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ROOT ROTS AND OTHER DISEASES OF WHEAT

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ROOT ROTS, FOOT ROTS AND OTHER DISEASES of the lower stem and crown reduce wheat yields each year in Michigan. In gross appearance, an affected wheat field generally looks deceptively healthy. Individual diseased plants are easily obscured by adjacent healthy plants. Results of poor growth may not be evident, but the fewer tillers, fewer heads and shriveled grain result in fewer bushels per acre. Only timely observation and careful digging of unthrifty plants to examine roots will reveal to what extent each of these diseases is damaging a grower's crop.

COMMON ROOT ROT

Common root rot is caused by the fungus *Helminthosporium sativum*. Certain species of *Fusarium* may also contribute to common root rot. *H. sativum* can live on over 100 species of grass plants. The fungus over-winters saprophytically (on dead tissues) in these hosts in or on the soil to cause disease in the next susceptible crop. The fungus can attack any plant part but is most destructive to the roots and crowns.

Soon after the planting of wheat, the fungus can germinate and enter the subcrown internode and seminal roots to interfere with growth. It may spread in the crown roots as well as the crown. The above-ground plant becomes yellowish as if starved for nitrogen. Often, only the first few leaves are killed before new crown roots revive the plant. These remain attached at the base of the plant. The fungus may sporulate so profusely that a black mass of fungal spores (seeds) develops beneath the sheaths of tillers. Host plants may die at any stage, but they usually remain alive, though stunted, and produce shriveled grain.

Fig. 1 — Three wheat plants with similar above-ground symptoms consisting of yellowing to dead lower-most leaves. LEFT: Common root rot. Subcrown internode decayed by *Helminthosporium sativum* just above seed. Seminal roots and seed are detached. CENTER: Physiological browning of lower leaves. Normal white subcrown internode and roots. RIGHT: Lower leaves damaged below ground by chewing insects. Roots are deep, healthy and white.

Control

Neither variety selection nor seed treatment insures sufficient protection from common root rot. Altering certain cultural practices is practical and produces the best results. Wheat after wheat, or barley or wheat after grassy hay or pasture, with or without summer fallow, results in the most severe disease and greatest losses from common root rot. The sequence of susceptible crops must be broken for at least one year with a non-grass row crop such as soybeans or field beans. Wheat may follow corn for *H. sativum* but not for *Fusarium*. Turning under crop residues by clean plowing helps destroy the pathogen.

Mulch planting, no-till and similar practices provide the best means of survival of the causal fungus. The deeper the placement of seed the greater the opportunity for infection. More disease results from early seeding in the fall because *H. sativum* is favored by higher temperatures. Therefore, planting should be delayed for one week to ten days after the local Hessian fly-free date, particularly during a warm, dry autumn. Adequate and balanced nutrition helps the plant to make rapid and vigorous growth, thereby counteracting somewhat the effects of the disease.

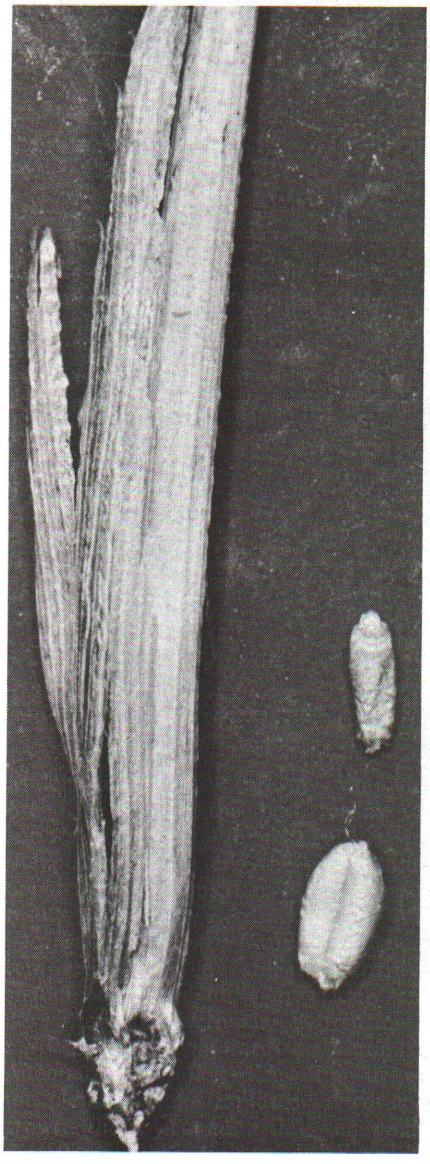

Fig. 2 — Common root rot caused by *Fusarium sp.* All roots rotted off below crown. In fresh plants, tissue just above crown is pinkish from fungus. Upper kernel is from this plant and is shrunken and small. Plump lower kernel is from nearby healthy plant.

Fig. 3 — Take-all root rot. Note stubbed-off crown roots and blackened lower stem extending upward from crown.

TAKE-ALL ROOT ROT

Take-all root rot is caused by the fungus *Gaeumannomyces graminis*, formerly *Ophiobolus graminis*. Take-all is most severe in fields where wheat follows wheat. The causal fungus thrives in roots and lower stems, producing abundant spores in a dark mycelial mat much like *Helminthosporium*. These germinate to infect the next wheat crop through the roots. The resultant root decay brings starvation and drouth to the plant, resulting in death and/or an unhealthy, grayish color instead of a golden hue as the crop nears maturity. The grain is shriveled and small and is borne in visibly lightened (white) heads on severely affected plants.

Take-all root rot can be suspected where circular patches of shorter off-color wheat are visible. Roots should be carefully examined because sand pockets, low fertility, soil acidity, poor drainage and many other localized soil conditions can cause poor growth. The most characteristic symptom of take-all root rot is the development of a black onion-skin layer just beneath the lower sheaths. Dark hyphae (strands) of the fungus are present. The culm, or inner stem, will be a characteristically shiny coal black. Only root stubs are present below ground in severe cases. Common root rot causes similar root decay. Wheat plants infected by both diseases can be easily pulled from the ground. White heads, though frequently the result of take-all, can also be caused by stalk-boring insects and certain other fungal pathogens.

Control

For successful control, wheat should not follow wheat or other grassy plants, especially quackgrass. Wheat following corn, soybeans or oats will suffer less damage. Low soil fertility and alkaline soils accentuate the effects of take-all root rot. Adequate, balanced nutrition should be provided, particularly available nitrogen. Since the form of nitrogen affects take-all, nitrogen as ammonium rather than nitrate should be used when possible.

Fig. 4 — Strawbreaker foot rot or eyespot. Note fungus lesion above crown. Note also extensive normal root system.

STRAWBREAKER FOOT ROT OR EYESPOT

Strawbreaker foot rot is also called eyespot of wheat. The disease affects many cereals and is caused by the fungus *Cercosporella herpotrichoides.* Lodging in late May and June is the most noticeable symptom resulting from the fungus girdling the wheat stem near ground level.

The causal fungus persists for more than one season in the lower stems of small grains and some grasses. The fungus is most active during cool, wet weather from late fall through early spring. It is largely dormant during hot, dry summer weather. Spores splashed by rain onto young wheat seedlings germinate, and the fungus enters the leaf sheath near ground level. Beneath this sheath on a diseased plant, a characteristic lesion with pointed ends can be observed on the inner stem. There is a similar lesion on the leaf sheath. If the fungus continues to advance into the stem, water and nutrient translocation is affected. Shriveled kernels and white heads appear. The stem may be so weakened by girdling that wind and rain easily lodge diseased plants. Scattered tipping of individual stems is typical of strawbreaker. The roots of such plants remain healthy and white. Hence, eyespot can be distinguished from common and take-all root rots.

Control

Control is complicated by the fact that *Cercosporella* can survive in host tissue for two or three years depending on rate of decomposition. Hence, crop rotation in fields with considerable eyespot fungus would require two to four years without a susceptible gramineous (grass) host. This interval may be shortened if stubble is clean-plowed and all diseased residues remain buried at least three inches. Plowing should thoroughly cover diseased plant residues to assure rapid breakdown and consequent reduction in inoculum.

High soil fertility, particularly higher nitrogen, increases disease severity indirectly by causing a denser canopy and higher humidity near the ground, which favors the fungus. Nevertheless, the advantages of higher fertilization outweigh the ill effects of increased strawbreaker infection and subsequent lodging. For a similar reason, early seeding results in more eyespot and greater loss. Just as for common root rot, the date of planting can be profitably delayed for a week to ten days after the local Hessian fly-free date. No fungicide is now registered for control of eyespot in wheat.

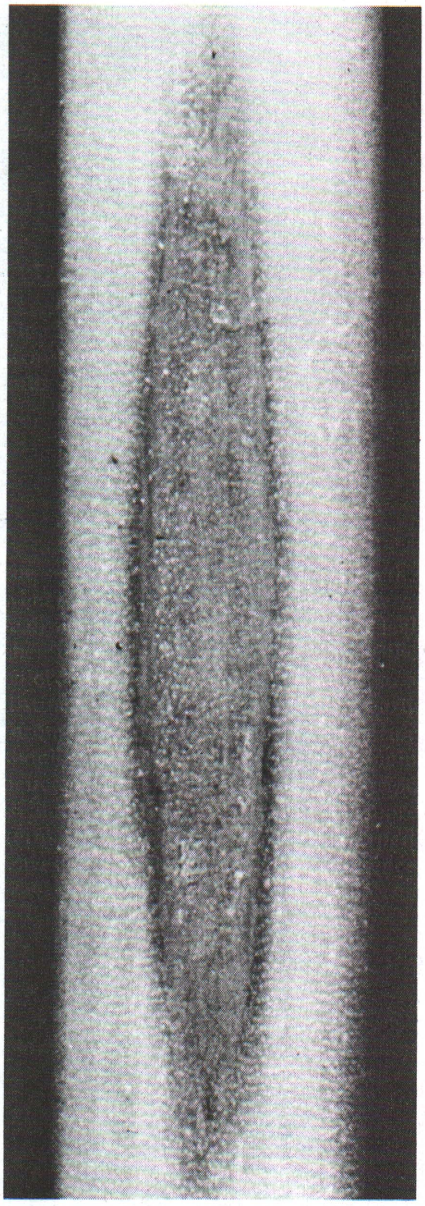

Fig. 5 — Closeup of lesion on culm of strawbreaker foot rot. Note the pointed ends of the lesion.

CEPHALOSPORIUM STRIPE

Cephalosporium stripe is caused by the fungus *Cephalosporium gramineum.* The fungus survives in soil on the straw and stubble from wheat and other gramineous hosts. It is most active in the fall and spring during the early growth of wheat. The fungus produces numerous spores which infect roots, particularly where a rootlet is injured or broken by freezing and thawing. The fungus can also enter the subcrown internode just as the seed is germinating. Once inside the wheat plant, the fungus moves systemically in the vascular tissues to the leaf sheath and blade. Here it destroys the chlorophyll on each side of the vein so a distinct yellow stripe forms continuously through sheath and blade. This stripe should not be mistaken for potassium deficiency, especially if the fungus stripe is along the leaf margin. one or more veins within *Cephalosporium*-striped leaves will be darkened by the presence

Fig. 6 — *Cephalosporium* leaf stripe. Note uniform leaf stripes extending length of leaf blade.

of the fungus. The fungus usually invades all tillers so that the entire plant is striped and often dwarfed.

Control

Certain cultural practices can prevent this disease from causing serious losses. *Cephalosporium* stripe-infested plant residues can support the fungus for up to three years. A non-susceptible crop should be grown for at least one year before planting wheat. A row crop such as soybeans, corn or field beans is preferred because grassy weeds can be more easily kept to a minimum. Wheat after wheat with shallow discing of infected stubble is a most effective way to perpetuate and increase the fungus and this disease. Conversely, deep plowing that will bury diseased residues at least 3 inches below the soil surface speeds residue decomposition and inactivation of the pathogen, usually to within one year. Unlike take-all root rot, acid soils favor *Cephalosporium* stripe but like other diseases, *Cephalosporium* stripe is reduced by delayed fall planting.

SUMMARY

Cultural control measures for all of the above soil-borne diseases can be summarized as follows:

1. At least one year should elapse between consecutive wheat crops. During this time a row crop should be grown, particularly soybeans or field beans. Corn may be used if toxicity from residual herbicides is reduced to non-injurious levels. All grass weeds should be controlled in these row crops. Avoid planting wheat on land where the previous crop was weedy hay, pasture, conservation land, waste land, native grasses, wheat, barley or oats.

2. Plant winter wheat one week to ten days after the local Hessian fly-free date.

3. Plant wheat no deeper than necessary to assure adequate soil moisture for prompt germination.

4. Follow good management practices and provide adequate, balanced nutrition to assure vigorous growth.

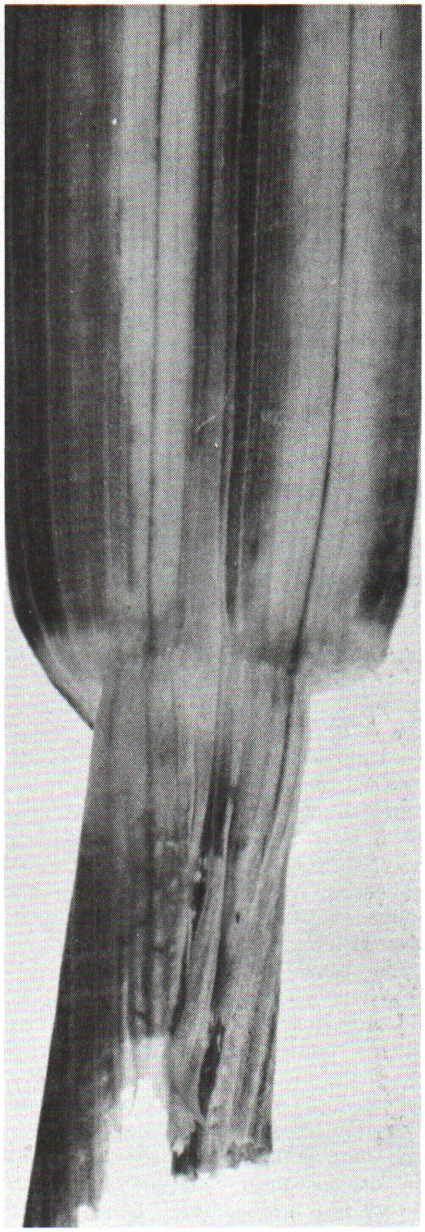

Fig. 7 — *Cephalosporium* leaf stripe. Note darkened vascular bundle in center of each stripe extending from leaf blade into the leaf sheath below.

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