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NORTH DAKOTA STATE UNIVERSITY
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HEAD BLIGHT (SCAB) OF SMALL GRAINS

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Figure 1. Scabbed wheat heads showing partly infected white and green heads (left and center) and entire head infected (right). (Photo by Vernyl Pederson)

Head blight or scab is a fungus disease that can occur on all small grain crops, but is most commonly seen in North Dakota on spring wheat and durum. Other names for this disease include *Fusarium* head blight, pink mold, white heads, and tombstone scab. Yield losses from scab are due to sterility of the florets (flowers) and to formation of shriveled, light test-weight kernels, some of which may pass out the back of the combine. Scabby grain may be downgraded at the market. Scab not only causes yield and quality losses, but may also be associated with fungal toxins (mycotoxins) that are hazardous to animals.

Symptoms

Any part or all of the head may appear bleached (Figure 1). These white heads are very conspicuous in a green field (Figure 2). Frequently only part of the head (often the upper half) is affected by scab. These partly white

Figure 2. Severe scab in field. (Photo by Marcia McMullen)

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and partly green heads are diagnostic for scab. The fungus also may infect the stem (peduncle) immediately below the head, causing a brown/purplish discoloration of the stem tissue. Additional indications of scab infection are pink to salmon-orange spore masses of the fungus often seen on the scabbed spikelet and glumes during prolonged wet weather (Figure 3).

Scab infections of barley are not always readily apparent in the field. Infected spikelets may show a browning or watersoaked appearance (Figure 4).

Many scab-infected wheat kernels are shriveled, lightweight, and are a dull greyish or pinkish in color (Figure 5). These kernels are sometimes called "tombstones" because of their chalky, lifeless appearance. Other scab-infected kernels may be more normal in size, if infection occurred late in kernel development. These kernels, however, may have a dull appearance or a pink discoloration. Scab-infected kernels of durum often lose their amber translucence and appear chalky or opaque. Scab-infected barley kernels show a brown discoloration (Figure 6) similar to that caused by other kernel blighting organisms.

Estimates of scab levels in a field are based on actual counts of blighted and healthy heads. Samples of entire diseased heads are helpful for confirmation of scab. Grain suspected to contain scabby kernels also may be examined. Samples should be submitted to county extension offices or to the Plant Diagnostic Laboratory at North Dakota State University. There is a nominal fee for processing the samples.

Seedling blights, poor stands and poor vigor are symptoms frequently associated with the planting of scabby grain. Infected seedlings may exhibit a brownish-red discoloration of the roots and crown and may rot at the soil line.

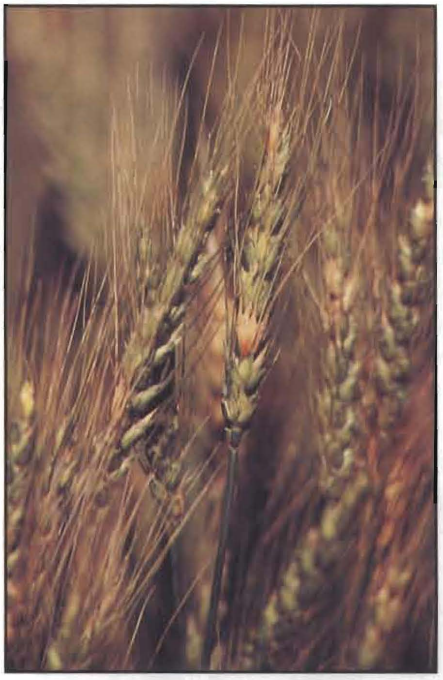

Figure 3. Salmon-orange spores visible on glumes of wheat. (Photo by Marcia McMullen)

Figure 4. Symptoms of scab on barley heads. (Photo by Robert Stack)

Survival and Spread

Scab is caused by fungal species in the genus *Fusarium*. The most common species causing scab is *Fusarium graminearum* (sexual stage–*Gibberella zeae*). This fungus is the same one that is frequently associated with stalk rot of corn. Another common cause of scab is *Fusarium culmorum*. Both *F. graminearum* and *F. culmorum* also may cause root rot of small grains. These fungi persist and multiply on infected crop residues of small grains and corn. During moist weather, spores of the fungi are windblown or splashed onto the heads of cereal crops.

The small grain crops are susceptible to infection from the flowering (pollination) period up to soft dough stage of kernel development. Spores of the causal fungus may land on the exposed anthers at flowering time and then grow into the kernels, glumes, or other parts of the head.

Little is known about how the fungus infects barley. For barley, which flowers when the head is in the boot, infection may be most common after the flowering period.

Figure 5. Scab-infected hard red spring kernels (left) and durum kernels (right). (Photos by Jim Miller)

Figure 6. Scab-infected and healthy barley kernels. (Photo by Brian Steffenson)

The most favorable conditions for infection are prolonged periods of high humidity (48-72 hours) and warm temperatures of 75-85 degrees Fahrenheit. However, infection does occur at cooler temperatures when high humidities persist for longer than 72 hours. Early infections subsequently may produce air-borne spores which are responsible for secondary spread of the disease.

Since scab development depends on favorable environmental conditions from flowering through kernel development, disease occurrence and severity varies from year to year. A combination of factors leads to the severest yield and quality losses: abundant inoculum is present, prolonged or repeated dews from flowering through kernel development occur, and a very susceptible cultivar is grown.

Management

Repeated scab epidemics and large economic losses have resulted in increased emphasis on developing resistant cultivars. Breeding and pathology programs are actively screening and developing genetic material with improved resistance to scab head blight.

None of the currently available commercial cultivars have resistance, but differences in tolerance to scab have been observed among named and numbered lines of hard red spring (HRS) wheat and durum wheats in field evaluations in recent years. Producers in areas of high risk for scab should select cultivars that have shown more tolerance to scab. Information on cultivar response to scab is available in NDSU variety trial publications and from county extension offices.

Seed treatment and the use of quality seed will help reduce seedling blight due to scab infection but will ***not*** protect against subsequent scab head blight. If scabby grain is to be used as a seed source, it should be thoroughly cleaned and conditioned to remove the majority of scabby kernels and to improve test-weight. A germination test should be run to indicate germ and vigor, and seed treatment fungicides commonly used for small grains should be considered for improvement in stand and vigor.

Other crop management techniques should also be used to reduce the risk of scab. Although environmental conditions play a key role in scab development, certain cultural practices will reduce survival and carryover of the fungal pathogen and lower risk of severe scab infection.

Tillage practices that bury residue from small grains or corn reduce the inoculum potential of the fungus, since the fungus survives best on residue left on or above the soil surface. In minimum or no-till practices, effective spreading and distribution of chaff and other residue will allow for faster decomposition of the chaff, reducing inoculum potential.

Crop rotation is effective in reducing scab levels. Crop rotation to a non-host crop or the planting of a small grain on last year's broad-leafed crop ground should be considered. The greatest risk of scab infection is when small grains are planted on last year's scab-infected residue or on last year's corn residue. Species of *Fusarium* that cause scab (and in particular *F. graminearum*) also attack corn, causing stalk and ear rot, and survive for several years in corn residue.

Staggered planting of the small grain crop or planting of cultivars differing in days to maturity is advised, so that the entire crop of a producer is not at risk of flowering during a period favorable for scab infection.

A fungicide spray program to reduce leaf diseases may reduce scab damage somewhat, but results with registered fungicides applied prior to the scab infection period have been very inconsistent. No fungicides are currently registered for the control of scab. Use of systemic fungicides registered to be applied at the flowering stage hold the most promise for control, but few are currently registered for this time of application, none have scab control on the label, and cost effectiveness is currently unproven.

At harvest, the combine may be adjusted so that lightweight, scabby kernels are removed along with the chaff. However, this will not remove **all** scabby kernels, since some scab infections occur late in the development of the kernel, and these infected kernels may still be fairly plump. Scabby barley and oat kernels are not so easily removed in the combining process.

Visible scab damage is considered a part of total kernel damage by the Federal Grain Inspection Service and, if excessive, will lower the market grade. Severely affected grain may be graded "feed" rather than "milling," or rather than "malting" in the case of barley.

Mycotoxins

Scab-infected grain may contain fungus-produced toxins called mycotoxins. The most common mycotoxin associated with scab infected grain in the Northern Great Plains is vomitoxin (deoxynivalenol = DON), a mycotoxin that may cause vomiting and feed refusal in nonruminant animals. Grain with vomitoxin would have to be ingested in very high amounts to pose a health risk to humans.

The presence of scab in grain does not automatically mean mycotoxins are present. The occurrence, amount and kind of mycotoxins may depend on several factors, including environment, species of fungus present, severity of infection, and the variety or kind of crop. Scab-infected grain may be tested for vomitoxin and other mycotoxins at properly equipped laboratories. In North Dakota, quantitative analysis for several mycotoxins, including vomitoxin, is provided by the Veterinary Science Diagnostic Laboratory, Van Es Hall, NDSU, Fargo, ND 58105, phone (701) 231-8307. A one-half to one pound representative sample of the harvested grain should be submitted. A fee is charged.

The Food and Drug Administration (FDA) established the following advisory levels for vomitoxin in food and feed in 1993:

- 1 part per million (ppm) for finished grain products for human consumption
- No standard for raw grain going into milling process
- Cattle, over four months old: 10 ppm (providing grain at that level doesn't exceed 50 percent of diet)
- Poultry: 10 ppm (providing grain at that level doesn't exceed 50 percent of diet)
- Swine: 5 ppm (not to exceed 20 percent of ration)
- All other animals: 5 ppm (providing grains don't exceed 40 percent of diet)

A veterinarian or feed specialist should be contacted for further information on safe livestock feeding levels. The risk of human exposure to vomitoxin ingestion is minimal under the FDA guidelines, but producers and elevator operators need to be aware that moldy grain can cause allergy and breathing problems. A good quality dust mask should be worn when working around grain with high amounts of scab or other molds.

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