AGRICULTURAL RESEARCH FOUNDATION
INTERIM REPORT
FUNDING CYCLE 2017 – 2019

TITLE: Evaluating overwintering behavior of an Asian egg parasitoid of BMSB in hazelnut orchards

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EXECUTIVE SUMMARY:

Brown Marmorated Stink Bug (BMSB) is an invasive insect that feeds on vegetables, fruits, and nut crops. To successfully reduce BMSB populations, growers rely on a suite of practices, which may include chemical applications, cultural, and biological controls. Due to movement patterns between crop and field edges, BMSB creates a challenge for management strictly by insecticides. In the last few years, economic damage has been reported in Willamette Valley orchard crops including peaches and hazelnuts. BMSB's feeding beneath the shell makes it difficult to recognize damage to hazelnut before harvest. As hazelnut production is currently valued above 118 million dollars (US) and is forecast to increase substantially in the near future, there are timely concerns to identify effective management practices to control BMSB.

Biological control using the samurai wasp (*Trissolcus japonicus*), a specialist parasitoid is one low-input management option. This species lays eggs and develops inside BMSB eggs. Since the samurai wasp's initial detection in 2016 in Oregon, it has been released in multiple regions of Oregon where there are specialty crops grown that are susceptible to damage. The Pacific Northwest is a similar climate to some of the wasp's native range of eastern Asia. The wasp survives in temperatures as low as – 17° C (Santacruz et al. 2017), but it is unclear how well the wasp will perform in a wet, warm winter such as in the Willamette Valley. It is likely that wasps will survive Oregon's winter, and there is evidence that adventive wasp populations are establishing in western Oregon. However, the insect small size (<2 mm in length) makes it a challenge to detect and monitor. Almost nothing is known from the literature on overwintering behavior of *Trissolcus* parasitoid wasps despite their significance as important natural enemies of stink bug (pentatomid) pests in agriculture. Additional information on samurai wasp's overwintering behavior and cold tolerance will improve our ability to release, monitor and use biological control in efforts to manage BMSB. This information will determine the conditions that enable successful colonization and survival in or near orchards.

OBJECTIVES:

Objective 1: Evaluate the effect of overwintering substrate on samurai wasp survival

Objective 2: Investigate temperature thresholds that restrict winter survival of samurai wasp parasitoids

PROCEDURES:

Objective 1: At two sites, we set up outdoor enclosures to evaluate the optimal environment for samurai wasp survival during the winter months. Each enclosure included 4 treatments: catalpa bark, catalpa leaves, maple bark, and maple leaves (Fig. 1). We also included the same treatments in an indoor growth chamber to control for the effect of precipitation and wind. Temperatures in the growth chamber are similar to field conditions. We selected the above woody materials based on their attractiveness to BMSB, with the assumption that wasps will overwinter on or near ornamental trees that host BMSB. Wasps were placed inside clip cages with one of the woody material treatments, and the clip cages were covered by the same material. We modified our protocol slightly by placing these enclosures at experimental research sites, rather than on the orchard floor. Wasp mortality is being assessed every other week through Spring 2018.

Objective 2: Exposure to low temperatures is expected to increase mortality in overwintering wasps. We will acclimate female wasps to 8° C and place wasps in several treatments that simulate temperatures near, above, and below freezing. After being exposed to cold temperatures for several hours, we will evaluate survival. All surviving wasps will be transferred to one of three winter climates representative of areas where BMSB currently damages orchard crops and tree nuts in the Pacific Northwest. Mortality will be assessed regularly in each climate, and we will conclude the experiment after 50 days. Surviving wasps will be presented with BMSB egg masses to determine how temperature affects reproduction after a winter period.

SIGNIFICANT ACCOMPLISHMENTS TO DATE:

We initiated Objective 1 in Fall 2017 by establishing two field plots and an indoor control. As of December 2017, nearly 10% of samurai wasps remained alive after 4 weeks of exposure to field conditions. After two months of exposure to field conditions, all wasps died. This suggests a high mortality rate at the onset of diapause. It is not unusual for a high percentage of insects to die during the winter months. We will continue to analyze the ideal conditions for winter survival and repeat the experiment in Fall 2018. We will initiate the experimental protocol for Objective 2 in winter/spring 2018. We published a document with EESC (EM 9164) that identifies features of parasitized BMSB egg masses. This document is being distributed at grower field days and regional meetings.

Fig. 1. From top left clockwise: A) Wooden enclosures are built to contain woody material. B) Leaves and bark from catalpa and maple are placed into each enclosure. C) After 4 weeks, catalpa leaf litter decomposes the most. D) In each woody material, wasps are stored in foam clip cages. A single surviving wasp (black circle) is visible on maple bark.

ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:
We received funding to study components of samurai wasp behavior in orchard and small fruit systems. The Clackamas County Innovative Fund provided costs ($6,378) to investigate samurai wasp dispersal in hazelnut. We also received funds ($2,550) from the Oregon Blackberry and Raspberry Commission to study the effects of insecticide application on samurai wasp.

FUTURE FUNDING POSSIBILITIES:
We anticipate submitting a proposal to USDA-AFRI regarding parasitoid release strategies in and around orchards.

REFERENCE:
Santacruz et al. 2017. Cold tolerance of *Trissolcus japonicus* and *T. cultratus*, potential biocontrol agents of *Halyomorpha halys*, the brown marmorated stink bug. Biol Control 107: 11-20.