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COMMON ROOT ROTS OF SOYBEANS

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ROOT ROTS ARE probably the most important diseases of soybeans in Michigan. Wilting and dying plants are easily recognized, but more often the root destruction which reduces yields is not noticed. These root rot diseases are caused by soil-borne fungi. The continued increase in soybean acreage, coupled with less and less crop rotation, increases the threat of more severe root rots.

Phytophthora Root Rot

Phytophthora root rot was first observed in neighboring areas in Ohio in 1951 and Ontario, Canada, in 1954. By 1956, Ohio reported the disease in 43% of the fields surveyed. In 1962, the disease was in 33% of the soybean fields in Illinois. *Phytophthora* root rot is present in the Saginaw Valley and southeastern Michigan and possibly other areas.

Phytophthora root rot is caused by the soybean strain of the fungus *Phytophthora megasperma* and is designated as *P. megasperma* var. *sojae.* Within the soybean strain of this fungus, there are at least seven races. Commercial soybean varieties sold as "*Phytophthora*-resistant" refer only to Race 1 and 2. Michigan-adapted varieties such as Amsoy-71, Beeson, Chippewa-64 and Harosoy-63 are susceptible to Race 3 and 4. These last two fungus races occur in adjoining Ohio and Indiana and probably are present in Michigan. Three additional races are reported to occur in Ontario.

The fungus persists in the soil as dormant spores which are stimulated to germinate when in close proximity to soybean rootlets and roots. The fungus penetrates the taproot and invades the tissues of the root. Destruction of the roots and lower stem prevents the movement of water and nutrients to the upper part of the plant. Young seedlings wilt, die and remain standing in the row. In older plants wilting and yellowing progress from the lower-most leaves to the top. The dying leaves remain attached to the stem. The fungus may move up into the stem, producing browning of the outside of the stem which may spread from the ground upward as much as 6 to 10 inches.

Root rots resembling *Phytophthora* root rot, expecially in so-called resistant varieties, should be referred to the county agricultural agent for confirmation by a plant pathologist to determine if newer races of *Phytophthora* are present or if other disease-producing organisms are involved.

Control

Until resistance to more races of the fungus is incorporated into new varieties, growers can use cultural control practices. *Phytophthora* root rot is more destructive in heavier, more clayey soils, on slightly lower and more poorly drained areas and where the soil is more compacted. These areas of lower soil aeration and higher soil moisture are unfavorable to plant growth and more favorable for development and movement of this water mold fungus. The disease can be reduced by planting in lighter, sandier soils, by improving soil drainage and by reducing soil compaction.

Fusarium Seed and Seedling Rot

Since 1969, a seed and seedling rot has been observed in St. Joseph and Cass counties. Seeds may decay, or if they germinate, the young seedling becomes swollen and often twisted and usually fails to emerge. Thus, gaps may occur in a row or over areas larger than an acre. This disease is caused by a *Fusarium* species and may resemble *Fusarium* diseases occurring in Iowa and Minnesota. Seed treatment has not been successful in improving stand. At first it was thought that herbicides or toxic plant residues from red clover or other plants caused the problem, but this has been ruled out. The disease does not appear to affect plants after they have emerged.

This *Fusarium* disease is extremely severe if excessive rainfall occurs immediately after planting. It has been observed in well-drained and poorly drained soils; in sandy as well as heavier soils; and in low and high organic soils. The disease appears sporadically. It may occur in one part of a field in one year, but the following year may appear elsewhere. Moreover, a second planting in a diseases area may (or may not) give a healthy stand.

Thielaviopsis Root Rot

Thielaviopsis root rot (also called black root rot) causes extensive damage throughout southeastern Michigan and extending into adjacent areas. This disease is caused by the fungus *Thielaviopsis basicola.* The fungus persists in soil and in soybean root residues as chlamydospores which germinate in contact with roots. This fungus is commonly found in many other plants but causes disease in only a few of these. In 1969, investigation in Michigan uncovered this serious disease of soybeans.

Thielaviopsis root rot appears as a black or dark brown rotting of the outer portion of the below-ground soybean stem and root system. The fungus decays the fibrous roots as well as the taproot. Sometimes the fungus severs the taproot one to two inches below ground. The

soybean plant responds by forming new shallow roots subject to drouth damage.

Diseased plants may appear normal although smaller and overgrown by adjacent, less diseased plants. Thus, *Thielaviopsis* root rot is easily overlooked unless the taproot is examined for the black cortical decay and the absence of fibrous roots. *Thielaviopsis* root rot occurs in the same general areas where *Phytophthora* root rot is prevalent.

Control

Little is known about control of this disease. The fungus is soil-borne. Frequent soybean crops on infested soil probably permit the rapid build-up of the fungus. Limited observation of commercial varieties indicates considerable variation in susceptibility. Beeson appears quite resistant both in field and laboratory tests. On the other hand, Amsoy-71, Harosoy-63, and Hark are very susceptible.

In greenhouse tests and limited field tests, the herbicide Amiben increased the severity of *Thielaviopsis* root rot. The herbicide causes increased leakage of nutrients from the roots, which stimulates more of the fungus spores to germinate and infect. Several herbicides may cause either abnormal distortions or burning of soybeans, particularly under unusual conditions, but in this *Thielaviopsis* X Amiben interaction, it is the disease which is increased.

Other Root Rots

Pythium and *Rhizoctonia* root rots cause disease in other soybean-growing areas of the Midwest. The causal fungi have not been isolated often enough in Michigan to warrant considering them as causing significant losses.

An unidentified disease causing decay of the lower stem and roots appeared in 1974 in the Lenawee County soybean disease monitor plots. The root rot appeared to be caused by a fungus. It does not appear to be a race of either *Phytophthora* or *Thielaviopsis*. For example, Amsoy-71 was severely attacked but Amsoy in adjacent rows was not affected.

Root and stem rots caused by pathogenic fungi result in important losses. Operating in a complex environment, they are difficult to detect and separate out. Some fungicides are sold to combat fungi in the soil but these are too specific and have not been adequately tested in Michigan. Soil fumigants have a much broader range of effectiveness but are far too expensive for general crop production. Seed treatment does not provide protection throughout the bulk of the soil that the seedling and roots ramify. Breeding for resistance is a long-term measure requiring concentrated effort. It has had limited but important success, as in the case of Race 1 and Race 2 of *Phytophthora megasperma* var. *sojae*.

Many of these root rots are more severe under conditions of low soil aeration and high soil moisture. Thus soil management should be directed toward promoting a more favorable soil environment. Soybeans should not follow soybeans. If root rot diseases are serious, the period between soybean crops should be extended with other crops. Biological control with antagonistic organisms is a possibility, but awaits further investigation.

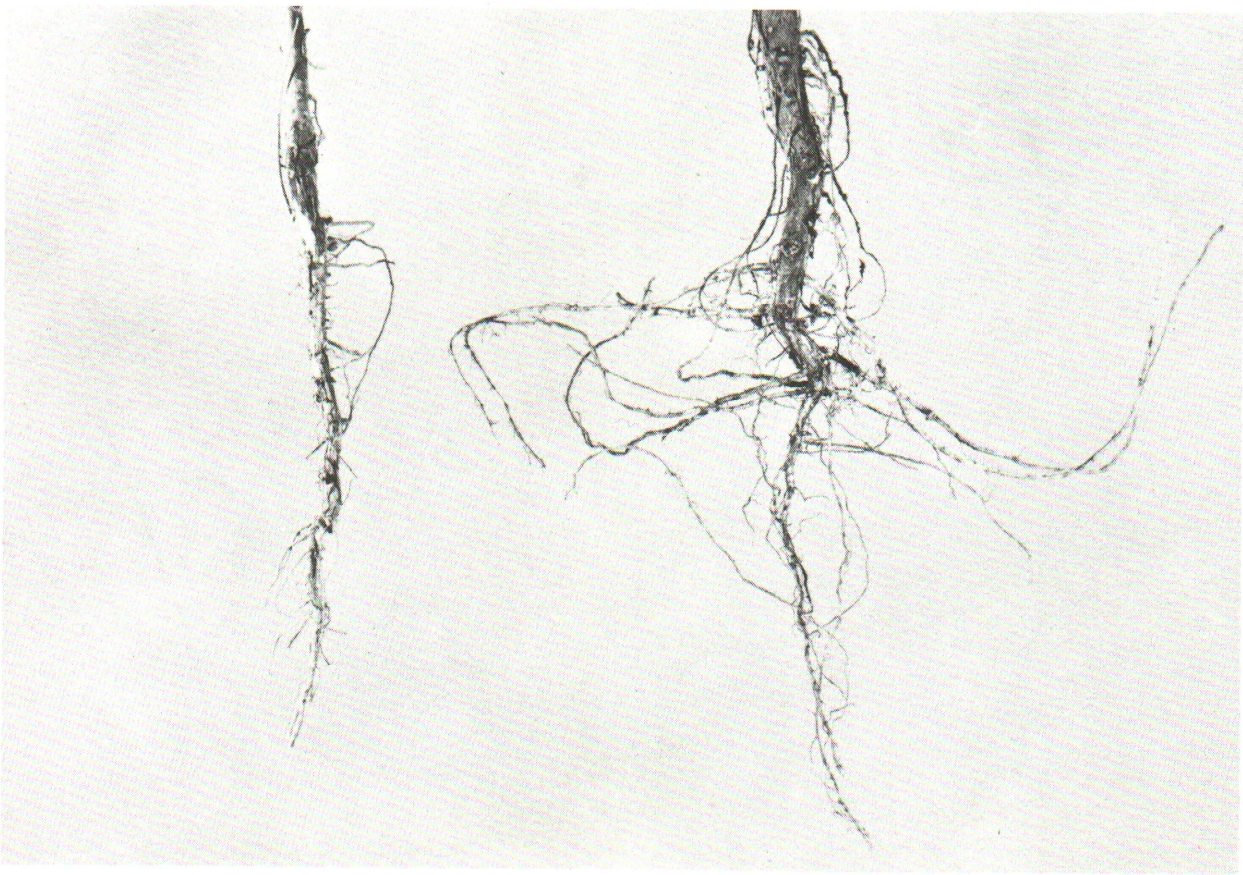

Fig. 1—Left—Root rot with decayed stubs of roots. Right—normal root system.

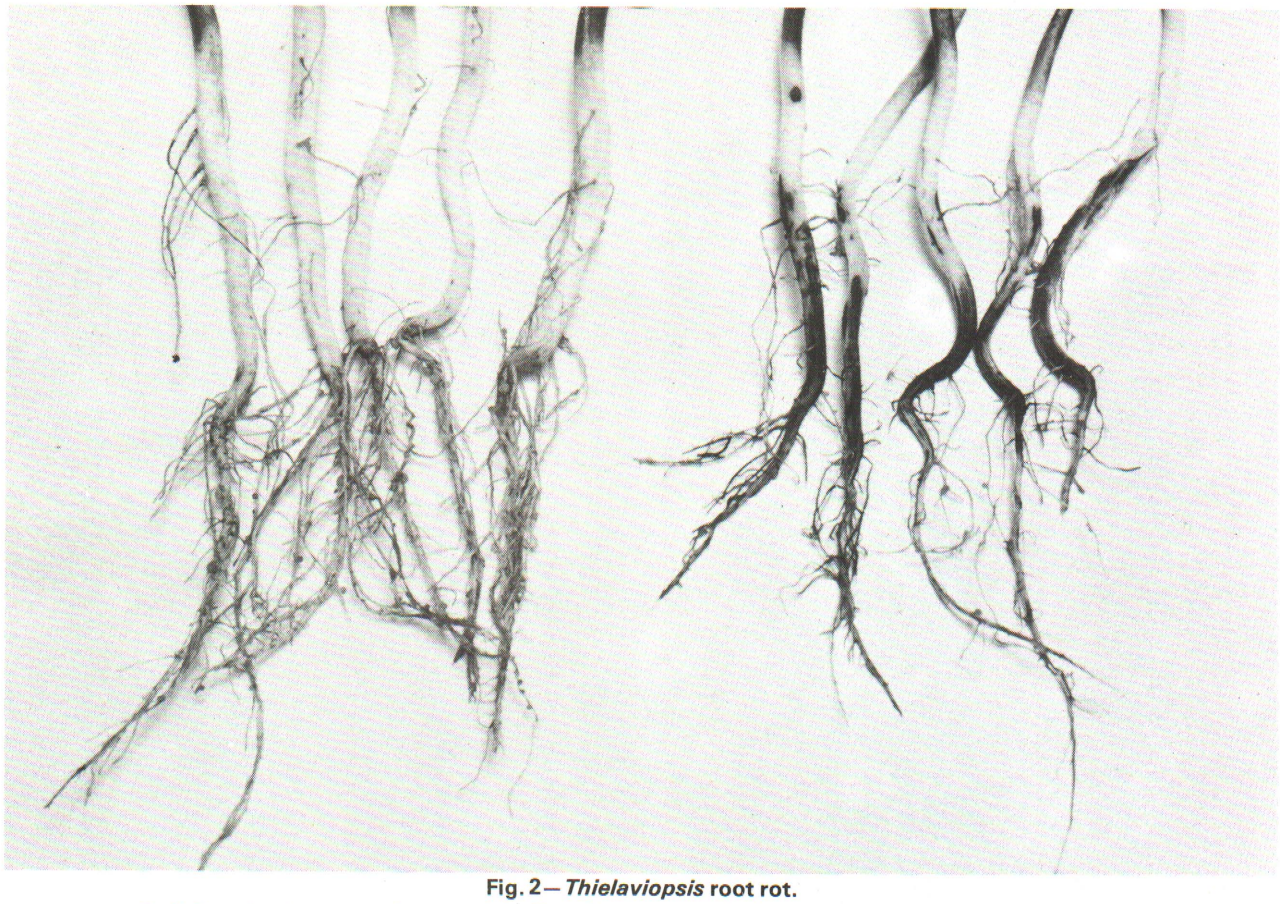

Fig. 2—*Thielaviopsis* root rot.
Left five plants—normal roots; right five plants—note dark fungus lesions on lower taproots.

Fig. 3—Different stages of *Fusarium* seed and seedling rot. Note diseased cotyledons and enlarged hypocotyls.

Fig. 4 — *Phytophthora* root rot. Note darkened lower stems and wilting leaves.

Fig. 5 — *Thielaviopsis* root rot and herbicide interaction. Left—Plants grown in soil treated with Amiben. Center—Plants grown in soil containing spores of *Thielaviopsis basicola.* Note moderate root rot. Right—Plants grown in soil treated with Amiben and containing spores of *Thielaviopsis basicola.* Note severe root rot.

Fig. 6—*Thielaviopsis basicola.* Dark chlamydospore chains with scattered endoconidia.

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