Soybean Seedling Diseases

Soybean seedling diseases are often the cause of reduced stand and can cause significant economic losses on an annual basis. Diseased seedlings are often less vigorous and severe stand loss may require replanting of affected areas. Seedling diseases are often more prevalent when wet weather occurs soon after planting. They are also more common in compacted and poorly drained soils or in areas where seedlings have been injured from herbicides.

Diagnosing seedling diseases in the field can be difficult since the symptoms of various seedling blights are similar, and seedlings often decompose quickly (Figure 1). 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 these seedling diseases.

The soybean seedling diseases that are most commonly observed on soybean 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 can indicate the presence of seedling diseases.

Fusarium Root Rot (*Fusarium* spp.)

Many *Fusarium* species reside in the soil and can infect soybean. Infected plants may be stunted and spindly with brown or black lesions on the roots (Figure 2) and poorly developed root systems.

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

Rhizoctonia Seedling Blight (*Rhizoctonia solani*)

Rhizoctonia seedling blight is caused by the fungus *Rhizoctonia solani*. The characteristic symptom of Rhizoctonia seedling blight is a reddish-brown lesion on the lower stem or hypocotyl, usually at the soil level (Figure 3). Lesions on the diseased stem appear sunken (canker-like) and dry, and can girdle the hypocotyl.

This disease can occur over a wide range of soil conditions. Affected plants typically appear in patches or in rows in a field. Temperature and moisture requirements for infection and disease progression vary, although this disease tends to be common in warm and moist, but not saturated, soil. Stressed seedlings may be more vulnerable.

Phytophthora Root and Stem Rot (*Phytophthora* spp.)

Phytophthora root rot of soybean is caused by the oomycetes *Phytophthora sojae* and *P. sansomeana.* Infected plants appear alone or in patches (Figure 4).

The stems of Phytophthora-infected seedlings are typically mushy and water-soaked. Overall, infected seedlings will be wilted and stunted. These symptoms resemble those of many other seedling disease pathogens. *Phytophthora sojae* can also cause a stem rot of mature plants, characterized by chocolate brown stem lesions. Phytophthora root rot occurs across many environments, but is most common in warm (>60°F/15°C) and wet conditions.

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

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

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.)

Pythium, another group of oomycetes, contains multiple species that can cause soybean seedling blight and seed rot. Species of *Pythium* cause symptoms similar to *Phytophthora* species.

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).

Pythium seedling blight can occur across a range of temperatures, but high soil moisture increases the likelihood of disease and disease severity. Consequently, symptoms are most severe in poorly drained soils and areas prone to flooding. Recent research indicates that many *Pythium* species prevalent in the northern United States and Canada infect plants at a lower temperature range (50-77°F/10-25°C) than *Pythium* species in the southern United States (85-95°F/30-35°C).

Figure 5. Pythium seedling blight may kill seedlings prematurely.

Diagnosing Seedling Blights

Seedling diseases are difficult to correctly diagnose in the field, and are easily mistook for other problems (such as herbicide or environmental damage). In addition, seedlings may be affected by more than one seedling disease in a field at the same time.

For these reasons, we recommend sending injured soybean seedlings to a local diagnostic lab to confirm the cause before implementing a disease management program. Obtaining an accurate diagnosis is the first step in determining a management strategy. In addition, it may also be necessary to identify the species of organism (i.e. *Phytophthora sojae* vs. *Phytophthora sansomeana*) to customize management as fungicide efficacy and varietal resistance may vary depending on pathogen species.

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

Conditions With Similar Symptoms

Fluopyram Fungicide Effects

The fungicide fluopyram (ILEVO®, BASF) is marketed as a seed treatment to manage sudden death syndrome and soybean cyst nematode (SCN). Fluopyram can discolor soybean cotyledons in a way that can resemble disease or 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 on seedlings grown from ILEVO® treated seed; however, environmental conditions may affect symptom appearance and severity. Research conducted by several land-grant universities and the 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: Symptoms of fluopyram phytotoxicity will be consistent across seedlings treated with the fungicide and present on edges of cotyledons, but not on roots or stems.

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

Preemergence Herbicide Damage

Preemergence herbicides can damage soybean seedlings, particularly when cool temperatures coincide with rain shortly after seedlings begin to emerge from the soil. Preemergence herbicides, typically PPO-inhibitors or photosynthetic inhibitors (flumioxazin, metribuzin, saflufenacil, sulfentrazone), can injure plants growing in cold, wet soils. Soybean is typically able to metabolize these herbicides, but when plant metabolism slows due to stress (such as cold temperatures) herbicide injury can occur (Figure 7).

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

Preemergence herbicide injury is more likely to occur in sandy soils with low organic matter (OM) 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 preemergence herbicide damage from seedling diseases: Check spray application records to determine if a preemergence herbicide application occurred on the field in question. Symptoms of preemergence herbicide damage are typically consistent on all treated soybean, whereas seedling blights are observed in patches.

Figure 7. Symptoms of PPO-inhibitor herbicide damage on soybean seedlings.

Figure 8. Necrotic areas on leaves that are the result of preemergence herbicides splashing on leaves.

Environmental and Planting Issues

Frost or freeze damage is evident several days after occurring 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 can emerge (Figure 10).

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

How to distinguish environmental or planting issues from seedling diseases: Seedlings may exhibit above-ground injury from a frost event, but roots should appear healthy. Planting issues will result in gaps or patchy emergence, but seedlings present will appear healthy. Seedlings that are crusted over and die prematurely may be difficult to distinguish in the field from those that die due to seedling blights and therefore require laboratory diagnosis.

Figure 9. 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 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
Pythium seedling blight	• Rotting brown root tissue • Wilting • Plants are easy to pull from the soil	• Patchy • Most common in low-lying or compacted areas prone to flooding
Phytophthora root rot	• Rotting brown root tissue • Wilting • Plants are easy to pull from the soil • Internal discoloration in lower stem cortex	• Patchy • Most common in low-lying or compacted areas prone to flooding
Fusarium root rot	• Lack of secondary roots • Light to dark lesions on taproot and roots extending to hypocotyls	Patchy
Rhizoctonia seedling blight	Red-brown sunken lesions on hypocotyl	Patchy or entire row sections
Fluopyram seed treatment (ILEVO®)	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
Preemergence herbicide injury (PPO/ flumioxazin, metribuzin, saflufenacil, sulfentrazone)	Speckled brown necrotic spots on cotyledons, hypocotyls, or trifoliates	• Streaks or scattered • Usually follow herbicide application patterns, but may be scattered if caused by rain-splash • Higher incidence in coarse soils
Frost/freeze injury	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 many years, and most are capable of infecting other crops such as alfalfa, corn, sugar beet, and wheat, as well as weeds. Therefore, crop rotation may not effectively manage these diseases. Short rotations of crops between soybean may also 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 blights.

Fungicide seed treatments vary in efficacy, and products that control *Pythium* and *Phytophthora* diseases (such as ethaboxam, metalaxyl (-M), mefenoxam, and oxathiapiprolin), do not control *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 strain of fungus or oomycete, and in some cases, a strain may have reduced sensitivity to fungicides. Therefore, it is important to accurately diagnose the seedling blights present in a particular field, if possible, down to the species level, 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* (CPN-1020).

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