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Biological Control of Persea Mite with Predatory Mites

Continuing Project, Year 3 of 4

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Benefit to the Industry

Persea mite *(Oligonychus perseae* [Acari: Tetranychidae]) continues to be the major foliar pest of avocados, particularly in northern growing areas of California. Control of persea mite has recently become more urgent as mite induced defoliation of trees promotes leaf flush which could potentially exacerbate population growth of avocado thrips *(Scirtothrips perseae* [Thysanoptera: Thripidae]) which prefers young foliage for feeding and oviposition. Effective control of persea mite will reduce feeding damage to leaves, defoliation of stressed trees, may increase fruit yields, and may reduce population growth and feeding damage by avocado thrips.

Objectives

This study was conducted to determine the efficacy of early and late inundative releases of six commercially available predatory mites (Acari: Phytoseiidae) for the control of persea mite on avocados in Ventura County.

Summary

The seriousness of persea mite as a pest of avocado in southern growing regions of California is perceived by growers and pest control advisors to be a problem of lessening concern. Reasons for reduction in pest status are undetermined, but may be attributable to recent weather patterns being unfavorable for mite population growth, increased efficacy of endemic natural enemies towards persea mite or, perhaps, secondary plant compounds (e.g., elevated levels of toxic alkaloids) produced in response to prolonged herbivory. In northern growing areas e.g., Ventura County,

persea mite is still a major foliar pest attacking avocados. The study reported here sought to determine if inundative releases of six predatory mite species and two different release timings of predators differed in efficacy for persea mite control on avocados in Ventura County.

Study site, experimental design and sampling regimen. Evaluation of predatory mites were conducted in a single 20 acre orchard comprised of 1479 trees 10-12 years of age in Camarillo, Ventura County. Two release strategies were tested; an early release and a late release strategy.

Release timings were based on two *a priori* release thresholds selected to determine if early and late releases of predatory mites affected the efficacy of inundative releases. The early release strategy was designed to determine if difference existed between species of phytoseiids with respect to their ability to establish and control persea mites on avocado trees with low initial persea mite densities. Early releases were initiated when 25% of sampled leaves on pre-assigned early release trees had one or more persea mites. When this threshold was reached, trees were individually inoculated with one species of predator.

The late release strategy was identical to the early release strategy and was initiated when 75% of sampled leaves on trees assigned to late treatments were infested. Here we sought to determine if predator species differed in their ability to establish and reproduce when prey abundance was high, and consequently provide different levels of control of the target pest.

Each release strategy consisted of seven treatments randomly assigned to three trees for a total of 42 experimental trees (21 trees were used for each release strategy). The trial was conducted over the period March 17 to October 13 1997 inclusive.

Predatory mite releases. The trial consisted of seven treatments; six commercially available predatory mites were released onto trees and control treatments on which no predators were released. Six phytoseiid species *(Galendromus annectens, G. helveolus, G. occidentalis, G. pilosus, Neoseiulus californicus,* and *Typhlodromus rickeri)* were released at a rate of 2000 per tree. Predatory mites received from an insectary were packaged in vermiculite. Vermiculite and mites were evenly divided amongst four paper envelopes, which were attached to leaves with paper clips. Envelopes were evenly distributed around trees and predators were left to disperse from envelopes onto trees.

Sabadilla applications began four days after initial releases of predators on early release trees and three applications were subsequently made 13-16 days apart thereafter for control of avocado thrips. Failure to recover predators on early release trees prompted a second release of predators (Figure 1 A).

Data collection and analysis. Every two weeks all experimental trees had ten leaves removed which were examined in the laboratory with a dissecting microscope. Numbers of persea mites, mite nests, and predatory mites on excised leaves were recorded. All phytoseiids were slide mounted and identified to species. Numbers of persea mites on leaves collected from experimental trees were compared when populations peaked and mean numbers of mites per leaf at this time were compared using an ANOVA. Tukey's

HSD was used to separate means that were significantly different.

Results of the early release strategy on persea mite population growth. Persea mite population trends on early and late release trees showed a tendency to peak once (around late July-early August) before declining (Figure 1A and IB). Releases of phytoseiids on early release trees occurred before persea mite populations peaked (Figure 1 A). Significant differences between mean numbers of persea mites per leaf were observed at peak population densities (Table 1). Mean numbers of persea mites on all trees treated with predators did not differ significantly from control frees (i.e., those which did not receive predators.) Persea mite numbers were significantly higher on frees treated with *N. californicus* when compared to frees treated with *G. helveolus* and *T.* rickeri. This suggests that persea mite densities were, by chance, naturally higher on randomly frees treated with *N. californicus* and lower on frees treated with G. *helveolus* and *T. rickeri.*

Table 1. Mean number of persea mites ((SE) per leaf at peak population growth in the early release treatments. Means followed by the same letter are not statistically different from each other.

Treatment	Mean No. Persea Mites/Leaf (SE
Control (no predators released)	44.2 (7.8ab
Galendromus pilosus	43.4 (5.3ab
Galendromus annectens	48.6 (5.6ab
Galendromus helveolus	38.7 (5.4b
Galendromus occidentalis	45.9 (9.8ab
Typhlodromus rickeri	40.1 (6.9b
Neoseiulus californicus	72.7 (8.7a

Results of the late release strategy on persea mite population growth. On all experimental frees assigned to late releases, persea mite populations began to decline naturally in numbers before the late release threshold of 75% of collected leaves were infested (Figure 1B). Exact cause of decline is unknown, but analysis of weather station data suggests that decreasing mean minimum temperatures may be responsible. Mean numbers of mites per leaf at peak population density across experimental frees before phytoseiid releases began differed significantly from each other indicating infestation severity was not uniform across experimental frees (Table 2).

Table 2. Mean number of persea mites ((SE) per leaf at peak population growth in the late release treatments. Means followed by the same letter are not statistically different from each other.

Treatment	Mean No. Persea Mites/Leaf (SE
Control (no predators released)	48.4 (11.1a
Galendromus pilosus	69.4 (10.4ab
Galendromus annectens	44.2 (13.0a
Galendromus helveolus	38.4 (9.7a
Galendromus occidentalis	46.4 (11.1a
Typhlodromus rickeri	109.6 (15.2b
Neoseiulus californicus	67.9 (8.8ab

Persea mite numbers, by chance, peaked at greater densities on trees pre-assigned to *T. rickeri* releases when compared to trees that had been pre-assigned releases of G. *helveolus, G. annectens, G. occidentalis,* and no treatment (control trees).

Results of early and late release strategies on predator recovery. A greater number of phytoseiid species (4/6) were recovered after early releases compared to late releases (3/6), and predator species typically reached greater densities on early release trees. *Galendromus occidentalis* and G. *pilosus* were not recovered on trees after early or late releases, while G. *annectens* was not recovered after late releases. Released predators were recovered at low densities. Naturally occurring G. *annectens, G. helveolus, N. californicus,* and *E. hibisci,* were occasionally found at very low (<0.5 adults per leaf) densities on experimental trees not treated with these predtors. *E. hibisci* was found more frequently than *Galendromus helveolus* and *N. californicus* which were found more often than G. *annectens.* Recovery records of predators following release are shown in Table 3.

Table 3. Recovery of predatory mites on experimental trees after early or late releases.

Treatment	Phytoseiid Species	Recovered after Release?
Early Release		
	Galendromus pilosus	No
	Galendromus annectens	Yes
	Galendromus helveolus	Yes
	Galendromus occidentalis	No
	Typhlodromus rickeri	Yes
	Neoseiulus californicus	Yes
Late Release	*Galendromus pilosus*	No
	Galendromus annectens	No
	Galendromus helveolus	Yes
	Galendromus occidentalis	No
	Typhlodromus rickeri	Yes
	Neoseiulus californicus	Yes

Conclusions

Early releases (25% of sampled leaves were infested with persea mites predators were released onto trees) resulted in greater recovery rates of more species and larger numbers of predators after release. The early release threshold was reached before persea mite populations begin to decline naturally. Late release thresholds in this study were reached after persea mite numbers began to decline. This resulted in the recovery of fewer species and lower numbers of recovered mites after releases had been made. *Galendromus occidentalis* and G. *pilosus* appear unable to establish in avocado orchards in California when released early or late in response to increasing persea mite numbers and are not recommended for use. *Galendromus helveolus* and *N. californicus* appear to be the best species commercially available for early and late releases against persea mites. Inundative releases of *Galendromus helveolus* and *N. californicus* in Ventura may augment naturally occurring populations of these predators which were found on uninoculated trees.

Laboratory studies have shown that sabadilla has low toxicity toward predatory mites. Low establishment rates of phytoseiids in this study may be due to sabadilla use. The addition of sugar as a phagostimulant for thrips produces sticky residues on leaves which could trap foraging predators on leaf surfaces.

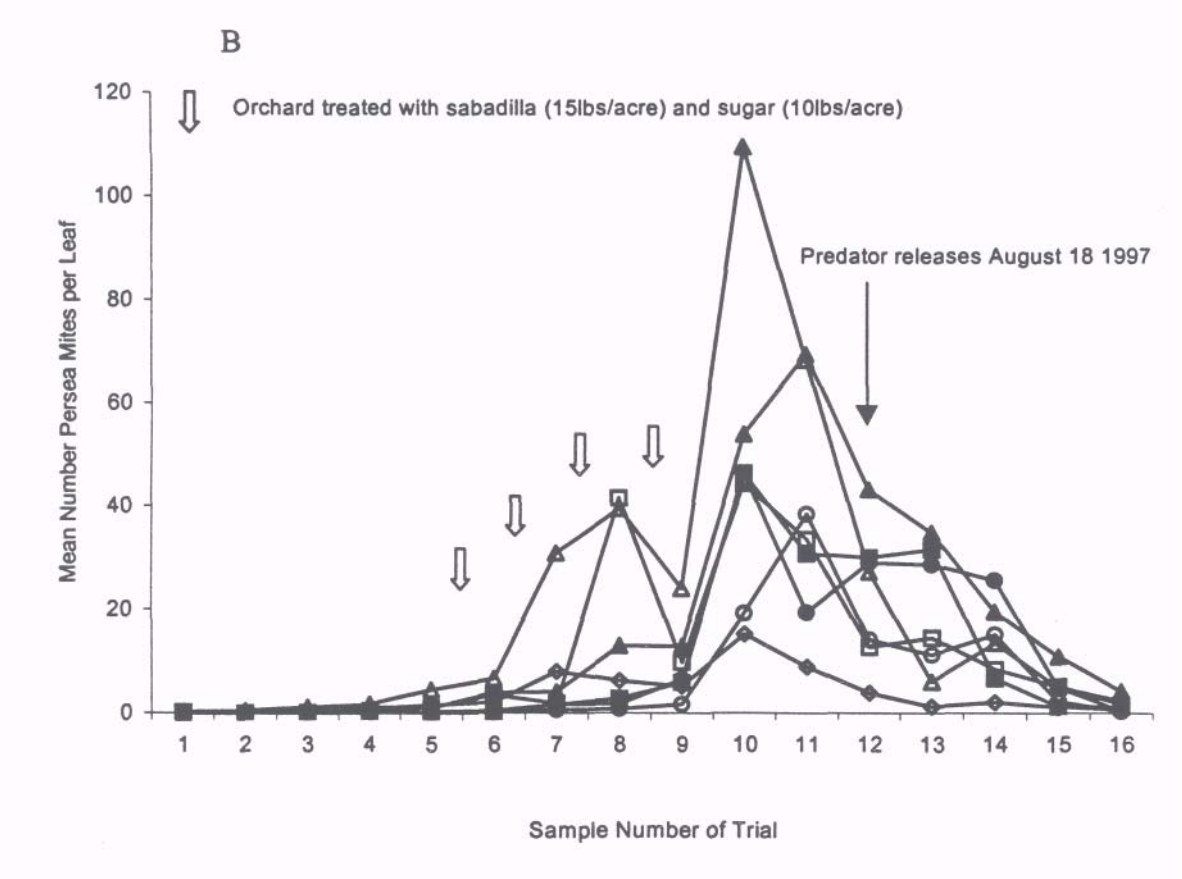

Figure 1. Persea mite population trends on early release trees (A) and late release trees (B).