PROJECT NO.: CH-04-409

WTFRC Project # **Organization Project #**

Final Report: Orchard floor management and insecticide timing for thrips suppression in stone fruits and cherries.

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OBJECTIVES:

1. Evaluate the influence of cover crops on the diversity and abundance of pest and beneficial arthropods in cherry and stone fruit orchards.
2. Evaluate the effect of chemical and mechanical treatments to the orchard floor on the spatial distribution and abundance of western flower thrips.
3. Determine the optimal timing of insecticide application for reducing thrips feeding injury to late-bearing cherries.

SIGNIFICANT FINDINGS:

Cover Crops

Sweep Net Surveys: Alfalfa hosted significantly more aphids than any other cover crop studied. Aphids were also abundant in the Bug-n-breakfast and alfalfa/ryegrass blends. Aphid numbers were quite low in the native grass blend, burnett, bared dirt, alsike clover, endemic weedy plants, perennial ryegrass, and native grass blend treatments. Lygus abundance was greatest in the alfalfa, alsike clover, endemic weedy plants, and birdsfoot trefoil cover crops. Lygus numbers were low in the native grass blend, perennial ryegrass, and strawberry clover treatments. The bare dirt and native grass blends hosted significantly fewer leafhoppers than did the other treatments. Spiders were most abundant in the alfalfa, alsike clover, and birdsfoot trefoil treatments. The bare dirt treatment contained the lowest abundance of spiders. Lady bird beetles were not abundant in any of the treatments.

Yellow Sticky Card Surveys: The yellow sticky card traps indicated that the alfalfa, alfalfa/ryegrass, alsike clover, and perennial ryegrass treatments hosted the greatest abundance of thrips. Bug-n-breakfast, bare dirt, and the native grass blend hosted the fewest thrips. Our study also illustrated the change in thrips abundance over time. Two population peaks occurred, one in early July and the other in the middle of August.

Indigenous plants:

The yarrow, salt bush, and Woods rose treatments hosted the greatest abundance of thrips. The Reed canary grass and stinging nettles hosted the fewest thrips.
Thrips also experienced two distinct population peaks in the indigenous plant plots. The first peak of thrips abundance in the indigenous plants occurred in early July directly corresponding to the first peak in the cover crops. Conversely, the second peak was much later than recorded in the cover crops.

Orchard Floor Treatments:
Immediately after the treatments were applied, sticky card data showed that thrips were more abundant in the canopy compared to the orchard floor for all treatments. The following week, thrips abundance was greatly reduced in the canopy of the Roundup treatment and the unaltered control. Two weeks after the treatment, the insecticide treatments still had a lower abundance of thrips on the floor, but the same amount of thrips in the canopy compared to the other treatments.

Lygus were not detected before the treatments were applied. A week following the treatments, Lygus began to inhabit the orchard. The sweep net samples showed that Lygus were significantly less abundant in the mowed plots when compared to the other treatments. The following week showed a reduction in Lygus abundance across all treatments, but the Asana and Roundup treatments hosted fewer Lygus.

Thrips Feeding Damage:
Premature fruit drop at two of the three locations utilized for the thrips cherry cage studies made evaluations of those fruit impossible. For the location where we were able to evaluate a significant amount of the caged fruit, the data indicate that cherries showed more damage when subjected to thrips feeding early during fruit formation (April 26). Another period of damage occurred during three weeks later in development.
The attempt to use spinosad within the cherry orchard to suppress thrips feeding damage was inconclusive.

METHODS:

1. Evaluate cover crops and indigenous plants for their impacts on populations of pest and beneficial arthropods and their effects on disease incidence and severity.

A. Cover crops- In spring 2003 established replicated field stands of several legume type (alfalfa, vetch, & clover) cover crops and several non-legume type (buckwheat, grasses etc.) cover crops. Cultural practices for cover crop management were conducted in a fashion as close to commercial as possible. Sweep net surveys were conducted every 2 weeks and the arthropods present will be quantified based on treatment/ cover crop type. Yellow sticky cards were used to evaluate the population density of thrips pests.

B.** Indigenous plants- In early spring 2000 we established 3 field survey sites of along protected waterways adjacent to apple orchards. From these surveys selected 18 plant species and we have established replicated stands of plants of native and established exotics. We will evaluate these plant species for their ability to serve as hosts for western flower thrips and Lygus bugs.

2. Conduct orchard floor treatments with formetanate hydrochloride and several candidate synthetic pyrethroid insecticides. Replicated blocks of cherry orchards with a history of thrips infestation will be treated 35 days pre-harvest and post-harvest with formetanate hydrochloride, esfenvatlerate, and fenpropathrin. Additional treatments will include the herbicide glyphostate and mechanical mowing. Subsequent assessment of Lygus population abundance will be taken by sweep netting ground cover on 7, 14, 21, and 28 days post treatment. Thrips abundance on the orchard floor and within the canopy will be quantified by placement of yellow 3” by 5” sticky cards. Fruit will be sub-sampled from each treatment at harvest and insect damage will be quantified.

3. Determine the optimal timing of insecticide application for reducing thrips feeding injury to late-bearing cherries. The recent registration of spinosad and imidacloprid will enable us to treat individual trees with an echo-duster mister sprayer on short time intervals. We will adjust spray timings with these (and other registered) insecticides to suppress thrips populations on trees prior to harvest. We will also cage cherry clusters in cages and introduce thrips at a ratio of 25 thrips per fruit at 30, 20, 15, 10, and 5 days prior to harvest. The thrips cage studies will be conducted on late-bearing cherries in mid-summer.

RESULTS/ DISCUSSION

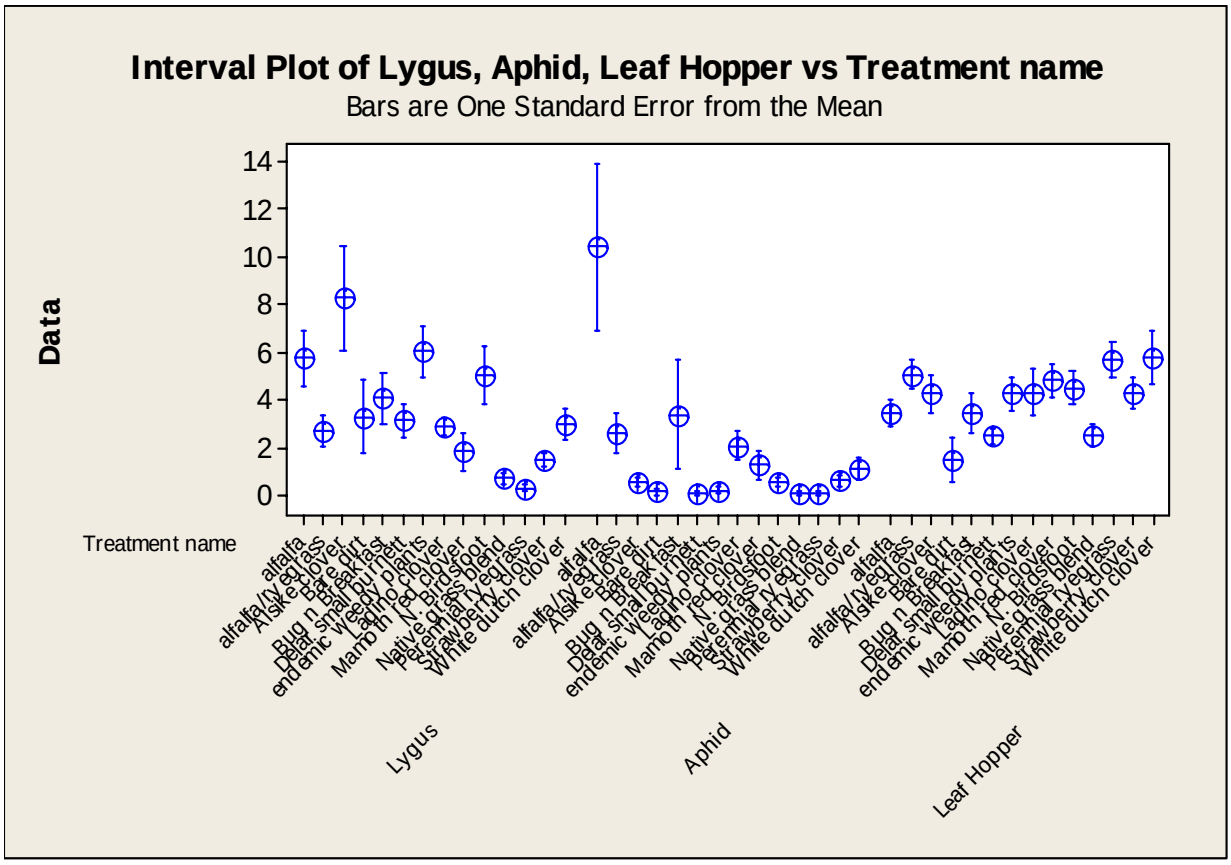
Cover Crops

Fourteen different cover crop blends were established in replicated 900 ft^2 blocks at IAREC in Prosser, WA. Plots were managed to mimic how they would be handled in a commercial orchard in terms of irrigation and mowing regime. Sweep nets were used to monitor arthropods every other week by sweeping each plot five times. Yellow sticky cards were also utilized every other week to assess thrips abundance .As this cover crop study could have broad application among a number of tree fruit crops, the pests we surveyed included Lygus, thrips, aphids, and leaf hoppers.

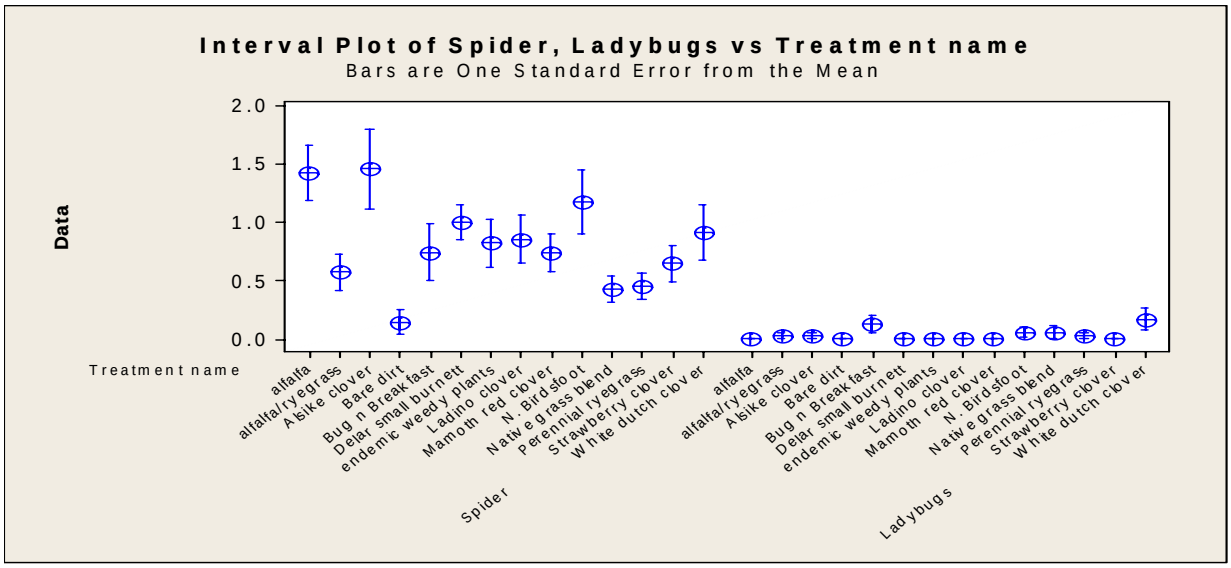
Sweep Net Surveys: Alfalfa hosted significantly more aphids than any other cover crop studied. Aphids were also abundant in the Bug-n-breakfast and alfalfa/ryegrass blends. Aphid numbers were quite low in the native grass blend, burnett, bared dirt, alsike clover, endemic weedy plants, perennial ryegrass, and native grass blend treatments. Lygus abundance was greatest in the alfalfa, alsike clover, endemic weedy plants, and birdsfoot trefoil cover crops. Lygus numbers were low in the native grass blend, perennial ryegrass, and strawberry clover treatments. The bare dirt and native grass blends hosted significantly fewer leafhoppers than did the other treatments. This data indicates that the native grass blend and perennial ryegrass were the treatments least likely to host the pest arthropods we monitored.
Spiders were most abundant in the alfalfa, alsike clover, and birdsfoot trefoil treatments. The bare dirt treatment contained the lowest abundance of spiders. Lady bird beetles were not abundant in any of the treatments.

Yellow Sticky Card Surveys: The yellow sticky card traps showed that the alfalfa, alfalfa/ryegrass, alsike clover, and perennial ryegrass treatments hosted the greatest abundance of thrips. Bug-n-breakfast, bare dirt, and the native grass blend hosted the fewest thrips. Our study also illustrated the change in thrips abundance over time. Two population peaks occurred, one in early July and the other in the middle of August. This data could prove beneficial in timing insecticide applications for controlling thrips on orchard floors.

The cover crop work indicates that the native grass blend host the fewest pests of all of the treatments studied. This study has enabled us to develop a more refined list of possible cover crop blends to be utilized on orchard floors to reduce pest numbers within the orchard ecosystem. Unfortunately, all of the blends that host more beneficial arthropods also host a great abundance of pests making those blends poor choices. The next phase in this study will involve the implementation of the cover crops on this refined list into commercial orchards. Large blocks in commercial orchards will enable us to study how the pests may move from orchard floor to within the canopy and visa versa over time. Studying the spatial dynamics of pests within the orchard will help to further narrow the candidate list of cover crops in order to make specific recommendations on cover crop blends for use in orchards to reduce pest.



Sweep net survey data 2004 (Cover Crops).



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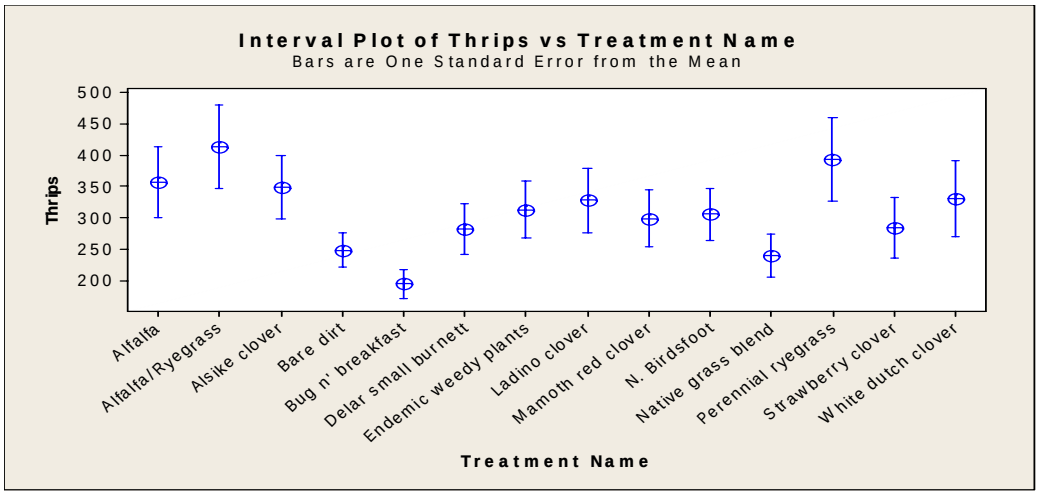
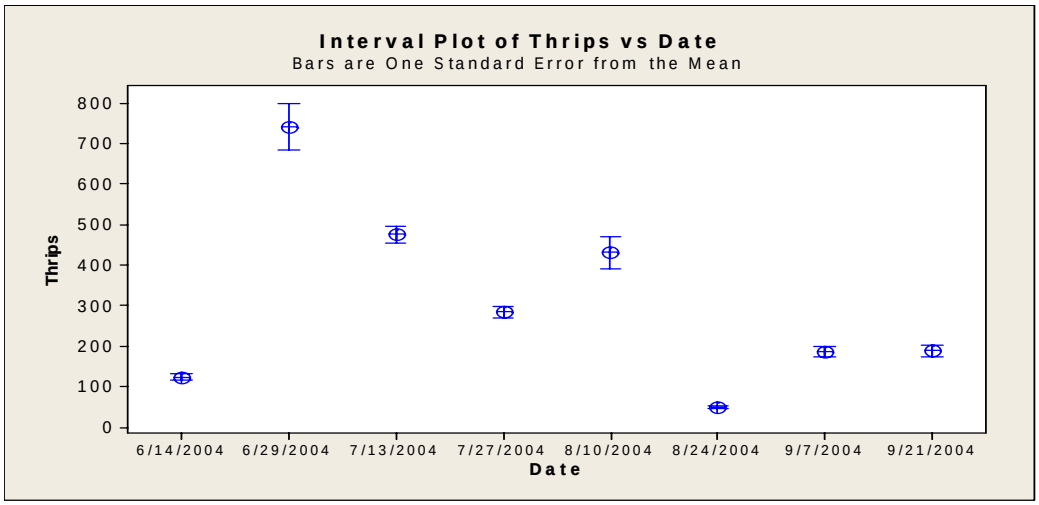


Yellow sticky card data 2004 (Cover Crops).



Yellow sticky card data 2004 (Cover Crops).

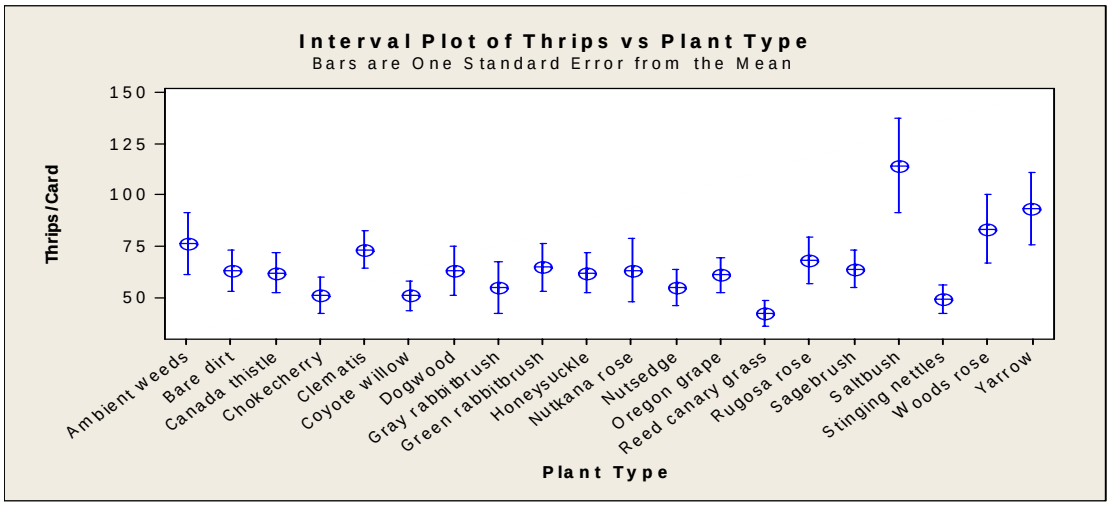
Indigenous plants:

Eighteen different plant species were established in 1 m^2 replicated blocks on the IAREC in Prosser, WA. Yellow sticky cards were placed within each plot every other week in order to assess thrips abundance on the particular plants. Restoration efforts often focus on the establishment of native plant species. These restored areas are often in close proximity to agricultural land. Little work has been done to attempt to determine the pest insects associated with certain indigenous and invasive plant species that can persist in non-crop areas. If not properly maintained, non-crop areas can serve as reservoirs for pestiferous species that can subsequently migrate into agricultural fields.

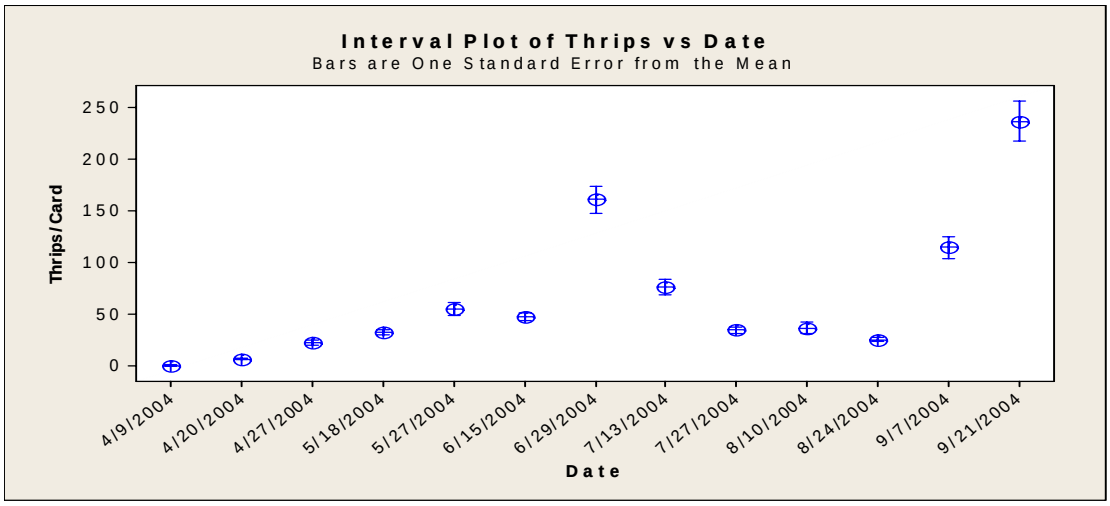
The yarrow, salt brush, and Woods rose treatments hosted the greatest abundance of thrips. The long flowering period of the yarrow and Woods rose creates ideal habitat for thrips. The Reed canary grass and stinging nettles hosted the fewest thrips. The fewer flowers and pollen provided by the Reed canary grass and stinging nettles contributed to the decreased attraction for thrips. Additionally, the stinging trichomes present upon stinging nettles would presumably render them less attractive to most soft bodied insects. Chokecherry and coyote willow were two other plants that hosted fewer thrips and would be good candidates for restoration projects.

Thrips also experienced two distinct population peaks in the indigenous plant plots. The first peak of thrips abundance in the indigenous plants occurred in early July directly corresponding to the first peak in the cover crops. Conversely, the second peak was much later than recorded in the cover crops.

The peak in thrips abundance in late September is most likely associated with the late flowering of a number of the indigenous plants. Most other habitats are void of flowers in late September while the native plants continue to provide flowers. Knowledge of these population peaks should enable growers to increase monitoring for thrips before these peaks are expected to occur so that they can take measures to control thrips when they begin to infest their orchard.



Indigenous plants Yellow Sticky Cards 2004.



Indigenous plants Yellow Sticky Cards 2004.

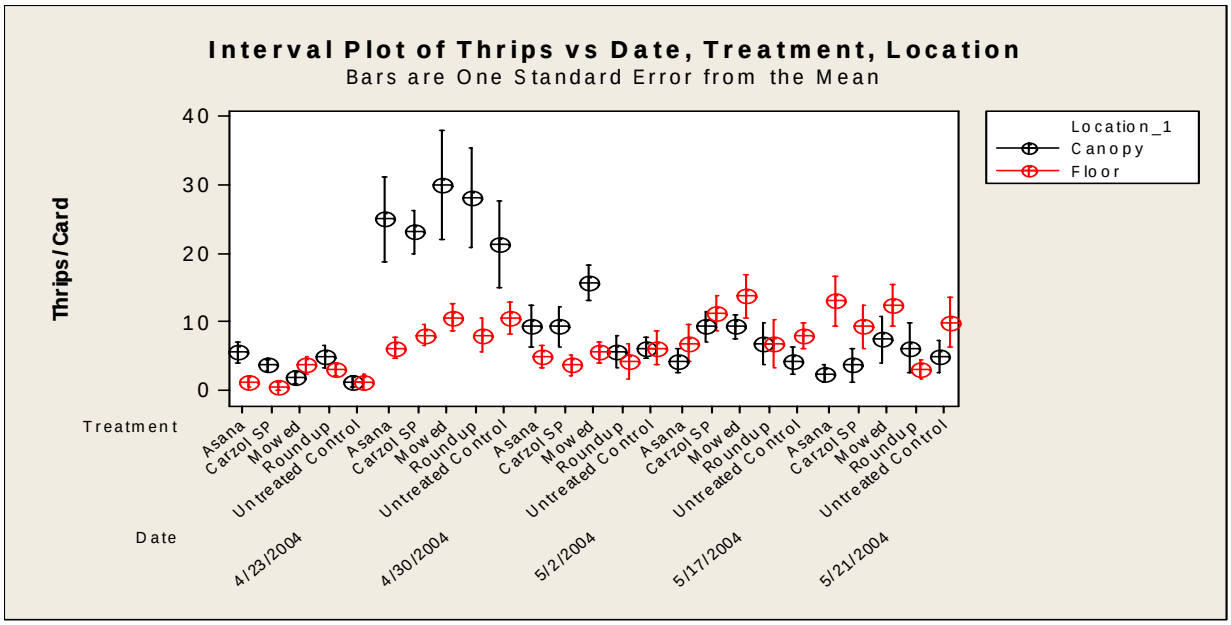
Orchard Floor Treatments:

Replicated 5,000 square foot blocks were established in a commercial orchard. Carzol, Asana, and Roundup were applied at recommended field rates with an ATV mounted boom sprayer. Controls were left unaltered while in the mowing treatment vegetation was cut to four to five inches. Pesticide treatments and mowing were conducted on April 27, 2004 in an attempt to assess how thrips and Lygus would respond. For each sample date, four yellow sticky cards were placed on the orchard floor and canopy in each plot to assess thrips abundance. Lygus were surveyed by sweeping the orchard floor with a sweep net five times per plot.

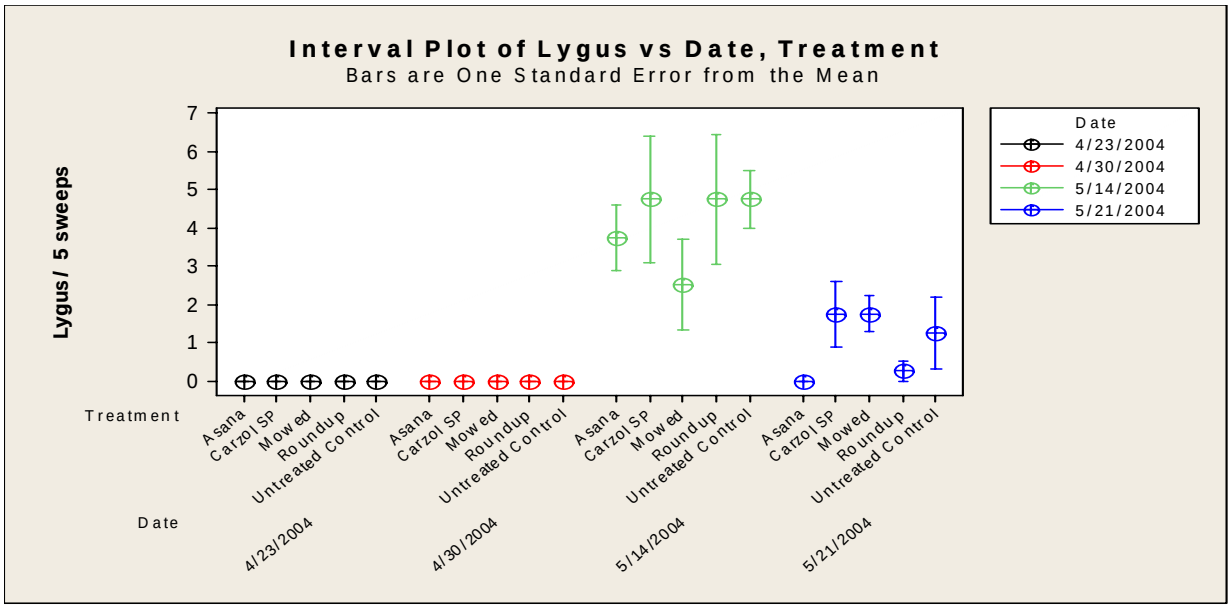
Thrips have been noted to cause cosmetic damage to a number of fruits and also have the ability to vector a number of plant pathogens. Immediately after the treatments were applied, sticky card data showed that thrips were more abundant in the canopy compared to the orchard floor for all treatments.

It appears that the immediate response of the thrips to all of the disturbances on the orchard floor were to fly to the canopy. Even the control showed an increase in thrips occupying the canopy. This is probably due to the fact that blossoms were present in the canopy at this time. The following week, thrips abundance was greatly reduced in the canopy of the Roundup treatment and the unaltered control. It seems as if the insecticide and mowing treatments discouraged thrips from occupying the floor and encouraged occupancy of the canopy. Two weeks after the treatment, the insecticide treatments still had a lower abundance of thrips on the floor, but the same amount of thrips in the canopy compared to the other treatments.

Lygus are a generalist native pest in the Pacific Northwest. Lygus were not detected before the treatments were applied. A week following the treatments, Lygus began to inhabit the orchard. The sweep net samples showed that Lygus were significantly less abundant in the mowed plots when compared to the other treatments. The following week showed a reduction in Lygus abundance across all treatments, but the Asana and Roundup treatments hosted fewer Lygus. By this time, the vegetation in the Roundup treatments was dead and subsequently unlikely to host Lygus. This data indicates that frequent mowing of the orchard floor may help to reduce Lygus abundance.



Orchard Floor treatments 2004.

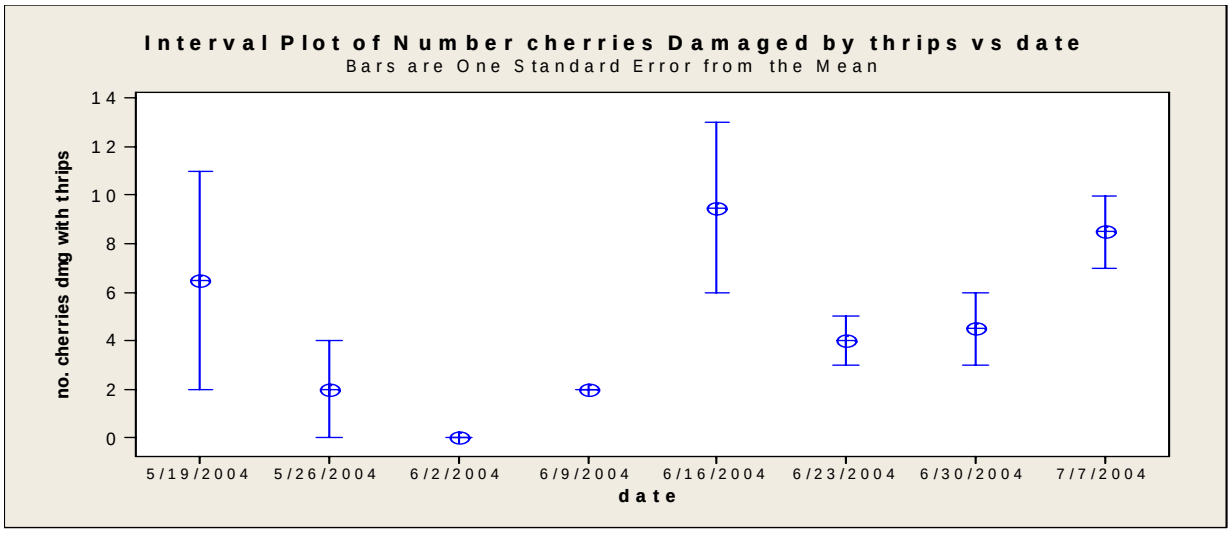


Orchard Floor treatments 2004.

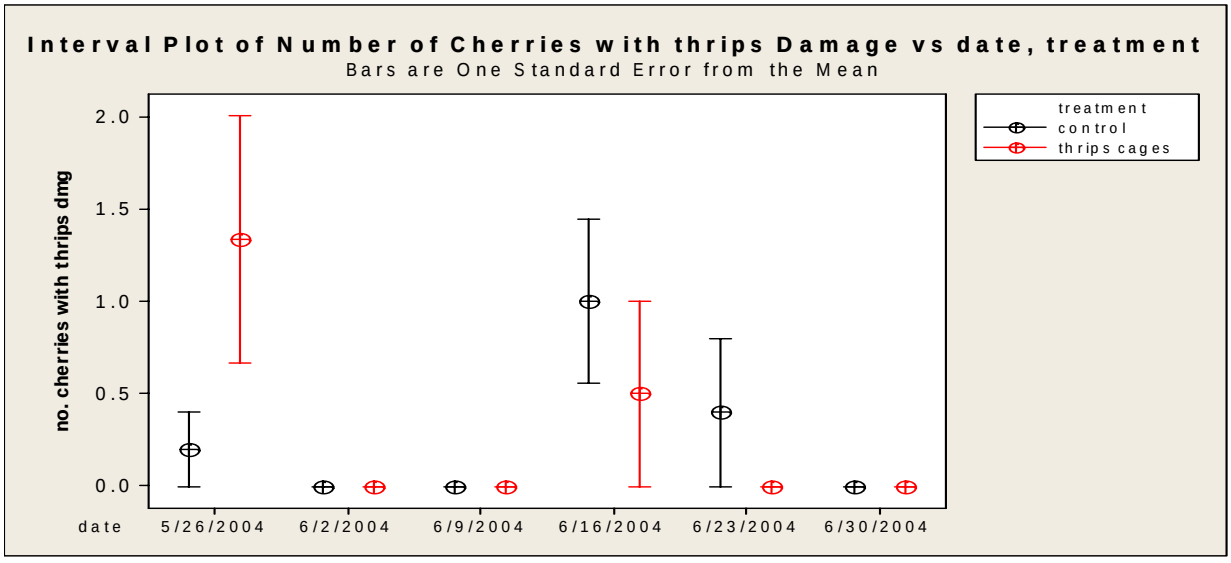
Thrips Feeding Damage:

Cherry clusters were caged weekly and thrips introduced into the cages in an attempt to elicit thrips feeding on the fruit. Controls were also maintained by applying Warrior to fruit clustersto deter thrips. Fruit were harvested during the commercial harvest period and evaluated for cosmetic thrips feeding damage. Premature fruit drop at two of the three locations utilized for the thrips cherry cage studies made evaluations of those fruit impossible. For the location where we were able to evaluate a significant amount of the caged fruit, the data indicate that cherries showed more damage when subjected to thrips feeding early during fruit formation (April 26). Another notable period of damage occurred during three weeks later in development. Using these predictive dates, growers could attempt to focus control efforts at these increments to reduce thrips feeding damage. Refinement of our technique for this experiment could yield more conclusive data.

A backpack air mist sprayer was used to apply spinosad to two trees per week. On subsequent application dates, all trees that had previously been treated were again treated with spinosad. The attempt to use spinosad within the cherry orchard to suppress thrips feeding damage was inconclusive. The trees used for study were treated with azinphos by the grower during late May. Thrips are highly mobile and subsequent immigration coupled with the short residual of spinosad would make its use ineffective or quite expensive to continually reapply. All suppression techniques could be enhanced by using a predictive model on thrips peak abundance. Reducing thrips in other nearby crops or non-crop areas could also improve thrips control in cherry orchards.



Thrips feeding damage spinosad applications 2004.



Thrips feeding damage Cherry Cages 2004