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report on
PLANT
DISEASE

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ROOT AND CROWN ROTS OF SMALL GRAINS

Root and crown or foot rots occur wherever the cereal crops are grown. Some plants are weakened and may be killed. Weakened plants produce yields of reduced quantity and quality. For example, grain is commonly shriveled, light in weight, and often cannot be separated completely from sound grain.

Figure 1. Wheat field showing early damage from sharp eyespot caused by Rhizoctonia cerealis. (Purdue University photo)

The losses from root and crown rots are usually greatest in moist soils continuously planted to small grains and grasses. Individual plants may be affected, or populations of plants forming circular to irregularly shaped areas within fields may occur.

The amount of damage varies greatly from season to season and from one field to another, depending on the type of cereal and cultivar grown, temperature and moisture conditions, amount of inoculum, and mechanical or chemical injuries to the small grain host. Moderate infections are often overlooked in field surveys.

The root and crown rots of wheat, oats, barley, and rye are among the least conspicuous but most destructive diseases of cereals. These rots are believed to cause a yield loss of 10 percent per year and are present every year in all fields of small grains in Illinois.

These rots are caused by species of seed- and soil-borne fungi, including *Bipolaris sorokiniana, Fusarium (Gibberella)* spp, *PythiumI* spp*, rhizoctonia solani, R. cerealis, Gaeumannomyces graminis (Ophiobolus graminis), Pseudocercosporella herpotrichoides, Colletotrichum graminicola*, and other minor fungi. Several of these fungi are subdivided into many distinct minor parasitic races that vary in their ability to infect species and cultivars of small grains. The same fungi attack a wide range of forage and wild grasses. A microscopic examination and laboratory culturing is usually necessary to determine the exact cause of root or crown rot. Two or more fungi can simultaneously attack a single plant.

The damage by root- and crown-rotting fungi is often increased by root-lesion (*Pratylenchus* spp) and other nematodes feeding on the roots, drought, winter or chemical injury, and other stress factors. Stress also may be caused by foliar diseases, yellow dwarf virus, or soilborne mosaic virus.

Root- and crown-infecting fungi generally overseason in the soil, infected seed, and crop residues. Seedling infections come from sowing infected seed, bits of straw and leaves carried with the seed, cereal or grass residues on or near the soil surface, and wind- or rain-splashed, soilborne fungal spores.

Various names have been given to the diseases of roots and crowns of cereal crops: damping-off, seedling blight, take-all, basal stem rot, foot rot, stem break, snow mold, anthracnose, "Helminthosporium" and Fusarium blights, spot blotch, common or dryland root rot, eyespot and sharp eyespot, root and rootlet necrosis, and so on. Several of the causal fungi also attack the upper part of the plants, causing head and seed blights, foliage lesions, and rotting of the nodes.

Figure 2. Young wheat plants infected with root and crown rot caused by the fungus Bipolaris sorokiniana (courtesy J.E. Watkins)

Symptoms

Root and crown (foot) rot fungi can attack small grains at any stage of development. Several diseases are identified according to the causal fungi, climatic conditions, type of cereal, and growth stage of the plant.

Seed decay and preemergence killing. Seeds may rot in the soil, and seedlings may become blighted and die before they reach the soil surface. Preemergence or early postemergence killing (damping-off) causes stands to be thin and uneven or blank in small to large areas.

Seedling blights. The seedlings that do emerge are weak and stunted; dark green-to-purplish, dull bluish gray, pale green, or lemon yellow. They soon wither and die due to a light brown-to-black rotting of the roots, the crown, or both (Figure 2). If diseased plants survive, tillering and vigor is reduced or may be excessive; maturation is often delayed or accelerated.

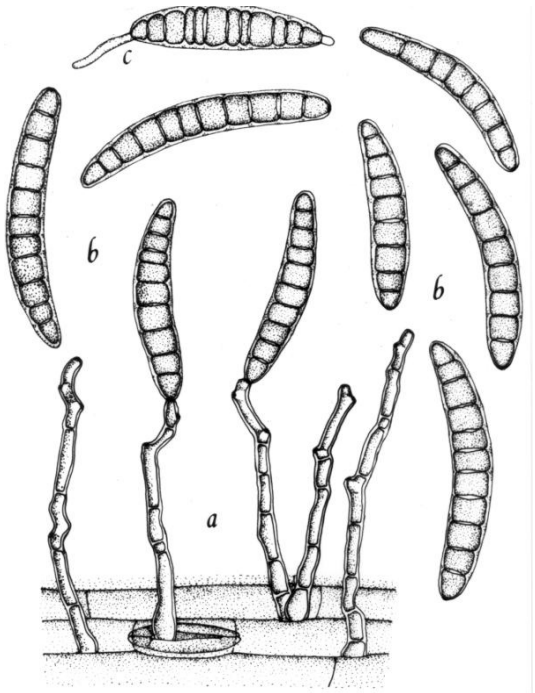

Figure 3. Bipolaris sorokiniana, the cause of seedling blight, common root or foot rot and spot blotch of cereals and grasses, as it would appear under a high-power microscope: (a) conidiophores emerging from a cereal leaf, two bearing conidia at their tips; (b) conidia; (c) conidium germinating from both end cells (drawing L. Gray).

Root and crown (foot) rots. Diseased plants from the seedling stage to heading time are stunted, lack vigor, and are pale green, purplish, yellow to bronze, or bleached. Infected plants may suffer winter injury or damage from drought. Damage commonly occurs in distinct, small to large, circular to irregular patches within fields (Figure 1). These patches commonly later increase in size. Affected plants become brittle and are easily pulled up. The roots are often brown or black, with water-soaked areas. Later, the roots die and slough-off. Infected crown tissue is bleached, brown or black, and rotted. Following wind and rain, lodging is common and may be severe. The heads are often white and "blasted" or filled with a few shriveled seeds. Disease development and symptoms of the important pathogenic fungi in Illinois are outlined below.

COMMON ROOT OR FOOT ROT AND SEEDLING BLIGHT

Common root rot or dryland root rot is caused by one or more unspecialized, widespread soilborne fungi. The more common pathogens include *Bipolaris sorokiniana* (synonyms *Helminthosporium sativum* and *H. sorokinianum,* (Figure 3), *Fusarium culmorum,* and *F. graminearum* (Figure 4), whose teleomorph or sexual state is *Gibberella zeae*. Less virulent root and crown rot pathogens include *Fusarium avenaceum,*

F. acuminatum, F. oxysporum, and *F. equiseti*. Besides causing root rot (Figures 2 and 5), these fungi can attack seedlings, foliage, heads, and developing grain.

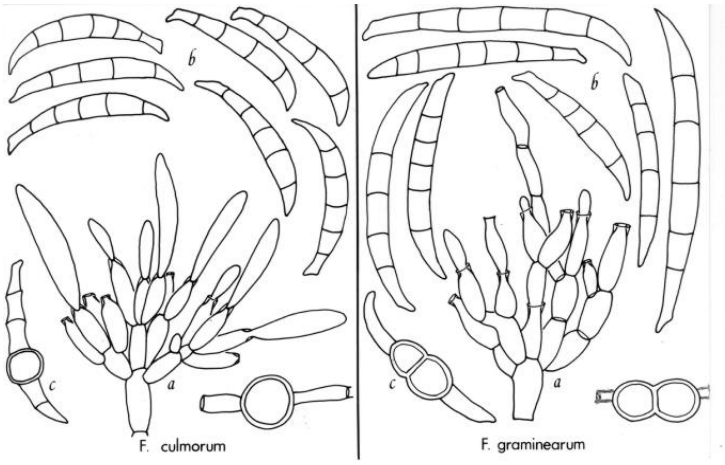

Figure 4. Two species of Fusarium (F. culmorum and F. graminearum) that cause common root or foot rot and seedling blight of cereals, as they might appear under a high-power microscope: (a) branched monophialides bearing immature macroconidia; (b) macroconidia; (c) Left, intercalary chlamydospore in a macroconidium, right, intercalary chlamydospore (or paired) in a hypha (drawing by L. Gray).

Symptoms

If the fungus (or fungi) is seedborne, seedlings may be killed before or soon after emergence (damping-off) or they may be stunted and off-color with brown lesions on the roots, crown and coleoptile (Figure 2). If infection comes from infested plant debris or the fungi are soilborne, initial symptoms appear as small, brown lesions on the primary or secondary roots, coleoptile, subcrown internode, lower leaf sheaths, and culms. The lesions may elongate, causing severe constriction of the subcrown internode which turns brown to dark brown or nearly black. Infected tissue near the crown may become yellowish (chlorotic) with brown lesions near the leaf base. Diseased plants, which often occur in random patches in a field, are stunted, often have reduced tillering and may prematurely ripen. For Fuasrium foot rot, discolored culm tissue may extend two or three internodes (3 to 10 cm) above the soil line (Figure 5). Severely infected plants mature early, produce shriveled grain, appear bronzed or bleached, and form whiteheads. Diagnostic cottony pink mycelium frequently develops within the hollow culms and between the culm and lower leaf sheaths.

Figure 5. Left, wheat culms discolored by Fusarium foot rot; right, healthy culms (courtesy APS).

Disease Cycle

The fungi that cause common root and foot rot occur on cereals and numerous wild and cultivated grasses, contaminate seed, and persist indefinitely in soil and plant debris. The *Fusarium* fungi overwinter as fruiting bodies (perithecia) and chlamydospores in infested debris. *F. culmorum* can survive in soil up to 8 or 9 years without a cereal or grass host. The mycelium, conidia, chlamydospores, and ascospores of *Fusarium* spp. are all infectious (Figure 4). *Bipolaris sorokiniana* persists between growing seasons as mycelium in crop debris and as thick-walled conidia in soil (Figure 3).

Figure 6. A wheat field severely infected with Pythium root rot (courtesy British Ministry of Agriculture).

Primary infections from conidia or chlamydospores occur on coleoptiles, subcrown internodes, and less frequently on primary and secondary roots. Moisture stress and warm-to-hot (68° to 86°F or 20° to 30°C) soils, lack of nutrition, deep planting, freezing and insect injuries all predispose cereals to infection by common root rot pathogens. Secondary conidia of *B. sorokiniana* form on infected tissue above the soil level and are dispersed by wind and splashing water, causing lesions on the

leaves and culms later in the season. Movement of soil by wind, water, and equipment will spread wind and splashing water, causing lesions on the leaves and culms later in the season. Movement of soil by wind, water, and equipment will spread these fungi. Infested seeds also serve to transmit the pathogens over long distances.

PYTHIUM ROOT ROT (ROOT NECROSIS OR BROWNING), DAMPING-OFF, AND SEEDLING BLIGHT

There are numerous species of *Pythium* which can be found in practically all agricultural soils, parasitizing the roots of cereals, grasses, and higher plants–particularly where soils remain wet for long periods. The more common species, which act singly or in combination, causing Pythium root rot include: *Pythium aphanidermatum, P. arisosporum, P. arrhenomanes, P. debaryanun, P. graminicola, P. hypogynum, P. irregulare, P. monospermum, P. myriotylum, P. rostratumn, P. splendens, P. tardicrescens, and P. ultimum.* Infection is difficult to diagnose, as cereals and grasses can be thinned and stunted without obvious symptoms of disease. The diseased plants tend to be more uniformly distributed in a field than with other root and crown rots (Figure 6).

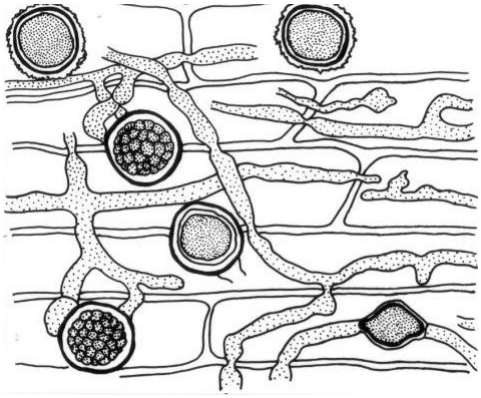

Figure 7. A species of Pythium *within wheat cells, as it might appear under a high-power microscope, showing the nonseptate branching hyphae, round oospores and an inercalary chlamydospore (drawing by L. Gray).*

Symptoms

Severe damage by *Pythium* species results in missing, stunted, off-color or poorly tillered plants. The first true leaf of seedlings is often stunted. Adult plants may appear stunted, light green to chlorotic, and nitrogen-deficient. Heading and maturity are often delayed with heads small and poorly filled. Infected roots have soft and wet yellow-brown to brown root tips, which lack root hairs, and tan to light brown lateral roots.

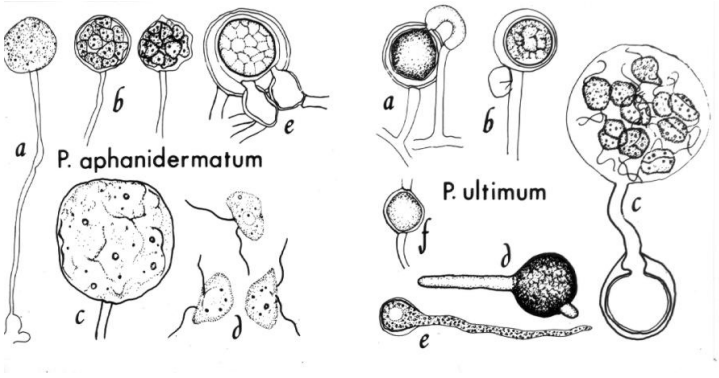

Figure 8. Two Pythium species which commonly cause damping-off, seedling blight and root rot of small grains and many other plants, as they would appear under a high-power microscope. Left, P. aphanidermatum; (a) immature sporangium, (b) two mature sporangia prior to release of zoospores, (c) mature sporangium with several zoospores which are released in a mass from the sporangium, (d) motile zoospores, (e) oospore with two paragynous antheridia attached. Right, P. ultimum; (a) oogonium with a single paragynous antheridium attached from a nearby hypha, (b) oogonium with a single paragynous antheridium attached originating from the antheridial stalk, (c) oospore germinating by a germ tube which has formed a sporangium containing zoospores, (d) sporangium germinating with two germ tubes, (e) oospore germinating with a germ tube, (f) intercalary sporangium (drawing by L. Gray).

Disease Cycle

Pythium species are mainly found in the top 5 to 7 inches of soil where crop residues serve as a source of nutrients and moisture. The fungi survive as thick-walled oospores and chlamydospores (Figures 7 and 8) in infested plant residue and can persist for 5 years or more in soil or embedded in plant refuse. In moist soil, oospores germinate directly or indirectly by forming 10 to 40 motile zoospores, which swim to root tips where infection occurs within 3 to 5 hours after the oospores germinate

(Figure 8). Initial infections often begin in the embryos of germinating cereal seeds within 48 hours after planting. New roots, especially the root tips of fine lateral roots and root hairs, become infected. New oospores form in parasitized roots, and the fungi also grow on clean straw, chaff, and debris not colonized by other fungi and left on or close to the soil surface. Infection and growth of *Pythium* species are optimal between 59° and 86°F (15-30°C) in wet, compacted soils deficient in phosphorus and cropped previously to cereals and grasses.

RHIZOCTONIA ROOT ROT, SEEDLING BLIGHT, AND SHARP EYESPOT

Rhizoctonia root rot, caused by *R. solani* and *R. cerealis*, occurs any time during the growing season on all cereals and a wide range of higher plants throughout the world. Like many other root diseases, it often goes unnoticed unless the roots, and especially the root tips, are carefully washed and examined under a microscope. The fungus is most active in the top 5 to 7 inches of soil where it girdles and "prunes" individual roots and rootlets. When root pruning is severe, affected plants are stunted and exhibit symptoms of drought or nutrient deficiency. The disease is sometimes localized in fields, resulting in distinct bare or purple patches.

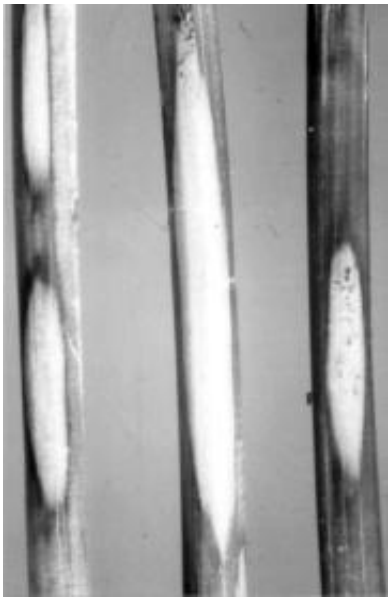

Figure 9. Sharp eyespot at the base of barley culms (courtesy British Ministry of Agriculture).

Symptoms

Patches of *Rhioctonia*-infected plants are stunted to dwarfed, are lodged, or produce whiteheads. Seedlings may be killed before emergence, resulting in more or less circular bare patches up to 3 meters in diameter. Many cereal plants are winter-killed from root browning and pruning. Other plants may outgrow the disease and form new roots. "Purple patches" in a field are a result of stunted diseased plants with stiff, dull blue-gray leaves. Maturity is delayed as with Pythium root rot.

Sharp eyespot of wheat, barley and rye is the most distinctive symptom caused by strains of *Rhizoctonia solani* and *R. cerealis*. Oats are less susceptible than other cereals. Severe sharp eyespot causes lodging and premature ripening or whiteheads. More commonly, the lesions are superficial. Leaf sheaths and culms near the base of the plant develop round to elliptical, light tan or straw-colored lesions with sharply defined, dark brown borders. The lesions are oriented vertically on the lower leaf sheaths (Figure 9). Diseased leaf tissues rot leaving a characteristic central hole. Frequently, dark mycelium and sclerotia of *Rhizoctonia* may develop in the lesions and between culms and leaf sheaths. Several lesions, up to a centimeter in diameter, may form near the base of a single plant. Severe infections result in seedling blight, but most infected plants survive to maturity, ripen prematurely, may produce whiteheads, and often lodge. Lodged culms frequently bend at the second or third internodes.

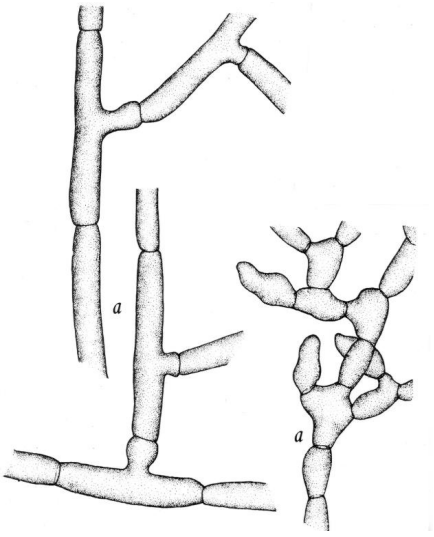

Figure 10. Mycelium of Rhizoctonia solani, the cause of rhizoctonia root rot, seedling blight and sharp eyespot, as it would appear under a high-power microscope. Left, young mycelium showing right-angled branching and constriction near each branch; right, older mycelium with barrel-shaped cells (drawing by L. Gray).

Disease Cycle

Rhizoctonia solani and *R. cerealis* persist indefinitely in soil and crop refuse as mycelium (Figure 10) and sclerotia–these fungi produce no spores. Soil nutrients and bits of crop residue are used as food. The amount of damage depends greatly on the soil environment. Root infections are most damaging before seeds set and in untilled soil kept moist during seedling development. Sharp eyespot requires cool, (48°F or 9°C) moist conditions at the base of the plant.

FOOT ROT, EYESPOT OR STRAW-BREAKER

This important and widespread disease of wheat, barley, rye and oats is caused by the soilborne fungus *Pseudocercosporella herpotrichoides* (synonym *Cercosporella herpotrichoides*). Wheat is more susceptible to foot rot than other small grains and grasses. Winter cereals are damaged more often than spring cereals. The disease is most common where wheat, barley or rye is grown almost every year and planted early, the weather is cool and wet, the crop canopy is dense, and humidity is high near the soil level. Plants also may be predisposed to infection by spring frosts and excessive nitrogen fertilization.

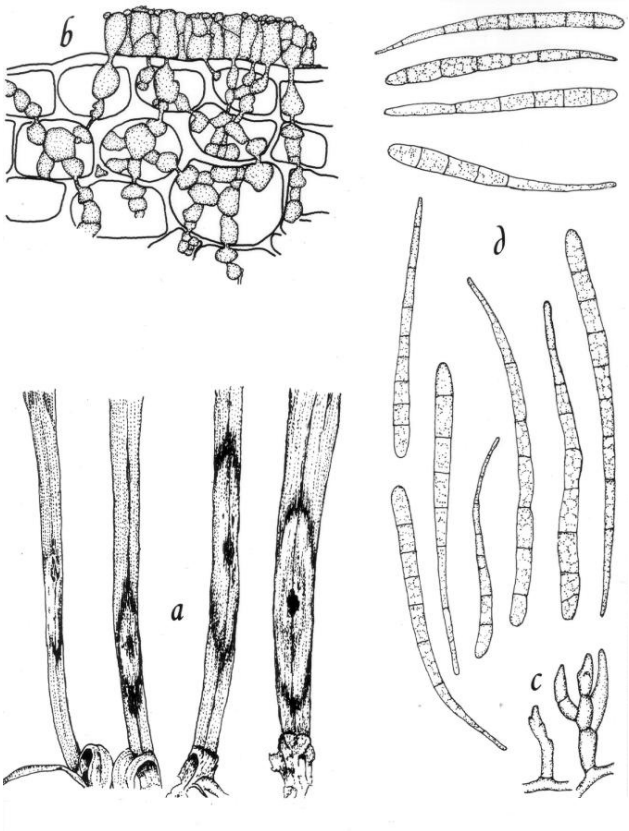

Figure 11. Foot rot, eyespot or strawbreaker caused by Pseudocercosporella herpotrichoides, as it would appear under a high-power microscope: (a) typical eyespot lesions at the base of wheat culms, (b) mycelium growing in wheat cells, (c) two conidiophores which bear the conidia, (d) conidia (drawing by L. Gray).

Symptoms

Foot rot is diagnosed by distinct elliptical or "eye" shaped lesions at the plant base which are most common after jointing. The lesions are initially white to tan-brown with brown margins. They later develop fungus-darkened centers, increase to 4 cm long, and become sunken (Figure 11). A weft of gray

Figure 12. Severe foot rot or strawbreaker in two wheat fields. It is typical for cereal plants to lodge in all directions. (Left photo, courtesy W.G. Willis).

mycelium can sometimes be seen inside the hollow culm beneath a large lesion. On maturing plants the culm base appears charred (**not** shiny and black take-all). Diseased plants tend to mature early and produce whiteheads with poorly filled kernels. Later, following wet weather, the whiteheads become covered with "sooty" molds. Severe foot rot lesions cause the weakened tillers to fall randomly in all directions. Large patches of lodged plants may be seen (Figure 12).

Figure 13. An area of wheat in the foreground severely affected with take-all disease.

Disease Cycle

Eyespot lesions form on winter cereals throughout autumn, winter and spring, originating largely from water-splashed spores (conidia) or from mycelium of the *Pseudocercosporella* fungus persisting on infected cereal or grass debris (Figure 11). The fungus is dormant or nearly so during the summer, but produces large numbers of conidia on living or dead hosts during cool (maximum near 50°F [10°C]), moist weather. The conidia germinate and penetrate coleoptiles and leaf sheaths directly or through stomates near ground level, within 15 hours, between 43° and 59°F (6° to 15°C), in a water-saturated atmosphere. The conidia are distributed principally by splashing rain. Symptoms commonly do not appear for several weeks after infection has occurred and autumn infections may not be evident until spring. Crops of conidia form on new lesions within 1 to 3 months and result in secondary lesions that may provide inoculum for succeeding small grain or grass crops. Mild winters and cool, wet springs prolong the production of conidia and infection periods. The fungus persists in soil or crop residue for several years in the absence of small grain crops.

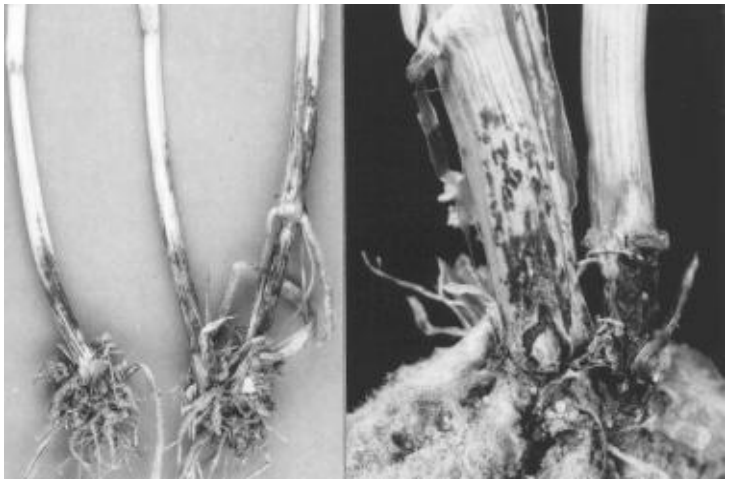

Figure 14. Culms of wheat (left) and rye (right) with shiny plates of coal-black mycelium under the lowest leaf sheath, a characteristic sign of the take-all disease fungus. (Left, courtesy T.M. Sjulin; right, courtesy Clemson University and the U.S. Department of Agriculture).

TAKE-ALL ROOT AND CROWN (FOOT) ROT

Take-all is a widespread root, crown and foot rot of winter cereals and numerous grasses caused by the soilborne fungus *Gaeumannomyces graminis* (synonym *Ophiobolus graminis*). The disease is most important in the Midwest where one cereal crop is grown continuously for 3 to 6 years, the soil pH is neutral or alkaline, the soil is sandy or infertile (especially deficient in nitrogen and phosphorus), compacted and poorly drained, and moisture is plentiful. The loss from take-all depends on when and how severely the roots and culm bases are colonized. The earliest infections are the most severe. When symptoms become obvious, yield may be reduced by 50 percent. Take-all is somewhat more damaging to winter cereals than to spring cereals, and where reduced tillage is practiced. Early, wet springs favor disease infection and development.

Symptoms

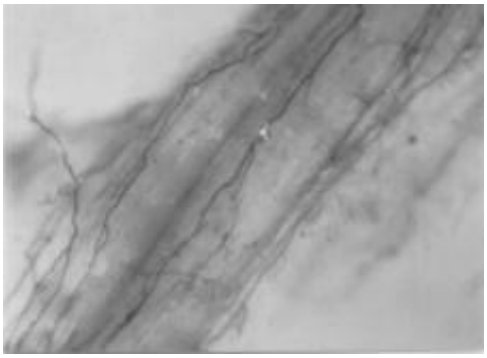

Figure 15. Black "runner" hyphal strands on the surface of a wheat root, a characteristic sign of the take-all disease fungus (courtesy R.W. Smiley).

When the weather is relatively moist, symptoms of take-all appear about heading time. In localized areas of a field, severely infected plants are stunted, turn pale green, ripen and die prematurely, and develop sterile whiteheads or heads containing a few shriveled kernels (Figure 13). When the weather is wet before harvest, the leaves, culms, and heads of affected plants become "sooty" from the growth and spore production of secondary molds (such as species of *Alternaria, Cladosporium, Epicoccum, Stemphylium,* and *Sporobolomyces).* Plants at an earlier stage are stunted to severely dwarfed, somewhat yellow and have fewer tillers. Diseased plants are easily pulled up or break off near the soil line. The roots are sparse, blackened and brittle. The black-brown rot commonly extends into the subcrown internode, crown and culm bases where a diagnostic, superficial, shiny plant of coal-black mycelium covers the culms under the lowest leaf sheath (Figure 14). Coarse "runner" hyphae of the fungus often form black strands several millimeters long on the surface of the roots (Figure 15). Under prolonged moist conditions the mycelial plate may be speckled with black fruiting bodies (perithecia) which erupt through leaf sheaths. Diseased culms, weakened at the base, lean or lodge in all directions.

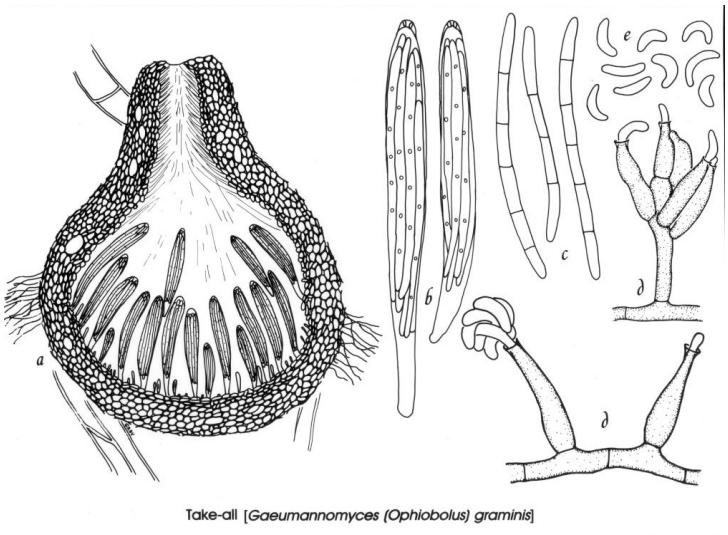

Figure 16. Gaeumannomyces (Ophiobolus) graminis, anamorph Phialophora sp. the cause of take-all disease of cereals and grasses, as it might appear under a high-power microscope: (a) vertical section through an erumpent perithecium containing club-shaped asci (Gaeumannomyces state; (b) two asci, each containing eight elongate ascospores; (c) three septate ascospores; (d) conidiophores (phialides), some bearing immature conidia (Phialophora state); (e) conidia or phialospores (drawing by L. Gray).

Disease Cycle

The causal fungus overseasons on infected roots of living cereal or grass plants and in or on host debris. Roots become infected as they grow through soil near infested debris. The roots first become colonized by runner hyphae (Figure 15). Infection by hyphae, and to a lesser degree by ascospores produced in perithecia (Figure 16), occurs throughout the growing season, with an optimum between 50° and 68°F (10° to 20°C). Root infections and colonization in autumn or early spring are most likely to produce a crown (foot) rot.

Most plant-to-plant spread occurs through black runner hyphae advancing across "root bridges." The fungus is widely dispersed by any agency that moves infested soil and host debris. Ascospores are spread by splashing rain and to some extent by wind.

Take-all is favored by alkaline, nitrogen- and phosphorus-deficient soils that remain cool and wet for prolonged periods.

ANTHRACNOSE

This worldwide disease of cereals and many grasses is caused by *Colletotrichum graminicola*, teleomorph *Glomerella graminicola*. It is only damaging on small grains that are nutritionally stressed, grown in alkaline or sandy soils, and grown under reduced tillage. Anthracnose is a much more serious disease on corn and sorghum than on small grains.

Figure 17. Wheat anthracnose caused by Colletotrichum graminicola. Severely infected wheat plants ripen prematurely (courtesy IL Natural History Survey).

Symptoms

Roughly elliptical lesions, 1 to 2 cm long, occur on roots, crowns and culms. The lesions are first water-soaked, then bleached, and later turn brown. At host maturity they are elongated and covered with black fruiting bodies (acervuli; Figure 17) containing clumps of dark spines (setae; Figure 18) visible with a hand lens or reading glass. On crowns and culms the lesions may resemble eyespot or sharp eyespot until the dark acervuli appear. Anthracnose normally is confined to the lower half of culms. When severe, the disease may cause a reduction in vigor, lodging, premature ripening, whitening of heads, and lightweight shriveled grain (Figure 17).

Disease Cycle

The *Colletotrichum* fungus overseasons in living cereal or grass plants, on host residues, seed, and soil as mycelium and conidia produced in acervuli (Figure 18). The conidia are dispersed by wind and rain. They germinate in water films and penetrate root, crown and basal culm tissues directly. Infected leaf tissue and/or heads are the result of secondary inoculum. Weed grasses and continuous growing of small grains promote the development and overwintering of the anthracnose fungus. Prolonged, warm (optimum 17°F or 25°C) wet weather favors infection and the production of acervuli.

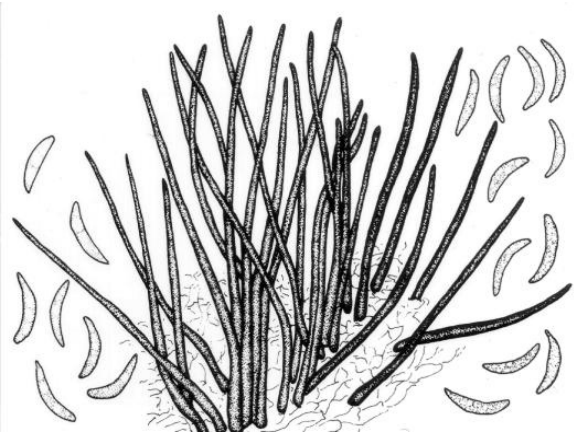

Figure 18. An acervulus of the anthracnose fungus Colletotrichum graminicola, as it might look under a high-power microscope. The dark "spines" are setae, and curved "early moons" are one-celled conidia (drawing by L. Gray).

MINOR ROOT ROT FUNGI

There are a number of other fungi associated with darkened and rotted cereal and grass roots (root necrosis) in Illinois. They usually go unnoticed since they are not serious pathogens and a microscopic examination is usually needed to observe them. Most can be found in plants that appear healthy as well as in plants with symptoms of disease. These widespread, soilborne fungi include *Microdochium bolleyi* (synonyms *Aureobasidium bolleyi* and *Gloesporium bolleyi*), *Naucoria cerealis, Marasmius graminum (*synonym *M. tritici Periconia circinata, Agrocybe molesta* (synonyms *A. dura and Pholiota dura*), *Polymyxa graminis*

(vector of soilborne wheat mosaic and wheat yellow mosaic [spindle streak mosaic] viruses), *Phialophora graminicola* (synonym *P. radicicola* var. *graminicola*), *Olphidium brassicae*, and *Phaeosphaeria herpotrichoides.*

Control

No single practice will control root and crown rots. When carried out collectively, though, the measures outlined below will keep losses to a minimum.

1. **Sow thoroughly cleaned, certified, plump, disease- and crack-free seed of adapted cultivars.** Use the ones recommended for your area by Illinois Extension agronomists and or your nearest Illinois Extension adviser. The seed should be treated with a recommended fungicide before planting. For details see the latest revision of Illinois Agricultural Pest Management Handbook.

2. **Where practical, plant resistant or tolerant cultivars**. A number of small grain cultivars are resistant or tolerant to one or more root- and crown-rotting diseases. See the above mentioned Handbook for resistant cultivars.

3. **Plant in a fertile, well-prepared well-drained seedbed after the hessian fly-free date at the time recommended for your area. Plant no deeper than 2 inches.**

4. **Maintain an adequate, balanced soil fertility.** An optimum supply of available phosphorous, potassium, and nitrogen–based on a soil test–must be provided. Avoid high rates of nitrogen. Research has shown that ammonium and slow-release forms of nitrogen (anhydrous ammonia or urea) better suppresses take-all root rot, compared to the nitrate forms of nitrogen.

5. **Rotate small grains with nongrass crops**, preferably legumes (soybeans and forage legumes), corn, sorghum, or canola for 3 or 4 years.

6. **Where feasible, if there is no legume underseeding, chisel plow or plow down cereal stubble deep and clean before planting**. In cultivated fields, keep down volunteer small grains and grassy weeds, such as foxtails, quackgrass, cheat, wild rye and barley, bottle-brush grass, windmill grass, and fescues.

7. **Do not spread manure containing infested straw and corn stalks on fields that will be planted in small grains or grasses within the next year or two.**