Perimeter Trap Cropping for Spotted Wing Drosophila Control

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Spotted wing drosophila (SWD) was a new invasive insect pest that was first discovered in the USA in California in 2008 although not identified until 2009. It was discovered in Michigan in 2010 (Isaacs, et al, 2010) and entered CT in mid-season 2011. The arrival of SWD caught CT growers, university and research staff off-guard resulting in almost complete loss of late season blueberries and fall berry crops in 2011. The SWD lays its eggs in berries as they are maturing and the resulting larvae then feed on berries making them unmarketable. This has wreaked havoc with most of the berry growers in CT, particularly with berry crops that are harvested mid-summer through the fall as the SWD populations increase exponentially throughout the growing season. Late season blueberries, late summer blackberries and raspberries, fall brambles and day-neutral strawberries (fall strawberries/everbearing strawberries) are some of the preferred crops that now require pesticide applications once or twice a week in order to maintain close to a SWD-free harvestable product.

A survey was sent to fruit growers in the fall of 2012 to gather information regarding losses and increased costs due to the SWD. Crop losses were reduced, not eliminated, from 2011 to 2012 by many growers due to awareness of the pest and use of available pesticides. Organic growers continue to incur heavy losses because of the limited availability of effective organic insecticides. Survey comments included "the organic pesticide did not work. Tried it since there was a zero day harvest interval and that was very important for brambles." "Have increased from a 10 day spray interval for blueberry maggot to a 3 to 5 day schedule." "Had to take a week off from picking and return to Delegate." "Pest control costs have almost doubled. Modifications made to sprayer to enable spraying blueberries under bird nets." "Damage about the same as last year with our later berries basically a total loss." And, "spraying is a new cost for us directly attributable to SWD."

History

In CT, commercial berry growers have had one management tool available to them with varying degrees of success – pesticides. Materials are applied every 3-7 days (Concklin 2012 survey) and growers must rotate between pesticide classes to reduce the potential for resistance development. Organic growers have two pesticides available to them for SWD, spinosad (Entrust) and a pyrethrin (Pyganic). Unfortunately, the pyrethrin has a 0 to 2 day efficacy and the females have been known to be knocked down, bounce back and lay eggs. Non-organic growers have several more chemical options available.

Past pesticide applications have been minimal to non-existent in berry crops in CT. Many blueberry growers had never applied a pesticide to their crops, bramble growers would apply an occasional fungicide for *Botrytis* fruit rot, depending on the season, and with dry summers that was not necessary, day-neutral strawberry growers could skip the usual insecticides that were often needed with June strawberries because of pest life cycles and occasionally applied a fungicide for *Botrytis.* The advent of the SWD has increased costs by the inclusion of insecticide applications, the purchasing of pesticide application equipment and monitoring. It has reduced the number of days many farms are open for pick-your-own to allow for pesticide applications and the required pre-harvest-interval of the particular pesticide material. (Concklin 2012 survey; personal communication with many growers)

In CT and other states impacted by the SWD, a variety of trap colors and styles have been tested to try to determine effectiveness. Red cups with small holes were used in New England and CT in 2012. In 2013 red cups with black tape were used. It had been shown that the SWD were attracted to the black on the cup (April 24, 2013 New England SWD Team meeting, Windsor, CT). Additional trap work was conducted. Baits that are considered to be more appealing to the

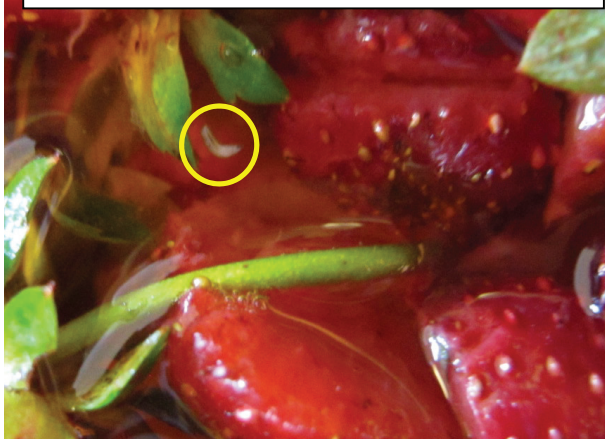
Insects in trap solution prior to counting/identifying.

Male SWD on strawberry

SWD Trece trap in strawberry

SWD Trece trap in raspberry

SWD larvae in salt-water solution in strawberries



SWD larvae in salt-water solution in raspberries

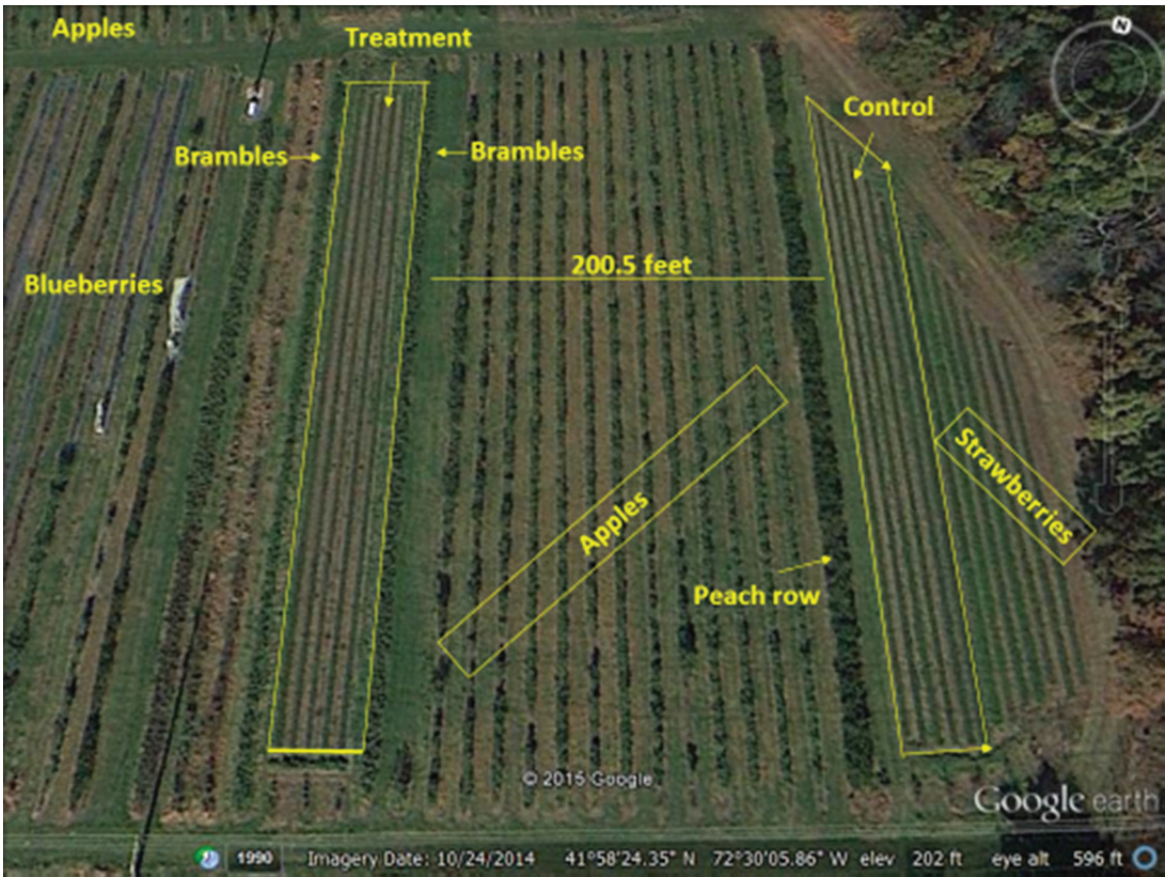
SWD than the ripening fruit have been tried and work is continuing on that. Michigan preferred apple cider vinegar (Isaacs, R, 2010). New England and CT used that same bait in 2012 but found it is not a first indicator of when the SWD have entered a field. In 2013, a yeast-whole wheat flour bait that was found by Dr. Richard Cowles, CAES, to be more effective (http://www.uvm.edu/vtvegandberry/SWD/2013_SWD_Trapping.pdf) was used. In 2013, 'trapping out' was tested in CT, RI and Me using baited traps throughout the planting. It was not successful or cost effective.

Proposed Solution

Perimeter trap cropping (PTC) has been successfully utilized in vegetable crops for many years. This project used that concept by using an established planting of fall red raspberries as the trap crop for the SWD, planted around a day-neutral strawberry planting. A separate field of day-neutral strawberries was established without the raspberries planted around them. The raspberries and strawberries were monitored for the presence of SWD with traps and fruit inspections. Insecticide applications were made only to the raspberries, spraying from the inside of the block out, to avoid spraying the day-neutral strawberries. It was expected that the raspberries would either intercept the SWD as they entered the field or the SWD would find the raspberries more appealing than the strawberries, and the pesticide applications would control them before they had a chance to infest the day-neutral strawberries. If successful, PTC would provide another management tool for berry growers to use to control SWD without applying pesticides to the strawberries.

Procedure

Seascape day-neutral strawberries were planted May 2014 on black plastic, double rows, 9 inches be-



tween plants, 12 inches between rows; 36 inch aisles. The trap crop plot consisted of five 350 ft. long double rows of Seascape, surrounded by an established 365 foot long row of Caroline fall raspberry 12 feet to the east, and 6 feet to the north and south; and a 365 foot long row of Polana fall raspberry 12 feet to the west of the Seascape. The check plot consisted of five double rows of Seascape strawberries were planted 200.5 feet to the east of the trap crop plot with mature apple and peach trees located between the treatments. Drip irrigation was installed on the strawberries and the north and south end raspberries. Drip irrigation already existed on the east and west raspberry rows. Straw mulch was applied in late fall 2014 to all the strawberries.

The grower applied insecticides plus sugar for SWD to the raspberries, using a speed sprayer, as fruit were ripening by spraying from the inside blowing outward. This reduced the chances of insecticide drift onto the strawberries protected by the raspberry trap crop. In 2014, eight applications were made on a 4-12 day schedule, and in 2015, nine applications were made on a 5-9 day schedule. No insecticides were applied to either the trap crop strawberries or check strawberry plot.

Mature strawberry and raspberry fruit were randomly sampled weekly for the presence of SWD larvae beginning in mid-August and continuing through October in 2014 and through September in 2015. 100 fruit samples from control strawberries, strawberry treatment and raspberries were placed in salt water for approximately 15 minutes. An Optivisor 10X lens was used to detect larvae.

Kumbucha lure trap was initially used but was changed to the commercially developed Trece traps and SWD lures with vinegar as the drowning solution. Traps were set out in the raspberries and strawberries and checked weekly. The drowning solution from the traps was collected weekly and poured through coffee filters. The filters were placed under a microscope for ease of counting SWD adults. New drowning solution was added to the traps weekly.

Results

In 2014, larval infestation in the treatment strawberries ranged from 0% to 4% with only a single week, October 2, with any infestation (4%). The raspberry larval infestation occurred during a five week period from September 4 through October 2, and ranged of 2% to 18%. The infestation in the check plot strawberries began September 4 and continued off and on weekly through October 16, with infestations of 2%, 0%, 4%, 0%, 6%, 12%, and 24%.

In the strawberries protected by the trap crop, no SWD were caught in traps the first three weeks although they were present in the raspberries during this interval. Trap captures began in the trap crop plot strawberries September 11, peaked October 2 and continued in lower numbers through October 23. The range was 3 to 44 adult SWD. Raspberry SWD trap captures were immediate and sustained throughout with a range of 3 to 73. Although SWD were present in the trap crop strawberry traps, they appeared to prefer the raspberry fruit over the strawberry fruit. SWD trap captures in the check plot strawberries began August 29 and continued through October 23 ranging from 3 to 97. See Figures 1 and 2 for details.

In 2014, strawberries in both the control and treatment areas were not commercially harvested.

In 2015, larval infestation in the strawberries protected by the trap crop occurred only during two weeks, August 24 and September 8, at 2% each week. The raspberries were infested beginning August 24 and continuing through September 28 with a range of 2% to 14 % with the sole exception of the week ending September 8 which had zero fruit infested. The check plot strawberry infestation was almost identical to the trap crop protected strawberry infestation with two weeks at 2% each, August 31 and September 14, the remainder weeks had 0% infestation. Strawberries in the control and treatment were commercially harvested throughout the season with no impact on the trials under the weeks of September 21 and 28 when they were picked heavily by the picking crew leaving only 22 and 20 fruit for September 21 and 28 respectively to be checked for larval infestation. By September 28 there were very few fruit left in the control block to mature which effectively ended the trial. See Figures 3 and 4 for details.

Although there was a difference between the strawberry fruit infestation in the two plots in 2014, there was no significant difference in 2015. Trap captures as well as fruit infested with SWD larvae were lower in 2015 than 2014 throughout the harvest season.

Figure 1

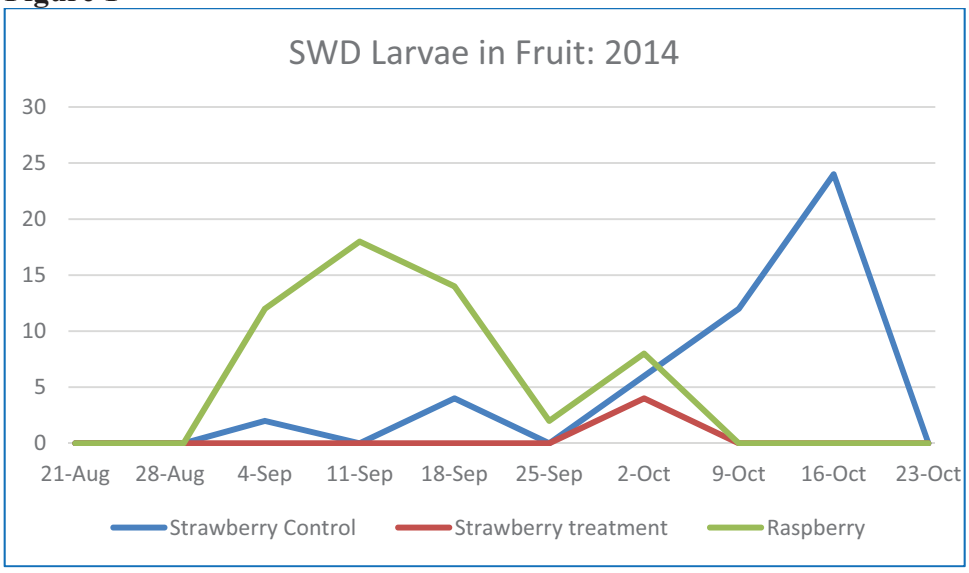
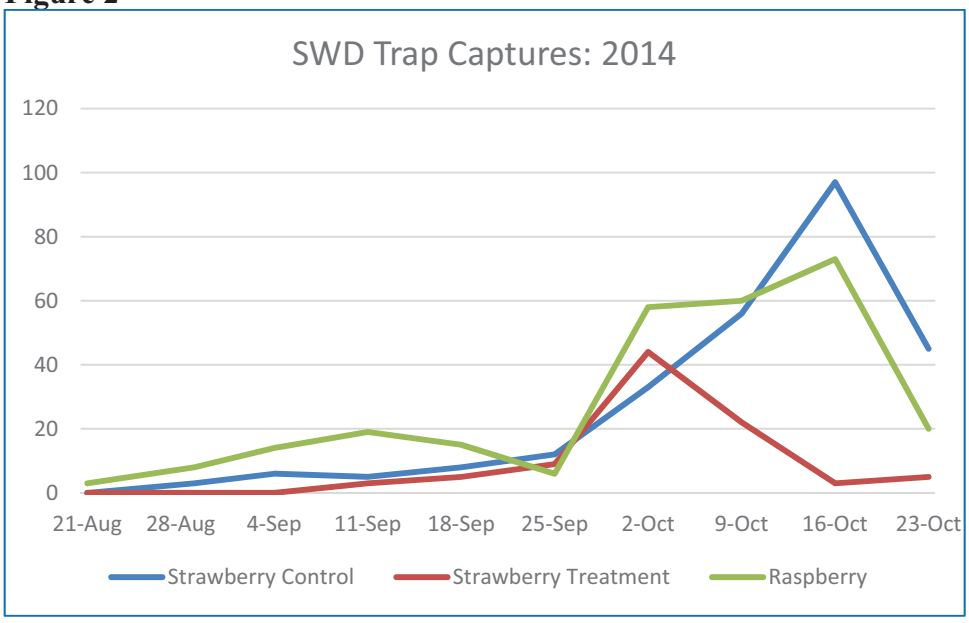


Figure 2



Conclusions

The goal for this project was to achieve at least 90% SWD-free fruit in the trap crop protected strawberries. Based on these results, the use of raspberries surrounding the strawberries made a difference in the strawberry fruit infestation of SWD. Trap crop protected strawberries never had less than 96% SWD-free fruit in either year, so fruit were marketable throughout the experiment.

Infestation rates of the check plot strawberries were expected to be very high as no insecticides were applied. However, infestation rates in the check plot were lower than expected and well within the 90% SWD-free goal, with the exception of the weeks of October 8 and 16, 2014. During those two weeks in October, SWD-free fruit dropped to 88% and 76% respectively – an unacceptable level for commercial production. Those two weeks also correspond to the highest SWD trap captures in the check plot.

It is possible the distance between the two plots at 200.5 feet, even with tree fruit between, was not enough to overcome the attractiveness of the raspberries in the trap crop plot, and resulted in low populations in the check plot strawberries..

Data from the two years of this study indicate that raspberry fruit are more attractive to SWD than strawberry fruit and can function as an effective trap crop for strawberries. This pilot study shows promise for the use of PTC for SWD management. Trails are needed at additional farms to discern if the relationship holds in difference environments.

Figure 3

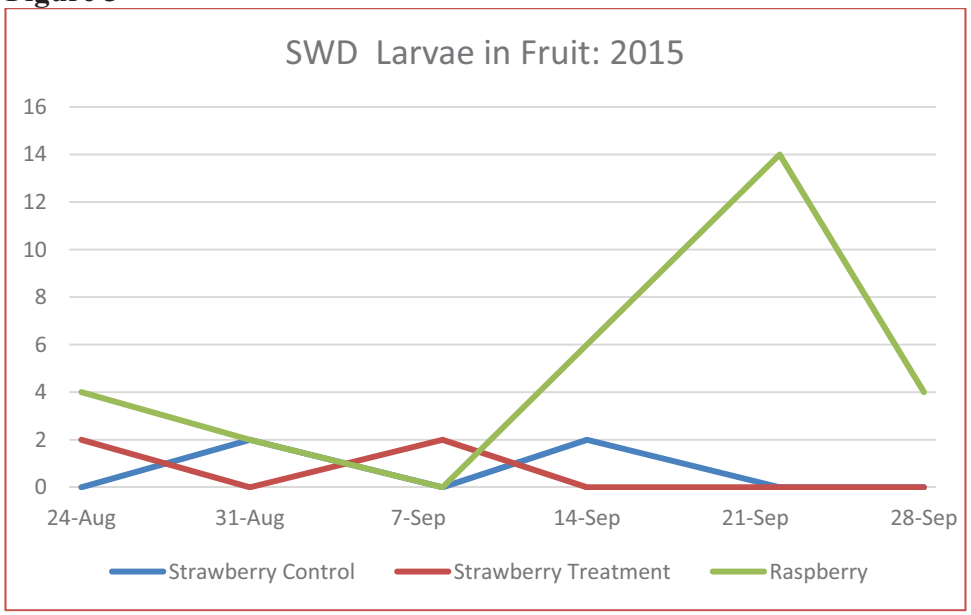
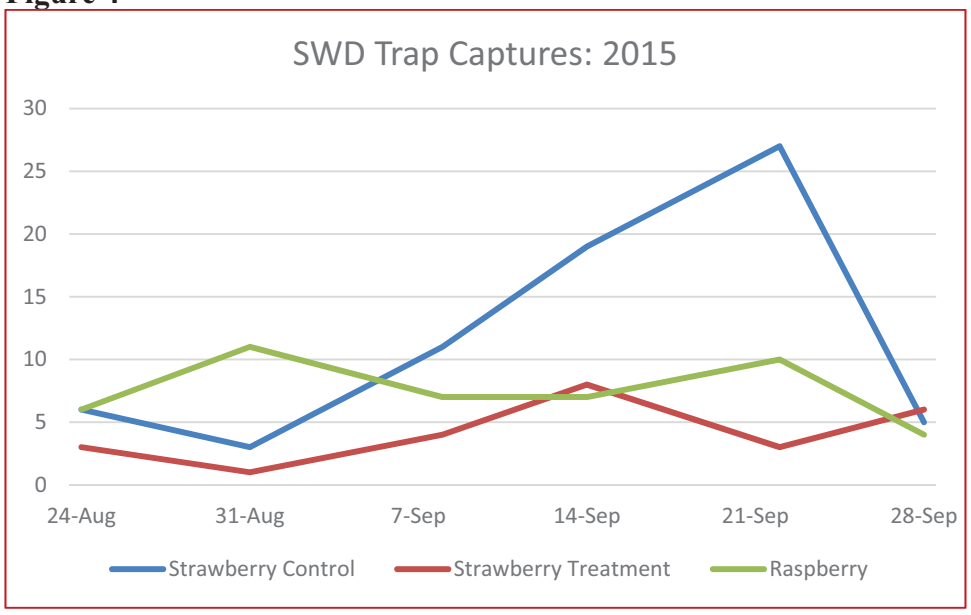


Figure 4



Acknowledgements

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