Integrated Pest Management of *Oligonychus Perseae*: Development of Action Thresholds, Conservation and Identification of Indigenous Natural Enemies

Thesis

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By

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Abstract

The persea mite, *Oligonychus perseae*, is a pest of Avocado originating from Central America, was first discovered in Israel in the autumn of 2001 in several avocado plots located in the Western Galilee and has since spread to most of the growing areas. As no damage thresholds have been developed for this pest, some growers will apply up to four acaricide applications per year, while others will not spray at all, often leading to extensive foliar damage. With the intent of reducing pesticide use on the one hand, and preventing damage to fruit quality and yield on the other, I attempted to develop an action threshold for this pest. I created different pest levels on the Haas cultivar by applying acaricides (spirodiclofen and abamectin) at 50, 100, 250 mites/leaf and a non sprayed control, evaluating the leaf damage and yields of 2005-2007. Based on cumulative mite days (CMD's) the plots sprayed at 50 and 100 mites/leaf were similar and differed from the two higher levels, the latter pair also being similar. Mite population levels significantly affected leaf damage and mean tri-annual yields (2005-2007). A positive correlation was found comparing persea mite CMD's with leaf damage, while, a negative correlation was found comparing the CMD's with fruit yield. At the higher mite population levels mean yield was reduced by 20% in comparison to the mean yield attained when plots were sprayed at a threshold of 50-100 mites per leaf.

While field monitoring for persea mite I observed predatory mites (Phytoseiidae) feeding on *O. perseae* within torn nests and outside of the nests. To identify the indigenous predatory mite fauna on avocado, a survey was conducted. The survey revealed that *Euseius scutalis* was by far the most predominant species in the orchards. Subsequently I preformed laboratory studies to evaluate the predation efficacy of this indigenous predator. Preliminary laboratory leaf disc trials indicated that *E. scutalis* cannot enter intact nests of the persea mite. To determine the predation potential of *E. scutalis* when persea nests are intact vs. torn, I conducted trials on leaf discs that were infested with persea mite within their densely woven nests. Four treatment combinations were compared: 1) intact nests with 1 female predator/disc; 2) intact nests without a predator; 3) torn nest with 1 female predator/disc; and 4) torn nest without a predator. In the relevant treatments the nets were torn gently, using a fine needle, making sure not to damage any of the mites. Because species of the genus *Euseius* are known as pollen

feeders I also explored the possibility to conserve *E. scutalis* on avocado (Hass cultivar) seedlings in the lab and on trees in the field by provisioning pollen as a food supplement. The lab experiment began by applying a surplus of pollen on one leaf to the seedlings of both treatments (control and pollen provision). Once *E. scutalis* populations established (after a fortnight) the pollen was removed from the control and all seedlings were infested with persea mite. For the remainder of the experiment we continued to provision pollen to half the seedlings twice a week.

The field experiment was conducted in an organic orchard. Pollen was applied fortnightly with a prototype electrostatic pollen applicator on trees that were previously sprayed with a fine mist of water, while the negative control was sprayed with water only. *Euseius scutalis* reduced adult persea mite populations in the lab on torn and intact nests, however the predation of eggs was improved by tearing the nests. The provision of pollen on seedlings increased *E. scutalis* populations and substantially enhanced (significantly) persea mite control. Without pollen *E. scutalis* left the plants and *O. perseae* populations increased. In the field trial, on the trees that received pollen applications there was a non significant trend of lower pest and higher predator populations.

Field monitoring of persea mite revealed a large proportion of torn nests, implying the possible involvement of additional predator species in pest predation (as *E. scutalis* are not able to tear the nest). To identify these predators, insects were collected from avocado trees using a beating tray. Individuals were placed on newly infested leaf discs and monitored for several days. I observed nest tearing and predation by green lace wing *Chrysoperla carnea*, dusty wing *Conwentzia* sp., the omnivorus bug *Creontiades pallidus* and a predatory thrips (unidentified). To determine the impact of these nest-tearing predators on the field populations of persea mite, these insect generalist predators were monitored as well as the proportions of abandoned intact nests, ripped nests with and without mites, in two avocado orchards (without chemical treatments) through the summer and autumn of 2006. Based on my laboratory observations, I interpreted: 1) the abandoned intact nests as nests that were not attacked by predators, and that the persea mite developed fully and left. 2) ripped nests with no live mites as nests that were attacked (motiles either eaten or fled, eggs were eaten) and 3) ripped nests that still contained live mites as nests that a predator frequented but did not consume all prey,

creating an opportunity for intra-guild facilitation (i.e., providing opportunity for other predators to prey on the now exposed mites).

Throughout the season monitored, in both orchards, the proportion of torn nets with or without mite was between 30%-70%. I also found that the relation between the presence of the nest tearing predators and the amount of torn occupied nests on leaves (nests that a predator recently torn) was positive. These two results combined indicate that nest tearing predators are playing a role in persea mite control.

To the best of my knowledge this is the first time that yield reductions have been correlated with *O. perseae* CMDs. This result has a number of implications. The first being that *O. perseae* is an economic pest that must be dealt with. Second, an action threshold of 50-100 mites/leaf can be adopted, at least as a starting point, future refining of this action threshold can be expected. Third, the damage threshold found in this study can be used to assess the degree of success of integrated control programs, such as conservation and augmentation of mite predators.

The results of the pollen provision experiments on seedlings and trees signify the importance of pollen for persea mite biocontrol. Extending the period of pollen availability by the establishment of cover crops that would release wind-borne pollen could be a viable way of keeping *E. scutalis* populations high, thereby preventing persea mite outbreaks.

In this work I developed tools to improve the IPM of the persea mite, and, have laid the foundations for the continuation of research focusing on augmentation and conservation of acarine and insect indigenous natural enemies in the avocado orchards.