DEPARTMENT OF AGRICULTURE

Status of Invasive Fruit and Vegetable Pests in Minnesota

2023 Annual Report

2/28/2024

Minnesota Department of Agriculture

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Pathways Survey for Invasive Pests of Fruits 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. In addition, high tunnels were surveyed for diseases of tomatoes, peppers, and cucumbers. These sites were chosen because high tunnels can be sheltered areas where invasive diseases have the potential to overwinter and become established. Some of the most important invasive species that are currently impacting Minnesota urban agricultural include brown marmorated stinkbug and Swede midge. These invasive species were first found in urban areas before spreading into more rural areas of the state. Thus, agricultural systems in and around urban areas can be thought of as part of a system of pathways by which invasive species become established and can spread.

Urban agricultural systems make good survey sites due to the high diversity of crops. This provides opportunities to monitor for a broad range of invasive insects and plant pathogens. 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 which insects and diseases to include in the survey. Some key criteria for including an invasive pest in the survey are:

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

Survey

The 2023 Agricultural Pathways Survey was conducted from June through September, with sites visited approximately every two weeks. A total of 35 orchards, 20 gardens, 16 vineyards, 10 high tunnels, and seven residential areas were surveyed across 27 counties (Table 1). In addition to sites in rural areas, sites in the Twin Cities and surrounding suburbs, Duluth, St. Cloud, Alexandria, and Rochester were included as survey sites to monitor for people driven pathways for possible introduction of new pests.

Table 1. Agricultural Pathways Survey Site Numbers by Type.

Site type	Sites with visuals and traps	Sites with visuals only	Sites with BMSB traps only	Total Sites
Orchards	26	0	9	35
Residential	0	0	7	7
Vegetable gardens	20	0	0	20
Vineyards	16	0	0	16
High tunnels	0	10	0	10
Totals	62	10	16	88

There were 12 insect pests (Table 2) and 16 plant disease pests (Table 3) in the Agricultural Pathways Survey. 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 of target plant pathogens were found. Insect traps were checked at each site visit, and samples were collected and submitted to the MDA Laboratory. Insects were then screened, and if suspects were found, those with national implications were submitted to the USDA for final identification.

Seven orchard sites and three vineyard sites were located within the endangered rusty patched bumble bee (RPBB) habitat zones and so adjustments in trapping had to be made. White wing traps were cut entirely at these vineyard sites since no alternative is approved for survey. White delta traps are typically used for light brown apple moth; locations that fell within RPBB habitat were switched to an alternative color from the approved methods.

Table 2. Insect Pests in the Agricultural Pathways Survey.

Scientific Name	Common Name	Survey Site Type	Survey Method
Halyomorpha halys	Brown marmorated stink bug	Vegetable gardens, Orchards, Vineyards	Visual observation
Adoxophyes orana	Summer fruit tortrix moth	Orchards	Lure and trap
Epiphyas postvittana	Light brown apple moth	Orchards	Lure and trap
Lycorma delicatula	Spotted lanternfly	Orchards	Visual observation
Trichoferus campestris	Velvet longhorned beetle	Orchards	Lure and trap
Acrolepiopsis assectella	Leek moth	Vegetable gardens	Lure and trap
Neoleucinodes elegantalis	Tomato fruit borer	Vegetable gardens	Lure and trap
Phthorimea absoluta (formerly Tuta absoluta)	Tomato leafminer	Vegetable gardens	Lure and trap
Lobesia botrana	European grapevine moth	Vineyards	Lure and trap
Depressaria depressana	Purple carrot seed moth	Vegetable gardens	Visual observation
Thrips parvispinus	Thrips	High tunnels	Visual observation
Cryptoblabes gnidiella	Christmas berry webworm	Vineyards	Lure and trap

Table 3. Plant Disease Pests in the Agricultural Pathways Survey.

Scientific Name			
Candidatus Phytoplasma mali 16SrX-A			
Candidatus Phytoplasma ziziphi	Jujube witches' broom	Orchards	Visual observation
Gymnosporangium yamadae	Red star rust	Orchards	Visual observation
Monilinia fructigena	Apple brown rot	Orchards	Visual observation
Clavibacter michiganensis subsp. *michiganensis*	Bacterial wilt and canker of tomato	Vegetable gardens	Visual observation
Cucumber Green Mottle Mosaic Virus	CGMMV	Vegetable gardens	Visual observation
Pseudoperonospora cubensis	Cucurbit downy mildew	Vegetable gardens	Visual observation
Ralstonia solanacearum race 3 biovar 2	Bacterial wilt	Vegetable gardens	Visual observation
Phyllachora maydis	Tar spot	Vegetable gardens	Visual observation
Tomato Brown Rugose Fruit Virus	ToBRFV	High tunnels	Visual observation
Candidatus Phytoplasma australiense 16SrXII-B	Australian grapevine yellows	Vineyards	Visual observation
Candidatus Phytoplasma solani 16SrXII-A	Stolbur disease	Vineyards	Visual observation
Candidatus Phytoplasma vitis 16SrV-C	Flavescence dorée	Vineyards	Visual observation
Pseudopezicula tetraspora	Angular leaf spot	Vineyards	Visual observation
Pseudopezicula tracheiphila	Rotbrenner disease	Vineyards	Visual observation
Xylella fastidiosa	Pierce's disease	Vineyards	Visual observation

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 1). 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. It is currently considered an agricultural and nuisance problem pest in Minnesota.

Brown marmorated stinkbug was first identified in Minnesota in 2010, and it continues to be detected throughout the state. To date, it has been detected in 29 counties. Most of BMSB finds have been in the greater Twin Cities metropolitan area. The insect is now considered established in the seven-county metropolitan area. The MDA tracks the distribution and abundance of BMSB across Minnesota in multiple ways, including citizen reports and field surveys.

Traps were set at residential sites in early May and remained through early November. All other BMSB traps ran alongside other Ag Pathways traps in 78 sites covering 26 different counties. There were 46 survey sites with BMSB detections in fifteen counties. The amount of BMSB captured at most of these locations was very small, and there is little evidence that they are causing any widespread damage in these settings. Populations are building quickly in urban settings and may require implementation of integrated pest management strategies soon.

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

Figure 2. A brown marmorated stink bug sticky trap in a Minnesota apple orchard.

Figure 3. 2023 BMSB survey locations and results.

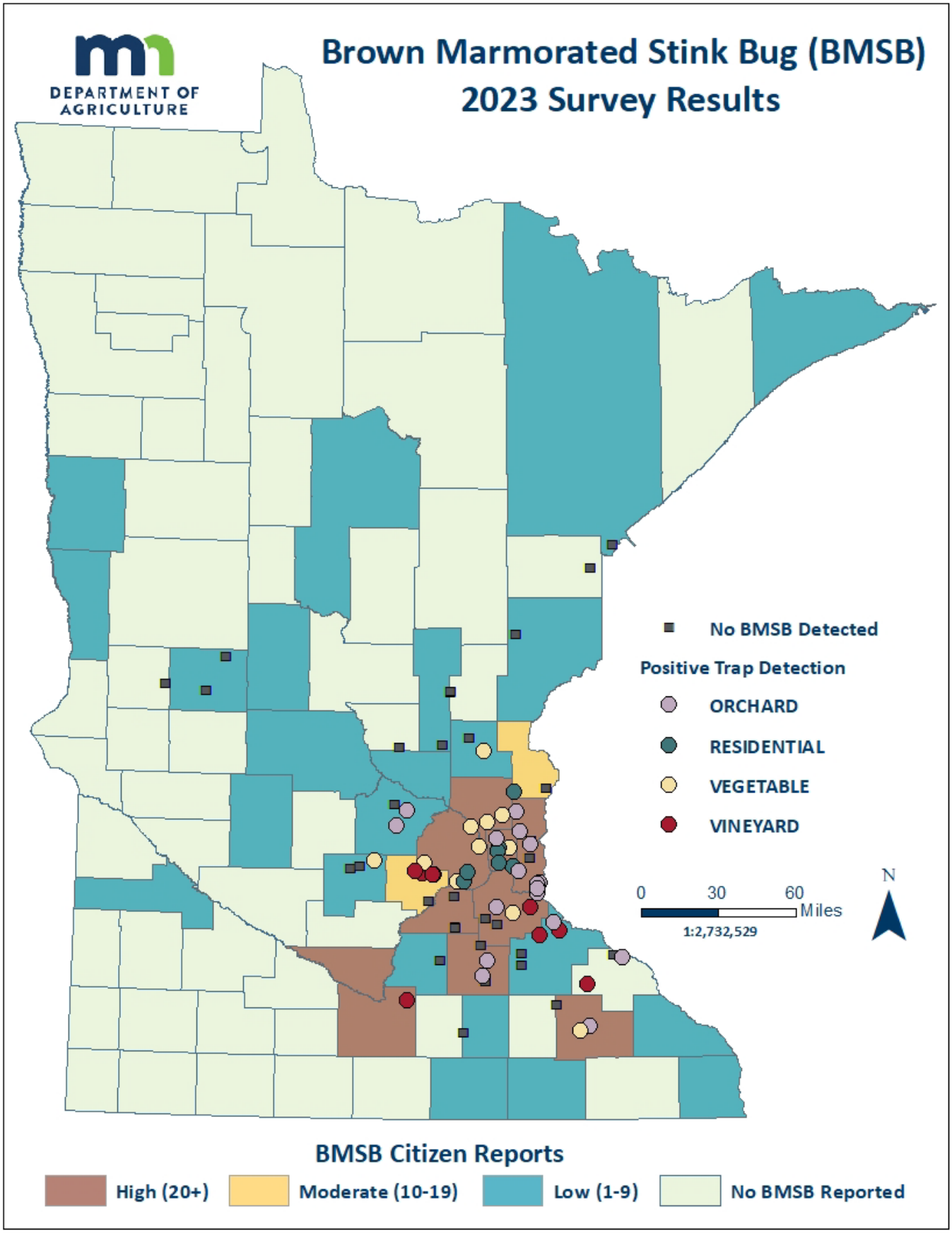


Table 4. BMSB positive counties by survey site types.

County	Orchard	Residential	Vegetable Garden	Vineyard
Anoka	0	0	2	0
Blue Earth	0	0	0	1
Carver	1	0	0	3
Chisago	0	1	0	0
Dakota	1	0	1	1
Goodhue	2	0	0	2
Hennepin	0	2	4	0
Isanti	0	0	1	0
McLeod	0	0	1	0
Olmsted	1	0	1	0
Ramsey	1	4	2	0
Rice	2	0	0	0
Wabasha	1	0	0	1
Washington	8	0	0	0
Wright	2	0	0	0
Totals	19	7	12	8

The MDA partners with the U of M through data sharing and research. 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 organizes 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 on the MDA's BMSB webpage.

A large increase in reports and trap catches of BMSB in 2023, including trapped nymphs, has indicated growing activity and establishment in the Twin Cities metropolitan area. It is also becoming more common for sites to have detections across multiple years. The increase has been well documented with seven years of monitoring data (Figure 6 and 7). 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 can provide information that could possibly help avoid reactive use of insecticides by agricultural producers.

In addition to monitoring BMSB, the MDA placed yellow sticky cards from mid-June through September 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 119 cards at 10 locations where BMSB nymphs had been detected in previous years. Cards were screened throughout December and suspect *T. japonicus* were removed for further identification.

In 2022, four wasps were identified by a specialist at the Florida Department of Agriculture as the BMSB egg parasitoid *Trissolcus japonicus*. This was the first find in Minnesota. These came from residential sites in St. Paul and Roseville where reproducing populations of BMSB are well documented. The other specimens identified *were T. euschisi* and *T. thyantae*. In 2023 T. japonicus were recovered from a residential site in St Paul and two residential sites in Roseville.

Figure 4. Percent of Minnesota counties with BMSB detections and number of agricultural production sites with BMSB detections since 2014.

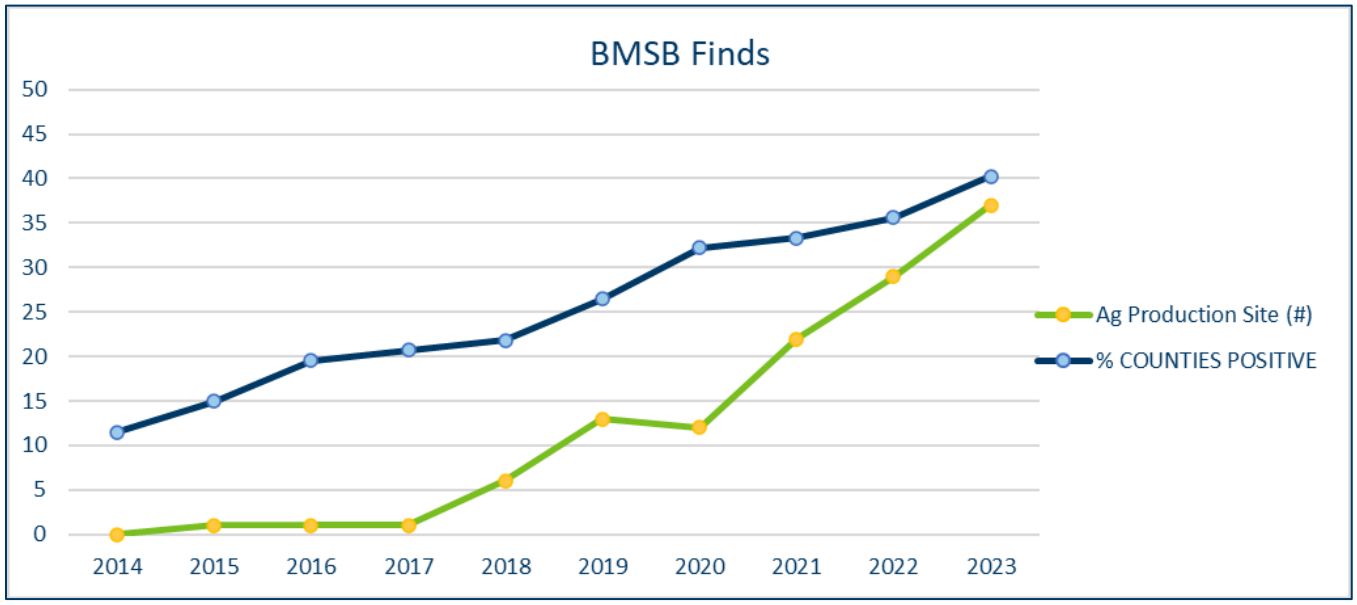
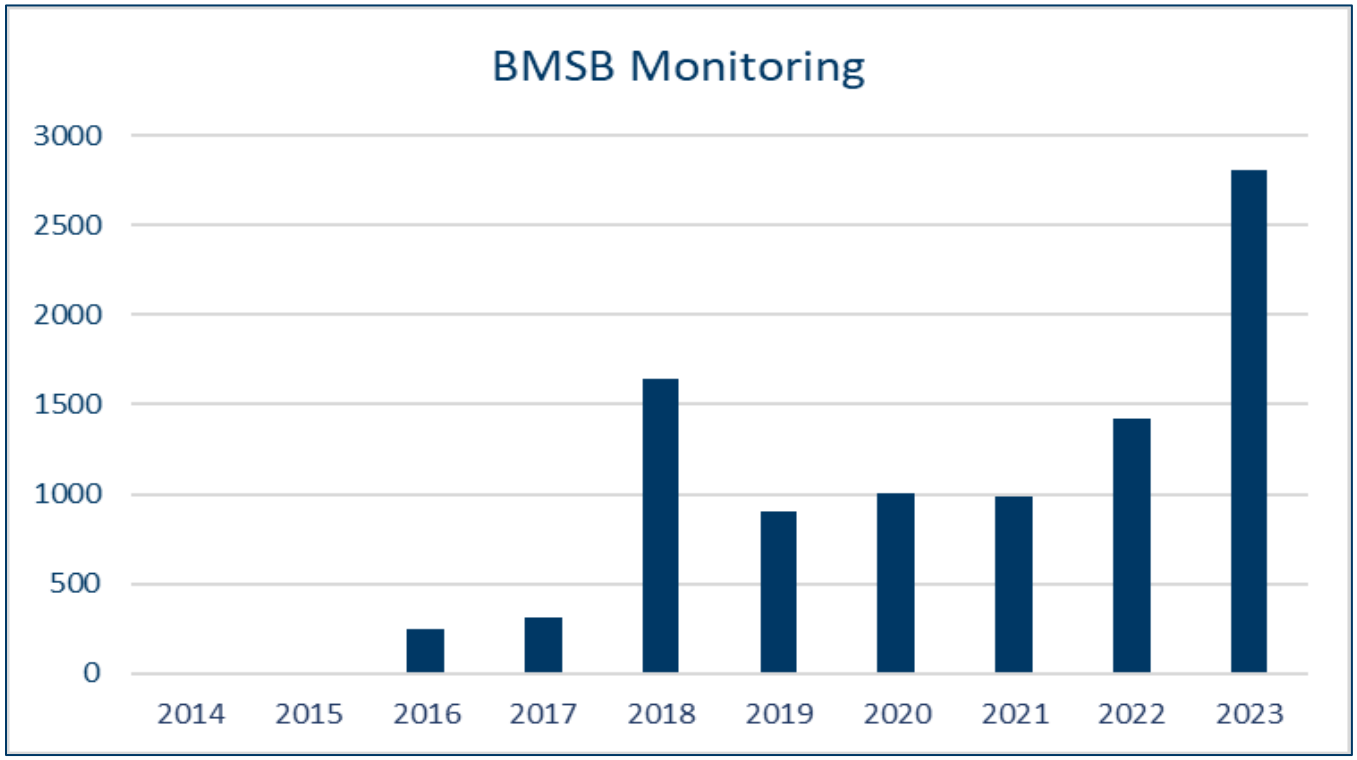


Figure 5. Number of BMSB adults and nymphs captured in survey traps each year.



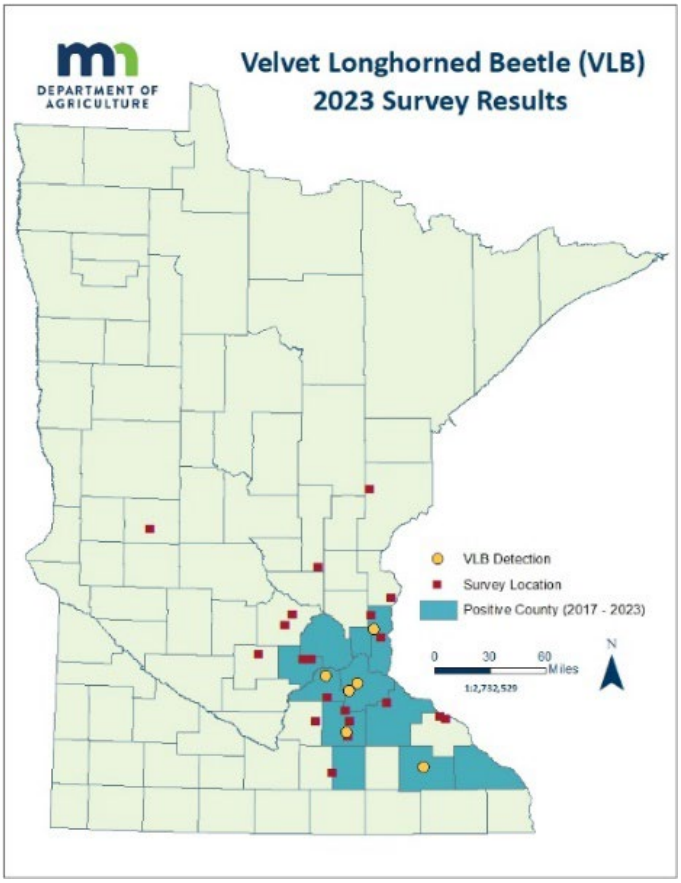
Velvet Longhorned Beetle

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 6). 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 like 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 6 Adult velvet longhorned beetle. Steven Valley, Bugwood.net

In 2023, VLB traps were set in 16 counties at 26 orchards. Adult beetles were captured in five counties: Dakota, Olmsted, Rice, Scott, and Washington. Finds in recent years indicate that VLB is likely widely established in parts of central and southern Minnesota. No evidence of damage caused by VLB has been observed. The MDA will continue monitoring for VLB in orchards in 2024.

Figure 7. VLB trapping locations and positive detections.



Disease Finds

Red Star Rust

Red star rust (formerly known as Japanese apple rust), caused by the fungus *Gymnosporangium yamadae*, is native to Japan, China, and Korea. This disease was first identified in the US in 2009 in several northeastern states and was reported in Wisconsin in 2021 and in Minnesota in 2022. In 2023, MDA identified red star rust in Carver and Washington counties. Infected apple trees were present in commercial apple orchards and nurseries.

The red star rust fungus infects apple, crabapple, and juniper at different stages of its life cycle. The most common symptom on apple and crabapple are bright red, orange, or yellow leaf spots. Some susceptible varieties of apple will drop infected leaves, resulting in yield loss. Small (<0.4 inches in diameter) woody galls form on juniper twigs. These produce a bright orange gelatinous mass full of fungal spores in wet spring weather. Spores produced on infected junipers are carried by wind and rain to infect apple and crabapple leaves in spring. In fall, chestnut brown powdery spores produced on infected apple and crabapple leaves are carried by wind to infect nearby junipers.

Figure 8. Red and orange leaf spots caused by red star rust in a Zestar apple.

Figure 9. Bright red leaf spot with long finger like spore producing structures emerging from the lower leaf surface on a crabapple tree infected with red star rust.

Tomato Brown Rugose Fruit Virus

Tomato Brown Rugose Fruit Virus (ToBRFV) is a federally regulated virus that infects tomatoes and peppers. Diseased plants have a mosaic pattern on their leaves and fruit are deformed, ripen irregularly, and have rough brown (rugose) skin making them completely unmarketable. This virus was first described in Jordan in 2015 and has now been found in multiple countries across the globe. ToBRFV can be carried to new areas on infected seed and transplants. Only a small number of infected plants can result in widespread disease problems because the virus easily moves from plant to plant on workers hands and tools.

In 2023, MDA scouted 10 farms with high tunnel production of tomatoes and peppers for ToBRFV in nine counties. The virus was detected at one site at the very end of the growing season. All infected plants were destroyed and the appropriate steps to eradicate the virus from the site were taken. More information about ToBRFV can be found on the USDA ToBRFV webpage.

Figure 10. Irregular patterns of dark and light green on the youngest leaves of the tomato plant are symptoms of infection with ToBRFV.

Aster Yellows Phytoplasma

The 2023 Ag Pathways surveyed for three invasive grapevine diseases caused by phytoplasmas (a small bacteria that lives in the plants vascular system). None of the targeted invasive diseases were found in any vineyard in 2023. The test used to detect phytoplasmas indicates the presence of any phytoplasma, including native phytoplasmas. In 2023, four vineyards in four counties tested positive for *Candidatus* phytoplasma asteris 16Sr1-A, the aster yellows phytoplasma. Aster yellows is not a regulated plant disease in Minnesota and has been detected in many different crops in the state. It has not been previously reported in grape vines in Minnesota.

Aster yellows (AY) is spread by the aster leafhopper, which migrates into Minnesota from southern states. The AY phytoplasma infects a broad range of plants including many common garden flowers, vegetables, and weeds. It lives in the plant's phloem and will move into the roots and crowns of perennial plants to survive winter. Once infected, with AY, there is no way to cure the plant of the infection.

Grape vines in the survey with aster yellows displayed foliar symptoms including yellowing, purpling, and brown discoloration around the leaf margin. Aster yellows has also been reported to cause uneven lignification of vines, flower abortion and berry withering in grapes.

More information about aster yellows can be found at the U of M Extension aster yellows webpage.

More information about aster leaf hopper at the U of M Extension leafhopper webpage.

More information about grapevine yellows can be found at the Ontario Ministry of Agriculture, Food, and Rural Affairs Grape IPM webpage.

Figure 11. Purplish red discoloration of the leaf edges is a symptom of aster yellows in purple grapes. In white grapes leaf edges turn yellow.

Outreach

The MDA conducts outreach to keep cooperators and the public informed about invasive species in Minnesota. The Report a Pest system allows people to report pests using an online form, by phone, email, or via EDDMapS (www.eddmaps.org) and is a participation tool that can help focus awareness and make early detection campaigns more efficient. This was a slower year for reporting invasive species with just over 1,400 reports via all the methods mentioned.

The Report a Pest online reporting form was updated to include new species and prompts citizens to input an address, picture, and contact information. This form has reduced the number of email correspondences needed with the public to correctly identify invasive species. It has also streamlined the tracking process by automatically assigning reports to the appropriate MDA staff based on the general public's selection of species or question. The benefits from this activity include the development of a broader audience awareness of invasive pests and better early detection of quarantine pests.

Through a grant from the USDA Plant Protection Act 7721, the MDA also conducted an advertising campaign in 2023 to highlight the risk of invasive species in southeast Minnesota. Advertising about tree of heaven and spotted lanternfly early detection efforts included online, social media (Figure 14), newsprint, poster, and gas station (Figure 15). A website and tagline "double trouble" was created to bring awareness to these two invasive pests that could already be in the state. The website www.mda.state.mn.us/doubletrouble received 10,097 page views since the advertisements began. The google ad impressions were 4,940 with a click through rate (CTR) of 10.55%, and the Facebook ad impressions were over 255,000 with a CTR of 5.87%. Both ads had higher engagement rates than the industry standard.

Figure 124. Advertisement for early detection of two invasive species.

Figure 15. Advertisement posted at a gas station in southeast Minnesota.

For More Information

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