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Corn Stalk Rots

P. Vincelli and D.E. Hershman

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Stalk rots are the most common diseases of dent corn in Kentucky. It is estimated that these diseases reduce annual yields by a minimum of 3 percent. In certain years, yield losses may reach 10 to 20 percent. Losses are due to (1) premature plant death which results in poor filling of ears or light test weights for the grain, and (2) harvest losses associated with stalk breakage or lodging. Furthermore, problems with ear rot are usually greater where lodging occurs, particularly when the harvest season is wet.

Several fungi and bacteria can cause stalk rots. Those which may occur in midseason include Pythium stalk rot (Pythium aphanidermatum) which most frequently develops when weather is excessively wet during the summer months, and bacterial stalk rot (Erwinia chrysanthemi pv zeae) which most frequently develops when heavy rains occur prior to tassel emergence.

However, the majority of stalk rots observed in Kentucky occur late in the season. The common late-season stalk rots are caused by fungi and include: Gibberella stalk rot (Gibberella zeae, =Fusarium graminearum), anthracnose (Colletotrichum graminicola), Fusarium stalk rot (Fusarium moniliforme), charcoal rot (Macrophomina phaseolina), and Diplodia stalk rot (Diplodia maydis). It is common for more than one stalk rot organism to attack a plant at the same time.

Symptoms

Stalk rots caused by Gibberella, Fusarium and Diplodia fungi are not usually apparent until several weeks after pollination. Diseased plants may die suddenly in various areas within the field, with leaves first turning a dull, grayish-green similar to the color caused by frost or drought damage. Death of the entire plant follows within 7 to 10 days in susceptible hybrids. The lower internodes turn from green to tan, straw-colored, or dark brown and are spongy and easily crushed. When the stalks are split lengthwise, only the vascular strands are intact and the pith tissue is decayed.

Stalks infected with the Gibberella fungus have a characteristic pink to reddish discoloration of the pith and vascular strands. The breakdown of pith tissues starts at the nodes soon after pollination and becomes more severe as the plant matures. Rotting also commonly affects the roots and crown as well as the lower internodes. An additional identifying feature is the presence of small, round, bluish-black perithecia (fungal-fruition bodies) which form on the surface of Gibberella-infected stalks in the fall or the following spring. These fruiting bodies are easily scraped off with a thumbnail. Fusarium stalk rot looks similar to Gibberella, except that the discoloration of infected tissues commonly varies from whitish-pink to salmon.

Diplodia stalk rot can be distinguished from other stalk rot diseases by the numerous, small, black dots (pycnidia) which the fungus produces at or near the lower nodes of infected stalks. Unlike the perithecia formed by the Gibberella fungus (which may also be clustered near the lower nodes), the pycnidia of Diplodia are embedded in the rind and can not be scraped off with a fingernail. However, individual stalks may have fruiting bodies of both fungi if a double infection has occurred.
Corn anthracnose has become much more prevalent in Kentucky since the early 1970s. In addition to rotting the lower stalk, the anthracnose fungus is capable of attacking the stalk above the ears, causing dieback and breakage of the plant tops (borer injury in the top of the plant may cause similar symptoms). The fungus also commonly causes a leaf blight. Although the lower stalk rot phase of anthracnose may cause very susceptible hybrids to be killed before pollination, most hybrids are killed only a week or two before normal maturity. A shiny black or dark brown discoloration of the rind late in the season is a typical symptom of anthracnose on the stalk. This black discoloration usually extends up the stalk for several internodes and may uniformly discolor the rind or give it a blotchy or speckled appearance. The pith tissue beneath these lesions becomes brown or black, especially around the nodes. When lodging occurs, it is usually higher on the plant than with other stalk rot diseases.

Charcoal rot is most abundant in hot, dry seasons. As infected plants approach maturity, stalks are killed and the interior of the lower internodes disintegrates. The disease is readily distinguished by the presence of numerous, small, round to irregular, black fungal bodies (sclerotia), which are present in large numbers along the vascular strands in the interior of rotted stalks. The disease derives its common name from the presence of these sclerotia, which resemble specks of charcoal dust. Sclerotia may also be found just beneath the stalk surface and on the roots.

Pythium stalk rot usually occurs during extended hot (optimum temperature of 90 degrees F or 32 degrees C), wet weather from late June to September. The disease is most common in riverbottom fields where the air and soil drainage are poor and the humidity is high. The interior of the stalk looks water-soaked. Usually, only a single internode just above the soil line is attacked. Diseased tissue appears water-soaked and brown, becomes soft, and often causes the plant to collapse; however, infected plants may remain green and turgid for several weeks because the vascular bundles remain intact. Positive diagnosis can be made by microscopic examination for the round, thick-walled oospores of the Pythium fungus in diseased tissue.

Bacterial stalk rot usually appears as a tan to dark brown, water-soaked, soft or slimy disintegration of pith tissues at a single internode. Affected stalks suddenly collapse and are usually twisted. The tips of the uppermost leaves often wilt, followed by the appearance of a slimy soft rot at the base of the whorl. The decay spreads rapidly downward until the affected plants collapse. Diseased plants often have a foul odor. The development of bacterial soft rot, like Pythium stalk rot, is favored by high temperatures (85 to 95 degrees F, 29 to 35 degrees C) and poor air circulation. General infection may occur following flooding and where corn is sprinkler-irrigated from a surface source of water, such as a river, farm pond or lake.

**Disease Development**

Development of stalk rots is generally favored by an early environment that encourages kernel set and by a late environment that is stressful. Postflowering stresses may include: 1) an excess or lack of moisture; 2) nutrient deficiency or imbalance; 3) excessive cloudiness; 4) insect, nematode, hail or other mechanical injury to the leaves, stalks or roots; 5) loss of effective leaf area due to foliar diseases; or 6) an excessive plant population. Extended periods of very dry or wet weather prior to pollination, followed by an abrupt change for several weeks after silking, also encourage the development of stalk rot.

High yields are often associated with stalk rot problems because plants may overcommit to yield if the environment is ideal from kernel set through the pollination period and stress occurs afterwards. The large number of kernels places a high demand on the plant for sugars, and if photosynthesis (which produces sugars) is subsequently reduced because of stress, most of the plant's available sugars will go to the kernels. This deprives the stalk and root tissue of adequate nutrients, making them more susceptible
to infection by stalk rot organisms.

High nitrogen (N) levels combined with a low level of potassium (K) may increase stalk rot. However, high rates of nitrogen balanced with adequate to high levels of potash (K2O) do not increase the potential for stalk rot. Adequate to high levels of nitrogen that stimulate early growth followed by a loss of available nitrogen due to denitrification or leaching may dramatically increase the incidence of stalk rot.

Injury to roots, stalks or leaves by nematodes, diseases, insects, hail or equipment can also increase the incidence of stalk rot. Injuries created by European corn borers, northern and western corn rootworms and other insects often provide avenues of entry for stalk rot fungi. Hail injury may predispose plants to stalk rot primarily because the effective leaf area is reduced, thereby reducing photosynthesis. Diseases such as gray leaf spot, northern corn leaf blight, southern corn leaf blight, Stewart's leaf blight, yellow leaf blight, and anthracnose similarly reduce the area of photosynthetic leaf tissue, thereby increasing the plant's susceptibility to stalk rot.

**Control**

Stalk rots cannot be entirely controlled. However, the damage can be reduced through the conscientious use of an integrated control program. Use the following practices to reduce harvest losses: (1) plant well-adapted disease-resistant hybrids; (2) follow a balanced soil fertility program; (3) control insects; (4) plant at the proper rate; (5) avoid stress through proper irrigation, soil management, and foliar disease and weed control; and (6) practice regular field scouting.

**Disease-Resistant Hybrids**

Corn growers should select high yield potential hybrids that also have stalk rot resistance, leaf disease resistance, and good standability. Full-season hybrids are generally more resistant than those that mature early in a given area. Resistance to the fungi that cause stalk rots helps prevent losses from premature plant death and lodging.

Many resistant hybrids are available. Most hybrids, however, are only resistant to the organisms causing Diplodia, Gibberella and Fusarium stalk rots. Hybrids that are resistant to these fungi may be highly susceptible to anthracnose stalk rot. Hybrids resistant to anthracnose may be somewhat susceptible to other stalk rot fungi. Thus, it is important to know which organisms are causing major stalk rot damage in an area and to which stalk rot fungi a hybrid is resistant.

In addition to stalk rot resistance, growers should select hybrids resistant to foliar diseases important in their area. Resistance to leaf diseases is important since loss of leaf area can predispose the corn to stalk rot problems.

Hybrid standability is another factor that should be considered. Hybrids with thick rind or other characteristics that increase standability often remain standing even though the interior of the stalk is thoroughly decayed. Corn producers should check out such characteristics before selecting a particular hybrid.

It is often worthwhile to tour local hybrid strip plots to check on the susceptibility of various hybrids to stalk rot. Up-to-date information on the yield performance and lodging of many hybrids is also available in the latest issue of the U.K. publication "Kentucky Hybrid Corn Performance Test."

**Balanced Soil Fertility**
Balanced soil fertility, particularly with respect to potassium, is important. Fertilizer should be applied based on the results of soil tests. Recent research has shown the importance of an adequate supply of nitrogen throughout the season in reducing the severity of stalk rot. In areas where leaching or denitrification is expected, the use of a nitrification inhibitor may help reduce stalk rot.

**Insect Control**

Control of insects such as the European corn borer and the northern and western corn rootworms is important in reducing stalk rot losses. Corn growers should follow the "Insect Management Recommendations for Field Crops and Livestock" published annually by University of Kentucky Extension entomologists. The use of scouting procedures will greatly help identify if and when insecticides should be applied for maximum benefit.

**Proper Rate of Planting**

Corn growers should plant at populations suggested for the particular hybrid, soil type, fertility level, available soil moisture and productivity potential in a given field. Planting at "excessive" rates can result in spindly stalks with reduced standability. Growers should consult seed-corn handbooks for suggestions on planting rates for hybrids.

**Stress Reduction**

Timely irrigation (where possible), weed and nematode control, and other stress reducing practices are important in controlling stalk rot damage.

**Field Scouting**

Monitoring fields on a weekly basis is the best way to determine pest levels in a field. Corn producers should begin to scout fields for stalk rots (lodging potential) when the corn kernels contain 30 to 40 percent moisture. An effective scouting procedure is to walk a zigzag pattern through the field while pinching the stalks (of at least 100 plants) between two lower nodes to check for firmness. An alternate procedure is to push a similar number of random plants 8 inches from the vertical and estimate the ease of lodging. If more than 10 to 15 percent of the plants have spongy stalks or appear to lodge easily, it would be beneficial to harvest the field early to prevent potential harvest losses. The same procedure can also be used to assess hybrids in strip plots. Growers should also check the extent of premature plant kill when inspecting strip plots.