Wisconsin Fruit News

Insect Pest Supplemental – Feb 2, 2018

In This Issue:

Here is a summary of the insect pest monitoring and research projects that were conducted at the Guédot lab during the summer of 2017. For each pest, we have summarized our findings from last year, as well as looking forward toward projects we will begin this coming spring.

We hope you find it interesting, and do not hesitate to contact us if you have further questions or are interested in collaborating with us on projects in the future!

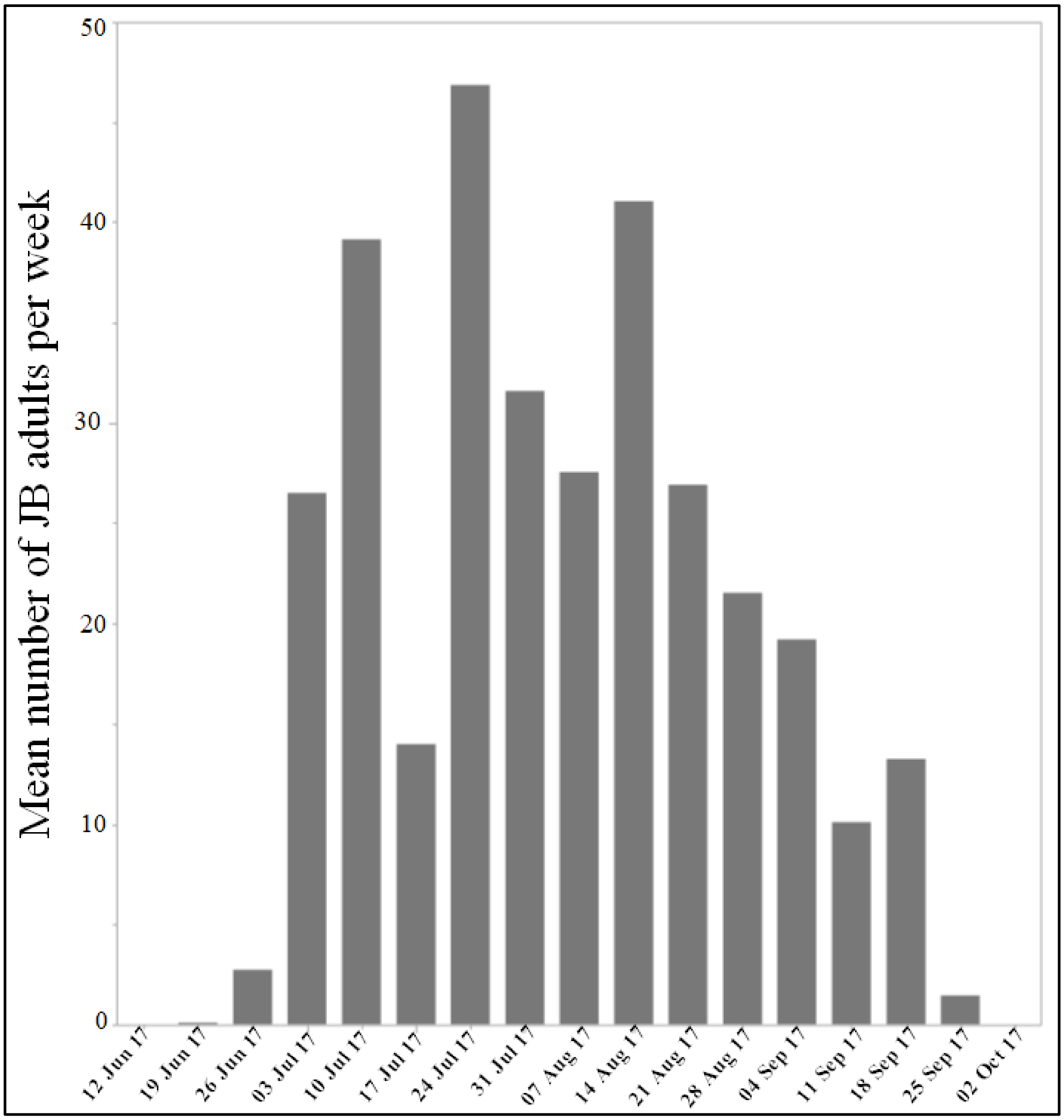
Japanese Beetles - Seasonal phenology and spatial distribution in vineyards

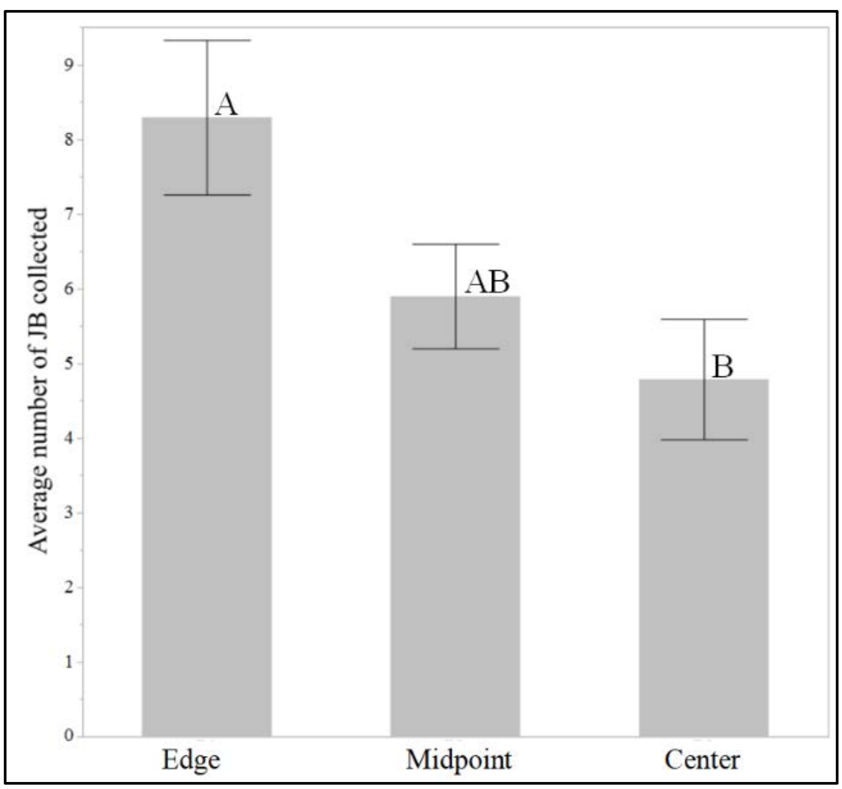
By: Jacob Henden and Christelle Guédot, UW- Madison Department of Entomology

Japanese beetles feeding on grape leaves. Photo by Jeff Hahn, University of Minnesota

The Japanese beetle (JB) is an invasive insect that feeds on over 300 species of plants. Within the last decade, JB has become a significant pest for grape growers in Wisconsin. Grape plants are a preferred source of food for adult JB, and it is common to see large aggregations of JB defoliating canopies within vineyards. Additionally, turfgrass often utilized as groundcover between grape rows are highly suitable for JB females laying eggs. Monitoring for JB can be done by visually inspecting plants. JB adults are most active during mid-morning to late afternoon (around 10:00AM-3:00PM). The JB adults are about 1cm in length, have metallic green bodies, and coppery brown elytra (outer wings). Information on JB control methods and available insecticides can be found in Volume II Issue 8 of this newsletter.

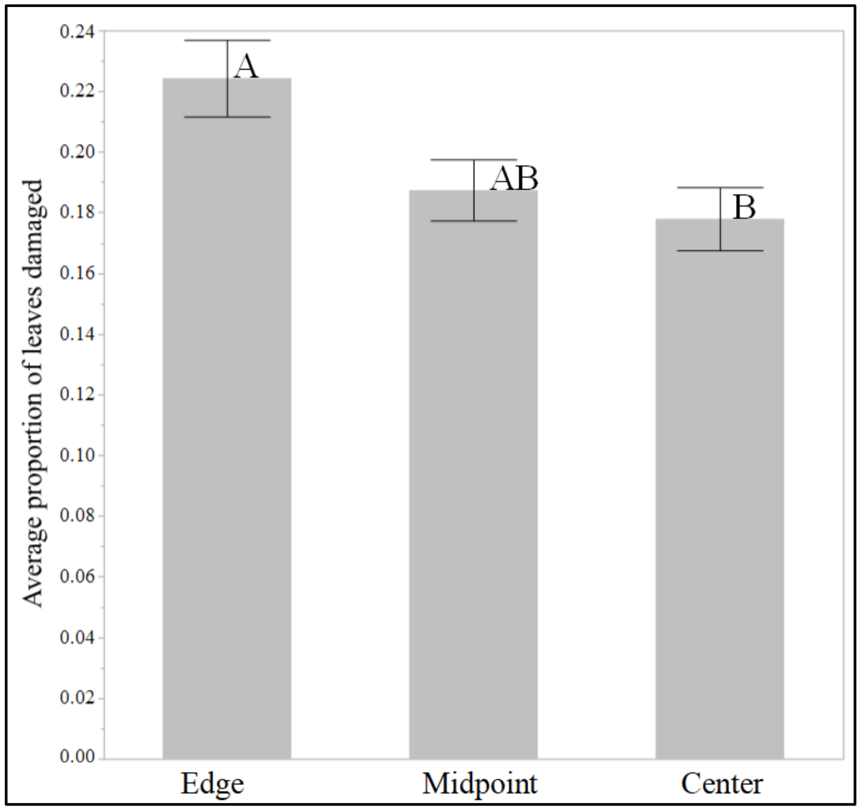
During the summer of 2017 we sampled for JB at 20 vineyards across Southern Wisconsin. At each vineyard we set up transects and collected JB adults at 3 sampling points: at the edge of the field, halfway from the edge to the center, and at the center of the field. We sampled each of the vineyards weekly from June 12th to October 2nd. The earliest we observed JB adults was on June 21st, and the latest we saw JB adults was on September 25th. The highest abundance of JB adults was observed during late July into early August. A graph of the average number of adult beetles collected per vineyard during each week of the study is shown below.





There was a higher average abundance of adult JB on the edge of vineyards compared to the center, with a significantly higher average number of JB adults collected at the edge of the transects compared to the center (n=340; F=4.3522; P=0.0131). A graph of the average number of JB adults collected at each of the transect points is shown below (different letter signify significant differences between groups).

In addition to sampling for JB, we also assessed the proportion of leaves damaged at each sampling point. This assessment was done by counting up to 40 leaves on a grape vine and counting any leaf that appeared to have 10% or more area lost to feeding as damaged. We alternated vines used for this assessment on a weekly basis. We found a similar pattern, with a significantly higher amount of leaf damage observed at the edge compared to the center (n=279; F=4.8527; P=0.008). A graph of the average proportion of grape leaves damaged at each of the sampling points is shown below (different letter signify significant differences between groups).



Our results suggest that JB are not evenly distributed throughout vineyards, but that there is an edge effect for density, with higher abundances of JB adults on the edges of fields. Additionally, our results show that the damage caused by JB feeding on leaves follows the same pattern. This is consistent with previous research that found a similar distribution pattern for JB adults in soybean fields (Sara et al., 2013). Monitoring for JB adult populations in vineyards should focus on vineyard edges, where most JB adults were found in our study. When using insecticides to manage populations of JB adults in vineyards, grape growers may consider spraying edge rows to reduce inputs, while keeping track of populations inside blocks.
Again, more information on JB control methods and available insecticides can be found in Volume II Issue 8 of this newsletter.

Social wasps in Wisconsin vineyards

By: Abby Lois and Christelle Guédot, UW- Madison Department of Entomology and Extension

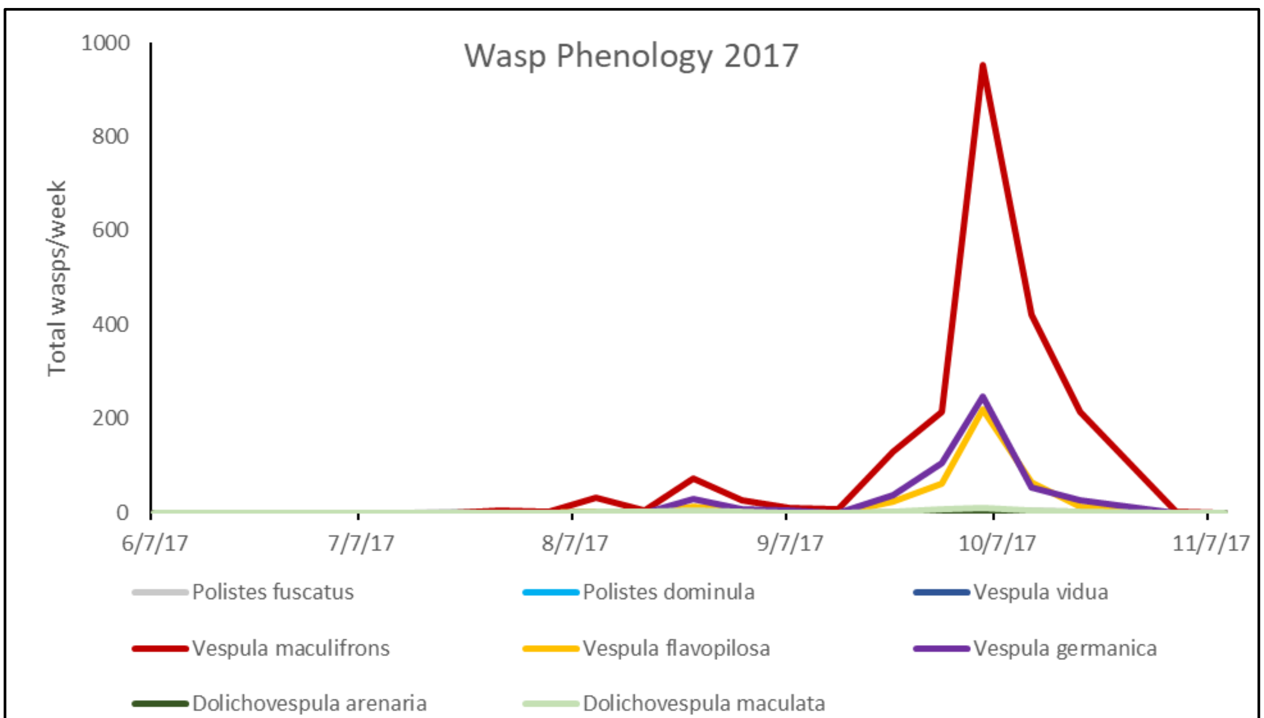
As discussed previously in this newsletter, the consequences of social wasp populations in vineyards can be both positive and negative, making them a difficult group of insects for growers to manage. Due to the life history of wasps, the results of their impact depends widely on the species composition present, as foraging habits, the general size of the population, and when peak activity occurs throughout the growing season varies by species. In order to develop a better management system, it is first critical to fully understand the relative threat occurring in Wisconsin vineyards, with a logistical focus on South Central Wisconsin. Since little research has been done in this geographic area and growing system, we performed a replicated study in 2015 and 2017 to determine which social wasp species represent the largest populations in vineyards and how wasp populations fluctuate throughout the season or from year to year.

Wasp populations were tracked using Dommit traps, a trap that can be attached to a fruiting trellis and contains a lure with a chemical wasp attractant. These traps allow a wasp to fly up a funneled hole in the bottom of the trap to pursue the lure, but prevent the wasps from exiting, leaving them stuck in a drowning solution. We collected these solutions once a week from June through harvest in 2015, and from June to November in 2017 in multiple vineyards in South Central Wisconsin. Our results from both seasons showed that wasp population numbers fluctuate seasonally and yearly, but also illustrate that certain wasp species represent a consistent threat from year to year and spatially across all vineyards.

In both 2015 and 2017, we found that social wasps from the genus *Vespula* (yellow jackets), were the most prevalent in vineyards, *Polistes* was recorded in minimal numbers, and other genera were rare or nonexistent. In both seasons, general wasp population numbers remained low in June and July and started to rise in late August, with the exception of the species *V. vidua*. The species composition suggests that the seasonal rise in numbers can be attributed both to a natural rise in population numbers throughout the season, and an increased attraction to vineyards as wasps are foraging for sugar sources. Social wasps follow an annual life cycle in which overwintering mated queens start a new nest in the early spring and the larvae in the hive depend on protein rich sources, like beetle grubs, aphids, flies, etcetera. The number of foraging workers is low and wasps pose little threat to the fruiting area of vineyards as grubs and other protein rich sources are often concentrated on the lower level of vineyards or in nearby areas. In fact, during this time in June and July, presence of wasps is most likely beneficial for lowering population levels of other pestiferous species in vineyards. However, foraging habits of the workers change in late summer after most larvae have become adults and the large population starts scavenging for high sugar sources upon which to feed themselves. Vespula becomes highly attracted to fruiting vineyards and, by extension, our fermenting fruit volatile lures.

A commercially available Dommit wasp trap. Photo by Katy Hietala-Henschell.

Within the genus *Vespula*, *V. maculifrons* posed the largest threat in both seasons, with a total of 762 in 2015, and over 2098 individuals caught in 2017. In 2015, *V. vidua*, *V. flavopilosa,* and *V. germanica* followed as the next largest populations, with 632, 362, and 206 individuals respectively. The only species that did not peak during the late September harvest in 2015, was *V. vidua*, which appeared to peak in late July and early August. In 2017, *V. germanica* and *V. flavopilosa* were once again recorded at high numbers with 508 and 401 respectively, but *V. vidua* showed a dramatic reduction across all vineyards surveyed, with a total of 22 specimens. This population change may be due to annual or biannual fluctuations in population size which have been recorded in other wasp species like *V. vulgaris.* Information about what causes such cyclic population differences is largely undocumented, but is most likely a combination of both abiotic and biotic factors.



The large seasonal difference in catches in the other three major species, *V. maculifrons*, *V. germanica* and *V. flavopilosa,* is likely due to changes in the trapping period between the seasons. In 2015, the peak week occurred during harvest and trapping concluded directly after harvest finished in late September, whereas, the 2017 season extended until no more wasps were detected in early November. A comparison of both seasons suggests that populations around harvest were similar, and therefore, it is likely that the 2015 population may have continued to rise. Trap populations in the extended 2017 season peaked the first week of October, right after harvest occurred. This indicates that wasps may be feeding on discarded berries left behind during harvest. This trend was especially true for populations of *V. maculifrons* which more than tripled in size right after harvest. This result indicates that taking the time to remove any discarded fruit from the vineyard may be beneficial, especially in cases where vineyards are located in close proximity to houses, where stinging continues to be a large risk even after visitors and employees leave.

Aggregation of wasps.

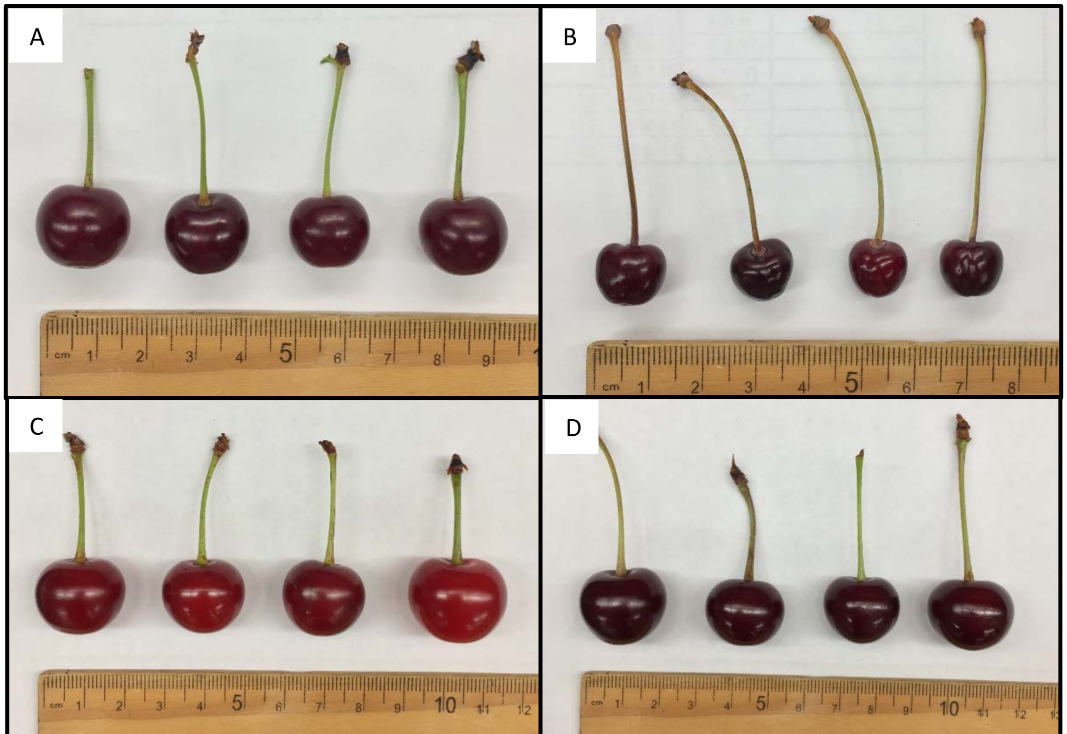
The results of this study also showed that seasonal and annual population fluctuations will pose an additional challenge for management. In both seasons, the foraging habits of wasp workers, allowed for quick explosions in the population. This can make it difficult for growers to target wasps because a vineyard that appears to have no wasp population problem early in the season or in previous years can become suddenly overwhelmed at harvest. Documented annual fluctuation patterns may further perpetuate this deception problem making it difficult for growers to implement a management program from year to year. We suggest that traps may likely be the most effective management tool, because they can be deployed as soon as a problem comes to fruition (pun intended).

The relative size and temporal rise of a harvest population documented in this study illustrates that managing *Vespula* will be important for Wisconsin vineyards going into the future. Developing better management strategies for social wasps is important since current recommendations for managing wasps are limited. Insecticides for wasps are not currently available in Wisconsin, and populations coincide with the pre-harvest interval. In addition, natural enemies of *Vespula* do not provide adequate biological control, and locating/destroying *Vespula* nests is often difficult, poses a stringing threat, and is generally not cost effective for growers. Therefore, over the next couple of years, our lab will be following up this project with studies focusing on two major management questions: 1) are the four most prevalent *Vespula* species primary or secondary pests of table and wine grapes, and if they are, what are the factors (e.g., previous damage, skin thickness, sugar content) that make certain cultivars more susceptible than others; 2) what chemical volatile combinations for traps are most attractive and repellent to wasps, to implement a push-pull strategy that targets *Vespula* within vineyards safely and effectively.

Impact of spotted-wing drosophila on different varieties of tart cherry

By: Matt Kamiyama and Christelle Guédot, UW – Madison Entomology and Extension

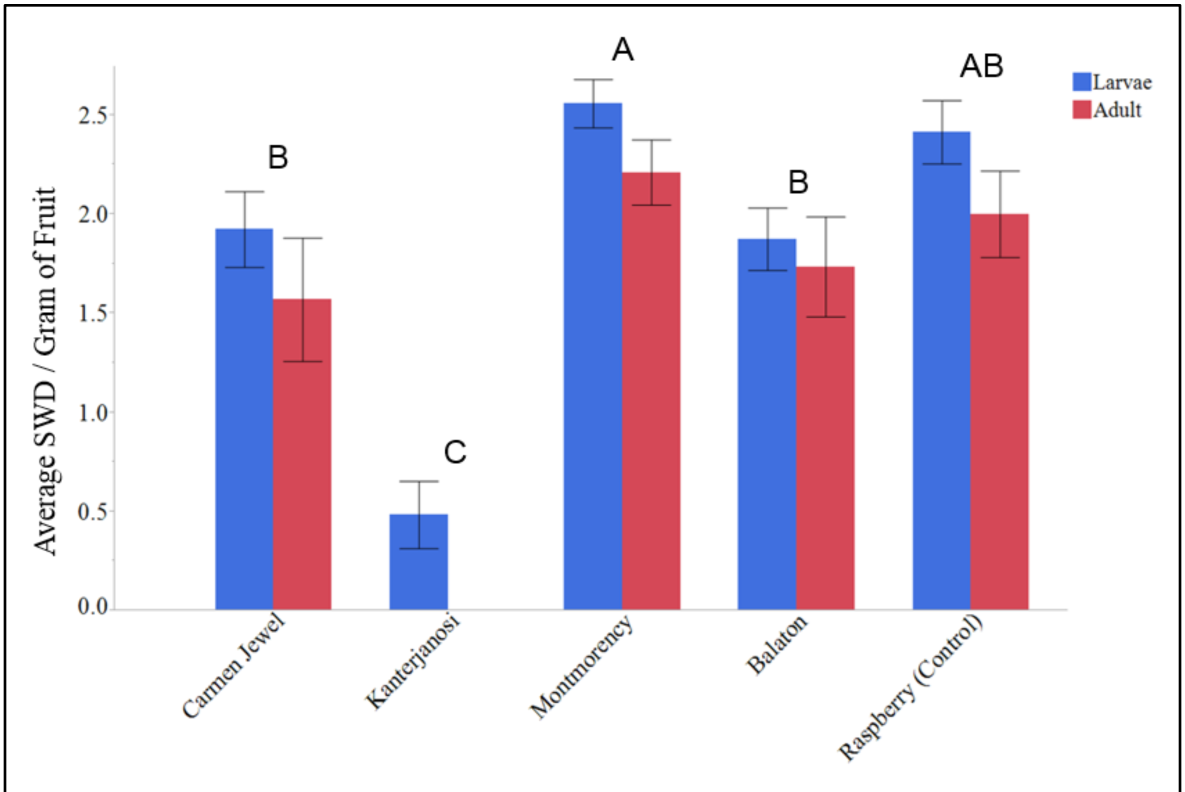
In July 2017, the Guédot Fruit Crop Entomology Lab at UW – Madison conducted a study to determine the susceptibility of Wisconsin tart cherries to spotted wing drosophila (SWD). This study is important as Wisconsin was the fourth highest tart cherry producing state in terms of total production in 2016 (USDA, 2017). The four varieties of tart cherry that were implemented in this assay were: Carmine Jewel, Kantorjanosi, Montmorency, and Balaton. Carmine Jewel is a dwarf Canadian hybrid cultivar which became commercially popular in the US in the early 2000's. Kantorjanosi is a cherry native to Hungary, and is scarcely cultivated in the US. Montmorency cherries are the most common cultivar grown in Wisconsin, constituting about 80% of the state's total tart cherry production. Lastly Balaton is another, more popular variety from Hungary known for its dark burgundy colored flesh. This experiment was conducted to determine which tart cherry varieties and at what ripening stage the different cultivars are most susceptible to SWD.



Four cultivars of ripe tart cherries used for lab assays: Carmine Jewel (A), Kantorjanosi (B), Montmorency (C), and Balaton (D).

The four tart cherry cultivars were tested at three different developmental stages (straw, ripening, and ripe). Four freshly picked cherries of the same variety and developmental stage were placed in a deli container and exposed to five male and five female SWD for a period of 48 hours. Six days following the removal of the SWD, two cherries were destructively sampled to determine how many larvae were present per cherry. The other two cherries were kept to rear SWD to adulthood. Control tests were run similarly simultaneously using four ripe raspberries. Lab assay data is presented in the figure below.

The following varieties not connected by the same letter are significantly different from each other ($F = 35.5$; df: 4,99; $P < 0.001$, Tukey's HSD test, $P < 0.05$). Montmorency (A), Raspberry Control (AB), Balaton (B), Carmine Jewel (B), Kanterjanosi (C). Our results suggest that in the ripe stage of development, Montmorency had the highest susceptibility to SWD, followed by Carmine Jewel and Balaton which had relatively similar susceptibility rates. Kantorjanosi had the lowest susceptibility of any cultivar. The Kantorjanosi used for the lab assays were collected post-harvest which may have accounted for the lower infestation rates. The results from this study illustrate the possibility that other, less susceptible varieties of tart cherry to SWD may be implemented in future tart cherry breeding programs and later introduced to markets in the tree fruit industry.



Average number (±SEM) of larva and adult SWD per gram of fruit.

Brown marmorated stink bug in 2017: end-of-season update

By: Janet van Zoeren and Christelle Guédot

The invasive brown marmorated stink bug (BMSB) has been seen in urban areas of Wisconsin since 2010, and has been trapped in agricultural crops in the state since 2016. So far, damage due to BMSB seems to be at relatively low levels, if any; however, there is a potential for increasing populations in coming years to cause significant economic losses in apple, soy and corn, as well as affecting other fruit, vegetable and forage crops in Wisconsin. In this article, we will provide a summary of our summer's findings from projects monitoring the phenology and habitat preferences of BMSB, and researching alternative trap design effectiveness. We will also briefly discuss some other new research pertaining to BMSB management, and our recommendations for fruit growers in Wisconsin for coming years.

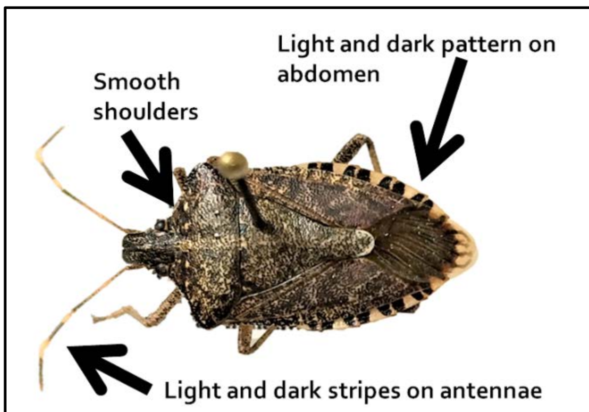


Figure 1: Brown marmorated stink bug adult, showing key identifying characteristics to distinguish BMSB from other similar-looking stink bugs.

BMSB Basics:

There are many resources available if you would like to learn the basics of BMSB identification, damage symptoms, monitoring and control. Please see the following online resources for more information.

Brown marmorated stink bug: An invasive insect pest (A4143). Guédot and van Zoeren. 2017. Available online at: https://learningstore.uwex.edu/Brown-Marmorated-Stink-Bug-An-Invasive-Insect-Pest-P1863.aspx

StopBMSB website. Access online at :http://www.stopbmsb.org/

WisContext series on BMSB. Access online at: https://www.wiscontext.org/brown-marmorated-stink-bug

BMSB phenology and habitat preferences: In the 2017 growing season, similarly to 2016, we continued monitoring BMSB in four habitats: urban, woodland, apple, and an alternate crop (either pumpkin or corn). Our average trap catches from these four habitats are presented in Figure 2 below.

In 2017, BMSB was caught much earlier in the season in urban areas than in the other habitats. BMSB was first trapped in an urban area on June 7th, and numbers in urban traps peaked in late-September with the highest trap-catch of 63 BMSB (including adults and nymphs) in a single trap! By around October, once urban trap catch numbers began decreasing, numbers began increasing in the apple and alternate crop traps. In 2017, the peak apple trap catch was on Oct 18th, with nine BMSB in a single trap in one orchard. This is surprisingly similar to 2016's peak apple trap catch, which was on Oct 20th. The last BMSB trapped in 2017 was on Nov 8th.

Very few BMSB have been caught in the woods trap – none were caught in 2016 and only one in 2017.

We cannot directly compare between this year and last year, because we used a different lure system. Specifically, in 2017 we used a dual lure system in each trap, consisting of both a BMSB and a green stink bug lure, with the goal of catching more early-season BMSB (which seem to be more attracted to the green stink bug lure). In fact, we did catch BMSB significantly earlier in 2017 than in 2016, and we would recommend using the dual lure system to monitor in your orchard.

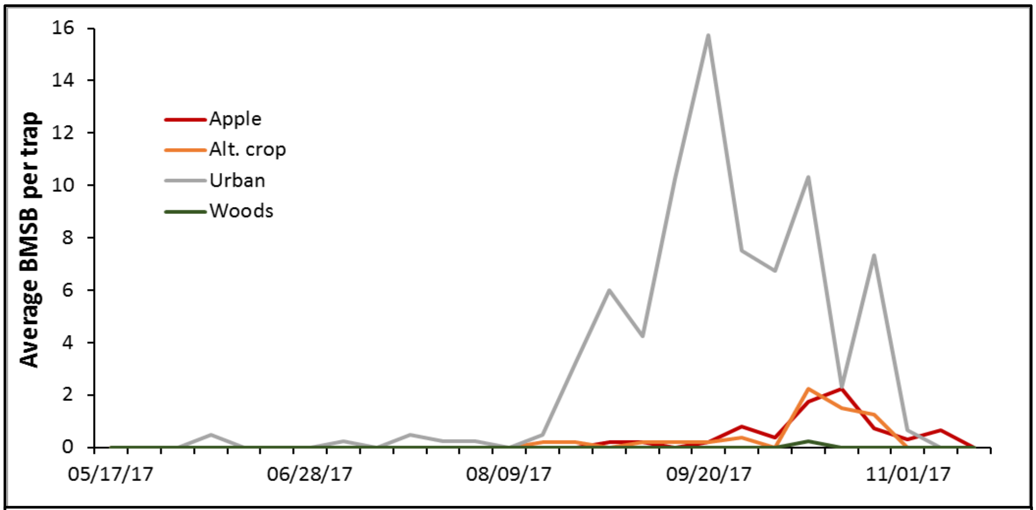


Figure 2: Brown marmorated stink bugs trapped in black pyramid traps during the growing season of 2017 in four different habitat types (red=in an apple orchard, orange=near a corn or pumpkin patch, gray=in an urban backyard, green=in a woodlot near the farm).

We'd like to thank the Wisconsin Apple Growers Association for partially funding this project, our collaborators at the IPM Institute and DATCP, and Sara Woody and Matt Kamiyama for servicing traps.

Trap comparison study: In addition to looking at habitat preferences of BMSB, we also collaborated on a multi-state investigation looking at an alternative trap design, in hopes of being better able to monitor BMSB populations, especially early in the season. We compared the black pyramid traps (which we have been using the past few years in the habitat/phenology study, Figure 4a) to a clear sticky panel trap design (Figure 4b). Sticky traps caught significantly more BMSB throughout the season, and did show a trend toward earlier-season trap catches (Figure 5).

It is too early at this time for us to make a recommendation regarding the use of the sticky or the pyramid trap, and your decision may also depend on whether you already own a pyramid trap , and the time and money you have available for monitoring BMSB. The pyramid trap represents a higher initial investment (approximately $30 for a pyramid trap for the first year, compared to approximately $15 for the sticky traps); however, the sticky traps will need to be purchased every year, whereas the pyramid traps are likely to last at least 2 to 3 years. It also took longer initially to set up the black pyramid traps, but then took slightly longer to check and replace sticky traps throughout the season.

Figure 4: BMSB trap designs: black pyramid trap (a) and clear sticky panel trap (b).

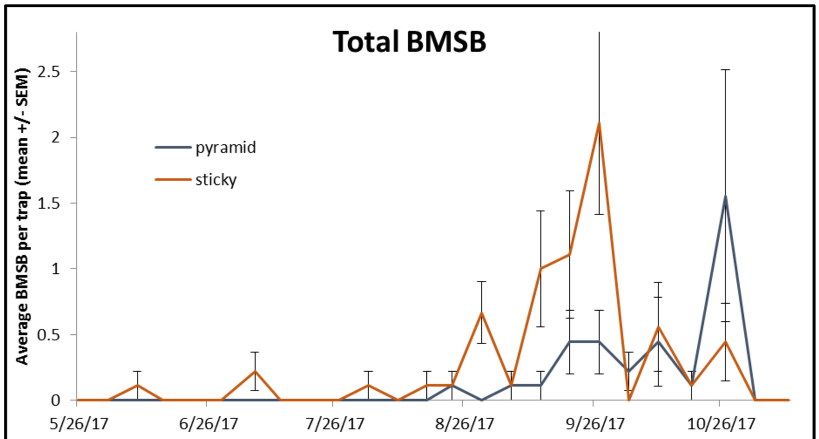


Figure 5: Brown marmorated stink bugs trapped in black pyramid (gray) and clear sticky panel (orange) traps during the growing sesaon of 2017.

Distribution: BMSB has been confirmed in 20 counties in Wisconsin. This includes six new counties that were confirmed during the summer of 2016, which expands the range north and west from the Madison/Milwaukee area (Figure 3).

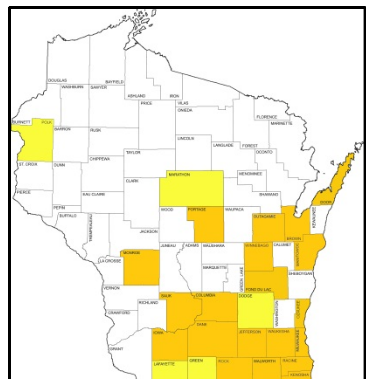


Figure 3: Counties in Wisconsin where BMSB has been confirmed (orange), or is suspected (yellow).

Moving forward: BMSB is certainly established in Wisconsin, and continues to expand away from the more urban areas and into agricultural crops. Luckily, a lot of recent and upcoming research across the United States has focused on developing better monitoring trap designs and control methods for BMSB.

One monitoring and control method being investigated at Penn State and Michigan State University is called a "ghost trap", which consists of the dual lures inside a black mesh, which has been infused with a pyrethroid insecticide. The idea for the ghost trap, which is not yet commercially available, is that the bugs do not need to be trapped inside a canister to be killed, because contact with the mesh should cause mortality. However, a disadvantage is that bugs may not stay in or around the trap area, making it less accurate of a monitoring tool.

Recent BMSB biocontrol research has focused in two directions: on classical biocontrol (identifying potential parasitoids from the original range of BMSB, to release in the United States) and augmentative/conservation (finding ways to boost the biocontrol potential of native US predators). A survey in Michigan found low rates of native predation on BMSB (Poley 2017). However, biocontrol as a control strategy for BMSB is likely to increase in importance in coming years; biocontrol tends to be especially important for pests like BMSB and spotted wing drosophila because they are prevalent in the woods and non-crop landscapes, so you cannot control all individuals in the population with an insecticide spray. We hope to conduct a preliminary survey of baseline predation and parasitism rates of BMSB in Wisconsin this coming summer of 2018, in order to be able to determine what steps are needed to improve biocontrol here in future years.

In the meantime, in coming years as BMSB numbers increase, some growers may reach a point where they consider spraying to control BMSB. The first step is knowing when an orchard has reached the economic threshold, at which point a spray may be warranted. Research on the East coast supports a threshold of spraying whenever any single trap in the orchard reaches a cumulative season-total of 10 adult BMSB in a trap with the dual lure system (Short et al. 2017). Once the threshold of 10 has been reached, an insecticide is applied, and accumulation begins again at zero. Based on this threshold, we would have recommended spraying twice late in the season in one of the orchards where we monitored, and would not have recommended any control at the other orchards.

Because BMSB prefer edges of orchards and fields, if an insecticide is necessary, by spraying only to the outer few rows (perimeter spray) you can still maintain approximately 85% of the effectiveness of an insecticide applied throughout the crop. To make the spray even more effective, a pheromone-baited lure can be placed approximately every 20 feet along the edge of the crop or in a neighboring trap crop, increasing the likelihood of BMSB to settle along this edge, where you would then spray. The most effective insecticides for BMSB at this point include pyrethroids, carbamates, and neonicotinoids.

For more information:

Poley, KR. 2017. Biological Control of *Halyomorpha halys* (Hemiptera: Pentatomidae) Using Native Natural Enemies in Michigan. MS Thesis, Michigan State University. Available online at: https://d.lib.msu.edu/etd/4672

Short, BD, Khrimian, A and Leskey, TC. 2017. Pheromone-based decision support tools for management of *Halyomorpha halys* in apple orchards: development of a trap-based treatment threshold Journal of Pest Science (90). pp 1191-1204. Available online at: https://doi.org/10.1007/s10340-016-0812-1

Calendar of Events

UPCOMING EVENTS:

Mar 16, 2018 – Organic Apple Growing Class
9 am – 3:30 pm. Michael Fields Agricultural Institute, W2493 Country Rd ES, East Troy, WI

Mar 16-18, 2018 – Midwest School for Beginning Apple Growers
9 am – 4:30 pm. University of Wisconsin, Madison, WI

Edited by: Christelle Guédot, Entomology Specialist, UW-Madison and Amaya Atucha, Horticulture Specialist, UW-Madison. *Formatting by:* Janet van Zoeren, Fruit Crops Extension Associate, UW-Extension. Articles provided by other sources as attributed. Funding provided by the University of Wisconsin-Extension.
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