DEPARTMENT OF
B·O·T·A·N·Y
PLANT·PATHOLOGY
PURDUE UNIVERSITY • WEST LAFAYETTE IN

Corn Diseases

Purdue University
Cooperative Extension Service

Stalk Rots of Corn

G. E. Shaner and D. H. Scott
Department of Botany & Plant Pathology
Purdue University
West Lafayette, IN 47907

Stalk rots occur to a greater or lesser degree every year in Indiana. Losses from stalk rots may occur directly when plants are prematurely killed and ears are lightweight and poorly finished or indirectly when harvest losses are increased due to lodging (Fig. 1). Development of stalk rot is frequently favored by excellent growing conditions early in the season that encourage kernel set and development followed by stress after pollination. Stress may occur from leaf injury due to disease, insects, hail, etc., or from poor soil conditions such as compaction, low K coupled with high N, or injury from root insects, stalk damage, etc. Frequently, severe cases of stalk rot occur through a complex of several stalk rotting organisms.

FIG. 1 Severe lodging from stalk rots.

For ease of understanding the various stalk rots and their control measures, stalk rots are classified as either soil-borne or air-borne. The soil-borne stalk rots are those in which the pathogen survives in the soil (sometimes for several years) and infection starts in the root system. Infection of roots may occur at any time during the growing season, but frequently occurs early in plant development. With the soil-borne stalk rots, the fungi remain in the roots, totally innocuous, until after grain filling commences. As the carbohydrate levels of the stalk tissues are depleted through grain filling, the natural resistance of the stalk diminishes and the stalk rotting organisms then spread from the root system into the pith tissues. The rotting of the pith weakens the stalk and makes the plant prone to lodging.

The air-borne stalk rots are those in which the pathogens infect the stalks above ground. These stalk rot organisms generally do not survive in the soil once the plant residues that harbor them are broken down. Infection occurs beneath leaf sheaths when spores are carried by rain splash or wind from infected residues. From these infections, the fungi may penetrate through the rind and into the pith tissues. Tillage and rotation practices are more important for the control of air-borne stalk rots than they are for the soil-borne stalk rots.

The three air-borne stalk rots in Indiana are anthracnose, Pythium, and possibly Diplodia. Anthracnose is the most common and important of these. It is not clear whether the Diplodia stalk rot

pathogen is air-borne, soil-borne, or both. Diplodia stalk rot is discussed with the other soil-borne stalk rots.

Air-Borne Stalk Rots

Anthracnose Stalk Rot. Anthracnose stalk rot has been an important disease in Indiana since the mid 1970s. Anthracnose may occur as an early or late season foliar disease, a top kill, a stalk rot, or combinations of these. The stalk rot phase is the most important. Stalk infections may occur at various stages of growth depending on susceptibility of the inbreds or hybrids. Most hybrids are not affected until after tassling and usually not until shortly before normal senescence. The top kill phase of anthracnose may occur at any point above the ear from 4 to 6 weeks after pollination, while the lower portions of the stalk remain green. The top kill phase is easily confused with corn borer injury, but is differentiated from corn borer injury by the fact that there are no insect entrance holes in the stalk. The stalk rot phase of anthracnose generally first appears as narrow, vertical to oval, water-soaked lesions in the rind tissue. With age, these lesions enlarge and become tan to reddish brown, finally turning dark brown to black late in the season (Fig. 2). The black, blotchy areas on the stalk rind may extend through the rind and into the pith tissues. This separates anthracnose from secondary mold growth that occurs on stalk surfaces after plant death. Secondary molds can be scraped from the surface of the rind tissue. The black lesions of anthracnose cannot be scraped from the rind surfaces. Anthracnose stalk rot causes a light tan to brown disintegration of the pith. The color of the pith disintegrated by anthracnose is indistinguishable from other stalk rots The diagnostic characteristic for anthracnose is the black, blotchy areas within the rind tissues. Anthracnose stalk rot generally causes lodging higher on the plant than is normal for the other stalk rot organisms.

FIG. 2 The dark brown to black, blotchy areas in the stalk rind are characteristic of anthracnose stalk rot late in the season.

The anthracnose fungus overwinters in infected plant debris. It is a poor soil competitor and its population drops dramatically as infested residues disintegrate. Therefore, anthracnose is more severe where corn follows corn and infected residues are left on the soil surface. Anthracnose stalk rot has been recorded in fields where no debris was left on the surface and there is evidence that the fungus may survive, to some extent, as resting spores in the soil, but the greatest spread of this disease is from infected corn residues on the soil surface.

Management of anthracnose stalk rot is through the use of resistant hybrids, crop rotation, or clean, deep plowing of crop residues. Use of resistant hybrids in combination with crop rotation is usually highly effective

Pythium Stalk Rot. Pythium stalk rot is a rare disease usually confined to bottom lands or lower portions of a field. Infection occurs only under extended, hot, humid conditions. It is a rapidly developing stalk rot generally confined to a single internode close to the soil line.

FIG. 3 Twisted and collapsed tissues on the lower internodes of stalks are characteristics of the rare Pythium stalk rot.

The infected internode tissues are water soaked (dark green), soft, and collapsed (Fig. 3). The stalks may twist, distort, and fall over. Infected plants remain green and turgid up to several weeks after lodging because the vascular bundles remain intact.

The disease develops primarily during extended periods of hot (above 86˚F), wet, and very humid conditions. It is most likely to be encountered in fields with poor soil drainage when relative humidity is near 100%.

Soil-Borne Stalk Rots

Diplodia Stalk Rot. Symptoms of Diplodia stalk rot generally do not occur until several weeks after silking. Infected plants may die prematurely. When premature dying occurs, the plants first appear grayish green in color as though injured by frost. The lower internodes become brown to straw colored, spongy, and are easily crushed. The pith tissues disintegrate and turn tan or brown. Frequently, only the vascular bundles remain intact. The diagnostic symptom of Diplodia stalk rot is the development of small black specks that are frequently clustered near the lower nodes (Fig. 4). A white fungal

FIG. 4 The tiny black dots (pycnidia) clustered at the nodes and beneath the stalk epidermis suggest Diplodia stalk rot.

growth may also be present on the stalk surface in humid weather. These specks are subepidermal (formed beneath the epidermis) structures called pycnidia. Pycnidia are spore-producing structures of the fungus *Diplodia* and cannot be scraped from the stalk rind with the thumbnail. This characteristic separates this disease from other stalk rot organisms.

Dry conditions early in the season followed by warm (80˚ to 87˚F) wet weather 2 to 3 weeks after silking favor the development of Diplodia stalk rot. High nitrogen and low potassium, high plant populations, and loss of leaf area through disease, hail, or insect damage predispose plants to this disease. Early maturing hybrids are generally more susceptible than full season hybrids.

The causal fungus *Stenocarpella maydis* (*Diplodia maydis*), overwinters in infected plant residues (stalks, ears, husks, cobs, ear shanks, and possibly in leaf sheaths). Plant infection may occur through root, mesocotyl, or crown tissues early in the season. Infection of stalks directly from air-borne spores has been suggested. For purposes of disease management, it is prudent to consider Diplodia stalk rot as either an air-borne or a soil borne disease. It is more severe where corn follows corn.

Management of Diplodia stalk rot is through use of resistant hybrids, balanced soil fertility, appropriate plant population for the hybrid selected, and crop rotation.

Diplodia stalk rot and Diplodia ear rot are caused by the same fungus. These diseases were virtually non existent in the Midwest for about 20 years, but they reappeared about 5 years ago in southcentral Indiana. Since, they have been found in other areas of western Indiana. To date, Diplodia ear rot has been severe only in fields where corn followed corn and reduced tillage practices were used. The stalk rot phase appears to be less damaging than the ear rot phase. The stalk rot phase of the disease has been found primarily in fields where corn follows corn and reduced tillage practices have been used, but we suspect that there may be some cases where the disease occurred in individual fields where corn followed corn and conventional practices were used.

Gibberella Stalk Rot. Gibberella stalk rot is one of the more common stalk rots in Indiana and occurs every year to a greater or lesser degree. The distinguishing characteristic of Gibberella stalk rot is the pink to reddish discoloration of the disintegrated pith tissues (Fig. 5). Plants may be prematurely killed as with Diplodia stalk rot. Gibberella stalk rot can be confused with Fusarium stalk rot which also may produce a pink to salmon discoloration of the pith tissues. The diagnostic sign of Gibberella stalk rot is the presence of small, round, black specks (perithecia) that are formed on the surface of the stalk rind and frequently clustered near the nodes. These perithecia may be easily scraped from the rind tissue with the thumbnail.

The causal fungus, *Gibberella zeae* (*Fusarium graminearum*) survives in infected plant residues (stalks, ears, ear shanks, cobs). The disease is caused by the same fungus that causes head scab of wheat and barley. Infection occurs primarily through the roots, mesocotyl, or crown tissues, much as with the Diplodia fungus. However, it is common to find Gibberella stalk rot in fields that have been rotated and conventionally plowed. Therefore, Gibberella stalk rot is considered to be a soil-borne stalk rot that may occur in nearly every field when the conditions are favorable. Gibberella stalk rot is more severe when the crop is stressed by some other factor, especially after tasseling.

Management of Gibberella stalk rot is through the use of resistant hybrids, balanced soil fertility, proper plant populations, and reduction of plant stress caused by insect disease, soil compaction, etc.

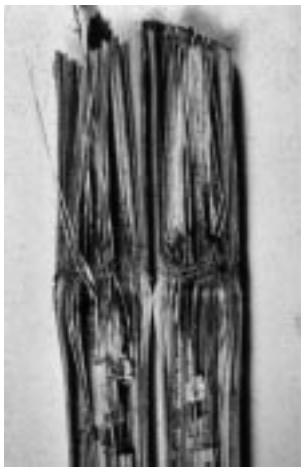

FIG. 5 Pink or reddish, shredded pith tissues suggest Gibberella stalk rot.

Fusarium Stalk Rot. Fusarium stalk rot is the most difficult of all stalk rots to diagnose. Frequently, the disease occurs as a non-diagnostic shredding of the pith tissues (Fig. 6). The color of infected pith can vary from tan to white-pink to salmon. Generally, Fusarium stalk rot is implicated when the diagnostic symptoms or signs of the other stalk rots are absent. Premature killing of plants may occur with Fusarium stalk rot as it does with Diplodia, Gibberella or anthracnose stalk rots.

Fusarium stalk rot is more severe where stress factors occur during the growing season, as with Gibberella stalk rot. The causal fungus, *Fusarium moniliforme*, survives in crop residues (stalks, ears, ear shanks, cobs) or in the soil. Infection occurs directly through wounds caused by hail or insects, but more importantly, through the roots, mesocotyl, or crown tissues during the growing season.

FIG. 6 Disintegrated pith tissue of Fusarium stalk rot may easily be confused with other stalk rots and is not diagnostic for a specific stalk rot.

Management of Fusarium stalk rot is the same as for Gibberella stalk rot.

Charcoal Stalk Rot. Charcoal stalk rot is found primarily in southern Indiana and in years of drought and high temperature stress. The disease is distinguished by the numerous black specks (sclerotia) on the vascular bundles. The pith tissues are generally highly disintegrated and only the vascular bundles remain.

The causal fungus, *Macrophomina phaseolina*, attacks the roots, mesocotyl, or crown. Infection frequently occurs early in the season, but the stalk rot symptoms do not develop until plants approach maturity or are severely stressed. The causal fungus survives in the soil for several years. The causal fungus attacks corn, sorghum, soybeans, and a wide range of other plants. Low soil temperature and high soil moisture decrease the severity of the disease.

Management of charcoal stalk rot is primarily by reduction of stress on the corn crop. Stresses include high plant populations, soil compaction, poor fertility, drought, insect injury and other diseases. The disease can frequently be minimized by maintaining soil moisture during dry periods after tasseling, where irrigation is available.

NEW 7/98 (1M)