Barley Yellow Dwarf Management in Small Grains

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Overview

Barley Yellow Dwarf (BYD) was first described in 1951 and now is considered to be the most widespread viral disease of economically important grasses worldwide. This complex, insect-vectored disease can have considerable impacts on small grain yield and quality and may be encountered by growers in Delaware. This factsheet will describe the disease, its vectors, and current management options.

Symptoms

Symptoms of BYD vary with host species, host resistance level, environment, virus species or strain, and time of infection. The hallmark symptom of BYD is the loss of green color of the foliage, especially in older foliage. In wheat, the foliage may turn orange to purple (Figure 1). Similar foliar symptoms may occur in barley, except that the foliage may appear bright yellow. In severe cases, stunting can occur and result in a failure of heads to emerge. In other severe cases the heads may contain dark and shriveled grain or not contain any grain. Tillering and root masses may also be reduced. BYD is often observed in Delaware in patches 1-5 feet in diameter, however, larger infections have been reported in other states. Symptoms of BYD, as with other viruses, are easy to overlook or confuse with other issues such as nutrient deficiency or compaction. Thus, diagnosis cannot be confirmed by symptoms alone and samples must be sent to diagnostic labs for confirmation using specialized techniques.

Figure 1. Wheat showing characteristic foliar symptoms of BYD virus infection. Symptoms typically occur in small patches, 1-5 feet in diameter.
Photo by N. Kleczewski

Disease Cycle

The disease cycle for BYD is complex due to the added role of an aphid vector (Figure 2). Aphids are small, soft bodied insects with piercing-sucking mouth parts. They can be either winged or wingless as adults, which can impact aphid and BYD spread. In the fall, winged aphids migrate into small grain fields as other host plants, such as grasses, begin to dry. If aphids feed on a plant with BYD and the plant contains a BYD virus that particular aphid species can transmit, then the insect becomes a BYD vector. Once an aphid has acquired the virus, it can vector it to healthy plants for the remainder of its life, typically several weeks.

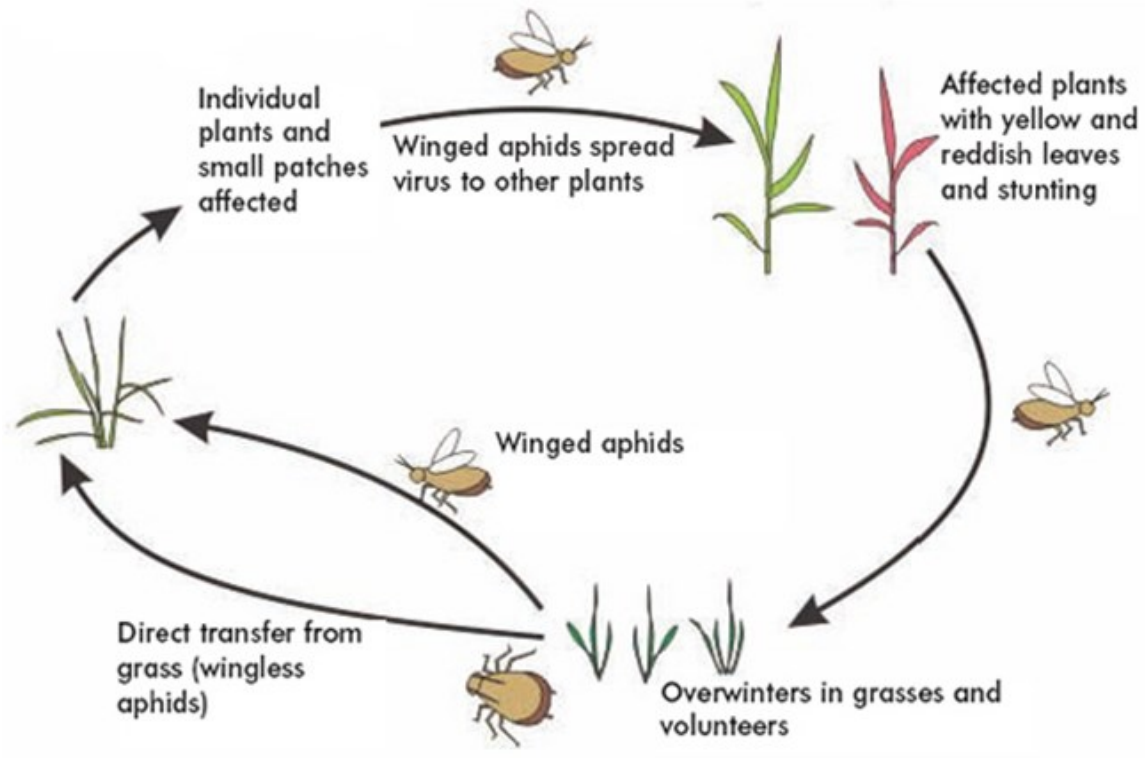

Figure 2. Barley Yellow Dwarf Disease Cycle, courtesy of Agriculture & Horticulture Development Board, AHDB

Aphid Identification

In general, aphids are small pear-shaped insects (1/16 to 1/8 inch long) varying in color from green to black and sometimes pinkish in color. Immature and adult aphids appear similar and both winged (Figure 3) and wingless (Figure 5) forms can be found in fields at the same time. All of the aphids found in small grain fields will have a pair of "tail-pipe" shaped projections called cornicles that are found on the top side of the tail end of the aphid.

Figure 3. Winged Aphid. Photo by Jack Kelly Clark, courtesy of University of California Statewide IPM Program

There are four common species of aphids that infest small grain fields in Delaware. They include the bird cherry-oat (BCO), *Rhopalosiphum padi*, English grain (EGA), *Sitobion avenae*, corn leaf (CLA), *Rhopalosiphum maidis*, and green bug aphid (GB), *Schizaphis graminum*. All four species are capable of vectoring BYD viruses. However, the bird cherry-oat aphid (Figure 4) is the only species known to vector the more severe strain of the virus.

The only two species known to cause direct damage to small grains include the green bug aphid (Figure 6) and English grain aphid (Figure 5). Green bug aphid feeding can cause leaves to redden around the feeding site and can kill seedling wheat or cause severe yield losses. This is the result of a toxin in the saliva of the aphid. English grain aphids are the only species found in the heads of wheat during grain filling time. They can reduce wheat yield and test weight by feeding on the wheat heads from head emergence through milk stage.

Figure 4. Bird Cherry-Oat Aphids

Figure 5. English Grain Aphid

Figure 6. Green Bug Aphids

Figure 7. Corn Leaf Aphids

Photos by Jack Kelly Clark, courtesy University of California Statewide IPM Program

Additional images can be found online: Photo guide to Common Aphids Infesting Small Grains in Delaware, http://extension.udel.edu/ag/insect-management/e-ipm-implementation-projects/

Aphid Life Cycle

Aphids overwinter on small grains as eggs or females. Aphids have an unusual lifecycle in that females can reproduce without mating for several generations, giving birth to live young, which are typically wingless females. As small grains begin to mature in late spring to early summer, winged females move to other wild or cultivated grasses for the summer. In the fall, they return to newly planted small grain fields to overwinter. Aphids are most active when temperatures are above 50 degrees F. Temperatures below 30 degrees F reduce aphid survival and reproduction. Mild fall-winters favor aphid reproduction, movement, and survival, and are when we see the greatest infestations of aphids in small grains.

The following graphs show the relative abundance of these four species (Figure 8) and seasonal aphid abundance (Figures 9 and 10) in Delaware small grain fields based on surveys conducted from 2013 through 2016.

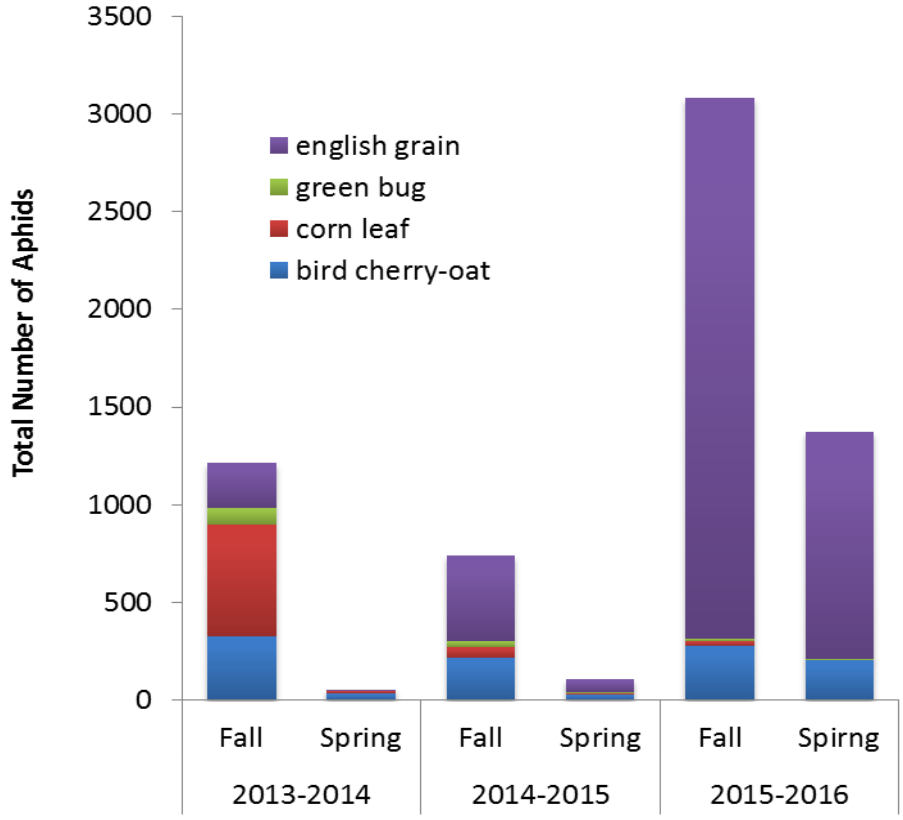

Figure 8. Total Number of Aphids Detected by Species in Delaware Small Grain Fields: 2013-2016

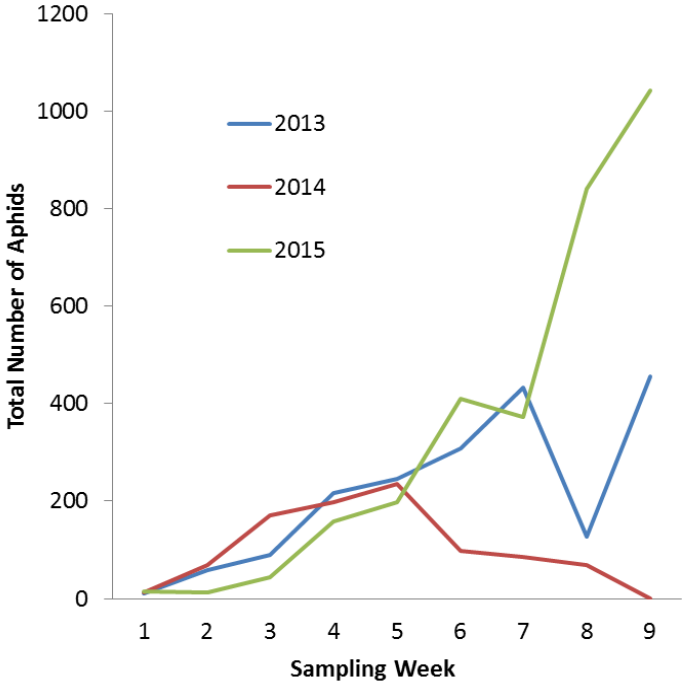

Figure 9. Abundance of Aphids for Each Sampling Week: Fall 2013-2015

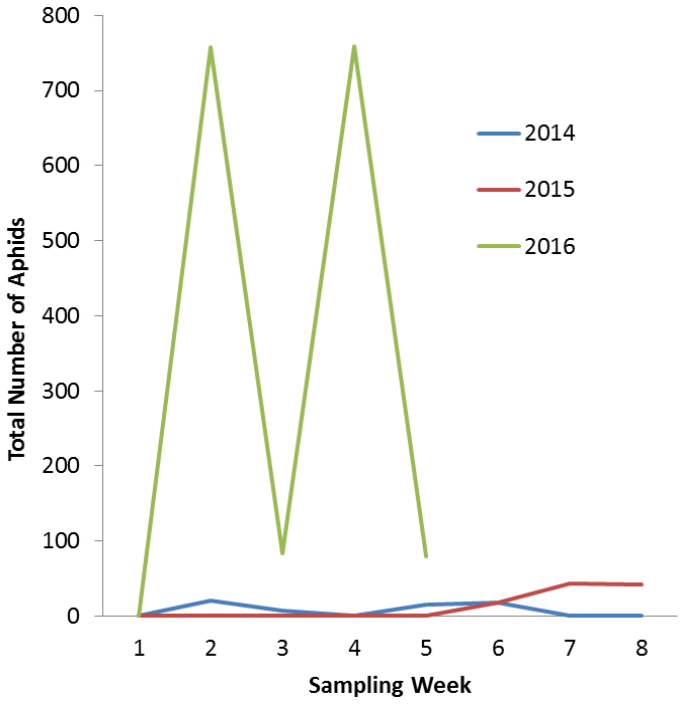

Figure 10. Abundance of Aphids for Each Sampling Week: Spring 2014-2016

Assessing your risk level with BYD

Although BYD has not been observed at significant levels across Delaware (Table 1), some situations may put certain fields at higher risk for this disease. Factors that increase risk for a field include those that may favor early aphid movement into fields and an unfavorable response by the plant host. These include fields that are: 1) in close proximity to pastures or large wooded areas; 2) contain a BYD susceptible variety; 3) are planted early (before the Hessian fly free date). Environmental factors such as a warm fall/winter or warm, early spring can increase overall aphid activity and increase potential BYD risk.

Table 1. Survey Results for Barley Yellow Dwarf Virus in Delaware Small Grain Fields: 2015-2016

	% Fields with BYD	Average BYD Incidence for Affected Fields	Range of BYD Incidence
Spring 2015	19	2 %	1-6 %
Spring 2016	32	4 %	1-8 %

Small grain fields were sampled at heading stage (feekes 10.1-10.5) for BYDV symptoms.

Barley Yellow Dwarf Management

Management of BYD involves an integrated approach involving several cultural practices, variety selection, and chemical intervention if needed.

Planting date:

Planting early puts a field at greater risk for BYD because plants will have a higher chance of being exposed to aphids that carry BYD viruses. Planting after the, "Hessian fly free date" has been shown to reduce BYD symptoms by 47.9% and yield loss by 57.7% in some cases. Planting after the Hessian fly free data increases the odds that aphids will be exposed to a hard freeze before moving into fields to a significant degree. Planting date can help protect small grains from severe, fall infections but will not impact BYD if aphids arrive in the spring.

Alternate host management:

Ensure a good burndown of all grassy weeds at least 2 weeks prior to planting. Grassy weeds could be a host of the virus and their presence may increase local BYD development if aphids enter the field during the growing season and feed on these hosts.

Variety selection:

Although no true resistance to BYD is present in commercially available wheat and barley varieties, many varieties have excellent tolerance to this disease (Figure 11). Tolerance means that symptoms may be noted without a noticeable impact on crop yield. Recent research indicates that varieties with BYD tolerance can reduce BYD symptoms by 80.9% and yield loss by 72.6% when compared to susceptible varieties. If you are planting early into a field with a history of BYD issues, a tolerant variety should be considered. Information on regional variety BYD tolerance can be found at the Virginia Tech Cooperative Extension Small Grains website at https://www.ext.vt.edu/topics/agriculture/crops-grains/small-grains/index.html. Remember: the protection from tolerant varieties is year round, unlike benefits from altering planting dates or utilizing chemical intervention, and requires no additional cost.

Figure 11. Varieties differ in their responses to BYD. Selecting varieties rated high for BYD tolerance will significantly reduce BYD impacts of yield without any additional inputs. Photo by N. Kleczewski

Chemical Control

No chemicals can be applied that will cure plants with BYD. However, insecticides may reduce overall aphid populations and limit BYD damage in situations that may favor disease (i.e. extremely early planting dates, early arrival of aphids into fields).

Systemic, insecticide seed treatments can be incorporated to reduce the number of aphids in the field. Research has documented that BYD symptoms can be reduced by 35% when a seed treatment is applied and reduce yield loss by 16.4%. However, these treatments are only effective for a 2-3 week window after seedling emergence and will have no effect if aphids arrive in fields after this period of time. In addition, because aphids need to feed to ingest these insecticides, BYD will still occur, but secondary spread may be reduced.

Scouting small grain fields, starting in the fall, immediately after crop emergence and applying a foliar insecticide may reduce the incidence of BYD. Although there are a number of thresholds reported in the popular literature, there are no research based thresholds in Delaware available at this time to determine when a fall application is needed. A treatment may be considered if you have a history of BYD in your fields, aphids are present and factors occur that increase the risk of BYD (early planting, use of a BYD susceptible variety, proximity to pastures or large wooded areas , late warm fall and/or early warm spring). As with seed treatments, foliar insecticide treatments will not prevent primary infections from occurring, but may reduce secondary spread of aphids and BYD during the growing season. This may be important during unusually, warm fall and winters.

References

Bockus, W. W., De Wolf, E. D., and Todd, T.C. 2016. Management strategies for barley yellow dwarf on winter wheat in Kansas. Plant Health Prog.17:122-127

D'Arcy, C.J. and P.A. Burnett, eds. 1995. Barley Yellow Dwarf: 40 Years of Progress. American Phytopathological Society Press. St. Paul, MN

D'Arcy, C.J. and L.L. Domier. 2000. Barley yellow dwarf. *The Plant Health Instructor*. DOI: 10.1094/PHI-I-2000-1103-01. *Updated 2005***.**

Miller W.A. and L. Rasochova. 1997. Barley yellow dwarf viruses. Annu. Rev. Phytopath. 35:167-190.

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