Further Progress on Biological Control of Persea Mite

Continuing Project: Year 6 of 3

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Benefit to the Industry

Persea mite, *Oligonychus perseae*, was first described in 1975 from specimens collected from avocado foliage that were intercepted from Mexico at an El Paso, Texas quarantine facility. Persea mite is native to Mexico and damages avocados in arid regions, but it is not a major pest in the state of Michoacan where Hass avocado production is greatest. Persea mite has also been recorded as a pest from Costa Rica and Israel. Persea mite was first discovered attacking avocados in San Diego County in 1990, and was originally misidentified as *Oligonychus peruvianus*. By the summer of 1993, the pest had spread north to Ventura County. Santa Barbara had its first record in spring 1994, and in 1996 persea mite had established in San Luis Obispo County. There are no records of this pest in the San Joaquin Valley. Contaminated fruit bins, harvesting equipment, and clothing probably assisted in the dispersal of persea mite throughout California. High mite densities (≈100-500 per leaf) and subsequent feeding can cause partial or total defoliation of trees. Mite-induced defoliation opens the tree canopy, increasing the risk of sunburn to young fruit and exposed tree trunks. Premature fruit drop can subsequently occur. Non-chemical control options are the use of natural enemies, in particular commercially available phytoseiid mites for biological control of persea mite, and cultural control practices that reduce the pest's reproductive and colonization potential. A better understanding of how persea mite re-colonize trees after defoliation in the spring or following pest induced defoliation would improve our ability to interpret and predict persea mite population dynamics. For example, persea mite does not appear to be a persistent pest in many orchards. Severe infestations are often followed by light infestation for the following 2-3 years. It has been suggested that natural enemies that built up during the heavy phase of the outbreak persist and keep mite numbers low, or an induced "immune" response by the tree suppresses persea mite population growth over this time period. We are suggesting an alternative explanation related to leaf drop and leaf retention rates that are a function of persea mite feeding pressure. Consequently, the leaf drop hypothesis we are testing predicts that heavy persea mite infestations are followed by light years as few leaves bearing small populations of mites capable of re-colonizing new leaf growth are retained by trees. The majority of heavily infested leaves drop once feeding damages ~ 10% of the leaf surface. Infested leaves retained by trees are often badly damaged and are poor feeding and reproductive substrates for the few surviving mites on retained leaves. Therefore, surviving mites subsequently migrate from highly damaged but retained leaves and begin the process of building to large numbers again as they continually migrate and exploit a growing population of healthy undamaged leaves. This process ultimately leads to another population outbreak, followed by a population crash and high levels of defoliation, and then a period of low mite densities as the re-colonization phase of new leaves occurs.

Objectives

1) Investigate colonization of leaves produced during spring and summer flush periods and correlate leaf drop rates with persea mite densities on these two distinct leaf cohorts. Leaf drop and persea mite density data will be collected for spring and summer leaves by quadrant (north, south, east, and west) for 'Hass' on rootstocks D-7, D-9, Thomas; Lamb Hass on D-7 will also be studied to determine if rootstocks have an effect on leaf retention patterns.

Summary

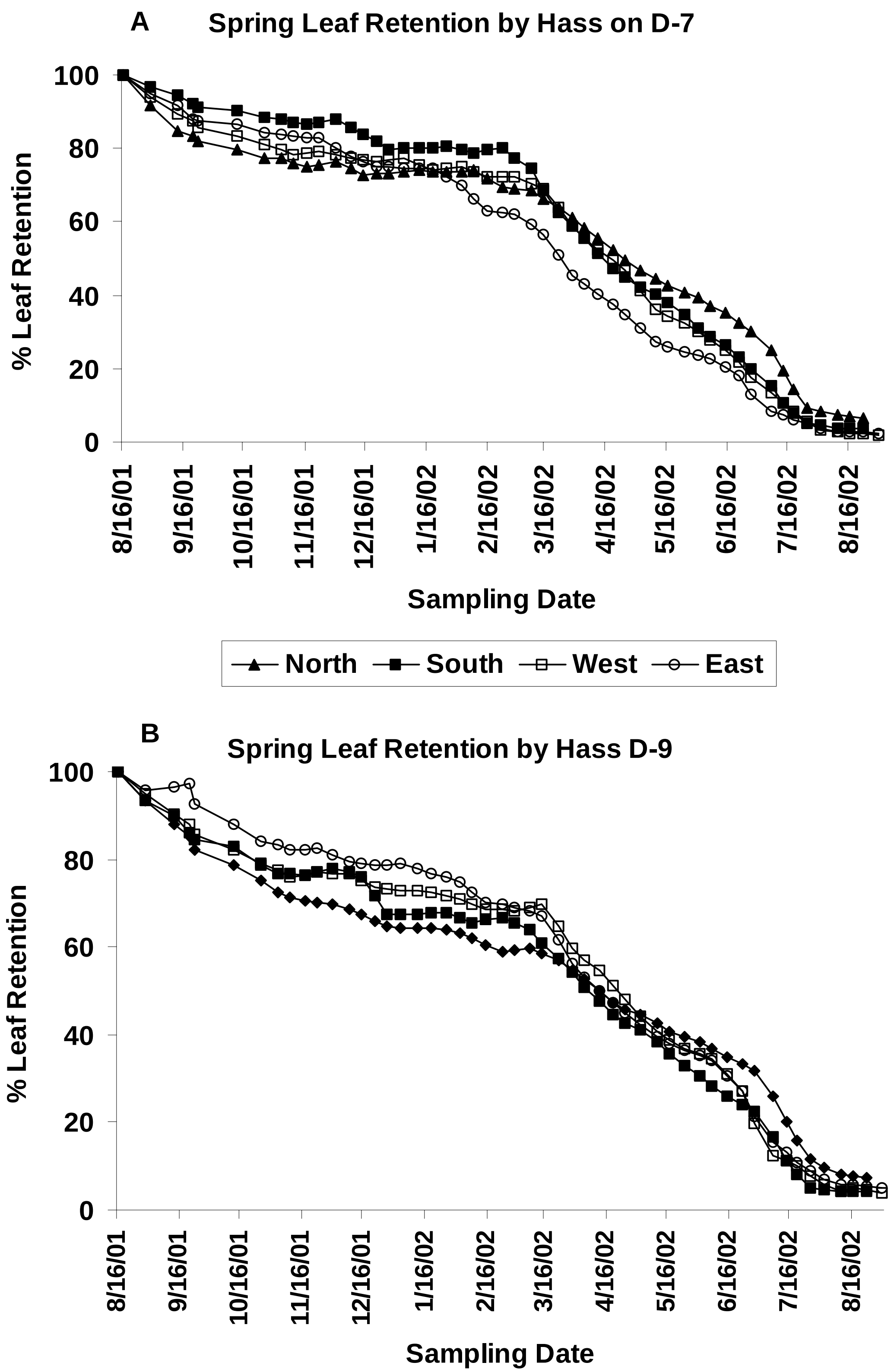
1) *Leaf Drop and Persea Mite Infestations (work by Vega, Robinson, & Hoddle).* In August 2001, this study was initiated at the South Coast Field Station and trees in the rootstock plot supervised by Mary Lu Arpaia were used. In the preceding year, persea mite numbers had been severe in this plot. Four different rootstocks were selected for this trial. Nine trees with Hass grafted to D-7, D-9, Thomas, and Lamb Hass on D-7 were selected. Each tree was divided into quadrants with north, south, west, and east facing aspects. Twenty branches in each quadrant for each experimental tree were selected and 5 mature leaves produced from the spring growth period were tagged with colored tape. Every two weeks leaf retention rates in either the north and south, or west and east quadrants were monitored by counting numbers of tagged leaves remaining on branches in quadrants on experimental trees. Control leaves were set up on experimental trees also. Control leaves belonged to the same age cohort as tagged leaves, except control leaves were not tagged with tape. This additional data collection was necessary to determine if tagging leaves with tape caused leaves to drop prematurely. This procedure was repeated for summer-produced leaves that were tagged in quadrants in late October 2001. Leaves chosen for the summer cohort were immature at the time of tagging.

Every week, spring produced leaves (non-experimental leaves lacking colored tape) were picked from experimental trees and the numbers of persea mites and predatory mites on leaves were recorded in the lab. This procedure was repeated for leaves in the summer leaf cohort. Persea mite numbers on non-tagged leaves in this leaf cohort were counted on leaves that were harvested weekly.

Leaf retention rates for spring Hass leaves on D-7, D-9, and Thomas rootstocks are shown in Figs. 1A-1C, respectively. Leaf retention by Lamb Hass on D-7 is shown in Fig. 1D. In light persea mite years, tagged spring leaves exhibit remarkable longevity. Approximately 50% of spring leaves tagged in August 2001 were still on trees by March 2002, and some (< 5%) leaves were retained for ~ 12 months. Quadrant effects appeared to have been most pronounced on Hass grafted to D-7, D-9, and Thomas, although there was no consistent effect (see leaf retention rates for leaves in east quadrants). No quadrant effects were observed for Lamb Hass (Fig. 1D).

Fig. 1. Leaf retention rates for Hass on D-7 (A), D-9 (B), and Thomas (C) rootstocks, and Lamb Hass on D-7 rootstock (D)

(see next pages)


A
Spring Leaf Retention by Hass on D-7
% Leaf Retention
100
80
60
40
20
0
8/16/01
9/16/01
10/16/01
11/16/01
12/16/01
1/16/02
2/16/02
3/16/02
4/16/02
5/16/02
6/16/02
7/16/02
8/16/02
Sampling Date
North
South
West
East
B
Spring Leaf Retention by Hass D-9
% Leaf Retention
100
80
60
40
20
0
8/16/01
9/16/01
10/16/01
11/16/01
12/16/01
1/16/02
2/16/02
3/16/02
4/16/02
5/16/02
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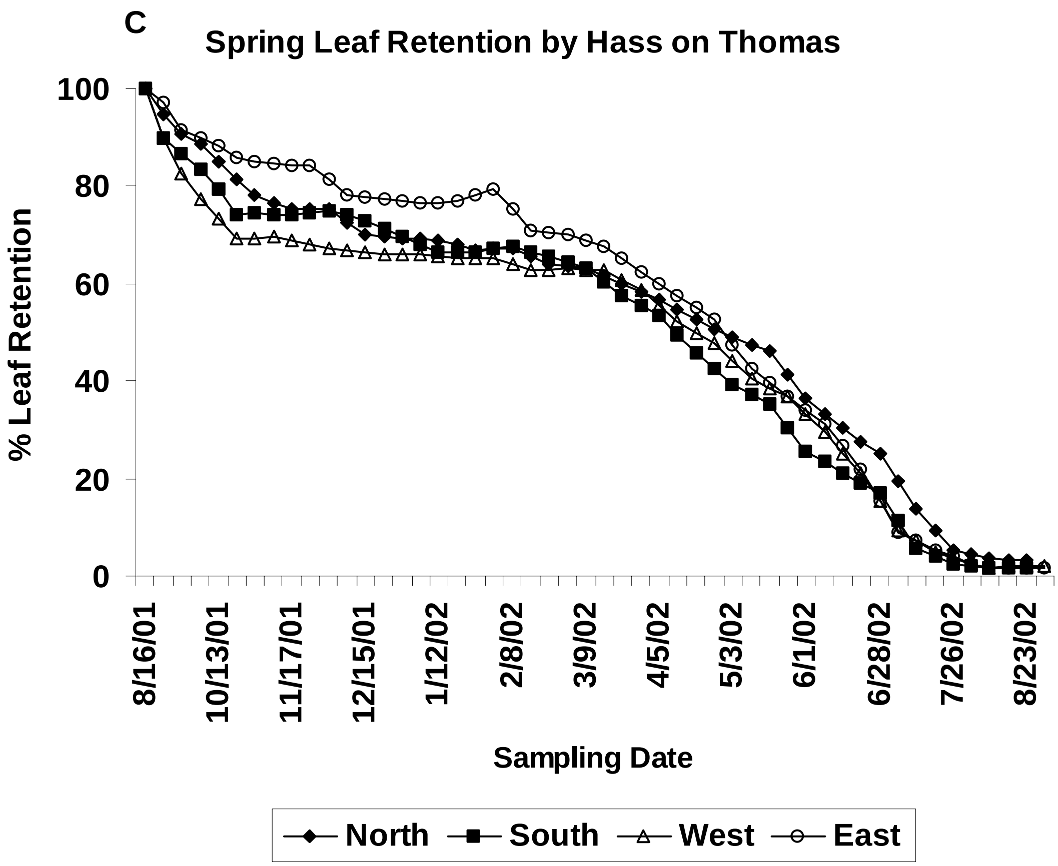
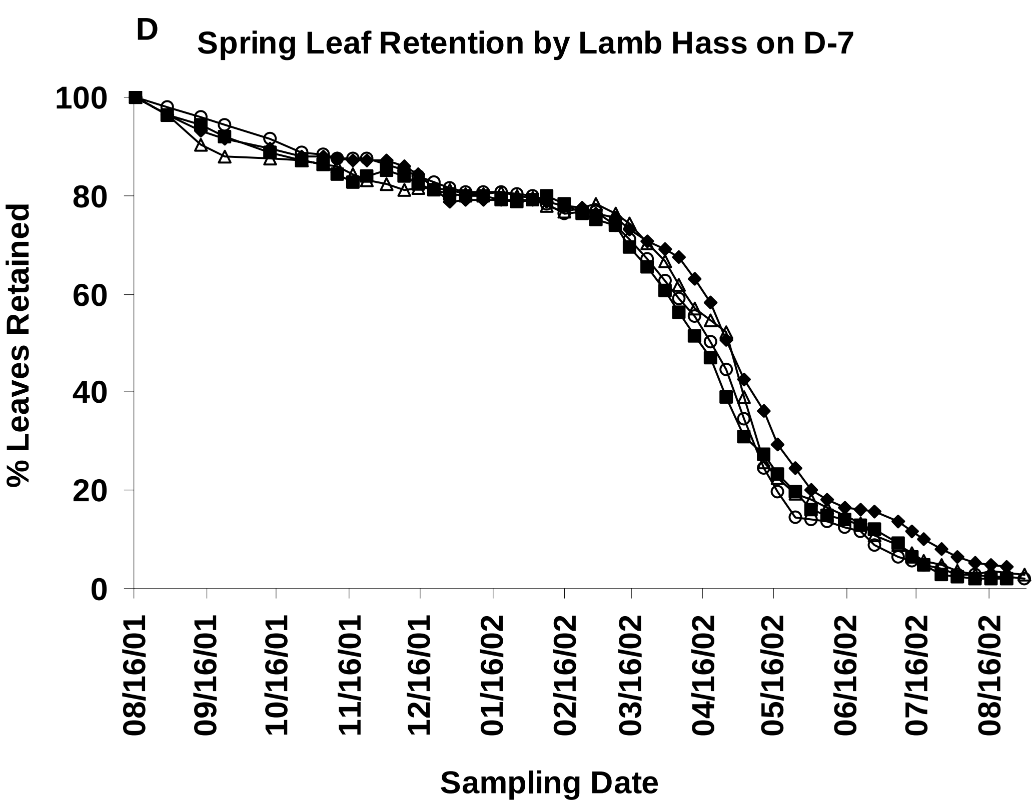
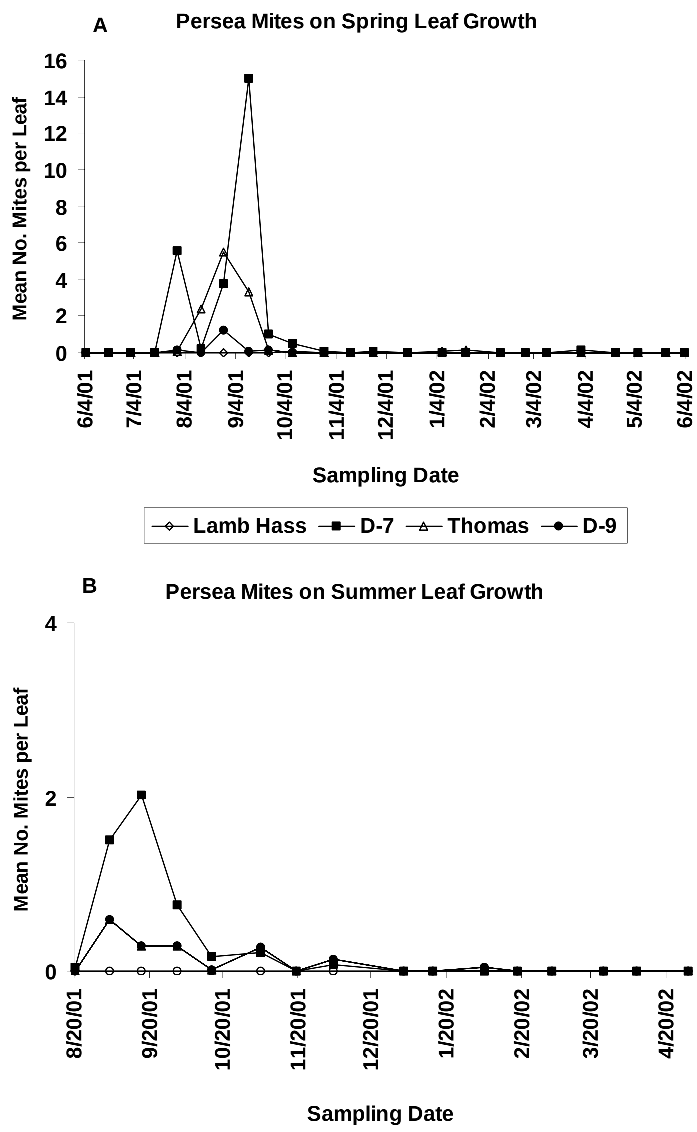
8/16/02
Sampling Date


C
Spring Leaf Retention by Hass on Thomas
% Leaf Retention
100
80
60
40
20
0
8/16/01
10/13/01
11/17/01
12/15/01
1/12/02
2/8/02
3/9/02
4/5/02
5/3/02
6/1/02
6/28/02
7/26/02
8/23/02
Sampling Date
North
South
West
East


D
Spring Leaf Retention by Lamb Hass on D-7
% Leaves Retained
100
80
60
40
20
0
08/16/01
09/16/01
10/16/01
11/16/01
12/16/01
01/16/02
02/16/02
03/16/02
04/16/02
05/16/02
06/16/02
07/16/02
08/16/02
Sampling Date

As expected, persea mite numbers on spring growth and summer growth were low (Fig. 2). This may have occurred because 2000 was a heavy year for persea mite in this plot and damage to experimental trees (excluding Lamb Hass) was very high. Few mites probably survived defoliation events and poor leaf quality to carry over in large numbers to following year to continue the outbreak.

Fig. 2. Persea mite population trends on spring leaves (A) and summer leaves (B).



The results shown here part of an on-going study investigating the relationship between persea mite outbreaks, leaf retention rates, and subsequent re-colonization and pest population growth following mite outbreaks that induce defoliation. We anticipate that approximately five years of data collection in the manner outlined in this progress report will be necessary to fully understand the complex interactions and dynamics between mite outbreaks, defoliation, re-colonization, and subsequent population growth leading to successive persea mite outbreaks. Funding for this project has been eliminate, but we will try to continue this work examining mite outbreaks on Hass on D-7 and Thomas rootstocks over the next few years.