

PP1867

Soybean Disease Diagnostic Series

Samuel Markell
Associate Professor and Extension Specialist
Department of Plant Pathology
North Dakota State University

Dean Malvick
Professor and Extension Specialist
Department of Plant Pathology
University of Minnesota



UNIVERSITY OF MINNESOTA
EXTENSION

NDSU EXTENSION SERVICE

Root Diseases

Fusarium root rot	PP1867-1
Phytophthora root and stem rot	PP1867-2
Pythium root rot	PP1867-3
Rhizoctonia root rot	PP1867-4
Seed and seedling rot complex	PP1867-5
Soybean cyst nematode	PP1867-6
Sudden death syndrome	PP1867-7

Stem Diseases

Anthracnose	PP1867-8
Brown stem rot	PP1867-9
Charcoal rot.....	PP1867-10
Pod and stem blight.....	PP1867-11
Stem canker	PP1867-12
White mold.....	PP1867-13

Leaf Diseases

Bacterial blight.....	PP1867-14
Bacterial pustule	PP1867-15
Bean pod mottle virus.....	PP1867-16
Cercospora leaf blight.....	PP1867-17
Downy mildew.....	PP1867-18
Frogeye leaf spot	PP1867-19
Powdery mildew	PP1867-20
Septoria brown spot.....	PP1867-21
Soybean mosaic virus	PP1867-22

Additional Diseases (not known to occur in ND/MN)

Soybean rust	PP1867-23
--------------------	-----------

Cover photo: Sam Markell, NDSU

The NDSU Extension Service does not endorse commercial products or companies even though reference may be made to tradenames, trademarks or service names. NDSU encourages you to use and share this content, but please do so under the conditions of our Creative Commons license. You may copy, distribute, transmit and adapt this work as long as you give full attribution, don't use the work for commercial purposes and share your resulting work similarly. For more information, visit www.ag.ndsu.edu/agcomm/creative-commons.

**For more information on this and other topics, see
www.ag.ndsu.edu**

County commissions, North Dakota State University and U.S. Department of Agriculture cooperating. NDSU does not discriminate in its programs and activities on the basis of age, color, gender expression/identity, genetic information, marital status, national origin, participation in lawful off-campus activity, physical or mental disability, pregnancy, public assistance status, race, religion, sex, sexual orientation, spousal relationship to current employee, or veteran status, as applicable. Direct inquiries to Vice Provost for Title IX/ADA Coordinator, Old Main 201, NDSU Main Campus, 701-231-7708, ndsu.eoaa@ndsu.edu. This publication will be made available in alternative formats for people with disabilities upon request, 701-231-7881.



Fusarium root rot

Fusarium solani, F. oxysporum, F. tricinctum
and other *Fusarium* species (fungi)

Photo: B. Nelson, NDSU



Figure 1

Photo: Giesler, Univ. of Nebraska



Figure 2

Figure 3



Photo: J. Bienappf, Univ. of Minnesota

Figure 4



Photo: D. Mueller, Iowa State Univ.

Fusarium root rot

Fusarium solani, *F. oxysporum*, *F. tricinctum*
and other *Fusarium* species (fungi)

AUTHORS: Dean Malvick and Sam Markell

SYMPTOMS

- Brown to black discoloration and rot of roots, especially the taproot
- Plant stunting and yellowing of leaves may occur if root rot is severe
- Seedling damping-off

FIGURE 1 - Dark brown/black discoloration of roots

FIGURE 2 - Root rot and dieback of tap root

FIGURE 3 - Seedling damping-off

FIGURE 4 - Plant chlorosis

FACTORS FAVORING DEVELOPMENT

- Soil compaction
- Presence of soybean cyst nematode (SCN)
- Plant stress
- Drought

IMPORTANT FACTS

- Disease can infect and kill seedlings and damage older plants
- *Fusarium* survives for long periods in soil
- Dry edible beans, corn and pulse crops are hosts
- *Fusarium* is dispersed with soil (on equipment, in water, by wind, etc.)
- Management: improve soil drainage, reduce compaction, fungicide seed treatments
- Commonly confused with other root rots, SCN and iron deficiency chlorosis

Card 1 of 23



Phytophthora root and stem rot

Phytophthora sojae (oomycete)



Figure 1



Figure 2



Figure 3

Phytophthora root and stem rot

Phytophthora sojae (oomycete)

AUTHORS: Sam Markell, Dean Malvick and Berlin Nelson

SYMPTOMS

- Seeds may rot and/or seedlings may die before or after emergence (damping-off)
- Mid- to late-season symptoms include a chocolate brown stem lesion extending up from the soil line
- Leaf chlorosis, necrosis and plant wilting can develop
- Frequently occurs in patches of fields and low areas

FIGURE 1 - Close-up of lower stem lesion

FIGURE 2 - Lower stem lesion and wilting

FIGURE 3 - Severe infection in field

FACTORS FAVORING DEVELOPMENT

- Excessive moisture and/or flooding, especially early in the season
- Poorly drained, heavy clay or compacted soils
- Short/no crop rotation

IMPORTANT FACTS

- Can cause significant yield loss
- The pathogen is specific to soybeans
- Management tools available include genetic resistance and seed treatments
- The pathogen has many pathotypes and many can overcome Rps genetic resistance
- Commonly confused with other root rot diseases

Card 2 of 23



Pythium root rot

Pythium ultimum
and other *Pythium* species (oomycete)

Figure 1

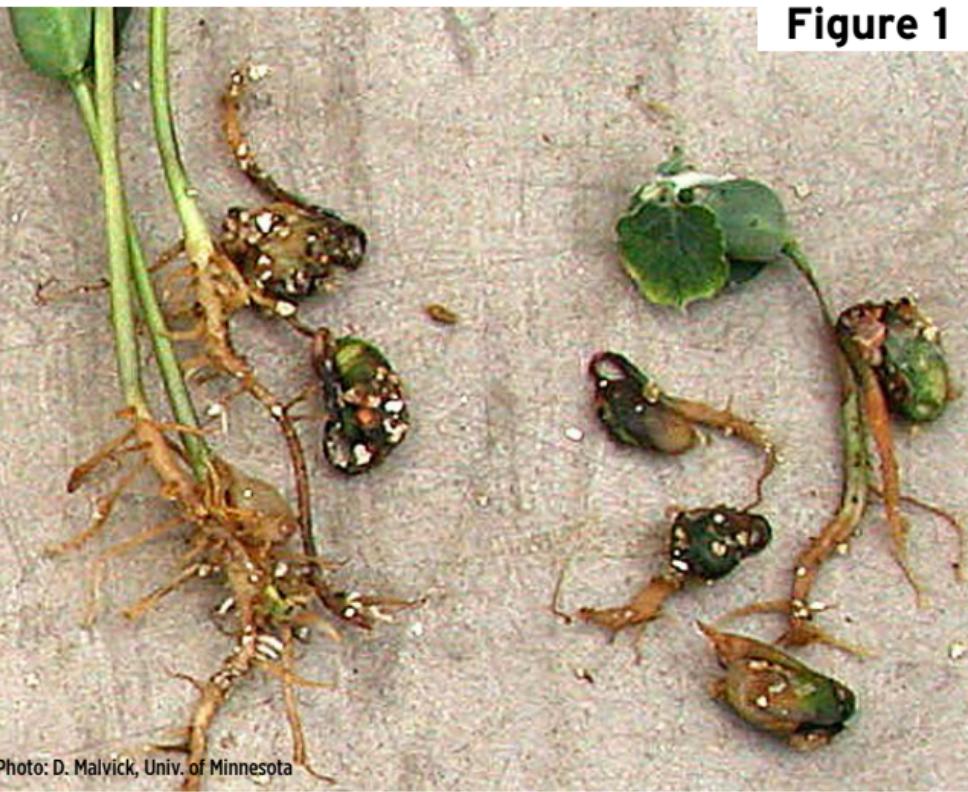


Photo: D. Malvick, Univ. of Minnesota

Figure 2



Photo: M. Chilvers, Michigan State Univ.

Figure 3



Photo: A. Robertson, Iowa State Univ.

Pythium root rot

Pythium ultimum
and other *Pythium* species (oomycete)

AUTHORS: Dean Malvick and Sam Markell

SYMPTOMS

- Soft, slimy rot of seeds in ground
- Light brown rot of outer part of roots (cortex)
- Damping-off of seedlings

FIGURE 1 - Seed rotting due to *Pythium*

FIGURE 2 - Damping-off of seedlings

FIGURE 3 - Light brown infected roots

FACTORS FAVORING DEVELOPMENT

- Persistent wet soil after planting
- Soil compaction, heavy soil with high clay content
- Slow growth of seedlings and plant stress

IMPORTANT FACTS

- *Pythium* survives for years in soil
- Pathogen may damage roots of older plants
- Dry edible beans, corn and other crops can be hosts
- *Pythium* is dispersed with soil (on equipment, in water, by wind, etc.)
- Management: improve soil drainage, reduce compaction, some seed treatments
- Symptoms on seed and seedlings very similar to *Phytophthora* damage
- Commonly confused with other seedling diseases



Rhizoctonia root rot

Rhizoctonia solani (fungus)

Photo: D. Malvick, Univ. of Minnesota

Figure 1



Photo: D. Malvick, Univ. of Minnesota

Figure 2



Photo: D. Malvick, Univ. of Minnesota

Figure 3



Rhizoctonia root rot

Rhizoctonia solani (fungus)

AUTHORS: Dean Malwick and Sam Markell

SYMPTOMS

- Rusty-brown, dry, sunken lesions on lower parts of stems
- Dark brown lesions than girdle the stems near the soil
- Plants stunted, yellow, and wilting

FIGURE 1 - Rusty-brown lesions on soybean stems

FIGURE 2 - Soybean seedlings with girdled stems

FIGURE 3 - Seedlings dying in a row

FACTORS FAVORING DEVELOPMENT

- Warm and moist soil while plants are in early vegetative stages
- Delayed planting in spring due to rain
- High soil organic matter
- Plant stress due to physical or chemical/herbicide injury

IMPORTANT FACTS

- Dry edible beans, corn, sugar beet and pulse crops can be hosts
- *Rhizoctonia* is dispersed with soil (on equipment, in water, by wind, etc.)
- Management: some seed treatments, crop rotation, tillage, early planting
- Soybean varieties vary in susceptibility to *Rhizoctonia*
- Commonly confused with other roots rots

Card 4 of 23



Seed and seedling disease complex

Pythium (oomycete), *Phytophthora* (oomycete),
Rhizoctonia (fungus), *Fusarium* (fungus)

Figure 1



Photo: D. Malvick, Univ. of Minnesota

Figure 2



Photo: D. Malvick, Univ. of Minnesota

Figure 3

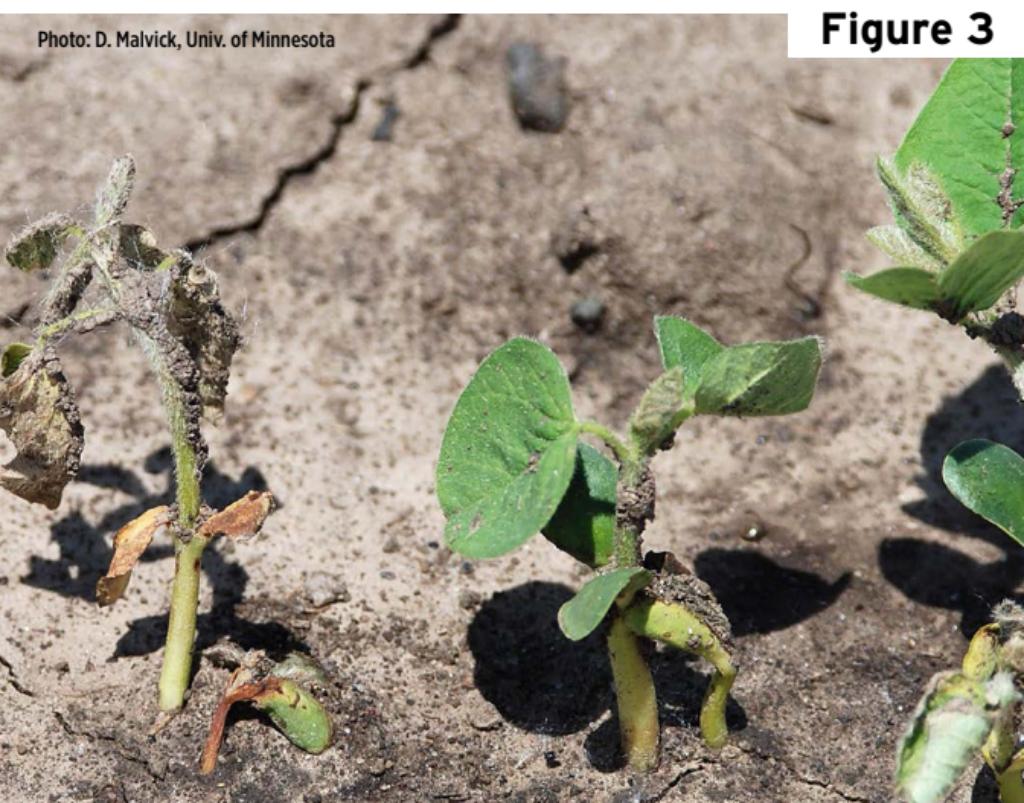


Photo: D. Malvick, Univ. of Minnesota

Seed and seedling disease complex

Pythium (oomycete), *Phytophthora* (oomycete),
Rhizoctonia (fungus), *Fusarium* (fungus)

AUTHORS: Dean Malvick and Sam Markell

SYMPTOMS

- Rotting of seed in the ground
- Pre-emergence death
- Post-emergence death and stunting
- Soft, tan roots with intact steel (*Pythium* and *Phytophthora*)
- Dark brown discoloration and rot of tap roots (*Fusarium*)
- Rusty-brown lesions on stem and roots (*Rhizoctonia*)

FIGURE 1 - Seedling decomposing due to infection

FIGURE 2 - Pre-emergence death of seedling

FIGURE 3 - Post-emergence death of seedling

FACTORS FAVORING DEVELOPMENT

- Wet soil
- Cool soil that delays germination and growth
- Poor-quality seed
- Plant stress

IMPORTANT FACTS

- Pathogens are favored by different conditions for infection and disease development
- Multiple pathogens often infect seeds/seedlings
- Difficult to diagnose principle pathogen
- Symptoms can look similar for different pathogens, but management may differ
- Management options: soil drainage, tillage, varieties with resistance, seed treatments
- Seed treatment ingredients vary in efficacy for different pathogens
- Commonly confused with water damage

Card 5 of 23



Soybean cyst nematode (SCN)

Heterodera glycines (plant parasitic nematode)

Photo: S. Markell, NDSU

Figure 1



Photo: S. Markell, NDSU

Figure 2



Photo: S. Markell, NDSU

Figure 3



Soybean cyst nematode (SCN)

Heterodera glycines (plant parasitic nematode)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- Small (approximately 1/32 inch) lemon-shaped female worms (cysts) on roots
- Cysts' color ranges from cream to dark brown
- Above-ground symptoms often are absent
- Soybeans can become stunted and yellow

FIGURE 1 - White SCN females (cysts) and a nodule on soybean roots

FIGURE 2 - Mature brown cysts

FIGURE 3 - Yellowed areas near field entrance caused by severe SCN

FACTORS FAVORING DEVELOPMENT

- Short crop rotation with soybeans and/or dry edible beans
- High soil pH, light soil texture
- Dry growing seasons

IMPORTANT FACTS

- SCN is the most yield-limiting disease in the U.S.
- SCN can make other diseases (sudden death syndrome, brown stem rot) worse
- Soybeans, dry edible beans and several weeds are hosts
- SCN is dispersed with soil (on equipment, in water, by wind, etc.)
- Soil sampling is the most reliable way to determine if you have SCN
- Management tools available include crop rotation, variety resistance and possibly seed treatments
- Commonly confused with root rots, iron deficiency chlorosis, other abiotic stress

Card 6 of 23



Sudden death syndrome (SDS)

Fusarium virguliforme (fungus)

Figure 1

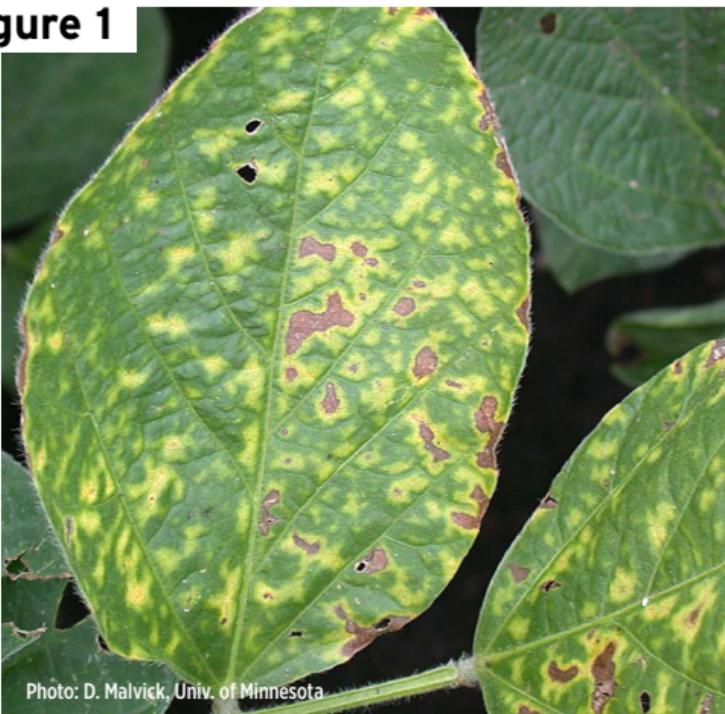


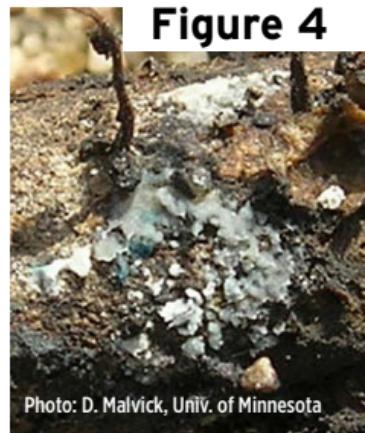
Figure 2



Figure 3



Figure 4



Sudden death syndrome (SDS)

Fusarium virguliforme (fungus)

AUTHORS: Dean Malvick and Sam Markell

SYMPTOMS

- Yellow and brown discoloration between leaf veins
- Tan stem under the epidermis near the soil line, while pith remains white
- Symptoms develop in plant seed fill stages (August)
- Leaflets can fall and petioles remain attached to plant
- Root rot and occasionally blue fungal growth on root

FIGURE 1 - (L) Internal stem browning; (R) Early chlorotic blotches between veins

FIGURE 2 - Severe leaf symptoms

FIGURE 3 - Severe infection in a patch in a field

FIGURE 4 - Root rot and blue fungal growth on root

FACTORS FAVORING DEVELOPMENT

- Wet soil for two to four weeks after planting
- Field history of SDS
- Compacted soil, poor drainage
- Periodic heavy rain and moist soil through mid-Aug.
- High soybean cyst nematode populations

IMPORTANT FACTS

- Common in southern and central Minnesota, rare in northern Minnesota, not yet confirmed in North Dakota (2017)
- Pathogen can cause root rot of dry edible bean and other legumes
- Pathogen dispersed with soil (on equipment, in water, by wind, etc.)
- Management options: varieties partially resistant to SDS, seed treatments
- Commonly confused with brown stem rot

Card 7 of 23



Anthracnose

Colletotrichum truncatum
or other *Colletotrichum* species (fungi)

Photo: D. Malvick, Univ. of Minnesota

Figure 1



Photo: S. Markell, NDSU

Figure 2



Photo: S. Markell, NDSU

Figure 3



Anthracnose

Colletotrichum truncatum
or other *Colletotrichum* species (fungi)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- Symptoms usually not seen until plants reach maturity
- Dark brown lesions may appear on stems, pods and petioles
- Small black fungal patches develop in irregular patterns on stems, pods and petiole
- Black, infected areas covered with tiny black spines (setae) that can be seen with a 10X hand lens

FIGURE 1 - Irregular-shaped blotches on stem

FIGURE 2 - Abundant black fungal growths of irregular arrangement and size

FIGURE 3 - Close-up appearance of fungal growths

FACTORS FAVORING DEVELOPMENT

- Warm and wet/humid weather
- Planting infected seed
- Short/no crop rotation

IMPORTANT FACTS

- A common late-season disease that rarely causes significant yield loss
- Pathogen(s) have a wide host range and may infect other legume crops and weeds
- Pathogen can be seedborne
- Commonly confused with pod and stem blight, stem canker, charcoal rot



Brown stem rot (BSR)

Cadophora gregata (fungus)

Figure 1

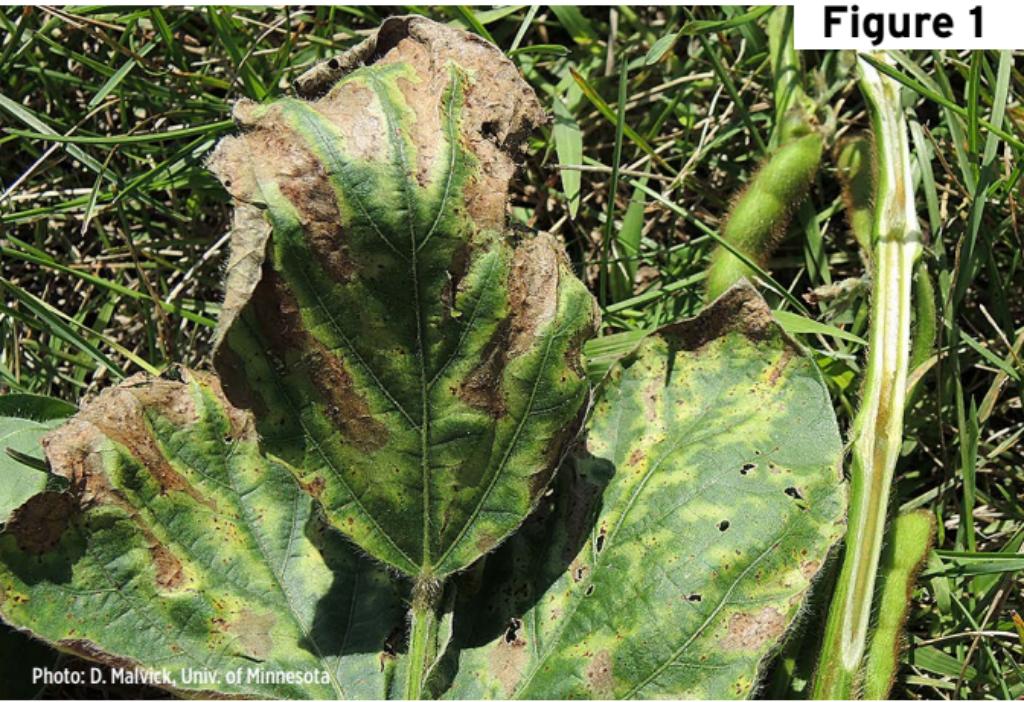


Photo: D. Malvick, Univ. of Minnesota

Figure 2



Photo: D. Malvick, Univ. of Minnesota

Figure 3



Photo: D. Malvick, Univ. of Minnesota

Figure 4

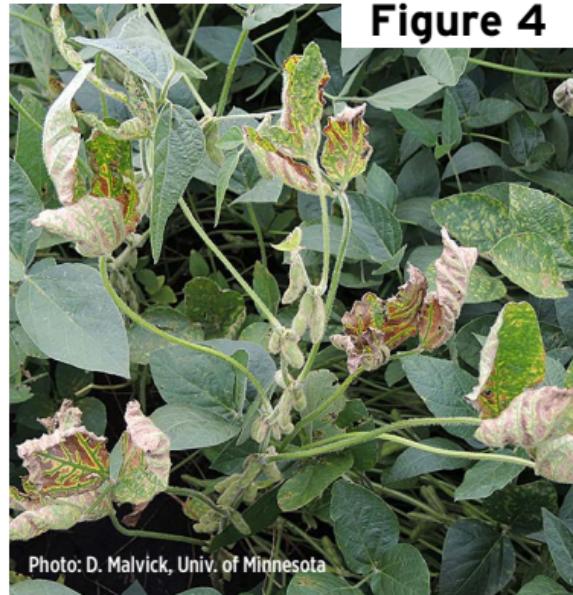


Photo: D. Malvick, Univ. of Minnesota

Brown stem rot (BSR)

Cadophora gregata (fungus)

AUTHORS: Dean Malwick and Sam Markell

SYMPTOMS

- Brown pith in stem, especially in lower stem
- Brown and yellow discoloration between leaf veins may be present
- Symptoms commonly develop in mid-August

FIGURE 1 - Light brown discoloration in pith and leaf

FIGURE 2 - Dark brown discoloration in pith of stem

FIGURE 3 - Brown and yellow discoloration between veins

FIGURE 4 - Symptoms on leaves of whole plant

FACTORS FAVORING DEVELOPMENT

- Short/no crop rotation
- Wet and cool weather in July/August
- History of disease in a field
- Susceptible soybean varieties
- Presence of soybean cyst nematode

IMPORTANT FACTS

- Stems should be longitudinally split to identify BSR
- Commonly confused with sudden death syndrome
- Pathogen overwinters/survives in infected soybean stems
- BSR pathogen dispersed with soil (on equipment, in water, by wind, etc.)
- Soybean is only known definite host
- Two pathogen types: type A causes leaf and stem symptoms; type B only stem symptoms
- Type B thought to be more common in our region
- Management options: crop rotation and varieties resistant to BSR

Card 9 of 23



Charcoal rot

Macrophomina phaseolina (fungus)

Figure 1



Photo: S. Markell, NDSU

Figure 2



Photo: S. Markell, NDSU

Figure 3



Photo: D. Malvick, Univ. of Minnesota

Figure 4



Photo: S. Markell, NDSU

Charcoal rot

Macrophomina phaseolina (fungus)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- Symptoms usually not apparent until flowering or later
- Taproot and lower stem may appear gray/silver
- Numerous black fungal specks (microsclerotia) under epidermis give a “charcoal” appearance
- Premature death with wilted leaves attached
- Frequently occurs in patches in fields

FIGURE 1 - Gray lesion on lower stem

FIGURE 2 - Gray lesion peeling away, revealing profuse “charcoal” microsclerotia

FIGURE 3 - Black microsclerotia embedded in tap root (epidermis scraped off)

FIGURE 4 - Microsclerotia in root tissue

FACTORS FAVORING DEVELOPMENT

- Hot temperatures
- Drought stress
- May be more severe when soybean cyst nematode is present

IMPORTANT FACTS

- Yield loss may occur in hot, dry growing seasons
- Disease typically most severe in drought-prone areas of fields
- Very wide host range, which includes corn, sunflower, other legume crops and weeds
- Commonly confused with anthracnose, Phytophthora stem rot, pod and stem blight, stem canker

Card 10 of 23



Pod and stem blight/ Phomopsis seed decay

Diaporthe sojae and *Diaporthe longicolla* (fungi)

Photo: D. Malvick, Univ. of Minnesota

Figure 1



Figure 2



Photo: D. Malvick, Univ. of Minnesota

Pod and stem blight/ Phomopsis seed decay

Diaporthe sojae and *Diaporthe longicolla* (fungi)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- Small, raised black dots (pycnidia) arranged in distinct rows on stem, pods and petioles
- Tops of plants may discolor and die, leading to plant death
- Symptoms often not apparent until plants near maturity
- Wavy, black zone lines inside infected stems and roots may occur (see stem canker)
- Seed may be cracked, shriveled, moldy and have poor germination

FIGURE 1 - Linear rows of raised black dots

FIGURE 2 - Infected (L) and healthy (R) plants

FACTORS FAVORING DEVELOPMENT

- Warm and humid weather
- Short/no crop rotation
- Planting infected seed
- Delayed harvest due to wet weather

IMPORTANT FACTS

- Yield loss and reduction in seed quality may occur
- Host range includes dry edible bean and dry edible pea
- Pathogen survives in crop residue and seed
- Pathogen is widespread, even in apparently healthy plants
- Black dots arranged in rows are diagnostic (anthracnose and charcoal rot dots are random)
- Commonly confused with anthracnose, charcoal rot and stem canker

Card 11 of 23



Stem canker

Diaporthe caulivora (northern stem canker) and
D. aspalathi (southern stem canker) (fungi)

D. Malvick, Univ. of Minnesota

Figure 1



Photo: S. Markell, NDSU

Figure 2



Photo: S. Markell, NDSU

Figure 3



Stem canker

Diaporthe caulivora (northern stem canker) and
D. aspalathi (southern stem canker) (fungi)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- Reddish-brown lesions on the lower stem starting at branch points/nodes
- Lesions expand and may become sunken cankers
- Tiny black fungal structures may be produced on lesions
- Narrow black “zone lines” sometimes under epidermis, but importantly, zone lines also are associated with pod and stem blight

FIGURE 1 - Reddish-brown stem canker lesion

FIGURE 2 - Sunken canker on lower stem of mature plant

FIGURE 3 - Zone lines beneath epidermis of sunken canker

FACTORS FAVORING DEVELOPMENT

- Extended periods of wet weather (one to four days) with moderate temperatures (70 to 85 F)
- Short/no crop rotation in fields with history of disease
- Reduced tillage

IMPORTANT FACTS

- Yield loss can occur if disease is widespread in a field and kills plants before pod fill
- Management tools include crop rotation (wheat, corn, etc.), resistant varieties and foliar fungicides
- Commonly confused with anthracnose, charcoal rot, late-season Phytophthora root rot, and pod and stem blight



White mold (*Sclerotinia sclerotiorum* (fungus))

Sclerotinia sclerotiorum (fungus)



Figure 1



Figure 2



Figure 3

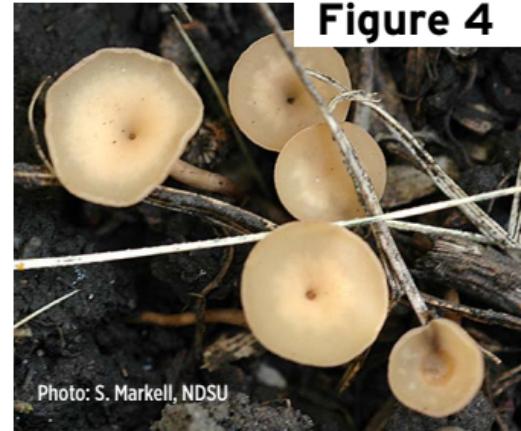


Figure 4

White mold (*Sclerotinia sclerotiorum* (fungus))

Sclerotinia sclerotiorum (fungus)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- Stem lesions begin as water-soaked spots near nodes
- Lesions enlarge, fluffy white fungal growth develops on moist stems
- Infected stems become bleached white and may shred
- Hard black structures (sclerotia) form on infected tissue

FIGURE 1 - Lesions with white mold and sclerotia

FIGURE 2 - Severe white mold infection

FIGURE 3 - Black sclerotia among shriveled seeds

FIGURE 4 - Apothecia

FACTORS FAVORING DEVELOPMENT

- Wet soils prior to and during soybean flowering
- Frequent wetness (rain, fog, heavy dew) and cool temperatures during bloom
- Dense plant canopy, high fertility, high plant populations
- Disease history in field

IMPORTANT FACTS

- Severe yield losses can occur when July and early August are cool and wet
- Many broadleaf crops and weeds are hosts
- Pathogen survives in soil for many years as sclerotia
- Sclerotia produce apothecia (about 1/4-inch mushrooms), which produce ascospores that initiate infection
- Apothecia commonly confused with bird's nest fungi
- Management options: partially resistant varieties and fungicides

Card 13 of 23



Bacterial blight

Pseudomonas savastanoi pv. *glycinea* (bacteria)

Figure 1



Figure 2

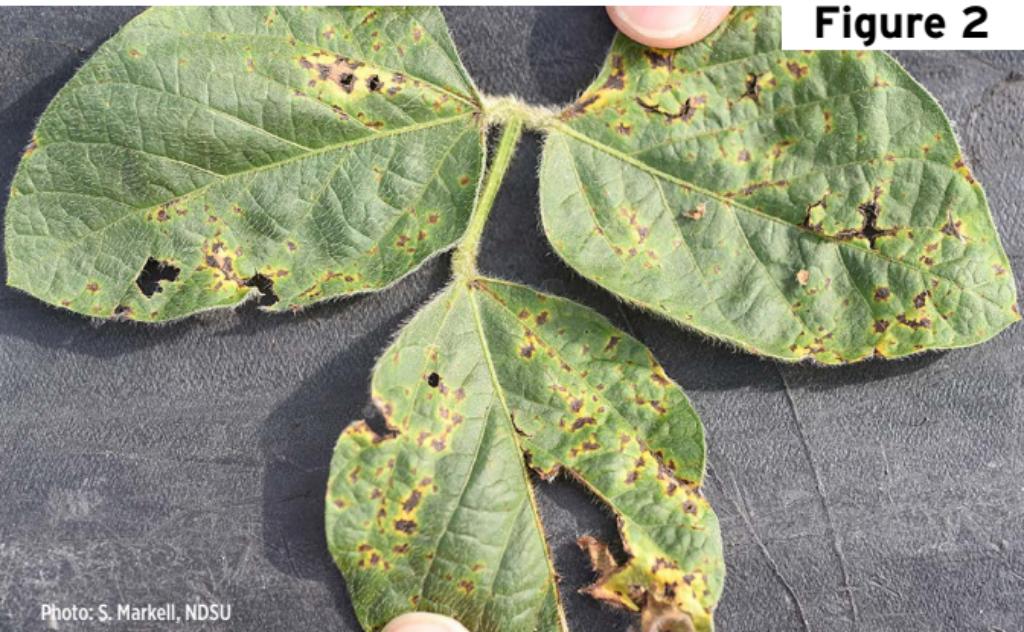
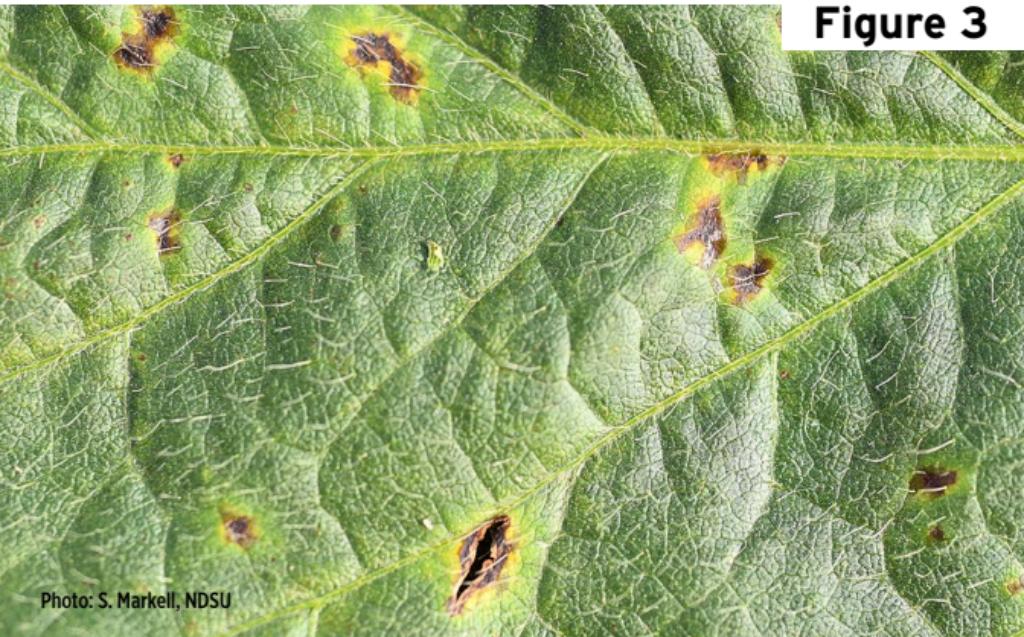


Figure 3



Bacterial blight

Pseudomonas savastanoi pv. *glycinea* (bacteria)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- Typically observed first in upper canopy in July
- Small, water-soaked and angular leaf lesions
- Lesion centers turn brown and are surrounded by a bright yellow halo
- Lesions often coalesce and leaves will tatter
- Often widespread distribution in field

FIGURE 1 - Brown angular lesions with bright yellow halos

FIGURE 2 - Coalescing lesions and leaf tattering

FIGURE 3 - Magnified lesions

FACTORS FAVORING DEVELOPMENT

- Cool temperatures, frequent rains and thunderstorms
- Weather that damages plant tissue (hail, high winds, etc.)
- Short/no crop rotation
- Planting infected seed

IMPORTANT FACTS

- Widespread but rarely economically important
- Lesions may occur on stem, petiole and pod
- Pathogen survives and can be spread with seed and infested crop residue
- Fungicides are not effective
- Commonly confused with Septoria brown spot, bacterial pustule, downy mildew

Card 14 of 23



Bacterial pustule

Xanthomonas axonopodis pv. *glycines* (bacteria)

Photo: S. Markell, NDSU

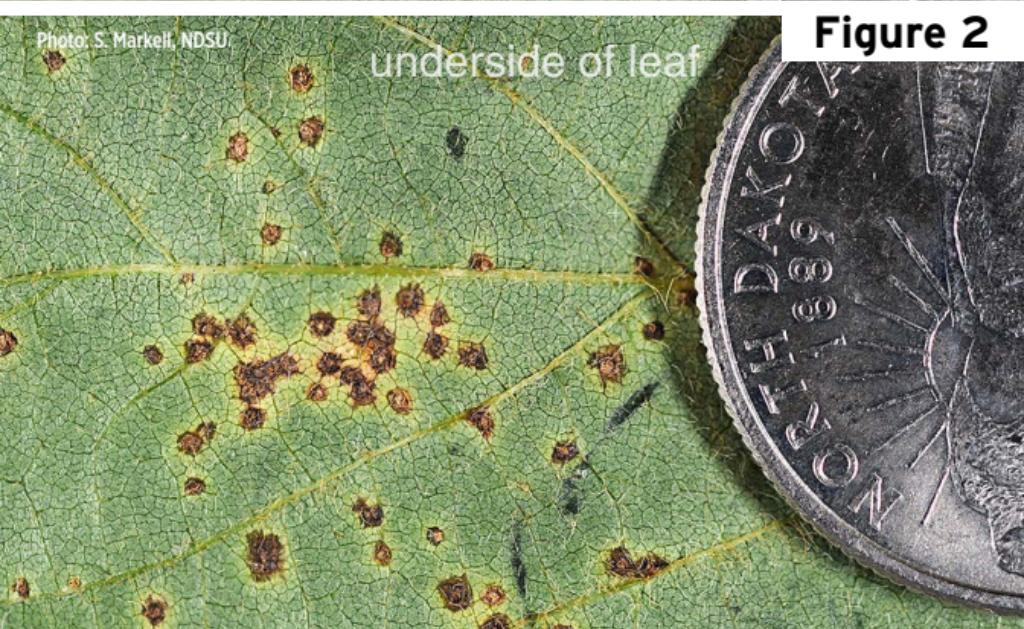
Figure 1



top side of leaf

Photo: S. Markell, NDSU

Figure 2



underside of leaf

Photo: S. Markell, NDSU

Figure 3



Bacterial pustule

Xanthomonas axonopodis pv. *glycines* (bacteria)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- Lesions begin as small (1/16 to 1/4 inch) light green specks with yellow halos
- Lesion centers turn brown
- Raised pustules appear in lesions

FIGURE 1 - Lesions with chlorotic halos on upper side of leaf

FIGURE 2 - Lesions and pustules on underside of leaf

FIGURE 3 - Pustules (approximately 5 to 10X)

FACTORS FAVORING DEVELOPMENT

- Wet and rainy weather
- Prolonged humid conditions

IMPORTANT FACTS

- Uncommon in Minnesota and North Dakota
- Unlikely to cause yield loss
- Can be mistaken for soybean rust, a disease that has not occurred in Minnesota or North Dakota
- Commonly confused with bacterial blight or Septoria brown spot



Bean pod mottle virus

Photo: A. Dorrance, Ohio State Univ.

Figure 1

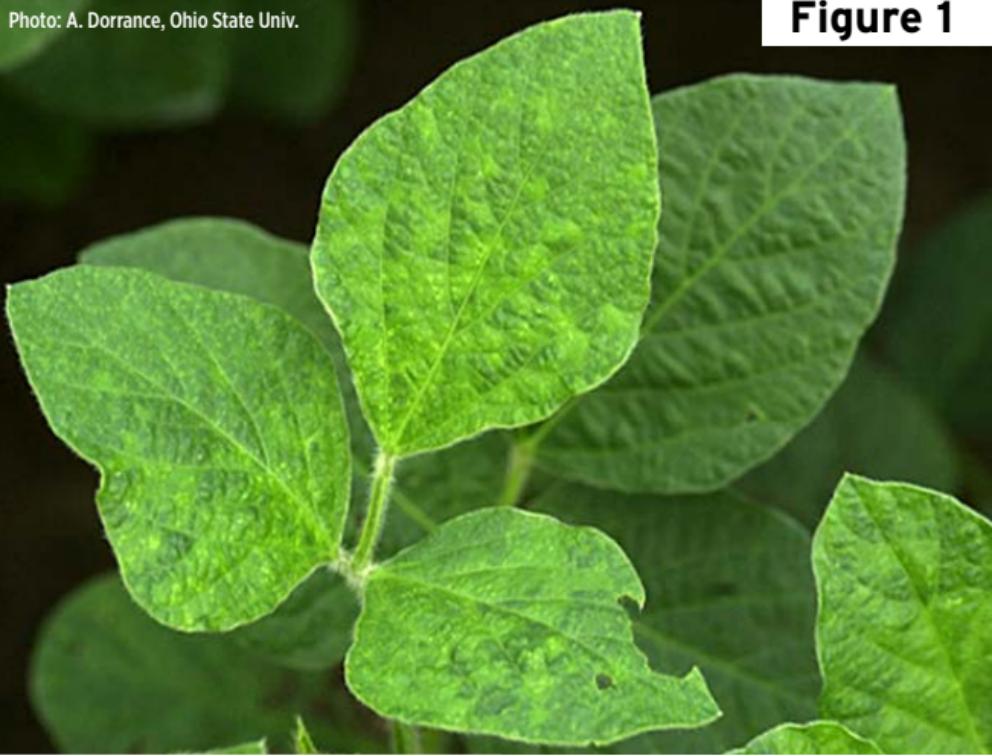


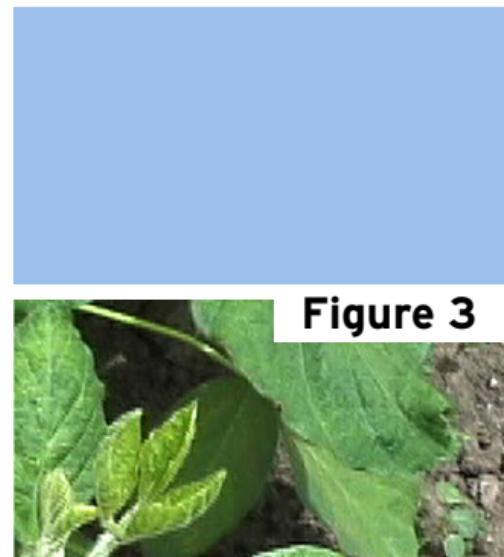
Photo: A. Dorrance, Ohio State Univ.

Figure 2



Photo: Univ. of Illinois

Figure 3



Bean pod mottle virus

AUTHORS: Dean Malvick and Sam Markell

SYMPTOMS

- Green to yellow mottling of young leaves
- Leaves may become puckered and wrinkled
- Symptoms may not be visible during high temperatures or after pod set
- Seed may become mottled with dark stains

FIGURE 1 - Light green to yellow leaf mottling

FIGURE 2 - Wrinkling, puckering and light green mottling

FIGURE 3 - Leaf puckering and wrinkling

FACTORS FAVORING DEVELOPMENT

- High populations of bean leaf beetle (or other beetles) early in the season
- Cool weather

IMPORTANT FACTS

- Not thought to be common in Minnesota and North Dakota
- Virus can be transmitted by bean leaf beetle or other leaf feeding beetles
- Infection primarily occurs early in the season
- Host range includes dry edible bean, clovers and other legumes
- Management options: delay planting, seed applied insecticides
- Commonly confused with other viruses and possibly herbicide injury

Card 16 of 23



Cercospora leaf blight

Cercospora kikuchii (fungus)

Figure 1



Photo: A.K. Chanda, Univ. of Minnesota

Figure 2



Photo: A.K. Chanda, Univ. of Minnesota

Figure 3

Photo: Univ. of Illinois



Cercospora leaf blight

Cercospora kikuchii (fungus)

AUTHORS: Dean Malwick and Sam Markell

SYMPTOMS

- Purple to bronze discoloration of upper leaf surfaces
- Red-brown spots on both leaf surfaces
- Large necrotic areas can develop on leaves, followed by leaf drop
- Seed coats can develop purple discoloration

FIGURE 1 - Purple discoloration of leaf

FIGURE 2 - Bronze discoloration and death of leaf tissue

FIGURE 3 - Purple seed stain

FACTORS FAVORING DEVELOPMENT

- High humidity and warm temperatures
- Lack of crop rotation

IMPORTANT FACTS

- Disease is more common and severe in southern U.S.
- Pathogen overwinters on infested soybean debris and seed
- Plants susceptible from flowering to maturity
- Management options: pathogen-free seed, susceptible varieties, crop rotation and fungicides
- Commonly confused with sunscald



Downy mildew

Peronospora manshurica (Oomycete)

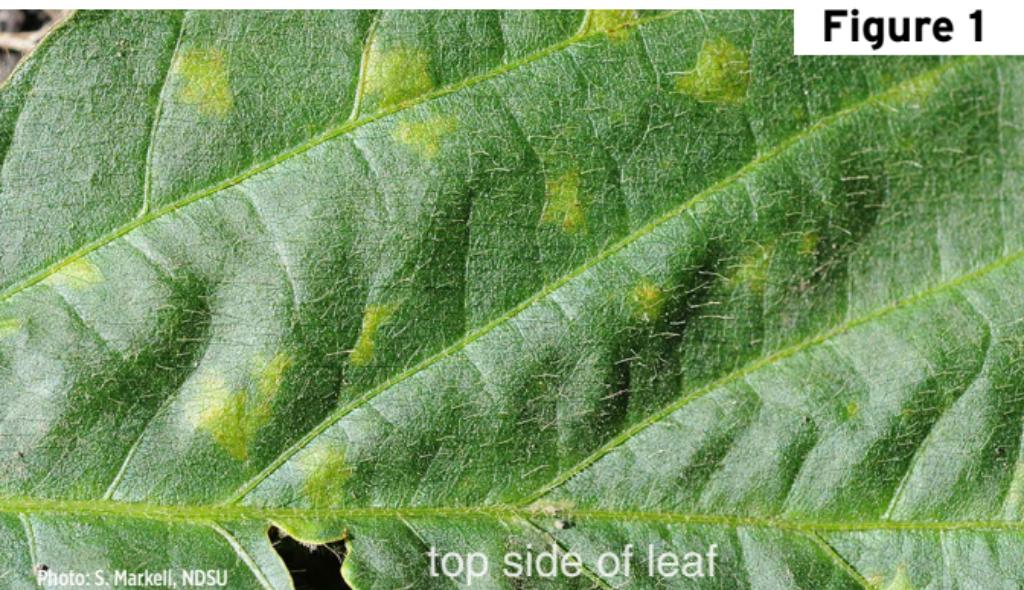


Figure 1



Figure 2



Figure 3

Downy mildew

Peronospora manshurica (Oomycete)

AUTHORS: Sam Markell and Dean Malwick

SYMPTOMS

- Lesions begin as discrete pale green to light yellow spots on top side of leaves
- Fluffy tan tufts of fungal growth occur opposite lesions on underside of leaves
- Lesions become brighter yellow and turn brown with age

FIGURE 1 - Discrete lesions

FIGURE 2 - Fungal growth opposite lesions (inset: approximately 5 to 10X)

FIGURE 3 - Severe infection

FACTORS FAVORING DEVELOPMENT

- Frequent and prolonged periods of high humidity or free moisture (dew)
- Moderate temperatures
- Short crop rotation
- Planting infected seed or field history of downy mildew

IMPORTANT FACTS

- Yield loss thought to be rare; however, severe outbreaks have occurred in North Dakota and Minnesota
- Pathogen is specific to soybeans and will not cause downy mildew of other crops
- Can be confused with Septoria brown spot, powdery mildew and bacterial diseases



Frogeye leaf spot

Cercospora sojina (fungus)

Photo: D. Malwick, Univ. of Minnesota

Figure 1

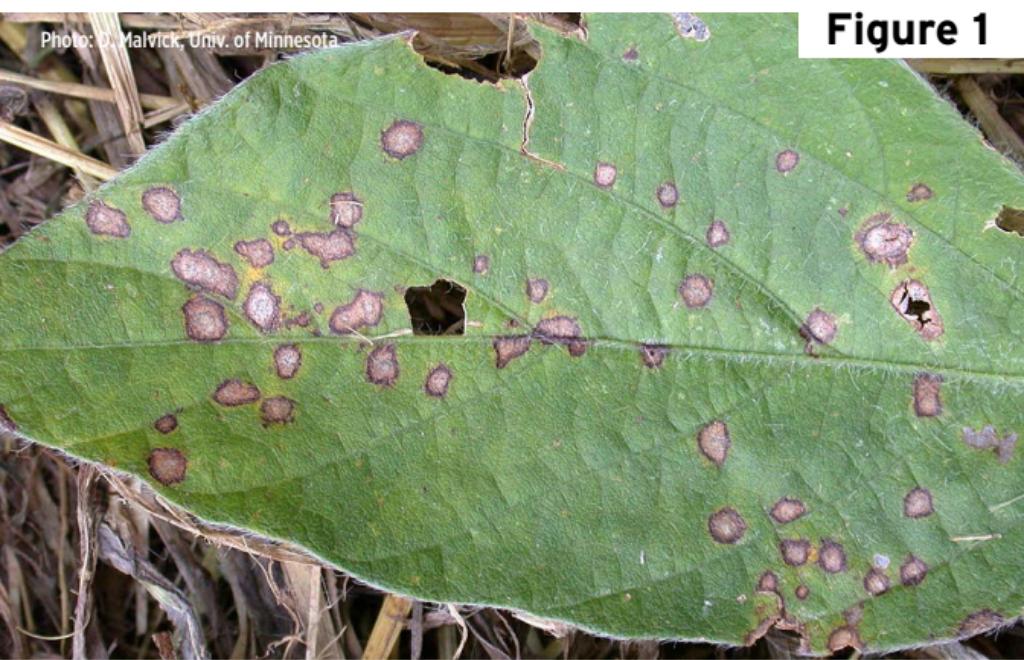


Photo: D. Malwick, Univ. of Minnesota

Figure 2



Figure 3

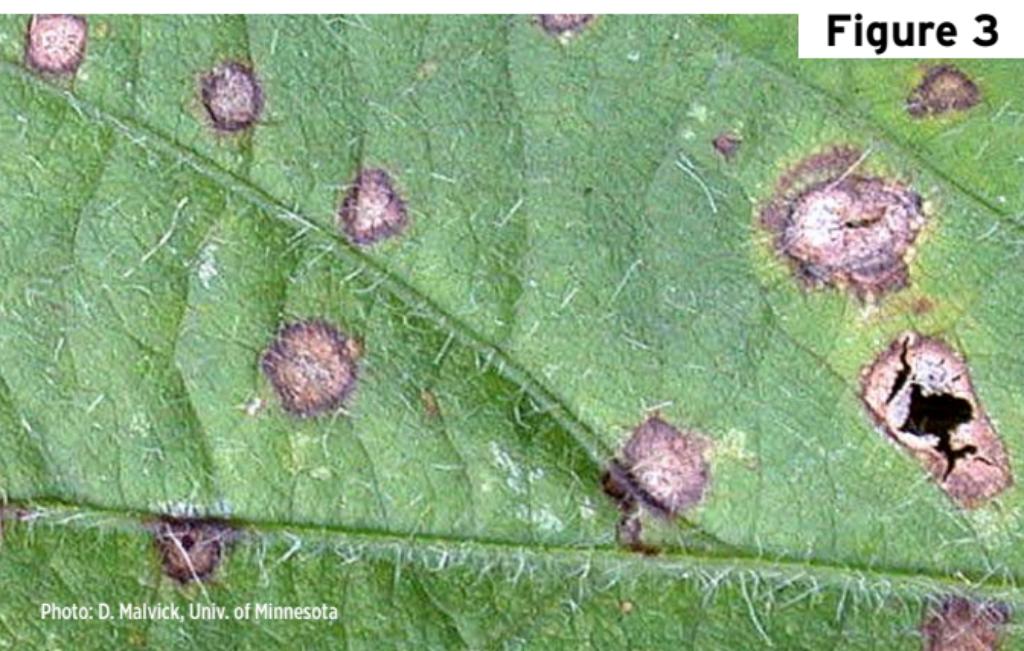


Photo: D. Malwick, Univ. of Minnesota

Frogeye leaf spot

Cercospora sojina (fungus)

AUTHORS: Dean Malvick and Sam Markell

SYMPTOMS

- Brown leaf spots surrounded by a darker reddish-brown or purple ring
- Centers of spots become tan as they age and develop black specks
- Spots may coalesce, fall out and kill large parts of leaves

FIGURE 1 - Spots and patterns of lesion development on leaf

FIGURE 2 - Infected leaf

FIGURE 3 - Close-up of spots and holes in leaves

FACTORS FAVORING DEVELOPMENT

- Warm and humid weather
- Highly susceptible soybean varieties

IMPORTANT FACTS

- Disease more common in southern areas of the Midwest
- Pathogen overwinters in infected soybean residue and seed
- Management options: crop rotation, tillage and fungicides
- Pathogen in southern Midwest is insensitive to Strobilurin (Qo1, FRAC 11) fungicides
- Commonly confused with bacterial blight, Septoria brown spot



Powdery mildew

Erysiphe diffusa and E. glycines (fungi)



Figure 1

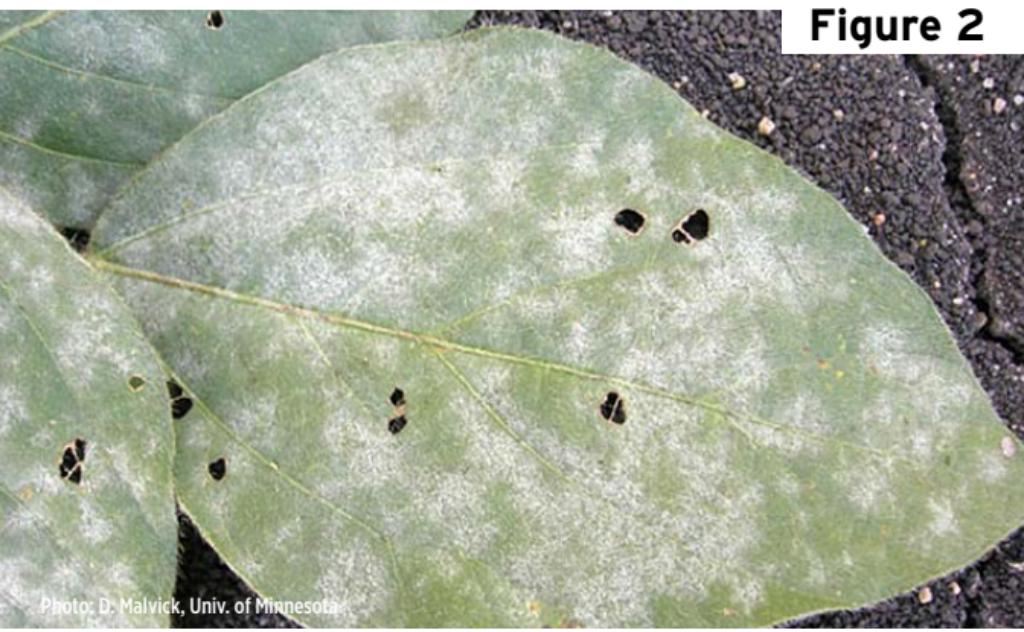


Figure 2



Figure 3

Powdery mildew

Erysiphe diffusa and E. glycines (fungi)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- Powdery white tufts of fungal growth on upper side of leaf
- Fungal growth may look like white flour sprinkled on the leaves
- Fungal growth can expand and may cover entire leaf surface
- Small black specs in growth may be observed late in season
- White fungal growth can be rubbed off leaf easily

FIGURE 1 - White tufts of fungal growth

FIGURE 2 - Severe infection covering leaf

FIGURE 3 - Infection spreading in hot spot

FACTORS FAVORING DEVELOPMENT

- Temperatures from 64 to 75 F
- Low humidity with periods of limited leaf wetness
- Late-planted soybeans

IMPORTANT FACTS

- Yield loss is rare in Minnesota and North Dakota
- Usually occurs late in growing season
- The pathogen also may infect dry edible beans and field peas
- Commonly confused with downy mildew



Septoria brown spot

Septoria glycines (fungus)

Figure 1



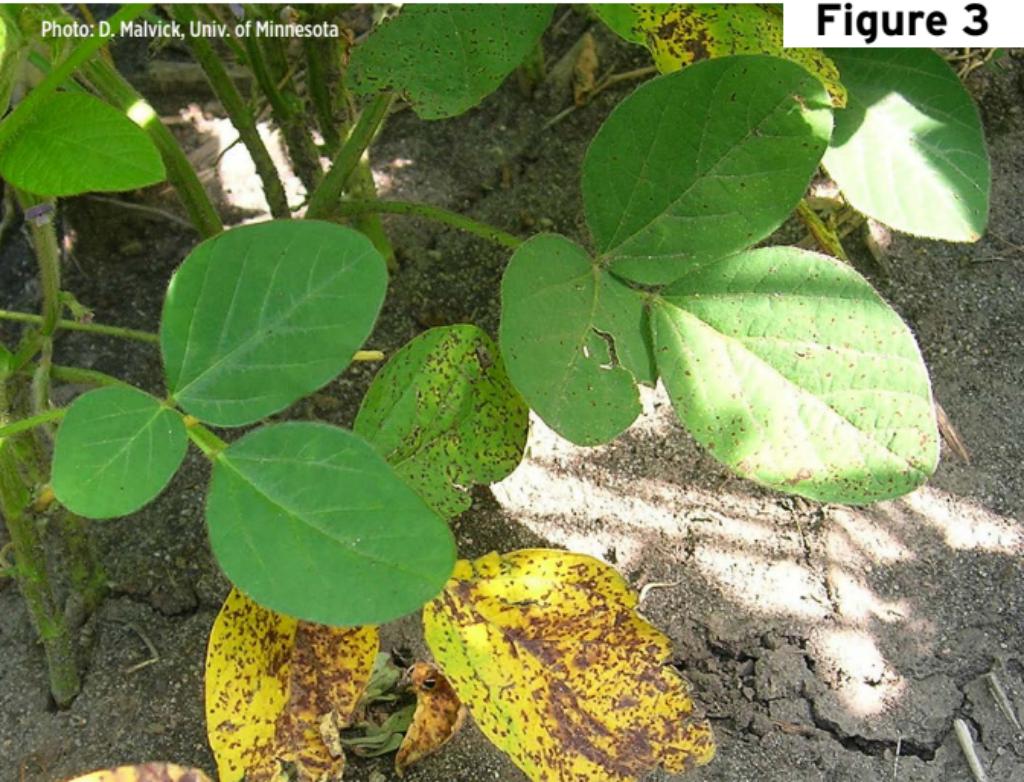
Photo: D. Malvick, Univ. of Minnesota

Figure 2



Photo: D. Malvick, Univ. of Minnesota

Figure 3



Septoria brown spot

Septoria glycines (fungus)

AUTHORS: Dean Malvick and Sam Markell

SYMPTOMS

- Dark brown spots (less than 1/8 inch diameter)
- Brown spots coalesce into large brown areas
- Irregular brown and yellow patches on one side of leaf
- Symptoms first develop in lower part of plant, then move up

FIGURE 1 - Brown spots and chlorosis

FIGURE 2 - Trifoliolate with brown spots and chlorosis

FIGURE 3 - Common pattern of symptoms developing in lower canopy

FACTORS FAVORING DEVELOPMENT

- Wet and warm weather
- High plant density
- Continuous soybean planting
- Minimum tillage

IMPORTANT FACTS

- Typically does not cause yield loss
- Under severe conditions, defoliation and yield loss can occur
- Pathogen survives on infected residue and may be transmitted by seed
- Soybean varieties may vary in susceptibility
- Management options: crop rotation and fungicides
- Commonly confused with bacterial blight



Soybean mosaic virus

Photo: A. Tenuta, OMAFRA, Ontario, Canada

Figure 1

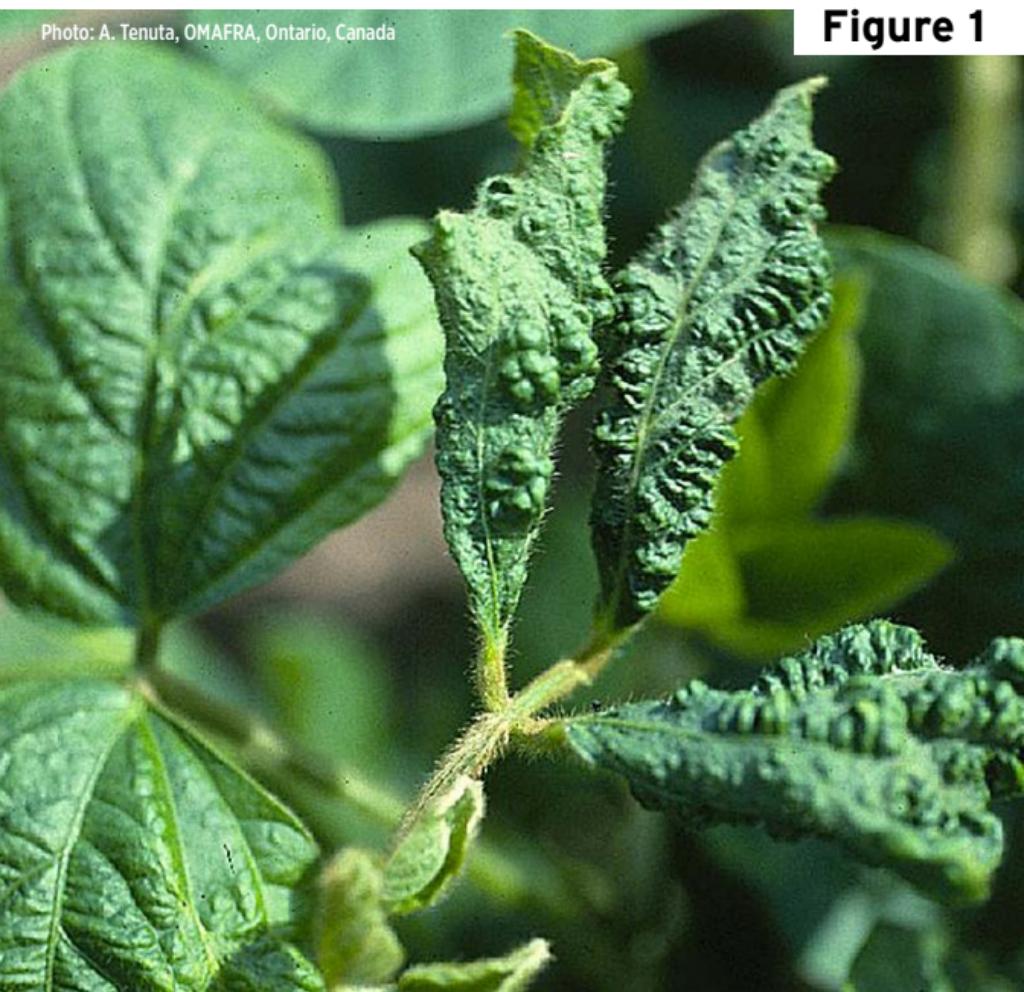


Photo: A. Tenuta, OMAFRA, Ontario, Canada

Figure 2



Soybean mosaic virus

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- Light and dark green mottling of leaves
- Leaf puckering and downward curling
- Symptoms most severe on youngest leaves
- Flattening of pods, reduced seed size, seed discoloration and stunting may occur
- Infected plants can be asymptomatic

FIGURE 1 - Leaf mottling and curling

FIGURE 2 - Discolored seed

FACTORS FAVORING DEVELOPMENT

- Planting infected seed
- Aphid infestation

IMPORTANT FACTS

- Not thought to be common in Minnesota or North Dakota
- Virus is seedborne and aphid-vectored
- Commonly confused with herbicide injury and bean pod mottle virus



Soybean rust

Phakopsora pachyrhizi (fungus)

Photo: S. Markell, NDSU

Figure 1



Figure 2

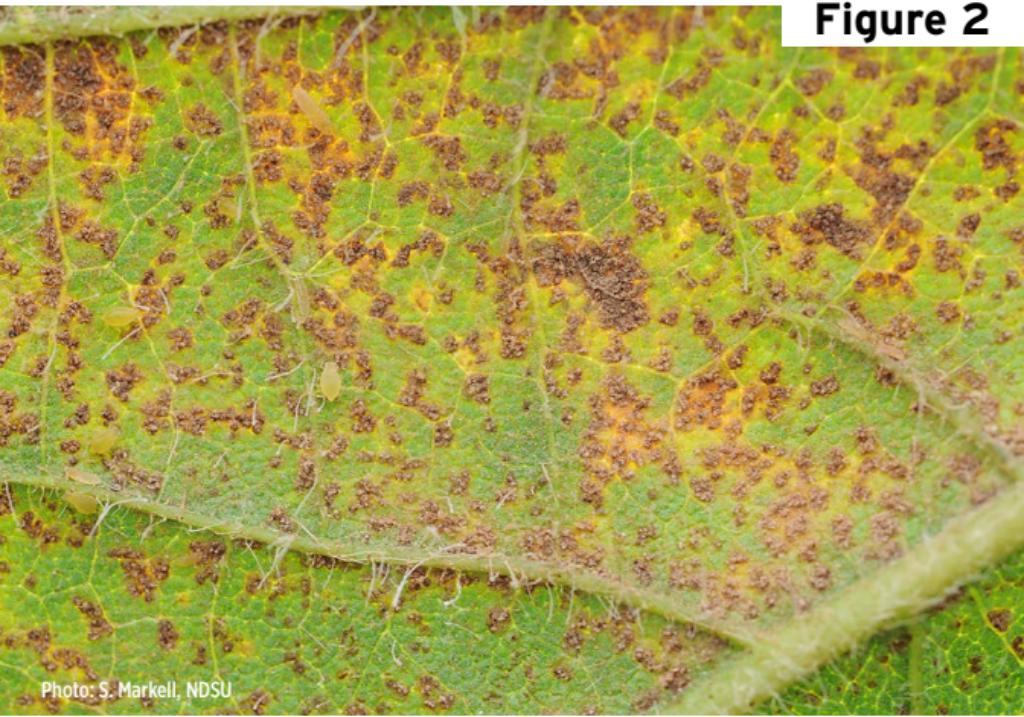


Photo: S. Markell, NDSU

Photo: D. Malvick, Univ. of Minnesota

Figure 3



Soybean rust

Phakopsora pachyrhizi (fungus)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- Very small gray-green, tan and/or red-brown spots on leaves
- Very small pustules on underside of leaf (hand lens needed)
- Leaf chlorosis and defoliation may occur

FIGURE 1 - Pustules visible on leaf wrapped around finger (approximately 5 to 10X)

FIGURE 2 - Profuse sporulation and leaf chlorosis

FIGURE 3 - Magnified pustules

FACTORS FAVORING DEVELOPMENT

- Proximity to areas that do not freeze (southern Florida, Louisiana, Texas)
- Storms traveling from south to north that may bring spores showers (for example, hurricanes)
- Prolonged leaf wetness and moderate temperatures

IMPORTANT FACTS

- *Soybean rust has never been recorded in Minnesota or North Dakota*
- Dry edible beans may be a host
- Can cause significant yield loss
- Commonly confused with bacterial pustule and other foliar diseases.