Managing Phytophthora Root and Stem Rot of Soybeans

Phytophthora is a soybean disease associated with wet soil conditions commonly occurring on heavy, poorly-drained or compacted soils. However, if normally well-drained fields are saturated for an extended period due to heavy rainfall or even excessive irrigation, Phytophthora can infect those fields as well. The ideal temperature for infection is 60 to 80°F. Disease severity is highly dependent on environmental conditions, Phytophthora races in the field, and genetic resistance or field tolerance of the soybean variety.

Phytophthora Impact on Soybean Crop

- The Phytophthora fungus can kill plants at all stages of growth.
- Stand reduction may result in replanting or yield loss.
- Replanting is common when early infection results in severe seed rot and damping off of seedlings.
- In some cases, infected stands survive but are less productive than healthy stands.
- Yield reductions can range from as little as 5% to more than 50% depending on severity.

Phytophthora Development and Symptoms

Phytophthora may attack soybeans at any time during the growing season. The seed rot phase may affect soybeans as soon as seeds imbibe water and swell. The seedling blight phase may occur prior to emergence or during early seedling growth. The root and stem rot phase may occur any time throughout the summer.

Seed Rot Phase: Soybeans seeds are at risk to Phytophthora as soon as seeds begin the germination process. Infected seeds are dark brown and soft to mushy. Severe infection at this stage may result in complete deterioration of the seed. Seed rot is most common when soils become saturated immediately after planting, conditions remain wet, and temperatures are optimum for disease development.

Seedling Blight Phase: The seedling blight phase of Phytophthora may infect plants during the emergence process or shortly thereafter. Severe infections can result in rapid decay, wilting, and death of the just-emerged seedling, commonly referred to as "damping off". Symptoms include a dark brown to black discoloration of the stem, usually beginning at the soil line. Diseased tissues quickly become soft and water-soaked, and wilting and plant death may soon follow. Seedling plants may also succumb to Phytophthora at later stages.

Another soil pathogen, Pythium, can also result in seed rot and damping off. Pythium is the more active of these two pathogens from 50 to 60°F. Above 60°F, Phytophthora is more active.

Root and Stem Rot Phase: Because the Phytophthora fungus is a soil-borne organism, infections begin in the root of the plant and then progress into the lower stem. Infections may eventually kill the soybean plant outright or just weaken it to varying degrees. Even if plants survive, productivity is often greatly reduced compared to that of healthy soybean plants.

Root symptoms include brown, discolored secondary roots and an overall reduction in root mass that allows the plant to be easily pulled from the ground. The main tap root is also brown on the surface, and splitting the root reveals a tan discoloration of the inner tissues. Nodulation is often minimal on the roots, and this is expressed as light-green plants above ground. Plants may also be stunted, resulting in fields with an uneven appearance. Root damage results in wilting of the plant during periods of stress.

If the root infection spreads into the stem, a brown discoloration begins to develop at the soil line. Eventually, a dark-brown to red-brown lesion may progress several nodes up the stem from the base of the plant. This girdling lesion is one of the key diagnostic features of the stem rot phase of Phytophthora. However, the disease may not progress to this stage when infection is moderate or begins later in the season.

Note dark-brown lesion extending upward from soil line.

Above-ground symptoms of Phytophthora may not be evident for several weeks after initial infection. Often, a period of drought stress is required before diseased plants begin to show the effects of reduced root systems and inadequate water transport capability within the stem. Symptoms progressing from the bottom to the top of the plant include leaves wilting followed by petioles drooping. As plants reach the permanent wilt stage, leaves may develop a grayish cast followed by yellow spots.

Plants wilting among healthy plants is often a sign of Phytophthora infection.

Management Practices for Phytophthora

Variety Selection: Phytophthora is a highly diverse organism – over 70 different races have been identified throughout the US. In a given field, many different races are represented

in the Phytophthora population, with one or two of these being the most dominant (most frequently occurring). A field population of Phytophthora is dynamic – it is constantly changing in response to climate and soil conditions, varieties grown, crop rotation and other factors.

Plants in foreground are wilting due to the root and stem blight stage of Phytophthora root rot.

Genetic resistance bred into soybean varieties is race-specific. This means it is able to defeat certain races but is overcome by others. When the dominant race in a field shifts, it may overcome the resistant soybean varieties developed for an area. Soybean breeders must then find a new source of resistance to defeat that race and incorporate it into new varieties. This illustrates the drawback of race-specific resistance – it may eventually lose its effectiveness as Phytophthora populations change. In fact, use of the same resistance gene continuously will eventually cause a race shift that reduces the effectiveness of the gene.

Another type of genetic protection against Phytophthora is known as "field tolerance". This term is alternately referred to as "tolerance", "partial resistance", and "rate-reducing resistance" by various researchers and seed companies. Field tolerance is not race-specific; it is effective against all races of Phytophthora. This type of protection is more enduring over time than that offered by specific resistance genes, which may eventually need to be replaced. Many Pioneer® brand varieties are bred to have both a resistance gene and field tolerance. When two competing varieties with the same resistance gene perform differently in the field, it is often because of genetic differences in field tolerance.

Phytophthora races differ from area to area, and new races emerge as the most dominant in an area. DuPont Pioneer researchers evaluate soybean varieties in hundreds of environments throughout North America. These researchers are developing new varieties with the appropriate resistance genes for each area, as well as incorporating higher levels of field tolerance into new varieties.

Field Drainage: Because Phytophthora development requires saturated soils for a prolonged period, improving field drainage is one key to successful management. Other field characteristics that contribute to waterlogged soils include compaction and hardpan layers. Remediating these soil structure issues is another useful management tool to reduce Phytophthora infections.

Planting Date: Early planting may increase the risk of Phytophthora damage if soils are wetter, and cool temperatures slow soybean emergence. Planting later when temperatures are more favorable to soybean growth gives soybeans the edge in outpacing disease development. This is more important on heavy soils or in no-till systems where seedbeds are cooler.

Genetic Mechanisms to Help Protect Against Phytophthora

- Rps 1C and Rps 1K are the most common race-specific resistance genes used today. DuPont Pioneer soybean breeders also use genes 6, 1a and 3a, depending on local need.
- Race-specific resistance is most effective during the seed and seedling growth stages.
- Field tolerance, effective against all races of Phytophthora, is more enduring than race-specific genes.
- Field tolerance is not as effective in the seed and seedling growth stages.
- Varieties containing both genetic resistance and field tolerance have two mechanisms of protection.
- DuPont Pioneer rates its varieties for tolerance and provides ratings to customers; ratings range from 4 to 6 (9=tolerant).
- Your local DuPont Pioneer sales professional can help you select the appropriate Phytophthora resistant or tolerant varieties with other traits needed for your fields.

Seed Treatments: Use seed-applied fungicides in fields with a history of Phytophthora damage. Pioneer Premium Seed Treatment (PPST) contains metalaxyl, which has specific activity against early-season Phytophthora and Pythium diseases:

- Provides protection for up to three weeks;
- Especially useful when cool, wet soil conditions develop after planting.

The early period of protection of seed treatments often covers the period from planting to emergence and allows soybean seedlings a head start on the diseases. They are especially useful in cool, wet soil conditions after planting.

Manure and Fertilizer Application: Application of high levels of potash, manure or municipal sludge immediately before planting soybeans may result in more severe Phytophthora root rot. This is because of the chloride, salt or nitrate contained in fertilizer, manure and sludge. Application of these products should be made in the fall to allow time for leaching of soluble salts prior to planting. Growers should also avoid concentrating manure or sludge in specific fields, even if they are closer to the source.

PIONEER PREMIUM SEED TREATMENT

Seed treatment services are provided by independent contracted sales professionals of Pioneer. Not all sales professionals will offer the services and costs will vary. See your Pioneer sales professional for details.