1989

G89-906 Barley Yellow Dwarf Disease of Barley, Oats, and Wheat

John E. Watkins
University of Nebraska&#8211Lincoln, jwatkins1@unl.edu

Leslie C. Lane
University of Nebraska&#8211Lincoln

G89-906-A

Barley Yellow Dwarf Disease of Barley, Oats, and Wheat

The symptoms of barley yellow dwarf are covered here, as are disease occurrence and spread, and control.

John E. Watkins, Extension Plant Pathologist
Leslie C. Lane, Associate Professor

Barley yellow dwarf (BYD) is distributed worldwide. It is the most economically important disease of barley and oats in North America. Barley yellow dwarf, wheat streak mosaic (WSM) and soil-borne wheat mosaic (SBWM), are three virus diseases that caused serious cereal grain yield losses in Nebraska during the last decade.

Since the mid-1980s barley yellow dwarf has become increasingly widespread in Nebraska, and now is a serious concern to oat and wheat producers. Outbreaks occasionally reach epidemic proportions as occurred in wheat in 1987 and oats in 1988.

The barley yellow dwarf virus (BYDV) actually includes several related viruses grouped into five strains based primarily on the specific aphid species able to transmit the particular strain. Barley yellow dwarf virus can be transmitted by 23 species of aphid and infects almost 100 species of annual and perennial grasses, including barley, corn, oats, rye and wheat.

Symptoms

Barley yellow dwarf sometimes is difficult to diagnose in the field and may go unrecognized in some cases. Symptoms of barley yellow dwarf are highly variable and can be confused with those of wheat

streak mosaic, nutrient deficiency, root and crown diseases, and environmental stress. Diagnosis is even more difficult when both wheat streak mosaic and barley yellow dwarf are mixed in the same field or even in the same plant.

A big stumbling block to laboratory confirmation of barley yellow dwarf is the difficulty in consistently detecting all five strains of barley yellow dwarf virus. This sometimes leads to a false negative diagnosis when, in fact, barley yellow dwarf virus is present. On the positive side, developing technologies using new serological, biochemical and biotechnological methods are expected to accurately and rapidly detect all five barley yellow dwarf virus strains.

Barley yellow dwarf is diagnosed in the field by the presence of yellowish to reddish stunted plants grouped singly or in small patches among normal plants.

Early infection of any of the cereal grains may result in severe stunting, excessive or reduced tillering, bright-yellowing or reddening of older leaves, delayed heading or ripening, increased sterility, and fewer and lighter-weight kernels.

Post-seedling infections are progressively less severe to the point where only the upper leaves, or the flag leaves, show discoloration. Mildly infected wheat may not show any discoloration.

The leaves of plants infected with barley yellow dwarf virus are shorter than normal, and the flag leaf may be severely shortened. Leaves often are stiffer and more erect. Root systems are reduced and diseased plants are more easily pulled than healthy plants.

Stunted plants result from the failure of the stem internode to elongate. This leads to a "telescoped" plant where the leaves may unfurl before they have fully emerged from the sheath of the previous leaf. Infected plants are "dwarfs" and have lost their normal confirmation. Even the head, or panicle, doesn't emerge fully or properly.

Patterns of barley yellow dwarf in a field either may be seen as random within the crop or as circular or angular patches which reflect the pattern of movement of the aphid vectors or carriers. Many of the infected plants ripen prematurely, after which they may be invaded by sooty molds which give a dirty appearance to the plants and may lower germination of harvested seed.

Barley

In barley a bright-golden yellowing begins at the leaf tip and rapidly progresses down the entire blade (*Figure 1*). Necrotic brown flecking or spotting may accompany the yellowing.

The blotchy or uneven discoloration within leaf blades is one of the most characteristic symptoms of barley yellow dwarf and helps distinguish it from other virus diseases and nutritional or environmental maladies.

Figure 1. Symptoms of barley yellow dwarf on barley. 58 KB JPG

The brilliant yellowing is seen on older living leaves, and infected plants stand out among surrounding healthy plants in a field. A reddening or purpling of leaves may occur with some barley varieties.

The blotchy yellowing begins near the leaf tip; as it progresses towards the leaf base, the green tissues discolor unevenly along the leaf margins, leaving a green stripe along the mid-rib area. When adult plants become infected, usually

only the uppermost leaves on the main stem turn yellow.

Oats

Symptoms vary according to the oat variety, the virus strain, the growth stage of the plant at the time of infection, and the general health of the plant. The main color change is to shades of yellow, reddish-orange, reddish-brown, or purple (*Figure 2*).

Figure 2. Red leaf symptom on barley yellow dwarf infected oats. 52 KB JPG

The first symptoms of infection are yellowish-green spots or blotches near the tips of older leaves. Eventually these blotches enlarge and coalesce, turning various shades of yellow, red and brown. The entire leaf ultimately becomes a reddish-orange to brown or purple. Severely infected plants are shorter, produce lower test weight grain, and have more blasted florets.

Wheat

If winter wheat is infected in the fall, yellowing of leaves usually does not occur until mid-spring. In severe fall infections, some stunting and reduced tillering may develop. Barley yellow dwarf symptoms start to become obvious at about the jointing stage of growth.

Figure 3. Yellowing of barley yellowing dwarf infected wheat. 17 KB JPG

Barley yellow dwarf virus does not produce a distinct mosaic pattern, as do wheat streak mosaic virus or soil-borne wheat mosaic virus. The pattern of symptom expression is similar to that in barley or oats.

Leaf symptoms begin as blotches near the tip, and with time, these turn various shades of yellow, red or purple (*Figure 3*). Progression of symptoms is from leaf tip to base and margin to mid-rib. Symptoms are more pronounced under cool temperatures, causing the tips of flag leaves to sometimes become a reddish-purple.

The yellowing in wheat is not as brilliant as it is in barley, and the reddening of leaves is not as pronounced as it is in oats. In wheat, the pale yellowing of older leaves is the more typical symptom. The extent of yellowing, stunting and yield reduction is contingent on whether the plant is infected as a seedling or during post-seeding development.

Leaves of some cultivars under some conditions remains green, but plants are stunted.

In the field, barley yellow dwarf first appears in small localized patches that increase in size as more and more infected plants show symptoms. Generally the plants in the center of these patches show more severe symptoms, with the symptom intensity decreasing toward the perimeter.

Disease Occurrence and Spread

Epidemics of barley yellow dwarf in Nebraska generally are caused by passive migrations of the winged form of the aphid vectors carried from south to north by low-level jet winds. Of the more than 20 aphid species that transmit barley yellow dwarf virus, the most important are the oat bird-cherry aphid (*Rhopalosiphum padi*), the corn leaf aphid (*A. maidis*), the English grain aphid (*Sitobion avenae*), and the greenbug (*Schizaphis graminum*).

At present the Russian wheat aphid (*Diuraphis noxia*) is not known to transmit the barley yellow dwarf virus strains found in North America. The oat bird-cherry and the English grain aphids are the most important carriers of barley yellow dwarf virus in oats.

The barley yellow dwarf virus overwinters in infected winter cereals and in wild and cultivated grasses. Perennial grasses such as bluegrass, orchardgrass, tall fescue and little bluestem may serve as reservoirs of the various strains of barley yellow dwarf virus.

In most areas winter cereals are more important than wild grasses as sources of barley yellow dwarf virus for infection of spring grains. Many native grass species have grown next to wheat and oats in Nebraska for many years without causing serious outbreaks of barley yellow dwarf.

Oats and barley are very susceptible to barley yellow dwarf virus. Where these crops are planted late for soil cover, for wind erosion control, for forage, or are volunteer, they often are heavily infected. Therefore, they can be an important local source for migration of aphids and virus into adjacent fall planted wheat.

If these crops are still green when winter wheat emerges in the fall, virus infection can produce severe epidemics.

Aphids acquire barley yellow dwarf virus by feeding on infected plants. It normally takes 24 to 48 hours of feeding to acquire the virus, but once done the aphid remains a carrier for life.

Spread of barley yellow dwarf virus depends entirely on aphid movement. One very active aphid feeding for short periods on different plants is a more important carrier than several stationary aphids. In the spring, aphids overwintering as adults on winter wheat or perennial grasses immediately are active as carriers.

Aphids do not overwinter in Nebraska, but are blown north on low-level jet winds from overwintering sites to the south. Other aphids acquire barley yellow dwarf virus in the spring by feeding on infected cereal grains and grasses during migration. The virus and aphids also carry over the summer in volunteer cereals and weedy grasses, and cause fall infection of winter wheat.

Damaging outbreaks of barley yellow dwarf are most likely in cool moist seasons that favor grass and cereal growth as well as aphid reproduction and migration. A driving rain may spread aphids, but also will reduce aphid populations.

Barley yellow dwarf virus is specialized in its relationship with the aphid carriers and is not transmissible through seed, plant sap, or by other insects.

Control

Early planted winter wheat and winter barley, late planted spring oats, and spring barley are the most susceptible to infection. Younger plants are more attractive to aphids than older plants. Planting winter cereals should be delayed until aphid populations decline to minimize barley yellow dwarf outbreaks. Proper seeding date allows the plants to develop when aphid populations are lowest.

Although early seeding of spring cereals does not give full protection against barley yellow dwarf, it allows plants time to develop past the seedling stage before they might become infected. This delay significantly reduces damage to the crop.

Optimum seeding dates for winter wheat and winter barley and spring oats and spring barley are well established for the various growing areas of Nebraska. These can be obtained from your local extension agent.

The best control approach is based on varietal resistance or tolerance. No high level of barley yellow dwarf resistance is available in wheat; however, resistance or tolerance is available in barley and oats. The oat varieties Bates, Hazel, Noble, Otee and Pierce are resistant to barley yellow dwarf; Don, Lang, Larry, Ogle, Starter and Steele are moderately resistant.

Cultural methods of barley yellow dwarf control are aimed at the control of grassy weed species within and near cereal production fields. In addition, small grains should not be planted in midsummer as cover or companion crops in cereal-producing areas.

Insecticidal control of aphids in the fall may reduce the incidence of barley yellow dwarf infections; but if aphids escape the treatments or migrate in from untreated areas, insecticides are of little use except in reducing secondary spread within the field.

Insecticide treatment of spring cereals to control barley yellow dwarf rarely is justified. For insecticides to be effective, application needs to be timed to coincide with the migration of aphids into the field. This is difficult because there is not an adequate system of forecasting migration of cereal aphids in North America.

Summary of Control Methods for Barley Yellow Dwarf

- Plant spring cereals as early as possible for your growing area.
- Delay planting winter cereals to avoid peak aphid populations.
- Use barley yellow dwarf resistant or tolerant varieties when possible.
- Control grassy weeds and volunteer cereals within and around cereal production fields.
- Do not plant small grains in midsummer as cover or companion crops in cereal-producing areas.
- If insecticides are used, they should be applied close to the peak of fall aphid migration.
- Do not plant highly susceptible grasses (e.g. fescue) on Conservation Reserve Program (CRP) acres.

File G906 under: PLANT DISEASES
C-28, Field Crops
Issued May 1989; 15,000 printed.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Elbert C. Dickey, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.