

MU Guide

Soybean Disease Management

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Average soybean yields in Missouri increased slightly in the last decade primarily because of newer varieties with greater yield potential and more disease resistance. Unfortunately, yields are still reduced by diseases because no soybean variety has resistance to every disease. Diseases reduced soybean yields in Missouri by 15 percent in 1989, 6.7 percent in 1992 and 8.2 percent in 1995. This guide briefly describes the most serious soybean diseases in Missouri and outlines appropriate disease control strategies. Many of the controls described here are based on research conducted by University of Missouri scientists and funded by the Missouri Soybean Merchandising Council.

Overview

Recent losses in soybean yield would be lower if all farmers used three basic strategies to manage soybean diseases:

- Plant disease-resistant varieties.
- Rotate soybeans with other crops.
- Use fungicide seed treatments and foliar fungicides when necessary.

Resistance to all or most soybean diseases is not available with current soybean (*Glycine max*) varieties. However, newer varieties adapted to Missouri conditions often possess improved levels of disease resistance (Table 1). Farmers should select varieties because of yield potential (consult the most recent University of Missouri *Soybean Performance Report*) and resistance to locally important diseases. Table 1 includes information on resistance of some public varieties; seed companies can provide information about disease resistance of certain private company varieties.

Contributing specialists

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Many diseases can be avoided or controlled by rotating crops. Most of the organisms that cause soybean diseases need soybean plants in order to thrive and will die over time without them. For example, the population of most organisms that cause soybean diseases will decline greatly if corn is grown for 2 years after a soybean crop. Diseases of the next soybean crop will be less severe as a result.

Some of the organisms that cause seed and seedling diseases in Missouri soybeans can be carried on seed. Stands will be more uniform and vigorous and usually healthier when disease-free seeds are planted. The seed cleaning process will remove many of the small, shriveled seeds that carry disease-causing organisms.

Fungicide seed treatments help control seed and seedling diseases. Table 2 lists those fungicides registered for use on soybeans in Missouri. Fungicide seed treatments should be used when planting seeds that germinate poorly (less than 80% germination), when planting early and when planting into fields or parts of fields where the soil is wet.

Foliar fungicides such as Benlate, Bravo, Supanil, and Topsin M reduce the severity of certain late-season diseases. Table 3 presents guidelines for assessing the need for foliar fungicides.

Tillage can affect some diseases. In Missouri trials with double-crop soybeans, soybean cyst nematode, bacterial blight and brown spot seem to be less severe in no-till fields than in disk-till fields. Unfortunately, sudden death syndrome, Phytophthora root rot and stem canker can be more severe in no-till than in disk-till fields. When planting in reduced or no-till conditions, choose varieties with resistance to these diseases.

Accurate disease diagnosis is important and should always be completed before changing production practices. Whenever possible, consult your regional extension agriculture staff or the plant pathologist at the University of Missouri Plant Diagnostic Laboratory in Columbia, (573) 882-3018, for assistance in diagnosis and current disease management information.

Table 1. Disease resistance of some maturity group 3, 4 and 5 public variety soybeans.

Variety	Maturity group	Nematodes			Diseases			
		Root knot	SCN		SDS	Stem canker	Frogeye	Phytophthora
			Race 3	Race 14				
Charleston	3		S	S				
Flyer	3		S	S	S			R
Linford	3		R	R	M			T
Maverick	3		R	M				R
Resnik	3		S	S	R			R
Saline	3		R	R	M			S
Williams 82	3		S	S	S			R
Avery	4	R	R	R	R	R	R	T
Delsoy 4210	4	R	R	R	M	R		S
Delsoy 4710	4	S	R	R	M	R		S
Hamilton	4		S	S	R			T
Magellan	4		S	S				S
Manokin	4	R	R	S	R	R		S
Mustang	4		R	M	M			S
Clifford	5		S	S		S		
Delsoy 5500	5	M	R	M	M	R		
Hartwig	5	R	R	R	R	S		T
Holladay	5		S	S		R		S
Hutcheson	5	S	S	S	S	R	M	T

Key: R = resistant, T = tolerant, M = moderately resistant, S = susceptible, Blank space = resistance unknown.

Note: Ratings supplied by S. Anand, D. Sleper, G. Smith, P. Donald - Missouri University; P. Gibson - Southern Illinois University; and G. Sciombato - Mississippi State University.

These ratings should be used as a guide when choosing varieties. Disease pressure, environmental conditions and cultural practices may cause disease severity and damage to vary from location to location and year to year.

Seed and seedling diseases

Cause: Seedling diseases are caused by fungi (*Pythium*, *Phytophthora*, *Rhizoctonia*, *Fusarium*) that can act independently or together. These fungi live in soil wherever soybeans are grown. They can attack the seed before germination, as the seedling emerges or after it is established. Cool wet soils favor seedling diseases. The cool temperatures slow seed germination and seedling growth and favor the growth of many fungi that cause seedling diseases.

Symptoms: Dark brown or reddish lesions on the



Figure 1. Lesions on soybean seedling roots are a symptom of seedling disease.

root are evidence of seedling disease (Figure 1). Other symptoms include blackened and decayed lesions on the cotyledons, shriveled cotyledons, water-soaked primary leaves and soft stems. Seedling diseases can severely reduce stands, which in turn can result in reduced yields. The severity of seedling diseases has been shown to be greater in no-till fields.

Control: Factors that delay germination and seedling emergence, such as poor seed quality, improper planting depths, poor seedbed preparation and exposure to certain herbicides, enhance seedling diseases. The following techniques will help reduce seedling disease: plant high-quality seed, and treat the seed with a fungicide when planting in fields where seedlings are at greater risk of developing these diseases (Table 2). Seedlings are at greater risk in heavy silt or clay soils that hold water, in areas of a field where water collects or drains poorly, and in cool soil.

Root and stem diseases

Phytophthora root and stem rot

Cause: *Phytophthora sojae*, the fungus that causes Phytophthora root and stem rot, is present in most Missouri soybean fields. It can survive in the soil for long periods without the presence of soybeans. Phytophthora outbreaks are associated with periods

Table 2. Fungicides registered for use as soybean seed treatment in Missouri.

Fungicide			Diseases controlled			
Trade name ¹	Common name	Hopper box applied ²	Pythium seed rot	Early-season phytophthora	Seed and soil-borne diseases	Pod & stem blight of seedlings
Agrosol	captan + thiabendazole	Yes			X	X
Apron	metalaxyl	Yes	X	X		
Apron XL	mefenoxam	Yes	X	X		
Bean Guard	captan + carboxin	Yes			X	
Captan	captan	Yes			X	
Chloroneb	chloroneb	Yes			X	
Enhance	captan + carboxin	Yes			X	
Epic	biological	No			X	
Granox P-F-M	maneb + captan	Yes			X	
Nu-Flow AD	chloroneb + metalaxyl	No	X	X	X	
Nu-Gro Captan	captan	No			X	
Prevail	carboxin + PCNB + metalaxyl	Yes	X	X	X	
Protector-D	thiram	Yes			X	
Rival	captan + PCNB + thiabendazole	No			X	X
System 3	PCNB + metalaxyl + biological	Yes	X	X		
Thiram	thiram	Yes			X	
Vitavax	carboxin + thiram	Yes			X	

Notes:

¹ Trade names used here are for example only and do not imply endorsement or exclusion of other products by the Missouri Agricultural Experiment Station. Consult the Agricultural Electronic Bulletin Board for current lists.

² Consult label for method of proper application to seed.

of high soil moisture and with poorly drained clay soils. Infection and damage can occur at any soybean growth stage.

Symptoms: Symptoms of this disease include stand reduction caused by seed and seedling death, lesions on the stems and roots, and yellow leaves. During the summer, leaves on older plants that are infected become yellow between the veins, followed by a general wilting and death of the entire leaf. The withered leaves generally remain attached (Figure 2). Lower stems of these plants have dark brown lesions that may be several inches long extending up from the soil line. The disease may be more severe in no-till fields.

Control: Plant varieties with resistance or with known field tolerance to this disease and improve

drainage in fields, breaking hardpans if possible. Apply a seed treatment containing metalaxyl or mefenoxam (see Table 2) either alone or in combination with Ridomil (metalaxyl) or Ridomil Gold (mefenoxam) in-furrow at planting.

Fusarium root rot

Cause: Fusarium root rot is caused by various species of *Fusarium* fungi, which are present in most soils and survive from season to season on crop residues. They infect seed, seedlings and the roots and lower portions of soybean stems.

Symptoms: Infected seeds and seedlings may rot and die. Surviving seedlings may be stunted and wilt when soil moisture is low. Older plants are seldom killed by this fungus, but they wilt when soil mois-



Figure 2. *Phytophthora* root and stem rot may cause wilting and death of leaves, which generally remain attached to the plant.

ture is low. The disease often is more severe in early-planted soybeans and in clay soils.

Control: Plant high-quality seed in warm, well-drained soil. All varieties are susceptible and crop rotation is of little value in control.

Charcoal rot

Cause: Charcoal rot, caused by the fungus *Macrophomina phaseolina*, occurs worldwide and is common in the United States. The fungus has a wide host range and can infect soybean roots soon after emergence with no outward symptoms. Wilt and defoliation become noticeable when plants are under drought stress. Symptoms appear in hot, dry weather usually after flowering.

Symptoms: Charcoal rot is primarily a root rot, but symptoms may be seen on aboveground parts of infected plants from midseason to harvest. Infected soybean stems have many tiny black specks (sclerotia) that resemble a sprinkling of powdered charcoal just beneath the bark (Figure 3).

Control: Follow fertility programs that encourage vigorous plant growth, and avoid excessively high seeding rates. Research results from the University of Missouri Delta Center indicate that planting corn or cotton for 2 years will help reduce the population of this pathogen in the soil. Planting no-till has no apparent effect on the severity of charcoal rot.

Southern blight

Cause: Southern blight is caused by a fungus, *Sclerotium rolfsii*, that lives in soil and is common in clay soils of the southern United States. It has been observed on soybeans in the Missouri Delta. It attacks a wide range of crops and survives in the soil from year to year.

Symptoms: This fungus produces a variety of symptoms on soybeans, including death of seedlings just before or after emergence and lower stem rot. The fungus produces a white, cottony growth over the



Figure 3. In late summer, a light gray or silvery discoloration may be seen on lower stems of soybean plants damaged by charcoal rot, and the tissue beneath the bark may appear grayish black.

lower stem surface, which usually is visible in mid-summer. Round, tan to reddish brown or dark brown structures (sclerotia) about the size of mustard seeds eventually develop in the cottonlike growth.

Control: Rotate to less susceptible crops such as grasses between soybean crops.

Sudden death syndrome (SDS)

Cause: *Fusarium solani* f. sp. *glycines* is a fungus that lives in the soil and can infect soybean roots soon after emergence. The fungus grows in the roots and sometimes into the lower stem. When environmental conditions are appropriate, SDS symptoms develop on leaves, and young pods may abort. Leaf symptoms are sporadic and symptoms may occur in some fields but not in neighboring fields and may occur in one year but not the next. Yields may not be affected when foliar symptoms develop after pod fill. However, when symptoms develop during early bloom, pod abortion may occur and yield losses may be severe.

This disease is a problem in parts of Missouri, Arkansas, Illinois, Indiana, Kentucky, Mississippi and Tennessee.

Symptoms: Foliar symptoms of SDS appear from flowering to pod fill. The first symptoms are yellow areas between veins that become brown over time (Figure 4). Severely damaged leaves may defoliate prematurely and leave the petioles attached to the stem. Pod abortion can reduce yield. Dark streaks may be visible in tissue inside the upper root and lower stem. Lateral roots may be rotted. Symptoms are rare on double-crop soybeans. Planting no-till can increase the severity of the symptoms.

Control: There are no known control tactics for sudden death syndrome except to plant varieties that are resistant to leaf symptoms (Table 1). Available varieties are all susceptible to root infection.



Figure 4. The first foliar symptoms of sudden death syndrome are yellow areas between veins. These areas turn brown as the disease progresses.

Pod and stem diseases

Pod and stem blight

Cause: Pod and stem blight, caused by the fungus *Diaporthe phaseolorum* var. *sojae*, occurs in every soybean-producing area of the United States. The fungus overwinters on seed and on crop residue. This disease is favored by warm, humid weather during pod fill. Seed infection is more severe when harvesting is delayed.

Symptoms: Soybeans are infected early in the growing season, but symptoms on the pods and stems do not appear until the plants are mature. The most characteristic symptom of this disease is the presence of small black structures (pycnidia) arranged in linear rows on the mature stems or scattered on the pods.

Infected seed may be covered with white mold or may be dull, cracked, or shriveled. Such seeds are weak or dead. When planted, diseased seed often decay, resulting in poor stands.

Control: Plant disease-free seed, apply an approved fungicide seed treatment before planting (Table 2), rotate crops, apply a foliar fungicide to soybean fields when necessary (Table 3) and harvest promptly.

Stem canker

Cause: Stem canker, caused by the fungus *Diaporthe phaseolorum* var. *caulivora*, can occur throughout the United States. The fungus that causes the disease in southern states differs slightly from the fungus that causes the disease in northern states.

Symptoms: The disease usually appears in mid-July or early-August. Brown, slightly sunken lesions develop on the main stem at the base of branches or leaf petioles, and the branch eventually dies. Leaves on affected branches turn yellow between the veins and die. These leaf symptoms are similar to those of sudden death syndrome. Dead plants with leaves still

attached are characteristic of stem canker. Symptoms on the lower stem may be confused with *Rhizoctonia* root rot or *Phytophthora* root rot. This disease has been shown to be worse in no-till fields.

Control: Plant disease-free seed, apply a fungicide seed treatment before planting (Table 2), rotate soybeans with crops such as corn, milo, cotton or forages, and plant resistant varieties (Table 1).

Anthracnose

Cause: *Colletotrichum dermatium* var. *truncata* and *Glomerella glycines* are the two fungi that cause anthracnose. *Glomerella glycines* generally infects older plants. Both fungi overwinter either in infected seeds or in soybean residues. They spread from residue to healthy plants in the spring.

Symptoms: Both fungi produce similar symptoms. Reddish brown or dark brown areas develop on the infected stems and pods. Later, black structures develop on the plant. Stems, pods and leaves may be infected without showing external symptoms until weather conditions become favorable for further disease development. Like seeds infected with the the pod and stem blight fungus, anthracnose-infected seeds may be shriveled and moldy, or they may show no visible signs of infection.

Control: Plant healthy seed that has been treated with an approved fungicide (Table 2), apply foliar fungicides (Table 3) if needed and rotate soybeans with nonhost crops such as corn, milo, cotton or forages.

Foliar diseases

Brown spot

Cause: Brown spot is caused by a fungus, *Septoria glycines*, that overwinters in tissues of fallen leaves and stems. The fungus is common in most soybean fields, and it infects plants in the spring and early summer.

Symptoms: Small, red-brown, angular spots appear first on infected lower leaves in spring or early summer (Figure 5). Heavily infected leaves turn yellow and drop off. During warm, rainy weather the fungus spreads to other leaves and other plants. This disease is less severe in no-till fields.

Control: Plant disease-free seed, use seed treatments (Table 2), apply foliar fungicides when weather conditions favor the disease (Table 3) and rotate crops.

Downy mildew

Cause: The fungus, *Peronospora manshurica*, that causes downy mildew overwinters in infected leaf residues or in seed. The disease is prevalent on susceptible soybeans in wet seasons but usually does not cause severe damage.

Table 4. Point system to determine the advisability of spraying soybeans with a foliar fungicide.

<p>This table is intended to help growers decide whether a foliar fungicide should be used for disease control in soybeans. Note that foliar fungicides are not recommended for use when yield potential is less than 35 bushels per acre.</p> <p>Answer the following questions about 7 days after bloom begins and then add the points corresponding to your answers. For example, if you planted an early maturity group variety, record 5 points, and if you planted late, record 1 point. If the total from all questions is 18 or above, a fungicide should be applied. If the total is 16–17 points, a fungicide may or may not be profitable. If the total is 15 or less, a fungicide should not be applied.</p>	
<p>1. Variety maturity group^a?</p> <p>Late maturity group (MG) = 1 Medium MG = 3 Early MG = 5</p>	
<p>2. Planting date^b?</p> <p>Late = 1 Optimum = 2 Early = 3</p>	
<p>3. Field history?</p> <p>Disease not present last year = 0 Disease present last year = 2</p>	
<p>4. Crop will be kept for seed?</p> <p>No = 0 Yes = 4</p>	
<p>5. Cropping history?</p> <p>Other crops previous year = 0 Soybeans previous year = 2 Soybeans previous two years = 3</p>	
<p>6. Disease symptoms present at bloom?</p> <p>No = 2 Yes = 3</p>	
<p>7. Moisture?</p> <p>Flood irrigation after first bloom = 2 One day of wetness after first bloom (rain, dew, fog or sprinkle irrigation) = 3 Three days wetness after first bloom (rain, dew, fog or sprinkle irrigation) = 5</p>	
<p>Notes:</p> <p>^a Early = MG 3 in north Missouri and MG 3–4 in south Missouri, Medium = MG 4 in north Missouri and MG 4–5 in south Missouri, and Late = MG 5 in north Missouri and MG 6 in south Missouri.</p> <p>^b Late = June, Optimum = most of May, Early = April.</p>	

Symptoms: Early symptoms are indefinite yellow-green areas on the upper leaf surfaces. The spots enlarge become grayish brown to dark brown with yellowish green margins. A grayish mold develops on the underside of the leaves with symptoms. Severe infections may result in premature leaf drop. The fungus can spread to pods and infect the seed.

Control: Plant disease-free seed and treat with a fungicide before planting (Table 2), and rotate crops.

Bacterial blight

Cause: Bacterial blight, caused by *Pseudomonas syringae* pv. *glycinea*, is a common bacterial disease of soybeans in all areas where soybeans are grown. Although the disease is of limited importance in most production areas, it can cause some yield reduction under heavy disease pressure. The bacteria overwinter on soybean seeds and in infected plant residue and spread to seedlings during rainy weather.

Symptoms: Bacterial blight is primarily a leaf disease. Leaf symptoms begin as small, angular, water-soaked spots that turn dark reddish brown to black with age. Spots are surrounded by a yellow halo. Spots often merge to form irregular brown areas that may drop out, giving leaves a ragged appearance. The symptoms are most often seen before midsummer. Dry, hot weather stops the spread of this disease.

Control: Plant disease-free seed, and rotate crops.

Frogeye leaf spot

Cause: Frogeye leafspot, caused by the fungus *Cercospora sojina*, is sporadic but may be severe in wet

seasons. When a high percentage of leaves are heavily infected, serious yield loss can occur.

Symptoms: Young, expanding leaves are extremely susceptible, whereas fully expanded leaves are more resistant to infection. However, lesions are never seen on young expanding leaves because visible lesions develop nearly two weeks after infection. Leaves that expand during dry weather remain relatively free of disease.

The leaf lesions measure up to 0.2 inch in diameter, but they may merge to form larger spots. Young lesions have a gray to brown center with a distinct purplish to reddish brown margin. As lesions age, the center turns tan to nearly white and the margin darkens.

Control: Plant resistant varieties, rotate crops, and apply foliar fungicides when necessary (Table 3).

Virus diseases

Causes: Soybean mosaic, bean pod mottle and bud blight are the principal virus diseases affecting soybeans in Missouri. Soybean mosaic virus can be spread by seed and from plant to plant by feeding aphids. There is some evidence that bean pod mottle virus can be spread from plant to plant by certain beetles and that tobacco ringspot virus, which causes bud blight, can be spread by thrips.

Symptoms: Symptoms vary depending on the variety of the soybean and the strain of the virus. Stunted plants with crinkled and mottled leaves are characteristic of soybean mosaic. Yellow mottling of young leaves during periods of rapid growth is char-



Figure 5. Brown spot, a common disease in early summer, first appears as small, red-brown spots on lower leaves.

acteristic of bean pod mottle virus infection. Plants infected by tobacco ringspot virus are often stunted, and petiole and leaf growth are abnormal. Plants can be infected by two or more of these viruses.

Control: Plant disease-free seed.

Nematodes

Cause: Several nematodes attack soybeans, but soybean cyst nematode (SCN), *Heterodera glycines*, is the only one that has been a severe problem in Missouri. Root-knot nematode is a problem in some southeast Missouri fields.

Symptoms: The symptoms of SCN infection can be mistaken for symptoms of other soil problems, such as nutrient deficiency, drought and root rot. Consequently, it is important to know what to look for in diagnosing the problem.

The aboveground parts of affected plants are often stunted and may or may not have yellow-green leaves. The leaves may wilt in the midday summer sun more readily than those on healthy plants. These symptoms may develop in circular or oval areas in a field. Damage and yield loss can occur without visible symptoms.

Check the root system when the above symptoms

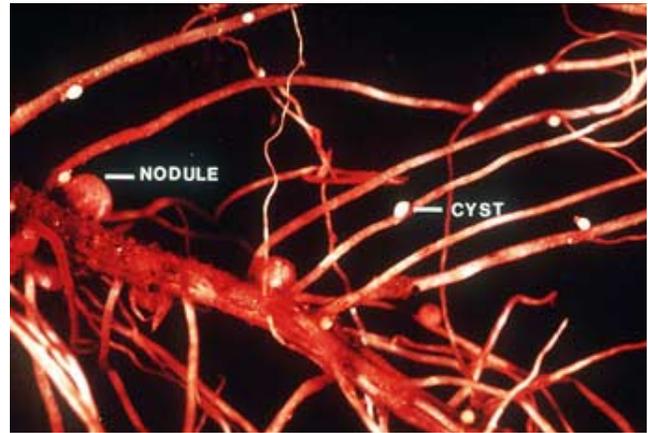


Figure 6. Soybean cyst nematode cysts and nitrogen-fixing nodules on soybean roots

are noticed. Cyst-infected roots are stunted and darker in color than health roots and have fewer nitrogen-fixing nodules. Attached SCN females may be visible as shiny white or yellow spherical bodies on the roots (Figure 6). The only sure way to confirm an infestation of SCN is to submit soil samples to a laboratory for nematode analysis.

Control: Plant resistant varieties, and rotate soybeans with corn, milo, cotton and certain forages. Nematicides such as Telone (preplant injected fumigant), Temik (in-furrow), or Vydate (in-furrow or preplant incorporated) are labeled for nematode control in soybeans but are generally not economical.

Root-knot nematode

Cause: Root-knot nematode (*Meloidogyne incognita*) is present in some southeast Missouri fields and occasionally causes damage.

Symptoms: Infected plants may be stunted and yellow-green, with a tendency to wilt under moisture stress during hot, dry weather. The disease can be identified by the presence of knots or galls of varying size and shape on the roots of infected plants.

Control: Plant resistant varieties, and rotate soybeans with milo and certain forages.

For further information

Fungicides registered in Missouri for use on soybeans

Agricultural Electronic Bulletin Board (AgEBB)

"Plant Disease Management Information"

modem: (573)882-8289

voice assistance: (573)882-4827

World Wide Web

www.ext.missouri.edu/agebb/

Soybean disease diagnosis

World Wide Web

www.missouri.edu/~agwww/AES/delta.html

Soybean cyst nematode

MU publication G4450, *Soybean Cyst Nematode: Diagnosis and Management*

University of Missouri *Soybean Performance Report*,
Agricultural Electronic Bulletin Board (AgEBB)



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