

# SOYBEAN MANAGEMENT

## DESCRIPTION OF VEGETATIVE AND REPRODUCTIVE STAGES

Stage no.	Stage title	Abbreviated Description
VE	Emergence	Cotyledons above the soil surface.
VC	Cotyledon	Unifoliolate leaves unrolled sufficiently so the leaf edges are not touching.
V1	First-node	Fully developed leaves at unifoliolate nodes.
V2	Second-node	Fully developed trifoliolate leaf at node above the unifoliolate nodes.
V3	Third-node	Three nodes on the main stem with fully developed leaves beginning with the unifoliolate nodes.
V(n)	nth-node	n number of nodes on the main stem with fully developed leaves beginning with the unifoliolate nodes. n can be any number beginning with 1 for V1, first-node stage.

## DESCRIPTION OF VEGETATIVE AND REPRODUCTIVE STAGES (cont.)

Stage no.	Stage title	Abbreviated Description
R1	Beginning bloom	One open flower at any node on the main stem.
R2	Full bloom	Open flower at one of the two uppermost nodes on the main stem with a fully developed leaf.
R3	Beginning pod	Pod 3/16 inch (5 mm) long at one of four uppermost nodes on the main stem with a fully developed leaf.
R4	Full pod	Pod 3/4 inch (2 cm) long at one of the four uppermost nodes on the main stem with a fully developed leaf
R5	Beginning seed	Seed 1/8 inch (3 mm) long in a pod at one of the four uppermost nodes on the main stem with a fully developed leaf.
R6	Full seed	Pod containing a green seed that fills the pod cavity at one of the four uppermost nodes on the main stem with a fully developed leaf.
R7	Beginning maturity	One normal pod on the main stem that has reached its mature pod color.
R8	Full maturity	Ninety-five percent of the pods that have reached their mature pod color. Five to 10 days away from 15% moisture.

## INSECT SCOUTING CALENDAR FOR SOYBEAN

<b>Pest</b>	<b>Apr</b>	<b>May</b>	<b>June</b>	<b>Jul</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>
Seedcorn Maggot							
Slugs							
Bean Leaf Beetle							
Mexican Bean Beetle							
Green Cloverworm							
Grasshoppers							
Japanese Beetle Adult							
Twospotted Spider Mite							
Soybean Aphid							

## SOYBEAN PEST ASSESSMENT METHODS

**Defoliation Assessment:** To estimate defoliation collect at random 30 or more trifoliates and estimate average level of defoliation (see examples on next page). Avoid samples from field perimeter.

Maximum levels of defoliation tolerated by soybeans without significant loss in yield.

From	To	% Defoliation
Seedling	Bloom	40
Bloom	Pod Fill	15
Pod Fill	Maturation	25

**Pod Injury Assessment:** To evaluate pod injury inspect 10 or more whole plants, selected at random. Pod injury is highest in the upper canopy. When 10 to 15% or more of pods exhibit injury seed damage is evident, especially if high moisture infection periods trigger mold development.

**Sweep Net Sampling of Insect Pests:** Trends of increasing or decreasing pest activity on soybeans can be determined by periodically taking 10 sweeps from 3 or more locations in a field.

**Assessing Soybean Aphid:** Count the number of aphids per soybean plant at 30 locations throughout the field, and calculate an average number of aphids per plant.

## SOYBEAN DEFOLIATION LEVELS



## SEEDCORN MAGGOT



*Larva and Damage*

**Identification & Incidence:** Soybean emergence failure due to feeding by small, yellowish-white, legless fly larvae (maggots) on germinating seeds. Damage is likely to occur in fields having high organic matter (especially fields that have had green material, such as cover crops or weeds incorporated into the soil) and when cool and damp soil conditions delay emergence.

**Sampling:** Maggots may be detected by inspecting areas in the field exhibiting lack of emergence. Check seed to see if maggot damage has occurred.

**Economic Threshold:** No economic threshold exists for this insect and no rescue treatment is available.

**Management Options:** Seed maggot injury may be prevented by use of seed treatment at planting. For a list of labeled insecticides, see <http://entomology.osu.edu/ag/>.

## SLUGS

*Damage*

**Identification & Incidence:** Slugs are soft-bodied animals belonging to a class called Gastropoda (not insects). They range in color from pale cream to gray to shiny black and range in size as adults from less than an inch to over two inches in length. They can damage seeds and seedlings reducing stand and may defoliate established stands that may delay plant development. Slugs damage soybean by destroying the germinating seed prior to emergence and causes significant defoliation.

**Sampling:** Inspect several areas of the field and determine percentage of plants being fed upon and percent defoliation. Slugs are nocturnal animals and it may be necessary to inspect fields at dusk or after dark to see slugs and determine population densities.

**Economic threshold:** Treatment may be necessary if defoliation is greater than 40% on slow growing plants or if plants are being killed.

**Management Options:** Several formulations of metaldehyde are labeled for use on soybean for slug control. For a list of labeled molluscicides, see <http://entomology.osu.edu/ag/>.

## BEAN LEAF BEETLE



*Adult*



*Pod Injury*

**Identification & Incidence:** Damage to soybeans by bean leaf beetle (BLB) extends from feeding of overwintering adults on emerging seedlings to pod feeding by 2nd generation adults in the fall. Life cycle of BLB includes 2 generations with the peak of the 1st generation in July and the peak of the 2nd generation in late August or September. BLB impact on soybeans tends to increase when most soybeans are planted early.

**Sampling:** Early in the season sample 5 plants in 5 locations for defoliation. Late in the season sample for both defoliation and pod damage.

**Economic Threshold:** Treatment is warranted when BLB adults are actively feeding and the defoliation is 40% pre-bloom, 15% bloom to pod-fill and 25% pod-fill to harvest. Treatment may be needed late in the season for pod damage if 10% or more of the pods are being fed upon and BLB is still present.

**Management Options:** Timely application of rescue treatment will reduce losses in yield and seed quality. Late plantings of soybeans will escape defoliation by overwintering BLB and limit establishment of first generation. For a list of labeled insecticides, see <http://entomology.osu.edu/ag/>.

## MEXICAN BEAN BEETLE

*Adult**Larvae & Damage*

**Identification & Incidence:** Both the bronze adult Mexican bean beetle (MBB) having 16 black spots and the spiny larvae stage cause skeletonized foliar injury of soybeans. Egg and pupae stages are also found on the foliage. MBB infestations in Ohio occur primarily in the eastern and southern regions. Severe defoliation generally occurs in late summer when late instar larvae of the 2nd generation reach peak activity.

**Sampling:** Inspect 5 plants from 5 locations and determine the percent defoliation. Determine the predominant growth stage of MBB.

**Economic Threshold:** Treatment is warranted when MBB larvae and/or adults are actively feeding and the defoliation is 40% pre-bloom, 15% at pod fill and 25% at full pod to harvest.

**Management Options:** Rescue treatments should be applied in a timely manner to prevent peak injury caused by late instar larvae. Treatments applied after larvae begin pupating achieve limited results. For a list of labeled insecticides, see <http://entomology.osu.edu/ag/>.

## OTHER INSECT DEFOLIATORS



*Japanese Beetle*

Metallic colored adult Japanese beetles (JB) emerge in early July and remain abundant until summer. JB adults tend to aggregate and are often more abundant in pockets in the field. Thus, random sampling of foliage is important.



*Grasshopper*

During hot summers, various species of grasshoppers may be abundant, especially along grassy borders of a field.

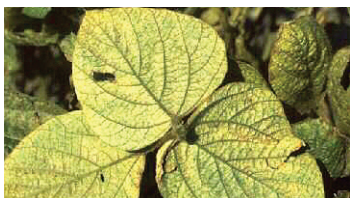


*Green Cloverworm*

This pest is often found in soybeans in low numbers and economic infestations warranting treatment are uncommon.

The occurrence of one or more insect defoliators in abundance may lead to unacceptable defoliation. Defoliation levels should be monitored closely, especially from bloom to pod-fill. Treatment is warranted when defoliation is 40% prebloom, 15% bloom, and 25% pod-fill to harvest. For a list of labeled insecticides, see <http://entomology.osu.edu/ag/>.

## TWO-SPOTTED SPIDER MITE

*Injury*

**Identification & Incidence:** Drought conditions initiated during the spring may lead to the development of two-spotted spider mite (TSSM) outbreaks by early or mid-summer. Initial signs of infestations will be evident where drought stress is most severe. Foliage discoloration and mites will be detected on the underside of the foliage. Use of a hand lens is advised to detect presence of adults and immature stages. Mite eggs appear as clear or yellow marbles under magnification. Recently hatched nymphs have 6 legs compared to later nymphs and adults, which have 8 legs.

**Sampling:** Inspect plants especially along the field margins but also farther inside the field for mites and damage. Record the stages of mites that are present in the field.

**Economic Threshold:** Economic thresholds have not been established for two-spotted spider mites. Treatment is warranted if infested areas begin to increase in size and weather forecasts continue to call for hot, dry weather.

**Management Options:** Treatment of TSSM may be applied by air or ground equipment. Aerial treatments require the use of a miticide with systemic activity. Onset of cool and wet weather conditions may reduce TSSM infestations. For a list of labeled miticides, see <http://entomology.osu.edu/ag/>.

## SOYBEAN APHID



*White objects are aphid cast skins*

**Identification & Incidence:** The soybean aphid is a small, yellow aphid with distinct black tailpipes, or cornicles, on the abdomen. The adult aphid is the size of a small potato leafhopper nymph. Adults lay live young rather than eggs. Early in the season the aphids will be found on the upper leaves. As populations increase, they can be found on the upper stems and later on the lower leaves.

**Sampling:** Sample plants from 30 locations throughout the field and make an estimate of the average number of aphids per plant.

**Economic Threshold:** The economic threshold for soybean aphid has been established at 250 soybean aphids per plant, with an increasing population density. Thus, at least two samples are needed to determine whether the population size is rising.

**Management Options:** There are several predators, including lady beetles, which may help take care of soybean aphid. If populations reach 250 aphids per plant and the density is rising, then the use of an insecticide might be needed. For a list of labeled insecticides, see <http://entomology.osu.edu/ag/>.

## YIELD REDUCTION FROM WEEDS IN SOYBEANS

Weed Species	% Soybean Yield Loss					
	1	2	4	6	8	10
	(# weeds or clumps/100 ft <sup>2</sup> )					
Giant ragweed	0.1	0.2	0.4	0.5	0.8	1
Cocklebur	0.4	0.8	1.6	2.4	3.2	4
J. artichoke	0.4	0.8	1.6	2.4	3.2	4
Pigweeds	0.8	1.6	2.4	4	6	8
Lambsquarters	0.8	1.6	2.4	4	6	8
Velvetleaf	3.2	6.4	9.6	12.8	16	20
Morningglory	3.2	6.4	9.6	12.8	16	20
Jimsonweed	3.2	6.4	9.6	12.8	16	20
Pennsylvania smartweed	3.2	6.4	9.6	12.8	16	20
Giant foxtail*	2	4	6.8	10	12.8	17.6
Shattercane**	0.8	2	3.2	4.4	5.6	7.2
Volunteer corn	0.4	0.8	1.2	1.6	2	2.4

\* 5 to 8 foxtail stems per clump

\*\* 2 to 3 shattercane stems per clump

## HERBICIDE INJURY DIAGNOSIS SOYBEANS

### Germination/Emergence

#### Poor germination and uneven emergence

- misapplication of 2,4-D or dicamba for burn-down in the spring prior to soybean planting. Allow 7 to 30 days, depending upon rate, between 2,4-D ester application and soybean planting.
- severe injury from sulfentrazone or flumioxazin caused by low organic matter soils, high rainfall and cool temperatures.

### Cotyledon/Young plant

#### Cotyledon burn, veinal chlorosis, and/or stunted plants

- sulfentrazone or flumioxazin injury due to low organic matter soils, high rainfall and cool temperatures, or splash up of treated soil onto young plants.

#### Leaf puckering/shortened midrib/"drawstring" leaves

- excessive rates and/or cold, wet conditions following application of acetamide herbicides: metolachlor, s-metolachlor, alachlor, dimethenamid (shoot inhibitors)

#### Leaf burn on margins of older leaves

- excessive rates or wet conditions following application of metribuzin, or carryover of triazine (atrazine, simazine) herbicides.

## HERBICIDE INJURY DIAGNOSIS SOYBEANS (CONT.)

### Leaf burn on young & old leaves

- postemergence applications of PPO-inhibiting herbicides: Aim, Cadet, Cobra/Phoenix, Flexstar, Reflex, Resource or Ultra Blazer. Use of crop oil concentrates and UAN during hot, humid conditions may increase injury.

### Leaf puckering/cupping/epinasty

- growth regulators (2,4-D, 2,4-DB, Crossbow, dicamba, Status, MCPA, Stinger, Tordon). Spray drift from nearby applications should follow wind channels. Hot, moist conditions up to three days following application of a growth regulator may lead to volatilization. Injury from volatilization does not necessarily reduce yields.

In some instances similar symptoms are present where a growth regulator can be ruled out. Current theories explain this phenomenon as a plant hormone response regulated in the apical meristem of the plant, which may be initiated as a result of plant stress coupled with or without postemergence herbicide application. Effect on yield is probably minimal.

### Bleaching (white) of leaves

- potential carryover of mestotrione (Callisto, Lexar/Lumax), most likely from late-season postemergence application the prior year.

### Swollen or cracked hypocotyls/pruned roots/brittle stems

- excessive rates of DNA herbicides (pendimethalin, trifluralin), or high rainfall following preemergence application. Lateral roots may be short and thick.

## HERBICIDE INJURY DIAGNOSIS SOYBEANS (CONT.)

### Interveinal chlorosis/stunting/purple mid-veins/ deformed leaves

- usually associated with amino acid inhibitors. Could result from drift or tank contamination with products containing nicosulfuron, rimsulfuron, primisulfuron, glyphosate, halosulfuron. Can also be due to plant stress in conjunction with the application of Classic, Extreme/ThunderMaster, FirstRate, Harmony GT, Pursuit, Raptor, Scepter or Synchrony STS. New growth will be the first to yellow. Severe injury will result in death (browning) of growing point and stem pith tissue and eventual necrosis of leaf tissue.

### **Bloom/Pod set**

### Speckled leaves

- spray drift from nearby application of a cell membrane disruptor (paraquat).

### Leaf puckering

- growth regulator type herbicides (2,4-D, dicamba, Stinger). Should not appear this late in the season, but the possibility does exist. Refer to the discussion on leaf puckering /cupping/epinasty in "Cotyledon/Young plant" section.

## TIME OF DISEASE SYMPTOM OCCURRENCE ON SOYBEANS

Disease	April	May	June	July	Aug	Sept	Oct
Pythium Seed Rot and Damping Off		■					
Phytophthora Damping Off and Root Rot	■	■	■	■	■	■	
Rhizoctonia Seed Rot and Stem Rot		■	■	■	■	■	
Bacterial Leaf Blight				■	■	■	
Brown Spot				■	■	■	
Downy Mildew				■	■	■	
Bud Blight Virus				■	■	■	
Soybean Mosaic Virus	■	■	■	■	■	■	
Yellow Mosaic Virus					■	■	
Bean Pod Mottle Virus				■	■	■	
Sclerotinia Stem Rot or White Mold					■	■	
Sudden Death Syndrome				■	■	■	
Stem Canker				■	■	■	
Soybean Cyst Nematode		■	■	■	■	■	
Brown Stem Rot				■	■	■	
Charcol Rot					■	■	
Pod and Stem Blight				■	■	■	■
Phomopsis Seed Rot					■	■	■
Soybean Rust				■	■	■	■

## PHYTOPHTHORA DAMPING-OFF AND ROOT ROT



**Description:** Phytophthora damping-off is recognized as a pre- or post-emergence damping off. Affected seedlings have brown, water-soaked lesions on the hypocotyl.

**Location:** Phytophthora root rot is primarily a problem in the heavy clay, poorly drained soils throughout Ohio. This disease has re-emerged as a major pathogen of soybeans due to the adaptations by the Phytophthora populations to all of the commonly deployed Rps genes (Rps1a, Rps1c, Rps1k and Rps3a) as well as fewer varieties with high levels of partial resistance.

**Time of infection:** Plants of any age can be infected, and infections occur when soils are saturated. The best time to see symptom development is one to two weeks after a heavy rain.

### **Management:**

- Resistant varieties
- Crop rotation
- Improve drainage
- High rates of fungicide seed treatment (metalaxyl/ mefenoxam)

## SOYBEAN RUST



*Leaf and close-up of pustule*

**Description:** Lesions are very, very small and appear necrotic on the top side of the leaf. On the underside of the leaf, pustules form which are raised and under high humidity these craters open and the spores (urediniospores) can be seen. Soybean rust causes premature defoliation, fewer seeds per pod, decreased number of filled pods per plant and early maturity which all contribute to yield loss.

**Time of infection:** Rust, to date, has been limited to the southern states, where it has overwintered in the gulf states and then has built up late in the growing season. Soybeans appear to be most susceptible following flowering.

**Monitoring and Management:** Soybean rust is monitored throughout the south in order to identify key areas where high levels of potential inoculum exist. Management is based on risk. Low risk indicates that very low levels of inoculum are present in the southern U.S. and there is little chance the soybean rust will arrive in Ohio or impact the crop. Moderate risk indicates that high levels of inoculum are present in nearby states at levels that with the right rain storm may bring significant levels to Ohio. High risk indicates that rust has been found in Ohio and there is still time in the growing season for it to negatively impact the crop.

## RHIZOCTONIA ROOT AND STEM ROT



**Description:** Rhizoctonia infects seed, hypocotyls and roots of soybeans. Brick red lesions form on plants. Plants that are not killed will appear yellow and stunted late in the season.

**Location:** Rhizoctonia is a soil borne pathogen that is present in most fields throughout Ohio

**Time of infection:** Rhizoctonia can infect plants across a wide variety of temperature and moisture conditions. It is found most often in seasons that begin very wet and then turn dry.

**Management:**

- Crop rotation
- Seed treatment

## PYTHIUM SEEDLING DAMPING-OFF AND ROOT ROT



**Description:** Pythium is another type of water mold that can infect seeds, seedlings and roots when soils are saturated. Lesions can range in color from light tan to dark brown and can cover the whole root and hypocotyl. They can be found in wet spots as well as compacted areas of fields.

**Location:** Throughout Ohio, but most severe in fields with low organic matter and poor drainage.

**Time of infection:** Anytime during the growing season when fields are saturated, but the most severe damage is shortly after planting prior to seedling emergence.

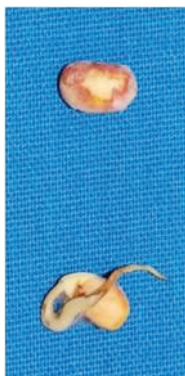
### **Management:**

- Improve drainage
- Seed treatments
- Crop rotation

## FUSARIUM ROOT ROT

**Description:** Fusarium produces dark brown to tan discolorations on the roots and seeds. In cases where high levels of soil moisture are present, white to pinkish-red mycelial growth can be found on the roots and seeds.

**Location:** Fusarium is a common residue borne plant pathogen, infections will be higher in fields which are no-till or have a lot corn and wheat residue remaining in the field.



**Time of infection:** Our studies to date have only confirmed this as a seed and seedling pathogen in which infections occur shortly after planting.

**Management:**

- Seed treatment
- Reduce corn and wheat residue through tillage or rotation

## BACTERIAL LEAF BLIGHT



**Description:** Bacterial leaf blight appears as small angular, water-soaked dark spots surrounded by a narrow yellow halo. The centers of lesions may fall out or tear leaving the leaves with a ragged appearance.

**Location:** Bacterial leaf blight is rare, but can occur throughout Ohio.

**Time of infection:** Bacterial leaf blight can be found throughout the growing season and is spread by driving rain from infected cotyledons to newly developing leaves.

**Management:**

- Resistant varieties
- Crop rotation

## BACTERIAL PUSTULE



**Description:** Another bacterial leaf disease where dark spots surrounded by bright yellow. On the underside of leaves, the tissue forms pustules which appear very similar to soybean rust. The necrotic areas are much larger than soybean rust.

**Location:** Tends to be rare but has been found throughout Ohio.

**Time of infection:** Any time during the year but more prominent during wet seasons. Bacteria are easily spread by wind driven splashing rain.

**Management:**

- Resistant varieties
- Crop rotation

## BROWN SPOT



**Description:** Brown spot is a fungal disease that produces irregular, dark brown spots that vary in size from flecks to 3/16" in diameter. Spots coalesce, turn a darker brown and infected areas turn chlorotic or yellow. Affected leaves are primarily limited to the lower canopy but may reach the mid-canopy in highly susceptible varieties.

**Location:** Brown spot occurs throughout Ohio, but is especially prevalent in fields where soybeans follow soybeans.

**Time of infection:** Spread of brown spot occurs early in the season as spores (conidia) are splashed from residue onto unifoliate leaves. Wet conditions and heavy rains splash spreads the fungus upwards in the plant canopy.

**Management:**

- Resistant varieties
- Crop rotation
- Tillage to bury soybean residue

## DOWNY MILDEW



**Description:** Downy mildew appears on the upper surface of young leaves as pale green to yellow spots that enlarge into bright yellow lesions of indefinite size and shape. During moist weather lesions on the lower leaf surface are covered with the tufts of white mold. Seeds may be encrusted with dull, dried whitish mold.

**Location:** Wherever soybeans are grown in the state.

**Time of infection:** First symptoms may be seen on trifoliolate leaves of young plants in June during periods of high humidity and cool temperatures. Disease spread continues if temperatures remain cool. Most commonly found in years with above normal rainfall.

**Management:**

- Crop rotation
- Tillage

## FROGEYE LEAF SPOT



**Description:** Frog-eye leaf spot is caused by the fungus *Cercospora sojina*, which infects new young leaves. Circular to irregular shaped lesions form that are gray in the center and surrounded by a deep purple ring. On the bottom side of the lesion on the underside of the leaves, spores in the center of lesion can be seen.

**Location:** Frog-eye is a residue borne pathogen as well as a rain and wind borne. Typically damaging levels can be reached when susceptible varieties are planted into fields where the disease was prevalent on soybeans the year before.

**Time of infection:** When inoculum is present, infections can occur at any time of the season. In soybean fields which are continuous, and a susceptible variety is grown, then infections can occur very early in the season. If the pathogen is wind blown, it is more often found at the late R5/R6 growth stage.

**Management:**

- Resistant varieties
- Crop rotation

## POWDERY MILDEW



**Description:** Powdery mildew appears on the upper surface of leaves as powdery tufts of mycelium.

**Location:** Rare but can occur where ever soybeans are grown.

**Time of infection:** First symptoms are seen on young leaves in mid to late July during periods of high humidity and cool temperatures.

**Management:**

- Resistant varieties
- Crop rotation

## STEM AND LATE SEASON DISEASES

### BROWN STEM ROT



**Description:** Leaf symptoms of brown stem rot consist of interveinal chlorosis and necrosis where the veins remain green. The most reliable characteristic is the dark, reddish brown discoloration of the stem pith in the lower stem. Leaves may suddenly wilt and plants die 3 to 4 weeks prior to maturity.

**Location:** Brown stem rot is more prevalent in fields with a long history of soybean cultivation. Studies from Wisconsin have also shown that soybeans grown in soils with a low pH have greater expression of disease severity.

**Time of infection:** The brown stem rot fungus resides in the soil and generally attacks plants during the first half of the growing season. No obvious symptoms develop on plants until after flowering then symptoms develop rapidly during periods of dry weather.

#### **Management:**

- Maintain best soil management practices with optimum pH
- Resistant varieties
- Crop rotation

## CHARCOAL ROT



**Description:** Charcoal rot has been diagnosed more frequently in Ohio following several summers of drought like conditions. Early season diagnosis is very difficult but during the later stages of plant development very small, black resistant structures (sclerotia) become evident as a grayish-black discoloration in the root and lower stem tissues. Cutting the lower stem with a knife will expose the discolored tissues in comparison to the normally healthy white tissues of healthy plants.

**Location:** This disease is more prevalent in southern Ohio than in the northwest region.

**Time of infection:** Infection occurs early in the season and seedlings and the fungus grows slowly in the plant until hot dry weather occurs after flowering. Premature death of the plants suffering from drought stress is an indication of charcoal rot.

**Management:**

- Crop rotation
- Plant at lower plant populations to reduce drought stress
- Maintain adequate soil fertility

## SCLEROTINIA STEM ROT OR WHITE MOLD



**Description:** Sclerotinia stem rot is identified as a white cottony mold growth on soybeans stems after flowering. As the cottony growth ages, hard, black oval to elongate resistant structures (sclerotia) form on the stem surface or inside the stem. The sclerotia are gray to pinkish white on the inside with a black outer surface.

**Location:** Sclerotinia stem rot occurs throughout the state, but has been more severe in fields surrounded by woods with high plant populations and high fertility.

**Time of infection:** Wet weather before and during flowering of the soybean plant is important for infection. The duration of the wet period during flowering and the capacity of the soybean canopy to keep stems wet for extended periods of time contribute to disease severity. Symptoms first appear in late August or early September.

### **Management:**

- Resistant varieties
- Fungicide applications as seed treatment and also at flowering
- No-till production
- Reduce plant populations

## PHYTOPHTHORA STEM CANKER



**Description:** In adult plants a severe root rot develops which then moves several nodes up the stem and girdles the plants. Plants can die throughout the season and tend to be those with low levels of partial resistance (also called field resistance).

**Location:** Phytophthora root rot is primarily a problem in the heavy clay, poorly drained soils throughout Ohio. This disease has re-emerged as a major pathogen of soybeans due to the adaptations by the Phytophthora populations to all of the commonly deployed Rps genes (Rps1a, Rps1c, Rps1k and Rps3a) as well as fewer varieties with high levels of partial resistance.

**Time of infection:** Plants of any age can be infected, and infections occur when soils are saturated. The best time to see symptom development is one to two weeks after a heavy rain.

### **Management:**

- Choose varieties with high levels of partial resistance
- Crop rotation
- Improve drainage

## STEM CANKER



**Description:** Stem canker begins as a reddish-brown lesion on the leaf scar after the petiole on the stem has fallen. The lesion enlarges rapidly forming a slightly sunken, reddish-brown to black girdling canker. The stem above the canker generally dies.

**Location:** Stem canker can occur anywhere in Ohio.

**Time of infection:** Lower leaves may be affected early in the season, but girdling occurs after mid-season such that dead plants can be found in August.

**Management:**

- Resistant varieties
- Crop rotation

## SUDDEN DEATH SYNDROME



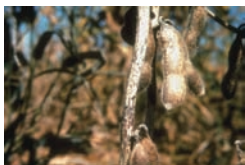
**Description:** Leaf symptoms start as bright yellow, small spots which grow to necrotic areas. The pith in the stem is white in contrast to brown stem rot. For SDS the roots are rotted and the tissue in the root crown is discolored and gray.

**Location:** SDS has been found throughout Ohio. In almost all cases, SCN is also present at high levels.

**Time of infection:** Wet weather following planting appear to correlated with higher incidence of disease.

### **Management:**

- Reduce SCN populations
- Improve soil drainage
- Crop rotation
- Plant resistant varieties

**POD AND STEM  
BLIGHT****PHOMOPSIS  
SEED ROT**

**Description:** Linear rows of small black fruiting bodies (pycnidia) on stems of plants and scattered over the surface of pods at or before harvest are signs of pod and stem blight.

**Description:** Phomopsis seed rot can be detected in harvested grain as badly cracked, shriveled and moldy seed.

**Location:** Pod and stem blight and Phomopsis seed rot occur throughout Ohio, but are more prevalent in the southern and western regions of the state.

**Time of infection:** The fungi that cause these diseases reside on residues or on seed. Infection occurs during pod formation, but symptoms do not develop until plants begin to mature and pods turn yellow. Under wet conditions that prevent timely harvest of the crop, the pod and stem blight fungi enter the developing seed and cause Phomopsis seed rot.

**Management:**

- Crop rotation
- Seed treatments
- Tillage

## SOYBEAN CYST NEMATODE



**Description:** The most common symptom of soybean cyst nematode is reduced yield with no above ground plant symptoms. Yellowing and stunting of plants is generally only detect in fields with high cyst populations. The cyst nematode can best be seen on roots in the field during late July or August. Plants should be dug to keep roots intact. Gently remove soil from around roots and examine root surfaces for very small (about the size of a shirt pin head), white cysts. Later in the season cysts turn brown and are difficult to see. Soil samples should be collected in the fall after harvest for disease management strategies.

**Location:** Soybean cyst nematode has been found in all soybean production counties in Ohio.

**Time of infection:** Soybean cyst nematode can infect plants throughout the growing season. The nematode is capable of several generations during the growing season.

**Management:**

- Crop rotation among crops (wheat-corn)
- Rotation among sources of cyst resistance (PI88788, Peking, PI 437654 also referred to as Hartwig and branded as CystX)

# VIRUS DISEASES OF SOYBEAN

## BEAN POD MOTTLE VIRUS



**Description:** Bean pod mottle virus has increased in incidence and is transmitted by bean leaf beetles and other chewing insects.

**Location:** Very common virus disease of soybean.

**Time of infection:** More infections and greatest yield impact occur when soybeans are infected early in the season. This tends to coincide on first planted fields in early to mid April. This coincides with the emergence of the overwintering stage of the bean leaf beetle.

**Symptoms:** Virus symptoms can vary from severe stunting, pale mottling and rugosity. Bean pod mottle virus is one of several soybean viruses which can also develop severe seed coat mottling.

## BUD BLIGHT



**Description:** Bud blight is a virus disease transmitted by thrips. Damage is usually confined to the perimeter of the field. Seedling infections result in severe stunting, shortened internodes, curving of the terminal bud to form a crook, and a brown discoloration of the pith near the nodes. Buds become brittle and fall off and leaves become rugose and bronzed. Plants stay green and do not mature. Do not confuse with herbicide injury.

**Location:** Throughout Ohio.

**Time of infection:** Seedlings through adult plants.

Virus symptoms vary on different soybean varieties and more than one virus can infect a plant. Laboratory analysis is necessary for determining which virus is responsible for the disease.

## NUTRIENT DEFICIENCY SYMPTOMS IN SOYBEAN

### Potassium



- Potassium deficiency symptoms appear as a chlorosis along the leaf tip progressing toward the leaf base along the leaf margins.
- It can occur on both the older, lower leaves and the newer, upper leaves.

## NUTRIENT DEFICIENCY SYMPTOMS IN SOYBEAN (CONT.)

### Manganese



- Manganese deficiency symptoms appear as an interveinal chlorosis of newer, upper trifoliates.
- Can be confused with iron deficiency, but iron deficiency is quite uncommon in Ohio.
- Manganese deficiency typically occurs on high organic matter soils, soils with higher pH levels, and poorly drained soils.
- Drought conditions also induce manganese deficiency.

## NUTRIENT DEFICIENCY SYMPTOMS IN SOYBEAN (CONT.)

### Nitrogen

- Pale green or yellow leaves (fairly uniform discoloration)
- Look for poor nodulation on roots

### Phosphorus

- Growth stunted, leaf cupping and some discoloration possible
- Deficiencies are rare in Ohio

### Calcium

- Leaf tips pinched, leaf bronzing, early leaf drop, growing point goes necrotic
- Deficiencies are rare in Ohio

### Magnesium

- Pale green lower leaves with yellow mottled interveinal tissue, later looks speckled bronze
- Deficiencies are rare in Ohio (causes: sandy soils, low pH, high K)

### Sulfur

- Stunted plants, pale green color, similar to nitrogen deficiency except chlorosis may be more apparent on upper leaves
- Most likely during cool wet conditions or on sandy soils

### Iron

- Same symptoms as manganese (also a problem in high pH and/or dry soils)
- Deficiencies are rare in Ohio

## NUTRIENT DEFICIENCY SYMPTOMS IN SOYBEAN (CONT.)

### Boron

- Small seed, poor quality
- No deficiencies have been documented in Ohio
- Toxicity can occur at low pH's, symptoms include yellowing to browning of leaf margins, crinkled leaves and leaf edges that cup up or down (can stunt plant)

### Copper

- No deficiency symptoms are visible
- Deficiencies are rare in Ohio

### Zinc

- Stunted plants with light green to yellow leaves (interveinal chlorosis), lower leaves may turn bronze and drop
- Scarce flowers, malformed pods, slow maturation

### Molybdenum

- Molybdenum is necessary for nitrogen fixation, symptoms are the same as nitrogen deficiency

### Chlorine

- Toxicity: necrosis along the leaf margin, leaves shed prematurely, occurs most frequently during reproductive stages

## POTASH (K<sub>2</sub>O) RECOMMENDATIONS FOR SOYBEANS AT VARIOUS YIELD POTENTIALS, CEC'S & SOIL TEST LEVELS.

Yield Potentials	bu/ acre	30	40	50	60	70
Soil Test K		lb K <sub>2</sub> O per acre				
ppm (lb/acre)	CEC	5 meq/100g				
25 (50) <sup>1</sup>		140	155	170	180	195
50 (100)		110	125	135	150	165
75 (150)		80	90	105	120	135
88-118 (176-235) <sup>2</sup>		60	75	90	105	120
130 (260)		25	30	35	40	45
140 (280)		0	0	0	0	0
	CEC	10 meq/100g				
25 (50)		175	190	205	215	230
50 (100)		135	150	165	180	195
75 (150)		100	115	130	140	155
100-130 (200-260) <sup>2</sup>		60	75	90	105	120
140 (280)		30	40	45	50	60
150 (300)		0	0	0	0	0
	CEC	20 meq/100g				
50 (100)		210	225	240	255	270
75 (150)		160	175	190	205	220
100 (200)		110	125	140	155	170
125-155 (250-310) <sup>2</sup>		60	75	90	105	120
165 (330)		30	40	45	50	60
175 (350)		0	0	0	0	0
	CEC	30 meq/100g				
75 (150)		250	265	280	290	300
100 (200)		185	200	215	230	245
125 (250)		125	140	155	165	180
150-180 (300-360) <sup>2</sup>		60	75	90	105	120
190 (380)		30	40	45	50	60
200 (400)		0	0	0	0	0

<sup>1</sup> Values in parentheses are lb/acre.

<sup>2</sup> Maintenance recommendations are given for this soil test range.

## PHOSPHATE (P<sub>2</sub>O<sub>5</sub>) RECOMMENDATIONS FOR SOYBEANS

Soil Test	Yield Potential-bu per acre				
	30	40	50	60	70
ppm (lb/acre)	lb P <sub>2</sub> O <sub>5</sub> per acre				
5 (10) <sup>1</sup>	75	80	90	100	105
10 (20)	50	55	65	75	80
15-30(30-60) <sup>2</sup>	25	30	40	50	55
35 (70)	10	15	25	25	30
40 (80)	0	0	0	0	0

<sup>1</sup> Values in parentheses are lb/acre.

<sup>2</sup> Maintenance recommendations are given for this soil test range.

### NUTRIENT SUFFICIENCY RANGES FOR SOYBEANS (Upper fully developed leaf sampled prior to initial flowering)

Nutrient Element	Unit	Sufficient
Nitrogen (N)	%	4.25-5.50
Phosphorus (P)	%	0.30-0.50
Potassium (K)	%	2.01-2.50
Calcium (Ca)	%	0.36-2.00
Magnesium (Mg)	%	0.26-1.00
Sulfur	%	0.21-0.40
Manganese (Mn)	ppm	21-100
Iron (Fe)	ppm	51-350
Boron (B)	ppm	21-55
Copper (Cu)	ppm	10-30
Zinc (Zn)	ppm	21-50
Molybdenum (Mo)	ppm	1.0-5.0

Sampling information on page 204

## SOYBEAN STAND EVALUATION AND REPLANT DECISIONS

Suggested Seed Drop per Foot of Row for Combinations of Maturity, Planting Date and Row Width

Relative Maturity	Planting Date	Seeds/foot of row*		Thousand Seeds/ acre*	
		7.5"	15"	7.5"	15"
2.1-2.5	Before 5/20	2.8	5.6	195	195
	5/21-6/05	3.0	6.0	209	209
	6/06-6/20	3.3	—	230	—
2.6-3.0	Before 5/20	2.6	5.0	181	174
	5/21-6/05	2.8	5.4	195	188
	6/06-6/20	3.0	5.6	209	195
	After 6/20	3.3	—	230	—
3.1-3.5	Before 5/20	2.4	4.2	167	146
	5/21-6/05	2.6	4.5	181	157
	6/06-6/20	2.8	4.9	195	171
	After 6/20	3.1	5.4	216	188
	Double Crop	3.5	—	255	—
3.6-4.1	Before 5/20	2.3	4.1	160	140
	5/21-6/05	2.5	4.4	173	151
	6/06-6/20	2.7	4.8	188	164
	After 6/20	3.0	5.3	207	180
	Double Crop	3.4	—	245	—

\*For good growth environments these seeding rates can be reduced to 75% of the table values, and for poor growth environments they should be increased by 30% of the table values.

### Yield Effects from Reduced Plant Populations, Uniform Stand and Weed-free Conditions

Population Plants/acre	Yield as % of normal	
	Conventional Till	No-till
160,000	100	100
120,000	100	98
80,000	98	95
60,000	90	90

## SOYBEAN STAND EVALUATION AND REPLANT DECISIONS (CONT.)

Minimum Acceptable Plant Population at Emergence for Various Row Spacings to Prevent Replanting in 7-inch Rows

Row Spacing (in)	Emergence Date			
	May 15	June 1	June 15	July 1*
	No. Plants/ft			
7	1	1.2	1.6	1.6
15	2	2.2	2.4	2.4

\* Do not attempt replanting after July 10 in Northern Ohio or after July 18 in Southern Ohio.

### Yield effects from delayed planting (uniform stands)

Planting Date	Yield % of Normal
May 1	100
May 10	99
May 20	96
May 30	90
June 10	80
June 20	68
June 30	57
July 10	40

## SOYBEAN STAND EVALUATION AND REPLANT DECISIONS (CONT.)

### Expected Yield Loss from Defoliation

Development Stage at Defoliation	Defoliation %				
	10	25	50	75	100
	% Yield Loss				
V2	0	3	4	5	18
V6	0	3	5	8	26
R2	2	4	9	15	37
R4	7	13	18	36	83
R6	6	6	7	14	33
R7	0	0	0	0	0

NOTE: See pages 76 and 77 for vegetative and reproductive staging.

### Soybean Population as a Function of Hula Hoop Diameter

Hoop Diameter	Multilayer*
28 inches	10,200
30 inches	8,900
32 inches	7,800
34 inches	6,900
36 inches	6,200

## SOYBEAN STAND EVALUATION AND REPLANT DECISIONS (CONT.)

### Soybean Replant Worksheet

1. Base yield for field \_\_\_\_\_ bu/a
2. Est. of yield as % of normal from reduced stands \_\_\_\_\_ %
3. Est. of deficient stand yield  
(Base yield x line 2) ÷ 100 \_\_\_\_\_ bu/a
4. Projected gross income  
(line 3 x market price) \_\_\_\_\_ \$/a
5. Weed control cost for poor stand \_\_\_\_\_ \$/a
6. Gross return with no replanting  
(line 4 minus line 5) \_\_\_\_\_ \$/a
7. Est. of yield as a % of normal from delayed planting \_\_\_\_\_ bu/a
8. Est. of yield for replanting  
(Line 1 x line 7) ÷ 100 \_\_\_\_\_ bu/a
9. Projected gross income from replanting (line 8 x \$ price) \_\_\_\_\_ \$/a
10. Cost of replanting (tillage, seed, herbicide, labor) \_\_\_\_\_ \$/a
11. Gross returns from replanting  
(Line 9 minus line 10) \_\_\_\_\_ \$/a
12. Compare gross returns on line 6 and line 11 to determine whether to replant \_\_\_\_\_ \$