

Michigan Grape & Wine Industry Council
2014 Research Report

**Biology and management of invasive insect pests
in Michigan vineyards 2014**

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ABSTRACT

At twenty vineyards across Michigan, pheromone traps were used to monitor for European grapevine moth, light brown apple moth and the summer fruit tortrix, and none of these moths were detected. SWD and African fig fruit fly were monitored with baited traps. Spotted wing drosophila was found in traps at all vineyards and detections were earlier in the southern portion of the state. The highest levels of SWD populations in all regions occurred during grape harvest. No fig fruit flies were detected in our traps in 2014 and no brown marmorated stink bugs were found at any of the twenty focal vineyards. Our data suggest that early ripening red varieties may be the most susceptible to SWD infestation, but infestation by other vinegar flies (*Drosophila* species) did not show any trends among grape varieties. There was a significant positive relationship between the number of fruit flies that emerged and the severity of sour rot.

GOALS AND OBJECTIVES

In recent years, European grapevine moth and light brown apple moth have been detected in California vineyards. Both of these pests are damaging to grapevines, and so a detection program has been established to support monitoring for these pests at 20 vineyard sites in SW and NW Michigan. In addition monitoring for the summer fruit tortrix (a Eurasian pest of primarily tree fruit) is also part of this effort. This project includes research with a more detailed focus on spotted wing *Drosophila*, because it has now been found in all major fruit production regions of the state. The research described below is helping us to assess the link between SWD infestation and fruit quality. Finally, we will continue to monitor for brown marmorated stink bug to assess its activity in Michigan vineyards. This project will ensure that Michigan grape growers have the information needed to be prepared for these invasive insect pests, and have information to address spotted wing *Drosophila* and other vinegar flies as potential sources of cluster rot problems at harvest-time.

Objectives

Objective 1. Monitor Michigan vineyards for invasive insect pests.

Objective 2. Assess Michigan-grown grape cultivars for their susceptibility to SWD.

Objective 3. Determine the performance of different management approaches to minimize vinegar fly and sour rot infestation.

PROJECT PERIOD

This project was conducted during 2014, with field work occurring from May to October.

This report summarizes the first year of a project that focuses on the invasive insect species threatening the Michigan grape industry. Whether these pests are yet to arrive, present in Michigan at low levels, or here in abundance, we need to learn about their biology, management, and economic impact. The project is also linked to ongoing projects in the Isaacs Lab that are addressing spotted wing *Drosophila* (SWD) in blueberry and raspberry, and to a CAPS project on monitoring for invasive grape pests. However, that project only has funding sufficient for sampling every 2 weeks, for part of the season, and in a restricted number of locations. There is research underway currently in Virginia, New Jersey, and Minnesota on SWD in grapes but their cultivars, climate, and management practices are different. This project is the primary effort on this topic within the Great Lakes region.

WORK ACCOMPLISHED DURING THE PERIOD

Objective 1. Monitor Michigan vineyards for invasive insect pests.

Twenty vineyards across the grape production regions of Michigan were selected and monitored for the following exotic pests: European grapevine moth, *Lobesia botrana*; Light brown apple moth, *Epiphyas posivittana* and summer fruit tortrix, *Adoxophyes orana*, spotted wing *Drosophila*, *Drosophila suzukii*, the African fig fruit fly, *Zaprionus indianus* and brown marmorated stink bug, *Halyomorpha halys*. Thirteen of the monitored vineyards produce juice grapes and wine grapes are grown at seven vineyards. The vineyards were located in the following counties: Ingham (1), Ionia (1), Berrien (5), Van Buren (5), Allegan (3), Antrim, (1), Benzie (1), Grand Traverse (1) and Leelanau (2). At each vineyard, one sex pheromone baited delta trap for each of the moth species *L. botrana*, *E. posivittana*, and *A. orana* were hung on the trellis on the border of the vineyard facing a woodlot. A bucket trap made from a 32 oz clear plastic deli cup containing a 2x3 in yellow sticky card and baited with apple cider vinegar and a fruit fly lure (Trece Inc.) was also hung at the vineyard border to monitor for SWD. In vineyards in southwest and mid-Michigan, traps were set between May 12th and May 30th, in vineyards in northwest Michigan traps were set between May 29th and June 2nd. Traps were set during different time spans to account for differences in seasonal development of vineyards and pests between regions. Moth traps were checked each week for 12 weeks from May through August, and lures and traps were changed every three to six weeks depending on the species. Any insects that were suspected to be the exotic moth species mentioned above were removed from the trap and returned to the lab for examination under magnification.

Suspect moths were not captured at any of the monitored vineyards in 2014. In late May and early June, at several locations in southwest Michigan, the *Adoxophyes orana* traps consistently attracted a contaminant moth, *Croesia semipurpurana*, the oak leaf tier. In late June and early July a moth similar in appearance to *A. orana* was captured in more than half of the traps for that species in southwest Michigan. Samples of this moth were sent previously to John Brown

USDA-Beltsville Systematic Entomology Lab, and it was identified as *Pandemis limitata*, the three-lined leafroller. Using materials we obtained from the USDA-Beltsville Systematic Entomology Lab we were able to positively identify all specimens of this suspect moth collected in 2014 as *P. limitata*; therefore no samples were sent to USDA-SEL for identification this season.

SWD traps were deployed at all vineyards from early June through harvest in September or October, and these were also checked weekly. Trap contents were strained and contents and sticky traps were returned to the lab where the number of male and female SWD were recorded.

Apple cider vinegar bait was changed each week and SWD lures were changed every three weeks. Every other week when we visited the vineyards to check and service traps we also visually examined 5 vines along the vineyard border and 5 vines in the vineyard interior to look for brown marmorated stink bug. On each sampled vine, we checked five clusters and five shoots for the presence of insects or signs of feeding damage. Spotted wing *Drosophila* was captured at all the vineyards we monitored. Captures occurred a week earlier in southern Michigan with the first fly capture occurring on July 1st compared with July 8th in northern Michigan. The period of peak activity was later in northern as compared to southern Michigan (Figure 1).

Across vineyards, the average of the total number of SWD captured during the season was higher in northern Michigan (305 flies per trap) compared to vineyards in the southern part of the state (182 flies per trap). This may be a result of later harvest dates in northern Michigan co-occurring with the peak of the SWD population.

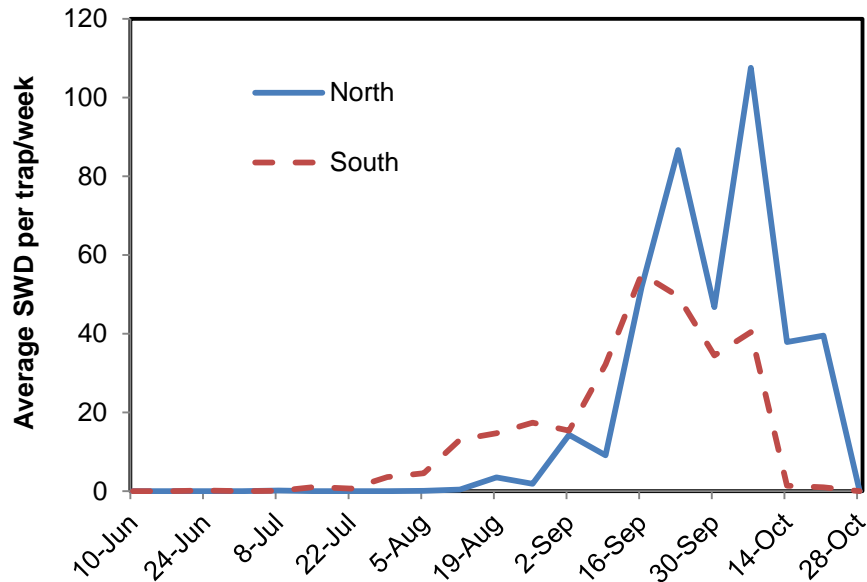


Figure 1. Spotted wing *Drosophila* captures in traps in northwest and southwest Michigan vineyards in 2014.

African fig fruit fly was not detected in any of our traps in 2014, and brown marmorated stink bugs were not detected during scouting in any of our sampled vineyards. This latter point is important because BMSB was found in other crop systems and natural areas in the vicinity of our sampled vineyards. In 2015 we plan to incorporate pyramid traps that contain stink bug attractant for monitoring BMSB at our focal vineyard sites. In the two to four weeks prior to harvest, three replicate clusters of each variety were collected each week. Individual clusters were weighed and the number of berries and % Brix of the terminal berry were recorded. A cluster was then placed onto a 2x2x1 inch piece of sponge in a 32 oz clear deli cup and assign a replicate cluster number

1, 2, or 3. A 2x3 in. yellow sticky card was placed in each cup to catch emerging flies and each cup was covered with a mesh lid. Clusters were stored at room temperature with a 16:8 light:dark cycle for two weeks to allow any fruit fly larvae in the fruit to develop into adults. At that time the number of SWD and other fruit flies on the sticky card were recorded. The total number of flies that emerged from clusters was compared among varieties with analysis of variance using cluster numbers as replicates.

Objective 2. Assess Michigan-grown grape cultivars for their susceptibility to SWD.

This study was performed in the grape variety plantings at the Horticulture Teaching and Research Center (HTRC) in East Lansing and the Northwest Michigan Horticulture Research Station (NWMHRS). At HTRC we sampled the hybrid and labrusca varieties: Marechal Foch, Marquette, Concord, St. Croix, Frontenac, Frontenac Gris, La Crescent, Vignoles, Seyval blanc, Cayuga and Niagara; while at NWMHRS, the vinifera varieties: Pinot Noir, Chardonnay, Riesling and Gewurztraminer were sampled. During the time of this investigation, no insecticides were applied to either planting. SWD traps placed in the variety plantings were checked weekly during this trial, and SWD and other fruit flies were caught through the duration of the study

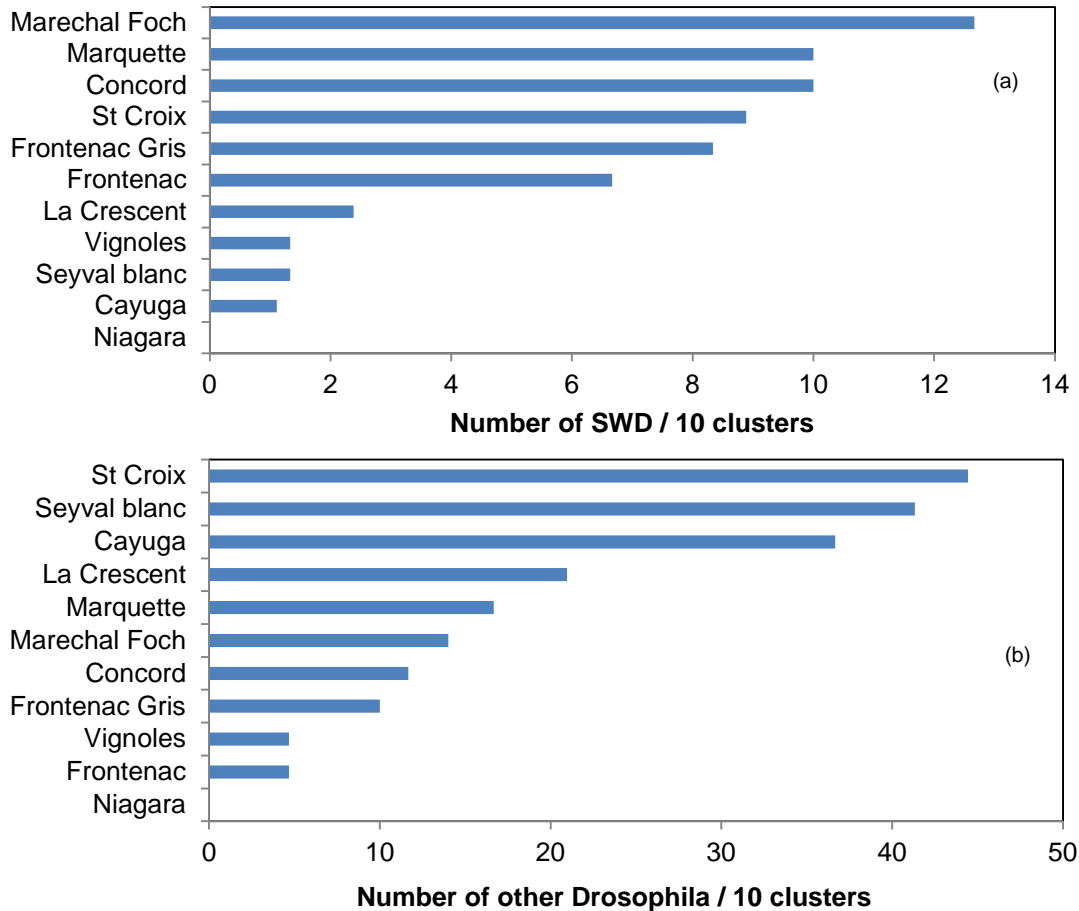


Figure 2. Total number of SWD (a) and other *Drosophila* (b) that emerged from clusters collected at from the variety planting at HTRC in 2014. No significant differences among varieties were detected in the number of SWD ($F_{10,32} = 1.07, P = 0.42$) or other *Drosophila* ($F_{10,32} = 0.82, P = 0.61$) that emerged.

In fruit collected from the variety planting at HTRC, the total number of SWD emerging from clusters ranged from 0 to 12 per 10 clusters, and the number of other *Drosophila* ranged from 0 to 44 (Figure 2). No SWD or other *Drosophila* emerged from fruit collected from the planting at NWMHRS, therefore only data from HTRC are included in further analysis. There were no significant differences in the number of SWD or other *Drosophila* that emerged among varieties (2(a) and (b)).

Within varieties there was substantial variation in the total number of flies that emerged from clusters, and this is most likely why no differences were detected in fly emergence between grape varieties. Nevertheless there are several interesting trends in these data. No SWD or other *Drosophila* emerged from any of the Niagara clusters that we collected. SWD emergence from clusters was higher for red varieties than for white (Figure 2a), but the same trend between fruit colors was not observed for other *Drosophila* (Figure 2b). Overall, the number of other *Drosophila* that emerged was much higher than the number of SWD. The results of this trial suggest that all varieties we sampled are at some risk of infestation, but red varieties appear to be more susceptible to SWD infestation than white. This may also be a function of their harvest date, as the population of SWD is increasing rapidly through September and into October.

No SWD or other fruit fly infestation was observed in the clusters collected from NWMHRS, that coincidentally were all vinifera varieties. We feel confident that the lack of infestation at NWMHRS is likely due to a generally low background SWD population and not a result of lower susceptibility of these varieties.

Objective 3. Determine the performance of different management approaches to minimize vinegar fly and sour rot infestation.

Due to widespread winterkill and frost injury, we were unable to find a suitable vineyard to perform the field trial comparing the use of insecticides and leaf pulling for combined fruit fly and sour rot management as outlined in our original proposal. This portion of the study will be completed in 2015 and will be reported in the 2015 report to MGWIC.

To determine the relationship between sour rot infection and fruit fly infestation in grapes, we collected clusters from a Vignoles vineyard in Berrien County, MI on September 5th. This vineyard has a history of fruit fly pressure and sour rot incidence. We purposefully chose clusters to include a range of sour rot infection; approximately half of the clusters had no sign of sour rot infection and the remaining clusters had sour rot symptoms. Clusters were placed in 32 oz clear deli containers to rear out larvae as described above. In addition we counted the number of berries with sour rot

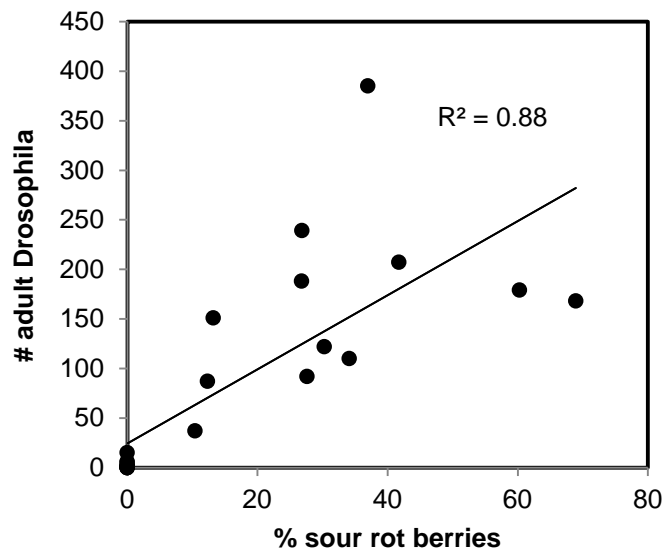


Figure 3. Relationship between fruit fly infestation and sour rot infection.

symptoms and calculated the % of berries with sour rot.

The number of *Drosophila* emerging from a cluster ranged from 0 to 368 and the level of sour rot infection ranged from 0 to 69 % of berries infected. Interestingly only two of the flies that emerged during this trial were SWD, which suggests other species of *Drosophila* may have out-competed SWD in these clusters. It also suggests that SWD may not pose any more of a problem than what growers are already facing with other vinegar flies. The relationship between the number of *Drosophila* emerged and the percentage of berries with sour rot was significant and positive ($F_{1,21} = 150.4$, $P < 0.0001$; Figure 3). The adjusted R^2 value of 0.88 indicates that 88% of the variation in the level of sour rot can be explained by the number of flies emerging.

We expect to see a similar relationship between fruit fly emergence and % sour rot infection when we perform our field trial in 2015. We also expect that the continuation of this project will raise awareness about the potential risks of invasive insect pests, and may potentially detect new pests if they are present in the state. Objective 2 will provide information that growers can use to focus their scouting and pest management activity as part of their IPM program, and so this is expected to help minimize the need for chemical inputs. The results from Objective 3 are expected to help growers select appropriate methods for minimizing the damage caused by sour rots at harvest time. All of these potential impacts are expected to contribute to reduced dependence on pesticides, and/or improved fruit quality at harvest. These impacts will be measured through questionnaires as part of winter extension meetings when this information is presented.

COMMUNICATIONS ACTIVITIES, ACCOMPLISHMENTS, AND IMPACTS

Results from this project have been shared during summer and winter grower meetings, including the SWMREC Viticulture Days, Great Lakes Expo, Southwest Hort Days, and the Northwest Orchard and Vineyard Show. The information was also presented in the ten Vineyard IPM Scouting Updates that were distributed electronically through MSU Extension Grapes News. In addition, information was incorporated into webinars hosted by members of the MSU Grape Team during summer, fall and winter of 2014. Results from this project were presented in a workshop covering late-season insect and disease issues in vineyards that was held in August 2014 at Lemon Creek Winery in Berrien Springs, MI.

RESULTS & CONCLUSIONS

This project has helped to inform the grape industry regarding the current state of invasive insect species in Michigan vineyards. We did not detect European grapevine moth, light brown apple moth, summer fruit tortrix, African fig fruit fly or brown marmorated stink bug in any of our sampled vineyards in 2014, but given the increase in globalization, monitoring for these and other invasive insects remains important to the Michigan grape and wine industry. Spotted wing *Drosophila* and other *Drosophila* species should still be a concern for growers as the peak in population occurs during grape harvest in Michigan.

OUTCOMES

This project is helping to ensure that Michigan grape growers have the information they need to prepare for invasive insect pests and to manage species that are already here. This project will also help to identify varieties that are susceptible to spotted wing *Drosophila*. It will also address spotted wing *Drosophila* and other vinegar flies as potential sources of fruit infestation, cluster rot development, and associated loss of berry quality at harvest-time.

ACKNOWLEDGEMENTS

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