Soybean Seedling Diseases

Soybean seedling diseases are one of the most important causes of reduced stand establishment and can cause economic losses. Diseased seedlings are often weak and less vigorous, and severe stand loss may require replanting. Seedling diseases are often more prevalent when wet weather follows planting. They are generally more common in compacted and poorly drained soils or in areas where seedlings have been injured (Figure 1).

Diagnosing seedling diseases in the field can be difficult since the symptoms of various seedling blights are very similar. This publication discusses the characteristics of the organisms that cause seedling diseases, describes injury symptoms that may appear similar to these diseases, and briefly addresses how to manage seedling diseases.

The soybean seedling diseases we examine are:

1. Fusarium root rot
2. Rhizoctonia seedling blight
3. Phytophthora root rot
4. Pythium seedling blight

Figure 1. Seedlings that die in patches or individually within a row are symptoms of seedling blight diseases.

Fusarium Root Rot (*Fusarium* spp.)

Many *Fusarium* species reside in the soil and can infect soybean. Infected plants may be stunted and spindly, and roots may have brown or black discoloration (Figure 2). Affected plants may also have poorly developed root systems.

In severe cases, seedlings may die before emerging. *Fusarium* species can infect plants under a wide variety of environmental conditions. Fusarium root rot is often associated with stressed plants.

Figure 2. Soybean plants infected with Fusarium root rot have poorly developed roots and dark, discolored lesions on the roots.

Rhizoctonia Seedling Blight (*Rhizoctonia solani*)

Rhizoctonia seedling blight is caused by the fungus *Rhizoctonia solani*. The characteristic symptom of Rhizoctonia seedling blight is reddish brown lesions on the seedling's lower stem or hypocotyl, usually at the soil level (Figure 3). Lesions on the diseased stem appear sunken and dry.

Figure 3. Rhizoctonia seedling blight lesions appear on the lower stem and often have a canker-like appearance.

This disease can occur over a wide range of soil conditions. Affected plants typically appear in patches. Temperature and moisture requirements for infection vary, and stressed seedlings may be more vulnerable to infection and disease.

Phytophthora Root Rot (*Phytophthora sojae*)

Phytophthora root rot is caused by the oomycete *Phytophthora sojae*. Infected plants appear alone or in patches (Figure 4). *P. sojae* also causes a stem rot characterized by chocolate brown stem lesions, but the symptoms of the seedling phase resemble the symptoms of many other seedling diseases.

Phytophthora-infected seedling stems are soft and water-soaked. Overall, infected seedlings will be wilted and stunted. Phytophthora root rot occurs across many environments, but is most common in warm (>60°F/15°C) and wet conditions.

Figure 4. Seedlings affected by Phytophthora root rot appear scattered in a field, and symptoms resemble other seedling blight diseases.

Pythium Seedling Blight (*Pythium* spp.)

Many *Pythium* species of oomycetes can cause soybean seedling blight. *Pythium* species cause symptoms similar to *Phytophthora sojae*, which is also an oomycete.

Pythium seedling blight symptoms include rotten, mushy seeds or seedlings with poorly developed roots. Water-soaked lesions may be present on the hypocotyl or cotyledons (Figure 5).

Figure 5. Pythium seedling blight may kill seedlings before or after emergence.

Pythium seedling blight can occur across a range of temperatures, but high soil moisture increases disease severity. Consequently, symptoms are most severe in poorly drained soils and areas prone to flooding.

Diagnosing Seedling Blights

Seedling diseases are difficult to correctly diagnose in the field, and it is easy to mistake them for other problems (such as herbicide damage). In addition, seedlings may be affected by more than one seedling disease.

For these reasons, we recommend sending injured or diseased soybean seedlings to a local diagnostic lab (along with all relevant field information) to confirm the cause before implementing a disease management program. Obtaining an accurate diagnosis will allow you to determine the best management strategies for your soybean field.

A few examples of disorders that can cause similar symptoms as soybean seedling blights are listed below.

Conditions With Similar Symptoms

Fluopyram Fungicide Effects

The fungicide fluopyram (ILeVO®, Bayer CropScience) is marketed as a seed treatment to manage sudden death syndrome. This treatment can discolor soybean cotyledons in a way that can resemble disease or abiotic stress, such as herbicide injury. The discoloration occurs because the fungicide is moderately systemic within the soybean plant, so it will naturally move to the plant's "sinks": the roots and cotyledons.

This accumulation can result in phytotoxicity, causing the tips of the cotyledons to turn yellow-brown. This necrosis is typically uniform and present on every seedling grown from a seed treated with ILeVO®, however, environmental conditions may affect the frequency, uniformity, and severity of the phytotoxicity observed. The phytotoxicity is not common on the trifoliate leaves. Research conducted by several land-grant universities and Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) demonstrated that this phytotoxicity (also referred to as "halo effect") does not result in long-term stunting or yield loss.

How to distinguish fluopyram effects from seedling diseases: Fluopyram phytotoxicity symptoms are consistent across seedlings treated with the fungicide, and are present on cotyledon edges, but not roots or stems.

Figure 6. The fungicide fluopyram can cause cotyledons to turn yellow or brown. This symptom does not result in yield loss.

Pre-emergence Herbicide Damage

Pre-emergence herbicides can also damage soybean seedlings, particularly when cool temperatures coincide with rain soon after seedlings begin to emerge from the soil. Pre-emergent herbicides, typically PPO-inhibitors (flumioxazin, sulfentrazone, saflufenacil; group 14) or photosynthetic inhibitors (metribuzin; group 5), can occasionally injure plants growing in cold, wet soils. Typically, soybeans can metabolize these herbicides, but when their metabolism slows due to stress (such as cold temperatures) herbicide injury can occur (Figure 7).

Pre-emergence herbicide injury also occurs when heavy rains splash concentrated droplets of residual herbicide from the soil onto the emerged seedlings. Spotty necrosis can occur on any exposed portion of the plant where splashing occurred. Metribuzin can cause symptoms similar to the phytotoxicity caused by ILeVO®.

Pre-emergence herbicide injury is more likely to occur in sandy, low organic matter (OM) soils than in loam or clay soils with higher OM. Also, some soybean varieties are more sensitive to these herbicides than others. Herbicide sensitivity information is available from some, but not all, seed companies.

How to distinguish pre-emergence herbicide damage from seedling diseases: Check spray application records to determine if a pre-emergence herbicide was applied. The symptoms of pre-emergence herbicide damage are typically consistent on all treated soybeans, whereas seedling blights are observed in patches.

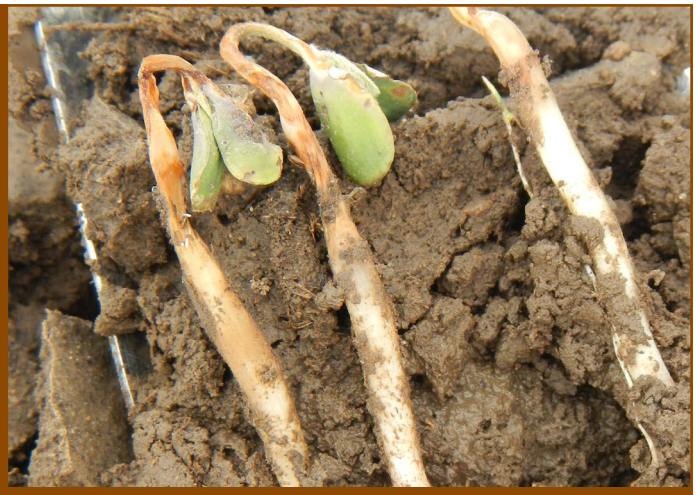

Figure 7. (Top) Symptoms of PPO-inhibitor herbicide damage on soybean seedlings.
Figure 8. Necrotic areas on cotyledons or unifoliate leaves can be the result of pre-emergence herbicides splashing on leaves.

Environmental/Planting Issues

Frost and/or freeze damage is evident several days after a frost event and will result in a brown-purple, water-soaked appearance on the hypocotyl and cotyledon (Figure 9). Soil crusting may prevent or slow seedling emergence, causing the seedling to die before it emerges.

Several factors can exacerbate environmental issues, including nonuniform planting depth, nonuniform seed spacing, and incomplete closure of the seed furrow. These factors would result in a gap in a row where seedlings may be absent or only partially emerged.

How to distinguish environmental/planting issues from seedling diseases: Seedlings may exhibit aboveground injury from a frost, but roots should appear healthy. Planting issues will result in gaps or patchy emergence, but seedlings will appear healthy. Seedlings that die prematurely because of severe soil crusting may be difficult to distinguish from seedling blights in the field and require laboratory diagnosis.

Figure 9. (Top) Frost injury results in brown or gray discoloration on seedling tissue.
Figure 10. Uneven emergence can result from equipment or soil issues during planting and may resemble the symptoms caused by poor emergence due to seedling blight.

Table 1. Symptoms and distribution of common soybean seedling blights and disorders.

Cause	Seedling Symptoms	Field Pattern
Fusarium root rot	• Lack of secondary roots • Light to dark lesions on roots extending to hypocotyls	• Patchy
Rhizoctonia seedling blight	• Red-brown sunken lesions on hypocotyl	• Patchy or entire row sections • Can be severe in sandy soils
Phytophthora root rot	• Internal discoloration in lower stem cortex • Soft, water-soaked lesions	• Patchy • Most common in low-lying or compacted areas prone to flooding
Pythium seedling blight	• Rotting brown root tissue • Wilting • Soft, water-soaked lesions • Plants are easy to pull from the soil	• Patchy • Most common in low-lying or compacted areas prone to flooding
Fluopyram fungicide effects	• Yellow to brown necrosis near the tips and edges of cotyledons	• Uniform in field where fluopyram-treated seeds were planted • May be more severe where soils are cool and wet
Pre-emergence herbicide damage	• Speckled brown necrotic spots on cotyledons, hypocotyls, or trifoliate leaves	• Usually follow herbicide application patterns, but may be scattered if caused by splashing rain • Higher incidence in coarse soils
Environmental/Planting issues	• Water-soaked discoloration of hypocotyls and cotyledons	• Uniform or in low spots of field • Follows period of frost and/or unseasonably cold temperatures

General Management

The organisms that cause seedling diseases can survive in soil for a long time, and many are capable of infecting other agronomic crops such as alfalfa, corn, sugar beet, and wheat. Therefore, crop rotation may not effectively manage these diseases, and short rotations of crops between soybeans may allow seedling disease organisms to build to high levels in the soil.

Seedling diseases may be more prevalent in no-till or reduced tillage systems since these soils typically warm up slower in the spring and retain more moisture. In these systems, additional practices, such as fungicide seed treatment, may be needed to manage seedling diseases.

Fungicide seed treatments vary in efficacy, and products that control *Pythium* and *Phytophthora* diseases (such as ethaboxam, metalaxyl (-M), and mefenoxam) do not affect *Rhizoctonia* and *Fusarium* species. Similarly, fungicides that are active against *Rhizoctonia* and *Fusarium* have little effect on oomycetes.

Additionally, fungicides may be more or less effective depending on the pathogen strain, and in some cases, reduced sensitivity to fungicides can occur. Therefore, it is important to accurately diagnose the seedling blights present in a particular field and choose fungicide seed treatments accordingly.

Fungicide seed treatment efficacy guides are updated annually and available through the NCERA-137 soybean disease working group. For a current list, see *Diseases of Soybeans: Fungicide Efficacy for Control of Soybean Seedling Diseases* (Purdue Extension publication BP-163-W), available from the Education Store, www.edustore.purdue.edu.

Find Out More

To learn more about seedling diseases, visit the NCSRP Soybean Research Information and Initiatve (SRII) website (www.soybeanresearchinfo.com) or consult your land-grant institution. Other publications in the *Soybean Disease Management* series are available by visiting the SRII website or your land-grant institution's website.

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