WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

BIOLOGICAL CONTROL

in Areawide Organic Pest Management

Tara M. Madsen and John E. Dunley
Washington State University
Tree Fruit Research and Extension Center
Wenatchee, WA 98801

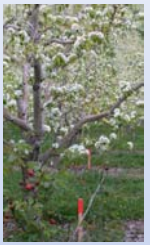
Introduction

Selective and ecologically-sensitive pesticides used in organic pest management often are not as efficient at controlling pests as are the chemicals used in conventional programs, yet organic orchards can be highly successful at maintaining low densities of pests. In Organic Pest Management much weight is placed on the role of predatory arthropods in controlling pest populations in the orchard. Because the pesticides used are generally less disruptive, beneficial insects are more likely to be maintained in orchards. Predatory insects (and parasitoids) are then able to assist the softer (and generally less effective) chemicals in maintaining control of pests.

While a greater density of natural enemies is generally expected in organic production, there is no documentation by direct measurement in the field of levels of biological control in pear orchards. The development of areawide organic pest management offers an opportunity to study predation in a situation where it is most likely to be observed.

Objectives

1. Monitor baseline predatory insect populations
2. Identify any distribution patterns related to native vegetation boarders
3. Directly measure the levels of biological control of pear psylla.



Methods

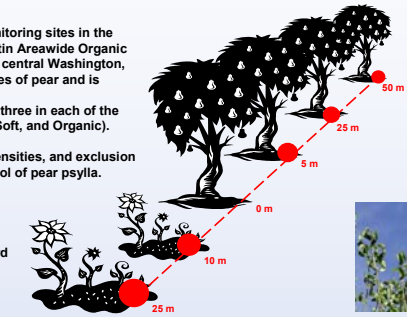
In spring of 2003, we established our monitoring sites in the Peshastin Creek valley within the Peshastin Areawide Organic Project. This narrow valley, on Hwy 97 in central Washington, supports a strip of approximately 300 acres of pear and is surrounded by native vegetation.

We chose 9 sites in our monitoring area, three in each of the three management types (Conventional, Soft, and Organic).

We used transects to monitor predator densities, and exclusion cages for direct measurement of biocontrol of pear psylla.

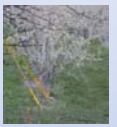
Transects

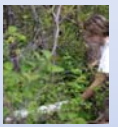
3 Conventional, 3 Soft, 3 Organic
Each 75m long, extending from the orchard into the surrounding vegetation.

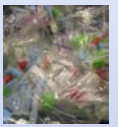


Sampling

Sampling was done weekly with beating trays, from late April into September. Predators were counted and identified, and Pear Psylla were also counted. Beginning 12 June all unknown specimens collected for identification.
Two transects were sampled once at night.







Exclusion cages

Pear leaves infested with sentinel psylla nymphs were prepared in the lab. We used 125-count silkscreen cloth to make exclusion sleeve cages. These cages prevented predators from reaching the sentinel psylla. Paired caged and un-caged leaves were set out along transects and pear psylla nymphs were monitored for mortality. We experimented with techniques in 2003 and ran trials at four transects in the project area.

1. Pear shoots infested with psylla were cut from the station orchard and trimmed into sections with 1 to 3 leaves. These shoots were placed in small floral tubes with water.

2. We then removed psylla eggs and nymphs to leave a population of 10 nymphs between 1st and 3rd instars.

3. Half of the shoots were placed in exclusion cages and half were left open. Four repetitions of paired shoots—caged and un-caged—were arrayed at each sample point of a transect. Small sleeves affixed to pear tree limbs held the floral tubes in the orchard canopy, while three-foot stakes with wire hoops on them held the cages suspended in the vegetation. After 1-4 days in the field, cages were brought back to the lab and nymphs were re-counted.

4. We also set up cages using clean pear leaves from greenhouse cuttings which we artificially infested either by hand-transferring psylla nymphs from orchard shoots, or by caging females with the shoots to inoculate them with eggs. Shoots were caged and placed in the orchards in the same way as the naturally infested shoots.

5. In other trials we used Sitotroga eggs, commonly used as food for predatory insects in the lab or during shipping, as substitutes for pear psylla. 20 flash-frozen eggs were glued to ¾ x 2 inch tags of card stock with a dilute 1:10 solution of mucilage glue. The cards were caged and deployed in the same manner as the shoots.

Results

Preliminary analysis of data from predator monitoring transects shows total predator densities higher in ORG and SOFT sites than in CONV (Fig 1). There was a great deal of variation in predator density through the 18 weeks of sampling, with increases in density late in the season (Fig 2). This late-season increase, also seen in sampling for the Peshastin Creek Project, was greatest in the ORG blocks but also occurred in SOFT (Fig 4). Pear psylla densities were also rising at this time (Figs 5, 6).

Distance from orchard border also had a significant effect on predator density (Fig 3). Predator densities were highest in surrounding vegetation, and tended to decrease slightly from the border toward the center of the orchard. Border effects seemed strongest in ORG (which had the highest native-vegetation predator densities) and CONV (which had the lowest in-orchard densities), while these effects were less sharply evident in SOFT.

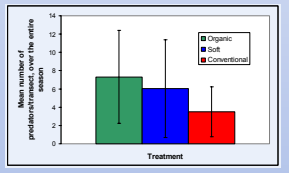


Fig 1. Mean total densities of predators on transects in 2003.

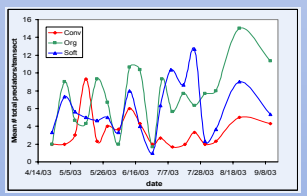


Fig 2. Seasonal variation in mean densities of predators on 9 transects in 2003.

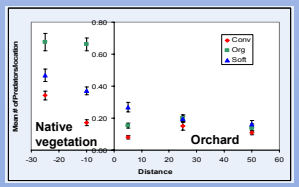


Fig 3. Spatial distribution of predators along transects, 2003.

Spider

Deraeocorid nymph

Ladybird beetle larva

Lacewing larva

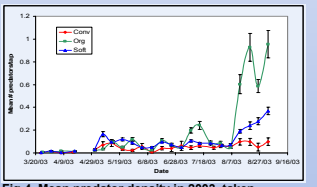


Fig 4. Mean predator density in 2003, taken from PCG Areawide Project (41 plots), by management type.

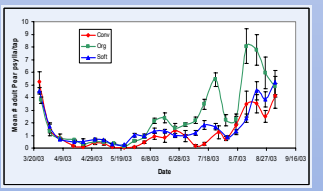


Fig 5. Mean adult Pear psylla densities in 2003, taken from PCG Areawide Project.

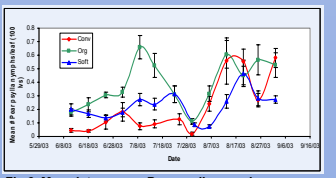


Fig 6. Mean late season Pear psylla nymph densities in 2003, taken from PCG Areawide Project.

Conclusion

An increase in predators densities was observed in late season, correlated with an increase in pear psylla densities. This suggests we may never see large numbers of predators in orchards managed for pear psylla, as damage thresholds for pear psylla may be too low to sustain higher densities of natural enemies . Nevertheless, predators appear to be more numerous in orchards under ORG pest management, and SOFT programs also appear to positively influence predator densities.

We will continue transect monitoring in 2004, and improve techniques for direct measurement of pear psylla predation.

Contact: dunleyj@wsu.edu
http://entomology.tfrec.wsu.edu/pearent