brown mite have occurred in orchards near fields of vegetable crops receiving frequent applications of pesticides (unpublished information). Spot spraying of heavily infested areas having unfavorable ratios of pests to natural enemies should be practiced, rather than blanket spraying of the entire orchard. The pesticide is thus used as a corrective measure to return the pest's natural enemy complex to a satisfactory balance with minimum disturbance to the ecosystem.

Additional procedures which might be considered for an area-wide pest management program include enlistment of consultants trained in the field of pest management and importation of new natural enemies. Critical monitoring and evaluation of the pest-natural enemy complexes may be necessary if the pest situation is potentially explosive and destructive. This type of supervision could result in reduction or even elimination of pesticide applications. Importation and establishment of new natural enemies requires the cooperation of research and regulatory personnel in state and/or federal agencies. This has resulted in cases of successful biological control of pests on many crops (1).

Summary

Many pest species occur on avocados in California but most of them are under satisfactory biological control. The pest most frequently occurring in moderate to high numbers is the avocado brown mite, *Oligonychus punicae* Hirst. The coccinellid beetle *Stethorus picipes* Casey usually suppresses mite populations before any defoliation results. However, heavy infestations sometimes occur and introductions and colonizations of new species of mite predators are being conducted with the objective of augmenting the existing biological control of *O. punicae.*

No pesticide sprays are recommended for control of mites or insects on avocados in California because of the danger of upsetting the generally favorable balance between pests and natural enemies. Practices which would be beneficial to biological control and pest management include: controlling those factors which are detrimental to natural enemies, such as ants, excess dust and pesticide drift; and the use of spot spraying of a pesticide rather than orchard-wide coverage to correct imbalances in emergency situations.

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