# Identifying Common Soybean Diseases During Vegetative Growth

The potential always exists for a bacterial, fungal, or viral, disease to develop in a soybean crop. Potential yield loss related to a disease infection can be minimal or dramatic depending on the disease, the environment, time of infection, and the soybean product. Knowing the disease history of a field and keeping abreast of reported disease developments during the growing season can help one make important management decisions to help protect yield potential.

Many of the diseases caused by fungi or bacteria can overwinter on residue and with the right environment, infect the next soybean crop. Each fungal pathogen has its own method of dispersal. Some are spread by wind and others by splashing rain or water movement within the soil. Because of climatic conditions within an area, some fungi-caused diseases are unable to overwinter; however, the spores can arrive through the wind from areas where the disease can overwinter.

Overwintering bacteria can infect plants by entering through the stomates or plant wounds after spreading to plants from residue by splashing rain, wind-driven rain, irrigation, or from plant to plant by animals, humans, or mechanical means when foliage is wet. Bacterial diseases may also be seedborne. Viral diseases rely heavily on vectors such as aphids or thrips to infect a plant through their feeding habits; however, viral diseases can also be seedborne.

Seed treatments can help protect seed and seedlings from most seed and seedling diseases such as Pythium rot and Fusarium blight. Foliar fungicides, depending on the fungal disease and applied at the correct time based on the disease, can help protect yield potential. Scouting for insects that have the potential to vector viral diseases and applying a timely insecticide may help protect plants from becoming infected via insect feeding. Common soybean diseases throughout the North include the following:

## // Bacterial Diseases

### Bacterial Blight

Figure 1. Bacterial blight lesions on a soybean leaf.

*Identification, Characteristics, and Diagnosis:*

- Caused by the bacterium *Pseudomonas syringae* pv. *glycinea*.
- More prevalent during the early part of the growing season but can appear late.
- Late-season symptoms include the development of angular lesions that form from small yellow to brown leaf spots (Figure 1).
- Spots appear first in the mid to upper canopy.
- Spot centers turn dark reddish-brown to black and dry out.
- Tissue around the spots appears water-soaked and develops a yellowish-green halo.
- Dried out lesions drop from the leaf.
- Seeds may be shriveled and discolored.
- Overwinters in crop residue.
- Spread by wind-driven rain or splashing of water droplets, cultivation when foliage is wet, and moving wildlife.
- Bacterium enters plant through natural openings and wounds when leaf surfaces are wet.
- Favored by temperature range of 70 to 80°F.

*Management:*

- Consider planting soybean products with higher ratings for resistance or tolerance.
- Rotate to non-susceptible crops.
- Incorporate residue.
- Avoid cultivation when foliage is wet.
- Fungicides containing copper may provide control if applied early in the disease cycle.

## Bacterial Pustule

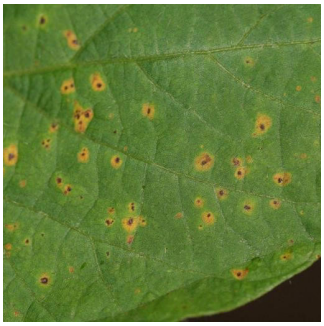

Figure 2. Bacterial pustule. Photo courtesy of Daren Mueller, Iowa State University. Bugwood.org

*Identification, Characteristics, and Diagnosis:*

- Caused by the bacterium *Xanthomonas axonopdis* (syn. *Campestris*) pv. *glycines*.
- Causes premature defoliation, reduced seed size, and reduced seed set.
- Initial symptoms include tiny pale green leaf spots with raised centers. Spots can be on either leaf surface but primarily on lower and are near main leaf veins (Figure 2).
- Later symptoms include the development of light colored pustules in the center of the spots.
- Pustules may have linear cracks across the top which are in contrast to the round openings that appear in soybean rust pustules. Additionally, bacterial pustules do not produce spores.
- In contrast to bacterial blight (*Pseudomonas syringae* pv. *glycinea*), water soaking is not present with bacterial pustule.
- Overwinters in crop residue.
- Spread by wind-driven rain or splashing of water droplets, cultivation when foliage is wet, and moving wildlife.
- Bacterium enters plant through natural openings and wounds.
- Favored by temperature range of 86 to 92°F.

*Management:*

- Plant resistant soybean products.
- Utilize tillage to help decompose residue.
- Avoid cultivation when plants are wet.

# Fungal Diseases

## Anthracnose

Figure 3. Anthracnose lesions on soybean stem. Picture courtesy of Daren Mueller, Iowa State University, Bugwood.org

*Identification, Characteristics, and Diagnosis:*

- Caused by the fungus *Colletotrichum truncatum*.
- Brown to black, irregularly-shaped lesions on stem, pods, and petioles (Figure 3).
- Premature defoliation can occur from petiole girdling.
- Infected pods may be filled with mycelium instead of seeds, or seeds may be fewer and/or smaller and can also be brown, moldy, shriveled, or normal in appearance.
- Dark spines or setae (acervuli) appear within lesions.
- Leaves roll and exhibit necrosis of veins between the major veins.
- Favors warm, wet, humid conditions.
- Infected seeds may fail to germinate.
- Infected seedlings develop dark, sunken cankers on the cotyledons, epicotyl, and radicle resulting in seedling damping off.

*Management:*

- Rotate host crops.
- Incorporation of infested residue.
- Plant pathogen free seed and/or treat seed with a recommended fungicide.
- Apply Delaro® 325 SC Fungicide. To learn more about Delaro® 325 SC Fungicide, please visit https://www.cropscience.bayer.us/products/fungicides/delaro and contact your retailer.

## Brown Stem Rot

Figure 4. Brown discoloration of soybean stem pith due to brown stem rot.

*Identification, Characteristics, and Diagnosis:*

- Caused by the soilborne fungus *Cadophora gregata*.
- Foliar symptoms occur when pods begin to fill, about R3 to R4 growth stages; however, infection occurs early in the season through the roots.
- Depending on environment and pathogen genotype, leaf necrosis may (genotype A) or may not (genotype B) occur along with vascular browning.
- A pathogen-produced toxin is believed to cause interveinal chlorosis and necrosis.
- Infected leaves remain attached to the plant.
- Pith of longitudinally split stems is dark, chocolate-brown (Figure 4).
- Favored by cool weather during pod fill and soil pH less than 6.5.

*Management:*

- Residue management through tillage can help reduce pathogen survivability.
- Crop rotation to non-host crops such as corn or small grains for a minimum of three years can help reduce the fungal population in the soil.
- Use of resistant soybean products.

## Cercospora Leaf Blight

Figure 5. Cercospora leaf blight.

*Identification, Characteristics, and Diagnosis:*

- Caused by the fungus *Cercospora kikuchii*.
- Usually noticed during reproductive growth stages.
- Light-to-dark purple areas develop on sun-exposed leaves and eventually cover entire leaf.
- Leaves become leathery, dark, reddish-purple, bronzed, and/or blighted (Figure 5).
- Infected pods may have a purplish discoloration.
- Fungus also causes purple seed stain.

*Management:*

- Apply Delaro® 325 SC Fungicide. To learn more about applying Delaro® 325 SC Fungicide, please visit https://www.cropscience.bayer.us/products/fungicides/delaro and contact your retailer.
- Earlier-maturing soybean products may not be infected.
- Individual soybean products may have higher tolerance levels.
- Rotate to non-host crops.
- Residue management through tillage can help reduce pathogen survivability.

## Charcoal Rot

Figure 6. Charcoal Rot.

*Identification, Characteristics, and Diagnosis:*

- Caused by the soilborne fungus *Macrophomina phaseolina*.
- Infection generally occurs within two to three weeks after planting when soils are wet; however, the disease becomes dormant unless hot, dry conditions occur during the growing season.
- During reproductive growth stages, developing leaves may be small, rolled, lose vigor, turn yellow, wilt, die, and remain attached to petioles.
- Infected plants may mature early and develop tiny black sclerotia that resemble charcoal powder beneath the epidermis on the lower stem, taproot, and pith (Figure 6).
- Black streaks may develop in the woody portion of the crown.
- Lower stems may appear silvery or light gray.
- Favored by light-colored soils under drought conditions. Infected plants may be noted first on field edges and ridges where soil is more prone to drought.

*Management:*

- Plant soybean products that have higher levels of tolerance or resistance.
- Plant early-maturing soybean products early to reduce the potential of plants achieving reproductive growth stages during typical high heat months.
- Plant a non-host crop for one to two years to help reduce pathogen population.
- Use conservation tillage and planting methods to conserve soil moisture.
- Maintain fertility.
- Avoid high seeding rates and if possible, irrigate to help reduce stress.
- Maintain good weed control to reduce stress.

## Downy Mildew

Figure 7. Downy mildew on soybean leaves.

*Identification, Characteristics, and Diagnosis:*

- Caused by a fungus-like organism, *Peronospora manshurica*.
- Infection occurs in the spring when oospores germinate and infect seedlings.
- Upper surfaces of young leaves develop pale-green to light-yellow spots which enlarge into pale to bright yellow lesions (Figure 7).
- White to gray fungal tufts develop on the underside of the lesion.
- Oldest lesions become grayish-brown to dark brown with yellowish-green margins.

*Management:*

- Plant resistant soybean products.
- Rotate with a non-host crop for one year or more.
- Rarely affects yield; therefore, foliar fungicides are not recommended.
- Residue management.
- Seed treatments can help protect seedlings from initial infection.

## Frogeye Leaf Spot

Figure 8. Frogeye leaf spot.

*Identification, Characteristics, and Diagnosis:*

- Caused by the fungus *Cercospora sojina*.
- Symptoms initially appear during reproductive growth stages as dark water-soaked lesions on younger leaves with centers that become ash-gray to light-brown.
- Later, the lesions become circular to angular with a purple to dark brown margin around the tan to gray center (Figure 8).
- On leaf undersides, the center of the lesions may have a dark black area where spores are being produced.
- Favored by warm (77 to 86°F) temperatures and prolonged periods of dew or light rain.

*Management:*

- Plant resistant soybean products
- Crop rotation and tillage to encourage residue decomposition can help reduce pathogen levels.
- Apply Delaro® 325 SC Fungicide. To learn more about Delaro® 325 SC Fungicide, please visit https://www.cropscience.bayer.us/products/fungicides/delaro and contact your retailer.

## Northern Stem Canker

Figure 9. Northern stem canker lesions on soybean stem, Brookings, SD, 9-13-11.

*Identification, Characteristics, and Diagnosis:*

- Caused by the fungus *Diaporthe phaseolorum* var. *caulivora*.
- Initial infection can occur around V3 growth stage at which point, seedlings can die quickly or survive and develop stem symptoms during pod set.
- Symptoms during reproductive growth stages appear as small reddish-brown spots on stems near a node within the canopy (Figure 9).
- Spots develop into long (1 to 3 inches) cankers running up the stem from the point of infection.
- Cankers can girdle the plant causing plant death from interrupted nutrient and water flow.
- On dead plants, the cankers are hard to distinguish from non-infected stem tissue. Plant death can occur from a fungus-generated toxin.
- Foliar symptoms appear during reproductive stages as yellowing between the veins, usually on one side of the leaf. Leaves turn brown, die, and remain attached to the stem.
- Pith of dead plants is light brown and stems can easily snap because of brittleness.
- Favored by cooler temperatures and extended periods of rain occurring early in the growing season.

*Management:*

- Plant resistant soybean products.
- Rotate to a non-host crop for two years to reduce pathogen population.
- Use tillage to help destroy infested residue.
- Applying a labeled fungicide at or before V3 infection may help protect plants.

## Septoria Brown Spot

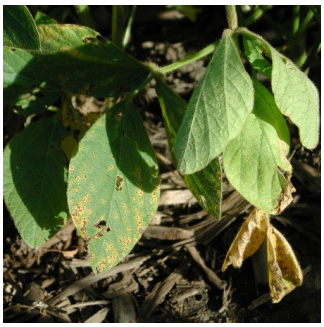

Figure 10. Septoria brown spot.

*Identification, Characteristics, and Diagnosis:*

- Caused by the fungus *Septoria glycines*.
- Irregular, dark brown lesions or spots that often have a surrounding yellow halo develop on lower plant leaves (Figure 10).
- Lesions can be small specks to 1/5 inch in diameter and coalesce to form larger spots.
- Defoliation can occur.
- Favored by wet weather and temperatures ranging from 79 to 83°F.

*Management:*

- Foliar fungicides are rarely justified; however, it may be economically justified if conditions are extremely favorable and the disease develops in the upper canopy. To learn more about applying Delaro® 325 SC Fungicide, please visit https://www.cropscience.bayer.us/products/fungicides/delaro and contact your retailer.
- Rotate to non-host crop for at least one year (avoid continuous soybean).
- If possible, improve field drainage.
- Planting later may reduce potential for saturated environment.

## Soybean Rust

Figure 11. Soybean rust.

*Identification, Characteristics, and Diagnosis:*

- Caused by the fungus *Phakopsora pachyrhizi*.
- Does not overwinter in most Midwestern areas. Spores are carried by wind currents from southern locations into the Midwest.
- Initial infection may appear as small brown or brick-red dots on the upper leaf surface (Figure 11).
- Later, raised pustules (viewable with a 30X lens), resembling small volcanoes, develop in angular lesions on the underside of leaves in the center and lower canopy. The pustules release spores through a central opening.
- Optimum conditions for infection include a minimum of six hours of leaf wetness (10 to 12 hours considered very favorable) and temperatures ranging from 70 to 80°F (infection can occur as low as 59°F).

*Management:*

- If local sentinel plots indicate a presence of soybean rust, scouting should be diligent and thorough, particularly in early-planted fields, early-maturing soybean products, low-lying or fields with prolonged wetness, and fields with early canopy closure.
- Apply Delaro® 325 SC Fungicide. To learn more about applying Delaro® 325 SC Fungicide, please visit https://www.cropscience.bayer.us/products/fungicides/delaro and contact your retailer.

## Sudden Death Syndrome

Figure 12. Sudden death syndrome of soybean.

*Identification, Characteristics, and Diagnosis:*

- Caused by soilborne fungus *Fusarium virguliforme*.
- Initial visual symptoms (infection usually occurs at seedling stage) appear as small yellow spots on leaves during reproductive growth stages.
- The spots progress to interveinal chlorosis (yellowing) and eventually, the leaf tissue dies.
- Leaves may fall prematurely, leaving petioles attached.
- The foliar symptoms are almost identical to those associated with brown stem rot.
- Roots are rotted, pith tissue remains white (Figure 12), and xylem (cortical tissue) is gray-to-brown. Under some conditions, a light blue spore mass may form on the tap root.
- More severe in the presence of soybean cyst nematode (SCN), and in low, wet field areas.
- Favored by cool, wet conditions and may be worse following corn as the pathogen also causes stalk rot.

*Management:*

- Plant soybean products with higher tolerance ratings. Earlier maturing products may have a lower potential for infection.
- Utilize soybean seed treatments.
- Delay planting until soil conditions are drier and warmer.
- Improve field drainage, reduce soil compaction, and manage SCN.

## Target Leaf Spot

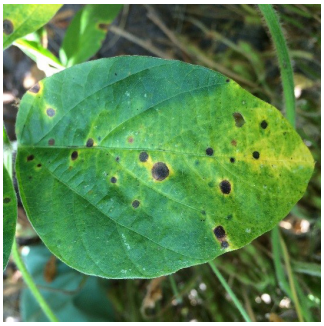

Figure 13. Target spot lesions on soybean leaf.

*Identification, Characteristics, and Diagnosis:*

- Caused by the fungus *Corynespora cassiicola*.
- Lower leaves develop small brown specks (spots) that are round to irregular with a possible yellow halo.
- Mature spots may be 3/8 to 5/8 inches or more in diameter. Some may have a zonate appearance (Figure 13).
- Areas of infection on stems and petioles are dark brown and range from specks to elongated lesions.
- Lesions developing on pods are circular, usually small (1/32 inch), and purple or black with brown margins.
- Favored by high humidity (greater than 80%) or free moisture. Dry conditions help suppress the disease.

*Management:*

- Plant tolerant soybean products.
- Reduce surface residue through tillage.
- If possible, avoid planting back-to-back soybean crops.
- Fungicides are not recommended because of a low potential for yield reduction.

## White Mold

Figure 14. Wilting in top of soybean canopy due to white mold.

Figure 15. White mold growth on soybean stems.

*Identification, Characteristics, and Diagnosis:*

- Caused by the fungus *Sclerotinia sclerotiorum*.
- Germinating sclerotia (small, hard, black fruiting structures) near the soil surface produce small tan-to-gray mushroom-shaped structures that produce spores which spread by wind and infect dead soybean flowers.
- During or after flowering, lesions develop at stem nodes.
- Lesions become larger (3 to 18 inches long), tops of plants turn grayish-green, wilt, and die (Figure 14).
- Stems become soft, watery, and covered with white mold (Figure 15).
- Dry, dead stems may have a bleached, white appearance.
- Hard, black fungal fruiting bodies (sclerotia) are produced on or inside stems and pods.
- Dead plants remain upright and may be scattered or in patches throughout infected field.
- Favored by moist soils, rainy weather, high relative humidity, cool (less than 85°F) conditions during flowering, reduced air circulation in fields with high populations and narrow rows, high fertility, and possibly earlier planting.

*Management:*

- Plant disease-free seed.
- Select soybean products that may have some level of resistance.
- Consider reducing seeding rates and utilize wider rows.
- If irrigating, reduce frequency during flowering.
- Sclerotia can remain viable for several years in the soil; therefore, long-term rotations to corn or other non-host crops may help reduce the potential for infection.
- Consider implementing biological controls such as Contans® WG.

# // Viral Diseases

## Bean Pod Mottle Virus (BPMV)

Figure 16. Bean pod mottle virus symptoms on soybean leaf. Picture courtesy of Edward Sikora, Auburn University, Bugwood.org.

*Identification, Characteristics, and Diagnosis:*

- Vectored by the bean leaf beetle (BLB), *Cerotoma trifurcate* Förster.
- Foliar symptoms range from mild chlorotic mottling on upper leaves to puckering and severe mosaic in lower leaves (Figure 16).
- Delayed maturity or green stems are often observed near harvest.
- Seed coat mottling may be present.
- Virus overwinters in BLBs seedlings as the beetles feed.
- Plant infection by BPMV and soybean mosaic virus (SMV), vectored by soybean aphid (*aphis glycines Matsamura*), may cause severe dwarfing, foliar distortion, leaf necrosis, leaf mottling, and severe yield loss.

*Management:*

- Managing emerging and first-generation BLBs in the spring with timely and labeled insecticides can reduce populations of the virus laden insects.
- Controlling alternative BPMV hosts (cowpea (*Vigna unguiculate*), other bean species, and *Demodium* species) can help reduce the inoculum source.
- Delayed planting may increase early-season death of BLBs, reducing vectoring population.

## Soybean Mosaic Virus (SMV)

Figure 17. Soybean mosaic virus symptoms. Picture courtesy of Daren Mueller, Iowa State University, Bugwood.org

*Identification, Characteristics, and Diagnosis:*

- Aphids are a primary vector.
- A green/yellow mosaic pattern is the most usual initial symptom on leaves (Figure 17).
- More mature leaves may exhibit a yellow/brown mosaic pattern.
- Premature defoliation is common.
- Infected seeds exhibit a brown or black mottling.
- Spread from plant to plant by soybean aphid (*aphis glycines* Matsamura) feeding.
- Plant infection by SMV and bean pod mottle virus (BPMV), vectored by bean leaf beetle (*Cerotoma trifurcate* Förster), may cause severe dwarfing, foliar distortion, leaf necrosis, leaf mottling, and yield loss.

*Management:*

- Seeds should be virus free.
- Plant resistant soybean products.
- Early planting may minimize aphid transmission at an early crop growth stage.
- Insecticide applications are not recommended because some insecticides may increase soybean aphid movement in the field, increasing the dissemination of the virus.

## Soybean Vein Necrosis Virus (SVNV)

Figure 18. Soybean vein necrosis virus, Galena, Maryland, 9-1-11.

*Identification, Characteristics, and Diagnosis:*

- Vectored by soybean thrips, *Sericothrips variablilis* Beach, and can also be transmitted by seed.
- Virus infection can occur throughout the growing season; however, symptoms are most visible after flowering, around mid-June.
- Initial symptoms appear as thread-shaped vein clearing along the main leaf veins; severe infections may result in purple to dark brown lesions across most of the leaf (Figure 18).
- Veins become yellow and necrotic as growing season progresses.
- Several areas on a leaf may have lesions.
- Early lesions lack defined edges.
- Highest canopy leaves are most affected because emerging leaves are prime feeding sites for soybean thrips.
- Favors cool temperatures and mild winters followed by warm spring which may help increase thrips population.

*Management:*

- Control of soybean thrips with timely and labeled insecticides.
- Control of alternate virus hosts, ivyleaf morning glory (*Ipomoea hederacea* Jacq), cowpea (*Vigna unguiculate*), and mung bean (*Vigna radiata*) can help reduce inoculum source.

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