DISEASES OF WHEAT

Wheat Viruses

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Each spring, one may commonly observe leaf mottling, yellow streaks, and mosaic discoloration across Indiana wheat fields. A number of different factors can cause these symptoms, including nitrogen deficiency, winter injury, and virus diseases (Figure 1).

The most common virus diseases in Indiana are barley yellow dwarf virus (BYDV), soilborne wheat mosaic virus (SBWMV), wheat streak mosaic virus (WSMV), and wheat spindle streak mosaic virus (WSSMV). These diseases are difficult to distinguish from each other in the field, and laboratory testing will be needed for an accurate diagnosis. Although not typically severe, in certain years wheat viruses can substantially affect yield.

This publication describes:

1. How to distinguish among wheat virus diseases
2. How each virus is transmitted
3. How to manage wheat virus diseases to minimize yield losses

Figure 1. A wheat field infected by barley yellow dwarf virus.

Wheat Spindle Streak Mosaic & Soilborne Wheat Mosaic

Wheat infected with soilborne mosaic viruses (WSSMV and SBWMV) may exhibit yellow-green streaks on leaves and plant stunting and/or leaf tip dieback (Figures 2, 3, and 4). SBWMV can cause a rosette symptom in susceptible varieties, which results in excessive production of severely stunted tillers. Researchers also have observed a reddish coloring on lower leaves on wheat plants infected with WSSMV and SBWMV. Plants infected with either virus may produce fewer stems and heads and have fewer kernels (Figure 4).

Figure 2. Mottling caused by soilborne wheat mosaic virus.

Figure 3. Streaking of leaf tissue caused by wheat spindle streak mosaic virus.

Figure 4. Healthy wheat plants (left) and plants susceptible to soilborne wheat mosaic virus.

SBWMV and WSSMV infect wheat plants in the fall. The soilborne, fungus-like organism *Polymyxa graminis* transmits both viruses to wheat roots. This organism does not damage wheat by itself, but it enters wheat roots and transmits the viruses to wheat plants.

Symptoms of virus infection are not apparent until spring, and the severity of symptom expression depends on varietal differences in susceptibility and weather. Prolonged cool conditions in spring (60°F, 15.5°C or less) enhance symptom development of both diseases in infected fields. As temperatures increase in the spring, symptoms often disappear and plants appear to recover.

If virus symptoms and distribution within a field are limited, yield may be reduced, but severe or widespread infections can cause stunting and yield loss. You may need to replant severely infected fields. Consult extension specialists to determine if replanting is necessary.

Management

There are no control options available to reduce virus symptoms in currently infected plants. Still, it is important to accurately diagnose viruses to manage future wheat plantings. There are wheat varieties available with resistance to one or both of the mosaic virus diseases. Be sure to check the variety if you have problems with both soilborne virus diseases in a single field, since some varieties are resistant to only one virus.

Crop rotation may not prevent infection by SBWMV or WSSMV since the organism that transmits the virus can survive in the soil for more than five years. Therefore, the best way to manage these virus diseases is to plant resistant varieties in areas that have a history of the diseases.

Wheat Streak Mosaic

The symptoms of wheat streak mosaic virus (WSMV, sometimes referred to as wheat streak virus) begin as discontinuous yellow streaks that run parallel to the veins on wheat leaves (Figure 5). As the virus multiplies and the disease progresses, leaves take on a mottled appearance, then eventually turn brown and die.

Infections vary in severity depending on the wheat's growth stage at the time of infection and on environmental factors such as temperature and moisture. Warm (75-80°F, 24-27°C), dry weather favors infection by stressing plants and encouraging the proliferation of the virus' primary vector, the wheat curl mite (*Aceria tosichella*). WSMV can also be transmitted mechanically in plant sap, but this is rare.

Figure 5. The discoloration of this wheat leaf is caused by wheat streak mosaic virus.

Wheat curl mite (Figure 6) is an obligate parasite that can colonize wheat, corn, and a wide variety of other perennial grass hosts at any point during the growing season. When a large number of mites infect a single plant, they can cause the leaves to curl inward, giving the plant a rolled or twisted appearance.

The mites acquire WSMV by feeding on infected plants, and they can then transmit the virus to other grasses for about one week. The mites do not have wings so they rely primarily on wind to move from one plant to another. The mites look like tiny grains of white rice when viewed under a hand lens or microscope, but they are not visible without magnification.

When mites colonize wheat plants early in the growing season (especially closely after planting) there will be greater yield loss and more pronounced symptoms. However, a fall infection will not show symptoms until the following spring.

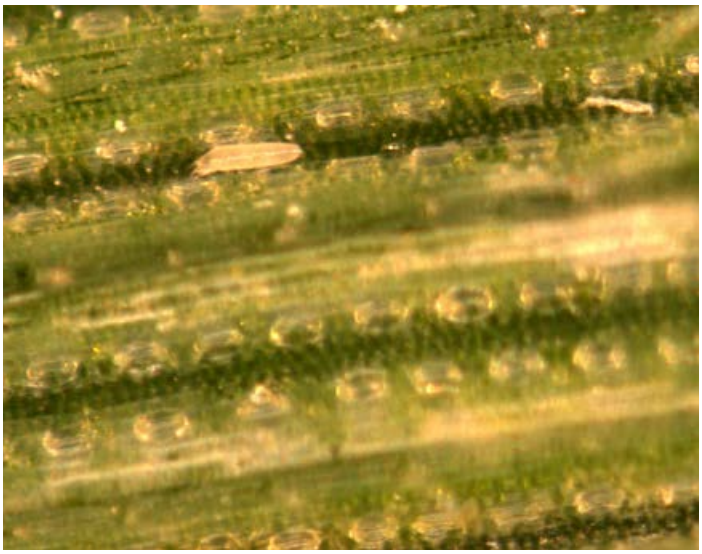

Figure 6. A wheat curl mite.

Management

Choose a wheat variety with partial resistance to either wheat curl mite or WSMV and plant after the Hessian fly free date — both practices are important management techniques in fields with a history of WSMV.

In addition, eliminate volunteer wheat and other grasses late in the season to help reduce the chances of the crop developing WSMV. Eliminating volunteer wheat and other perennial grasses also avoids creating a "green bridge" that allows the mite population to continue building throughout the season.

Since corn can also host wheat curl mites, try to avoid planting wheat within two weeks of harvesting late-maturing corn in adjacent fields. This will help interrupt the mite's life cycle and reduce the likelihood of wheat becoming infected with WSMV.

Barley Yellow Dwarf

Barley yellow dwarf (BYD) is caused by a number of different strains of Barley yellow dwarf virus (BYDV) and cereal yellow dwarf virus (CYDV). These viruses can infect more than 150 different grass species including wheat, oats, barley, rice, and corn.

Several aphid species transmit the viruses. Once an aphid contracts the virus by feeding on an infected plant, it can transmit the virus for two to three weeks. Symptoms usually appear in wheat two to three weeks after initial infection, but symptoms from fall infections may not appear until the following spring.

Typical BYD symptoms include stunted tillers and root systems accompanied by discolored foliage. Discoloration typically begins at the leaf tips and progresses downward, which leaves a striped appearance at the interface of healthy and infected tissue (Figure 7). In wheat, leaves can appear yellow, red, or purple. The specific discoloration varies widely from one grass species to the next (from severe to negligible).

Infected wheat plants may also exhibit reduced tillering, poor flowering, and sometimes kernel sterility or failure of the kernel to fill at all. Many factors influence how severe the symptoms will be including genotype, environmental stress, plant age at the time of infection, and the overall physiological condition of the plant. The healthier a plant is, the less severe the symptoms will likely be.

Cool (50-68°F, 10-20°C), wet weather is favorable for aphid migration. Symptom expression is favored by cool, bright days.

Figure 7. Barley yellow dwarf symptoms on wheat.

Management

No wheat varieties are completely resistant to these viruses, but there are several varieties that are less susceptible to the disease. Like the other virus diseases, planting a less susceptible variety is the first line of defense against BYD. Planting after the Hessian fly-free date and controlling grassy weeds that are aphid hosts can also reduce the chance of wheat contracting these viruses.

If plants are infected with BYDV, it is important to keep the plants healthy by managing other foliar diseases and maintaining adequate moisture and nutrients. Healthy plants can better tolerate the negative effects of infection. Managing aphids can help in areas with large populations, but spraying insecticides is not usually economical.

As always, it is important to correctly diagnose the problem before implementing any management practices. It is very difficult to definitively diagnose a wheat virus in the field by symptoms alone, so if you suspect viral infection, send a sample to the Purdue Plant and Pest Diagnostic Lab (PPDL) for testing (ppdl.purdue.edu). For an accurate diagnosis, it is important to dig up and submit entire plants exhibiting symptoms (see submission information at ppdl.purdue.edu/PPDL/physical.html).

Diseases and Disorders with Similar Symptoms

There are a handful of wheat diseases and disorders that have symptoms similar to wheat viruses. These are described below along with tips for how to distinguish them from viruses.

Septoria and Stagonospora Leaf Blotches

Septoria and Stagonospora leaf spots are common foliar diseases of wheat. Typical symptoms include round, elongated lesions, which, as they progress, develop small, black reproductive structures in their centers (Figure 8).

Septoria leaf spot lesions tend to have wavy, poorly defined edges. Stagonospora lesions have clearly defined edges, often surrounded by a yellow halo.

Figure 8. Mixed Septoria and Stagonospora leaf lesions on a wheat leaf.

How to distinguish Septoria and Stagonospora leaf spots from wheat viruses:

Septoria and Stagonospora leaf spots are distinguished by small, brown-black fungal structures at the centers of their lesions. Also, as these lesions colonize leaves, the older lesions will turn necrotic, unlike viral discoloration, which simply remains discolored.

Nutrient Deficiency

Several nutrient deficiencies in wheat cause leaves to turn pale green or yellow, including nitrogen deficiency and potassium deficiency (Figure 9). Nitrogen and potassium deficiencies first appear on older leaves and are usually most pronounced at the tips. Symptoms usually begin in one or several patches in a field (those with lowest levels of the nutrient).

How to distinguish nutrient deficiencies from wheat viruses:

Viruses cause foliar discoloration that is usually mottled or mosaic-like. Nutrient deficiencies cause leaves to turn a uniform pale green or yellow. This coloration may have a gradient from tip to node, but it will not appear splotchy as with virus infections.

Figure 9. Phosphorus-deficient wheat.

Winter Injury

Winter injury (or winterkill) typically occurs in aggregated areas throughout a field, often where conditions were conducive to prolonged periods of cold temperatures. Fields that were exposed to freezing and thawing cycles, and areas where ice developed on the soil surface, are particularly susceptible to winterkill.

Winterkill symptoms include stunted plants and reduced stand counts (Figure 10). This is most common after winters with prolonged periods of freezing weather.

Figure 10. This wheat plot suffered winterkill.

How to distinguish winter injury from wheat viruses:

Winter injury can result in tip dieback and stunted plants, but winter injury will not appear to spread throughout the field or express itself as mottling or streaking on leaves (unlike a virus).

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