# Re-distribution of Samurai Wasp (*Trissolcus japonicus*) on Fruit Farms in Ohio

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## Abstract

The samurai wasp, *Trissolcus japonicus* (Ashmead) (Hymenoptera, Scelionidae), is a parasitoid that was first detected in Ohio from a sentinel egg sample of brown marmorated stink bug in Franklin County, August 2017. Additional detections in May 2018 were used to start a lab colony. Sentinel egg masses that were deployed at 10 fruit farms in central Ohio in June 2018 did not detect any samurai wasp, thus releases of the wasp were made at five farms, with the other five farms used as a no-release comparison. In August 2018, all 10 farms were sampled with sentinel eggs and with yellow sticky traps, and the samurai wasp was found at one release site and one no-release site. In 2019, an additional 10 fruit farms were sampled with sentinel eggs, no samurai wasps were detected, and releases were made at five of these farms with the other five farms as no-release comparisons. In August 2019 and again in July 2020, all 20 farms were sampled with sentinel eggs. Yellow sticky traps were also used for sampling in 2020. No samurai wasps were detected by either sampling method, thus we have no evidence of the parasitoid being established at the release sites, however the sentinel egg sample size was likely too small or too infrequent for adequate detection. More intensive sentinel egg mass sampling at the original site shows seasonal trends in samurai wasp detection, and the benefit of more frequent sampling.

## Background

- The brown marmorated stink bug, *Halyomorpha halys* (Hemiptera: Pentatomidae; Figure 1), has been in Ohio since 2007. It is slowly spreading across the State, and there are increasing reports of it causing injury to fruit crops (Figure 2) as well as to vegetable and grain crops.
- The most common management tactic for control of the brown marmorated stink bug (BMSB) has been application of insecticides, which is not sustainable.
- Biological control is of great interest to fruit growers.
- We have been aware of how well the samurai wasp is controlling BMSB eggs in Asia, but the USDA has not allowed this parasitoid wasp to be released in the USA.
- Since an adventive population of the samurai wasp was found in Maryland in 2014 (Talamas et al. 2015), entomologists in many States have done sampling to find out whether this parasitoid has spread to other States, and attempts are being made at its re-distribution (Kaser et al. 2019, Lowenstein et al. 2019, Hoelmer et al. 2017).
- Our initial objective in 2017 was to determine whether or not the samurai wasp could be found in Ohio.
- Once we did detect the samurai wasp in Ohio in 2017, our objectives were to survey additional sites to find out if it is present, and to attempt to re-distribute it to farms where it was not detected.

Figure 1. Adult BMSB.

Figure 2. Typical injury on apple by BMSB.

## Methods, lab colony of samurai wasp

- in 50-ml plastic tubes with fine netting over tops (Figures 3, 4), held at 12°C (57°F), 9:15 L:D
- held fed dilute honey once per week, brushed on netting
- for progeny production: in one tube, two females provided with one fresh BMSB egg mass for 1 week, held at 24°C (76°F), 16:8 L:D
- average of 12 days from egg provision until emergence of new adults

Figure 3. Samurai wasps in rearing tube.

Figure 4. The colony of samurai wasp.

## Methods, sentinel egg mass sampling

- egg masses excised from bean plants in lab colony of BMSB, and taped to cards (Figure 5)
- cards clipped to underside of leaf on trees at edge of treeline adjacent to fruit plantings
- 15-25 fresh egg masses deployed per farm
- retrieved after 72 hours
- held for 6+ weeks in lab to observe parasitoid emergence

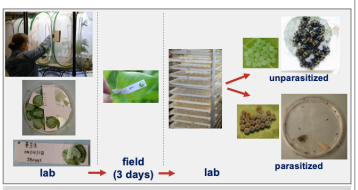


Figure 5. Sentinel egg preparation, distribution, evaluation.

## Methods, yellow sticky trap sampling

- double-sided traps from Alpha Scents (West Linn, OR)
- deployed in treeline adjacent to fruit crop (Figure 6)
- 5 traps per farm
- examined under microscope soon after retrieval from field (Figures 7, 8)

**YEAR 1: 2018**

- traps deployed at 10 farms
- deployed for 4 weeks, in July-August
- deployed between time of parasitoid release and time of re-sampling by sentinel eggs

**YEAR 2: 2019**

- 2019: none used

**YEAR 3: 2020**

- traps deployed at 20 farms
- deployed for 2 weeks
- deployed after sentinel egg mass sampling completed

Figure 6. Sticky trap clipped to branch in treeline adjacent to fruit planting.

Figure 7. Typical sticky trap after 2-week deployment.

Figure 8. Sticky traps held in lab after deployment, awaiting evaluation.

## Methods, re-distribution trial

- Based on method used by Kaser et al. (2019)
- 15 parasitized egg masses per site =~420 parasitoids
- released one day before expected adult emergence of samurai wasp
- each egg mass in mesh bag (Figure 9)
- in a 5-meter area of treeline adjacent to fruit crop (Figure 10)
- BMSB pheromone placed on stake at center of area at release and no release sites (Figure 11)

**YEAR 1: 2018**

- pre-release sampling, 10 farms, June 2018
- parasitoid release at 5 farms from 7/19 to 8/9
- no release at 5 farms
- re-sampling, 10 farms, August-September 2018

**YEAR 2: 2019**

- pre-release sampling, 10 new farms, June 2019
- parasitoid release at 5 new farms, 6/18 to 7/22
- no release at 5 new farms
- re-sampling, all 20 farms, August-September 2019

**YEAR 3: 2020**

- no releases
- re-sampling, all 20 farms, June 2020

Figure 9. Each parasitized egg mass placed in mesh bag to shield it from predators.

Figure 10. Clipping mesh bag to tree in release area.

Figure 11. Pheromone lure on stake at center of release area.

## Results

- After release in 2018, the samurai wasp was recovered from one sentinel egg mass at one release site, and on one sticky trap at one no-release site (Figure 12; Table 1).
- After release in 2019, the samurai wasp was not recovered in sentinel egg samples from any of the 10 release sites or the 10 no-release sites (Table 1).
- In 2020, neither sentinel egg samples nor sticky trap samples found the samurai wasp at any of the 10 release or the 10 no-release sites (Table 1).
- Retrieved egg masses showed the minimum number of samurai wasp emerged ranged from 101 to 379 per site, with an average of 270 for releases in 2018, and 353 for releases in 2019 (Table 2). This is considered to be a high release rate.
- Parasitoid species found, other than *T. japonicus*, were: *Anastatus mirabilis*, *Anastatus pearsalli*, *Anastatus reduvii*, *Telenomus persimilis*, *Telenomus podisi*, *Trissolcus brochymenae*, *Trissolcus euschisti*.
- At the research farm where the samurai wasp was initially detected, sentinel egg samples resulted in positive finds of the samurai wasp each year (Table 1).
- Seasonal trends in detection of the samurai wasp at the research farm in 2020 (Figure 13A) show that this species was found from late May through late August, even in small sample sizes (3-8 egg masses per day). Sampling at the commercial farm during the same time and in larger sample sizes did not result in any detections of the samurai wasp (Figure 13B).

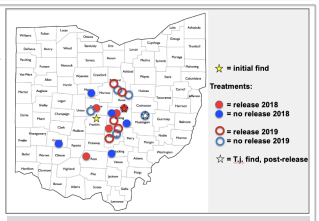


Figure 12. Map of Ohio locations used for re-distribution trial, marked with positive finds of samurai wasp.

**Table 1. Parasitism of sentinel egg masses on Ohio fruit farms, 2017-2020.**

| Year | # sites | # egg masses | # egg masses with parasitoids emerged | |
|---|---|---|---|---|
| | | | any species | *T. japonicus* |
| Commercial farms: | | | | |
| 2017 | 3 | 113 | 12 (10.6%) | 0 |
| 2018 | 10 | 333 | 5 (1.5%) | 1 (0.3%) |
| 2019 | 20 | 692 | 32 (4.6%) | 0 |
| 2020 | 20 | 469 | 18 (3.8%) | 0 |
| Research farm: | | | | |
| 2017 | 1 | 505 | 24 (4.8%) | 2 (0.4%) |
| 2018 | 1 | 489 | 42 (8.6%) | 31 (6.3%) |
| 2019 | 1 | 512 | 21 (4.1%) | 7 (1.4%) |
| 2020 | 1 | 680 | 70 (10.3%) | 41 (6.0%) |

**Table 2. Emergence of the samurai wasp in retrieved egg masses (EM) in Ohio re-distribution trials.**

| year | site | deploy date | # EM deploy | # EM retrieve | % emerge | min # emerged |
|---|---|---|---|---|---|---|
| 2018 | WH | 7/19 | 15 | 14 | 92 | 343 |
| 2018 | Br | 7/19 | 15 | 14 | 97 | 365 |
| 2018 | Ba | 7/27 | 15 | 15 | 69 | 260 |
| 2018 | St | 7/27 | 15 | 12 | 34 | 101 |
| 2018 | Hi | 8/9 | 15 | 14 | 79 | 279 |
| | mean | | | | 74 | 270 |
| 2019 | Hu | 6/18 | 15 | 15 | 88 | 371 |
| 2019 | GH | 6/20 | 15 | 15 | 88 | 358 |
| 2019 | AH | 6/20 | 15 | 15 | 68 | 287 |
| 2019 | Ly | 7/22 | 15 | 15 | 94 | 379 |
| 2019 | Ro | 7/22 | 15 | 15 | 89 | 369 |
| | mean | | | | 85 | 353 |

## Discussion

- We could not confirm establishment of a samurai wasp population at the 10 farms where a release was made.
- Inadequate sample size or incorrect time of the season could explain why the samurai wasp was not detected at sites where a release was made, but trends at the research farm in 2020 suggest that our sample size and timing were adequate for a site where this species is present.
- An inadequate population of the host, brown marmorated stink bug, at the commercial farms could have contributed to lack of success in re-distribution.
- We are hopeful that the samurai wasp will continue to spread on its own!

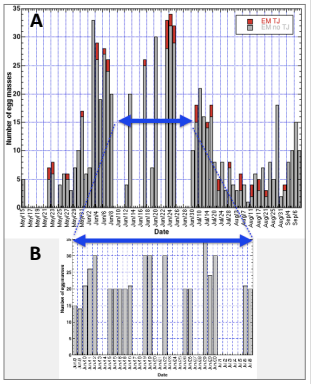


Figure 13. Seasonal distribution of sentinel egg masses (EM) at Ohio sites, 2020, gray bars showing negative for samurai wasp, red bars showing positive for samurai wasp, A) at the Franklin County site where the samurai wasp was first detected in 2017, and B) at 20 farms used for re-distribution trial.

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## Acknowledgements

Greatly appreciated is permission for farm use by 20 fruit growers, technical assistance from Becca Welsh, Ariel Fisher, Cecilia Stone, Brittany Heigley, Vashti Tatman, Brooke Friend, and Madeline Fox, and funding from USDA-NIFA-SCRI Project: Management of Brown Marmorated Stink Bug in US Specialty Crops, grant # 2016-51181-25409, and USDA NIFA EIP, grant # 2017-70006-27174.