ORGANIC FARMING RESEARCH FOUNDATION

P.O. Box 440 Santa Cruz, California 95061 (831) 426-6606 info@ofrf.org www.ofrf.org

Project Report Summary

Using trap crops in organic strawberries to control western tarnished plant bug

On California's Central Coast, the principal cosmetic pest of strawberries is the western tarnished plant bug (WTPB), *Lygus hesperus.* WTPB establishes populations in strawberry fields in mid-season in relation to the flowering status of weedy, broadleaved hosts in adjacent areas. In winter and early spring, numerous wild hosts serve as a bridge to the infestation of strawberry fields, when strawberry flowers and small green fruit become abundant. Feeding by all five WTPB nymphal stages and by adults causes distortion of the berries, known as catfacing, rendering the fruits unacceptable for fresh market sale.

To control WTPB, organic strawberry growers on the Central Coast rely on field isolation from hosts, adjustment in fresh-market harvest schedules, and whole field deployment of tractor-mounted insect vacuums, or "bug vacs."

Organic strawberry growers have recently become interested in plantings of trap crops which might simultaneously attract WTPB away from strawberry fields and increase levels of WTPB-associated predators and parasitoids. For example, alfalfa trap crops planted adjacent to cotton have been shown to provide protection from WTPB. We hypothesized that this relationship could also be true for an alfalfa/strawberry association. This project attempted to gather evidence in support of these trap crop uses in terms of the potential for the release of a mass-reared a selective WTPB egg parasitoid, conservation of native natural enemies, and use of tractor-mounted vacuums on the trap crop vegetation for WTPB control.

Alfalfa trap crop planted on standard strawberry bed adjacent to strawberry rows.

Trap crops can accumulate WTPB at 5-10 times greater density than strawberries, and while they also accumulate beneficial insects, they only do so at a slightly higher rate than in the strawberry crop. Therefore, trap crops alone may not lead to a substantial reduction in either WTPB densities or a reduction in damage caused by WTPB in adjacent strawberries. This study focused on WTPB control measures within the trap crop area as a means to reduce traditional whole-field vacuuming measures, which are energetically costly and have the potential to spread disease.

Three experiments were conducted:

1) Performance of a tractor mounted vacuum (bug vac) in reducing WTPB in alfalfa trap crops associated with organic strawberries;

2) Controlling damage of WTPB to organic strawberries with trap crop vegetation and a tractor mounted vacuum;

3) Effects of the release of a native WTPB egg parasitoid (*Anaphes iole*) in trap-cropped strawberries.

Catfacing in strawberries by WTPB.

Study objectives originally emphasized biological control measures utilizing both the *Anaphes* egg parasitoid as well as a non-native nymphal parasitoid, *Peristenus stygicis*. Unfortunately, the *Anaphes* parasitoid became unavailable from the supplier early in the experiment, and therefor the supplemental *Peristinus* treatment was not employed. Data from early releases of *Anaphes* are included here. Once the parasitoids became unavailable, treatment measures shifted

Project Notes

Principal investigator: Sean Swezey, University of California-Santa Cruz, Center for Agroecology and Sustainable Food Systems

Project participants: Janet Bryer, Polly Goldman, Diego Nieto, William Settle, Daniel Swezey, Nicolas Swezey, Alexia Ruby, and Ohri Yamada

Organic grower-collaborators: Miles Reiter (Driscoll Strawberry), Clint Miller (Driscoll Strawberry), Larry Eddings (Pacific Gold) and Dale Coke (Coke Farms)

OFRF support for project: $9,896, awarded spring 2001

toward mechanical controls, utilizing the bug vac to control WTPB within the trap crop.

Experiment 1. In the 2001 field season, a completely randomized block design alfalfa trap crop vacuuming experiment with four treatments (n= 4 replicates) was established on the row edges of organic strawberry fields. Treatments consisted of:

1) no vacuuming (tractor driven over the alfalfa trap crop row only) and;

2) single, double, and triple vacuuming, with samples taken pre-vacuuming, and after one, two, and three successive passes of a tractor-mounted vacuum.

Vacuuming was performed on three dates in July. A significant difference in WTPB counts from the alfalfa trap crop was always was detected after the first vacuuming treatment when compared with the pre-treatment counts, and the average adult WTPB reduction was 70%. The average single vacuuming WTPB nymphal reduction was 72%.

Using the bug vac to collect WTPB from an alfalfa trap crop adjacent to organic strawberries.

Subsequent vacuum passes two and three reduced adult and nymphal WTPB numbers further, but not significantly when compared with the effects of the first vacuum pass. Control passes of the tractor machinery (without using the mounted vacuum) did not reduce WTPB density. This experiment demonstrated that a tractor-mounted vacuum machine could remove over 2/3 of WTPB from an alfalfa trap crop in a single pass. However, vacuum treatment in the alfalfa also reduced beneficial insects by 40% in a single pass.

Experiment 2. In 2002, a randomized complete block design trapping experiment with three treatments (n= 4 replicates) was established on the row edges of an organic strawberry field. Treatments consisted of a market/culinary radish and wild mustard mix, alfalfa, or strawberry planting. When given this choice during the spring, WTPB was significantly (four times) more attracted to alfalfa than to either radish/mustard or strawberry from January-July. This is a fundamental result, as tractor-mounted management of a trap crop can only begin in May, when the threat of muddy row conditions has diminished and alfalfa is flowering.

Subsequently, a completely randomized block design with two treatments (n= 4 replicates) was established on an organic strawberry farm at Eagle Tree/Pacific Gold Farm in Salinas, California. Treatments included:

(1) planting of a field edge alfalfa trap crop, vacuumed twice weekly with a tractor-mounted vacuum device; and

(2) no trap crop, whole field weekly vacuuming (grower's program).

Results indicate that in June and July the vacuumed trap crop treatment significantly reduced damage due to WTPB bug feeding in associated strawberry rows (38-47%) compared with the grower's whole field vacuuming program. This is an important result because trap crop vacuuming constitutes a 75% reduction in machine energy/effort usually expended by organic strawberry growers in whole-field vacuuming programs. However, treatment significance could not be detected in August, and trap crop attractiveness may have been compromised by lack of irrigation water, a reminder that it is extremely important to maintain the horticultural quality of the trap crop throughout the production season, and especially to maintain irrigation supply.

A native predacious natural enemy of WTPB, big-eyed bug (*Geocoris spp*.) was more abundant in the trap crop and trap crop treatment strawberry rows in June and July, indicating that trap crops can also increase the abundance of this beneficial insect in organic strawberries.

Experiment 3. In 2001, the WTPB egg parasitoid *Anaphes iole* was made available by a commercial insectary in May. This parasitoid was released into 4 alfalfa trap crop replicates and average parasitism of WTPB eggs was measured in both the alfalfa trap crop and adjacent strawberry rows. Thirty-five percent egg parasitism of WTPB eggs was detected in the trap crop within 10 days of release of 2,000 parasitoids. Forty percent parasitism was detected in the first adjacent strawberry row, but average parasitism decreased rapidly outward to row 4 (4%) and no parasitism was detected in row 8. Of the plants that had WTPB eggs present, the average percent parasitism per "lygus egg/leaf" was 16% overall and ranged from 4 to 24%, depending on the farm site. Parasitoid treatments were discontinued when the *Anaphes* parasitoids became commercially unavailable.

Observed WTPB control results in an alfalfa trap crop:

WTPB reductions from the alfalfa trap crop were

70%
for adults
and
72%
for nymphs
after a single pass

Observed WTPB control results in the strawberry crop:

The vacuumed trap crop treatment reduced damage due to WTPB bug feeding in associated strawberry rows
(38-47%)
compared with the whole field vacuuming programs

Our results from the 2001-2002 seasons indicate that organic strawberry field edge alfalfa trap crops attract four times more WTPB than either radish/mustard or strawberry plants in the spring. Alfalfa trap crops can be planted on a designated bed (otherwise prepared for strawberry planting) in October and will grow slowly through the winter and early spring, until they flower and grow rapidly in the late spring and early summer. Alfalfa can be effectively vacuumed to remove at least 70% of the total WTPB from the trap crop in a single pass. A selective natural enemy could be released and colonized in the trap crop, and in this case, an important generalist predator, big-eyed bug, increased in abundance over the entire area of organic strawberries adjacent to the trap crop in June.

Based on these experimental results and other more recent (2003 and 2004) field observations, one grower-collaborator, Larry Eddings of Eagle Tree/Pacific Gold, has expanded his alfalfa trap-cropping program to over 75 acres of organic strawberry production on two farms in Monterey County. He has repeatedly expressed great satisfaction with the project. We intend to continue to replant trap crop experiments and we are currently evaluating the economic impact of these results in terms of reduced vacuuming and pest control costs, and increased protection of yield from WTPB damage.

Energy conservation:

Trap crop vacuuming constitutes a 75% reduction in machine energy/effort usually expended by organic strawberry growers in whole-field vacuuming programs

For the complete project report: *Control of the western tarnished plant bug,* Lygus hesperus *(Knight) in an organic strawberry production system using trap crops, mass-released parasitoids, and tractor-mounted vacuums*, go to http://ofrf.org/funded/reports/swezey_01s44.pdf

Notes on figures: The complete project report contains 17 figures, showing data on vacuuming effects on WTPB adults and nymphs in alfalfa and radish/mustard trap crops and in adjacent strawberries, vacuuming effects on beneficial insects, and accumulated WTPB damage by treatment and crop row. Figures 10-13 are shown here.

Figures 10 through 12 show accumulated WTPB damage to strawberries, by row, during three sampling periods in June, July and in August. No significant differences could be detected, although a numerical trend exists showing *higher* damage in several rows in the vacuumed trap crop treatment in August, a marked reversal of the trends seen in the first two harvest months.

Figure 13 shows a summary of overall strawberry damage in all rows by WTPB due to treatment in June, July and August. The vacuumed trap crop treatment accumulated 2.4% damage in June, 3.9% damage in July, and 10.9% damage in August, compared with 3.4%, 7.3%, and 7.7% damage respectively in the whole field vacuuming treatment.

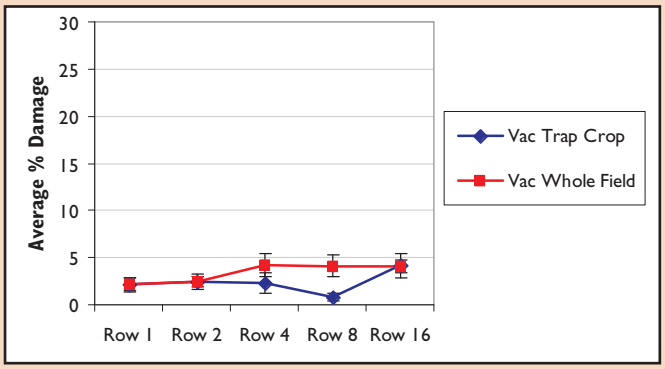

Figure 10. Accumulated WTPB damage by treatment and row, June 6 - June 25, 2002. Treatment means were not significantly different within the rows.

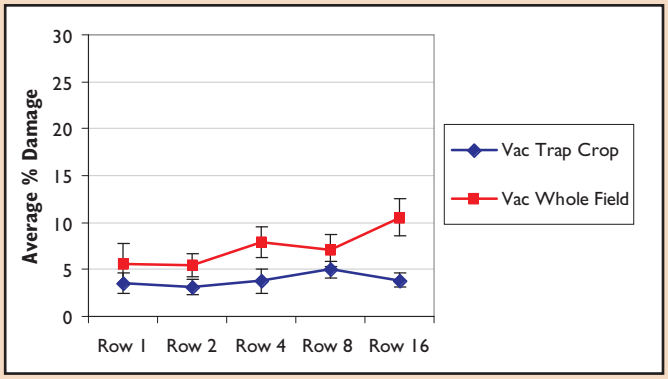

Figure 11. Accumulated WTPB damage by treatment and row, July 2 - July 30, 2002. Treatment means were not significantly different within the rows.

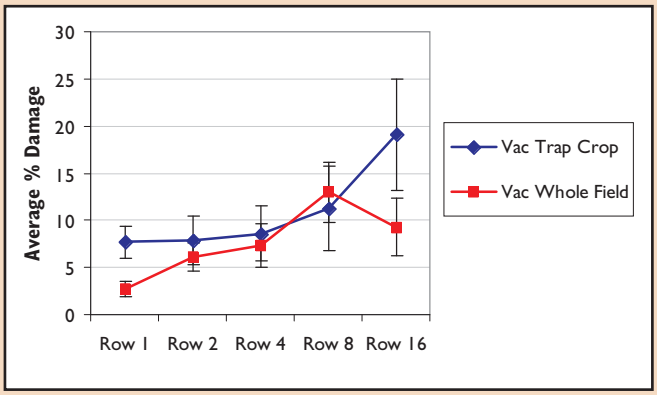

Figure 12. Accumulated WTPB damage by treatment and row, August 6 - August 27, 2002. Treatment means were not significantly different within the rows.

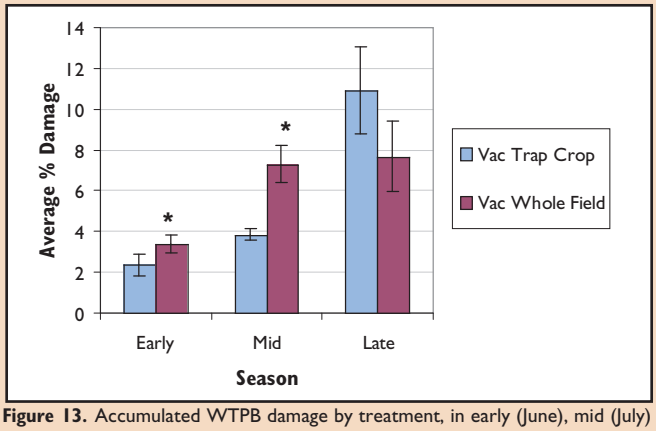

Figure 13. Accumulated WTPB damage by treatment, in early (June), mid (July) and late (August) samples. Means followed by (*) within trap crop or rows are significantly different. ANOVA, least significant difference text ($p<0.05$).