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) Plant Protection Act 7721 (formerly The 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. In addition, four high tunnel sites were added to the survey and tomatoes, peppers, and cucumbers were surveyed for diseases. Some of the most recent pests impacting fruits and vegetables in Minnesota include brown marmorated stink bug (BMSB), clubroot of cabbage, and Swede midge. These invasive species 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 2020 Agricultural 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 Laboratory. Insects were then screened, and if found, those with national implications 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 Laboratory 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 Agricultural Pathways Survey, Table 2 shows the site types by year, and Table 3 shows the pests surveyed by year.

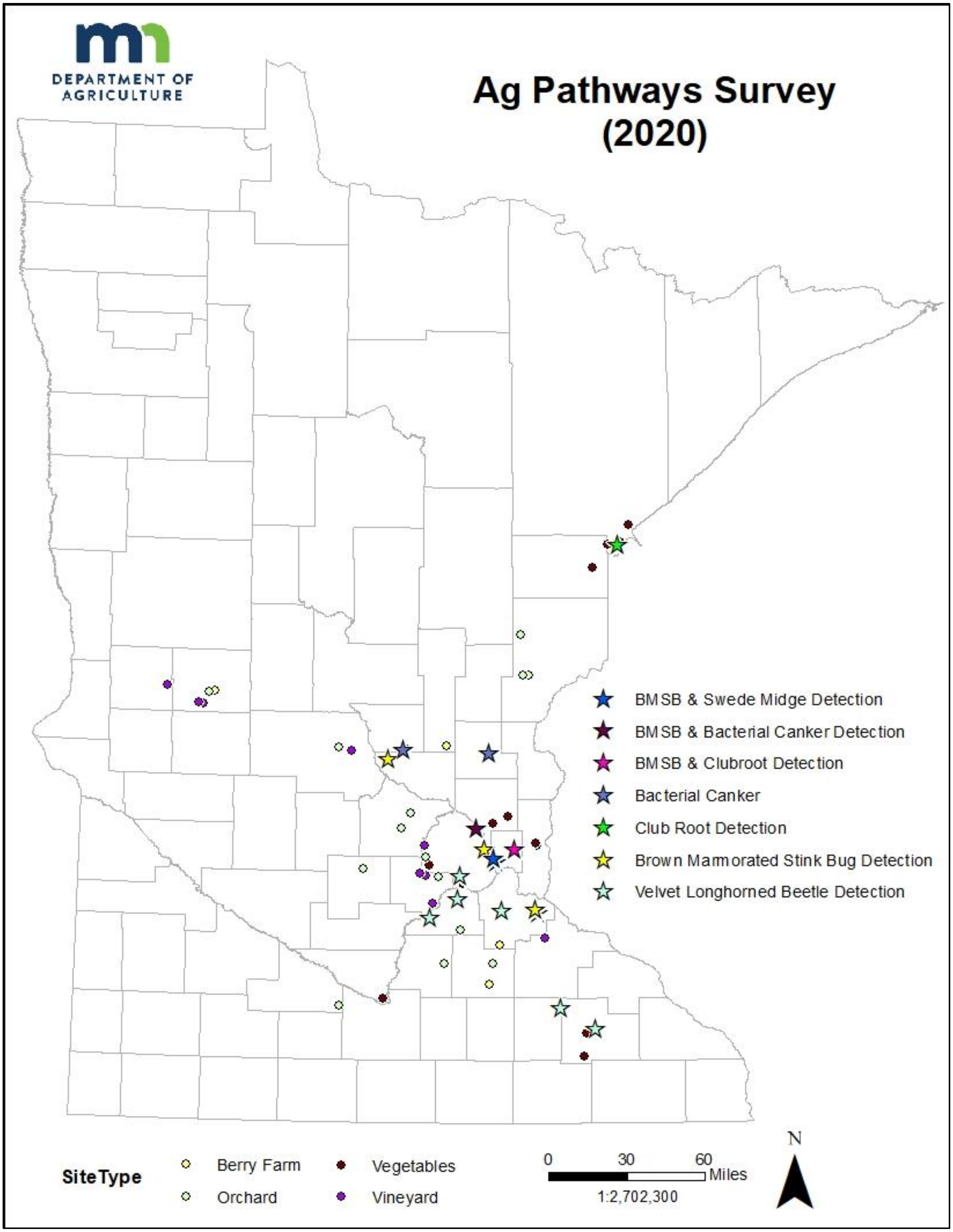

Figure 1. Results from sites monitored as part of the 2020 Agricultural Pathways Survey.

Table 1. Agricultural Pathways Survey Targets

Crop Type	Insects Monitored	Diseases Monitored
Apple	6	2
Blueberry	2	0
Grape	3	6
Vegetable	6	6

Table 2. Agricultural Pathways Survey Site Numbers at a Glance - 2014 through 2020

Year	Number of Counties	Total Number of Sites	Number of Community Gardens	Number of Small Farms	Number of Fruit Sites	Number of High Tunnels (Vegetables)
2014	18	66	49	17	---	NA
2015	22	95	61	34	---	NA
2016	24	100	54	29	17	NA
2017	28	71	18	11	29	NA
2018	28	70	18	12	40	NA
2019	27	69*	15	5	46	NA
2020	25	65*	16	4	41	4

*One of the small farms was considered two sites.

Table 3. Agricultural Pathways Survey Pest Numbers at a Glance - 2014 through 2020

Year	Number of Insects Surveyed	Number of Diseases Surveyed	Total Number of Insect Traps (across all sites)
2014	10	13	236
2015	10	13	391
2016	16	16	505
2017	12	10	194
2018	13	10	191
2019	16	13	290
2020	14	14	262

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 27 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.

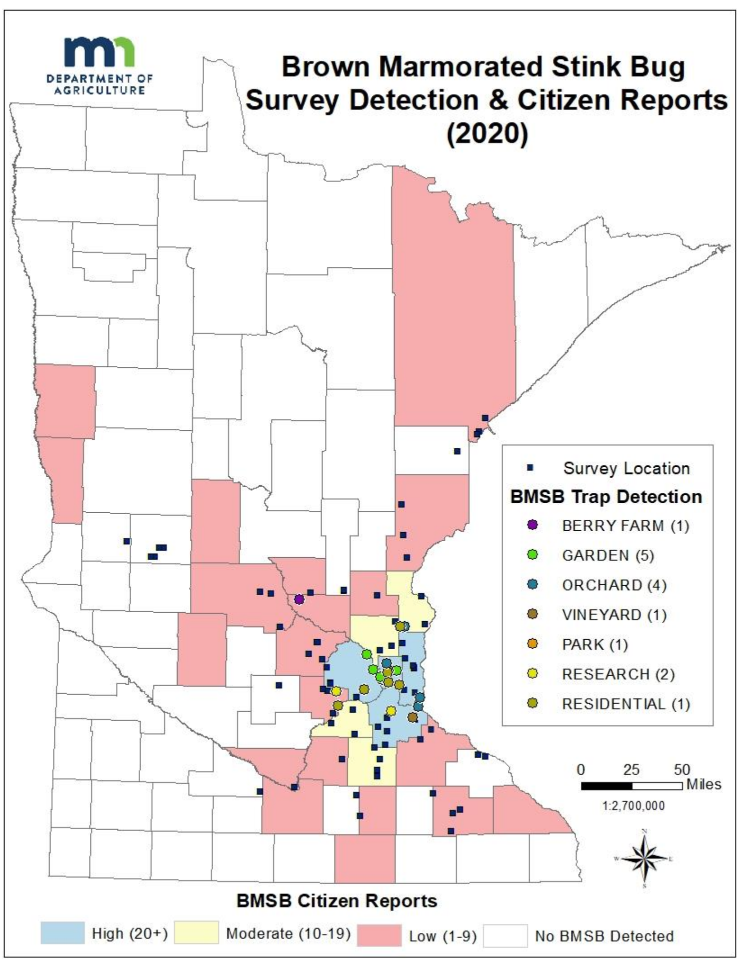

Figure 3. 2020 BMSB survey locations and results.

Survey

The BMSB survey ran from May through October at 94 sites covering 29 different counties (Figure 3). There were four BMSB detections at orchards in Chisago, Ramsey, and Washington counties. The amount of BMSB captured at these orchards was very small. The orchard in Chisago County had a single occurance of BMSB and the orchards in Ramsey and Washington counties had two instances of BMSB adults on traps. In addition, BMSB was detected at five gardens, one berry farm, and one vineyard. BMSB continues to be caught and reported at residential locations throughout the Twin Cities. 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/bmsb

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

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.

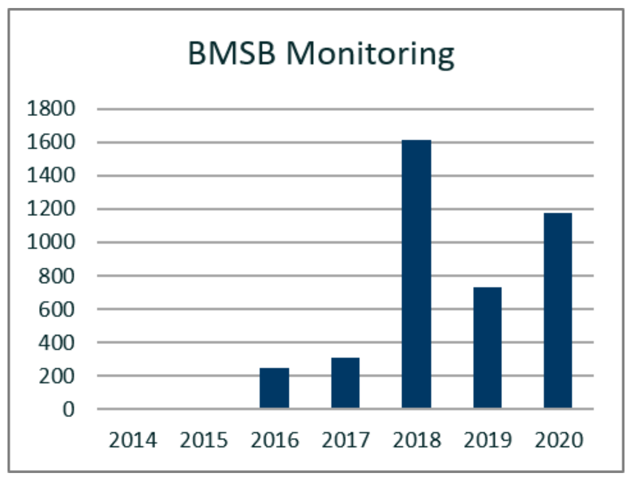

Figure 5. Number of BMSB adults and nymphs captured in survey traps each year.

In addition to monitoring BMSB, the MDA conducted a stickycard survey for *Trissolcus japonicus,* a non-native wasp species that parasitizes BMSB eggs that has been captured in other states that have BMSB. The MDA placed traps at locations where BMSB nymphs had been detected in previous years. While no *Trissolcus japonicus* were found, a native trissolcus species that parasitizes some BMSB eggs was detected.

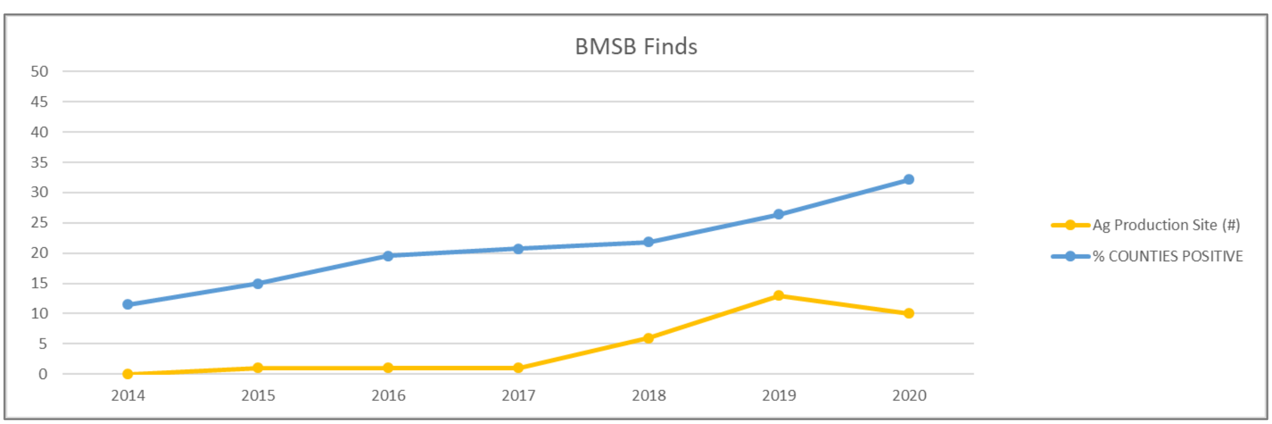

Figure 6. Percent of Minnesota counties with BMSB detections and number of agricultural production sites with BMSB detections since 2014.

Velvet Longhorned 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 7). 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.

In 2020, VLB traps were set in 28 counties at 65 orchards and parks. Nine new sites had adult beetles captured in Dakota, Goodhue, Olmsted and Scott counties. Recent finds indicate that VLB is likely widely established in parts of central and southern Minnesota. No evidence of damage caused by VLB has been observered. The MDA will continue monitoring for VLB in orchards and park locations in 2021.

Figure 7. Adult velvet longhorned beetle. Steven Valley, Bugwood.net

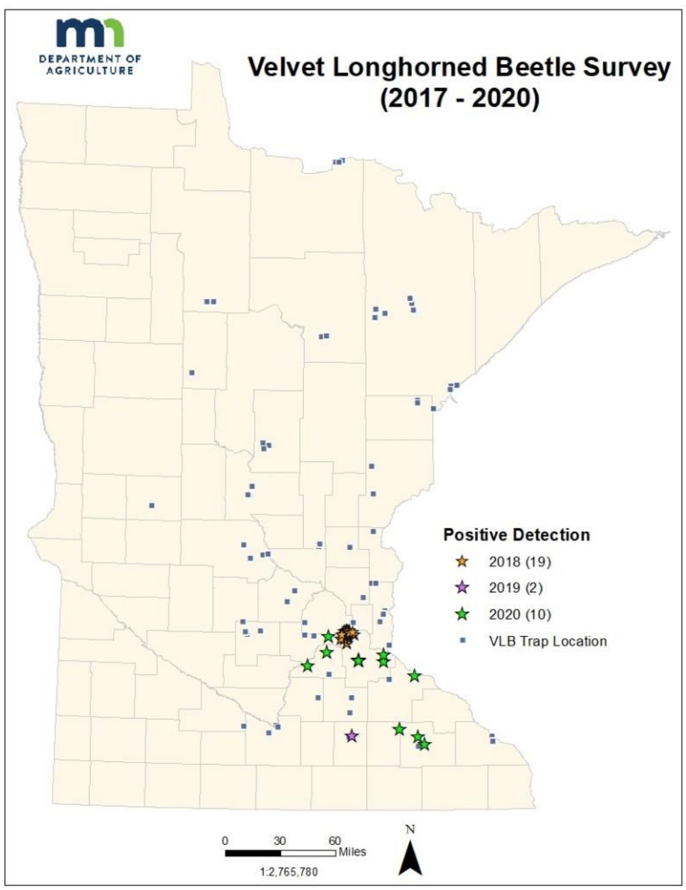

Figure 8. VLB trapping locations and positive detections.

Disease Finds

Clubroot

Clubroot, caused by *Plasmodiophora brassicae*, is a soil-borne disease that causes swollen and distorted roots (Figure 9) on plants in the cabbage family, which includes canola and many vegetables like broccoli, cabbage, and kale. Spores of clubroot can survive for 20 years in soil. The disease reduces yield and can result in total crop loss when severe. 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 9. Roots infected with clubroot.

The MDA surveyed for clubroot in community gardens and vegetable farms from 2015-2020. Clubroot was found in Ramsey, Hennepin, St. Louis, and Olmsted counties. The disease was found at several sites every year after the initial detection, indicating that the pathogen was able to survive over winter and infect susceptible crops the following year.

For more information about clubroot, visit https://extension.umn.edu/plant-diseases/clubroot

Bacterial Canker of Tomato

Bacterial canker of tomato, caused by *Clavibacter michiganensis* sbsp. *michiganensis* (CMM), can cause spots on fruit (Figure 10), leaf wilt, stem cankers, and plant death. In 2020, tomatoes grown in community gardens, commercial vegetable fields, and high tunnels were surveyed for symptoms of bacterial canker. Samples of suspect plants were analyzed at the MDA Laboratory to determine if CMM was present.

Figure 10. Tomato fruit infected with bacterial canker.

2020 was the first year tomatoes grown in high tunnels were surveyed. Infected plants found inside high tunnels had different symptoms than infected plants identified outdoors. In a field or garden, the CMM bacteria splash on rain and irrigation resulting in spots on fruit and discoloration of the leaf edges. Plants in a high tunnel are sheltered from rain and do not have fruit spots. CMM is more likely to spread on workers' hands and tools in a high tunnel or greenhouse where plants are frequently handled for pruning, staking, and tying. The bacteria infect minor wounds caused by handling, then move into the plant's vascular system. This results in wilt, cankers, and death of the plant.

Prior to 2015, the occurrence and distribution of bacterial canker of tomato in Minnesota was unknown. Previous surveys had identified CMM in 15 counties across Minnesota. The 2020 survey identified infected plants in two new counties, Isanti and Benton. It is likely that the CMM bacteria were introduced on infected tomato seed or tomato transplants, a common pathway for this pathogen.

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

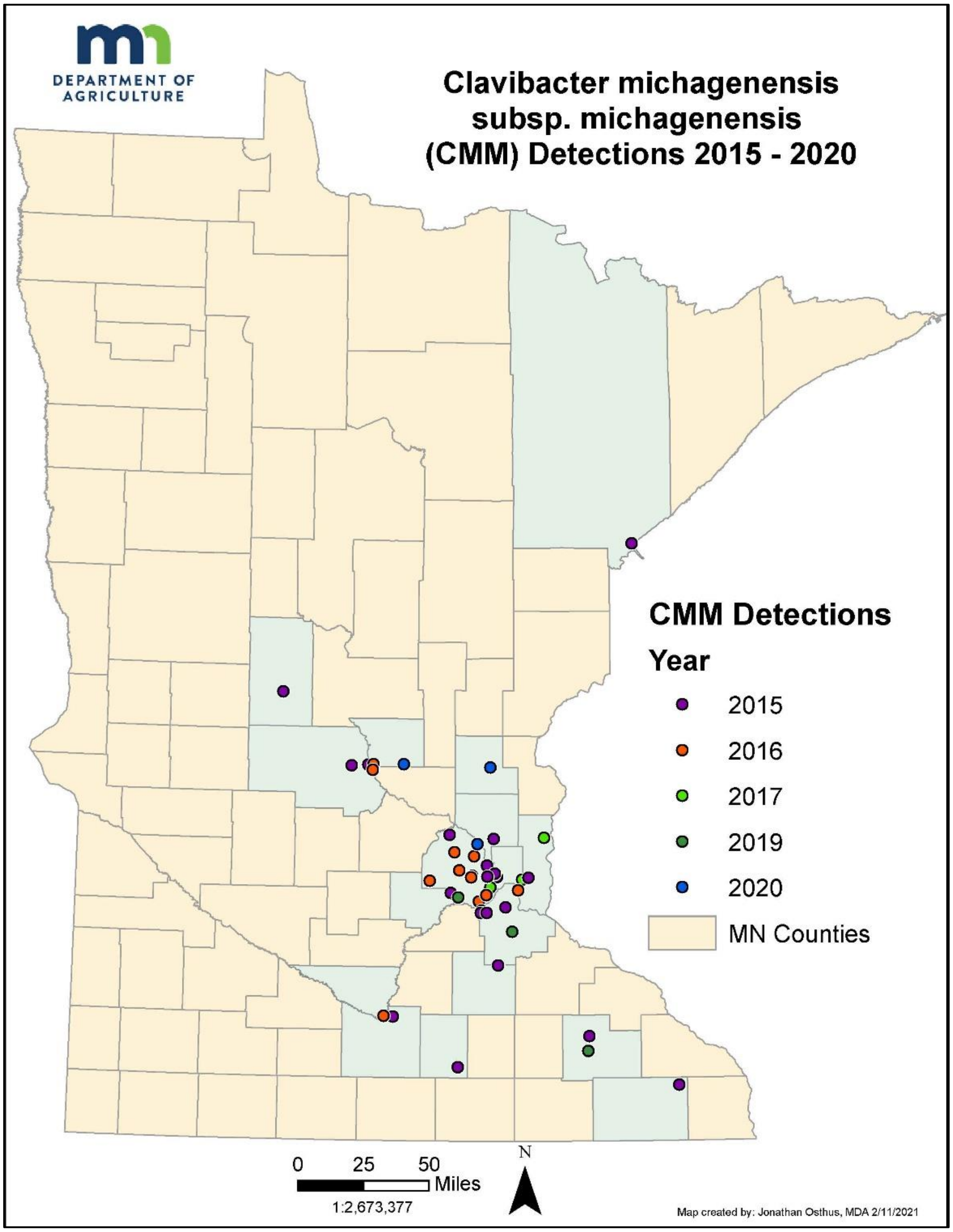

Figure 11. Counties where bacterial canker of tomato has been identified (2015-2020).

Tomato Brown Rugose Fruit Virus

Tomato Brown Rugose Fruit Virus (ToBRFV) was first identified in Minnesota greenhouse grown tomatoes in Jordan in 2015. Although it was found in California in 2018, all plants at the infected sites were destroyed and the disease is considered eradicated and not present in the U.S. The primary hosts of ToBRFV are tomatoes and peppers. This virus moves long distances on infected seeds and spreads easily from plant to plant on workers' hands, clothes, and tools. Infected plants have puckered or distorted leaves with unusual mosaic patterns in varying shades of green (Fugure 12). Fruit have unusual patterns and blotches of green, yellow, or brown. Brown patches may be dry and wrinkly. In addition to affecting the marketability of tomato fruit, ToBRFV can also reduce production by causing early fruit drop and smaller fruit.

Figure 12 : Symptoms of Tomato Brown Rugose Fruit Virus on tomato fruit. Photo by USDA APHIS.

In 2020, tomatoes and peppers grown in high tunnels were surveyed for symptoms of ToBRFV. High tunnel and greenhouse production are considered higher risk for ToBRFV than field grown tomatoes due to the frequent handling of plants in indoor environments. ToBRFV was not identified during the survey.

Phytoplasma Diseases of Grapes

In 2020, the MDA surveyed vineyards for phytoplasma diseases on the USDA priority pest list. Phytoplasmas are bacteria that live within the vascular system of plants and are spread from plant to plant by sap sucking insects like leaf hoppers. Australian grapevine yellows, blackwood disease, and flavescence dorée are grape diseases caused by invasive phytoplasmas. Leaves on infected vines begin to discolor at the veins, then large sections of the leaf turn color and curl under. Leaves on red varieties turn purple. On white varieties, leaves turn metallic white to yellow. Fruit production is reduced, and clusters often shrivel and drop off. Overall vine growth is reduced. Although these diseases do not currently occur in the United States, they could be introduced on infected plant material. There are no treatments for phytoplasma infected plants. No grape vines infected with invasive phytoplasma diseases were identified in the 2020 survey.

Figure 13: Shriveling of grape cluster due to flavescence dorée. Photo by Biologische Bundesanstalt für Land- und Forstwirtschaft, Bugwood.org

Brown Rot of Apple

Brown rot of apple, caused by *Monilinia fructigena,* causes significant damage to apples in Europe. Several species of *Monilinia* cause brown rot in fruit trees, resulting in shoot blight, branch dieback, and fruit rot. *Monilinia fructigena* has not been found in the US, but a native species, *M. fructicola*, causes significant damage to plums, cherries, apricots, and other *Prunus* trees. In 2020, apples with buff colored powdery spores characteristic of *Monilinia* spp. were found in commercial orchards in Le Sueur County. Cultures of the suspect fungus were sent to a USDA identifier, and were confirmed to be the native species of *Monilinia*. Although the native species of *Monilinia* rarely causes problems on apples, infections can occur through wounds.

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

For More Information

Angie Ambourn

Supervisor, Pest Detection and Export Certification Unit
angie.ambourn@state.mn.us
651-201-6073