Annual Report

Project Title: Organic Science Cluster III: Connecting Environmental Sustainability with the Science of Organic Production	
Period Covered by the Report: 2019-04-01 to 2020-03-31	
Activity #: 20 **Name of Activity:** Ecological pest management for Spotted Wing Drosophila (SWD).	**Principal Investigator:** Juli Carrillo

1. Activity Summary

Spotted Wing Drosophila (*Drosophila suzukii*, SWD) is a top priority for entomological and agricultural research programs because of the negative impact on global small fruit production. Additional ecological and cultural controls must be trialed within organic systems to sustain and grow organic production of berries and other small fruits while also reducing economic losses to fruit growers and managing pesticide resistance. Our research seeks to develop multiple, independent but potentially synergistic management strategies for SWD.

Objective 1: Develop a push-pull system of pest management for SWD

a. Evaluate the efficacy of intercropping and other insect repellent strategies to reduce SWD infestation (J. Carrillo, S. Fitzpatrick, A. Firlej, C. Rodriguez-Saona);

b. Increased understanding of SWD chemical ecology to aid in the development of more effective SWD lures and traps (J. Carrillo, S. Castellarin, A. Firlej, C. Rodriguez-Saona).

We conducted a laboratory bioassay to determine SWD emergence when exposed to volatiles from ground released peppermint essential oil, under high and low humidity. We found that both dry conditions and exposure to high concentrations of peppermint oil both independently decreased the emergence of SWD.

Secondly, we evaluated the effects of exposure to volatiles from peppermint essential oil to a generalist parasitoid which can parasitize SWD and is indigenous to BC, *Pachycrepoideus vindemiae*. We found that exposure to peppermint essential oil increased adult *P. vindemiae* mortality, but that the developing parasitoids were protected from negative effects of peppermint essential oil, suggesting that biocontrol from parasitoids will be affected by the timing of essential oil treatments.

This summer, we trialed a new intercrop, sweet alyssum, in blueberries and strawberries at the UBC Farm. Overall, SWD was too low in blueberry for us to evaluate the effects of our intercrop. We found variable effects of sweet alyssum intercrop in strawberries, dependent on the timing of sampling and the variety of the berry (i.e. Hood was more susceptible than Tillamook). We

finished a late season trial using baited fruit cages to examine the effects of sweet alyssum on raspberries compared to bare ground, but found no evidence of a protective effect. Future trials will be conducted where SWD is more prevalent, and will evaluate the effects of planted intercrops on biocontrol of SWD.

We recently completed greenhouse intercropping trials with sweet alyssum, peppermint, and grass/clover mix, and found that peppermint decreased SWD egg laying more than other ground covers, however bare ground had the lowest rates of SWD emergence.

Objective 2: Document the forecasted safety and efficacy of two Asian parasitoids to support a petition to release these agents in Canada to provide long-term, self-sustaining control of SWD

a. Identify potential non-target insect species in Canada and their vulnerability to exotic parasitoid attack (P. Abram, C. Moffat, J. Brodeur, S. Heard, A. Firlej, D. Moreau, J. Carrillo);
b. Determine parasitoid capacity and predict success of establishment in Canada (thermal response, overwintering capacity, seasonal synchrony, functional response and parasitism success variation across SWD strains) (A. Firlej, J. Brodeur, P. Mason, P. Abram, J. Carrillo);
c. Incorporate information from the above objectives and research conducted elsewhere, to prepare petitions for the release of the parasitoid species in Canada (A. Firlej, P. Abram, J. Brodeur, P. Mason, C. Moffat, J. Carrillo).

Dr. Paul Abram and his team has made the first discovery of two species of Asian larval parasitoids of SWD*, Leptopilina japonica* and *Ganaspis brasiliensis*, in North America. These species were being considered for introduction to the USA and Canada, however we found that at least *L. japonica* is already widespread and parasitizing SWD larvae in BC including the Lower Mainland and Vancouver Island. *Ganaspis* was found only at three sites in the Eastern Fraser Valley parasitizing SWD. The priority for the project will shift from building the scientific rationale for release these two species to Canada, to understanding and potentially increasing their impact and exploring the potential for their redistribution to Eastern Canada. We established a lab colony of *Leptopilina japonica* for future testing.

We have drafted the majority of the petition for introduction of the SWD larval parasitoid *Ganaspis brasiliensis* to Canada, which will now be modified into a petition for redistribution to Eastern Canada. The only section remaining to complete is the results of laboratory non-target testing with Canadian non-target drosophilid species. We anticipate receiving our own colony of *Ganaspis brasiliensis*, from one of our collaborators (CABI Switzerland) and will begin laboratory trials in September 2020, subject to major restrictions around COVID-19 being lifted by then. Trials on parasitoid capacity to establish in Eastern Canada will similarly be initiated when COVID-19 restrictions are lifted to a sufficient degree.

We collected data on the seasonal phenology and habitats used by non-target Drosophilids in BC and established >15 lab colonies non-target Drosophilids from BC and NS which will inform assessments of their risk of being attacked by parasitoids being considered for introduction and will also be included in the completed petition.

Objective 3: Enhance crop resistance through the evaluation of the development of more effective microbial bio-pesticides and through the use of soil amendments (microbial and non-microbial)

a. Evaluate and develop a microbial bio-pesticide for control of SWD larvae though synergistic microbe interactions (J. Carrillo, C. Haney);

b. Evaluate and develop microbe-mediated crop resistance through crop soil inoculation with microbial amendments (J. Carrillo, C. Haney);

c. Trial of AAS product for potential effects on SWD oviposition success and larval development (J. Carrillo, C. Haney).

We are incorporating our previously developed camera module to record insect behaviour with software to orchestrate simultaneous experiments on multiple olfactometers.

In parallel with the high-throughput behaviour assay development, we have begun isolating beneficial bacterial strains from healthy blueberry root and leaf tissue. We have focused on isolating *Pseudomonas fluorescens*, which are known to affect plant volatile production. Thus far, we have isolated more than 20 *Pseudomonas* strains and identified them by 16S rRNA sequencing. In combination with previously characterized beneficial plant-associated *Pseudomonas* isolates in the Haney Lab, these new isolates will allow us to test a variety of strains for effects on SWD behavior.

2. Key Achievements

Our discovery of *Leptopilina japonica* and *Ganaspis brasiliensis* having adventively established in North America for the first time is a major discovery in biological control research, and may have a major impact on how SWD is managed in organic fruit crops in the coming years, although their impact remains to be determined.

The registration of the first insect containment research facility in Summerland is a major accomplishment as it will permit research to be done there on potential candidates for biological control introductions against insect pests for years to come.