

MISSOURI

Soybean Disease Field Guide



MISSOURI
SOYBEANS



The Missouri Soybean Merchandising Council is a statewide organization growing opportunities for Missouri soybean farmers. The Merchandising Council, led by a group of farmer volunteers elected by their peers, works to improve the bottom line for soybean farmers through a combination of research, outreach, education and market development efforts made possible through the soybean checkoff.

This guide highlights significant soybean diseases and management practices for each, as determined through soybean checkoff-supported research. This resource is intended to help accurately identify, treat and prevent the occurrence of these diseases in soybeans.

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CONTRIBUTOR RECOGNITION

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DISEASE MANAGEMENT PRACTICES

Diseases can and do cause substantial economic losses for Missouri soybean farmers; however, implementing some simple integrated disease management practices can help minimize those losses. Several major diseases, including frogeye leaf spot, may be controlled with resistant varieties or fungicides once the disease is detected in the field. Other diseases, such as sudden death syndrome and charcoal rot, may only be prevented at or before planting by using resistant varieties, seed treatments or cultural practices such as crop rotation. With these diseases, there are no in-season management options once symptoms are present in the field. To prevent disease from reducing your soybean yields, consider implementing these best management practices:

✓ **Planting resistant varieties**

Disease-resistant soybean varieties are the first line of defense against diseases that rob soybean fields of yield. Selecting varieties that are resistant to disease reduces the need for fungicide applications, which also decreases your costs.

✓ **Using a seed treatment**

Seed treatments can be a relatively inexpensive line of defense against soybean disease, especially when soybeans are planted into wet

soils. However, not all seed treatments are created equal. Use a seed treatment that controls a broad range of diseases and addresses the problems of a particular field for best results.

✓ **Scouting and thresholds**

Regular scouting of your fields for disease is the only way to clearly identify disease problems.

If you spot a disease in the field, first consider the injury threshold before deciding to treat the disease. Soybeans can withstand a certain amount of stress while experiencing minimal yield loss.

Evaluating the level of disease can help determine if a treatment may be economical, before application.

✓ **Crop rotation**

Some pathogens and diseases survive in the soil from year to year in one form or the other.

Rotating to non-host crops helps prevent the buildup of large pathogen populations.

Follow the rotation recommendations of your local extension advisor or agronomist.

✓ **Appropriate fertilization, irrigation and drainage**

Over-application of fertilizer, too little drainage or over-irrigating can contribute to the development of disease.

MANAGING NEMATODES

Root-knot nematode and soybean cyst nematode are the most common and economically damaging soybean nematodes in Missouri. At the national level, nematodes cost U.S. soybean farmers more than \$1 billion in yield loss annually.

It is important to determine if nematodes are present in soils that will be planted to soybeans. A 2015 statewide survey found that 92% of samples collected from 62 soybean-producing counties in Missouri tested positive for soybean cyst nematode. The survey also found that 54% of farmers acknowledged they had never sampled their fields for soybean cyst nematode and only 34% of farmers reported they were aware of a soybean cyst nematode problem.

Symptoms of infection caused by nematodes and management practices to control nematode infestation are similar to the identification and management of other soybean diseases. Sampling for nematodes shortly after harvest or just prior to planting is imperative for determining management and/or treatment options. Plan to use the following best management practices to prevent nematodes from robbing your soybean yield:

✓ **Use resistant varieties and crop rotation**

Crop rotation and planting resistant or tolerant soybean varieties is the primary method of nematode control. Soybean cyst nematodes feed on soybeans and other legumes, so rotation with a non-host crop can reduce populations.

✓ **Sample your fields**

Soil samples analyzed by a diagnostic lab are the only way to determine level and type of nematode infestation. The best time to sample is immediately after harvest when nematode numbers are highest. The second-best time is just prior to planting soybeans. Soil sampling should ideally occur every three to five years in each field to monitor nematode levels.

✓ **Clean equipment**

Nematode-infested soil that remains on field equipment can transfer nematodes to a previously non-infested field, or can increase nematode numbers in fields that are already infested.

✓ **Scout your fields**

While you cannot see nematodes with your naked eye, you should still scout. Look for areas of the field with lower yields, as this could be an indication of a nematode infestation. Sample any fields you suspect are nematode infested.

✓ **Use nematicides or nematode-protectants only when economically beneficial**

While nematicides and nematode-protectants applied to seed or used in-furrow may reduce early-season root infection, it is important to remember they will not provide season-long control, and many not be economically beneficial.

SOYBEAN DISEASES

AND WHERE THEY AFFECT YOUR SOYBEAN PLANTS

1 VIRAL DISEASES

- Bean Pod Mottle Virus
- Soybean Mosaic Virus
- Soybean Vein Necrosis Virus

2 STEM DISEASES

- Anthracnose Stem Blight
- Brown Stem Rot
- Charcoal Rot
- Pod and Stem Blight
- Sclerotinia Stem Rot (White Mold)
- Stem Canker
- Sudden Death Syndrome

3 SEED, SEEDLING AND ROOT ROT

- Fusarium Seedling Blight and Root Rot
- Phomopsis Seed Decay and Seedling Blight
- Phytophthora Seedling Blight and Root Rot
- Pythium Seed Decay and Damping-Off
- Rhizoctonia Seedling Blight and Root Rot

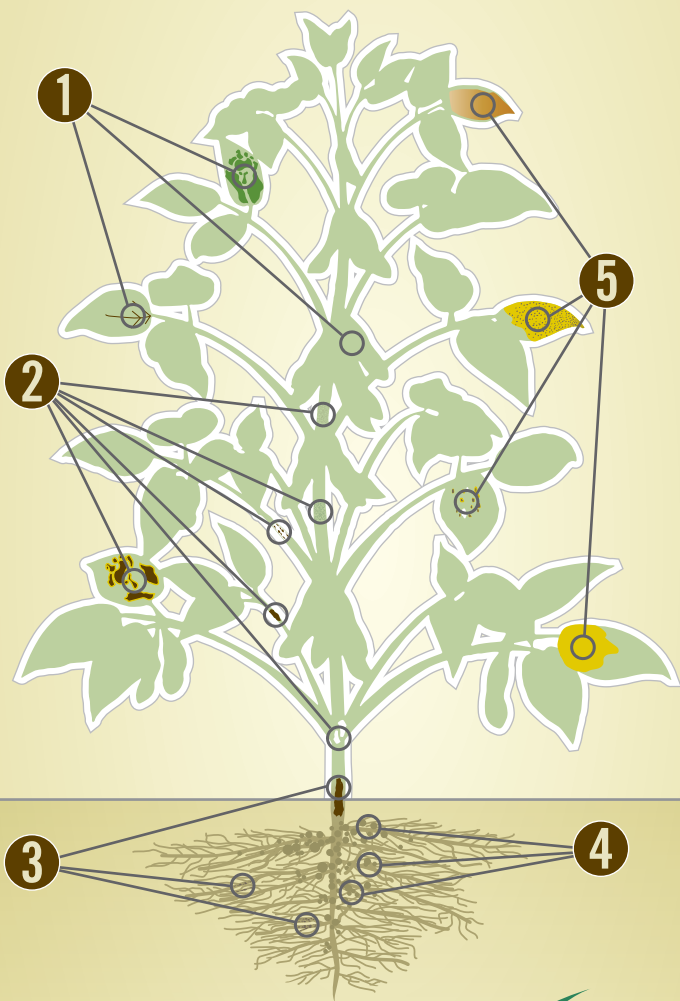
4 NEMATODES

- Root-Knot Nematode
- Soybean Cyst Nematode

5 FOLIAR DISEASES

- Bacterial Blight
- Cercospora Blight and Leaf Spot, Purple Seed Stain
- Downy Mildew
- Frogeye Leaf Spot
- Phyllosticta Leaf Spot
- Septoria Brown Spot

This is a list of the more common soybean diseases found in Missouri and is not comprehensive. Not all diseases may occur in each region.



To find out more about these and other soybean diseases, visit unitedsoybean.org.



BEAN POD MOTTLE VIRUS

Comovirus species

Type: Viral

Favorable conditions: Cool weather

When to scout: Bean pod mottle is most likely to appear during the soybean late vegetative (V) and early reproductive (R) growth stages and again during the soybean pod fill (R3-R6) stages. Bean leaf beetle is known to spread bean pod mottle virus, so be sure to scout when beetle populations are present.

Impact on yield: Yield loss averages about 16% in infected fields but has been documented as high as 52%. Greater yield loss may occur when plants are infected early in development.

Symptoms: Green to yellow mottled area may appear on leaves in the upper canopy. Symptoms may appear similar to herbicide drift injury and will be more apparent during periods of cool weather and rapid soybean growth. Young leaves will exhibit more severe symptoms than older leaves.

Symptoms of bean pod mottle virus are very similar to symptoms of soybean mosaic virus. Laboratory testing is necessary to accurately tell the difference.

Bean pod mottle virus is associated with green stem disorder, sometimes known as green stem syndrome, and can decrease pod formation and reduce seed size and weight. It may infect seed, which will cause discoloring and mottling on the seed coat.



*Photo credit: Martin Draper,
USDA-NIFA, Bugwood.org*

Management:

- Use foliar insecticides to control bean leaf beetle populations during the growing season
- Consider planting insecticide-treated seed if bean pod mottle virus has infected a field in previous years or if there is a history of bean leaf beetle presence in a field

SOYBEAN MOSAIC VIRUS

Type: Viral

Favorable conditions: Most likely to be introduced by planting infected seed. Can spread between plants by soybean aphid populations. Infection may be more severe when other diseases are present.

When to scout: It may be more frequently observed when soybean aphid populations are present in a field. Symptoms are most obvious during cooler temperatures.

Impact on yield: Yield losses average 8% to 35%; however, losses as high as 94% have been reported.

Symptoms: Plants infected with soybean mosaic virus have leaves with a mosaic of light and dark green patches, chlorosis and puckered or curled leaves. Plants may be stunted with fewer pods.

Symptoms of the soybean mosaic virus are similar to other soybean viral infections. Laboratory testing is necessary to accurately identify the disease present.

Management:

- Plant resistant varieties
- Plant disease-free seed
- Control soybean aphid populations



*Photo credit: Allen Wrather,
University of Missouri*

SOYBEAN VEIN NECROSIS VIRUS (SVNV)

Type: Viral

Favorable conditions: SVNV is vectored by thrips. Hot, dry weather that favors thrips may increase disease development.

When to scout: All season

Impact on yield: Unknown

Symptoms: Lesions begin as a yellowing chlorosis along the leaf vein. Yellowing will become red-brown, irregularly shaped lesions over time and will eventually lead to tissue death. Lesions spread from the edge of a vein and typically range from 1/4 inch to 1/2 inch in size, but may be larger. Veins may appear clear, yellow or dark brown on infected plants, with more noticeable discoloration on the undersides of leaves. Symptoms are not generally uniform across the leaves and are typically randomly distributed throughout the canopy.

Management:

- SVNV is a recently identified disease.
- Confirming SVNV infection must be done in a lab since it may resemble any other diseases, nutrient deficiencies or herbicide injury.
- Insecticide applications to control thrips are possible, but may yield no economic response for SVNV control.



*Photo credit: Kaitlyn Bissonette,
University of Missouri*

ANTHRACNOSE

Colletotrichum truncatum

Type: Stem

Favorable conditions: Warm, wet weather

When to scout: Near plant maturity (R7 to R8 growth stages)

Impact on yield: Generally, there is minimal loss in the Midwest. Infected pods may produce small seeds or no seeds. Harvest losses may occur if plants lodge due to severe infection.

Symptoms: Irregularly shaped brown to red-brown lesions on stems, petioles and pods, similar to symptoms caused by pod and stem blight. Small, raised black structures may be scattered on infected tissues. Be careful to not confuse anthracnose with pod and stem blight, in which infected plants exhibit small black specks organized into parallel rows. Symptoms on stem will be more severe if wet weather continues through harvest. Infected seeds either do not germinate or produce weak seedlings.

Management:

- Rotate crops with at least one year between soybean crops.
- Plant disease-free seed (pathogen may survive on infected seed).
- Use an appropriate fungicide seed treatment.
- Use of an in-season fungicide is rarely warranted, except in seed-production fields during seasons favorable for disease.



*Photo credit: Allen Wrather,
University of Missouri*

BROWN STEM ROT

Cadophora gregata

Type: Stem

Favorable conditions: Temperatures between 59 and 81 degrees Fahrenheit, particularly if the cool weather occurs around the time when plants transition to reproductive growth.

When to scout: Brown stem rot is not a widespread disease in Missouri, but scouting is beneficial during extended periods of below-normal temperatures around the beginning of reproductive growth.

Impact on yield: Yield losses of 10% to 30% are common, with 30% yield loss occurring in cases of severe infection.

Symptoms: Brown stem rot is characterized by a brown discoloration of the pith and vascular system in the stem, which can be observed when the stem is cut open. Foliar symptoms may develop, causing light green to yellow discoloration between veins, resembling sudden death syndrome. Upper affected leaves may turn brown and dry out.

Management:

- Plant resistant varieties.
- Rotate crops.



Photo credit: Daren Mueller, Iowa State University, Bugwood.org

CHARCOAL ROT

Macrophomina phaseolina

Type: Stem/Root

Favorable conditions: Hot, dry weather

When to scout: Charcoal rot may appear during early vegetative growth stages, but symptoms are more easily observed after flowering. Scout during early reproductive growth stages when weather conditions are hot and dry.

Impact on yield: Yield loss is highly variable, depending on the severity of disease, often ranging from 6% to 33% loss.

Symptoms: Infected plants will be less vigorous and will have smaller leaves. Leaves may turn yellow and wilt, eventually turning brown with a dry appearance.

Small black structures will develop on the lower stem and taproot, which will also have a silvery or light-gray discoloration. Epidermis may flake or shred off from the stem, giving the stem a tattered appearance. Black specks also may appear in stem tissue layers below the epidermis. A reddish-brown to blackish discoloration may be present if the stem and taproot are split open.

Infected seed will have low germination rates, and infected seedlings will die within a few days.



*Photo credit: Allen Wrather,
University of Missouri*

Management:

- Plant less susceptible varieties (please note that resistant varieties are not available).
- Add a small grain to crop rotation. Fungus will survive in soil during corn rotations, but small grains may reduce the amount of fungus in the soil.
- Avoid excessive seeding rates to reduce plant competition for moisture.

POD AND STEM BLIGHT

Diaporthe phaseolorum var. sojae

Type: Stem

Favorable conditions: Wet weather after flowering

When to scout: After flowering (R1 growth stage)

Impact on yield: Yield losses may be significant, depending upon varietal susceptibility and weather during maturity. Losses result from incomplete seed fill in infected pods.

Symptoms: The most characteristic feature of pod and stem blight are black specks (fungal spores) organized into parallel rows on mature soybean stems. Plants may also exhibit stunting and stem discoloration. Infection may result in poor seed quality. Seeds are more susceptible to infection if pods have insect damage. Seed infection can only occur if pods become infected. Pod infection can occur at or after flowering, but seed infection will not occur until pods begin to mature. Infected seed may be oblong in shape, shrunken or shriveled, and covered in white mold growth.

Management:

- Rotate crops with at least one year between soybean crops.
- Plant disease-free seed (pathogen may survive on infected seed).
- Use an appropriate fungicide seed treatment.
- Application of an in-season fungicide between the R3 and R5 growth stages may reduce stem and seed infection, which may improve seed quality but may not necessarily improve overall yield.



Photo credit: Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org

SCLEROTINIA STEM ROT

(White Mold)

Sclerotinia sclerotiorum

Type: Stem

Favorable conditions: Low to moderate temperatures (below 82 degrees Fahrenheit) and frequent rainfall, particularly around the R1 to R3 growth stages.

When to scout: It is not a widespread disease in Missouri, but scouting would be beneficial during extended periods of below-normal temperatures and frequent rainfall around the beginning of reproductive growth.

Impact on yield: Actual yield loss varies and depends on disease prevalence. Research has shown that yield losses of 2 to 5 bushels per acre for every 10% increment in Sclerotinia occurrence observed at the R7 growth stage.

Symptoms: Leaves in the upper canopy may first appear to have a wilted and gray-green (or moldy) appearance. Gray-green, water-soaked cankers may appear around nodes on the stem, eventually turning to brown, tan or bleached white with reddish-brown borders. White mold may be present on stems, and affected leaves may appear matted together.

As the disease progresses, small, black sclerotia may appear on stems, in the stem pith and on pods. Infected pods and seeds may have white mold growth.

Management:

- Plant resistant varieties.
- Plant disease-free seed.
- Rotate crops.



*Photo credit: Allen Wrather,
University of Missouri*

STEM CANKER

Diaporthe phaseolina

Type: Stem

Favorable conditions: Wet weather during early vegetative growth stages

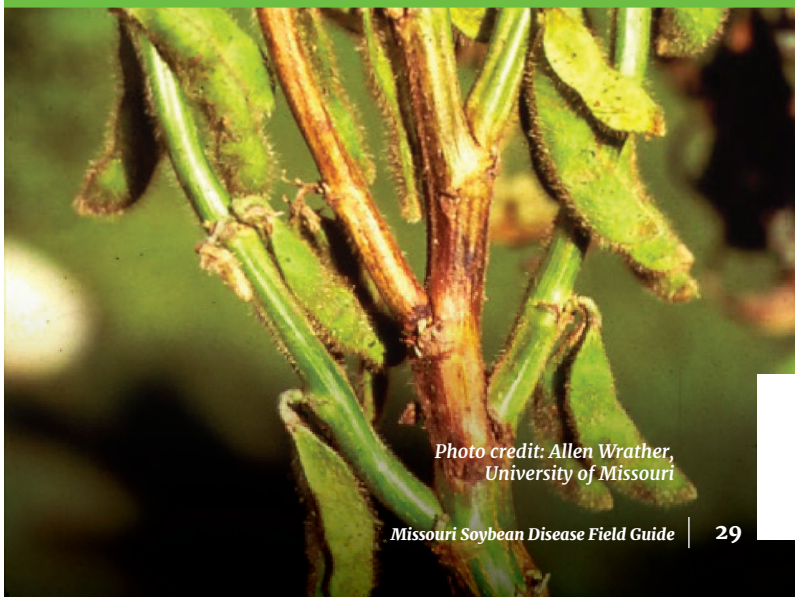
When to scout: Infection is most likely to occur early in vegetative growth stages, but symptoms may not appear until after flowering.

Impact on yield: Under favorable conditions, yield loss can be as high as 50% in susceptible varieties. Infections occurring earlier in the growing season are associated with higher yield losses.

Symptoms: Small, reddish-brown lesions may appear after flowering near nodes on the lower third of the stem. Lesions will expand over time and form sunken gray-brown to black cankers with reddish margins. Foliage may exhibit yellowing or browning between veins, similar to symptoms caused by brown stem rot and sudden death syndrome.

Management:

- Manage soybean residue. Incorporating residue into the soil by tillage may help reduce fungal spore survival and reduce future risk of infection.
- Plant resistant varieties.
- Rotate crops.



*Photo credit: Allen Wrather,
University of Missouri*

SUDDEN DEATH SYNDROME (SDS)

Fusarium virguliforme

Type: Stem, Root, Foliar

Favorable conditions: High soil moisture, via irrigation or rainfall, during vegetative growth stages; wet conditions and below-normal temperatures at or near bloom (R1 to R2 growth stages).

When to scout: Scout at the R4 to R5 growth stages, when symptoms are likely to appear. In some fields, symptoms may not appear until as late as R6.

Impact on yield: Reductions can range from 20% to 80% or more, depending on a variety of factors, such as severity of disease, variety resistance level, other pest pressure and weather conditions.

Symptoms: Symptoms are most evident after flowering. Yellow blotches appear on leaves between veins which increase in size. Leaf veins will remain green, with the yellow areas eventually turning brown. Severely affected leaves will dry out and curl and may fall from the plant, leaving the petioles intact.

When plants are dug up, the taproot and lateral roots may appear to have a light-brown discoloration. Infected plants may wilt and die prematurely.

As this pathogen lives in the soil, symptomatic plants are generally observed in patches in a field. Early detections can also appear as symptomatic plants in bands or streaks across a field resulting from soil movement via equipment.



*Photo credit: Kaitlyn Bissonette,
University of Missouri*

Management:

- Plant varieties that are less susceptible.
- Improve field drainage and reduce soil compaction.
- Delay planting until soils are warm and dry.
- Avoid additional crop stress when disease is present.
- Consider new seed treatment options for control or suppression of SDS.

BACTERIAL BLIGHT

Pseudomonas savastanoi

Type: Foliar

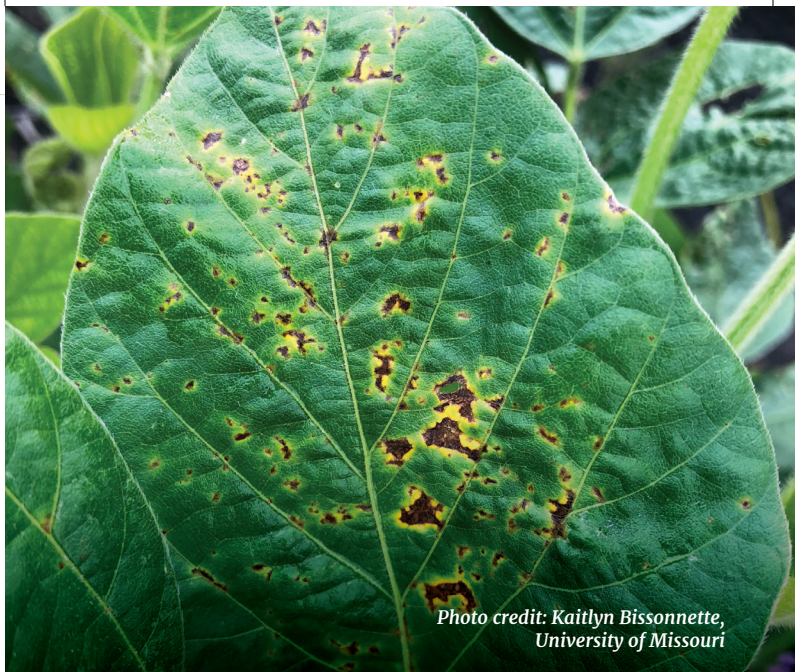
Favorable conditions: Cool, wet weather (70 to 80 degrees Fahrenheit) and cultivation when foliage is wet. Infections may follow rainstorms with high winds. Hot weather slows disease development.

When to scout: Mid-June through August

Impact on yield: Significant yield loss is uncommon, but seed quality may be affected. Though not typical, losses up to 40% have been reported in susceptible varieties during seasons favorable for disease development.

Symptoms: Small, angular, water-soaked spots appear on leaves. Lesions turn from yellow to brown to reddish brown as disease progresses. Spots may enlarge and merge, resulting in large, irregular dead areas in the leaf. Dead tissue will eventually drop out, giving the leaf a ragged appearance. Lesions do not typically cross leaf veins, and infected leaves usually remain on the plant.

Pods may also become infected, with small, water-soaked initial lesions that enlarge to cover most of the pod. Pods may turn brown to black. Infected seed may be shriveled, sunken and discolored or show no symptoms at all.



*Photo credit: Kaitlyn Bissonette,
University of Missouri*

Management:

- Plant disease-free seed.
- Rotate crops with at least one year between soybean crops.
- Do not cultivate when foliage is wet.
- Avoid highly susceptible varieties in areas where bacterial blight is common.
- Use of an in-season fungicide is not effective.

CERCOSPORA BLIGHT AND LEAF SPOT, PURPLE SEED STAIN (CLB)

Cercospora kikuchii and *Cercospora species*

Type: Foliar, Seedling/Seed Rot

Favorable conditions: Warm, humid weather

When to scout: Initial symptoms may appear around the R5 growth stage, when plants are beginning to set seed.

Impact on yield: It generally has a minor impact on yield in Missouri, but yield losses can increase the earlier the onset of disease symptoms. Seed quality may also be reduced.

Symptoms: Leaves that are in the upper canopy and exposed to sunlight may exhibit a purpling or bronzing appearance followed by yellowing that extends from the leaf tip to the base. Symptoms may appear during the R5 growth stage, as plants are beginning to set seed.

Cercospora leaf blight is more likely to develop after dry pod-fill conditions are followed by rainy weather. Symptoms may be found on the upper leaves, beginning with reddish-purple to reddish-brown lesions. Symptoms do not typically progress further than one or two nodes down. Premature yellowing of the youngest, uppermost leaves may be observed over large areas in the field. In severe cases, leaf drop can occur. Pods in the area of infection may develop round reddish-purple to reddish-brown lesions.

Purple seed stain occurs if the Cercospora fungus infects the seed. The seed coat will exhibit pink or purple discoloration, ranging from small specks to large blotches. Purple seed stain does not normally reduce yield; however, it may reduce seed grade.



*Photo credit: Kaitlyn Bissonette,
University of Missouri*



*Photo credit: Daren Mueller, Iowa
State University, Bugwood.org*

Management:

- Rotate crops.
- Avoid planting infected seed.
- Use an appropriate fungicide seed treatment when necessary.
- Application of fungicides to foliage at the R3 to R5 growth stage may minimize this disease.

DOWNY MILDEW

Peronospora manshurica

Type: Foliar

Favorable conditions: Cool (68 to 72 degrees Fahrenheit), humid weather, planting infected seeds and/or narrow row spacing

When to scout: All season

Impact on yield: Typically there is minimal loss — it may cause defoliation, reduce seed quality and significantly lower yields under ideal conditions for disease development.

Symptoms: Initial symptoms include pale green to light yellow spots or blotches on the upper surface of young leaves. Spots spread over the leaf as the disease progresses, enlarging into pale or bright yellow lesions of indefinite size and shape. Lesions eventually turn grayish brown to dark brown with a yellow margin. Severely infected leaves will turn yellow and then brown. Premature defoliation may occur.

During periods of dewy, humid or wet weather conditions, a gray to purple velvety mold may develop on the lower leaf surface beneath the diseased areas.

Infected seeds are encrusted with a white powdery coating of fungal spores and may be smaller in size and lighter in weight than healthy seeds.



*Photo credit: Kaitlyn Bissonette,
University of Missouri*

Management:

- Plant disease-free seed.
- Rotate crops with at least one year between soybean crops.
- Use a fungicide seed treatment.
- In-season fungicide is not usually needed.

FROGEYE LEAF SPOT (FLS)

Cercospora sojina

Type: Foliar

Favorable conditions: Warm, humid weather

When to scout: Scout at the beginning of the R1 growth stage, when plants begin to bloom. Young leaves are especially susceptible.

Impact on yield: Most reported losses are about 10%. Losses up to 30% are common in severe infections and as great as 60% in extreme cases.

Symptoms: Small, circular lesions develop on upper leaf surfaces. Lesions are initially dark and water-soaked in appearance. As lesions age, centers change to light brown to light gray in color. Older lesions have a light center with a darker red to purple-brown border. Lesions may merge and kill large areas of the leaf surface, causing these areas to drop out and give leaves a tattered or shot-hole appearance. Heavily spotted leaves usually wither and drop prematurely. Fields with high levels of frog-eye leaf spot may look brown and desiccated.

Later in the season, reddish-brown stem lesions may develop, becoming brown to gray in color as they age. Pods may also be affected, with reddish-brown circular to elongated lesions. Infected maturing seeds may show light or dark gray to brown discoloration on the seed coat.

Frog-eye leaf spot populations with resistance to strobilurin fungicides have been identified in Missouri.



*Photo credit: Kaitlyn Bissonette,
University of Missouri*

Management:

- Plant disease-free seed.
- Plant resistant varieties.
- Rotate crops with at least one year between soybeans.
- Consider applying an in-season fungicide in years when weather is especially favorable for disease development.

PHYLLOSTICTA LEAF SPOT

Phyllosticta sojicola

Type: Foliar

Favorable conditions: Cool, moist conditions

When to scout: All season

Impact on yield: Infection rarely impacts yield.

Symptoms: Circular, oval, irregular or V-shaped lesions will appear on leaves. Lesions appear gray or tan and have a dark, narrow margin. Older lesions may exhibit small black specks. Disease may progress to the petioles, stems and pods.

Management:

- Tillage will reduce survival of fungus in infested crop residue.
- Rotate crops.



Photo credit: Adam Sisson, Iowa State University Extension and Outreach

SEPTORIA BROWN SPOT

Septoria glycines

Type: Foliar

Favorable conditions: Warm, wet weather and splashing water. Disease progress slows in hot, dry weather.

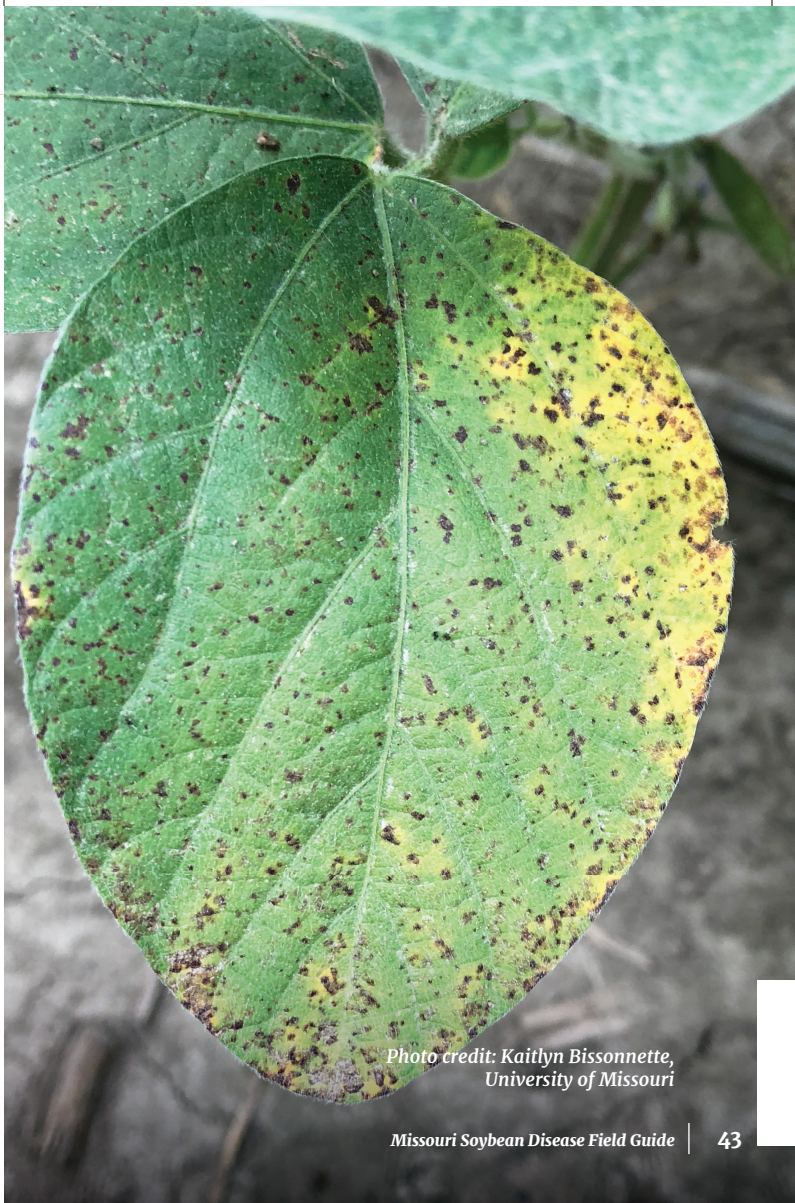
When to scout: All season

Impact on yield: Few economic losses are reported in Missouri from Septoria brown spot.

Symptoms: Septoria brown spot can begin at any point in the season in the lower canopy as small purple to brown spots. The affected leaves then turn yellow as the brown spots continue to develop and eventually the leaves drop from the plant. Assessing disease level can be difficult, as leaves often drop from the plant from one rating time to the next, giving the appearance of disease reduction. If warm, wet weather persists, disease can progress up the canopy and result in leaf drop.

Management:

- Rotate crops.
- Plant less susceptible varieties (please note that resistant varieties are not available).
- Application of fungicides to foliage at the R3 to R5 growth stages may slow disease development in the mid to upper canopy and/or protect yield.



*Photo credit: Kaitlyn Bissonnette,
University of Missouri*

FUSARIUM SEEDLING BLIGHT AND ROOT ROT

Fusarium species

Type: Seedling/Seed/Root Rot

Favorable conditions: Factors that could delay germination and emergence may include planting into crusted soils with hard pan layers, deep planting, poor seed quality, herbicide injury, hail damage, insect damage and poor fertility. Disease is most severe in conditions with saturated soils and soil temperature around 57 degrees Fahrenheit.

When to scout: Fusarium seedling blight will be observed around the time of emergence. Fusarium root rot may occur at any point during the growing season but is most common in seedlings and young plants.

Impact on yield: Yield losses specifically for Fusarium infection vary, depending on the severity of infection in combination with other diseases, such as soybean cyst nematode or Rhizoctonia root rot.

Symptoms: Fusarium seedling blight may cause uneven stands with skips in rows. Surviving seedlings may be stunted and weak. Roots and lower stem may be rotted with brown to black lesions on the taproot. Older plants may be off-color to yellow in appearance and may die if stressed by hot, dry conditions.

Fusarium is frequently discovered in combination with soybean cyst nematode or Rhizoctonia root rot infections.



Photo credit: Mary Ann Hansen, Virginia Polytechnic Institute and State University, Bugwood.org



Photo credit: Daren Mueller, Iowa State University, Bugwood.org

Management:

- Plant high-quality seed in good seedbed conditions.
- Use a fungicide seed treatment.
- Minimize or avoid stressors that may delay germination or emergence.

PHOMOPSIS SEED DECAY AND SEEDLING BLIGHT

Phomopsis species

Type: Seedling/Seed Rot

Favorable conditions: Cool, wet weather after planting

When to scout: This disease affects both the planted seed early in the season as well as the seed produced by the plant at the end of the season. After planting, scout during the emergence (VE) and cotyledon (VC) growth stages. Be sure to also scout plants before harvest (R8) for infected seeds.

Impact on yield: Yield losses specifically for Phomopsis infection vary, depending on the severity of infection in combination with other diseases. Profit loss is likely to occur with Phomopsis infection since harvested soybeans will be graded lower at sale due to symptoms causing seed discoloration, shriveling and splits.

Symptoms: After planting, infected seed will either not germinate or germinate more slowly than healthy seed. If the seed does emerge, the seed coat may stick to the cotyledons and have a white, moldy appearance. Seedlings that are severely infected may collapse and die.

Soybean seeds infected at harvest may be cracked, shriveled and/or covered with white mold, depending on the severity of infection. The infected soybean plant will exhibit symptoms of pod and stem blight, most apparent at maturity. Dead stems and pods may be covered with small black specks arranged in parallel rows on the stem or scattered on the pod, which are spores of the infecting fungus. Pods will likely be discolored and poorly developed.



*Photo credit: Daren Mueller,
Iowa State University, Bugwood.org*

Management:

- Harvest when seed reaches optimum moisture (13%), regardless of stem conditions.
- Rotate crops to reduce fungus survival in field.
- Applying fungicides to pods at flowering to late pod growth stages (R1 to R4) may reduce incidence of infection but is unlikely to increase yield.
- Plant disease-free seed and use an appropriate fungicide seed treatment.

PHYTOPHTHORA SEEDLING BLIGHT AND ROOT ROT

Phytophthora species

Type: Seedling/Seed/Root Rot, Stem

Favorable conditions: Warm, wet soil after planting, particularly in poorly drained, compacted or in clay or heavy soils

When to scout: Phytophthora can rot soybean seed before germination, kill seedlings just after emergence or cause seedling blight after seedlings appear to be established or even late in the season. Identifying an infection in the field in-season will be too late for treatment.

Impact on yield: Yield losses average around 10%, with severe infections potentially reducing yield by more than 50%.

Symptoms: Phytophthora may affect soybeans during several different growth stages. It may rot soybean seed before germination, with the infected seed turning soft and mushy and fuzzy in appearance, similar to the symptoms of Pythium. It may kill young seedlings just before or after emergence, with dark, reddish-brown to black lesions on the hypocotyls. Cotyledons and hypocotyls may turn brown or black with a wet, rotten appearance. Symptoms of Phytophthora-infected seedlings will eventually appear dry and stringy or shredded, similar to Pythium damping-off.

Phytophthora will cause seedling blight in established young seedlings, which will turn off-color to yellow, wilt and eventually die. Stems of the dead or severely stunted seedlings may exhibit a brown discoloration.

Symptoms of Phytophthora may not appear until late in the season, developing at flowering. Stem and root rot may develop in infected plants, with yellowing leaves and brown discoloration of the stem. Leaves will remain attached to the plant even after plant death.



*Photo credit: Allen Wrather,
University of Missouri*

Management:

- Improve field drainage and reduce compaction to avoid saturated soils at planting.
- Plant into good seedbed conditions.
- Plant resistant varieties.
- Use a fungicide seed treatment or apply fungicide at planting (metalaxyl or mefenoxam active ingredients are particularly effective).

PYTHIUM SEED DECAY AND DAMPING-OFF

Pythium species

Type: Seedling/Seed Rot

Favorable conditions: Wet, cool soils (50 to 59 degrees Fahrenheit)

When to scout: If present in the soil, Pythium can affect soybeans before or around the time of germination. Scout fields for Pythium while scouting for germination rates and stand. Discovering Pythium infection in-season will be too late for the current crop, unless replanting — then treated seed may be warranted.

Impact on yield: Losses as high as 30% have been recorded.

Symptoms: Infected seed becomes soft and rotten, decaying before germination. Diseased seed decomposes quickly and may be difficult to find in soil. Pythium may cause damping-off in surviving seeds, which kills the seedling just before or after emergence. Affected seedlings will have brown discoloration and soft, watery rot developing on hypocotyls and cotyledons. Seedlings will wilt, collapse and shrivel. Infected or dead seedlings may appear to be dry and stringy or shredded, similar to the symptoms of Phytophthora seedling blight.

Symptoms are more common in early-planted soybeans or soybeans planted into cool soil, ranging from 50 to 59 degrees Fahrenheit.



Photo credit: Alison Robertson, Iowa State University Extension and Outreach

Management:

- Plant high-quality seed into good seedbed conditions.
- Delay planting until soil temperature has surpassed 59 degrees Fahrenheit.
- Improve field drainage and reduce compaction to avoid saturated soils at planting.
- Use a fungicide seed treatment or apply fungicide at planting (metalaxyl or mefenoxam active ingredients are particularly effective).

RHIZOCTONIA SEEDLING BLIGHT AND ROOT ROT

Rhizoctonia solani

Type: Seedling/Seed/Root Rot

Favorable conditions: Heavy, poorly drained soils;
delayed emergence

When to scout: Rhizoctonia seedling blight may be discovered following delayed germination. Rhizoctonia root rot symptoms may be more severe in plants stressed by hot, dry conditions. Identifying Rhizoctonia infections in-season will be too late to treat the current crop.

Impact on yield: Yield reductions average 10%, but losses as high as 48% have been recorded.

Symptoms: Rhizoctonia can cause seed decay and pre-emergence damping-off, with red to reddish-brown discoloration and dry-rot decay. Seedlings infected by Rhizoctonia seedling blight will exhibit localized red to reddish-brown lesions on the hypocotyl. This is best observed immediately after plants are removed from soil. Leaves may be off-color to yellow in appearance, and root systems will be poorly developed. Plants usually survive but may be stunted in growth, resulting in uneven stands. Symptoms will be more severe during periods of drying winds or warm to hot weather.

Older, infected plants will have yellowing leaves, commonly resembling a potassium deficiency. Plants will be stunted and appear to be less vigorous than surrounding healthy plants. Root systems will be poorly developed, with discolored or rotting lateral roots. The stem may have a brick-red discoloration.

Rhizoctonia is frequently discovered in combination with soybean cyst nematode or Fusarium root rot infections.



*Photo credit: Allen Wrather,
University of Missouri*

Management:

- Plant high-quality seed in good seedbed conditions.
- Use a fungicide seed treatment.
- Minimize or avoid stressors that may delay germination or emergence.

ROOT-KNOT NEMATODE

Meloidogyne incognita

Type: Nematode

Favorable conditions: Infested soils; most commonly in southeast Missouri soybean fields, but presence has been confirmed in central areas of Missouri.

When to scout: Infection can appear any time during the growing season. Take soil samples in fields regularly to determine the presence and severity of existing populations.

Impact on yield: Yield losses depend on the severity of infestation, normally averaging around 10%.

Symptoms: The characteristic symptom of root-knot nematode is galling or swelling on the root system. Above-ground evidence of infestation may be exhibited as yellowing, wilting or stunted plants. Affected plants will typically be in patches that may be associated with equipment movement or water flow.

Management:

- Sample soil regularly to determine presence and severity of infestation.
- Plant resistant varieties.
- Include non-host crops in crop rotation, keeping in mind that root-knot nematode can infect and cause significant damage in corn.



*Photo credit: Allen Wrather,
University of Missouri*

SOYBEAN CYST NEMATODE (SCN)

Heterodera glycines

Type: Nematode

Favorable conditions: Infested soils

When to scout: Infection can appear any time during the growing season. Take soil samples regularly to determine presence and severity of existing populations.

Impact on yield: Reductions depend on severity of infestation, but yield losses of 30% or more are commonly observed in heavily infested fields, even in the absence of symptoms.

Symptoms: Depending on the severity of infestation, symptoms can range from no obvious symptoms to major yield loss due to stunted or dead plants. Plants infected with SCN may have yellowed leaves, similar to symptoms caused by herbicide injury, nutrient deficiencies and root diseases. Plants may also have poorly developed root systems with white females or brown cysts attached to roots.

SCN symptoms may be more severe if the infected plant is subjected to other stresses, such as herbicide injury, insect damage, drought stress, nutrient deficiencies or other diseases.

Management:

- Take soil samples regularly to determine if SCN is present and determine SCN egg counts.
- Plant resistant varieties.
- Rotate crops.
- Consider new seed treatment options for control or suppression of nematodes.



*Photo credit: Kaitlyn Bissonnette,
University of Missouri*

RED CROWN ROT

Calonectria ilicicola

Type: Root, Stem, Foliar

Favorable conditions: Warm, wet weather following early pod development

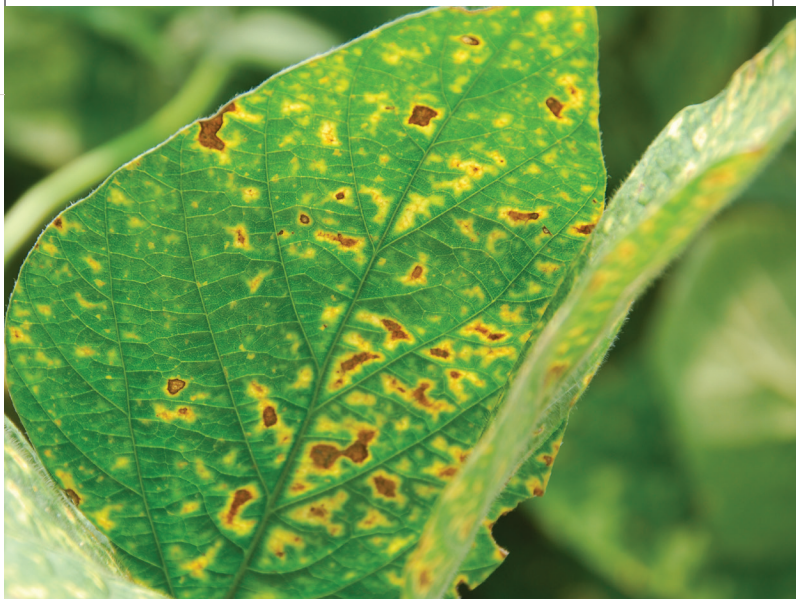
When to scout: Begin scouting starting at the R3 growth stage.

Impact on yield: Distribution in Missouri is currently unknown.

Symptoms: Interveinal chlorosis followed by necrosis, similar to soybean sudden death syndrome, begins in the early pod fill stages. The lower stem will also begin to become discolored and show the presence of white fungal growth near the soil line. When split open, the internal stem tissue may also appear discolored and browned. Plants will begin to die prematurely. Orange to red fungal growth will occur on the outer stem of affected plants that have died or are nearing death.

Management:

- Plant into warm, well-drained soil.
- Rotate crops and avoid rotations with peanuts.
- Manage soybean nematodes.



*Photo credit: Tom Allen,
Mississippi State University*

SOUTHERN BLIGHT

Athelia rolfsii

Type: Root, Stem

Favorable conditions: Warm, humid weather

When to scout: All season

Impact on yield: Distribution in Missouri is currently unknown.

Symptoms: Beginning at the lower stem near the soil line as a water-soaking appearance followed by wilting. Leaves become yellow and die, but often stay on the plant. At the stem base, there is often a fluffy white mass of fungal growth with small, round, tan to brown sclerotia.

Management:

- Rotate crops. Avoid a susceptible host for three or four years.
- Use deep tillage to bury sclerotia if necessary if infection is severe.



*Photo credit: Tom Allen,
Mississippi State University*

TAPROOT DECLINE

Xylaria species

Type: Root, Foliar

Favorable conditions: Warm, humid weather

When to scout: Beginning at the R1 growth stage through pod fill

Impact on yield: Distribution in Missouri is currently unknown.

Symptoms: Similar to soybean sudden death syndrome, symptoms first start as yellowing and tissue death between the veins (interveinal chlorosis and necrosis) beginning in the early reproductive stages through pod fill. Severely infected plants will easily snap off at the soil line, leaving roots in the ground. If dug up, the roots will be blackened in appearance, and frequently nearby at the soil surface, fungal structures often called “dead man’s fingers” will be present, which are signs of the pathogen.

Management:

- Rotate crops.
- Plant less susceptible varieties (please note that resistant varieties are not available).
- Research is ongoing to determine the impacts of this disease on soybean production in the state and region.



Photo Credit: Trey Price, Louisiana State University AgCenter

