

**AGRICULTURAL RESEARCH FOUNDATION
INTERIM REPORT
FUNDING CYCLE 2021 – 2023**

TITLE: Nontarget effects of the samurai wasp on native stink bugs when used for biological control of the brown marmorated stink bug in field settings

RESEARCH LEADER: Dr. Nik Wiman

COOPERATORS: Northern Willamette Research & Extension Center, Mid-Columbia Agricultural Research & Extension Center, and Southern Oregon Research & Extension Center

EXECUTIVE SUMMARY:

Claire Donahoo was hired in September, 2019 as a graduate research assistant for this project. She is pursuing her PhD in Horticulture with a concentration in Entomology and her assistantship is currently partly funded. Claire conducted her research for this project from January 2020 through January 31, 2022 (Years 1 & 2 of the grant). Research that was a result of this grant was presented at multiple virtual events in Years 1 & 2, including the Entomological Society of America Annual Meeting, Wilbur-Ellis Willamette Valley Hazelnut Grower Seminar, Annual Pacific Northwest Insect Management Conferences both years, and the Annual Orchard Pest & Disease Management Conferences both years.

We slightly modified our procedures from our original objectives, as Year 1 presented quite a few limitations. Travel and staffing restrictions were put in place due to the pandemic and the wildfires, which limited our sampling locations for this project. This also decreased the number of sites to collect adult stink bugs to be reared in the lab, which resulted in reduced sentinel egg masses. Additionally, Claire and our collaborators found far fewer BMSB in the field compared with previous years, further reducing our availability of sentinel egg masses. Finally, mass rearing and production of *P. maculiventris* (one of four research species) was halted due to the pandemic restrictions, so we were unable to purchase and rear *P. maculiventris* colonies in our lab.

However, despite our inability to complete most of our sentinel egg mass field work, we were still able to collect wild BMSB egg mass data providing us with a parasitism rate, as well as successfully rear three of four of our intended stink bug species. We also collaborated with researchers in northern and southern Oregon to assess samurai wasp establishment using yellow sticky cards. These data aided in identifying samurai wasp colony locations and successful dates of samurai wasp recovery.

In Year 2, we also saw far fewer BMSB and parasitoid numbers in field. Again, we were not able to rear as many BMSB eggs in the lab to use for our nontarget study with sentinel egg masses. However, we were able to do 1 round of sampling in late September/early October. We placed sentinel egg masses and yellow sticky cards in host plants of BMSB at 4 locations with established parasitoid populations in Eugene, Corvallis, and Monmouth. Adult samurai wasps, the parasitoid species of interest, were captured on the yellow sticky cards during this trial. Unfortunately however, no sentinel egg masses were parasitized by samurai wasps or any other parasitoid. This lack of parasitism by samurai wasps is consistent with other researchers in

Oregon and Washington who attempted use of sentinel egg masses for nontarget studies in the 2021 field season.

OBJECTIVES:

The objectives of this research are to determine potential nontarget effects of samurai wasps on native stink bugs when used for biological control of BMSB in field settings. We plan to conduct host-choice tests using sentinel egg masses placed in the field across different ecoregions where samurai wasps are established. We will examine parasitism of nontargets known from quarantine host tests as susceptible or unsusceptible to attack when paired with egg masses of nontarget pentatomids. Due to our limited results in Year 1, we also added yellow sticky cards to the research locations to observe if samurai wasps adults were present in the event there was no parasitism of sentinel egg masses.

PROCEDURES:

- Acquire specimens of *Halyomorpha halys* (BMSB), *P. maculiventris* (spined soldier bug; native predatory stink bug with conservation biological control value, known susceptible from quarantine testing), *Banasa dimidiata* (native stink bug, susceptible from quarantine testing), and *Chlorochroa ligata* (not susceptible from quarantine testing) and rear colonies in lab).
- Place sentinel egg masses of each species in field for 5 days in locations with established samurai wasp populations in riparian, agricultural, and urban habitats. Nontarget egg masses will be paired with BMSB egg masses and also placed alone when possible.
 - Assess samples for parasitism rates.
 - Assess samurai wasp offspring emerged from each pentatomid species for differences in body and tibia lengths (proposed nontarget egg masses vary widely in size).
 - Provide all offspring with sentinel BMSB egg masses to determine their fecundity and reproductive potential
 - This will help answer the question: do wasps emerged from smaller nontargets experience reduced fecundity or attack abilities against the target pest?
- Place yellow sticky cards for at same locations and timing as sentinel egg masses to assess for presence of parasitoids if sentinel egg masses are not parasitized.

SIGNIFICANT ACCOMPLISHMENTS TO DATE:

- Collected & reared specimens of *H. halys*, *B. dimidiata*, *C. ligata* (Figure 1)
 - Several adults of these species were successfully collected and reared in the lab. Many eggs laid by *H. halys* were used to propagate samurai wasp populations, but we were able to save enough for 1 round of sampling using the sentinel eggs. All eggs laid by *B. dimidiata* and *C. ligata* were placed either in the lab fridge or lab freezer for additional levels to our sentinel egg treatment.
- Collected wild BMSB egg masses and assessed for parasitism rates (Figure 2)
 - Out of 73 egg masses, 17 were parasitized, giving us a parasitism rate of 23.3% for Year 1. This is consistent with previous findings of parasitized egg mass rates in our lab of 26.8% in 2019 and 22.4% in 2018; However, the egg masses analyzed for those years also contained fresh and frozen sentinel BMSB egg masses. Because

of restrictions with travel due to the pandemic and wildfires this summer, egg masses collected and analyzed were all found in Corvallis, Monmouth, and Eugene, Oregon.

- Expanded knowledge of locations of samurai wasp establishment by placing sticky cards on BMSB host plants (Figure 3)
 - Because availability of sentinel egg masses was so limited in Years 1 & 2, we also placed yellow sticky cards on host plants of BMSB to assess for samurai wasp establishment. Claire collaborated with other members of our lab, as well as Chamberlain Agriculture and Mid-Columbia Agricultural Research & Extension Center in Hood River, Southern Oregon Research & Extension Center in Jacksonville, Central Oregon Agricultural Research & Extension Center in Madras, Hermiston Agricultural Research and Extension Center, Union Count Extension Office in La Grande, and Malheur Experiment Station in Ontario.
 - Out of 58 sites sampled in Year 1, samurai wasps were recovered on sticky cards at 5 locations (Figure 4). We greatly expanded our sampling locations in Year 2. Out of 94 sites across 6 ecoregions and 18 counties, samurai wasps were recovered at 21 locations (Figure 5). Finally, we analyzed the wasp recovery dates versus the sampling dates to maximize wasp recovery (Figure 6).

ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:

USDA-NIFA SCRI 2016-51181-25409

FUTURE FUNDING POSSIBILITIES:

Specialty Crop Block Grant Program; Ferrero Group; USDA-NIFA SCRI



Figure 1. Collecting adult stink bugs using the beat-sheet method (left). Bug dorms containing reared stink bug adults in a growth room on campus (middle). *Halyomorpha halys* sentinel egg masses laid on sleeve of bug dorm (right).

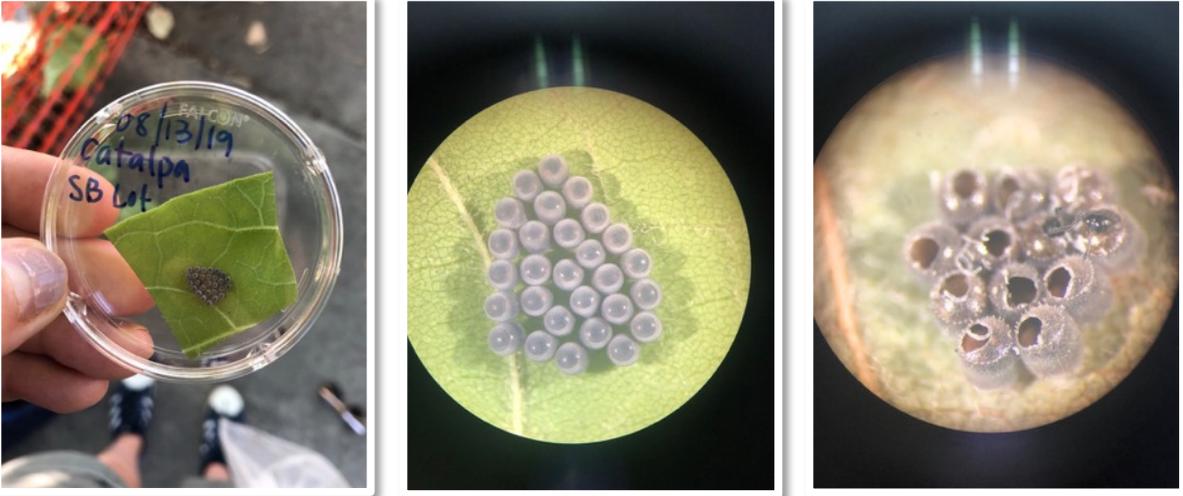


Figure 2. Wild-collected *Halyomorpha halys* egg mass contained in petri dish (left). Magnified view of parasitized *H. halys* egg mass with unemerged samurai wasp (middle). Magnified view of parasitized egg *H. halys* egg mass with emerged samurai wasps (right).



Figure 3. Yellow sticky card tied to host plant of *Halyomorpha halys* (left). Magnified view of samurai wasp on yellow sticky card (right).

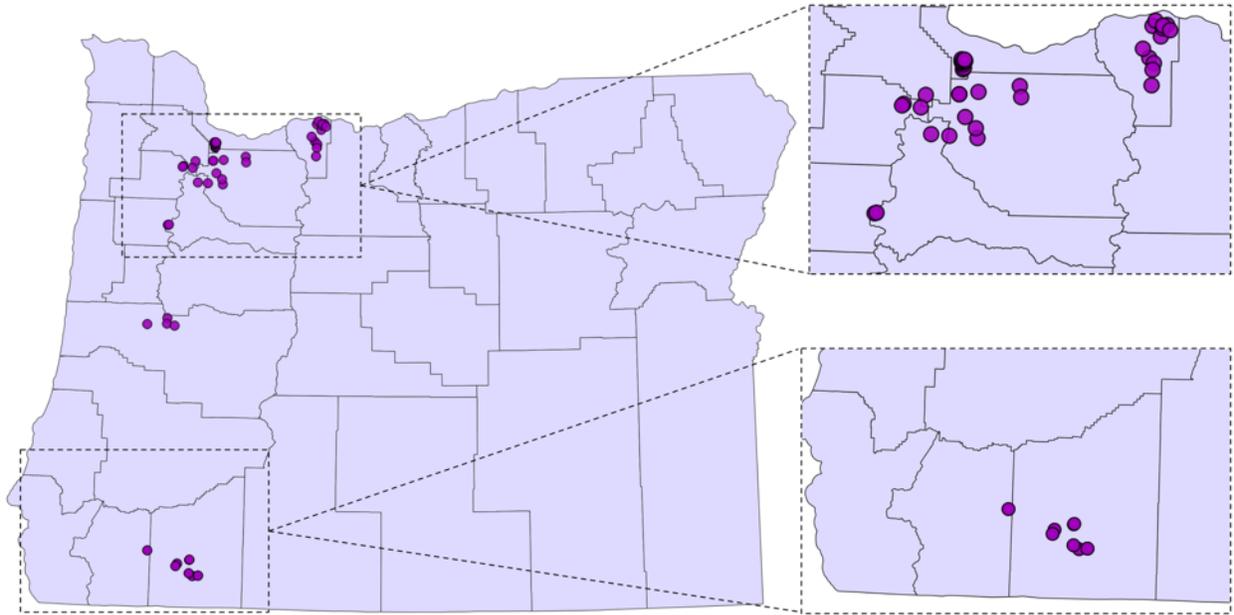


Figure 4. Sampling sites of yellow sticky cards in Oregon in Year 1.

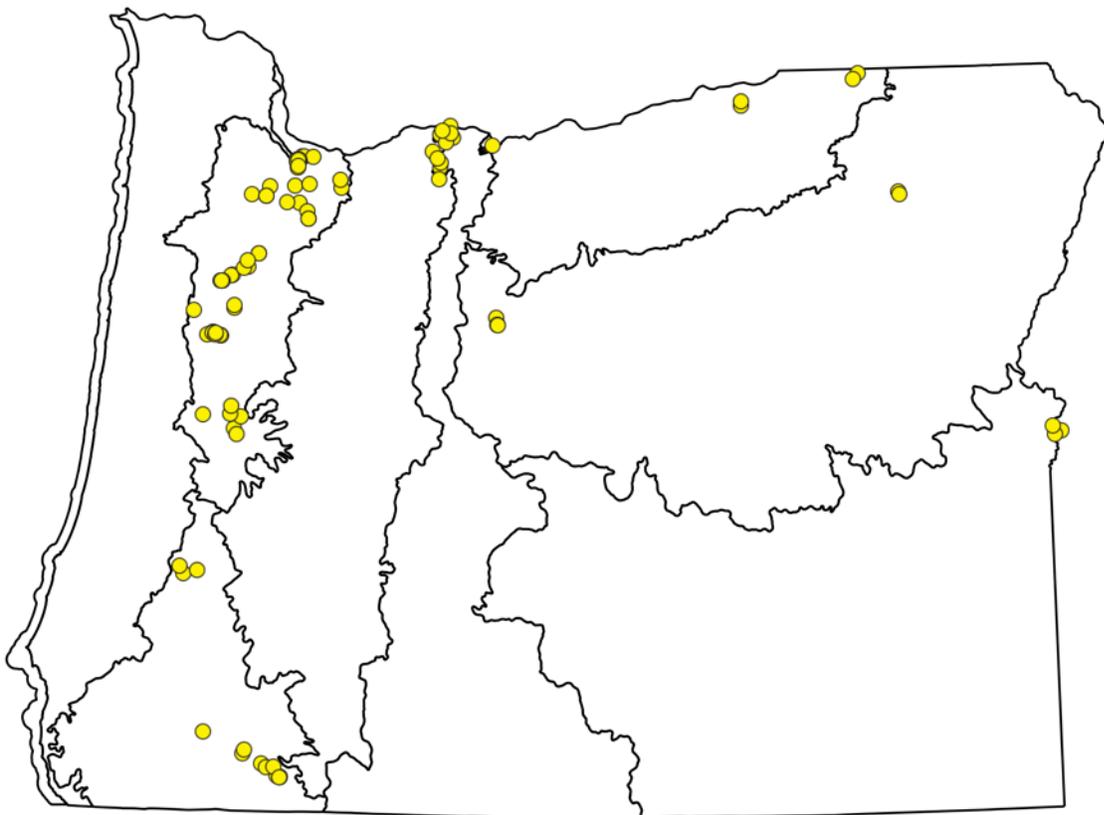


Figure 5. Sampling sites of yellow sticky cards in Oregon in Year 2.

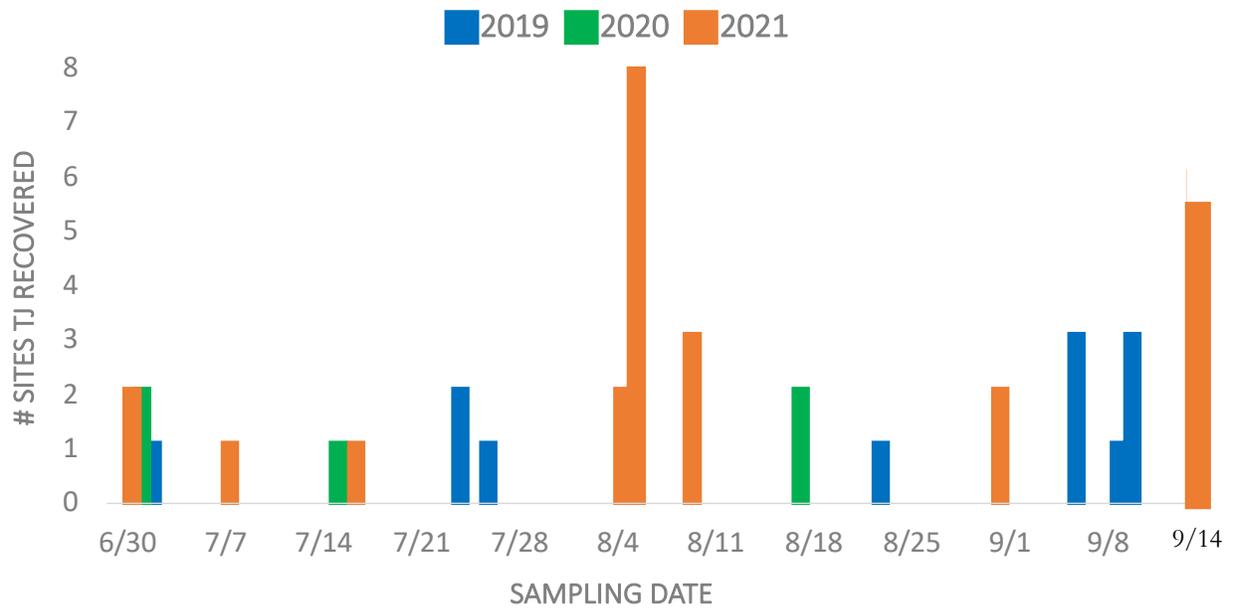


Figure 6. Sampling date of yellow sticky cards (x-axis) and number of sites samurai wasps were recovered (y-axis).