Final Report

Project Title: Pear IPM: Area-wide movement patterns of psylla and its interaction with chemical use and natural enemy abundance**.**

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Organization: USDA-ARS, Wapato WA

Cooperators: David Horton

Funding History:
Year initiated: 2000 $25,000
Final Year: 2001 $15,000

Objectives:
1) Measure pear psylla nymph and adult abundance, beneficial insect abundance, chemical use patterns and tree vigor in ca. 30 PIPM and 10 conventional blocks (2001)
2) Collect psylla adult abundance in spring and fall to describe more completely movement among orchards (2000)
3) Use multivariate and spatial statistical methods to identify the factors most predictive of good psylla control and provide a prescription for best IPM practices based on 1999-2000 Pew-EPA data and our own data collected in 2001. (2000-2001)
4) Evaluate accuracy of presence-absence sampling methods for psylla nymphal abundance. (2000-2001)

Significant Findings

- Differences in psylla abundance among orchards are very high in fall and fairly homogeneous in spring, indicating movement through winter produces regional population pressures. This supports an area-wide management approach as currently being proposed by John Dunley for Wenatchee pear orchards. Data not shown.
- In 1999-2001, psylla abundance was similar or lower in "soft" IPM blocks compared to "hard" or more conventionally managed blocks.
- Cost savings were observed in the Yakima Pew-EPA pear IPM project for growers using mating disruption and reduced Organophosphates but these savings did not continue in 2001.
- Predators were more abundant in soft blocks on a per/psylla basis.

Methods:
Psylla abundance was measured using standard beat tray and leaf sampling methods. Twenty to 25 beat trays were taken per block on any given sampling date. 100 leaves (50 inner and 50 outer) were used for leaf samples and 15 shoots for shoot samples. In studies of presence/absence sampling, the proportion of shoots infested, and the proportion of the 1^{st} fully expanded leaf, middle, and basal leaves infested were also enumerated. We used beat trays to measure relative predator abundance. Pesticide data was provided by DelMonte for their growers in 1998-2000 in association with the Pew-EPA project, and were sent to us directly by cooperating growers in 2001. Leaf brushing was conducted 5 times during the year, in May June, July, and August. Beat tray data was taken 7 times during the

Statistical analyses were correlative, using partial regression to measure the influence of certain pesticide use practices on predator abundance and seasonal psylla densities. Comparisons between management programs in 1999-2000 was based on membership in the Pew-EPA study versus all other pear growers in the Yakima Valley and versus 5 control orchard blocks that used a conventional management approach (did not use mating disruption). In 2001, 25 former Pew-EPA blocks and 10 nominally conventional blocks were employed.

Results and Discussion:

Pesticide usage in the Yakima Valley in 1999-2000 was 20% less overall in Pew-EPA implementation blocks—enough so to reduce pesticide + pheromone costs to $30 to $50 below average (See report to Washington Horticultural Association, Jeff Conner,

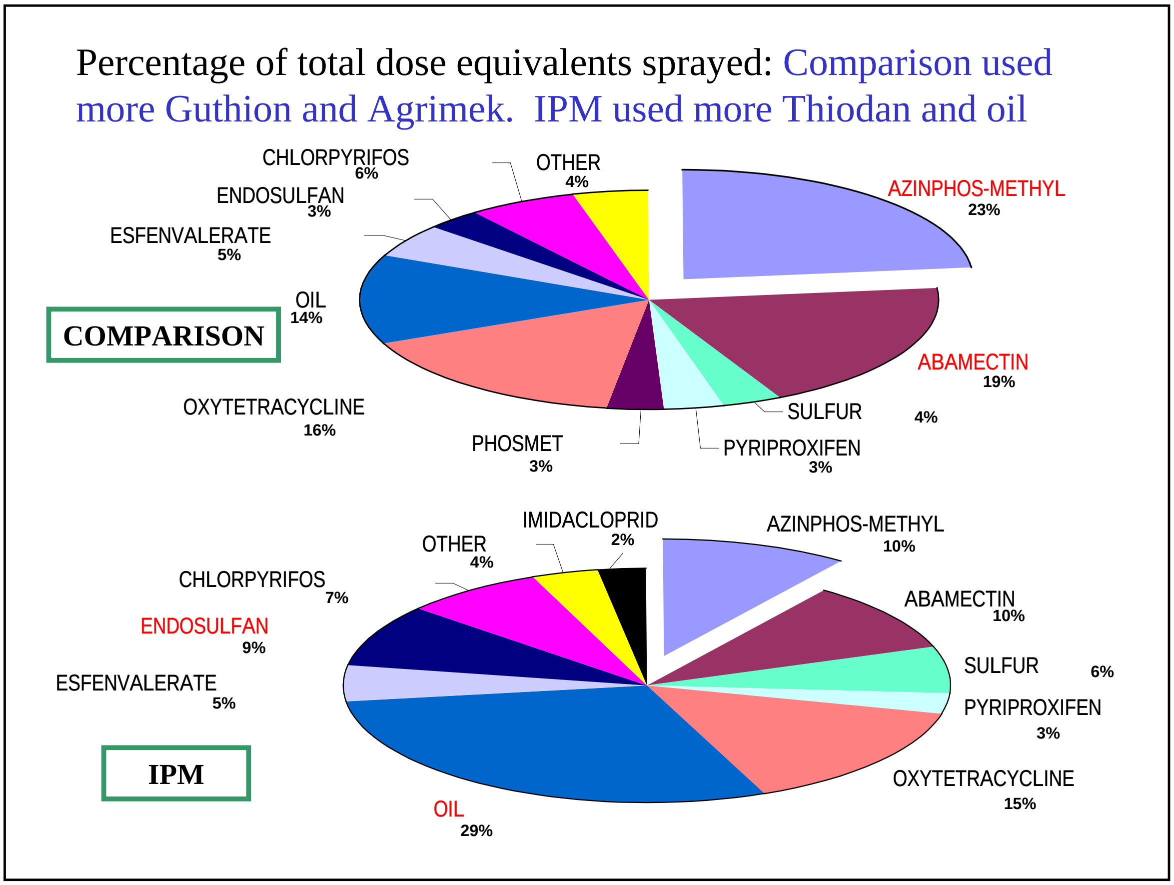
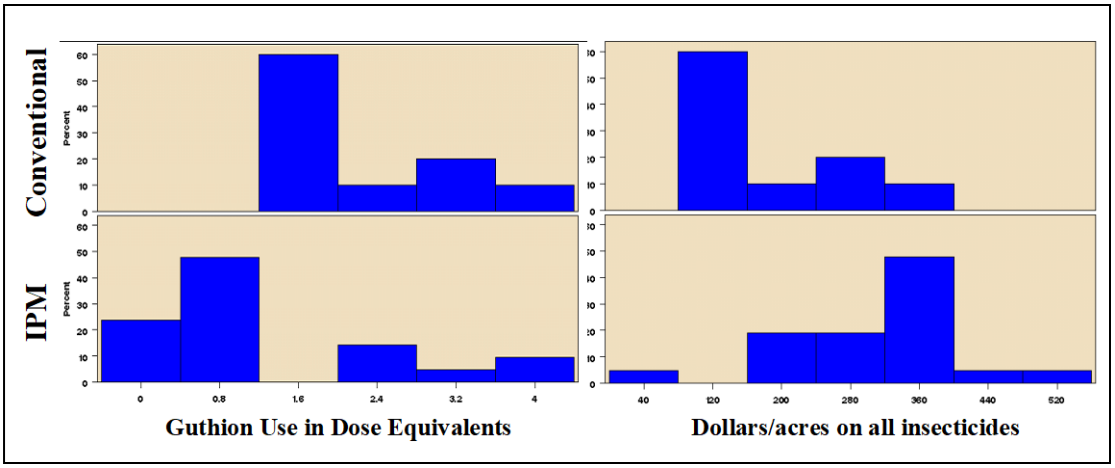


Figure 1. Pesticide use in 1999-2000:Pew-EPA versus conventional cannery pear blocks in the Yakima Valley.

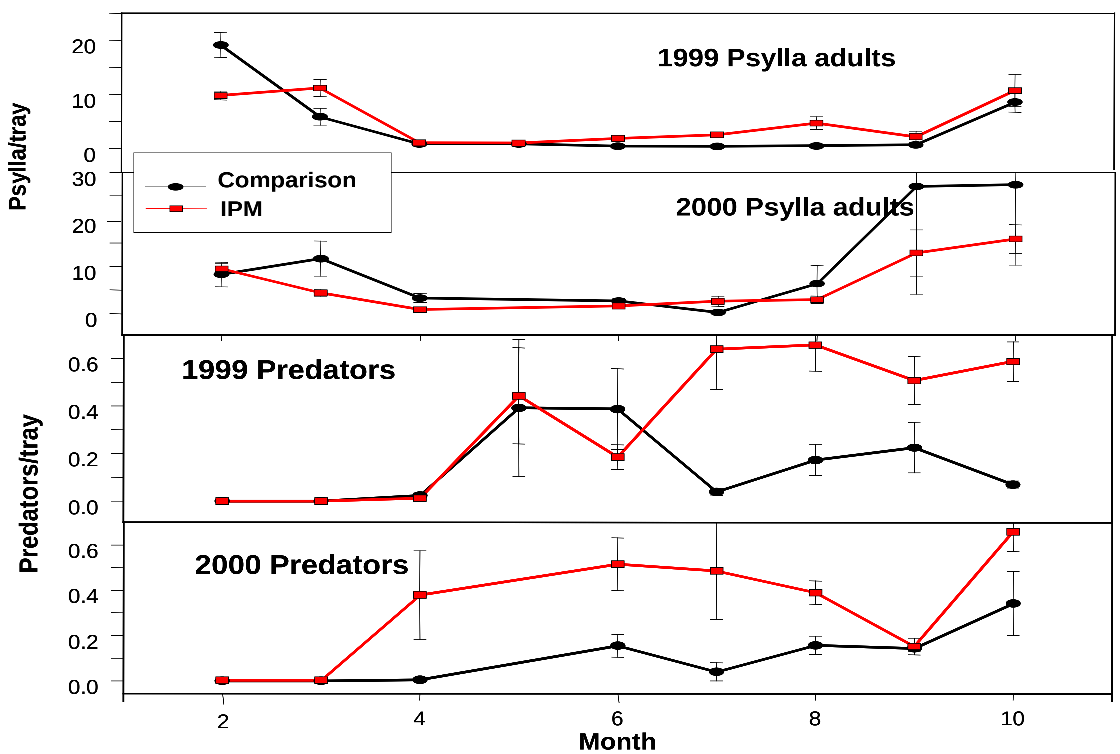
Oregon State University). Figure 1 shows azinphosmethyl and abamectin were used less by Pew-EPA growers compared to all other blocks (Yakima Valley-wide insecticide use in cannery pears). Also, IPM growers tended to more often use reduced rates of insecticides. About 1/3 of materials were applied at full rates by IPM growers while over ½ of materials were used at full rate in the Yakima Valley in general (not shown). In 2001, there was a significant retrenchment of pesticide use practices. Specifically, there almost $100 more spent by IPM growers (as defined by former membership in Pew-EPA project and use of MD for codling moth control) than conventional growers (Fig 2) . There was also a great range in Guthion use by IPM growers as seen in Figure 2.

Figure 2. Pesticide Use in 2001 in 25 IPM and 10 Conventional cannery pear blocks.



Psylla abundance was similar between Pew-EPA and conventional orchards during the growing season (Fig 3) but variation in psylla among blocks within programs was high. In 2001 we re-classified orchards based on pesticide use patterns. We grouped orchards that used 1 or more organophosphate applications after May into “hard. Thus under “soft” we had 4 growers that used 1 azinphos spray in May and several others that used no azinophos. Variation in psylla levels was high among orchards of each management type in both leaf brush and beat tray data in 2001 (Fig 4) but there was a trend for lower psylla levels in soft blocks. Predators were usually more abundant in IPM or soft blocks in 1999-2000 but not in 2001 (Fig 4). However, predator to prey ratios were significantly higher in soft blocks (Fig 4). Three key predators were seen: *Campylomma*, *Deraeocoris*, and lacewings. *Campylomma* was up to 5 times more abundant than all other predators in 1999 through 2002 (not shown).

Figure 3. Psylla and predator levels in 1999-2000.



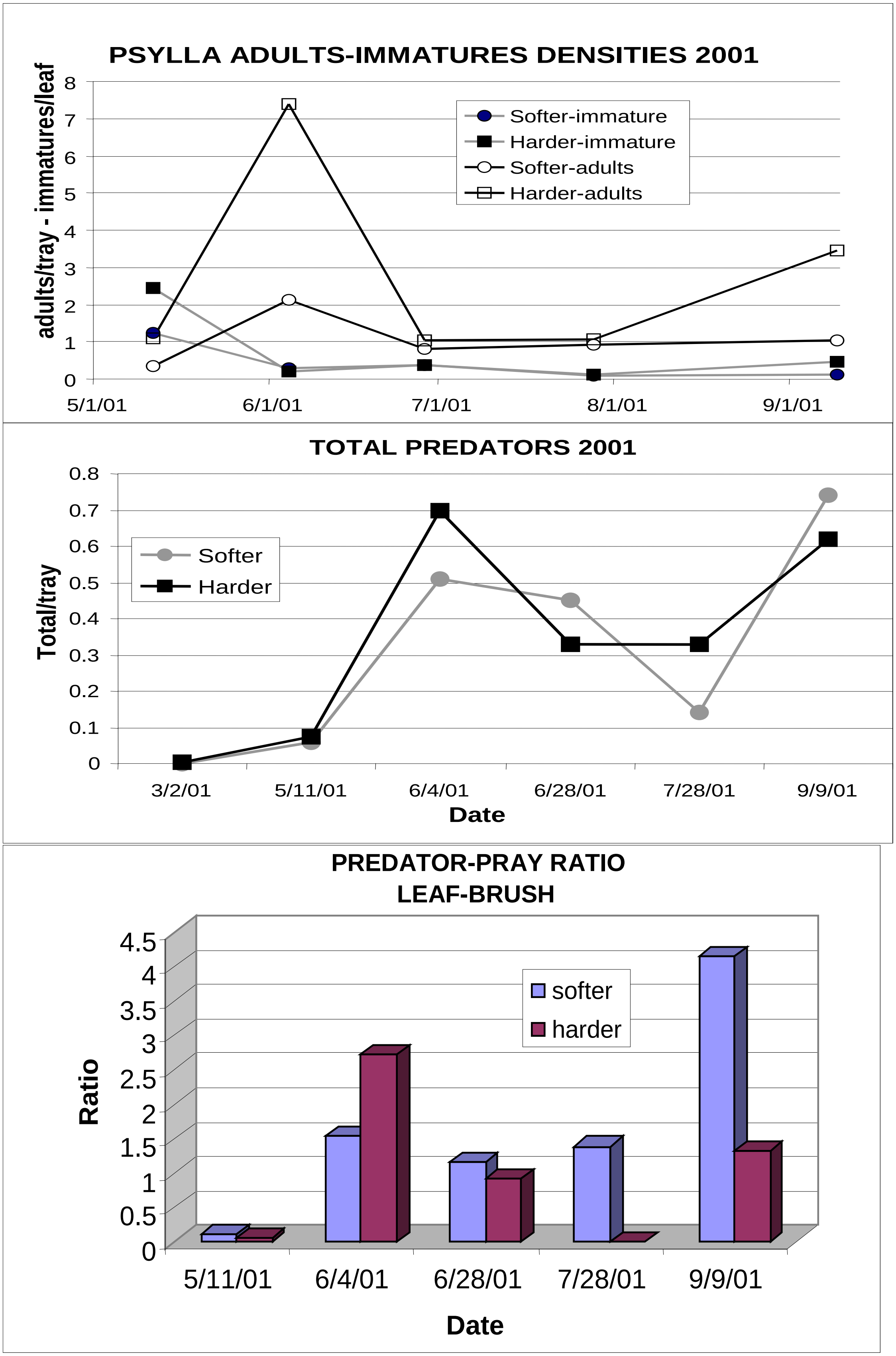
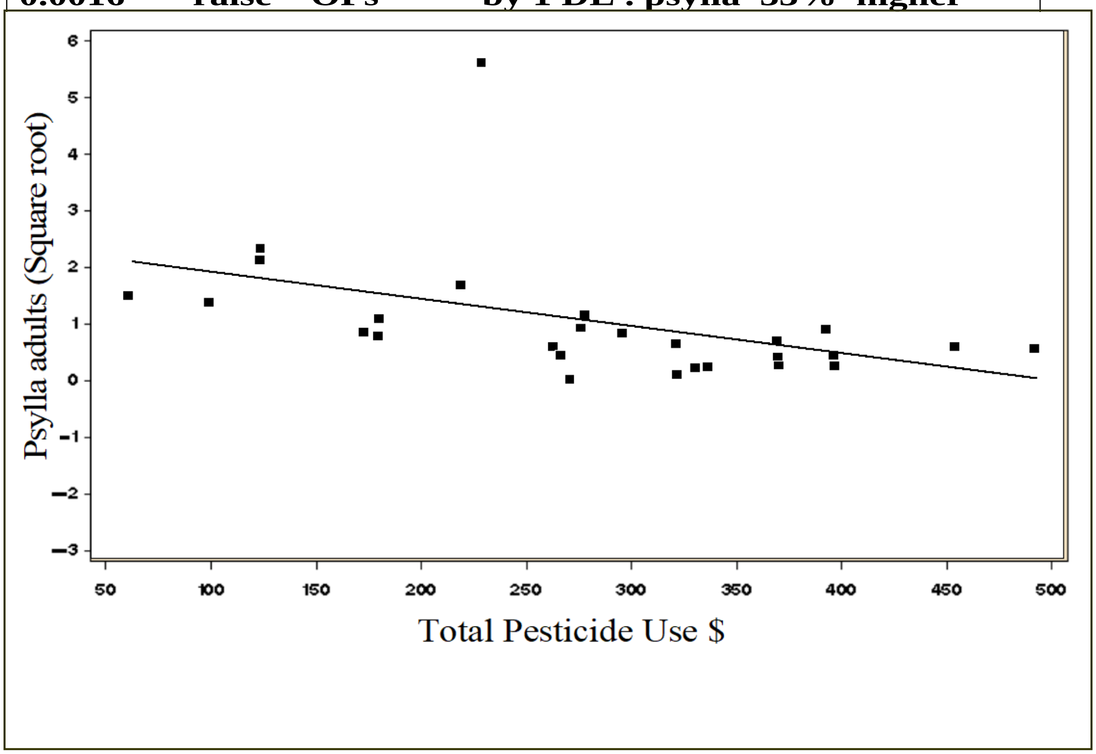


Figure 4. Psylla abundance and predator levels in 2001.

Psylla and predator abundance were influenced by pesticide use patterns (Figs. 3 and 4). To tease out other effects of pesticides I conducted a partial regression analysis. The results show (Fig 5) that use of Agrimek in early and mid-summer reduced psylla as expected. Interestingly, broad-spectrum chemicals used in the delayed dormant period were also negatively correlated to psylla abundance measured in July and August. Also, as obvious from above, guthion use enhanced psylla. Results of the regression study are shown as the effect in percentage increase of psylla after a one dose equivalent increase in use of the 3 classes of materials. Broad-spectrum insecticides used in pre-bloom were predominantly Thiodan and Asana. The benefit of this spring control was a constant message from Dr. Everett Burts and it apparently remains true. Unfortunately, in the Yakima Valley, spring use of Surround was trivial during this study period, so the potential of substituting it for more strident chemicals cannot be tested.

Figure 5. Interpretation of partial regression analysis of pesticide use on psylla abundance.

Signif.	**Meaning**		
0.0016	**raise**	**OPs**	**by 1 DE . psylla 33% higher**



Finally, in 2002, psylla control was positively associated with cost. That is, growers that spent more on insecticides got better psylla control (Fig 6.) and appears to stem from widespread use of Agrimek and Provado in late May and July.

Figure 6. Psylla density in May through August compared to $$ spent on control.

Presence-Absence Sampling. These investigations are in-complete because of several difficult problems encountered. First, we find that visual observation tend to underestimate actual infestation percentages. This is outlined in Figure 7 . In general, using a head visor, the percentage of leaves infested is underestimated by 30%.

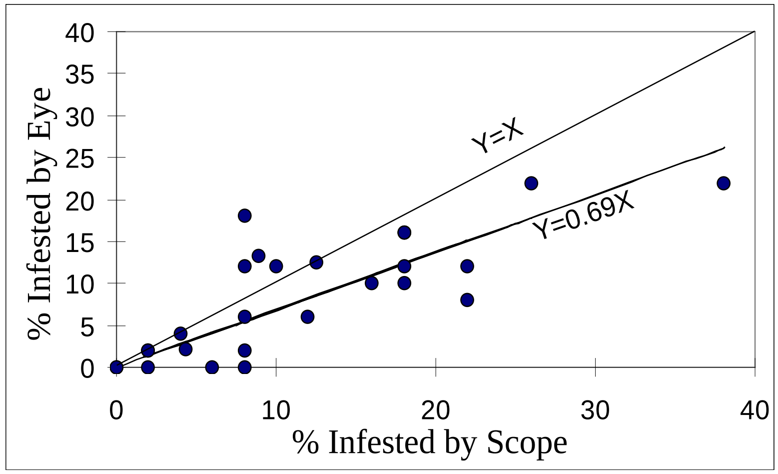


Figure 7. Percentage infested leaves by method

A second, more important observation, is the inadequacy of sample sizes that would be considered manageable by a pesticide consultant. In Figure 8 I show the percentage infested shoots and versus the average number of psylla/leaf when taking 15 top shoots and 3 leaves per shoot. The troubling observation is that there are outliers or extreme values where the percentage infested is low and the number of psylla per leaf is high. These are highlighted.

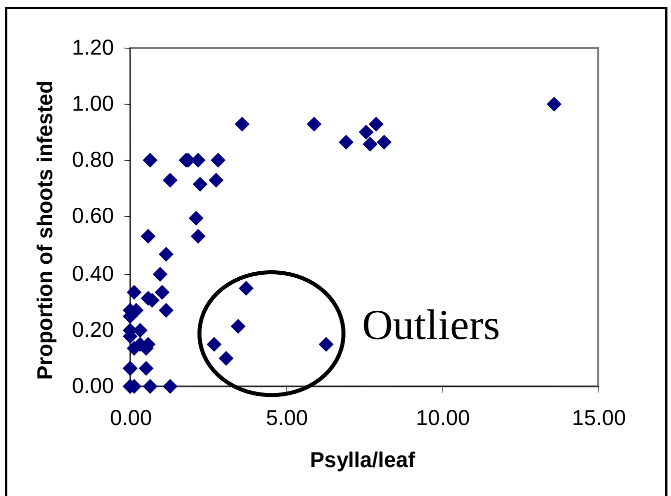


Figure 8. Outliers are a problem with small samples

Finally, there we have collected samples that show that an increase in the sample unit size can reduce this outlier problem. In Figure 9. you can see how increasing the saqmple unit to 5 leaves from 1, tightens up the relationship between proportion infested and psylla density. In the coming months we will try to more accurately estimate an optimal sample unit on which to count proportion infested (number of leaves). Until I find a sampling approach with the desired accuracy and ease of I will not make recommendations or publish a design for the use of Washington for pest consultants.

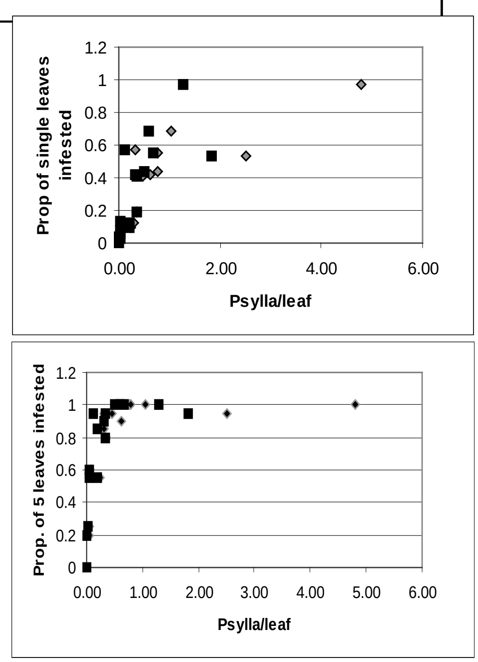


Figure 9. Proportion of 5 leaf and 1 leaf sample units infested versus psylla density. 5-leaf sample units are more accurate.