

Some Diseases of Corn in Florida

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INTRODUCTION

Sweet corn and field corn are the principal types of corn grown in Florida. Field corn is grown for animal feed and hybrid seed; sweet corn is grown primarily for the fresh market. Numerous diseases of corn occur in Florida and frequently have caused severe yield losses. Tentative field diagnoses should be confirmed with laboratory tests.

SEEDLING BLIGHTS

Seedling blights are caused by fungi such as *Fusarium* spp., *Rhizoctonia* spp., *Pythium* spp., and *Penicillium* spp. It is not uncommon for two or more of these fungi to be present in a seedling at the same time. These fungi infect many plant species including grasses and broadleaf plants. These fungi survive in the soil, some weeds, and old crop debris. Seedling blights tend to be most severe when the seedling is being stressed during emergence from factors such as cool soils or extremes in soil moisture. Seedlings may die before or after emergence.

Symptoms of seedling blights include discolorations of the roots and stems, stunting, and browning or yellowing of emerged seedlings. Infection from *Pythium* spp. typically results in a slightly greasy to watery rot of tissues, particularly of the root tips, outer root tissues, and lower stems. Infection from *Rhizoctonia* spp. typically causes reddish brown-orange lesions in stems and roots. *Penicillium* spp. secrete a toxin which translocates up the stalk and causes yellow streaks in, or a dull green appearance of, the leaves.

Seedling blights are reduced by the treatment of seed with a labeled fungicide, crop rotation with non-grass crops, planting in warm soils, and the avoidance of deep seeding. Also, debris from previous crops and weeds should be allowed to decompose as long as possible

before planting. Every possible control measure should be used with super-sweet types of sweet corn because they are highly susceptible to seedling blights.

ROOT AND STALK ROTS CAUSED BY FUNGI

Root rots occur in sweet and field corn. Stalk rots that are caused by fungi are common in field corn after tasseling but are typically uncommon in sweet corn. The fungi that cause root and stalk rots in Florida include those that cause seedling blights, *Exerohilum rostratum* (*Helminthosporium rostratum*), *Diplodia maydis*, *Macrophomina phaseolina*, and others. It is not unusual for more than one fungus to cause disease in stalks at the same time. Root and stalk rots tend to be most severe when crop rotation is not used (Fig. 1).

Root- and stalk-rotting fungi can survive in the soil, particularly if old crop debris is present. In susceptible varieties, some stalk rots progress from infections that originated in the roots. However, stalk rots caused by *E. rostratum* and *D. maydis* begin in the stalks. Root and stalk rots are enhanced by injuries caused by cultivation, excess fertilizer in the root zone, hail, nematodes, soil insects, dense stands, and excessive damage to the foliage from leaf diseases and foliar feeding insects.

Symptoms of root and stalk rots include stunting, off-colored plants, lodging (Fig. 1), discolored and abbreviated root systems (Fig. 2), and internal stalk discoloration (Fig. 3). Dark, internal, stalk tissues are typical for infections from *E. rostratum*, *D. maydis*, and *M. phaseolina*. Stalk rots caused by *Fusarium* spp. typically have reddish to pink, inner-stalk tissues.

Stalk rot can be reduced significantly by use of resistant varieties; crop rotation; control of nematodes, insects, and foliar diseases; proper use of fertilizers; and avoidance of extremes in

soil moisture. Excessive rates of nitrogen and insufficient rates of potassium are conducive for development of root and stalk rots. The crop should be harvested as early as possible.

BACTERIAL STALK ROT

Bacterial stalk rot (BSR) is caused by the bacterium *Erwinia carotovora*; it has occurred on occasion on the muck soils in the Belle Glade area. Warm soils that are excessively wet are conducive for BSR. Symptoms include lodging, shrunk or ropey stems (Fig. 4), watery or hollow inner stalk tissues (Fig. 5), and foul odors. The main control is to avoid excessively wet sites and to be able to pump water out of the production area should excessive rains occur.

COMMON SMUT

Common smut, caused by the fungus *Ustilago maydis*, is the only known smut of corn reported to exist in Florida. Teosinte (an ancestor of corn) is also susceptible. Smut is more likely to occur in field corn than in sweet corn. Some varieties of field corn are highly susceptible. The black spores (teliospores) produced in smut galls can survive in the soil and serve as inoculum. Infection occurs when the teliospore germinates and forms a germ tube-like structure (promycelium) which can penetrate the tissue or by the formation of a similar structure formed by the mating of sporedia (spores formed on promycelia) of two opposite mating types. Temperatures from 79 to 93° F are conducive for the infection process. The wounding of corn tissue from insects, hail, pesticides, fertilizers, cultivation, blowing sand, or other causes can increase the severity of smut. Young and meristematic tissues are most susceptible to infection.

Galls that are pea-sized to several inches across can be formed on any part of the plant above the soil. Commonly, galls occur on stems near nodal tissues (Fig. 6), ears (Fig. 7), and tassels. Sometimes, galls form on leaves (Fig. 8),

leaf axils, and brace roots above the ground. Initially a gall is a compact mass of white, fungal hyphae that gradually becomes transformed into a mass of dark teliospores which is enveloped by a whitish-colored covering (peridium) of hyphae. Smut galls that have not yet formed the teliospores have been eaten by humans. Recently, a limited fresh market has developed in the United States for these white, immature, smut galls.

Control of smut is best achieved by the use of resistant varieties. Ample resistance is available for corn breeders to incorporate into their varieties. Physical damage to corn plants should be minimized to the extent possible.

RUSTS

The three rust diseases that have occurred in corn in Florida are common rust (CR), caused by *Puccinia sorghi*; southern corn rust (SCR), caused by *Puccinia polysora*; and tropical corn rust (TCR), caused by *Physopella zae*. The former two rusts continue to occur but the one time occurrence of TCR at Fairchild Gardens was quickly followed by its eradication in 1974. Teosinte, a relative of corn, is also susceptible to CR.

Both CR and SCR produce similar symptoms with the formation of spore-bearing, orange-reddish brown pustules (uredia) in leaves or husks. However, CR typically produces its pustules without the peridium (covering over pustule) persisting (Fig. 9). The pustule of SCR may also exist without a persistent peridium, but typically, it is persistent (Fig. 10). The color of the spore mass of CR tends to be chocolate brown and that of SCR tends to be orange.

The shape of the pustule varies for the two rusts, but CR tends to have elongated pustules and SCR tends to have somewhat rounded pustules. Also, formation of the pustules on the lower surface of the leaf is delayed and commonly absent with SCR. Identification of which rust is present can be done quickly with a mi-

croscope. The somewhat round urediospores of CR are nearly isodiametric whereas those of SCR are oblong. Another spore stage, the teliospore, occurs in black telia after uredia have formed. Teliospores of CR and SCR can be distinguished with microscopic examination. The effects from rusts include lodging, reduced ear fill, and lower market grades.

Common rust is a cool weather disease. In south Florida, CR occurs routinely in the spring. Urediospores of CR germinate from 39-86° F with the optimum for spore germination and infection being from 59-63° F. After infection, pustules form most rapidly from 59-68° F. As temperatures deviate from the optimum, the time for formation of pustules takes longer at temperatures such as 86° F or 50° F.

Oxalis spp. serve as alternate hosts for two other spore stages (pycniospores and aeciospores) of CR. Infection of this alternate host occurs when teliospores germinate and form basidiospores which infect *Oxalis* spp. Apparently, this alternate host is of importance in Mexico.

Southern corn rust tends to occur more frequently during the fall in south Florida and summer months in north Florida, particularly with late-planted or double-cropped corn. The optimum temperatures for SCR are higher than for CR. Near 82° F, germination of urediospores and penetration of stomates of leaves is abundant for the fungus that causes SCR. New rust pustules will appear in nine days at 82° F but require about 14 days at 75°F. Development of pustules ceases at 90°F. Leaf-wetness periods of eight hours will support infection near optimal temperatures. As temperatures deviate from the optimum, leaf-wetness periods up to 16 hours may be required for infection.

Control of corn rusts is done best with resistant varieties. Resistance to CR is available, but resistance to SCR has not generally been incorporated into varieties. Any available resistance

is likely to be partial and subject to infection by “new” or different races of the rust fungi. When sequential plantings are used, earlier plantings should be downwind in relation to predominant winds. For example, in south Florida, east winds predominate during the sweet corn seasons, hence the corn should be planted from west to east.

Spraying with fungicides is a major measure to control foliar diseases in sweet corn, particularly in peninsular Florida. Spray programs should be initiated at the first sign of rust. Several sprays may be required. Super-sweet (shrunken-two types) are particularly susceptible. Spraying field corn for rust control may not be economical. However, if a major epidemic occurs and control is mandated, some fungicides may be labeled for field corn. However, strict adherence to cessation of sprays in relation to the days-to-harvest must be used to avoid residues in milk and meat products if the corn is used for animal feed.

FUNGAL LEAF SPOTS AND BLIGHTS

Northern corn leaf blight (NCLB), is caused by the fungus *Exerohilum turcicum* (*Helminthosporium turcicum*). NCLB is a problem primarily in sweet corn in Florida, particularly in peninsular Florida, but it can be a serious problem in field corn if susceptible varieties are grown.

Symptoms of NCLB vary depending on the genes for resistance and races of the fungus present. Individual leaf spots are typically 1 to 6 inches long and 1/2 to 1 inch wide (Figs. 11 & 12). Resistance is expressed as smaller lesions, fewer lesions, or delayed appearance of lesions. Usually the lesions are widest in the center and tapered or serrated at the ends. Lesions are typically tan to dark brown in color. When spores are produced in mass, the inner zones, sometimes concentric, have a greenish-black tinge. Sometimes the outer part of the le-

sion, particularly expanding lesions, will have water-soaked tissue. Lesions tend to form first in lower leaves and progress to higher leaves over time (Fig. 11). However, mid- or upper-stalk leaves may display lesions first, often in a band of lesions (Fig 12). This latter situation is the result of spores germinating in the moisture within the leaf whorl during a specific period of time that was favorable for infection or from large “spore showers” from nearby fields. When the leaves unroll and expand, a line of lesions is evident.

Sources of spores are from lesions in old crop debris, volunteer corn, and existing production fields nearby, particularly if they are upwind from your field. Spores of *E. turcicum* are disseminated naturally by wind. However, spores can be dislodged in mass by mechanical movement in nearby fields during cultivation, harvesting, or other processes.

Temperatures between 59° F and 86°F are suitable for production of spores and infection provided leaf wetness periods of at least 7 to 8 hours occur. With favorable weather, the time from infection to occurrence of symptoms can be as short as 5 to 7 days. As temperatures deviate from the optimum, fewer lesions form and the time for lesions to form is increased.

Sorghum, Sudangrass, Johnsongrass, gamagrass, and teosinte are also susceptible to *E. turcicum*. Pathogenic races that infect sorghum and Sudangrass apparently do not infect corn. However, some races that infect corn can infect Sudangrass.

Control of NCLB for field corn is accomplished primarily by the use of resistant varieties. When alternate rows of different varieties are planted to enhance pollination, higher levels of NCLB have resulted if one of the varieties is susceptible. For sweet corn, resistance may be available but sprays of fungicides are commonly necessary in peninsular Florida. Crop rotation should be used and sequential

plantings should be made into the predominant wind patterns for your area as described earlier for the control of rusts.

Southern corn leaf blight (SCLB) is caused by the fungus *Bipolaris maydis* (*Helminthosporium maydis*). In 1970, SCLB became epidemic on those F1 hybrid varieties produced with Texas male-sterile, cytoplasm (Tcms) primarily in the southeastern but also in other corn producing areas in the United States (Fig. 13). In Florida, the average statewide yield of field corn was reduced by 50%.

Seedling blight can be caused by *B. maydis*. However, symptoms of SCLB occur typically in leaves (blades & sheaths). Mature foliar lesions can be rounded on the sides but they tend to be parallel-sided, often restricted by the veins. Lesions are light tan in the center with a darker reddish-brown border (Fig. 14). A greenish growth near the center of the lesion may be evident if abundant spores are present (Fig. 14). Mature lesions range from 1/4 to 1 1/2 inches in length and may be tapered, flat or somewhat serrated on the ends. Typically, lower leaves are infected first (Fig. 15) with the epidemic progressing upward to higher leaves over time. Occasionally, infections of the ear husk, silks, kernels, cob, and floral bracts in tassels occur.

Sources of spores for infection include volunteer corn (Fig. 16), old corn debris on the soil from previous crops, stored corn seed, fodder, and nearby corn plantings. Teosinte and a wild grass (*Rottboellia exaltata*) are also susceptible. Other crop species are not susceptible to *B. maydis* in natural field situations.

With optimal weather conditions, the time from infection by germinating spores to lesion formation with new spores may be as short as 3 to 5 days. Temperatures near 73° F are optimum for production of spores, formation of germ tubes, infection, and formation of lesions. As temperatures deviate to 59° F and 86° F, the fungus is still active but progress of the dis-

ease will be delayed. Six hours of leaf wetness is all that is needed for spore germination and infection. Leaf wetness is not required for lesion expansion.

Control of SCLB is best achieved with resistant varieties. However, where resistance is lacking, spraying with fungicides may be necessary, particularly with sweet corn produced in peninsular Florida. Spray programs should begin at the first sign of disease if favorable weather is likely in the future. Also, the use of crop rotation and deep plowing of old crop debris will reduce inoculum for the next crop.

Two other leaf spots caused by *Helminthosporium* spp. occur occasionally in Florida but have been minor problems.

Helminthosporium leaf spot (HLS) is caused by the fungus *Bipolaris zeicola* (*Helminthosporium carbonum*). It can cause a leaf spot that is intermediate in size to NCLB and SCLB and may be linear or slightly oval (Fig. 17). Also, it causes an ear rot that usually appears near the tip of the ear on the kernels. In Florida, HLS has occurred in inbred lines within seed production fields. Leaf spots associated with *Helminthosporium setariae* have been found occasionally in sweet corn in the Zellwood and Everglades areas.

DOWNY MILDEWS

Two downy mildew fungi occur in corn in Florida. *Sclerophthora macrospora* causes crazy top and *Peronosclerospora sorghi* causes sorghum downy mildew.

Crazy top (CT) has been diagnosed only in Escambia and Santa Rosa Counties. The fungus grows systemically in the plant. It has occurred in spring planted corn when the soil became saturated or flooded for 1 to 2 days after planting but before the plants had 4 or 5 leaves. Stunting, excessive tillering, excessive twisting, and rolling of leaves, are common symptoms of plants prior to flowering. Excessive leafiness of ear husks and tassels (Fig. 18)

occur on older plants.

The fungus that causes CT produces resting spores (oospores) that can persist in the soil for many years. With water-saturated soils and cool temperatures, the oospores germinate and produce sporangia which, in turn, produce motile spores with tails (zoospores) that migrate in free water. Zoospores produce germ tubes that penetrate corn tissue in contact with the moist soil. Optimum temperatures for formation of zoospores is between 53 and 61° F but the fungus is active beyond these temperatures. Sometimes, sporangia produce germ tubes directly. Corn plants are susceptible until the fourth or fifth leaf stage. This fungus has been identified in more than 140 species of grasses including oats, wheat, sorghum, rice, crabgrass, witchgrass, and foxtails.

The best controls for CT are to provide for adequate water drainage in fields and to break soil hard pans. Planting in areas that are prone to flooding should be avoided.

Sorghum downy mildew (SDM) was found in the Zellwood and Leesburg areas in the early 1980s in sweet corn, forage grasses in the sorghum group used as summer cover crops, and *Sorghum alum*. Teosinte and *Panicum* spp. are also susceptible. The fungus grows systemically within the plant if infection occurs before the plants are about 4 weeks old. Symptoms include stunting, yellowing of leaves, light yellow-white leaf striping, leafy proliferation of tassels, and the presence of a greyish-blue downy, mold growth on the leaves (Fig. 19).

The downy growth is composed of sporangia (spore-like structures) and sporangiophores (stalks on which sporangia form). Sporangia are transported by wind or water. Sporangia are formed, germinate, and infect leaf tissue between 63° F and 84° F. Optimum temperatures are near 70 to 77° F if high humidity or free moisture is present. Some isolates have considerably lower optimal temperatures for germi-

nation (e.g., 59° F). Sporangia germinate by forming germ tubes that penetrate the leaves directly or through stomates (breathing pores). The fungus then grows systemically in the plant. After the plant becomes about four weeks old, infection of leaves results in the formation of distinct lesions.

Within the infected leaf, thick-walled, resting spores (oospores) can be formed which allow the fungus to survive in the soil for long periods of time. Also, infected corn or sorghum debris among seed or fodder could allow the fungus to be transported to new locations. The oospores produce a germ tubes which penetrate roots of seedling or plant tissue in contact with the soil and the fungus then grows systemically.

Control of SDM includes use of resistant varieties, if available; crop rotation, and plowing of land deep enough to place the oospores below the level of seed at planting. Susceptible grass weeds from the field area should be eliminated. Also, the use of select, systemic, fungicidal, seed treatments (e.g., those with mefenoxam) has effectively controlled SDM in sweet corn in Florida. Cover crops of sorghum-type grasses should be avoided.

BROWN SPOT

(Chocolate Brown Spot or Physoderma Brown Spot)

Brown spot (BS) is caused by the fungus *Physoderma maydis*. Teosinte is also susceptible. More than 50 years ago, this disease was reported to be a major problem in Florida. Over the past 30 years, BS has been seen on occasion in field corn but has not been a major problem. Symptoms include clusters (blotches) or bands of round to oblong yellow spots, each spot usually being less than 1/2 inch across, in leaf blades, leaf sheaths, ear husks, or tassels (Fig. 20). Symptoms tend to be more abundant near the base of the leaf blades or other areas where free water accumulates. Later these symptom-

atic spots turn brown to red (Fig. 20) and may form blister-like pustules. These pustules disintegrate which then expose a mass of dusty brown, powdery resting spores. Lodging can occur if severe infections are present.

The resting spores (sporangia) are the primary means by which this fungus survives between crops. Each sporangium can germinate by producing up to 50 spores (zoospores) with tails so they are motile in water. Zoospores germinate by producing small threads (hyphae) which penetrate corn tissue, particularly young tissue. New sporangia can be produced within 16 to 20 days after infection. Free water accompanied by temperatures from 73 to 90° F are most suitable for germination of spores and infection. Thus BS is most likely to be a problem in young field corn during warm and wet spring weather.

Control of BS includes crop rotation, tillage programs that allow for decomposition of corn tissue, and resistant varieties, if available.

BACTERIAL LEAF BLIGHT

Bacterial leaf blight (BLB) is caused by the bacterium *Pseudomonas avenae* (*P. alboprecipitans*). This disease has been an occasional problem on sweet corn in the central Florida area. Vasey grass (foliage and seed), Johnsongrass, *Setaria lutescens* (foxtail), Sudangrass, and goosegrass are also susceptible.

Symptoms of BLB include aggregations of elongated lesions of more than several inches in leaves (Fig. 21). When moist conditions exist, the lesions will have a greasy, water-soaked dark appearance, particularly on the margins (Fig. 21). Older lesions will tend to be light brown or tan in the center and may be shredded. Other symptoms include a basal rot of the ear, stalk rot, lodging, and a tassel rot.

Infections of leaves often occur when the

bacteria are in the moisture within the leaf whorl. The bacteria enter leaves through stomates (breathing pores) or wounds in leaves. New lesions appear three to four days after infection. As leaves age, they become progressively more resistant to infection. Although temperatures between 65 and 70° F are suitable for development of BLB, temperatures from 85 to 95° F are more conducive for development of this disease especially during wet weather.

Rain and overhead irrigation can spread this bacterium. Tractors and other mechanical movement within fields also spread this bacterium along the rows.

Because this bacterium does not survive well in soil, it is important to suppress the amount of vasey grass and other susceptible grasses around plantings of sweet corn. Some varieties are more resistant than others. Also, the movement of equipment should be minimized within fields when plants are wet if BLB is present.

BACTERIAL SOFT ROTS

An extensive discussion of this disease is available in Plant Pathology Fact Sheet No. 12.

FUNGAL EAR AND KERNAL ROTS OF FIELD CORN

Numerous fungi can cause ear and kernel rots of field corn. Infection can occur before or after harvest. Of significant concern are *Fusarium* spp., *Aspergillus* spp., and *Penicillium* spp. because many of these are capable of producing mycotoxins that are toxic to livestock and man. Some of the disorders in animals related to these toxins are cancer, reduced growth, hemorrhagic enteritis, abortion, tremors, staggering, convulsions, edema, toxicity to kidneys and livers, vomiting, feed refusal, decreased egg production, diarrhea, infertility, reduced immune

responses, gastrointestinal inflammation, degeneration of bone marrow, hormonal imbalances, and death. Because other factors can cause these symptoms in animals, consultations with veterinarians are advised.

Mold growth of *Fusarium* spp. tends to be white-pink-red. A brief treatise on *Fusarium*-infected corn and its relationship to toxic animal feed is presented in Plant Pathology Circular 1025.

Aspergillus flavus and *A. parasiticus* produce aflatoxins and grow rapidly above 75° F. The presence of greenish-yellow molds that fluoresce when exposed to a "black light" on kernels and silks are suggestive (but not conclusive evidence) of *A. flavus*. Many biological materials fluoresce and not all strains of *A. flavus* produce aflatoxins. It is imperative to have feed samples analyzed in a laboratory for the presence of any kind of mycotoxin. Mold growth of *Penicillium* spp. is blue-green-grey.

Ear and kernel rots are often associated with corn that is or was stressed from drought or poor production practices or damaged from insects (weevils, worms, thrips, or others). Some varieties are more susceptible, particularly those that do not have an adequate husk cover over the kernels. Harvesting time (22-30% moisture content of grain) and equipment (slower cylinder speeds) should be adjusted to minimize damage to grain. Corn grain should always be clean and dried to moisture content below 14% as soon as possible before storage. Storage facilities should be cleaned before use. Fans should be used routinely during dry weather to displace moisture that builds up on the storage structure or the grain. Sources of moisture during storage are condensation (warm grain with cool ambient temperatures), grain, and storage molds. Moldy grains generate more moisture than healthy grain. Consult Agricultural Engineering Circular 1104 for details on maintaining storage facilities. Certain chemical treatments (e.g., ammoniation, propi-

onic acid) are labeled to prolong storage by reducing damage from fungi. Some of them are corrosive to equipment, explosive, and harmful to humans. Some modern conveying equipment is coated with protective materials. Suppression of ear- and kernel-rotting fungi by non-chemical methods is best. Chemically preserved grain is not accepted in the grain trade.

DISEASES CAUSED BY VIRUSES AND MYCOPLASMA

Viral diseases of corn have been erratically occurring problems in Florida. Maize dwarf mosaic virus (MDMV) has occurred in sweet and field corn in Alachua County near dense stands of Johnsongrass. Aphids transmit the submicroscopic viral particles from infected corn or Johnsongrass on their mouth parts when feeding. Symptoms from nutrient imbalances can appear similar to those caused by viruses and mycoplasma. Symptoms of MDMV in corn

include stunting and somewhat linear, diffuse shades of greens, yellows, reds, and purples (Fig. 22). The elimination of Johnsongrass in and around corn fields is an effective control for MDMV.

In south Florida, particularly Dade County, several viral diseases have occurred in seed production fields for field corn. Maize stripe virus (MSV), maize rayado fino virus (MRFV), and maize mosaic virus (MMV) have been identified. In addition, maize bushy stunt mycoplasma and corn stunt spiroplasma (CSS) have been identified. Symptoms of these diseases can be similar to those of MDMV and display chlorotic spots or stripes (Fig. 23). Stunting and leaf twisting may be present (Fig. 23). While MSV and MMV are spread by planthoppers, MRFV and CSS are spread by leafhoppers. Resistant inbreds and varieties should be used. Also, weed grasses (e.g., itch grass) in the vicinity should be minimized as they may serve as hosts for these organisms. Little is known about virus-corn interactions in Florida at this time.



Figure 1. Most severe lodging where corn followed corn vs. corn followed by soybeans.



Figure 2. Most severe root rot where corn followed corn.

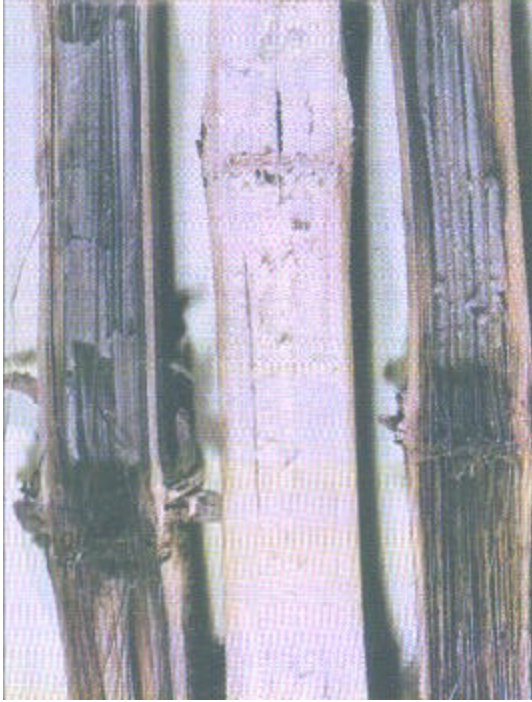


Figure 3. Internal stalk discoloration from fungal stalk rot.



Figure 4. Bacterial stalk rot.



Figure 5. Bacterial stalk rot in corn.



Figure 6. Corn smut on stalk.



Figure 7. Corn smut on ears.



Figure 8. Corn smut on leaf.



Figure 9. Common corn rust.



Figure 10. Southern corn rust.



Figure 11. Northern corn leaf blight.



Figure 12. Northern corn leaf blight in bands.



Figure 13. Susceptible vs resistant varieties to southern corn leaf blight.



Figure 14. Southern corn leaf blight.



Figure 15. Southern corn leaf blight.



Figure 16. Southern corn leaf blight on volunteer corn.



Figure 17. Leaf spot caused by *Bipolaris zeicola*.



Figure 18. Crazy top (downy mildew) in corn.



Figure 19. Sorghum downy mildew in corn.



Figure 20. Brown spot in corn



Figure 21. Bacterial leaf blight in corn.



Figure 22. Maize dwarf mosaic virus infections in corn.



Figure 23. Complex of mixed viral infections in corn.