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Head Scab

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Head scab (Fusarium head blight) is a major disease of wheat in humid production areas. The disease was first described in the late 1800s, but was only a sporadic problem for many decades. Beginning in the mid-1980s, however, the disease re-emerged as a much greater problem in the eastern Corn Belt, Michigan, and Upper Great Plains. In many of the past 20 years, head scab has been a problem in at least some areas of the Midwest.

Severe head scab reduces yield. Of even greater concern is the disease's effect on kernel quality. Aside from low test-weight, scabby wheat often contains mycotoxins. The simplest definition of mycotoxin is that it is a toxic or poisonous substance produced by fungi (molds). Mycotoxins are diverse in their chemical structures, and particular fungi tend to produce specific sets of mycotoxins.

Toxicity to animals depends on the type of mycotoxin, the amount of exposure, and the animal species. Diseases caused by mycotoxins are called mycotoxicoses, and include symptoms such as feed refusal, reproductive disorder, cancer, and death.

Several mycotoxins also are harmful to humans. The most common mycotoxin in scabby wheat is deoxynivalenol (also known as, DON or vomitoxin). On occasion, the pathogen will produce a second mycotoxin, zearalenone. Always assume that scabby wheat is contaminated with these mycotoxins unless a chemical analysis proves otherwise.

The toxic effects of DON and zearalenone are more significant in swine than in poultry and cattle. As little as 1 ppm DON can reduce feeding in swine, and they will completely refuse feed when contamination is near 10 ppm. The U.S. Food and Drug Administration (FDA) advises that grain and grain-products used in swine feed contain less than 5 ppm DON, and that these products should not comprise more than 20 percent of the ration (or a maximum 1 ppm DON in feed).

Zearalenone is an estrogenic mycotoxin that can cause infertility, abortion, or other breeding problems when fed to swine. As little as 0.1 to 0.5 ppm zearalenone in a feed ration may produce estrogenic syndrome in swine. Also, concentrations as low as 1 ppm zearalenone can cause uterine prolapse in young pigs.

More information, including links to other sites, is available on the NC1025: Mycotoxins: Biosecurity and Food Safety Web site, www.btny.purdue.edu/NC1025.

Although kernels without head scab symptoms may contain significant DON and zearalenone levels, the highest amounts will be found in small, shriveled kernels that are obviously scabby. Removing these scabby kernels by adjusting the combine or running grain over a gravity table can lower mycotoxin contamination. To prevent further deterioration, dry grain to 12 percent moisture before storing.

Symptoms

Bleached heads are the most conspicuous symptom of scab. Symptoms appear as grain filling begins. At first, only one or two spikelets on a diseased head may be bleached, but with time, bleaching includes most of the head in susceptible cultivars.

Typically, scabby wheat heads are not concentrated in a single area, but scattered among healthy heads (Figure 1). In humid weather, a pink growth (spores of

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Figure 1. *Scabby wheat heads intermingled with healthy heads. Note the different areas of bleaching on the wheat head, a reflection of when the wheat head was infected.*

Figure 2. *The fungus that causes head scab produces spores that appear as pink growth on infected heads.*

the scab fungus) is evident on scabby heads, particularly at the base of the spikelet (Figure 2).

Tiny, black, spherical structures (fruiting bodies of the fungus) may also form on the glumes. These fruiting structures could lead to confusion with other wheat head diseases. Glume blotch, another fungal disease of wheat, also affects heads directly. The fungus that causes glume blotch also produces fruiting bodies on the head, but they are embedded in the glumes and protrude partially, whereas the fruiting bodies of the head scab fungus are mainly superficial. A more striking difference between glume blotch and head scab is the color of the infected head. Heads with glume blotch are chocolate-brown, much darker than the bleached heads caused by scab.

Take-all also causes bleached heads, but usually results in premature death of the entire plant, not just the head. Take-all rarely occurs in Indiana.

All three of these diseases reduce kernel size, but scabby kernels often look chalky, which is why they are referred to as tombstones (Figure 3). Severely infected kernels will not germinate. Kernels with less visible damage may nonetheless contain high levels of mycotoxins, and should be analyzed before use. Symptomless kernels still may contain mycotoxins.

Causal Agent

Several related fungi, in the genus *Fusarium*, cause head scab. In the United States the principal pathogen is

Figure 3. *Scabby kernels that are severely infected are shriveled and discolored and often referred to as "tombstones."*

Fusarium graminearum, which also goes by the name of *Gibberella zeae*. *Gibberella zeae* is the same fungus that causes stalk rot and ear rot in corn.

Disease Cycle

Gibberella zeae survives in corn and wheat residue. Because there is much more corn in Indiana than wheat, and because corn stalks and ears take longer to decompose than wheat stubble, corn residue is the main overwintering site of this fungus. As temperatures rise in the spring, the fungus resumes growth in the corn residue and produces fruiting bodies on the surface of stalks or other debris (Figure 4).

Long periods of more than 90 percent relative humidity and temperatures of 48°F to 85°F promote spore production. The fruiting bodies on infected residues eject mature spores, which are then dispersed by wind.

Figure 4. *Corn residue can contain large amounts of head scab spores. The black dots on this corn stalk are sporulating structures of the fungus that causes wheat head scab.*

Wheat is most susceptible to infection during and shortly after the flowering stage, although heads can be infected through the soft dough stage (Figure 5). The fungus infects individual flowers (florets) in the wheat head. If wheat flowers during warm, humid weather, and airborne spores of *the fungus* are abundant, many florets may become infected. Once the fungus has infected a floret, it moves into the rachis (the stem of the wheat head) and may spread up and down the head from the point of infection. As each developing seed is infected, fungus mycelium replaces the starchy endosperm, rendering the grain unfit for milling or feed.

Grain from heads infected after the flowering stage will not be as severely shriveled as grain from heads infected at the flowering stage, but later-infected grain may still contain high DON levels.

Management

Head scab management requires a combination of measures; however, when weather is highly favorable for scab — prolonged periods of warm, wet weather starting about a week before flowering and continuing through flowering and early grain fill — even a combination of measures will fail to provide adequate control.

Figure 5. *Healthy wheat head during flowering. Head scab infection is determined by which florets are flowering when conditions for infection are most favorable.*

Planting

Time of planting has no consistent effect on head scab severity. However, planting varieties with different heading dates may spread out the risk. That's because the amount of inoculum and rate of infection depends greatly on weather conditions just before and during flowering. So, wheat varieties in the same area that flower on different dates may show greatly different amounts of scab.

Tillage

Tillage that buries corn residue (or the residues of other *Fusarium*-infested crops) may reduce head scab risk. One possible reason for a general absence of scab during the 1960s, '70s, and early '80s was widespread clean tillage practices. It was not until large-scale adoption of conservation tillage practices that scab re-emerged as an important disease. The benefits of conservation tillage — both for conserving soil and reducing production costs — make it impractical to return to clean tillage as a way to manage head scab. However, if a cornfield has severe stalk rot, tillage may be justified to reduce a local source of inoculum.

Rotation

Wheat planted into corn residue is at greater risk for head scab than wheat planted into a field with no corn residue. However, because wind can carry spores from one field to another, head scab can develop in any field if the weather is highly favorable for spore production and infection. If weather is only marginally favorable, a wheat field with corn residue on the soil surface may develop more head scab than fields with no corn residue.

Resistant Wheat Varieties

Wheat breeders have been working for several years to improve resistance in soft red winter wheat varieties. Several varieties with some degree of resistance are currently available. In years to come, more varieties with better levels of resistance should be available.

Chemical Control

Fungicides have been evaluated for several years at many locations in the eastern winter wheat and spring wheat regions of the United States. There are several promising fungicides, but none is currently labeled.

The U.S. Environmental Protection Agency has granted Indiana an emergency exemption (Section 18) to use Folicur® for head scab suppression. This use is granted on a yearly basis, so growers should check with their Purdue Extension county office or chemical dealer as to its availability. These fungicides need to be applied at the onset of flowering (Feekes growth stage 10.51) to be effective. For applications, use paired nozzle tips that direct the spray forward and backward to direct spray to the vertical heads.

Strobilurin fungicides do not provide any control and some studies have linked them to increased toxin accumulation in grain.

Harvesting

When harvesting a field with head scab, turn up the air on the combine to blow as many shriveled kernels out with the chaff as possible. There is no advantage to harvest such kernels because they lower the test weight and increase the likelihood that the grain's DON level will exceed what the elevator is willing to accept.

Acknowledgement

Some of the information presented here was developed from research sponsored by the U.S. Wheat and Barley Scab Initiative.

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