THE OHIO STATE UNIVERSITY EXTENSION

Extension FactSheet

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Barley Yellow Dwarf of Wheat, Oats, and Barley

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Barley yellow dwarf (BYD) occurs in most small grain growing regions of the U.S. Before 1951, the year BYD was first described, the characteristic red or yellow leaf symptoms were attributed to limited nutrient uptake by plants in soils thought to be too wet or too cold. The disease is now known to be caused by a virus that is spread by aphids. The name, barley yellow dwarf, describes the typical symptoms of an infected barley plant. The barley yellow dwarf virus can infect wheat and oats causing the same disease. Therefore, the same name is used to describe the disease regardless of the host affected. On oats "red leaf" or "grey spot" are sometimes used to describe the symptoms of BYD.

Barley yellow dwarf virus can infect many plant species, including perennial and annual grasses, but many of the hosts are symptomless and appear healthy. The severity of BYD damage depends on the plants' response to infection, the time of infection in the development of the plant, the variety of the crop, and the conditions under which the crop is grown. Plants infected in the seedling stage yield much less than plants infected at a later stage of development. Infected plants grown on poor soil or without fertilizer are damaged most severely.

Grain growers often fail to associate early aphid infestations with the incidence of BYD because symptoms usually do not appear until after aphids are gone. Symptoms from early fall infections may be suppressed until spring or, in the spring, symptoms may develop two or three weeks after aphid feeding.

Symptoms of BYD

Early symptoms of BYD are frequently overlooked because infected plants resemble plants with mineral deficiencies, low temperature damage, root rots, herbicide injury, or other problems. In Ohio, it is rare to see entire fields affected, but most frequently BYD occurs on scattered plants or in circular patches within fields. Distribution of diseased plants depends on the flight of winged aphids into the field. Spread within the field is dependent on the development of wingless forms which crawl, or are blown, from one plant to another. For entire fields to be severely affected, high aphid populations would have to be blown into a newly emerged wheat in the fall.

Leaf symptom development is dependent on the time of infection. Seedling infections slow plant growth, but rarely kill the plant. Symptoms generally appear first on the older leaves of young plants as faint yellowish-green blotches near the leaf tip. The blotches enlarge rapidly and merge, changing to shades of red to purple in oats, yellow to red in wheat and bright yellow in barley. The leaves may lose their flexuous appearance and become erect or stiff. The leaf margin near the tip may roll inward and become necrotic forming a stiff point. Plants infected early are usually dwarfed. Early fall infection frequently predispose plants to winter killing even if they are symptomless. Plants infected later may develop symptoms only on the leaves actively growing at the time of infections. Infections that occur in the spring may result in discoloration of only the top leaf, or flag leaf.

In barley, the most characteristic symptoms are dwarfing and the brilliant yellow coloring of the leaves. Severe dwarfing and yellowing are less common in wheat. Symptom development is enhanced by bright sunlight and cool temperatures 60 to 68 degrees F (16 to 20 degrees C).

Figure 1. Stunting of plants and reddening of wheat leaf tips due to barley yellow dwarf.

Aphid Vectors of BYDV

The occurrence of BYD in a field is totally dependent on the activity of its aphid vectors. Over 20 species of aphids are known to transmit BYDV. However, only four are common: the oat bird-cherry aphid (*Rhopalosiphum padi*), the corn leaf aphid (*Rhopalosiphum maidis*), the English grain aphid (*Macrosiphum avenae*), and the greenbug (*Schizaphis graminum*). An outbreak of disease is dependent on the efficiency of the aphid to transmit the virus, the source and strain of the virus, aphid mobility, aphid feeding habits, the age and susceptibility of plants when infected, and various climatic factors. For example, the aphid species responsible for the disease outbreak may not necessarily be the most abundant one. One very active aphid feeding for short periods on many plants is a much more important vector than 100 stationary aphids.

Some aphids, such as the greenbug, cause damage to plants by injecting phytotoxic secretions into the plant during feeding. These toxic substances produce a pattern of tiny spots on the leaves or stems where the aphids have fed. The very small spots become brown to black and adjacent tissues turn tan-brown after a period of yellowing. Before an aphid is capable of inoculating a healthy plant, it must acquire the virus by feeding on infected plants for a period of 12 to 30 hours (sometimes as short as 30 minutes). Once the aphid acquires the virus, it is capable of transmitting it for the rest of its life. It generally requires 4 hours or more of feeding on a plant for the virus to be transmitted.

Strains of the Virus

BYDV exists as several different strains, which are differentiated by their ability to be transmitted by various aphid species and their virulence on a selected variety of oats. Some strains of BYDV are transmitted equally well by several aphids, whereas other strains can be transmitted by only one or two aphid species.

Disease Cycle

The barley yellow dwarf virus survives from one crop to the next in volunteer wheat, oats, barley, perennial and annual grasses, and in its aphid vectors. The occurrence and spread of the virus is totally dependent on the movement of its aphid vectors. In the fall, emerging wheat seedlings can be inoculated by aphids that acquired the virus from infected volunteer cereal or grass hosts. Early spring infections are caused by aphids overwintering as adults on grasses or winter cereals. During the growing season each adult aphid may produce from 10 to 20 young each day. These young aphids must first acquire the virus from infected plants. These aphids, normally wingless, produce more aphids and move only short distances by crawling from plant to plant or by being blown in the wind.

Barley yellow dwarf epidemics occur when the weather conditions favor the multiplication of the aphid vectors. Cool (50 to 65 degrees F) moist weather is most favorable. Aphid movement can be local, from one field to another, or when assisted by winds, aphids can be carried hundreds of miles. Generally, aphids migrate from the southern states to the northern states in spring and from the north to the south in fall.

Barley yellow dwarf infections can occur throughout the growing season, but are most damaging in spring in areas where aphids overwinter. The earlier the plant is infected, the greater the yield loss. Inoculated plants become systemically infected and develop symptoms in two weeks at 68 degrees F, in four weeks at 77 degrees F, but no symptoms develop at 86 degrees F (30 degrees C) or above.

Barley yellow dwarf virus is not transmitted by seed, soil or by rubbing infected leaves onto healthy leaves.

Control

Barley yellow dwarf cannot be adequately controlled in the field at present. Some damage to oats, wheat and barley occur each year. The following practices should greatly reduce the incidence and damage to these cereal crops.

1. Resistant varieties are available for oats, but barley and wheat varieties show only small differences in reaction to BYD. Consult with your seed dealer for oat varieties with resistance to BYD.
2. Plant winter wheat after the Hessian fly-free date and barley as late as practical to avoid early fall infections. Fresh green leaves of early autumn plantings attract aphids and may lead to severe infestations. Later planting helps winter cereals escape population buildup of aphids in the fall. Plant spring oats as early as possible. Vigorously growing plants are more tolerant of BYD than are weaker ones. Large populations of aphids usually do not appear in Ohio until later in the spring.
3. Proper fertilization is necessary for good crop growth. Plants with nutritional stress are more susceptible and yield less if BYD is a problem.
4. Control volunteer wheat, barley and oats. Volunteer plants can be a problem in double-cropping systems. These plants can serve as important reservoirs of the virus for the next crop.
5. Foliar applied insecticides that control aphids are not recommended for control of BYD. Contact insecticides act directly on aphids, but have short residual effect and may not last long enough to protect the field from a subsequent influx of virus-carrying aphids. Systemic insecticides are better, but require that the aphids feed on the plant and feeding may be long enough to inoculate the plant with virus. If systemic insecticides are applied before aphids reach the field, the insects may be killed before they can inoculate other plants. Some systemic insecticides have been used successfully in some states where severe BYD epidemics occur. In these areas, aphids typically fly in from virus infected grain crops. In Ohio, aphids do not regularly carry the BYD virus. Application of insecticide prior to aphid flights is not practical because BYD is randomly distributed and its occurrence cannot be predicted accurately.

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