EXPERIMENTS TO DETERMINE EFFECTS OF PREDATOR RELEASES ON POPULATIONS OF OLIGONYCHUS PUNICAe
[ACARINA : TETRANYCHIDAE] ON AVOCADO IN CALIFORNIA

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To determine the effect of predator releases in suppressing populations of Oligonychus punicae (Hirst), 9 species of Phytoseiidae were released in single-tree replicated plots in an avocado orchard at rates of 1200 mites/tree over a 4-week period. The releases did not significantly affect average densities of O. punicae or total phytoseiids. However, the percentages of the released species in the total phytoseiid populations reached 40, 38, 29, 28, and 22 for Phytoseiulus macropilis (Banks), Amblyseius limonicus (Garman & McGregor), Iphiseius degenerans (Berlese), Amblyseius californicus (McGregor), and Typhlodromus occidentalis Nesbitt, respectively. Phytoseiulus longipes Evans, Euseius concordis (Chant), E. stipulatus (A.-H.), and E. tutsi (Pritchard & Baker) increased little following the releases.

The avocado brown mite, Oligonychus punicae (Hirst) increases to moderate numbers on "Hass" avocado trees nearly every season in southern California. Native predators, mainly the coccinellid, Stethorus picipes Casey, and the phytoseiid mite Euseius hibisci (Chant), usually suppress populations of O. punicae before severe leaf bronzing and defoliation occurs (McMurtry & Johnson, 1966). However, peak populations of O. punicae sometimes exceed 200 active stages per leaf and partial defoliation of the trees may occur (McMurtry & Johnson, 1966; McMurtry et al., 1969). As miticide applications for this mite could upset the favorable balance that usually exists, as well as induce resistance in the pest population, augmentation of natural predation, by supplementary releases of predators, would be a more desirable strategy for reducing the incidence of damaging infestations. McMurtry et al. (1969) demonstrated that mass releases of S. picipes resulted in effective suppression of O. punicae in small plots in 3 orchards which had consistently heavy mite infestations. Even though this method appeared promising, at least 2 factors seem to preclude its use on a commercial basis: (1) Stethorus species presently can be reared only on tetranychid mites, and high numbers are required for development and oviposition; (2) the time interval during which releases are effective is very narrow. If releases are made when prey densities are too low, released beetles will not stay in the orchard; if made too late, the releases will add little to the natural buildup of predators (McMurtry et al., 1969).
Because phytoseiid mites consume relatively fewer spider mites, (McMurtry et al., 1970), they can be reared more readily than the larger, more voracious Stethorus species. Some phytoseiid species are presently being reared commercially (McMurtry, 1982). Moreover, since phytoseiids can survive at low prey densities (some even in the absence of prey), they could probably be released sooner than Stethorus species. Therefore, experiments were conducted to determine if mass releases of certain species of phytoseiid mites could produce more effective suppression of O. punicae than natural predation.

METHODS AND MATERIALS

Experiments were conducted for 3 seasons (1980-82) in a .5 ha block in an unsprayed, mature Hass avocado orchard in Couser Canyon, ca. 20 km N of Escondido in San Diego County, California. The block was on slightly sloping terrain under drip irrigation. Predator release and non release (control) trees were tagged in 5 rows, each separated by a "guard" row. Each of the 5 rows contained 1 control and 3 release trees (1 for each of 3 different phytoseiid species) in random order and each separated by 1 tree (forming a 7 x 9-tree block). Each of 3 species of phytoseiid mites were released annually at the rate of 300/tree at weekly intervals for 4 consecutive weeks (total 1200/tree or 6000/treatment on 5 trees).

The species tested in 1980 were Phytoseiulus (Mesoseiulus) longipes Evans introduced from South Africa in 1975 (Badii & McMurtry, 1984), and 2 native species, Typhlodromus occidentalis Nesbitt and Amblyseius californicus (McGregor), which are not known to occur naturally on avocado. The 1st release was made on Aug. 6. In 1981, releases were made starting on Aug. 5 of Euseius stipulatus (Athias-Henriot) and Iphiseius degenerans (Berlese), both introduced from the Mediterranean region (McMurtry, 1977), and E. tutsi (Pritchard & Baker) from South Africa. In 1982, the species released were Amblyseius limonicus (Garman & McGregor), a native species occurring naturally on avocado only in coastal areas, Euseius concordis (Chant) from Brazil, and Phytoseiulus macropilis (Banks), collected from the Cook Islands in association with Oligonychus species on trees. The last species occurs along the coast of California, typically on Ricinus communis, where it preys on Tetranychus spp. The initial release of A. limonicus and E. concordis was on Aug. 3, when the O. punicae population averaged below 5♀/10 leaves, but releases of P. macropilis, which apparently requires mite prey for reproduction, were not started until Aug. 25, when the tetranychid population had exceeded 20♀/10 leaves. Of the 6 introduced species tested, only E. stipulatus is known to be established in California, mainly in citrus orchards (McMurtry, 1982).

Populations of O. punicae and phytoseiids were sampled during the summer and fall at weekly intervals, except in 1982, when samples were taken biweekly during the first part of the season and weekly thereafter. Ten leaves were picked from each release tree and each control tree and transported to the laboratory in an ice chest for examination under a binocular microscope. All active stages of phytoseiids but only adult ♀♀ of O. punicae were counted. For species determination, ♀♀, ♂♂ and larger immature phytoseiids were mounted on slides in Hoyer's medium and examined under a compound microscope. Mounts were not made of the 2 Phytoseiulus species and Iphiseius degenerans, as these species could be recognized under the binocular microscope.

RESULTS

1980.—The releases were probably started too late to achieve maximum effectiveness, as the population density of O. punicae averaged from 103-202 adult ♀/10 leaves on the date of the 1st release (table 1). The spider mite population persisted at high levels for several weeks,