TITLE:

SEASONAL PHENOLOGY AND MANAGEMENT OF SPOTTED WING DROSOPHILA IN RASPBERRY CROPS IN NY

DEC-2012 PROGRESS REPORT

PRINCIPAL INVESTIGATOR:

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This research is geared toward improving **production** of berry crops through a better understanding of seasonal biology and management of spotted wing drosophila

Year 1

RATIONALE AND BACKGROUND:

Spotted wing drosophila (SWD) represents a serious challenge for fruit growers in the Northeast and elsewhere (Walsh et al. 2010, Lee et al. 2011a). Unlike other fruit flies, this species 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, although stone fruit, such as peaches and sweet cherries, and grapes are potentially also at risk (Lee et al. 2011b). SWD first appeared in California in 2008 and has been rapidly expanding its distribution ever since. SWD was first observed in the Northeastern region in 2010 but became widespread during the 2011 field season with confirmed populations in NJ, RI, CT, PA, MA, NY, ME, NH and VT (Hauser 2011, Lee et al. 2011a). Serious economic losses were reported in fall raspberries where growers prematurely ended the harvest season due to infested fruit. In order to keep fruit clean and marketable, growers have resorted to treating raspberry plantings twice per week with insecticides. This level of emphasis on chemical management will hasten the development of resistance in SWD to insecticides, will have negative impacts on beneficial insects and the environment, and will increase the risk of worker and consumer exposure to insecticides.

Our knowledge of the biology and phenology of SWD is limited, especially in the eastern US. Based on initial research in the Western US, Michigan, and North Carolina, SWD appears to overwinter as adult flies in sheltered areas, probably at relatively low numbers. Traps baited with attractant lures, such as apple cider vinegar, typically do not capture adult flies until later in the summer (July), thereafter increasing in numbers well into the fall. Hence, mid- and late-season maturing fruits are most vulnerable to damage. It is unclear why flies are not detected earlier in the season, though it may be that their populations are below detection thresholds for the traps and lures being used. SWD also has been reared from a number of wild hosts such as wild cherry and wild blueberry.

As indicated above, controlling SWD is problematic. As internal feeders, immature life stages are well protected within fruit from pesticides. Adult flies appear fairly susceptible to a number of insecticides (Bruck et al. 2011). However, the flies continually emerge or immigrate into a planting therefore requiring repeated applications (weekly or biweekly) through the harvest period to maintain clean fruit. In addition to the economic costs of these insecticide applications, many of the compounds are detrimental to beneficial insects.

Since SWD has only recently invaded the Northeast, there is a need to gather data on pest phenology over the season, which crops appear to be the most negatively affected, and begin assessing efficacy of insecticides. This two year project was initiated to address these deficiencies.

OBJECTIVES:

1. Assess abundance of adults and larvae in multiple berry crops through the growing season.
2. Efficacy of labeled and unregistered insecticides against SWD in raspberry.

PROCEDURES BY OBJECTIVE:

Objective 1. Assess abundance of adults and larvae in multiple berry crops through the growing season.

Six farms with raspberries were included in this survey of phenology and damage of SWD. Most farms also included other fruit crops such as strawberries, blueberries, blackberries, sweet cherries, apples and peaches. Adult SWD were monitored using standardized deli cup traps baited with apple cider vinegar (ACV). Ripe, marketable fruit samples were used to rear larvae to the adult stage to determine species. Traps were placed at the edge and interior of each crop as well as at the edge of nearby woods starting the week of 21-May, and checked approximately once per week. Adult fruit flies were separated into male SWD, female SWD, and other *Drosophila* species. Grower cooperators were kept updated on the SWD status of their farms. Information and SWD status by county was also disseminated through various grower organizations and information channels.

Objective 2. Efficacy of labeled and unregistered insecticides against SWD in raspberry.

A primocane raspberry planting (cultivar = Caroline) was established during the 2012 growing season for the purpose of testing the efficacy insecticides against SWD during the 2013 season. Five 125' rows were established, providing sufficient row spacing for about ten different treatments in 2013.

RESULTS BY OBJECTIVE:

Objective 1: The seasonal occurrence of SWD in adult traps followed a similar pattern as had been observed in other growing regions following detection in the previous season. First capture occurred the week of 2-Jul (Figure 1). The population quickly grew as the season progressed, reaching relatively abundant numbers the week of 20-Aug. Occurrence of SWD was similar throughout the season in traps located in either crop edge or interior. Traps located in wooded perimeters of farms consistently captured more flies than traps located within farm plantings. The SWD population started to increase for the second half of the summer raspberry season. High numbers of SWD were detected throughout the fall raspberry season.

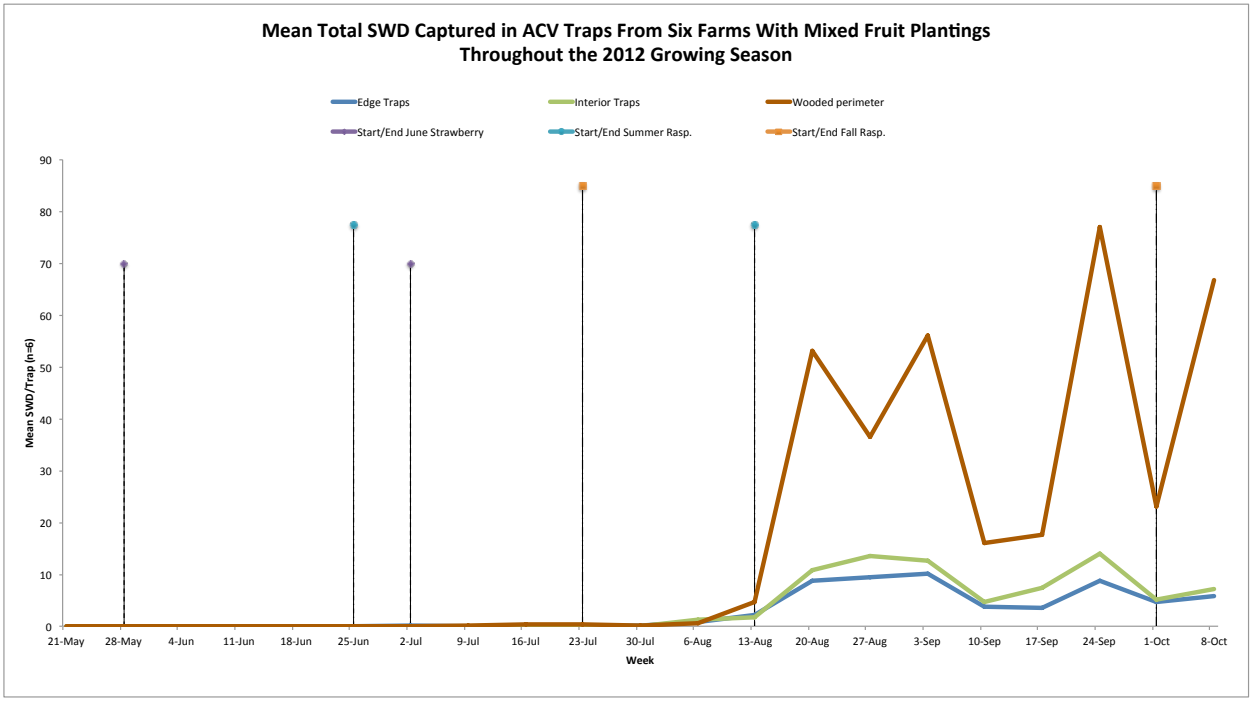

Figure 1. Mean total SWD captured in various fruit crop (combined for this figure) edges and interiors, and from wooded farm perimeters, from six Finger Lakes farms, throughout the 2012 growing season. Standard ACV deli-cup traps were used and checked weekly.

Proportion of SWD in ACV traps, in relation to other fruit flies captured, peaked around 20-Aug and stayed relatively consistent for the remainder of the season (Figure 2). Ripe fruit samples that were collected and held under insectary conditions provided some indication of the ability of various fruit crops to support development of SWD (Table 1). Rearing results should be interpreted keeping in mind factors related to the population dynamics of the SWD in relation to the fruiting season of the various crops.

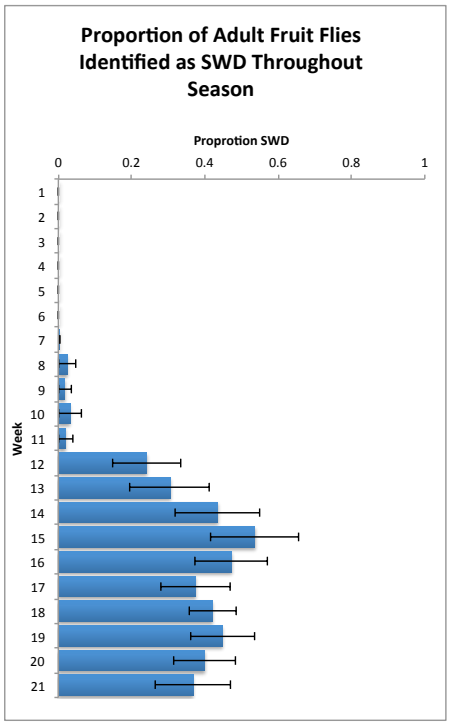

Figure 2. Mean proportion of Adult SWD captured from all ACV traps. Seventy-nine traps were located on 7 different farms, in various crops in the Finger Lakes Region, NY.

Table 1. Mean SWD per sample, other Drosophila per sample, and proportion of SWD reared from various possible SWD fruit hosts. Sampled from 7 different farms in the Finger Lakes Region, NY.

Host	n	Mean-SWD/Sample	Mean-other Drosophila/sample	Mean-proportion SWD
JuneStrawberry	33	0.0 ± 0	4.0 ± 2.5	
Sweet Cherry	7	0.0 ± 0	5.0 ± 5.0	
Blueberry	70	18.3 ± 7.6	4.4 ± 1.5	0.67 ± 0.07
Tunnel Raspberry	47	3.7 ± 1.6	19.7 ± 3.6	0.31 ± 0.06
Summer Raspberry	**82**	**11.2 ± 3.1**	**5.7 ± 1.7**	**0.59 ± 0.07**
Fall Raspberry	**45**	**32.5 ± 6.3**	**11.1 ± 3.2**	**0.67 ± 0.05**
D-N Strawberry (after 30-Jul)	35	5.3 ± 1.7	17.8 ± 5.0	0.32 ± 0.08
Peach	18	0.3 ± 0.3	2 ± 1.0	0.2 ± 0.2
Wild	7	0.3 ± 0.28	0.4 ± 0.4	0.5 ± 0.5
Wild-Cherry	1	0.0 ± 0	0.0 ± 0	
Wild-Sumac Buds	1	0.0 ± 0	0.0 ± 0	
Wild-Dogwood	5	3.8 ± 2.6	0.8 ± 0.6	0.85 ± 0.07
Wild-Honeysuckle	49	1.0 ± 0.7	2.9 ± 2.1	0.45 ± 0.21
Wild-Buckthorn	12	9.8 ± 4.8	1.7 ± 1.0	0.67 ± 0.17
Wild-Riparia	9	0.0 ± 0	0.0 ± 0	

Objective 2: While there were no data from 2012 to report specifically from raspberries, a related insecticide trial in day neutral strawberries was conducted during the time period of the season when fall raspberries would be vulnerable to SWD infestation. Subsamples of marketable strawberry fruit that were examined for fruit fly eggs indicated the degree to which both spinosad (Entrust SC) and bifenthrin (Brigade WSB) reduced occurrences of fruit fly oviposition (Figure 3). In subsamples of marketable fruit that were held in an insectary and flies allowed to develop to adulthood, bifenthrin-treated fruit produced considerably fewer adult flies than spinosad or control treatments (Figure 4). With respect to flies reared from strawberries treated with Entrust + sucrose, there were some anomalies in the data. In particular, numbers were quite low and comparable to Brigade treatments for all dates except one. Hence, we suspect some problems with experimental methods for that time period.

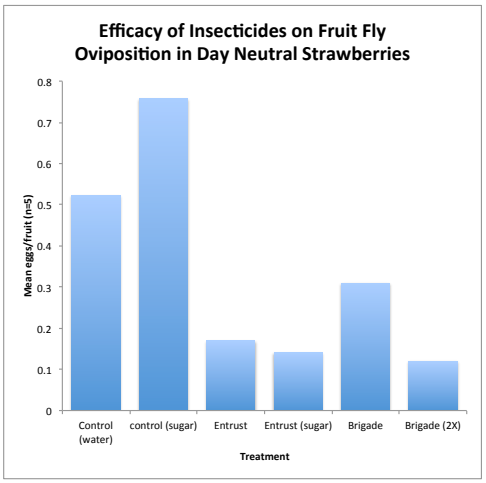

Figure 3. Mean number of fruit fly eggs per strawberry fruit from plots receiving different insecticide regimens between 5-Sep and 17-Oct at Cornell-NYSAES research farm, Geneva, NY.

DISCUSSION:

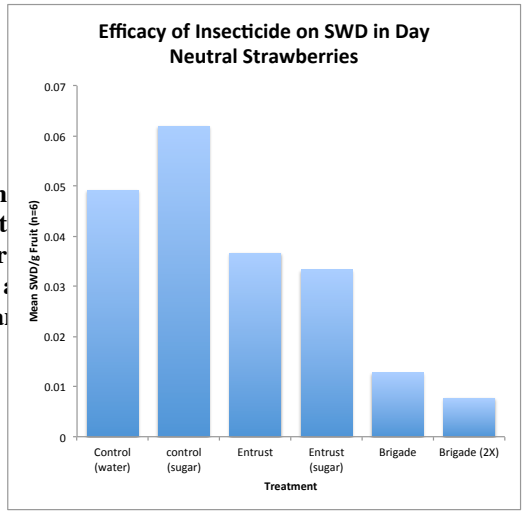

Figure 4. Mean
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Weekly monitoring of adult SWD and other fruit flies in different fruit crops over the 2012 field season revealed several important patterns. As has been observed elsewhere in the eastern US, SWD becomes abundant in mid-summer into the fall. We tended to capture more adult SWD in the traps set along the edge of woods near crops compared to in the crop themselves. This became very pronounced late in the season indicating a habitat shift on the part of adults, perhaps in search of places to spend the winter. Rearing data indicate fall raspberries and late-maturing blueberries were at high risk and experienced the greatest levels of infestations. Summer raspberries also experienced significant damage, but much of this came after the owners stopped selling the crop. Day-neutral strawberries experienced significant infestations, although to a lesser extent than fall raspberries and blueberries.

At its best, monitoring should provide an early warning of pending fruit infestations such that growers can apply some control measure before fruit is damaged. Our data indicate pretty clearly that ACV-baited traps are not very good in this regard. Typically, we were finding evidence of infested fruit at the same time we were capturing adult flies. We had hypothesized that traps in the woods would collect SWD prior to traps in the crops but this did not appear to be the case using ACV as the attractant. This strongly suggests we need improved lures and/or trap locations to provide more useful information for making decisions.

While insecticide trials in raspberry are not slated until 2013, insecticide trials in 2012 with day-neutral strawberries indicated that the pyrethroid bifenthrin provided reasonably good protection, especially when applied twice per week, although certainly not complete control. Spinosad provided some control, but in terms of infestation data, was not as effective as bifenthrin. Adding a feeding stimulant to the spinosad may have increased efficacy, although our results are not conclusive.

Plans for the 2013 field season include a more focused testing of alternative lures for monitoring SWD adults as a way to improve early detection of infestation risk and testing of insecticide efficacy for fall raspberries.

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