DEPARTMENT OF AGRICULTURE

Status of Invasive Threats to Fruits and Vegetables in Minnesota

Plant Protection Division

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Pathways Survey for Invasive Pests of Fruit and Vegetables

The Pathways Survey, funded by the United States Department of Agriculture (USDA) Farm Bill, focuses on agricultural systems near urban areas, such as community gardens, fresh market produce farms, apple orchards, and vineyards, as a means to maximize opportunities to detect new invasive species early in the infestation process. Some of the most recent pests impacting fruits and vegetables in Minnesota include brown marmorated stink bug (BMSB), clubroot of cabbage, Japanese beetle, and Swede midge. These invasives were first found in urban areas before spreading into more rural areas of the state. As a result of this pattern of movement, agricultural systems in and around urban areas can be thought of as part of a system of pathways by which invasive species become established.

Urban agricultural systems have a diversity of crops that make them good survey sites. Crop diversity provides opportunities to monitor for a broad range of invasive insects and plant pathogens; however, deciding what organisms are priorities for monitoring can be difficult. The Minnesota Department of Agriculture (MDA) works with partners including the USDA Animal and Plant Health Inspection Service (APHIS) Plant Pest Quarantine (PPQ) and the University of Minnesota (U of M) to determine what insects and diseases to include in the survey and which monitoring techniques to employ. Some key criteria for including an invasive pest in the survey are:

- The likelihood of an organism reaching Minnesota in the near future (due to proximity to existing infestations or ease of movement);
- The prevalence and importance of potential hosts in Minnesota; and,
- Climactic suitability, particularly likelihood of overwintering survival.

Survey Procedure

The 2019 Pathways Survey was conducted from early June through mid-September with sites visited approximately every two weeks. Sites were located in the Twin Cities and surrounding suburbs, Duluth, Mankato, St. Cloud, and Rochester (Figure 1). Primary sampling techniques included pest-specific traps and visual inspection of plants for symptoms of disease or insect injury. Insect traps were checked at each site visit, and samples were collected and submitted to the MDA Lab. Insects were then screened, and those that would have national implications, if found, were submitted to USDA identifiers for final identification.

On each site visit, a visual inspection was conducted on a portion of the plants. Plant samples were collected and submitted to the MDA Lab for further analysis when disease symptoms not identifiable as common garden diseases were found.

Table 1 shows the number of insects and diseases monitored by crop type in the Pathways Survey. Table 2 shows the site types and trap totals.

Table 1. Agricultural Pathways Survey Targets

Crop Type	# Insects Monitored	# Diseases Monitored
Apple	7	3
Blueberry	2	0
Grapes	4	5
Vegetables	8	5

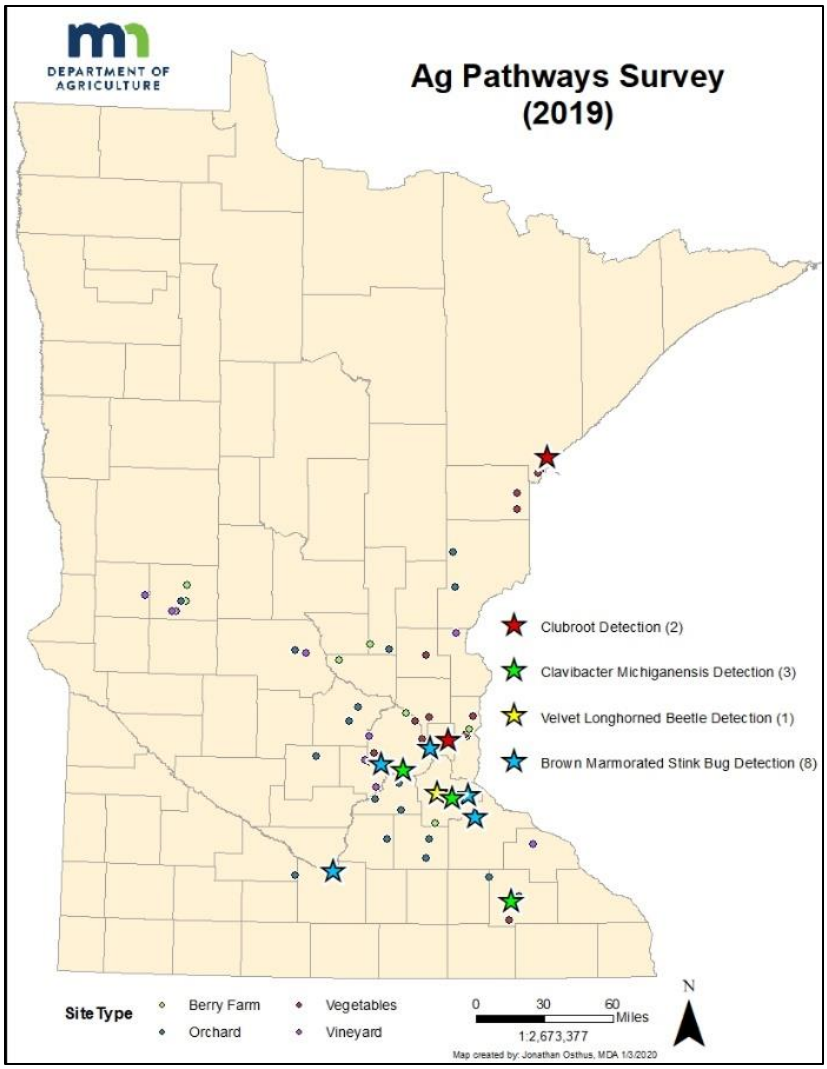

Figure 1. Results from sites monitored as part of the 2019 Agricultural Pathways Survey.

Table 2. Agricultural Pathways Survey Numbers at a Glance - 2014 through 2019

Year	Number of Counties	Total Number of Sites	Number of Community Gardens	Number of Small Farms	Number of Fruit (Berry, Grape & Orchard)	Number of Insects Surveyed	Number of Diseases Surveyed	Total Number of Insect Traps (across all sites)
2014	18	66	49	17	---	10	13	236
2015	22	95	61	34	---	10	13	391
2016	24	100	54	29	17	16	16	505
2017	28	71	18	11	29	12	10	194
2018	28	70	18	12	40	13	10	191
2019	27	69*	15	5	46	16	13	290

*Three of the small farms were considered as two sites each.

Insect Finds

Brown Marmorated Stink Bug

Brown marmorated stink bug (BMSB) (*Halyomorpha halys*) was first introduced to the United States in the mid-1990s from eastern Asia (Figure 2). It became a serious problem for fruit growers in the mid-Atlantic States in 2009. At present, BMSB is known to occur in most states as well as Canada. It is a generalist pest that will feed on many plants, including some economically important to Minnesota.

BMSB was first identified in Minnesota in 2010, and it continues to be detected throughout the state. To date, it has been detected in 23 counties. Most BMSB finds have been in the greater Twin Cities metropolitan area. The MDA tracks the distribution and abundance of BMSB across Minnesota in multiple ways, including citizen reports and multiple state and federally funded field surveys.

Figure 2. Adult BMSBs are approximately 1/2 inch long.

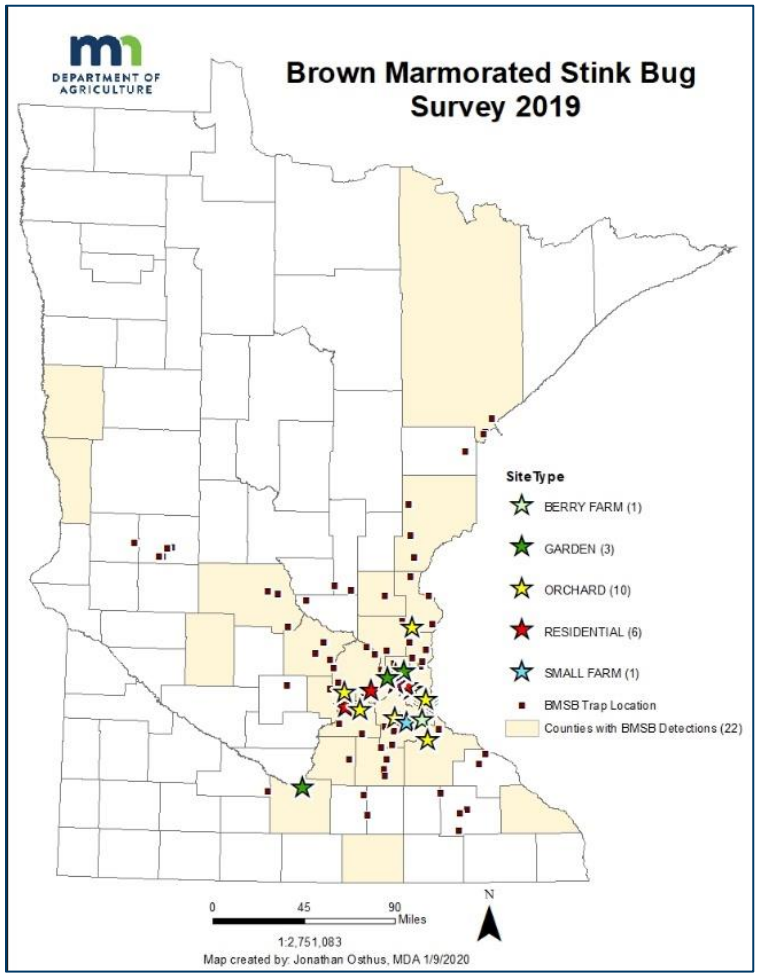

Figure 3. 2019 BMSB survey locations and results.

Survey

The BMSB survey ran from May through October at 102 sites covering 28 different counties (Figure 3). There were 10 BMSB detections at orchards in Carver, Chisago, Dakota, Goodhue, Scott, and Washington counties. All but one of the orchard detections was a single occurrence. This means that only one orchard site in Washington County has a reproducing population of BMSB at this time. In addition, BMSB was detected at three gardens, one berry farm, and one small farm. The Nicollet County garden site was added as a new county find. While BMSB is still relatively scarce in agricultural settings, populations are building and may require implementation of integrated pest management strategies in the near future.

BMSB Monitoring

The MDA continues to partner with the U of M through data sharing and a USDA Specialty Crop Block grant. The U of M evaluates and understands the community of natural enemies that are present in agricultural settings that may have an impact on BMSB population dynamics. The MDA orgainizes a monitoring network for BMSB to better track its distribution and abundance. An interactive map of up-to-date BMSB detections in Minnesota is available at MDA's BMSB webpage: www.mda.state.mn.us/plants-insects/brown-marmorated-stink-bug.

An increase in reports and trap catches of BMSB, including trapped nymphs, has indicated growing activity in the Twin Cities metropolitan area. The increase has been well documented with seven years of monitoring data (Figure 5 and 6). This information provides an opportunity to closely monitor the build-up of BMSB populations in urban and residential settings and its transition to agricultural settings. Detailed monitoring provides an opportunity to avoid reactive use of insecticides by agricultural producers.

Figure 4. A brown marmorated stink bug sticky trap in a Minnesota orchard.

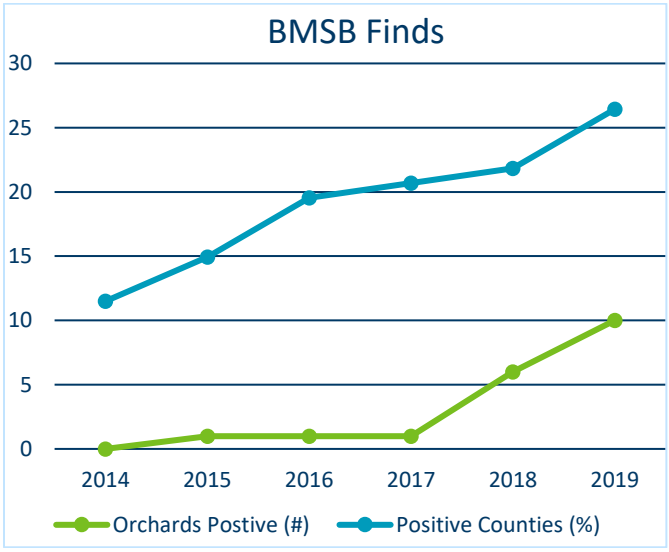

Figure 5. Percent of Minnesota counties with BMSB detections and number of orchards with BMSB detections since 2014.

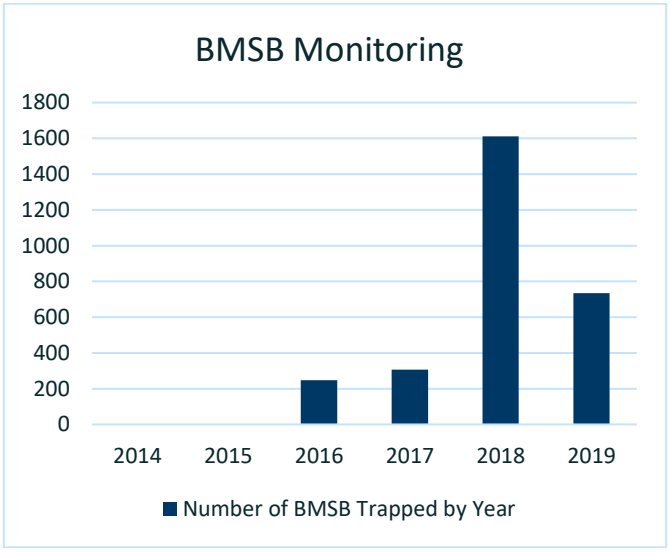

Figure 6. Number of BMSB adults and nymphs captured in survey traps each year.

Swede Midge

Swede midge (*Contarinia nasturtii*) is a small fly. It is a serious pest of cruciferous plants such as broccoli, cabbage, cauliflower, kale, and canola (Figure 7). The larvae feed on and disfigure or destroy the growing tip of the plant. The first discovery of Swede midge in the United States was in 2004 on a broccoli farm in Niagara County, New York. It was discovered in North America in 2000 near Toronto in Ontario, Canada. The insect is native to Europe and southwestern Asia.

The MDA is tracking the distribution and abundance of Swede midge across Minnesota. Efforts are focused at community gardens, small farms, and canola fields around the state.

Survey

Fifty-nine traps were monitored at vegetable and canola sites in 14 counties from June through September. Swede midge adults were confirmed from trap captures at two sites in Ramsey County that had positive detections in the previous year. This is the third year of confirmed finds in Minnesota, with the two confirmed sites located within the city of Saint Paul.

The MDA will continue monitoring for Swede midge in 2020 and increase outreach in an effort to prepare those already impacted or may be impacted in the near future. Small farms and community gardens growing cruciferous crops in or near the Twin Cities are likely to be hardest hit in the short-term, while the largest economic impact would be felt in the canola fields of northwestern Minnesota in the long-term.

Figure 7. Kohlrabi plant with multiple head formation caused by swede midge.

The MDA and the U of M created a guidance document for managing Swede midge infestations titled, "Current IPM Practices for Managing Late-season Swede Midge (Contarinia nasturtii) in Minnesota," which is available on the U of M's VegEdge website: www.vegedge.umn.edu/swede-midge-late-season.

Velvet Longhorned Beetle and Japanese Beetle

Velvet longhorned beetle (VLB) (*Trichoferus campestris*) is an exotic beetle native to Asia and Eastern Europe with the potential to become a pest in Minnesota (Figure 8). Preferred hosts include apple and mulberry, but it has also been recovered from maple in Canada and has been found attacking and causing damage in live cherry and peach trees in Utah. Velvet longhorned beetle biology is similar to other woodboring beetles, such as the Asian longhorned beetle, but it differs in that is has the potential to infest and complete its lifecycle under dry wood conditions. Thus, the range of potential hosts could include dry cut wood with bark as well as recently cut logs.

Figure 8. Adult velvet longhorned beetle. Steven Valley, Bugwood.net

Figure 9. Japanese beetles skeletonizing bean leaves.

In 2019, VLB traps were set in 16 counties at 24 orchards. One adult beetle was found at an orchard in Dakota County. The MDA will continue monitoring for VLB in orchards in 2020.

Japanese beetle (*Popillia japonica*) is a pest of turf and ornamental plants (Figure 9). Grubs feed on the roots of grass and adults feed on the foliage of more than 300 plant species. Japanese beetle continues to spread throughout Minnesota. This pest was visually surveyed as part of the Pathways Survey. It was found at 47 sites (vegetable, orchards, vineyards, and berry farms) in 19 counties.

Disease Finds

Clubroot

Clubroot, caused by *Plasmodiophora brassicae*, was identified at community garden sites in Ramsey and St. Louis counties. Clubroot is a soil-borne disease that causes swollen and distorted roots (Figure 10) on plants in the cabbage family (Brassicacea; also commonly called crucifers), which also includes canola. Spores of clubroot are able to survive for 20 years in soil. All of the clubroot finds in 2019 were on sites where the disease had been previously found, indicating that the clubroot pathogen can survive in Minnesota's environment. The disease can cause yield reduction and, if severe, can result in total crop loss. It is a growing threat to canola production in parts of Canada and North Dakota but has not been reported on canola in Minnesota.

Figure 10. Roots infected with clubroot.

For more information about clubroot, visit blog-yard-garden-news.extension.umn.edu/2016/07/clubroot-of-cabbage.html.

Bacterial Canker of Tomato

Bacterial canker of tomato, caused by *Clavibacter michiganensis* sbsp. *michiganensis* (CMM), can infect every part of the tomato plant. This disease causes spots on fruit (Figure 11), leaf wilt, brown stem cankers, and plant death when severe. The bacteria can be introduced on infected seed or transplants and easily spread on tools and hands. This disease poses a significant threat to tomatoes grown in greenhouses or high tunnels where the environmental conditions and frequent handling of plants favors disease.

Figure 11. Tomato fruit infected with bacterial canker.

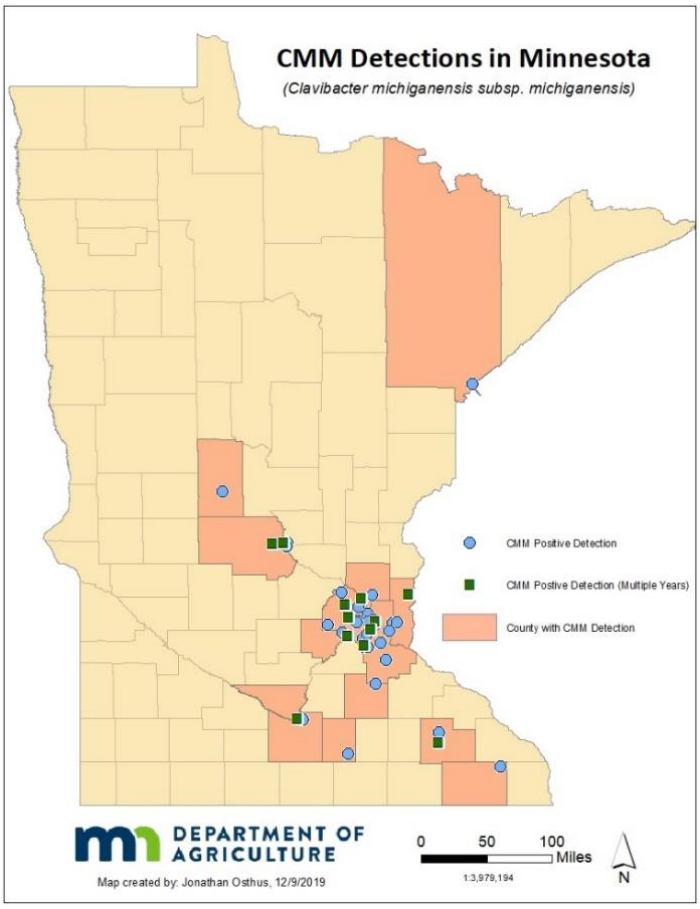

Figure 12. Bacterial canker of tomato finds from 2015 to 2019.

Prior to 2015, the occurrence and distribution of bacterial canker of tomato in Minnesota was unknown. Surveys have identified this bacterial plant pathogen in 15 counties (Figure 12). In 2019, bacterial canker of tomato was identified at two community gardens where the disease had previously been identified. One site has had repeat infections since 2015. This indicates that once bacterial canker of tomato is introduced to a site the pathogen can become established and disease can reoccur in subsequent seasons when environmental conditions are favorable. Bacterial canker of tomato was also found at a new site in Dakota County in 2019. It is likely that the bacteria was introduced on infected tomato seed, a common pathway for this pathogen.

For more information on bacterial canker of tomato visit www.mda.state.mn.us/plants/plantdiseases/cmm.

Angular Leaf Scorch of Grape

In July of 2019, a grape sample with symptoms characteristic of Rotbrenner, caused by *Pseudopezicula tracheiphila*, was collected from Goodhue County. Rotbrenner causes leaf blight and yield loss in the cool wine growing areas of Europe. It has not yet been identified in the US. This sample was submitted to the USDA National Mycologist which confirmed that the symptoms were caused by a closely related native fungus, *Pseudopezicula tetraspora*, which causes angular leaf scorch of grape. This was the first time angular leaf scorch had been identified in Minnesota.

Figure 13. Grape vine infected with angular leaf scorch.

Grape vines affected by angular leaf scorch have yellow to red blotches on leaves. These expand into large wedge shaped dead patches that extend to the leaf edge (Figure 13). In severe cases, leaves may be completely killed and flowers may shrivel up and die due to stem infections.

More information about angular leaf scorch can be found at www.canr.msu.edu/uploads/files/Diseases_PDFs/AngularLeafScorch.pdf.

Brown Rot of Apple

In summer of 2019, apples with buff colored powdery spores were found in commercial orchards in Scott, Washington, and Olmstead counties. The MDA Lab identified the fungus as *Monilinia* sp. Several species of *Monilia* cause brown rot in fruit trees, resulting in shoot blight, branch dieback, and fruit rot. *Monilinia fructigena* is a USDA priority pathogen that causes significant damage to apples in Europe. It has not been found in the US. *Monilinia fructicola* is a native fungus that causes significant damage to plums, cherries, apricots, and other Prunus trees. The native species of *Moniliina* rarely infects apple. All infected apples were sent to the USDA for identification and all were confirmed to be the native fungus, *M. fructicola* (Figure 14). The infections were likely the result of wounding of the fruit.

Figure 14. Wounded apple fruit infected with brown rot caused by the native fungus Monilinia fructicola.

For More Information

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