2014 Empire Producers EXPO SWD Session Presentation Summaries

Thursday January 23, 2014, 1-3 PM

Enhancing Insecticide Efficacy with Phagostimulants - *Greg Loeb, Johanna Elsensohn and Stephen Hesler, Department of Entomology, Cornell University, and Dr. Richard Cowles, Connecticut Agricultural Experiment Station*

At the moment the most effective approach to managing Spotted Wing Drosophila (SWD) is based on the use of insecticides. Vulnerable crops that ripen during the late summer and fall, such as fall raspberries, require at least weekly insecticide applications. Although the number of products registered for controlling SWD in NY is increasing, there are still a limited number of effective options. Moreover, in choosing an insecticide, growers must consider a number of factors in addition to efficacy, including restrictions on the number of applications and total amount of active ingredient allowed during the season, days to harvest restrictions, mode of action and resistance, rain fastness and impact on beneficial organisms such as pollinators and natural enemies. To address some of these factors, the entomology small fruit program at Cornell has been evaluating insecticide efficacy of registered and unregistered insecticides over the past several years. One aspect that we have been particularly interested in exploring is a proposed method to enhance efficacy of insecticide by including a feeding stimulant (also known as a phagostimulant) with the product. Specifically, we have been testing, along with our colleague Dr. Rich Cowles at The Connecticut Experiment Station, how the addition of a small amount of sugar (sucrose) may synergize toxicity of some compounds. Sugar was chosen because when fruit flies taste sugar they are induced to eat. This should increase toxicity of insecticides, especially those with active ingredients that must be consumed to be effective.

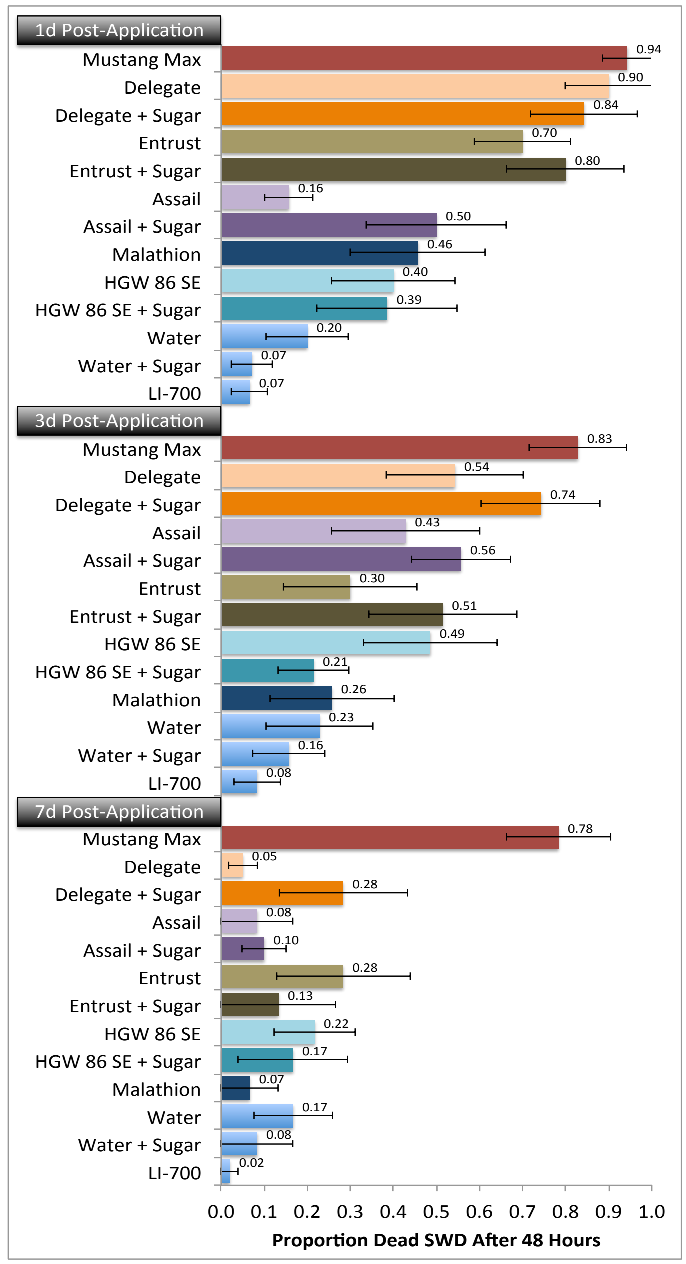

Figure 1. Proportion SWD that died as function of time of application of insecticide under lab bioassay conditions.

In this presentation, we will report the results of experiments conducted in fall raspberries and day-neutral strawberries and involve a number of different active ingredients. Experiment 1 was a broad evaluation of labeled and unlabeled insecticides, with or without an added phagostimulant (sucrose at 2 lb/100 gallons). This trial was conducted using individual fruiting canes of fall raspberry in a commercial planting. After treatment in the field, whole tip cuttings with ripe fruit were brought back to the lab and SWD were exposed under laboratory conditions to the treated tissue 1d, 3d and 7d after application. Results show that Mustang Max resulted in the highest proportion of dead adult SWD at all days post-application (Figure 1). Products tested with a phagostimulant generally exhibited increased mortality and a prolonged period of efficacy. The one exception was HGW 86 SE (also known as Cyazypyr). Proportion of SWD mortality for each product declined between 3d and 7d post-application.

In the second trial, we examined the efficacy of the organic version of spinosyn (Entrust) with and without sugar under field conditions in day-neutral strawberries, compared to the pyrethroid Brigade (bifenthrin). For most of the sample dates, the addition of sugar to Entrust reduced SWD infestation of fruit, although strawberry plants treated with Brigade applied weekly or twice a week had the lowest level of infestation.

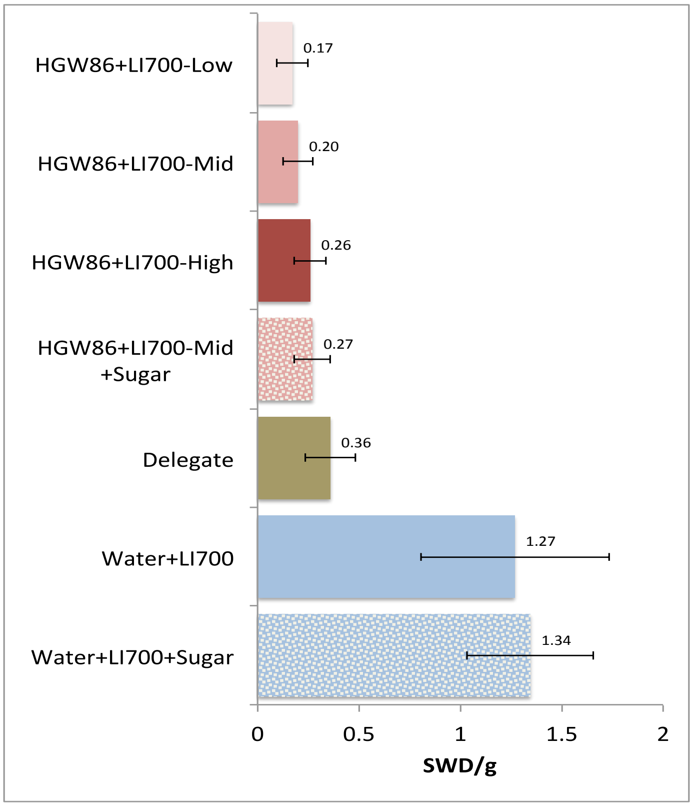

Figure 2. SWD per gram of fruit reared from raspberry treated with different insecticides over four-week period.

In a third field experiment, we tested the efficacy of an experimental product provided by DuPont. We used a two-year old planting of the primocane raspberry variety Caroline planted at Darrow Farm at NYSAES in Geneva, NY in the summer of 2012. Treatments included the Dupont product HGW 86 SE (Cyazypyr) at different rates and with or without sugar, compared to a grower standard, Delegate (spinetoram). Insecticides were applied on 29-Aug, 6-Sept, 13-Sept, and 18-Sept 2013. Results indicate that Cyazypyr was effective in reducing infestation rates and comparable to grower standard (Figure 2). The addition of sugar to Cyazypyr did not increase efficacy. We measured fruit infestation for several weeks after we stopped applying insecticides and found that Cyazypyr continued to reduce fruit damage for at least a week longer than Delegate.

In a fourth field experiment, we tested the efficacy of Cyazypyr, with and without sugar, along with Delegate, in day-neutral strawberries. Results were similar to those found with raspberry. Cyazypyr and Delegate were comparable in efficacy, sugar did not increase efficacy of Cyazypyr, and Cyazypyr appeared to have a longer residual effect than Delegate.

We would like to thank Gabrielle Brind-Amour, McKenzie Schessl, and Allison Wentworth for their assistance both in the field and the lab in completing this research. Funding for this project was provided from several sources, including the North American Raspberry and Blackberry Association, North American Strawberry Growers Association, NY Dept. of Ag and Markets Specialty Crops Program, USDA NIFA, and New York Berry Growers Association.

A Fixed-Spray System for SWD Management in High Tunnel Raspberries

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Spotted wing drosophila (SWD) represents a serious challenge for fruit growers in the Northeast and elsewhere. Unlike other fruit flies, SWD has the capacity to lay its eggs in ripe, marketable, soft-skinned fruit. Later maturing berries, such as blueberries, fall raspberries and day-neutral strawberries, appear to be especially vulnerable. SWD was first observed in the Northeastern region in 2010, became widespread during the 2011 field season, and in 2012 decimated fall berry crops throughout the region. Over 50% of the blueberry and bramble growers that responded to an end of season survey of small fruit growers in the Northeast conducted by Cornell University reported significant crop loss due to SWD.

High tunnels are increasingly being used for berry production in NY and elsewhere. Work by Pritts has been instrumental in the development and optimization of high tunnels for raspberry and blackberry production, showing that they perform particularly well under high tunnel conditions, with greater yields, extended harvest season, and greatly improved fruit quality. SWD represents a major economic constraint to the adoption of this profitable production innovation.

Raspberries grown in high-tunnels are particularly vulnerable to SWD. The invasion of SWD has forced raspberry growers to dramatically increase insecticide applications to produce marketable fruit, an especially significant logistical challenge for high tunnel production. Pesticides are the only practical management tools currently available to growers. To achieve a reasonable level of control, they need to be applied frequently (5–7-day spray intervals) over a long harvest period. These repeated insecticide applications are expensive (fuel and operator expenses plus the pesticides), time-consuming and sometimes not fully effective. Moreover, operating application equipment in the high tunnel environment can be very challenging. Previous work has been done in tree fruits using irrigation-type tubing fitted with greenhouse microsprinklers to deliver pesticide sprays directly to the crop canopy from a centralized pump. The supply lines are fixed on support wires within or above the canopy to optimize spray delivery and coverage.

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A fixed system to apply insecticides may help mitigate a number of pest management problems in high tunnel production. Fixed sprayer systems may be particularly cost-effective in high tunnels, as the framework to support the fixed lines is already present. A fixed sprayer system would save time in the application of insecticides compared with using conventional application equipment (e.g., a backpack sprayer). Coverage, and therefore effectiveness, may also be improved with a fixed system.

In mid-July 2013, an arrangement of fixed tubing and nozzles for pesticide application was installed in each of three high tunnel (HT) systems currently under bramble production in NY: a high tunnel raspberry research planting at the NYS Agricultural Experiment Station in Geneva, a blackberry research planting at the Cornell Horticulture high tunnels in Ithaca, and a high tunnel raspberry operation at Stonewall Hill Farm (Dale Ila Riggs), in Stephentown, NY. For the raspberry systems (Geneva and Stephentown), the main supply lines consisted of 3/4" polyethylene irrigation tubing strung above the planted rows, and affixed to the cross-struts of the HT structure using cable ties, with 1/4" micro-tubing drop lines suspended down to the plant canopy every 5' along each side of the row. Each drop line was fitted with a Netafim DAN 7000 series microsprinkler with an 8-mm orifice and a flat circular pattern spreader; each unit contained a 20-psi check valve. The nozzles were oriented laterally facing toward the row center, producing a spray profile in the vertical plane and directed slightly into the canopy. In the blackberry HT system (Ithaca), the structure was similar, but because of the higher plant density of this crop, the drop lines were suspended every 2.5' along the sides of the rows, and an additional overhead supply line was used to contact the row center from drop lines spaced every 5'; nozzles on this line were oriented with the spray profile being horizontal over the canopy. All supply lines were connected to a PVC manifold (mounted on a board near the HT entrance) fitted with an individual pressure gauge and ball valve for each line; the manifold in turn was connected to a portable wheeled greenhouse sprayer (Rear's Nifty Nursery-Cart model) with a 25-gal tank and a 3 HP gasoline motor powering a diaphragm pump. Each tunnel consisted of three planted rows, ranging from 100–120 ft in length; only a single line was operated at a time in order to optimize spray pressure along the extent of the line.

To make an application, all lines were first filled by sequentially opening each valve to receive spray solution from the pump until the line pressure reached 20 psi, or just before the check valves opened. Then, one valve at a time was opened to increase the pressure to 30 psi and spray the pesticide solution from one line, for a total application time of 30 seconds, which thoroughly wet the canopy foliage adjacent to the line of nozzles. The next line's valve was then opened as the first one was closed, to continue the process similarly until all six lines were allowed to spray; total time for priming plus application therefore required approximately 5 minutes, and took approximately 15 gal for the area sprayed (ca. 0.08 acre). To recover pesticide solution remaining in the tubing after spraying was finished, a length of hose attached to a valve on the PVC manifold drained off much of the contents of the supply lines into a container; this was used to fill a backpack sprayer for treating check rows in an adjacent HT planting not fitted with the fixed spray system.

During the last week of July, SWD adult traps were deployed adjacent to the HT systems at each site to get an indication of local population pressure near each planting. Traps were plastic deli cups containing a fermented yeast+flour mixture, with apple cider vinegar as a drowning medium. Numbers of SWD adults captured were very low initially and began to increase starting in mid-August; however, to protect the fruit from attack by undetected SWD females, preventive insecticide treatments were also started at the end of July. The two principal products used were Delegate [spinetoram] (3–6 oz/A) and Assail [thiamethoxam] (5 oz/A), to each of which was added 2 lb sugar/100 gal as a feeding stimulant. Sprays were applied weekly, and rotated on the following schedule: Delegate, 29 Jul; 19 & 26 Aug; 16 & 23 Sept; Assail, 5 & 12 Aug; 2 & 9 Sept. At Stephentown, additional sprays of Mustang Max [zeta-cypermethrin] were applied during the two weeks following the 23 Sept Delegate spray. All applications were made at dusk to minimize exposure to foraging bees.

To assess efficacy of the insecticide treatments in preventing SWD fruit infestation, samples of maturing fruit were taken weekly beginning the first week of August, and held at room temperature in the lab to rear out any larvae in the fruit to the adult stage. Numbers of samples taken ranged from 8-13 per site, each consisting of 10–20 berries (~50–100 g total), taken from both the fixed spray planting and a check planting at each site. At Stephentown, a commercial site where ripe fruit was picked nearly daily, there were generally low numbers of flies reared from the fruit, with no major difference between the fixed spray and backpack sprayer treatments. At the Geneva HT system, twice as many flies were obtained from backpack-treated fruits as at the commercial site, and 5 times as many from the fixed spray treatment. The Ithaca HT blackberries had the highest SWD adult emergence: 8 times more in the fixed spray treatment than the commercial site, and numbers comparable to Geneva in the backpack treatment (e.g., twice as many as the commercial planting).

On 25 Sept, to measure spray deposition from the system in the fully developed canopy, water-sensitive cards were stapled onto the leaves on the outside portion of the row as well as in the inside center of the canopy, both on the leaf tops and undersides, and on the left and right side of candidate rows. The system was run for 30 seconds with water only, and video imaging software was used to assess average card coverage. Results showed that spray coverage was highly variable, but predictably best on the outside of the canopy, and markedly better on the tops of the leaves (40-100% coverage, above the average seen in field trials) than on the undersides (1-26%). Cards in the inside center of the canopy were less well covered (16-67% on leaf tops, still acceptable levels; 1-8% on undersides).

Potential new areas of investigation next season include:

- Examine shortening the spray duration times, as it is possible the system is running too long and in effect washing off the active ingredient; changes in rates of water and insecticide may affect coverage and efficacy.
- Adding center overhead lines in the raspberry systems to improve coverage to the insides of the rows.
- Assessing spray coverage on the fruit, by using a fluorescent tracer dye.
- Examine the possibility of direct pesticide injection (dosing pump) rather than mixing pesticide solutions in the tank.
- Investigate whether there is a way to incorporate air-assist into the spray system.
- Quantify pesticide residue levels on the fruit, or conduct bioassays using lab-reared flies to see how efficacy changes over time.
- Look at cultural practices that might increase coverage (e.g., positioning of canes, cane pruning).

We believe that the availability of a fixed sprayer system could make growing high tunnel raspberries more feasible in the age of SWD. Fixed sprayer systems may also prove practical for smaller field plantings of high-value blueberries and raspberries. Importantly, the adoption of fixed sprayer systems for berry crops will reduce grower exposure to insecticides, as there will not be a need to travel through the planting to apply them.

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Season Long Evaluation of Wild Hosts for Spotted Wing Drosophila - *Johanna Elsensohn and Greg Loeb, Department of Entomology, Cornell University*

Spotted Wing Drosophila (SWD) is a serious pest to many soft-skinned fruit crops. This generalist vinegar fly has a wide host range of both cultivated and wild plant species. Known cultivated hosts include strawberries, raspberries, blackberries, blueberries, cherries, and to a lesser extent, grapes, stone fruit and tomatoes. In 2012, Cornell researchers surveyed vegetation surrounding multiple farms throughout the Finger Lakes and Lake Ontario region of New York. All plants bearing fruit that could potentially serve as a host for SWD were collected and brought back to the lab and monitored for fly emergence.

Building on this initial work, during the 2013 growing season we investigated the potential impact of these wild hosts on SWD populations. We asked the following questions; a) What, if any, plants serve as early season hosts? b) When do infestations occur in wild hosts? c) Which plant species produce the most SWD? Many of these wild hosts are found at the disturbed edges of wooded areas that are commonly found around NY farms. Eight sites were identified that possessed at least two or three wild hosts previously shown to support SWD reproduction. Plant species surveyed included wild black raspberry and blackberry, pokeweed, bush honeysuckle, buckthorn, bittersweet nightshade and dogwood. Study sites were visited weekly to look for ripe fruit, collecting a sample from up to five different plants of each species. Fruit samples were brought back to the lab, placed into a container at ambient temperatures and monitored for fly emergence. All flies were collected and identified. Fruit collections started in June when black raspberry ripened and continued through late November when most fruit was gone and flies ceased to be reared from collected samples. Figure 1 shows infestation rates for one of the sites. At this farm, the majority of emerged SWD came from honeysuckle and pokeweed.

Four monitoring traps were also placed at each sampling site throughout the season, starting in early June and continuing through the end of the year. Two traps were placed along the border of the woods where wild hosts were also found and two were placed within a fruit crop planting nearest the woods. Traps were baited with a fermenting wheat dough and an apple cider vinegar and ethanol drowning solution. Contents were collected weekly and traps were reset with fresh materials. Figure 2 shows the average weekly trap catch of SWD at the same site as in Figure 1. Across sites, woods traps caught more SWD than those placed in the crops. Data shown here is incomplete, as all traps from all weeks have not yet been sorted through.

While our data clearly show that uncultivated plants serve as hosts to SWD when crop fruit is unavailable, it is not clear at this point whether host removal would have a large impact on local population levels due to the high vagility of this fly. Future research should address the impact of on-farm removal of wild hosts on SWD crop infestation and also include an assessment of distantly distributed wild hosts to see if they are being utilized by SWD as well.

We would like to thank the growers who allowed access to their farms throughout the year for the survey work. We would like to thank Gabrielle Brind-Amour, McKenzie Schessl, and Allison Wentworth for their assistance both in the field and the lab in completing this research. Funding for this project was provided by the NY Dept. of Ag and Markets Specialty Crops Program and the New York Berry Growers Association.

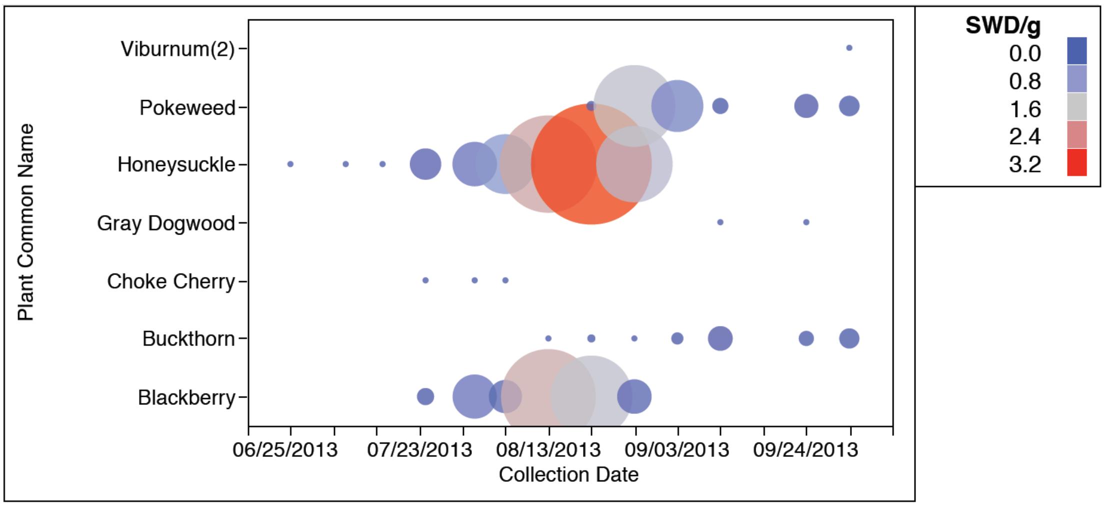

Figure 1. Average number of SWD per gram of fruit from various plants at Site 2 throughout the 2013 growing season.

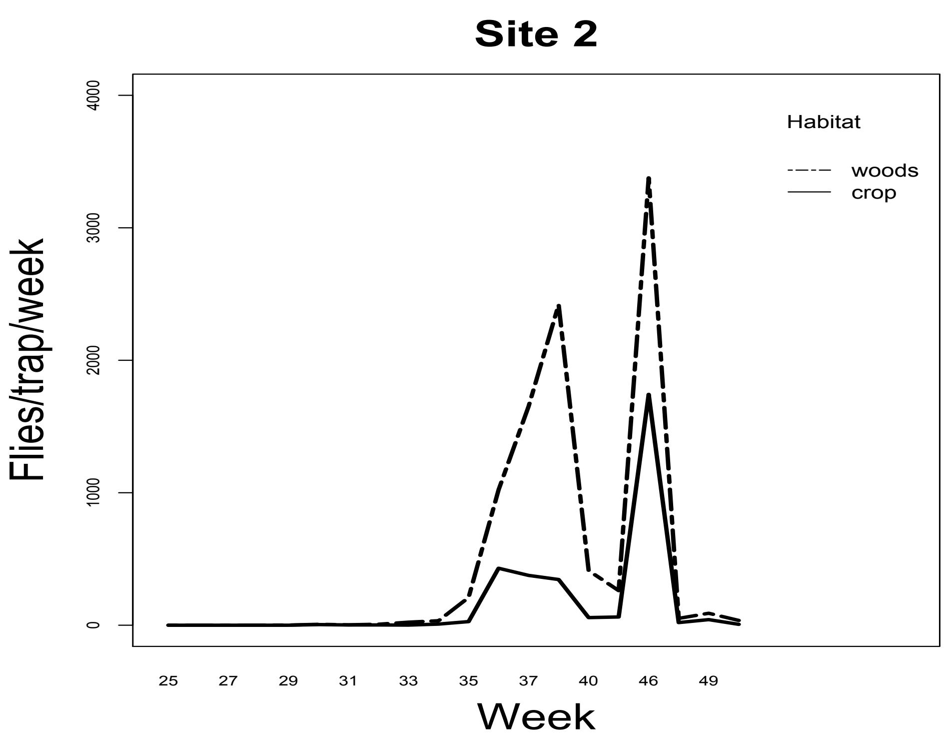

Figure 2. Mean weekly trap capture of SWD at Site 2.