

Distinguishing among Common Fungal Diseases in Soybean

- Symptoms of red crown rot, stem canker, sudden death syndrome (SDS), and brown stem rot (BSR) are similar and can be easily confused.
- Accurate diagnosis is critical to make management decisions and implement proper control measures.
- Some identification characteristics can be used to help decrease the incidence of misdiagnosis. A laboratory analysis may also be required to determine the cause of the disease.

These diseases are caused by fungi that are present in crop residue. 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. These fungal diseases have many different ways to distinguish which are described for each disease highlighted in this spotlight.

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 (77° to 86° F).¹ Symptoms typically appear during or after pod set as interveinal chlorotic spots expand and turn brown. Defoliation, including loss of petioles, can occur within two weeks. Roots of infected plants appear black and the stem can be gray-brown to red-brown 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). Red crown rot infested plants infected with root-knot or soybean cyst nematode, can result in a more 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 (Figure 3), are 2 to 10 cm long, and eventually girdle the stem, causing wilting and plant death. Lesions caused by southern stem canker rarely girdle the stem. Foliar symptoms, including interveinal chlorosis and necrosis, appear as a result of a phytotoxin produced by the fungus and often are quickly followed by plant death. Top dieback with a characteristic curling or shepherd's crook of the terminal bud may occur.



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



Figure 3. Stem infected with stem canker.

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 it can be associated with compacted soils. Soybean cyst nematode may increase the incidence and severity of



Figure 1. Foliar symptoms of stem canker (left), brown stem rot (middle), and sudden death syndrome (right) are caused by a phytotoxin and can appear very similar.

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SDS. The fungus infects the roots and the base of the stem, sending toxins to the leaves. Symptoms of SDS may be seen during the soybean vegetative growth 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 attached to the stem. Splitting the stem of a soybean plant infected with SDS will reveal a slightly 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 infected 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. (Picture courtesy of Dr. Koenning, North Carolina State University).

Brown Stem Rot (BSR)

Brown stem rot is caused by two genotypes of *Cadophora (Phialophora) gregata*. This disease is prevalent in the north central United States. The genotype A causes severe foliar symptoms on soybeans where as 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 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 moves up the stem as the disease progresses. 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. The severely damaged plants may have fewer pods, and limited number of seeds per pod.

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 during 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.
- 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:

¹Padgett, B. Red crown rot (*Cylindrocladium crotalariae*). LSU AgCenter. <http://text.lsuagcenter.com/> (7/1/2014).
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Koenning, S.R. 2000. Identification and management of mid- to-late season soybean stem and root rots. Soybean Disease Information Note 5. College of Agriculture and Life Sciences North Carolina State University.
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For additional agronomic information, please contact your local seed representative.

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Figure 5. Internal browning of the stem from brown stem rot.