University of Illinois Extension
College of Agricultural, Consumer and Environmental Sciences

report on **PLANT DISEASE**

RPD No. 200
December 1995

DEPARTMENT OF CROP SCIENCES
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

CORN STALK ROTS

Stalk rots are the most common diseases of dent corn in Illinois. These diseases reduce annual yields by a minimum of 5 percent. Losses in certain years reach 10 to 20 percent or more of the expected yield. Losses are due to (1) premature plant death, which results in poor filling of ears or lightweight and poorly finished ears and (2) harvest losses associated with stalk breakage or lodging (Fig. 1). Problems with ear rots are usually greater where lodging occurs, particularly when the harvest season is wet.

Figure 1. Diplodia stalk rot. Left: external discoloration; center: pycnidia below node; right: stalk split to show disintegration of tissue.

Several fungi and bacteria can cause stalk rots. Stalk rots result from the combined effects of more than one organism that attacks plants approaching maturity. Therefore, the identification of a specific organism causing the stalk rot is often difficult. The common stalk rot diseases caused by fungi in Illinois include Gibberella stalk rot (*Gibberella zeae*, anamorph *Fusarium graminearum*), anthracnose (*Colletotrichum graminicola*), Fusarium stalk rot (chiefly *Fusarium moniliforme*, teleomorph *Gibberella fujikuroi*), and Diplodia stalk rot (chiefly *Diplodia maydis*). In hot dry seasons, charcoal stalk rot caused by *Macrophomina phaseolina* may be prevalent. Pythium stalk rot (primarily *Pythium aphanidermatum*) is usually rare but may occur if the weather is excessively wet during the summer months. Nigrospora stalk rot (*Nigrospora oryzae*, teleomorph *Khuskia oryzae*) sometimes is found in severely stressed plants nearing maturity. Physoderma stalk rot (*Physoderma zeae*) is generally a minor disease occurring in Illinois during hot, wet weather.

Bacterial stalk rot (*Erwinia chrysanthemi* pathovar *zeae*, synonym *E. carotovora* pv. *zeae*) is not common in Illinois and rarely causes significant damage. Occasionally, bacterial stalk rot appears before tassel emergence on random corn plants following heavy rains. General infection may occur following flooding or sprinkler irrigation from a surface source of water.

Symptoms

Stalk rots caused by species of *Gibberella, Fusarium*, and *Diplodia* are not usually apparent until several weeks after silking and pollination. First, the leaves turn a dull gray-green, similar in appearance to frost or drought damage. Then the leaves turn brown, seemingly in a day or two. Death of the entire plant follows within 7 to 10 days in susceptible hybrids. The lower internodes turn from green to tan, straw-

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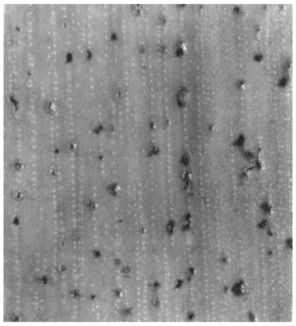

Figure 2. Dark brown to black pycnidia of Diplodia maydis embedded in rind of dead corn stalk.

colored, or dark brown and are spongy and easily crushed. When stalks are split lengthwise, only the vascular strands remain intact with the pith tissue disintegrated and discolored (Fig. 2a, 3, and 4a).

GIBBERELLA AND FUSARIUM STALK ROTS. Stalks infected with the *Gibberella* fungus have a characteristic pink to reddish discoloration of the pith and vascular strands. Fusarium stalk rot appears similar to *Gibberella*, except that the discoloration of infected tissues commonly varies from whitish pink to salmon. Rotting commonly affects the roots, crown, and lower internodes. The breakdown and shredding of pith tissues starts at the nodes (Fig. 3) shortly after pollination and becomes more severe as the plant matures. In addition, small, round, bluish black perithecia (fungal fruiting bodies) form superficially on the surface of Gibberella-infected stalks in the fall or during the following spring (Fig. 4c). These fruiting bodies are easily scraped off with a thumbnail (Fig. 4b).

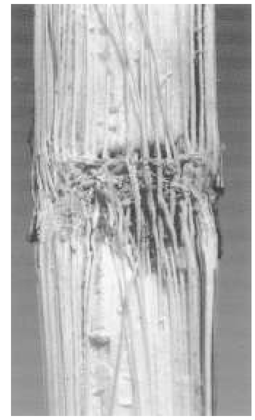

Figure 3. Fusarium stalk rot showing early breakdown and shredding of lower stalk node.

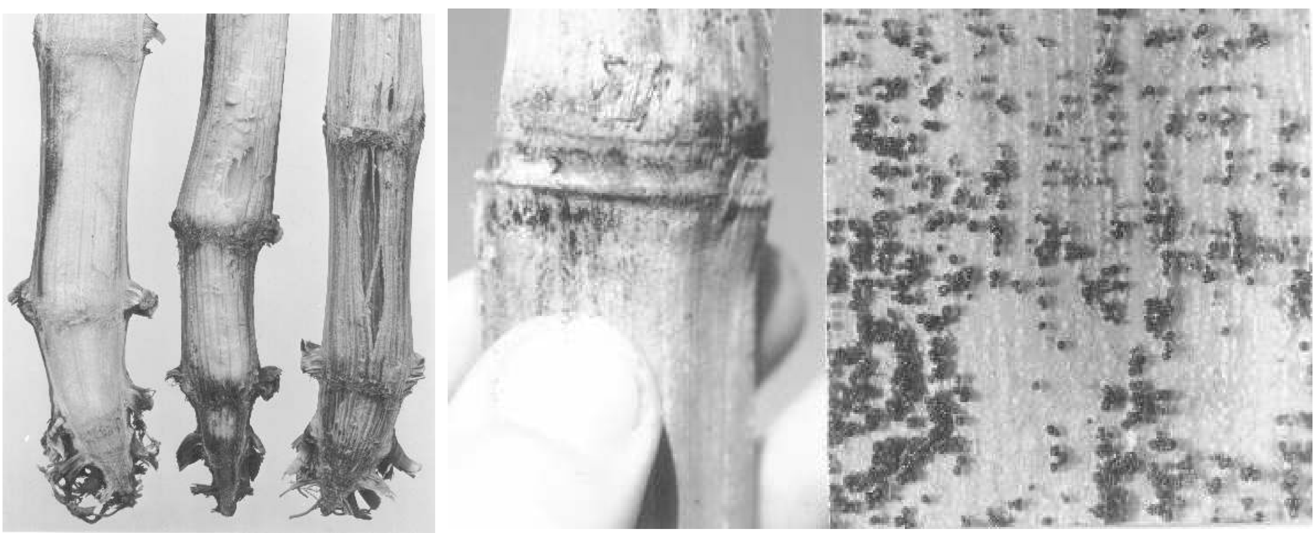

Figure 4. (A) Giberella stalk rot showing 3 split stalks. (B) tiny fungal fruit bodies of Giberella Zeae. (C) close-up of round, black perithecia on surface of corn stalk.

ANTHRACNOSE STALK ROT OR TOP-DIEBACK. This was a minor problem before 1970, but is now a serious disease. Unlike most other stalk rots, anthracnose, caused by the fungus, *Colletotrichum graminicola*, will often destroy several internodes of the stalk. The fungus may cause top-kill and lodging as well as infect most plant parts including the shanks, kernels, and roots. The fungus also causes an important leaf blight, which does not appear to be associated with the stalk rot phase. Very susceptible hybrids may be killed before pollination. Most hybrids, however, 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 typical of anthracnose. This black discoloration usually extends up the stalks for several internodes and may uniformly discolor the rind or give it a blotchy or speckled appearance (Fig. 5, left). Black specks (acervuli) associated with the production of microscopic spores by the fungus are often found on the stalk rind. When such stalks are split, the pith is dark brown and decayed (Fig. 5, right). In some hybrids the pith is soft, watery and easily crushed. Severely affected stalks are likely to lodge.

Sometimes portions of the stalk above the ear turn a gray-green, die and collapse (top-kill) 4 to 6 weeks after pollination, while the lower stalk remains green. The upper 2 or 3 leaves may turn yellow or reddish, collapse, and drop off. This may occur just before the lower leaves begin to normally wither and die.

Figure 5. Anthracnose stalk rot; (left) shiny black discoloration on stalk; (right) stalk split to show dark internal decay.

DIPLODIA STALK ROT. This rot can be distinguished from other stalk rot diseases by the numerous, minute, raised, black dots (pycnidia) produced by the fungus clustered on or near the lower nodes of infected stalks. White mycelial growth also may be present on the surface. Unlike the perithecia formed by the ***Gibberella*** fungus, the pycnidia of ***Diplodia*** are embedded in the rind and cannot be scraped off with a fingernail (Fig. 2b). Occasionally, stalks will have fruiting bodies of both fungi.

CHARCOAL ROT. This rot is most abundant in hot dry seasons. Soil temperatures near 99°F (37°C) are most favorable for disease development, while either low soil temperatures or high soil moisture decrease severity. Brown, water-soaked lesions, that later turn black, appear on the roots. As the plants mature, the fungus spreads into the lower internodes of the stalk. Infected plants appear to ripen prematurely and the interior of the lower internodes disintegrate. The disease is distinguished by the presence of numerous, tiny, round to irregular, black fungal bodies (sclerotia), which are present in large numbers along the vascular strands in the interior of shredded and rotted stalks giving them a charred appearance (Fig. 6). Sclerotia also may be found just beneath the stalk surface and on the roots. Kernels also are infected and turn completely black.

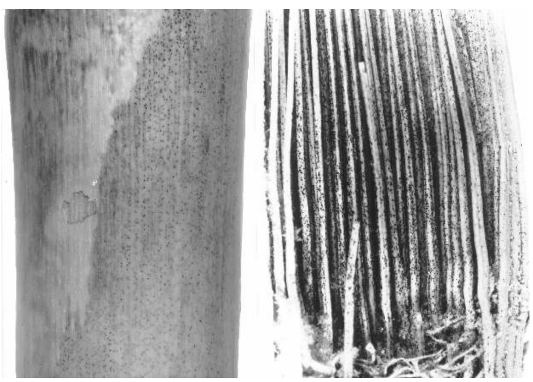

Figure 6. Charcoal rot. Note sclerotia on surface (left); fibers within the stalk (right).

PYTHIUM STALK ROT. Pythium stalk rot usually occurs during extended hot (optimum 90°F or 32°C), wet weather from late June to September. The disease is most common in river-bottom fields where air and soil drainage is poor and the humidity is high. Usually, only the internode just above the soil line is soft and brown. The interior of the stalk appears water-soaked. Plants often collapse, and may become twisted and distorted, but they remain green and turgid for several weeks because the vascular bundles remain intact (Fig. 7). Positive diagnosis can be made if microscopic examination reveals the round, thick-walled oospores of *Pythium aphanidermatum* in diseased tissue.

Figure 7. Pythium stalk rot. Affected plants collapse but remain green for several weeks.

NIGROSPORA STALK ROT. This minor, often secondary rot appears as superficial, dark gray to black lesions, with a slight bluish cast, on the lower internodes. The discoloration may be seen as many separate, tiny to large, irregular blotches. Nigrospora is not a serious disease and only occurs where plants are weakened or predisposed by poor fertility, other diseases, or injury.

PHYSODERMA STALK ROT. This stalk rot first appears as small, round, yellowish spots near the base of the leaf blade, often in bands. Later the lesions turn chocolate-brown to red-brown and merge to form large, irregular angular blotches. Infection at the nodes under the leaf sheaths cause similar, water-soaked lesions on the stalk (Fig. 8) which may lodge from a black decay.

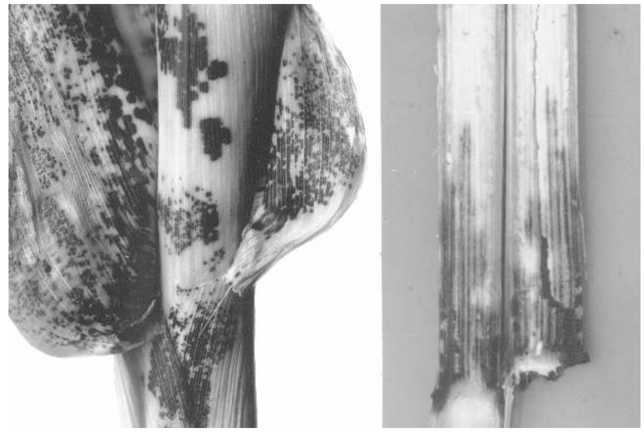

Figure 8. Physoderma stalk rot. (Left) Brown blotches on leaf and sheath; (right) black and decayed, lodged stalk.

BACTERIAL STALK ROT. This uncommon disease usually occurs about midseason in hot, damp weather 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 (Fig. 9). The tips of the uppermost leaves often wilt, followed by a slimy soft rot at the base of the whorl. The decay spreads rapidly downward until the affected plants collapse. Lodged plants usually have a foul odor. The development of bacterial soft rot, like Pythium stalk rot, is favored by high temperatures (85° to 95°F, 29° to 35°C) and poor air circulation. General infection may occur following flooding or where corn is sprinkler-irrigated from a surface source of water, such as a river, farm pond, or lake.

Figure 9. Bacterial stalk rot caused by Erwinia chrysanthemi p. zeae. Affected stalks collapse and twiste.

The causal bacterium lives as a saprophyte on plant debris in the soil. The organism also may be seedborne. Infection occurs when the bacteria are blown or splashed onto the plants followed by penetration through natural openings (stomates and hydathodes) or wounds made by hail or other injuries.

DISEASE DEVELOPMENT

Development of stalk rots is generally favored by an early season environment that encourages kernel set and by a late season environment that is stressful. Post-flowering stresses may include an excess or lack of moisture; nutrient deficiency or imbalance; excessive cloudiness; insect, nematode, hail, or other mechanical injury to the stalks or roots; loss of effective leaf area due to a foliar disease; and 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, favor the development of most stalk rot fungi.

High yields often are associated with stalk rot problems. Plants can over commit to yield when environments are ideal through the pollination period and stress occurs later. In a stressful environment, the large number of kernels places a high demand on the plant for sugars. If photosynthesis, which produces sugars, is reduced because of stress, the kernels draw sugars from stalk tissue and deprive the roots of adequate nutrients. Cloudy weather following pollination is the most common stress factor because photosynthesis is reduced by 40 to 50 percent as compared to bright cloudless days.

High nitrogen (N) levels combined with a low level of potassium (K) may also increase stalk rot. However, high rates of nitrogen, **balanced** with adequate to high levels of potash (K_20) and phosphorus

(P), do **not** increase the potential for stalk rot. Adequate to high levels of nitrogen followed by a loss of available nitrogen by denitrification or leaching may dramatically increase the incidence of stalk rot. The severity of stalk rot has been reported to decrease with increasing N rates applied in either spring or autumn as anhydrous ammonia.

Injury to roots, stalks, or leaves by diseases, insects, nematodes, hail, or equipment also can increase the incidence of stalk rot. Injuries created by European corn borers, corn rootworms, and other insects often provide avenues of entry for stalk rot pathogens. Observations indicate that the incidence of stalk rot is increased by nematode damage. High populations of root-lesion (*Pratylenchus* spp.) and spiral (*Helicotylenchus* spp.) nematodes have been associated with increased stalk rot. Hail injury may predispose plants to stalk rot primarily because the effective leaf area is reduced. The loss of photosynthetic leaf tissue because of diseases such as northern corn leaf blight, southern corn leaf blight, anthracnose leaf blight, Stewart's leaf blight, and yellow leaf blight may also increase the incidence and severity of stalk rot.

Control

Stalk rots cannot be entirely controlled. Damage can be reduced through the conscientious use of an integrated control program. The following practices will reduce harvest losses: (1) plant well-adapted, disease-resistant hybrids; (2) practice balanced soil fertility; (3) control insects; (4) plant the recommended plant population; (5) avoid stress through proper irrigation, soil management, and foliar disease and weed control; (6) practice regular field scouting; and (7) harvest when the crop is mature (30 percent grain moisture) to prevent losses from lodging.

1. Corn growers should select hybrids that have stalk rot and leaf disease resistance, good standability, and high yield potential. 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. Most hybrids, however, are not resistant to all stalk-rotting organisms.

   In addition to stalk rot resistance, growers should select hybrids resistant to foliar diseases important in their area since less of leaf area can predispose the corn to stalk rot problems. Hybrid standability is another factor that should be considered. Hybrids with a thick rind (stalk strength) or other characteristics that increase standability often remain standing even though the interior of the stalk is thoroughly decayed. Corn producers should consider such characteristics when selecting a particular hybrid and 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 also is available in the latest issue of the circular <u>Performance of Commercial Corn Hybrids in Illinois</u> (check with your nearest Extension office for circulars).

2. Balanced soil fertility, particularly with respect to potassium, is important, as high level of nitrogen along with a low level of potassium can increase the losses from stalk rot. However, a high level of nitrogen with adequate-to-high potassium and phosphorus availability does **not** necessarily increase the potential for stalk rot. Information on suggested nitrogen, potassium, and phosphorus rates can be found in the latest <u>Illinois Agronomy Handbook</u>, available at area Extension offices and revised semi-annually. Fertilizer should be applied based on the results of soil tests.

   Research has shown the importance of an adequate supply of nitrogen throughout the season in reducing the severity of stalk rot. High levels of nitrogen followed by a loss of nitrogen due to leaching or denitrification may increase the severity of stalk rot dramatically. In areas where leaching or denitrification is expected, the use of a nitrification inhibitor or stabilizer, may help reduce stalk rot.

3. Control of root- and stalk-attacking insects, such as the European corn borer and corn rootworms, is important in reducing stalk rot losses. Corn growers should follow the cultural and chemical recommendations of University of Illinois Extension Entomologists as given in University of Illinois Cooperative Extension Circular 899, Insect Pest Management Guide: Field and Forage Crops. The use of scouting procedures will reduce unnecessary application of pesticides and increase yields because applications will then be made at the precise time for optimum results.

4. Corn growers should plant a particular field at row widths and populations suggested for the particular hybrid, soil type, fertility level, available soil moisture, and productivity potential. Higher than recommended plant populations and narrow rows cause plants to be stressed, result in spindly stalks with a reduced standability, and reduced resistance to infection. Growers should consult seed-corn handbooks for suggestions on planting rates for hybrids.

5. Crop rotation with nongrass crops in conjunction with a deep plowdown of corn residues (**only** where soil erosion is **not** a problem) is beneficial in reducing anthracnose, Diplodia, charcoal, and Physoderma stalk rots.

6. Timely irrigations (where possible) to keep the soil moist during dry periods up to 50 to 55 days after tasseling, weed and nematode control, and other stress-reducing practices are important in reducing stalk rot losses.

7. Monitoring (or scouting) 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 contains 30 to 40 percent moisture. An effective scouting procedure is to walk a zig-zag pattern through the field while pinching the stalks below the lowest node to check for firmness. Another method is to push random plants (a minimum of 100) about 5 inches from the vertical. If more than 10 to 15 percent of the plants lodge using this procedure, it would be beneficial to harvest the field early to prevent potential harvest losses. The same procedure also can be used to assess hybrids in strip plots. Growers also should check the extent of premature plant kill when inspecting strip plots.

   By regularly scouting and rating fields for disease, insect, and weed infestation during the season, growers can carry out timely and effective measures **when** they are needed. Knowing which fields have the greatest potential for stalk and ear rots will help reduce losses by enabling the grower to schedule these fields for an early harvest.

For additional information on the control of corn diseases read Illinois Agricultural Pest Management Handbook, which is revised annually. Copies of this circular should be available in all area Extension offices.