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report on
PLANT
DISEASE

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SCAB OF CEREALS

Scab – also known as head blight, pink mold, or white-heads – is caused by several fungi in the genus *Fusarium*. The principal pathogens are *Fusarium graminearum, F. avenaceum*, and *F. culmorum* (synonymous name for all three is *F. roseum* f. sp. *cerealis*) and *F. nivale.* These fungi produce only asexual spores with limited genetic diversity. The sexual stage is known as *Gibberella zeae*.

Scab infects all small-grain cereal crops, corn, and many other grasses including spelt, emmer, cheat, wildrye, several foxtails, quackgrass, crabgrass, and bluegrasses. Other plants that may be attacked include clovers, alfalfa, pokeweed, sweet potato, and several members of the parsley family. In Illinois, the fungi that cause scab and related diseases are most widespread and damaging on wheat, barley, rye, and corn. Scab can be severe in wheat sown in residue from a previous host crop such as corn.

Figure 1. Left, healthy; and right, three scab-infected wheat heads.

The *Fusarium* fungi may cause a blast of the spikelets (usually called head blight or scab), a rot of the root, crown or foot, and stem blight. The fungi also cause a seedling blight and a rot of the stalk, root and the ears on corn. The stand, yield, quality, and feeding value of the grain may all be seriously affected by scab.
The disease has been reported from most of the humid and semihumid areas of the world where cereals and corn are grown. The severity of scab infection on cereal grains varies greatly from year to year. Severe infection occurs during the flowering stage and shortly afterward, when the weather is warm and moist. If the weather is dry after the head emerges, small grains will be nearly scab-free.

Symptoms

SCAB OR HEAD BLIGHT. In the field, the earliest and most conspicuous symptom of scab infection occurs soon after flowering. Diseased wheat spikelets become a bleached, light-straw color and ripen prematurely, while healthy spikelets are still a normal green. Diseased wheat kernels are grayish brown and lightweight. Scab-infected rye kernels are dark brown to carmine-red. If the entire head is infected, barley spikes are dwarfed; diseased spikelets are compressed rather than spreading. Scab-infected spikelets of oats are ash-gray; those of barley, light brown. One or more spikelets may be infected, or the entire head may appear prematurely bleached (Figure 1). The dead 'whiteheads,' which are sterile or contain only partially filled seed, are often rapidly colonized by secondary black molds.

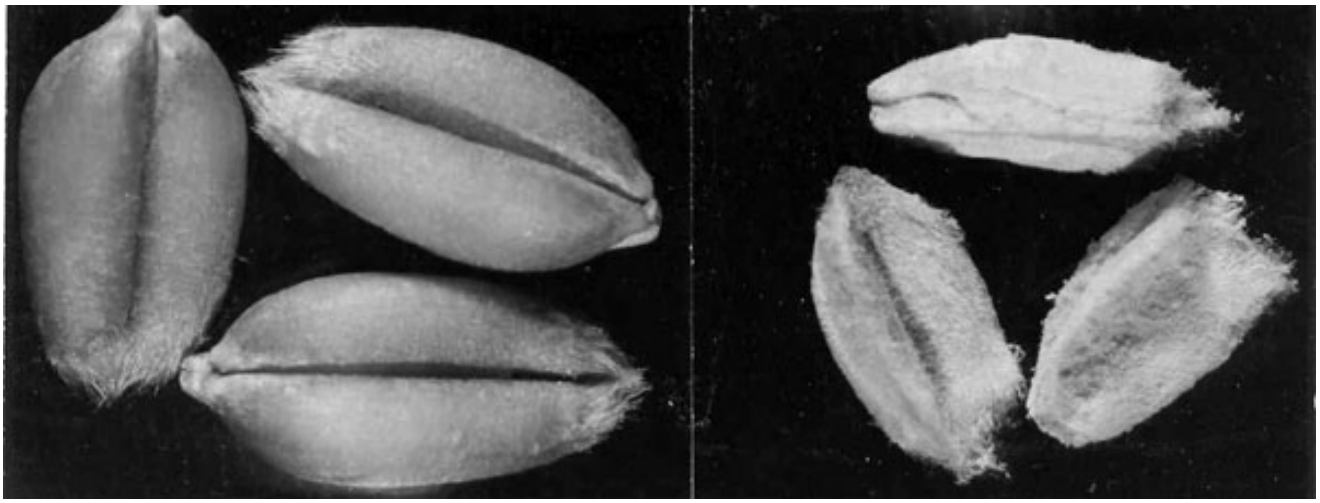

Figure 2. Three scab-infected wheat kernels are shown on the right, with three normal kernels on the left.

During warm and moist weather, masses of light-pink to salmon-colored mold (composed of mycelium and "summer" spores or conidia of the fungi) may form on infected glumes and lemmas of the spikelets, especially near the base of the kernel. This is an excellent diagnostic sign. Infected kernels are generally shrunken, wrinkled, and light in weight, with a rough and flaky-to-scabby appearance (Figure 2). These kernels range in color from light brown to pink or grayish white, depending on the time of infection and the weather conditions.

Occasionally, the fungus may girdle and kill the spike or rachis of a grain head, causing the parts beyond to die. The result is no grain at all or small, shriveled kernels that are separated-out in the process of harvesting or threshing. If the weather remains warm and moist, spikelets on heads infected early become speckled by harvest time with superficial, spore-producing bodies (perithecia) that are a dark purplish black (Figure 3).

SEEDLING BLIGHT, ROOT ROT, FOOT AND CROWN ROT.

Infected seedlings may be killed before or after emergence. The seedlings that emerge are stunted, turn yellow and die. The roots and hypocotyl (length of stem between the lowest node and the root) are water-soaked, light brown to reddish brown, and may be covered with a mass of pink or grayish mold. Severely blighted seedlings die. The infected seedlings that survive lack vigor, tiller poorly, and frequently send up a single stem on which a small head is produced. A light brown, reddish brown, or grayish brown rot of the crown and foot may occur as the weakened plants approach maturity. *Fusarium nivale* is favored by low soil temperatures while other *Fusarium* species are favored by higher temperatures.

Fig. 3. Wheat head covered with perithecia of Gibberella zeae.

Poor stands are common from sowing scab-infected seed. Scabby kernels are often dead, or else germinate weakly. If a sprout manages to emerge from the soil, it frequently decays before it can become established.

STEM BLIGHT. This occurs as a cereal grain approaches maturity. The worst attacks occur on crops on heavy wet soils. Affected plants die early or ripen prematurely, showing a bleached, yellowish appearance. The fungi commonly attack the culms at the 'joints' (nodes), causing a girdling and the death of the parts above the joints. Such plants lodge easily

during rain and wind storms. The fungus responsible for stem blight can often be seen as pinkish white, pinhead-sized pustules on the lower nodes of infected plants.

Disease Cycle

The scab fungi overseason and propagate in and on the soil as spores, mycelium (threadlike mold growth), and fruiting structures known as **perithecia** which produce **ascospores**. Light pink to orange-colored masses of conidia or "summer" spores are produced in tremendous numbers during warm, moist weather. Ascospores (often called "winter" spores) produced within the perithecia are discharged into the air during warm, moist weather in the spring and early summer. Air currents and rainsplash carry the ascospores and conidia to the young spikelets. The spores germinate in a film of moisture and first invade the flower parts, frequently spreading to the glumes and other parts of the head. Infections are most frequent and serious at anthesis. At this time, anthers and pollen may serve as a food base for pathogens. Blight symptoms develop within 3 days after infection, when temperatures range between 77° and 86°F and moisture is continuous. In areas that otherwise are too dry for scab development, sprinkler irrigation may predispose plants to the disease.

Conidia and ascospores may also fall on crop residues. These spores soon germinate, resulting in mycelium which produces large numbers of conidia. Both the ascospores and conidia are capable of producing infection if they land on the head of a cereal or grass plant during or shortly after the blossoming period. Within 7 to 10 days after infection, salmon-pink masses of conidia form at the base of the diseased spikelets. These conidia are carried by the wind to the heads of other cereal and grass plants in turn producing new, secondary infections. The process is repeated as long as the spikelets are susceptible and the moist weather prevails.

Secondary infections may result from the long-distance spread of airborne conidia. Ascospores are usually produced too late in the season to function as secondary inoculum, but persist in crop residue and will contaminate seed.

Seedling infections result primarily from seedborne mycelium and spores. When the soil temperature is above 60°, seedlings from clean seed may become infected from mycelium in decaying crop residues on or in the soil. Head and stem infections occur independently of seedling blight and root rot, since the fungi cannot grow for any distance within the cereal plant. However, the fungi may live for several years within infected kernels.

TOXICITY OF SCABBY GRAIN

The growth of the *Fusarium* fungi in scabbed grain produces toxic compounds (mycotoxins) that cause muscle spasms, acute vomiting, nausea, dizziness, diarrhea, and soreness in man, young chickens and ducklings, pigs, dogs, horses, and other nonruminant animals with simple stomachs. In swine feed, 3 percent or more of scabby grain cause vomiting, and then the swine refuse to eat the mixture. Cattle, sheep, and mature poultry (except pigeons) do NOT react to scabbed grain. Because one of the mycotoxins involved has some estrogenic activity, scabby grain should **not** be fed to breeding animals. The mycotoxins apparently remain stable for years in stored grain. Bread made from scabby grain has been described as 'intoxicating.'

Heavily scabbed wheat kernels are generally very lightweight and easily removed by modern cleaning equipment. However, scabbed barley and oat kernels are much more difficult to remove from healthy grain.

Control

1. Rotate small grains and corn with legumes, allowing at least a one-year break in cereal, grass, or corn cultivation. Plant small grains as far as possible from old cornfields.

2. Sow only plump, small-grain seed that has been thoroughly cleaned to eliminate all lightweight seed and then treated with a protective, broad spectrum fungicide or fungicide mixture. Proper seed treatment controls seedling damage from infected seed, but will NOT control the head blight or scab, foot rot, and stem blight phases of the disease.

3. Sow adapted and recommended small-grain varieties in a fertile, well-prepared seedbed.

4. Delay the sowing of winter cereal grains until the temperature is 60°F or below, to reduce the chances of severe seedling blight. Sowing spring cereal grains early tends to reduce losses from seedling blight, crown rot, and head blight.

5. Where feasible, plow under cleanly and deeply all infected stubble debris and straw of small grains and weed grasses, cornstalks, and rotted ears. Complete coverage of crop residues helps reduce head blight infections. Sanitation is most effective when it is done on a community-wide basis. Manure containing infected straw or cornstalks should **not** be used for top dressing.

6. No highly resistant varieties of wheat, oats, barley, or rye are available. Some varieties are infected less frequently, apparently because of physical barriers to the infection of florets and spikelets. Not all differences in the incidence of head blight among wheat or barley varieties growing in adjacent fields are genetically based. The time of anthesis and prevailing weather conditions at flowering can also influence the development of scab.

7. Store grain at a moisture level of <14% to prevent the growth of the fungus and the possible production of additional mycotoxins.