FINAL PROJECT REPORT

Project Title: SWD control

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Cooperators: Orchard View Farms, Inc.
Various anonymous orchardists
Peter Landolt, Dong Cha. USDA-ARS, Wapato, WA

Total Project Request: Year 1: $23,201

Budget History:

Item	2013
Salaries	
Benefits	
Wages	19,500
Benefits	1,701
Equipment	
Supplies	900
Travel	1,100
Miscellaneous	
Total	**$23,201**

Footnotes:

3.25 hourly temp. help for 3 months: $12.50/hr
Other payroll expenses for hourly temp. help: 8.6% + $2.43/mo
Mileage: weekly travel to The Dalles and Hood River: $0.555/mile

OBJECTIVES

1. ***Determine efficacy of insecticides against spotted wing drosophila in large plot trials in sweet cherry.***
   This replicated study compared efficacy of Sevin, Delegate, and Warrior II / Danitol for SWD control in sweet cherries.
2. ***Evaluate intensive sampling and monitoring for SWD to predict risk of infestation.***
   This trapping and fruit monitoring study evaluated 3 attractants, including the new Cha-Landolt lure developed at the USDA-ARS lab in Wapato, and two traps for monitoring SWD in sweet cherry orchards in the Mid-Columbia.

SIGNIFICANT FINDINGS

Objective 1. Determine efficacy of insecticides against spotted wing drosophila in large plot trials in sweet cherry.

Results from a large plot replicated study of grower-applied insecticides demonstrated that Delegate (7 oz/A), Sevin XLR (3 qt/A) and the pyrethroids Warrior II and Danitol (2.56 oz and 11 oz/A, respectively) provide protection against SWD. This is the first large plot SWD efficacy study conducted in the Mid-Columbia and results indicate that high label rates of Sevin XLR will control SWD as will the other products and rates listed above.

Objective 2. Evaluate intensive sampling and monitoring for SWD to predict risk of infestation.

The four-component Cha-Landolt SWD attractant, developed at the USDA-ARS facility in Wapato, WA, was the most effective bait tested in 12 Mid-Columbia cherry orchards. Traps baited with this attractant captured more SWD than traps baited with either apple cider vinegar (ACV) or yeast+sugar+water (YSW). Traps baited with YSW caught more SWD than ACV baited traps.

Significantly more flies were captured in orchards at the earliest ripening location (Dallesport) than in orchards at other locations. SWD were captured in these earliest ripening orchards when the fruit was mostly green.

RESULTS AND DISCUSSION

Objective 1. Determine efficacy of insecticides against spotted wing drosophila in large plot trials in sweet cherry.

The purpose of this study was to assess efficacy of two individual products, Sevin XLR and Delegate, and a class of products, pyrethroids, which have different PHIs (Warrior II and Danitol). The products were applied 3 times to the study sites except Warrior II was applied twice followed by Danitol shortly before harvest. The intent was to determine if these products protect cherries from SWD infestation. Results from this study can be used to develop rotational use patterns based on other target insects and insecticide resistance programs. This study was conducted in 12 blocks of Sweetheart cherry located in Dufur, OR. Blocks were approximately 1-2 acres in size. Treatments were randomly assigned to 4 blocks per treatment. The grower applied the treatments 3 times with an airblast sprayer calibrated to deliver 100 GPA (Table 1).

We placed red cup traps baited with yeast+sugar+water in each of the blocks to monitor for SWD. Female SWD were detected in the study sites but there were no differences in abundance between treatments (Table 2).

Table 1. Insecticides applied to replicated large plots and application dates.

Material[1]	Rate/acre[2]	Application Dates		
Sevin XLR	3 qt	4 July	14 July	20 July
Delegate	7 oz	4 July	14 July	20 July
Warrior	2.56 oz	4 July	14 July	--
Danitol	11 oz	--	--	20 July

[1]All applications included Silwet at 2.56 oz/A.
[2]Applied in 100 gpa.

Table 2. Average number of female SWD captured per week in yeast-baited traps.

	Average (±SEM) number of adult female SWD per trap[1]		
	Date		
Treatment	16 July	22 July	29 July
Sevin XLR	0.5±0.3ns[2]	1.8±0.3ns	0.8±0.5ns
Delegate	0.3±0.3	1.3±0.8	2.0±0.0
Warrior/Danitol	0.5±0.3	1.0±1.0	1.0±0.7

[1]Pre-treatment levels of SWD were monitored using two traps baited with yeast, sugar and water, 1June-8 July. No SWD were detected during that period.
[2]ns = means within a column are not significantly different.

Two fruit samples were collected to assess SWD infestation and fruit color. Four hundred fruit were collected from each of the 4 blocks per treatment (20 fruit from 20 trees in each of 4 blocks per treatment, n=1600 fruit per treatment per sample date). Thirty fruit per plot (n=120 fruit per treatment) were assessed for fruit color using the CTIFL color scale. All sampled fruit had color ranging from pink to various stages of red indicating the fruit was susceptible to attack by SWD (Fig. 1). Fifty fruit per plot (n=200/treatment) were examined for SWD eggs under a stereo-microscope. No eggs or oviposition sites were observed in any of the sampled fruit (Table 3). All fruit was then returned to its lot, aged for 5 days and then run through a cherry crusher on a block-by-block basis. Crushed fruit was then placed in brown sugar + water (15 brix) to asses for internal larvae. No SWD or Western cherry fruit fly larvae were found (Table 4).

Table 3. Number of SWD eggs observed in fruit, n=200 fruit per treatment per date.

	Average (±SEM) number of SWD eggs observed per fruit	
	Date	
Treatment	16 July	22 July
Sevin XLR	0.0±0.0	0.0±0.0
Delegate	0.0±0.0	0.0±0.0
Warrior/Danitol	0.0±0.0	0.0±0.0

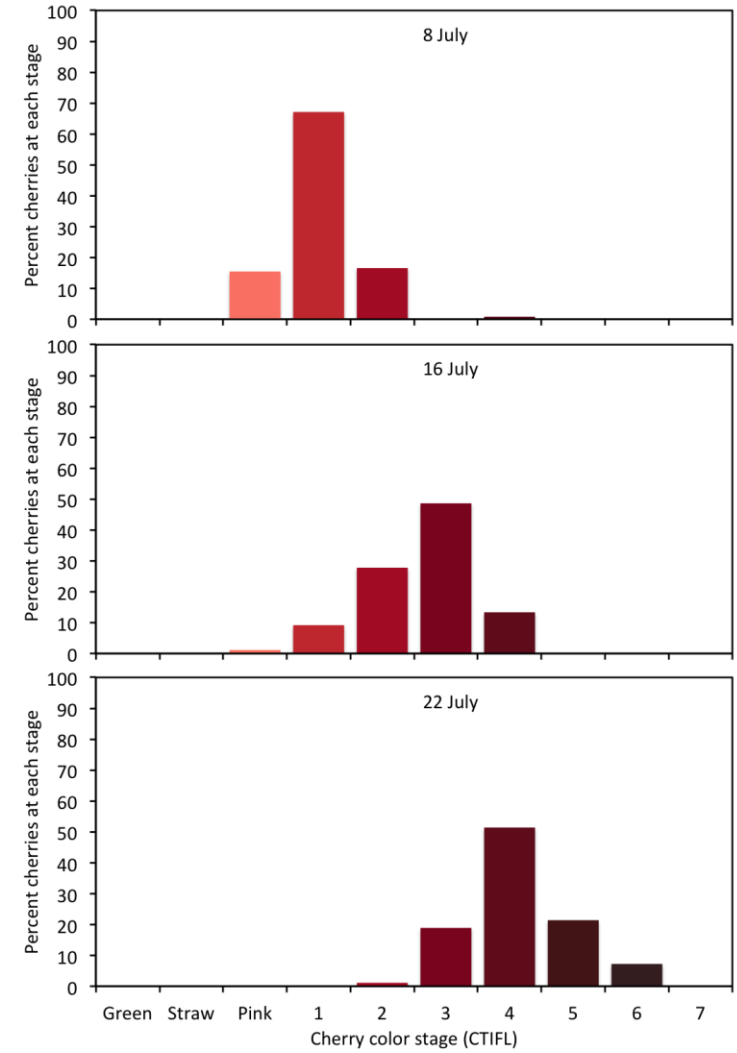

Figure 1. Stage distribution of Sweetheart fruit color during the study period.

Table 4. Number of SWD larvae recovered from fruit, n=1600 fruit per treatment per date.

	Average (±SEM) number of SWD larvae observed per fruit	
	Date	
Treatment	16 July	22 July
Sevin XLR	0.0±0.0	0.0±0.0
Delegate	0.0±0.0	0.0±0.0
Warrior/Danitol	0.0±0.0	0.0±0.0

The information from this study demonstrates that these insecticides are effective against SWD when applied at the rates provided above. It is important for PCAs and growers to understand that sequential applications were made so the products could be assessed individually without the confusing aspects associated with testing programs that contain multiple insecticides. Sequential applications of the same insecticide or class of insecticide can lead to faster development of insecticide resistance. Sequential applications of Sevin XRL caused leaf phytotoxicity that became

more apparent with each application, thus, this product should be used with care if applied more than once per season.

Objective 2. Evaluate intensive sampling and monitoring for SWD to predict risk of infestation.
This study was conducted in 12 sweet cherry orchards (three orchards in each of four locations in the Mid-Columbia district). Orchards were located in Dallesport, WA, The Dalles, Hood River and Parkdale, OR. At each site, 6 commercially available yellow Trappit dome traps and 6-16 oz red cups with lids (Solo) traps with 2-0.4 X 2" screen-covered entrances cut into the sides of the cups near the top (Fig. 2) were deployed, half in the border cherry row along the western edge, the other half in the interior of the orchard. The red Solo cup trap was chosen for this study because it was a superior trap when compared with the clear deli trap in previous studies. The Trappit dome trap was used per Dr. Peter Landolt request. This will allow him to compare these results with his previous efforts.

Traps were baited with one of the following attractants: apple cider vinegar (ACV), yeast+sugar+water (YSW), or the experimental Cha-Landolt (CHA) 4-component lure (USDA-ARS, Wapato, WA). There were two bait X trap combinations per site with one of each combination placed in the border row and interior of the orchard, respectively. The ACV, YSW and liquid component of the CHA lure were changed weekly. The remaining two components of the CHA lure were changed every two weeks.

Figure 2. Example of red cup (left) and Trappit dome traps (right) used in study.

Fruit samples were collected weekly to assess SWD infestation and fruit color. Fruit were collected from each orchard (20 fruit from 10 border and 10 interior trees per orchard, n=400 fruit per sample date). Thirty fruit per plot (n=120 fruit per treatment) were assessed for fruit color using the CTIFL color scale. All fruit was then returned to its lot, aged for 5 days and then run through a cherry crusher on a block-by-block basis. Crushed fruit was then placed in brown sugar + water (15 brix) to asses for internal larvae. One SWD larvae was found during the last sample date in a Parkdale orchard. Sampling fruit and traps continued until a particular block was harvested.

Traps were placed in orchards when the majority of the fruit were green and/or straw colored. When the seasonal abundance of female SWD captured was averaged within a location and then compared with the other locations, more flies were captured in Dallesport, WA orchards than any other location while the fewest flies were captured in the later ripening areas of The Dalles (Fig. 3). This was this was opposite of what we saw in previous years. Usually we capture low levels of flies early and more flies later in the season.

The Cha-Landolt lure captured more adult SWD than the apple cider vinegar or yeast+sugar+water baited traps (Fig. 4) (Table 5).

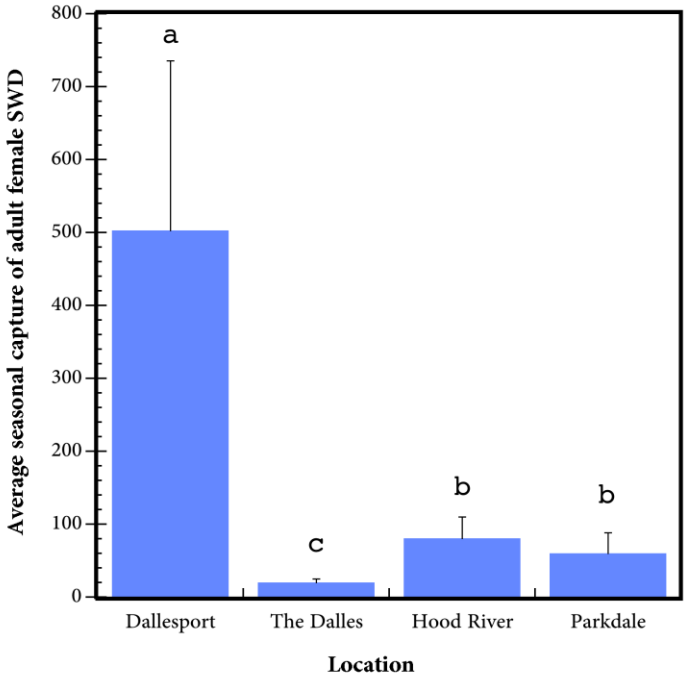

Figure 3. Seasonal abundance of SWD captured in baited traps through harvest. Three orchards were sampled in each location. (ANOVA, Tukey, $F_{3, 63} = 42.7$, $P<0.0001$).

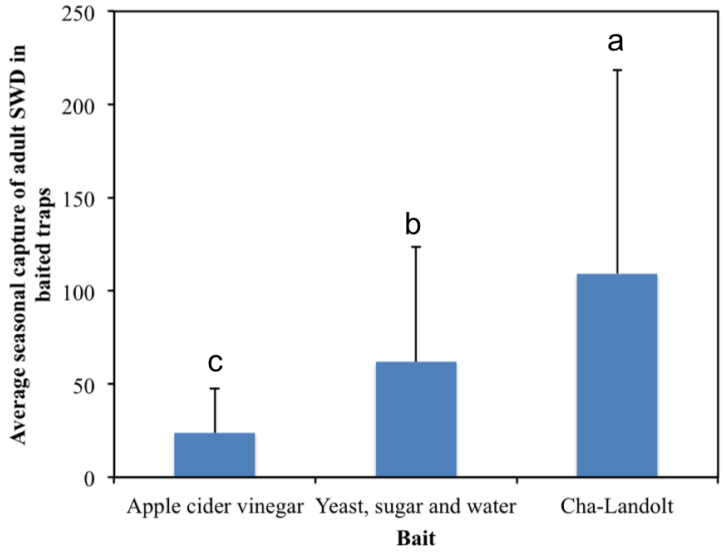

Figure 4. Average seasonal capture of adult SWD in baited traps from 12 Mid-Columbia sweet cherry orchards. (ANOVA, Tukey, $F_{2, 63} = 22.81$, $P<0.0001$).

Table 5. Effect of attractant on average seasonal capture of adult female SWD in baited traps within a location.

	Average (±SEM) seasonal capture of adult female SWD in baited traps		
	Attractant		
Location[1]	Apple cider vinegar (ACV)	Yeast, sugar and water (YSW)	Cha-Landolt (CHA)
Dallesport, WA	62.3±40.4	158.0±78.1	282.7±114.9
The Dalles, OR	2.7±0.3	6.0±1.7	11.0±3.6
Hood River, OR	10.3±5.9	32.3±6.8	38.0±16.8
Parkdale, OR	7.0±2.3	18.7±9.2	34.3±17.3

[1]n=3 orchards per location.

The Trappit dome trap captured more SWD than the red Solo trap (Fig. 5) (Table 6). The price of the Trappit dome trap was about $9 but it is durable and reusable. The red cup trap was hand-made, sometimes broke and occasional dried out.

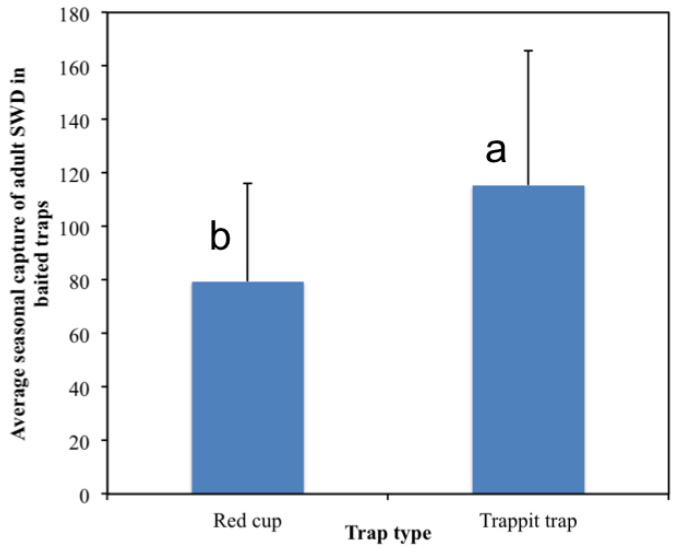

Figure 3. Average seasonal capture of SWD in the two trap types. (ANOVA, Tukey, $F_{1, 63} = 6.09$, $P=0.016$).

Table 6. Effect of trap type on average seasonal capture of adult female SWD within a location.

	Average (±SEM) seasonal capture of adult female SWD in baited traps	
	Trap Type	
Location[1]	Red cup	Trappit dome trap
Dallesport, WA	208.0±101.4	295.0±131.2
The Dalles, OR	8.3±3.5	11.3±1.8
Hood River, OR	35.3±14.9	45.3±14.2
Parkdale, OR	21.0±11.0	39.0±17.5

[1]n=3 orchards per location.

EXECUTIVE SUMMARY

Project Title: Enhanced monitoring and management of spotted wing drosophila in cherry orchards

A large plot replicated efficacy study conducted in a commercial orchard demonstrated that Sevin XLR, Delegate and the pyrethroids Warrior II and Danitol protected fruit from SWD infestation despite SWD being present in this orchard.

A SWD attractant developed in Dr. Peter Landolt's lab with funds from the WTFRC was tested as a SWD lure in 12 Mid-Columbia cherry orchards. It was very effective in capturing adult SWD in traps when compared with two other standard baits, apple cider vinegar and yeast+sugar+water.

Yeast+sugar+water was more effective than apple cider vinegar in attracting adult SWD to traps. However, it is not pleasant to work with.

A commercially purchased dome trap (Trappit dome trap, Great Lakes IPM, Vestaburg, MI) captured more SWD than a hand-made red cup trap.

Considerably more adult SWD were captured during the growing season in Dallesport, the earliest ripening cherry district n the Mid-Columbia.