Stalk Rots of Corn and Sorghum

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Stalk rot is the most prevalent disease of corn and sorghum in Kansas. Annual losses are difficult to determine, because unless lodging occurs, the disease goes mostly unnoticed. The best estimates are that at least 5 percent of the corn and sorghum crop are lost each year to stalk rot. The incidence of stalk rot in individual fields may reach 90 to 100 percent with yield losses of 50 percent. The most obvious losses occur when plants lodge, however recent advances in harvesting equipment have helped a great deal in recovering grain from lodged fields. More important may be the yield losses that go unnoticed. These losses are caused by reduced ear and head size, poor filling of grain, and early eardrop or head lodging as plants mature early.

There are many different pathogens known to cause stalk rot in Kansas. They can be found alone or in combination with one or more of the other pathogens in an infected stalk. In corn, the most common pathogens are *Fusarium moniliforme* (*Gibberella fujikuroi*) and *F. graminearum* (*G. zeae*), the causes of Fusarium stalk rot. Two other commonly found stalk-rotting fungi are *Macrophomina phaseolina*, the cause of charcoal rot, and *Colletotrichum graminicola*, the cause of anthracnose stalk rot. Occasionally *Diplodia maydis*, the cause of Diplodia stalk rot, can be found on corn, but it is much more important as an ear rotting organism. On grain sorghum, stalk rot is caused by *F. thapsinum* (*G. thapsina*), *F. moniliforme*, and *M. phaseolina*. In addition to stalk rot, *F. moniliforme* and *F. graminearum* also cause an early season seedling blight, and *C. graminicola* causes a leaf blight. These fungi do not ordinarily attack young physiologically active plants, but rather those approaching maturity. In addition to the fungal stalk rots there is also a bacterial stalk rot, caused by *Erwinia chrysanthemi*, which occasionally occurs on corn and sorghum in Kansas under hot, wet growing conditions.

Figure 1. *Severe lodging due to stalk rotting fungi in a Kansas sorghum field.*

Figure 2. *Shredding and disintegration of the lower stalk tissue is a key diagnostic of stalk rot.*

Figure 3. *Shredding and discoloration of inner stem tissue of sorghum caused by Fusarium; healthy plant at right.*

Figure 4. *Fusarium infected corn plant.*

Figure 5. *Fusarium infected sorghum plant.*

Although caused by many different organisms, the symptoms of the various stalk rots are somewhat similar. Symptoms generally appear several weeks after pollination when the plant appears to prematurely ripen. The leaves become dry, taking on a grayish-green appearance similar to frost injury. The stalk usually dies a few weeks later. Diseased stalks can be easily crushed when squeezed between the thumb and finger and are more susceptible to lodging during wind or rainstorms (Figure 1). The most characteristic symptom of stalk rot is the shredding of the internal tissue in the lowest internodes of the stalk, which can be observed when the stalk is split (Figure 2). This shredded tissue may be tan colored (Diplodia or Fusarium stalk rots, as seen in Figures 2 and 3); red or salmon, (Fusarium and Gibberrella stalk rots, seen in Figures 4 and 5); or grayish-black (charcoal rot, seen in Figure 6). A good diagnostic sign for charcoal rot is the numerous black fruiting structures, called sclerotia, that cover the vascular strands and give the interior of the stalks a sooty appearance (Figure 7). Anthracnose is identified by the development of black, shiny patches on the outer stalk, usually starting around the nodes (Figure 8). Diplodia stalk rot is identified by the presence of small, black pimple-like structures (pycnidia) embedded in the outer stalk of the lower internodes (Figure 9). Unless stalks are split, symptoms of stalk rot may not be readily

Figure 6. *Charcoal rot of corn caused by Macrophomina phaseolina.*

Figure 7. *The small, black fruiting structures (sclerotia) located on the vascular strands of the lower stalk tissue are a key diagnostic for charcoal rot.*

evident. Some times the only visible symptom is reduced ear size (Figure 10).

Symptoms of bacterial stalk rot generally appear in midseason when plants suddenly fall over (Figure 11). One or more of the internodes above the soil line may become soft and slimy and produce a foul odor. Collapsed, twisted stalks are a good indication of this disease. Affected plants may remain green for several days because the vascular strands remain intact.

The stalk rotting fungi survive freely in the soil or on crop residues. The spores of the fungi may be spread by wind, splashing rain, or insects. Under favorable conditions, the fungi infect the corn and sorghum stalks either directly through the roots or crown, or through wounds caused by hail or insects. Fusarium and Colletotrichum also can penetrate stalks at the base of the leaf sheaths and progress down into the lower internodes from there. The bacterial stalk rot pathogen lives on crop residue in the soil and invades the plant through natural openings or wounds in the leaves and stalks.

Stalk rot is a stress-related disease. Any stress on a crop can increase both the incidence and severity of stalk rot. Research has indicated that when the carbohydrates used to fill the grain become unavailable due to nutrient shortage, drought stress, leaf loss from insects, hail, disease or reduced sunlight, the plant uses nitrogen and carbohydrate reserves stored in the stalk to complete grain fill. This loss of nitrogen and carbohydrate reserves weakens stalk tissues and results in increased stalk rot susceptibility. Early-maturing hybrids are generally more susceptible than full-season hybrids.

Bacterial stalk rot is most likely to occur where river, lake or impounded water is used for sprinkler irrigation or where tail water is collected and reused for flood irrigation.

Environmental conditions favorable for disease development vary with the different organisms. Diplodia and Fusarium stalk rots are favored by dry conditions early in the season, which decreases nutrient solubility, making them unavailable to the plant. Later in the season following pollination, warm (82 to 86°F), wet weather can leach remaining nutrients from the soil resulting in late season nitrogen stress and an increase in stalk rot. Charcoal rot is favored by hot (higher than 90°F) droughty conditions during grain fill. Anthracnose is favored by early season moisture, which allows the leaf stage of the disease to develop. Later in the

Summary of corn and sorghum stalk rots

Disease	Host	Symptoms	Weather
Fusarium stalk rot	*Corn and sorghum*	*Internal shredding of lower nodes; tan or pink-to-purple internal discoloration*	*Dry conditions early and warm (82-86°F), wet weather 2 to 3 weeks after silking*
Charcoal rot stalk rot	*Corn and Sorghum*	*Internal shredding of lower nodes; black slerotial attached to the vascular tissue*	*High soil temperatures (98°F) and low soil moisture during grain fill.*
Anthracnose stalk rot	*Corn*	*Internal shredding of lower and sometimes upper nodes; tan internal discoloration; black shiny patches on the outer stalk*	*High temperatures and extended periods of cloudy, humid weather.*
Diplodia stalk rot	*Corn*	*Internal shredding of lower nodes; tan internal discoloration; small black pycnidia on the lowest part of the outer stalk*	*Same as for Fusarium stalk rot.*
Gibberella stalk rot	*Corn*	*Internal shredding of lower nodes; pink-to-red internal discoloration*	*Same as for Fusarium stalk rot.*
Bacterial stalk rot	*Corn*	*Collapsed, twisted stalk with a foul odor*	*High rainfall, or flood prone areas; temperatures of 86 to 95°F and poor air circulation*

season, if sufficient stress occurs, the anthracnose organism moves from the leaves to the stalk where it can cause a top dieback as well as the more typical stalk rot.

There is no one single control for stalk rot. No hybrid has complete immunity to the stalk-rotting pathogens. When choosing a hybrid, a grower should select a hybrid that is not only a high yielder, but one that has good standability and "stay-green" characteristics. This will help assure that if stalk rot does occur, losses due to lodging will be minimal. In corn, plants that develop two ears are often the first to become infected due to increased carbohydrate needs. There is some evidence that full-season hybrids may be less susceptible than early-season hybrids by being more resistant to the scavenging of nutrients from the lower stalk during times of low carbohydrate stress.

A balanced nutrition program based on soil tests should be used. Overall fertility levels should be adjusted to fit the hybrid, plant population, soil type, environmental conditions and management program. An excess as well as a shortage of nitrogen can lead to increased stalk rot problems. Research in southeast Kansas has shown that maintaining adequate levels of potassium and chloride, especially where high rates of nitrogen are used, can help reduce lodging caused by stalk rot. Rotation with nonsusceptible crops such as small grains and alfalfa will reduce the severity of stalk rot but will not eliminate it.

A good insect control program is a must in limiting losses to stalk rot. Pathogens may enter stalks or roots through wounds created by insects such as corn borers and corn rootworms. There is evidence that stalk rot incidence in Bt corn hybrids is lower because of the reduced insect feeding damage. Foliar feeding insects such as spider mites and leaf diseases such as gray leaf spot need to be managed because they can reduce the amount of leaf area available for photosynthesis, thereby limiting the plant's ability to produce and store the carbohydrate reserves necessary for seed development. Hail damage will generally increase the amount of stalk rot damage.

Figure 8. *Anthracnose stalk rot caused by Colletotrichum graminicola. Shiny, black patchy areas on the outer stem are an important symptom for diagnosis.*

Figure 9. *Stalk rot caused by Diplodia maydis. Black fruiting structures (pycnidia) located on the surface of the lower stalk are characteristic of this disease.*

Figure 10. *Ear size can be reduced by stalk rot; ears from healthy plant (left) and stalk rot infected plants (middle and right).*

Where irrigation is available, applications of water should be timed to avoid drought stress, both before and after pollination. Planting early or late to avoid drought stress at critical times can also be beneficial. Early harvest of severely infected plants will reduce losses from ear dropping and lodged plants.

Figure 11. *Bacterial stalk rot caused by Erwinia chrysanthemi.*

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