DEPARTMENT OF AGRICULTURE

Status of Invasive Field Crop Pests in Minnesota

2022 Annual Report

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Background

Several emerging and invasive insects, plant pathogens, and weeds threaten commodities in Minnesota. These pests have the potential to cause problems for production and export if they were to become established here. The Minnesota Department of Agriculture (MDA), along with partners at the United States Department of Agriculture (USDA) and the University of Minnesota (U of M), conduct an annual review of invasive pests that pose the greatest threat to crops in Minnesota. Many of these pests have not been found in Minnesota and others are present but not widely established. Survey efforts are designed to detect these organisms as early as possible by targeting high-risk areas. Commodity crops in Minnesota represent a large portion of the Minnesota agricultural industry. Corn, soybean, and wheat account for over 60% of the state's commodity exports. Trapping is focused on counties with the highest number of acreages of the commodity being monitored.

Corn, Small Grains, and Soybeans

The MDA Pest Detection Unit monitored corn, small grains, and soybean fields in 2022 for several invasive pests that are currently not known to occur in Minnesota or have limited distributions within the state. This survey was jointly funded by the USDA Animal and Plant Health Inspection Service (APHIS), Plant Protection Quarantine Program (PPQ), and the MDA.

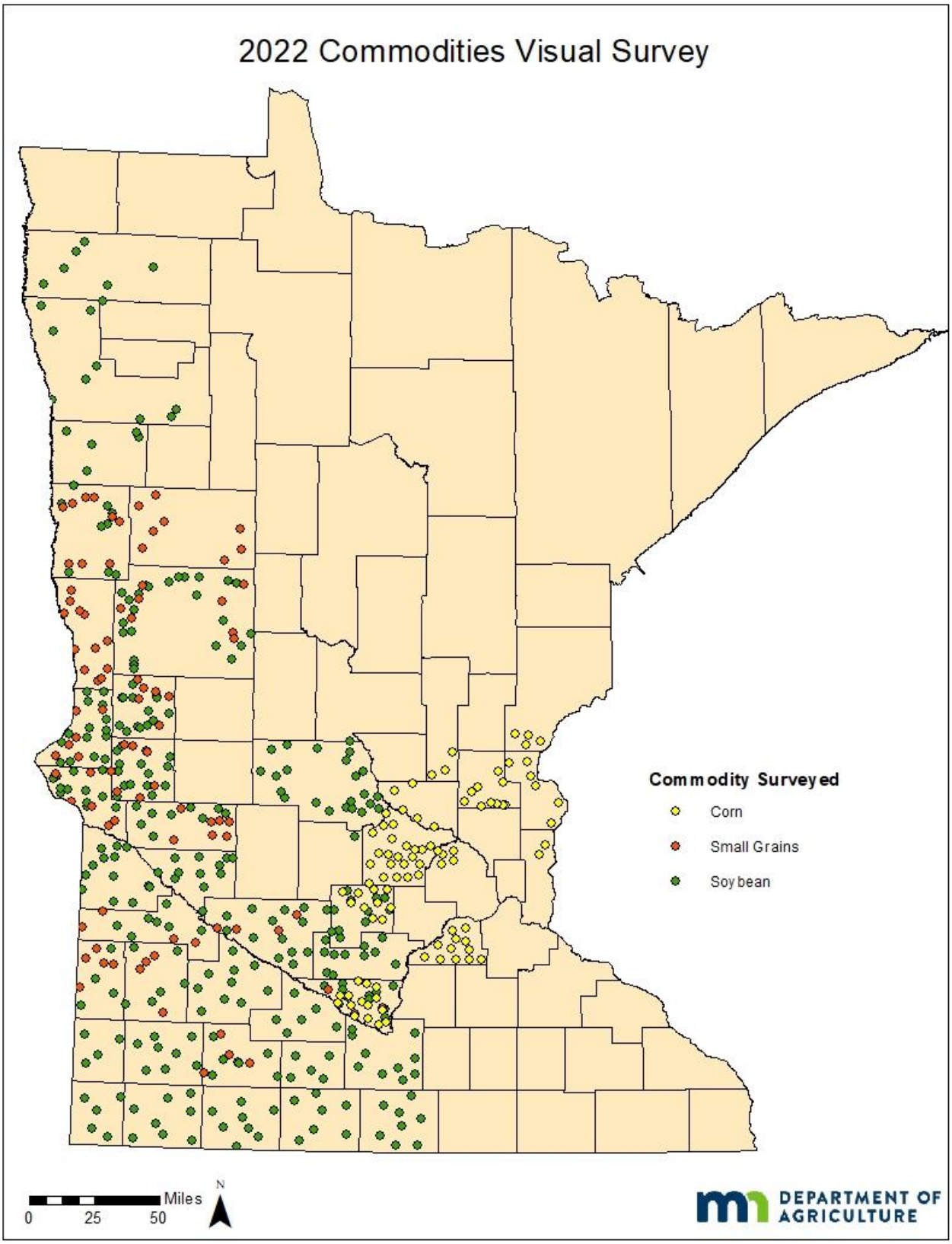
Visual Survey

Plants were visually inspected for the presence of target pests. Fields were objectively selected for survey, but an effort was made to space out sampled fields within counties (Figure 1). Small grain fields were visually surveyed in June, soybean fields were visually surveyed July through August, and corn fields were visually surveyed in September. Table 1 shows the number of counties and fields visually surveyed in 2022.

Table 1. Commodity visual survey

Crop	Counties	Fields Visually Surveyed
Corn	11	94
Small Grains	15	93
Soybeans	32	325

Figure 1. Locations of corn, small grains, and soybean fields surveyed in 2022.



Insect Visual Survey

In 2022, soybean fields were visually scouted for insects. Within each soybean field, a common protocol was followed for the target insect pests listed in Table 2. Four sets of 25 sweeps were made in separate areas of each field. Each set of 25 sweeps was separated from the other by at least 50 meters. Two sets of sweeps were made near the edge of the field (within 5-50 meters of field edge), and two sets of sweeps were made in the interior of the field (greater than 50 meters from the field edge).

Table 2. Soybean Visual Survey Insect Targets

Common Name	Scientific Name
Brown marmorated stink bug	*Halyomorpha halys*
Cucurbit beetle	*Diabrotica speciosa*
Japanese beetle	*Popillia japonica*
Soybean gall midge	*Resseliella maxima*

Brown marmorated stink bug (*Halyomorpha halys*), Cucurbit beetle (*Diabrotica speciosa*), and Japanese beetle (*Popillia japonica*) were not found in 2022. Soybean gall midge (*Resseliella maxima*) was found in one field in Rock County.

Soybean and Small Grain Disease Survey

Soybean and small grain plants were examined for disease symptoms. Samples were collected from plants displaying symptoms consistent with any of the target pathogens (Table 3). Diagnosis was performed by the MDA Laboratory Services. No target pathogens were identified in small grains. In soybean, *Cercospora sojina* was identified in eight counties: Brown, Jackson, Lincoln, Nobles, Redwood, Renville, Wataonwan, and Yellow Medicine. This was the first detection of *C. sojina* in Lincoln County. There were no finds of soybean sudden death, caused by *Fusarium virguliforme*. Bacterial wilt and tan spot of soybean, caused by *Curtobacterium flaccumfaciens*, was not identified in field surveys. However, this pathogen was detected in a phytosanitary field inspection in one county, indicating that it was present in low levels in 2022.

Table 3. Disease Targets

Common Name	Scientific Name	Survey
Tar spot	*Phyllachora maydis*	Corn
Tan spot, bacterial wilt	*Curtobacterium flaccumfaciens*	Soybean
Frog eye leaf spot	*Cercospora sojina*	Soybean
Sudden death syndrome	*Fusarium virgulifome*	Soybean
Dwarf bunt	*Tilletia controversa* (cereal strain)	Small grains
Wheat flag smut	*Urocystis agropyri* (wheat strain)	Small grains
Wheat seed gall nematode	*Anguina tritici*	Small grains
HPV	High Plains Virus	Small grains

2022 Tar Spot Survey

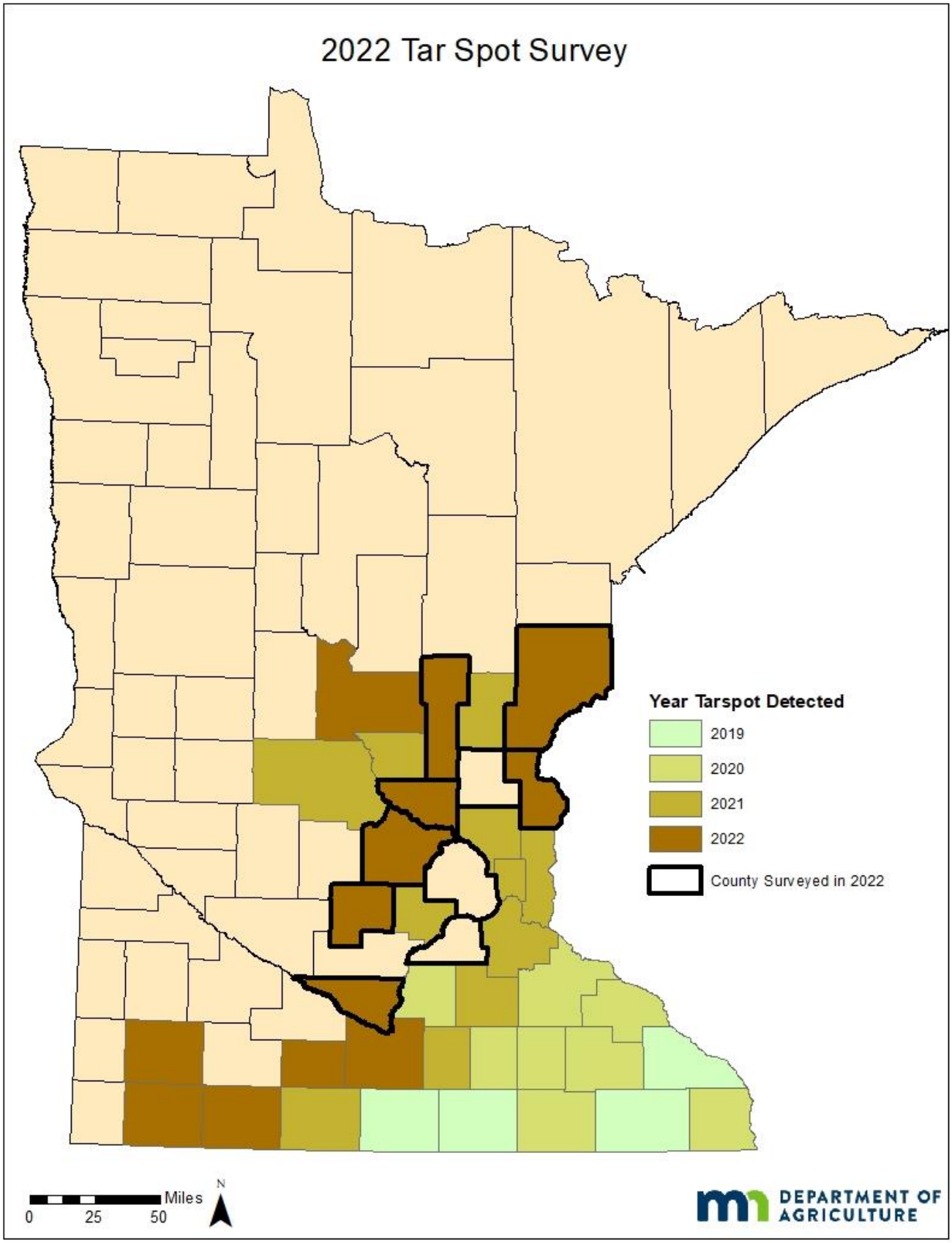
Tar spot is an invasive disease of corn caused by the fungus *Phyllachora maydis* (Figure 2). Yield loss as high as 50 bushels per acre have been reported in severe cases. Tar spot was first found in Minnesota in 2019 in the southeastern corner of the state. Each year, tar spot has spread further north and west from the original point of detection.

In 2022 the MDA conducted a survey of 10 counties at the leading edge of the known tar spot infestation. The survey followed the 2010 USDA corn commodity-based survey guidelines. The number of fields surveyed per county was determined based on reported acres of corn planted in previous years. Ten to twenty plants were closely inspected for tar spot at four locations within each field. Any leaf spots found were sampled and the presence of *Phyllachora maydis* confirmed by laboratory analysis of spores and spore producing structures.

Tar spot was detected in six new counties: Chisago, McLeod, Mille Lacs, Nicollet, Pine, and Sherburne (Figure 2). In all counties, infection levels were very low and would not affect yield. The presence of the pathogen within the county however indicates that future infections are possible. *Phyllachora maydis* overwinters on infected corn leaves left in the field as plant debris after harvest. In spring spores are carried by wind and rain to infect new leaves. These new leaf infections produce spores in 12 to 15 days. Tar spot is favored by cool temperatures (60-70F) and high humidity. If these conditions persist disease can continue to increase within infected fields.

Figure 2. Raised black spots of tar spot on an infected corn leaf.

Figure 3. Map of tar spot (*Phyllachora maydis*) distribution in Minnesota, including new finds in 2022.



Noxious Weed Visual Survey

Yellow witchweed (*Alectra vogelii*) was surveyed for in 325 soybean fields in 32 counties. This is a parasitic weed found in leguminous crops. Its presence in a soybean field can cause the soybean plants to be stunted with smaller leaf area and shorter petioles. The target weed was not found in 2022.

Insect Trapping Survey

In addition to visual inspections of fields, 125 plastic bucket traps were used for target insect pests listed in Table 5. Ninety traps for Old World bollworm (*Helicoverpa armigera*) and 37 traps for Golden twin spot moth (*Chrysodeixis chalcites*) were placed in 32 counties (Figure 4). Traps were set in late June and baited with a species-specific pheromone lure in ditches bordering soybean fields and suspended above the vegetation. Traps were checked at least once and removed in late August. Trap samples were screened and specimens that could not be eliminated as target species were submitted to the MDA Laboratory Services for the MDA Entomologist to screen. Specimens that could not be eliminated as suspects by the MDA were submitted to the USDA for final identification. The target pests were not found in 2022.

Figure 4. Location of insect traps placed in 2022.

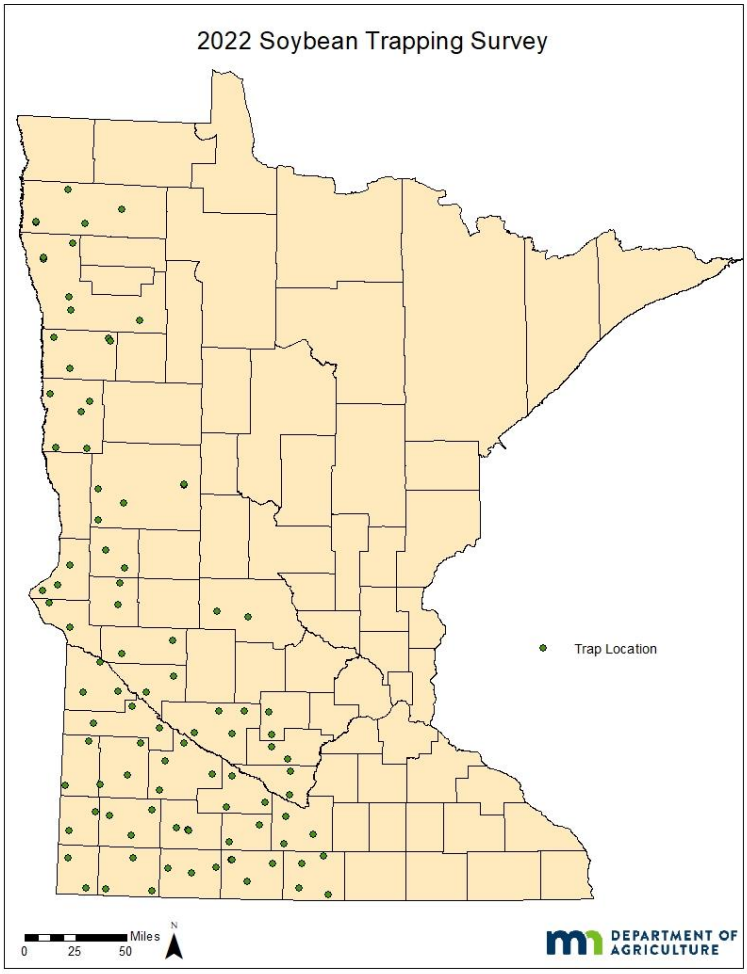


Table 4. Soybean Trapping Survey Insect Targets

Common Name	Scientific Name
Old World bollworm	*Helicoverpa armigera*
Golden twin spot moth	*Chrysodeixis chalcites*

Potatoes

Potatoes grown for seed are at high risk for moving certain soil-borne pathogens. Unlike potatoes grown for other uses, seed potatoes are not washed at any time, and they are planted back into the soil. Some of the most important soil-borne pathogens that could affect seed potatoes are nematodes that produce cysts. Nematodes are microscopic worms that feed on the roots of plants, causing reductions in growth and yield. Cysts, produced by the females of some species, are pinhead-sized egg sacs containing 200 – 400 eggs. They are protected by a hardened cuticle which allows them to survive for many years in a field, even in the absence of a host crop. Most kinds of cyst nematodes feed and reproduce on one or two kinds of plants, though some will feed on more. Several cyst nematodes are considered quarantine pests, such that severe long-term restrictions would be placed on movement of plant material and equipment from an area found to contain one of them.

To export seed potatoes to Canada, a grower must have documentation to confirm that the field from which the seed potatoes were harvested were free of potato cyst nematodes (PCN) based on a survey following USDA guidelines. The MDA surveys Minnesota seed potato fields for two species of PCN, pale cyst nematode (*Globodera pallida*) and golden nematode (*Globodera rostochiensis*). Both are quarantine pests in potato growing areas around the world, including the United States.

Table 5. Cyst Nematode Survey Targets

Common Name	Scientific Name
Pale cyst nematode	*Globodera pallida*
Golden nematode	*Globodera rostochiensis*

Results of the 2021 Cyst Nematode Survey

In 2021, soil samples were collected from 516 acres in Clay, Kittson, Lake of the Woods, and Wadena counties at the request of seed potato growers. All soil samples were sieved and examined for the presence of nematode cysts (Figure 5). A total of 349 cysts were submitted to USDA APHIS for identification. All submitted cysts were determined to be soybean cyst nematode (*Heterodera glycines*) a widely established pathogen of soybean in Minnesota. No potato cyst nematodes (*Globodera pallida* and *Globodera rostochiensis*) were detected in 2021.

Figure 5. Nematode cysts (circled in red) found in soil samples from seed potato fields.

The Minnesota PCN survey has been conducted every year since 2009. As a result of the longevity of this project and careful record keeping, the MDA can identify fields that qualify for exemption from sampling based on the 2014 USDA guidelines. In 2021, three fields (totaling 106 acres) became exempt after two years of sampling and no finds of PCN. These fields will be exempt from sampling for the next three potato crops. Minnesota was first in the nation to have fields qualify for exemption based on this survey.

2022 Cyst Nematode Survey

In 2022, soil samples were collected from 665 acres in Clay, Kittson, Lake of the Woods, Polk, and Wilkin counties at the request of seed potato growers. All soil samples have been sent to the USDA nematology lab in Idaho for processing and identification of cyst nematodes.

More information on potato cyst nematodes can be found at www.mda.state.mn.us/potato-cyst-nematode

Hemp

In 2022, hemp fields were surveyed for insect pests and diseases. Four sites in Dakota, Ramsey, and Washington counties were visited monthly June through September. Sites included both indoor and outdoor field production of hemp. Plants were visually inspected each month. All insect pests and diseases were sampled and identified. The insect and disease problems identified during the survey differed between indoor and field production sites, indicating that production environment strongly influences which pests are likely to be problematic.

Insect Survey

In July, yellow sticky cards and bucket traps baited with a corn earworm pheromone lure were set in field production sites to capture insect pests not present at the time of inspection. Traps were inspected and samples were collected on monthly site visits.

Many of the insect pests observed caused only minor damage to the plant that was unlikely to significantly affect production. This included Japanese beetle, leaf feeding caterpillars, tarnish plant bug, stink bug, and rose chafer beetle. Eurasian hemp borer was found within hemp stems and caused death and dieback of small shoots. In addition, borers could infest flower stalks, killing the flower buds. Borers that infested larger stems on established plants often did not result in visible damage to the plant beyond a minor swelling of the stem and small exit hole. Aphids and mites were also common. Most observable mite damage was seen on plants that were being grown indoors. Aphids were observed both indoors and in the field. There were also many beneficial and predatory insects present in the fields including various species of lady beetles, lace wings, wasps, and bees. These insects were present in almost all the of fields we sampled.

Figure 6. Aphids on underside of hemp leaves.

Grasshoppers caused the most severe and striking damage observed during the survey. One field experienced a severe infestation of grasshoppers where widespread defoliation occurred to the point that there were little to no leaves left on the plants. This damage had a significant effect on yield. At the second visit many grasshoppers were observed to be infected with *Entomophaga grylii*, a fungal pathogen of grasshoppers. This fungus causes summit disease, which causes the infected insect to climb to the upper part of a plant and grip the stem as they die.

Table 6. Hemp insect pests identified

Insect Common Name	Scientific Name	Sites Affected	Production Type
Two striped grasshoppers	*Melanoplus bivittatus*	1	Field
Red legged grasshopper	*Melanoplus femurrubrum*	1	Field
Clearwing grasshopper	*Camnula pellucida*	1	Field
Corn Earworm	*Helicoverpa zea*	3	Field (Bucket Traps)
Japanese beetle	*Popilia japonica*	3	Field
Tarnished plant bug	*Lygus lineolaris*	3	Field
Red Headed Flea Beetle	*Systena frontalis*	2	Field
Goldenrod soldier beetle	*Chauliognathus pennsylvanicus*	2	Field
Rose chafer beetle	*Macrodactylus subspinosus*	1	Field
Green lace wing	*Chrysopa chi*	1	Field
Eurasian hemp borer	*Grapholita delineana*	2	Field
Stink bug	various	1	Field
Various caterpillars	various	2	Field
Aphids	various	2	Indoor / Field
Potato Leaf hopper	*Empoasca fabae*	1	Field
Spider mites	-	1	Indoor
Russet mite	*Aculops cannabicola*	1	Indoor

Figure 7. Japanese beetle feeding on hemp leaves.

Figure 8. Stem damage caused by Eurasian hemp borer.

Figure 7. Severe defoliation caused by grasshoppers.

Disease Survey

Of the diseases observed, Fusarium wilt, hemp brown blight, and white mold caused the most significant damage. Fusarium wilt and hemp brown blight resulted in wilt and death of multiple plants within indoor production environments. White mold infected and killed plant stems, resulting in the death of flower heads. White mold was also observed directly infecting the flower heads. White leaf spot was observed at two sites, but infected leaves were restricted to the lower 1/3 of the plant. Although some leaf yellowing and leaf loss was observed, damage was not severe enough to significantly affect yield.

Table 7. Hemp Diseases Identified

Disease	Pathogen	Sites Affected	Production Type
Fusarium wilt	*Fusarium* spp.	1	Indoor
White leaf spot	*Phomopsis* spp.	3	Field
Hemp brown blight	*Alternaria* spp.	1	Indoor
White mold	*Sclerotinia sclerotiorum*	1	Field

Figure 8. White mold, caused by the fungus *Sclerotinia sclerotiorum*, killed the main stem of this hemp plant.

Figure 9. White leaf spot, caused by the fungus *Phomopsis* spp., was found at low levels at several sites.

For More Information

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