

Distinguishing among Common Fungal Diseases in Soybean

- It is important to diagnose the disease properly so that appropriate management practices can be applied for future plantings.
- Foliar symptoms of some soybean diseases can be very similar.
- Sudden death syndrome (SDS) and brown stem rot (BSR) are important soybean diseases, but are easily confused as foliar symptoms are very similar; however, internal pith browning only occurs in BSR.

The following diseases are caused by fungi that are present in crop residue and in the soil. In each case, wet weather and moist soil conditions favor infection and disease development. When present, foliar symptoms can be very similar and include chlorosis and browning of the tissue between the veins (Figure 1). These foliar disease symptoms can be hard to distinguish from early crop maturity and drought stress. However, as described below, there are many ways to distinguish among fungal soybean diseases.

Red Crown Rot

Red crown rot is caused by *Calonectria pyrochroa* (also known as *Cylindrocladium parasiticum*). This disease primarily occurs in warm-temperate regions such as the Southern United States. The fungus colonizes soybean roots 3 to 4 weeks after planting. Infection by red crown rot is favored by moderate soil temperatures.

Symptoms typically appear during or after pod set as interveinal chlorotic spots, which expand and turn brown. Defoliation, including loss of petioles, can occur within 2 weeks. Roots of infected plants appear black and the stem can be gray-brown to red-brown about 2 to 4 inches above the soil line. Bright red fungal structures called 'perithecia' form on the surface of stems, near the soil (Figure 2). Infestations of root-knot nematode or soybean cyst nematode along with the presence of red crown rot can result in a severe disease situation.

Stem Canker

Stem canker is caused by *Diaporthe phaseolorum* var. *caulivora* in the Northern United States and *D. phaseolorum* var. *meridionalis* in the Southern United States. Symptoms of both northern and southern stem canker first appear during the early reproductive stages as small, red-brown lesions. Initial lesions are usually found near a lower leaf node and expand lengthwise as the season progresses. Lesions caused by northern stem canker turn dark brown as they age, are 2 to 10 cm long, and eventually girdle the stem, causing wilting and plant death (Figure 3). Lesions caused by southern stem canker rarely girdle the stem. Foliar symptoms, including interveinal chlorosis and necrosis that appear as a result of a phytotoxin produced by

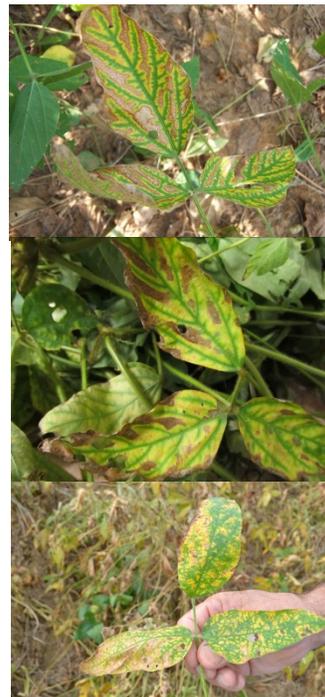


Figure 1. Stem canker (top, Terry Kirkpatrick, University of Arkansas), brown stem rot (middle, David Holshouser, Virginia Tech), and sudden death syndrome (bottom) foliar symptoms are caused by a phytotoxin and can appear very similar.



Figure 2. Soybean stems with bright red perithecia characteristic of red crown rot infection.



Figure 3. Stem infected with northern stem canker. Daren Mueller, Iowa State University, Bugwood.org

the fungus, are quickly followed by plant death. Top dieback with a characteristic curling or shepherd's crook of the terminal bud may occur.

Sudden Death Syndrome (SDS)

Sudden death syndrome is caused by *Fusarium virguliforme*. SDS is found across all soybean production regions in the United States and can be associated with compacted soils. Soybean cyst nematode may increase the incidence and severity of SDS. The fungus infects the roots and colonizes the base of the stem, sending toxins to the leaves. Symptoms of SDS may be seen during the soybean vegetative growth

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stages. However, they are most commonly seen during the early reproductive growth stages through pod fill. Leaflets on plants with severe foliar symptoms may detach from petioles. Unlike red crown rot, petioles remain upright and attached to the stem. Splitting the stem of a soybean plant with SDS will reveal a slight tan to light brown discoloration of the cortex, especially at the stem base, and a normal white to cream colored pith. Under moist conditions, plants with SDS may also display blue masses of spores on the tap root (Figure 4).



Figure 4. Soybean taproot with blue masses formed by the fungus associated with SDS. Initially, white spores appear which mature to blue or blue-green. (Dr. Steve Koenning, North Carolina State University).

Brown Stem Rot (BSR)

Brown stem rot is caused by 2 genotypes of *Phialophora gregata* (syn. *Cadophora gregata*). This disease is prevalent in the North Central United States. Genotype A causes severe foliar symptoms on soybean plants, while genotype B causes little or no foliar symptoms. Most commercial soybean products have resistance to genotype A. The infection is more severe during cool, rainy growing seasons and when the pathogen infects roots early in the season. Stem symptoms can begin to appear as early as the vegetative growth stages, while foliar symptoms are most evident around R4 growth stage. Vascular tissue and pith browning is a characteristic symptom of BSR (Figure 5). Browning starts at the root level and usually at the leaf nodes, and then as the disease progresses browning becomes more severe up the stem. Foliar symptoms consist of interveinal yellowing and browning of leaves. Affected leaves shrivel up, but remain attached to the stem. These symptoms can easily be confused with those of SDS. Plants can become stunted and may die prematurely. Severely damaged plants will have fewer pods, and limited seed number.

Summary

Fungi that cause red crown rot, stem canker, BSR, and SDS can be present in the soil or crop residue. Symptoms of these diseases are most severe when infection occurs early and with persistent wet weather conditions. Since foliar symptoms of these diseases look similar and initially develop during reproductive stages, an accurate diagnosis is critical for future management options. Distinct characteristic symptoms and geographic distributions can be used to correctly identify each disease:

Northern diseases - Northern stem canker, BSR, and SDS:

Distinguish between SDS and BSR by splitting the stem and looking at pith coloration. The pith will be discolored with BSR while the pith will be white with SDS.



Figure 5. Browning of the pith infected with brown stem rot.

Stem canker causes external stem lesions, whereas SDS and BSR will not.

Southern diseases - Red crown rot, Southern stem canker, and SDS:

Stem canker will have stem lesions start at a lower leaf node and expand longitudinally, whereas red crown rot lesions are located near the soil line.

The petioles of a soybean plant infected with SDS will remain upright and attached to the stem, while they will fall off when infected with red crown rot.

Sources:

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