

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 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. Fungal diseases have many differences which are described next.



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

Red Crown Rot

Red Crown Rot is caused by *Colonectria 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 three to four 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 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 above the soil line for two to four inches. 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 more severe disease situation.



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

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



Figure 3. Stem infected with stem canker: slight discoloration of the cortex is present and reddish brown cankers (at arrow) are evident.

northern and southern stem canker first appear during the early reproductive stages as small, red-brown lesions (Figure 3). 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 two 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 are often quickly followed by plant death. Top dieback with a characteristic curling or shepherd's crook of the terminal bud may occur.

*Monsanto employees may submit a sample to the disease diagnostic lab for further analysis. Find instructions for sample submission on the TDA web site.

Distinguishing among Common Fungal Diseases in Soybean

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 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 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 (Figure 4). Under moist conditions, plants infected with SDS may also display blue masses of spores on the tap root (Figure 5).



Figure 4. Stem infected with SDS: cortex has a slightly tan to light brown discoloration and a normal white to cream colored pith. (Picture courtesy of Dr. Shaner,



Figure 5. Soybean taproot with blue masses formed by the fungus associated with SDS. Initially starts as white spores and then mature to blue or blue-green. (Picture courtesy of Dr. Stephen 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 products have resistance to genotype A. The infection is severe during cool, rainy growing seasons and the pathogen infects roots early in the season. Stem symptoms appear at R2 growth stage, while foliar symptoms are evident around R4 growth stage. Vascular tissue and pith browning is a characteristic symptom of BSR (Figure 6). Browning starts at the root level and progresses up the stem as the disease progresses. Foliar symptoms consists interveinal yellowing and browning of leaves.



Figure 6. Internal browning of the stem on the left. (Picture courtesy of Craig Grau, University of Wisconsin)

Affected leaves shrivel up but remain attached to the stem. These symptoms easily can be confused with those of SDS. Plants can become stunted and may die prematurely. The severely damaged plants will have less number of pods, and limited number of seeds.

Sources: Westphal, A., Xing, L., Abney, T.S., and Shaner, G. 2006. Sudden Death Syndrome. Diseases of Soybean. Purdue Extension. Publication BP-58-W; University of Illinois Extension. 1997. Sudden Death Syndrome of Soybeans. University of Illinois Department of Crop Sciences Extension. Report of Plant Disease RPD No. 512; Yang, X.B. Midsummer soybean disease scouting. Department of Plant Pathology Iowa State University. Integrated Crop Management IC-496(19) July 10, 2006; Koenning, S.R. 2000. Identification and Management of Mid-to-Late Season Soybean Stem and Root Rot. Soybean Disease Information Note 5. College of Agriculture and Life Sciences North Carolina State University; Grau, C. 2006. Stem Canker of Soybean. University of Wisconsin Extension; Compendium of Soybean Diseases. Fourth Edition. 1999. APS Press. Robertson, A.E., Tabor, G. 2008. Soybean Brown Stem Rot. Iowa State University Extension. PMR 1004. Dorrance, A. E., and Mills, D. R. 2008. Brown Stem Rot of Soybean, Fact Sheet, Ohio State University Extension, AC-35-08; <http://ohioline.osu.edu/ac-fact/pdf/0035.pdf> (verified 6/14/13).

Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible. ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. Leaf Design® is a registered trademark of Monsanto Company. All other trademarks are the property of their respective owners. ©2013 Monsanto Company. AB050610; MEA070710; PLB061313.