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Plant Pathology Fact Sheet

Barley Yellow Dwarf

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Importance

Barley yellow dwarf (BYD) is a virus disease that can cause serious yield loss when stunted and discolored plants are widely distributed in a field. Severe losses due to BYD occur state-wide about every five years or so, but individual fields are impacted to varying degrees each year. There are many diseases that can reduce wheat yields, but in the case of BYD, most of the disease management decisions (such as field selection, tillage practices, variety, and planting date) are made by the time the seed is actually sown in the fall.

Symptoms

The primary symptoms of BYD include plant stunting, reduced tillering, and a yellow (Figure 1) to red-purple (Figure 2) discoloration of leaf margins. Affected plants may have an unusually erect “spiked” appearance. Symptoms can occur in the fall or spring, but they more commonly occur in the spring on the top two leaves of plants. Foliar symptoms are frequently accompanied by secondary bacterial infections. These infections are visible as brown spots and streaks on BYD-symptomatic leaves. Virus-infected plants frequently occur in random, small groups and along the edges of fields; however, large portions of fields, even entire fields, can be affected in severe cases.

Figure 1. Barley Yellow Dwarf yellowing symptoms

Disease Development in Relation to Aphid Biology

Barley yellow dwarf virus (BYDV) is transmitted from infected grasses into wheat and barley by several species of aphids. In the fall, the most important species are the bird cherry-oat aphid and, to a lesser extent, the corn leaf aphid (Figure 3). In the spring, overwintered bird cherry-oat aphids and

FIGURE 2. BARLEY YELLOW DWARF RED-PURPLE SYMPTOMS.

English grain aphids are the most important. Regardless of the aphid species, winged adults immigrate into wheat fields from neighboring and distant sites, feed, and deposit live young on plants. The migratory behavior of winged vectors is the reason why initial BYD symptoms are often seen along field edges and in randomly occurring groups of plants. Typically, the young aphids deposited by winged migrant adults develop into wingless adults that produce more offspring over several generations. These wingless aphids, in turn, produce a small number of winged aphids which fly locally. They also produce a larger number of wingless offspring that gradually spread in fields by crawling from plant to plant.

BYDV is transmitted to wheat through the feeding activities of both winged and wingless aphids. Aphids acquire the virus by feeding on diseased plants (weeds and crop hosts) for as little as 30 minutes. BYDV cannot be carried from adult aphids to young aphids, however. For this reason, the percentage of winged aphids originally carrying the virus into a field is an important piece of the picture. This percentage can vary greatly from field to field, season to season, and year to year. Although you can never tell which aphids are carrying BYDV and which are not, having knowledge of seasonal aphid activities can help you assess the potential for BYD to occur.

Fall Infestation

The numbers of aphids arriving in the fall depend largely on two factors: (1) general growing conditions the preceding summer and (2) when the first hard frost occurs in relation to wheat seedling emergence. Normal or greater rainfall during the preceding summer usually benefits the aphid population. In drier summers, fewer aphids are produced due to reduced host plant quality. For the same reasons, a greater proportion of BYDV-infected host plants die due to the extra stress. This can significantly reduce the reservoir of BYDV available for aphids to acquire, and later spread, to emerging wheat plants.

FIGURE 3. BIRD CHERRY-OAT APHID ADULT (LEFT) AND CORN LEAF APHID ADULTS AND NYMPHS (RIGHT)

Crops that emerge long before a hard freeze have a greater potential for aphid infestation (and exposure to BYDV) than those emerging after a hard freeze. The fly-free date, which is used to control Hessian fly infestations, is based on this principle and also works well for aphids as long as the freeze occurs when expected. This is the main reason farmers are encouraged to plant wheat after the Hessian fly free date for their area.

Winter Survival

Aphids arriving in the field during the fall continue to move, feed, and reproduce as long as temperatures remain above about 48°F. Mild temperatures or insulating snow

cover during cold spells usually results in significant survival of the aphids during the winter. Harsher weather results in greater mortality. BYDV-infested aphids that survive the winter months are a primary source of BYD increase in the spring.

Spring Infestation
The English grain aphid has a spring flight and arrives about the same time that winter wheat is greening up in early to mid-March. The overwintering bird cherry-oat aphid becomes active a little later in the spring. Because of the earlier timing of overwintering English grain aphids, this aphid species is somewhat less important than the cherry-oat aphid in the springtime movement of BYDV in Kentucky.

BYD and Aphid Management

BYD management is imperfect; complete control is rarely, if ever, achieved. Still, significant levels of BYD control can be achieved using multiple management tactics as part of an overall BYD management strategy.

Planting Date
Plant wheat after the Hessian fly-free date. This will help to minimize the exposure of seedlings to aphid feeding and possible transmission of BYDV in the fall.

Varieties
Plant wheat varieties that tolerate BYD or are moderately resistant to this disease. There are no highly resistant varieties, but some are considerably less impacted by the disease under the same conditions.

Seed Treatment Insecticides
Use of seed treatment insecticides is a relatively easy, but not always economical, method of aphid (and BYD) control. It is not a matter of whether insecticides will kill aphids; they will. Rather, the question is: do you need to kill aphids?

Generally the most likely return on investment will be for fields planted before the fly-free date. Sometimes, it is simply not possible to plant all wheat acres after the fly-free date. These fields may be good candidates for the use of seed treatment insecticides because earlier emerging wheat provides a longer window for aphids to feed and transmit BYDV to plants.

Early infections also allow more time for BYDV to reproduce in plants before cold weather sets in. These earlier infections have the greatest impact on crop yield and test weight the following spring. As the date of seedling emergence becomes closer to the onset of cold weather (as is usually the case when wheat is planted after the fly-free date), the chances of significant levels of aphid transmission of BYDV decreases significantly, and so does the need for seed treatment insecticides.

The above notwithstanding, it must be noted that a significant problem with applying seed treatment insecticides is that they must be deployed (and cost of treatment incurred) before you can know if aphids will even be present in a field. Early planting may open the door for greater aphid activity (and possible transmission of BYDV), but this is not certain just because a field is planted early.

As a result, many times seed treatment insecticides are used when they are not needed. This unnecessarily increases the cost of production. Making applications of foliar insecticides does not have this problem as long as treatment decisions are based on the results of field scouting for aphids (see next section).

Foliar Insecticides
Foliar-applied insecticides are an excellent means of managing aphid populations (and potential transmission of BYDV to wheat) if

aphid thresholds are reached. However, the need to manage aphids is highly variable from field to field, season to season, and year to year. As a result, spray decisions should be based on results of intensive field scouting.

Scouting

When to scout

In the fall, begin monitoring wheat fields for aphids once seedlings have emerged and continue until daytime temperatures remain below 45°F. In the spring, begin scouting when daytime temperatures regularly exceed 45°F; continue scouting through the flag leaf emergence (Feeke's 8) growth stage.

How to scout

Examine three separate 1-foot lengths of row at multiple locations in each field. Look over the entire plant, especially near the soil line. Count and record the number of aphids on each 1-foot section of row, then calculate the average. This sampling is for making decisions relative to the movement of BYDV. Label these records as "counts."

Economic threshold and use of foliar insecticides

In the fall when estimating risk of BYD, consider an insecticide application if aphid "counts" average three or more aphids per row-foot during the first 30 days after planting. An average of six or more aphids per row-foot from 30 to 60 days post plant, or ten or more aphids per row-foot thereafter, may justify the use of foliar insecticides (refer to ENTFACT-121, below).

The greatest probability for the successful (i.e., economical) use of foliar insecticides exists when the following criteria are met:

- Drought stress the previous summer was not widespread
- The crop is planted prior to the fly-free date or first killing frost
- There is an extended period of mild weather in the fall
- The winter is mild and/or there is good snow cover during cold periods
- There is an early, mild spring
- The crop has a high yield potential
- High wheat prices are projected

If the aphids-per-row-foot threshold is reached in the fall or spring, it is an indication that at least some of the above criteria have been met. If this aphid level is reached in the fall, especially within 30 days of seedling emergence, it may be advisable to make an insecticide application. If it turns cold after the application, wait and scout again in the spring. If the fall and/or winter are mild and winged aphids continue to arrive in the field, continue to scout. It is possible that a second fall application might be needed to achieve acceptable BYD control.

Regardless of what was done in the fall, a spring application may be needed if late winter to early spring weather conditions favor the build-up of aphid populations prior to flag leaf emergence. Failure to make the necessary spring applications may negate any gains associated with the fall applications.

Keep in mind that the above aphid treatment guidelines are not chiseled in stone. In some years the aphid thresholds may be too low and in other years too high. Herein is the difficulty when attempting to control BYD indirectly using insecticides: the system is not perfect. However, until our understanding of BYD epidemiology and aphid biology is enhanced by new research, the aphids-per-row-foot treatment guideline is the only one available with any experimental basis.

Additional Resources

The following University of Kentucky publications are available at County Extension offices, as well as on the Internet.

- Aphids and Barley Yellow Dwarf (BYD) In Kentucky Grown Wheat, ENTFACT-121 (2004) http://www.ca.uky.edu/entomology/entfacts/ef121.asp

- Comprehensive Guide to Wheat Management in Kentucky: Disease Management – Section 7, ID-125 (2009) http://www.ca.uky.edu/agc/pubs/id/id125/07.pdf
- Comprehensive Guide to Wheat Management in Kentucky: Insect Pests – Section 8, ID-125 (2009) http://www.ca.uky.edu/agc/pubs/id/id125/08.pdf

- Kentucky Integrated Crop Management Manual for Small Grains, IPM-4 (2009) http://www.uky.edu/Ag/IPM/manuals/ipm4smgr.pdf

- Kentucky Plant Disease Management Guide for Small Grains, PPA-10c (1993) http://www.ca.uky.edu/agc/pubs/ppa/ppa10c/ppa10c.pdf

- No-Till Small Grains Production in Kentucky, ID-136 (2000) http://www.ca.uky.edu/agc/pubs/id/id136/id136.htm

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Photos by Don Hershman, University of Kentucky (Figures 1 & 2); David Cappaert, Michigan State University, Bugwood.org (Figure 3, left); and Merle Shepard, Gerald R. Carner, and P.A.C. Ooi, Insects and Their Natural Enemies Associated with Vegetables in Southeast Asia, Bugwood.org (Figure 3, right)