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IDENTIFYING WHEAT AND BARLEY SEED AFFECTED BY FUSARIUM HEAD BLIGHT

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Fusarium head blight (FHB) is a fungal disease of small grain cereals. In North America, the three species of fungus most often responsible for the disease are *Fusarium avenaceum*, *F. graminearum*, and *F. culmorum*. *F. graminearum* and *F. culmorum* may produce a number of fungal toxins, called mycotoxins, in the grain. The most commonly produced mycotoxin is deoxynivalenol (DON), also known as vomitoxin. Economic losses from FHB arise from yield and grade reductions as well as problems associated with the presence of mycotoxins.

In **wheat**, susceptibility to FHB peaks at flowering and declines as the grain matures. Durum wheats are more susceptible to FHB than are the common wheats. *Fusarium* infection occurs only if there is precipitation during the period of susceptibility. Early infection results in shriveled, chalky white seeds or sterile florets. Many of the shriveled, light seeds are lost during combining, although some may remain in the harvested grain. Those seeds remaining are referred to as *fusarium damaged kernels* or FDK in Canada and *scabby kernels* in the U.S. The grading systems in Canada and the U.S. allow only a small number of FDK in grain destined for milling and other human uses.

In **barley and oats**, symptoms of FHB are often difficult to find. In most years, few infected seeds display the fungal sporodochia or perithecia which are typical symptoms of seed infection in these crops. The

symptoms become more common during wet harvests. Blackpoint is often present on barley seeds affected by FHB, but the resulting discoloration is not specific to *Fusarium*. Blackpoint is also associated with infection by *Helminthosporium sativum*, a cause of common root rot.

DON, often associated with FDK, is one of the milder mycotoxins. Non-ruminants, such as hogs, are the most sensitive to the presence of DON in their diets. A typical response is reduced feed consumption resulting in slower weight gain. The presence of detectable amounts of DON in a barley sample can lead to its rejection as malting barley.

MONITORING

Since 1984, when a few fields in southeastern Manitoba were found to have high levels of FDK caused by *F. graminearum*, researchers at the Grain Research Laboratory have been monitoring grain samples from western Canada for the presence of FDK and identifying the fungal species responsible. The fungal species of most concern is *F. graminearum*, an aggressive pathogen and a capable DON producer. *F. graminearum* appears to have spread westward from southern Manitoba, and is now an important pathogen in Manitoba and eastern Saskatchewan. However, it is only at very low levels outside of this area.

Presence of FDK is not always associated with the presence of DON, but depends upon which species produced the FDK.

DEFINITIONS

DON (Deoxynivalenol)—The mycotoxin most commonly produced by some of the fungal species which cause fusarium head blight. Also known as vomitoxin.

FDK—Fusarium damaged kernels. They are called scabby kernels in the U.S.

FHB—Fusarium head blight. This fungal disease of small grain cereals is caused by several species of *Fusarium*. In North America, the three species most often responsible for the disease are *F. graminearum*, *F. culmorum*, and *F. avenaceum*.

Mycelium—A fibrous, thread-like mass of fungal growth.

Perithecia—Bluish black fungal structures that produce a spore called an ascospore. The presence of these structures on the seed indicates that the seed was infected by *F. graminearum*.

Pycnidia—Small, black, spore-producing structures produced by a variety of fungi. The spores formed in these structures are called pycnidiospores. Pycnidia are not formed by *Fusarium* species.

Sporodochia—Masses of fungal spores. In *Fusarium* species they are typically orange. The spores in these frequently slimy masses are called conidiospores. All *Fusarium* species that cause fusarium head blight produce sporodochia.

Head Blight on Wheat



- a) **Fusarium head blight (FHB) on wheat**—Orange sporodochia are formed at the base of the glumes, as shown. Infected spikelets ripen prematurely.
- b) **FHB on wheat**—Bluish black perithecia are occasionally formed on the head.



c) **Sound red spring wheat seed**

- d) **Not a Fusarium Damaged Kernel (FDK)**—This seed does not have sufficient seed discoloration or fibrous fungal growth, also called mycelial growth, to qualify as a fusarium damaged kernel according to the Canadian Grain Commission Official Grain Grading Guide.
- e) **FDK with light symptoms**—Mycelial growth is visible around the germ and in the broad crease, and the seed looks shriveled and chalky white.
- f) **FDK with severe symptoms**—Abundant mycelial growth is visible on both seed surfaces, with some pink discoloration at the germ. The seed has a shriveled, chalky white appearance.

AMBER DURUM



a) **Sound durum wheat seed**

b) **Moderate symptoms of FDK**—Mycelial growth is visible at the germ and crease. Other symptoms are the wrinkled seed coat, broad crease and bronzy colour.

c) **Severe symptoms of FDK**—Mycelial growth is abundant, the seed coat is wrinkled, the crease is broadened, and the colour is bronzy.

PRAIRIE SPRING



a) **Sound Canada Prairie Spring Red wheat seed**

b) **Moderate symptoms of FDK**—Mycelial growth is visible at the germ and crease. Other symptoms are a wrinkled seed coat, a broad crease and a chalky white appearance.

c) **Severe symptoms of FDK**—Abundant mycelial growth is found at the germ and crease. The seed coat is wrinkled, the crease is broadened, and the appearance is chalky white with pink at the germ.

WHITE WINTER



a) **Sound white winter wheat seed**

b) **Moderate symptoms of FDK**—Mycelial growth is visible at the germ and crease. Other symptoms are a wrinkled seed coat, a broad crease and a whitish colour.

c) **Severe symptoms of FDK**—The seed coat is wrinkled, the crease is broadened, and the appearance is pink and chalky white.

Head Blight on Barley



- a) **Fusarium head blight (FHB) on barley**—Symptoms on barley heads are more subtle than on wheat. Orange sporodochia may be seen at the base of infected florets as well as some dark discoloration. Heads occasionally have perithecia present.

b) **Sound hulless barley seed**



- c) **Hulless with light symptoms**—Mycelial growth is visible in the crease and the germ. The perithecia and sporodochia characteristic of FHB in covered barley are absent in hulless barley because of removal of the hull where these structures are normally found. In this respect, damaged kernels of hulless barley more closely resemble FDK of wheat.
- d) **Hulless with moderate symptoms**—Mycelial growth is more apparent, with some dark discoloration of the seed and reduced seed size.
- e) **Hulless with severe symptoms**—Seeds are thin, with some dark discoloration and abundant mycelial growth.



- g) **Black perithecia**—Bluish black perithecia encrust the seed surface. The dark discoloration of this seed and the seed in (h) is also typical of infection of barley seed by fusaria and other pathogens.
- h) **Orange sporodochia**—These orange spore masses may be formed by a number of *Fusarium* species, some of which do not produce deoxynivalenol.

Seed symptoms mistaken for fusarium head blight



- a) **Midge damage with mould**—Feeding by the larva of the orange wheat blossom midge can result in shrunken, misshapen seeds. Depending upon the growing conditions, midge-damaged seeds may become visibly mouldy. A whitish fungal mycelia can result in seeds similar in appearance to seeds formed as a result of FHB. This type of fungal growth is frequently that of *Septoria nodorum* or one of the fusaria.
- b) ***Asteromella* species**—This fungus is recovered from seeds with a somewhat chalky appearance and visible mycelial growth. The seeds characteristically have an orangish translucence and black pycnidia on the surface, frequently at the brush end. In culture, *Asteromella* sp. grow very quickly and form a dense, white mycelial growth.
- c) ***Septoria nodorum***—Infection of the seed by this fungus, which causes glume blotch in wheat, can result in a seed visually indistinguishable from those formed by FHB. This type of seed appears primarily in Saskatchewan and Alberta durum wheat. However, no samples yet examined have shown a great number of these seeds present.



- d) **Fungal pycnidia**—These pycnidia are smaller and more discreet than the perithecia of *F. graminearum*.
- e) ***Helminthosporium* species**—The net blotch fungus *Helminthosporium teres* (and sometimes the leaf stripe fungus *H. graminea*) is frequently recovered from barley seeds that display an orange discoloration at the basal end. Unlike the discoloration of sporodochia associated with FHB, this discoloration is internal, and cannot be scraped off the seed.
- f) **Sooty moulds**—The dark, sooty moulds, usually species of *Alternaria* and *Cladosporium*, present on barley seed in years of wet harvests may be mistaken for perithecia. The sooty moulds, however, are fibrous and easily scraped off.