MSU-OSU Field Crops Insect Guide: Management of Insects and Spider Mites in Soybean
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How to Use this Guide

This publication is set up as a series of stand-alone tables with information on insect biology, damage, management recommendations, and insecticides registered in Michigan and Ohio on **soybean**. Pesticide names and rates are current as of the date at the top of the page.

- ✓ **Table 1** shows the timing of common insect pests in the crop, from early to late season.

- ✓ **Table 2** is a checklist of damage symptoms from these insects to aid in field scouting.

- ✓ **Table 3** has information on the life cycle of each insect, plus a detailed description of its damage and the conditions that may lead to or favor infestations. A rating of pest status (and thus damage potential) is given based on experience in the state. Most insect pests are uncommon or do not increase to damaging levels in a typical year.

- ✓ **Table 4** has information on management of each pest. Most insects are kept in check by natural enemies (biological control) or by adverse environmental conditions. Some pest problems can be reduced by simply changing or avoiding certain agronomic practices. Table 4 also gives scouting and threshold recommendations. Note that these recommendations vary in quality. Key pests tend to have research-based scouting methods and thresholds. But many insects are not at damaging levels often enough to generate good information; sampling recommendations and thresholds for these species are based on observations, experience, or a best guess. This is noted in the table.

- ✓ Insecticides registered in Michigan and Ohio (except where noted) on the crop are listed in **Table 5.** Active ingredients (AI) are listed alphabetically in column 1. All products with the same active ingredient are grouped together under each AI for easy comparison or substitution of one product for another. Label rates and pests are listed in columns 2 and 3. A letter under a pest indicates that a particular insect is on the label (i.e., the label claims control of that insect). The letter corresponds to an application rate in column 2. Some insecticides are applied at a single rate for all insects ('a'), while others vary ('a', 'b', 'c'). The final columns in the table list the preharvest interval (PHI) in days and notes on application - for example bee toxicity warnings, minimum recommended spray volumes, or other restrictions.

Soybean Table 1: Timing of damage from common insects and related pests.
Pests are listed from early to late-season. Key species are highlighted in bold text.

Common name	Overwintering stage, location	May	June	July	August	Sept
white grubs	larvae (grubs), underground	root feeding by annual grubs				
		root feeding by June beetle grubs				
seedcorn maggot	pupae, in soil	larval (maggot) damage to germinating plants				
wireworm	larvae, in soil	larval damage to roots				
slugs & snails	both eggs and adults, in field	feeding on seedlings				
black cutworm	Southern USA, migrate north	larval feeding on leaves and cutting of plants				
bean leaf beetle	adults, woodlots & residue		chew small holes in leaves		chew holes in leaves &into pods	
soybean aphid	eggs, on buckthorn		nymphs and adults pierce leaves, feed on plant sap and secrete honeydew			
silver spotted skipper	pupae		larvae feed on leaves & live in a distinctive shelter made of leaves folded or tied together			
leaf-feeding caterpillars = defoliators (multiple species)	beet armyworm, webworm, yellow woolly bear - pupae All others: Southern USA, migrate north		larval feeding on leaves (defoliation). Earworm and looper may also feed on pods. Timing depends on species. • As early as June: beet armyworm, green cloverworm, thistle caterpillar, webworm, woolly bear • Later, July - August: earworm, fall armyworm, soybean looper, velvetbean caterpillar			
grasshoppers (multiple species)	egg clusters, underground			nymphs, then adults, feed on leaves		
Japanese beetles	larvae (grubs), underground			adult skeletonizing, mainly along field edges		
spider mite	adult females, at base of hosts			multiple generations pierce plant cells		
soybean gall midge	pupae, on/in ground			maggots feed on lower stems; *not yet reported in MI or OH*		
thrips	depends on species			adults and nymphs 'punch' and suck plant cells		
stink bug	adults, in & around fields				piercing of pods & beans	

Soybean Table 2: Damage checklist to aid in scouting for insects and related pests.

Plant part or timing Type of damage or injury	bean leaf beetle	black cutworm	caterpillars (various)	earworm	grasshoppers	green cloverworm	Japanese beetle	seedcorn maggot	silver-spotted skipper	slugs & snails	soybean aphid	soybean gall midge	soybean looper	spider mite	stink bug	thistle caterpillar	thrips	velvetbean caterpillar	webworm	white grubs	wireworm
Stand (emergence)																					
seeds fed-on								x		x										x	x
cotyledons fed on underground								x		x										x	
cotyledons fed on at emergence		x								x											
seedlings cut before emerging		x																		x	
plants cut at ground level		x																			
gaps in row / stand loss		x						x		x										x	x
Leaves																					
slimy or shiny trails										x											
outer leaf surface scraped (windowpaning)										x											
small round holes	x																				
skeletonizing							x			x			x								
irregular leaf feeding			x	x	x	x	x		x	x			x			x		x	x		
generalized leaf yellowing											x			x							
stippled - tiny yellow spots														x							
pale scarring along veins																	x				
silvering of leaves																	x				
leaves cupped, crinkled											x			x							

Plant part or timing Type of damage or injury	bean leaf beetle	black cutworm	caterpillars (various)	earworm	grasshoppers	green cloverworm	Japanese beetle	seedcorn maggot	silver-spotted skipper	slugs & snails	soybean aphid	soybean gall midge	soybean looper	spider mite	stink bug	thistle caterpillar	thrips	velvetbean caterpillar	webworm	white grubs	wireworm
Leaves, continued																					
sticky or with sooty mold											x										
webbing														x		x			x		
leaf rolling									x							x					
leaf drop											x			x							
plant death												x		x							
Stems																					
discoloration at plant base												x									
brittle stems, lodging												x									
Roots																					
root hairs missing																				x	x
pruning of whole roots																				x	
Pods and beans																					
pods clipped off	x																	x			
pod surface-scarring	x																				
small holes chewed in pod	x																				
large holes chewed in pod				x	x								x					x			
beans chewed <u>in pod</u>				x	x								x					x			
discolored seed															x						
shriveled, aborted beans															x						
Other																					
virus transmission	x										x						x				

Soybean Table 3: Life cycle, damage, and pest status of insects in soybean.

Pest status is rated as follows. Rating applies to Michigan and Ohio.

- Rare: Insect is *unusual, not found in most fields*
- Uncommon: Insect is present in many fields, but typically *not in damaging numbers*
- Occasional: Insect is present in most fields, *sometimes increasing to damaging levels*.
- Important: Insect is present in most fields, *often increasing to damaging levels*; often a target of integrated management or insecticide use by growers.

- Sporadic: Economic outbreaks may occur in certain fields or seasons after *extreme weather* or *mass movement* from south to north early in the season
- Localized: Economic outbreaks may occur in specific locations under *specific agronomic conditions*, for example, in no-till or late-planted fields.

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
bean leaf beetle (BLB)	Adults overwinter in wooded areas, leaf litter, field margins. Beetles emerge in spring, moving into alfalfa and then into soy after first cutting, OR directly into early-planted soy. Eggs are laid on ground around plant. Larvae feed underground on roots & nodules and pupate in soil. New (1st generation) adults feed on leaves and pods. Potential for a 2nd generation in southern Michigan and most of Ohio.	• Overwintering adults feed on younger plants, leaving small round holes • Later in the season, adults feed both on leaves and the surfaces of pods; pod injury creates entry wounds for pathogens & results in shriveled or moldy beans • Adults may clip pods off • Adults can transmit bean pod mottle virus (BPMV) which can affect yield and discolor beans. BPMV contributes to 'stay green' syndrome	• Fields planted near alfalfa or planted very early are at risk for colonization by overwintering beetles • Late-planted fields avoid overwintering beetles, but can act as a trap crop and can have high late-season pod injury	Occasional BLB is a very common insect in soybean, but few fields go over threshold. Pod damage is typically more important than defoliation.
cutworm *including black and variegated cutworm*	Black cutworm moths migrate into Michigan and Ohio in early spring. Eggs are laid on low-growing weeds or residue. Small larvae feed on weeds, but shift to the crop after herbicide is applied. Larvae hide during the day & feed at night. Pupation in soil. 1st generation most damaging	• Small larvae may chew holes in leaves • Larger larvae damage the stem at the soil line or cut seedlings off, reducing stand	• Low, dense weeds or field edges (egg-laying sites) • No-till fields with high crop residue • Planting into cover crops or wet areas	Uncommon We have only seen BCW in soybean a few times.
grasshoppers *several species including redlegged & differential*	Eggs overwinter in soil. Nymphs emerge in June. Feeding increases as nymphs grow. Females deposit groups of eggs in the undisturbed soil in late summer. 1 generation per year	• Defoliation of plants by nymphs and adults; feeding has a ragged appearance • Hoppers may also chew into green pods and consume beans	• Undisturbed fallow areas, roadsides, & pasture are preferred egg-laying sites; hoppers move into field edges from these areas • A dry summer & fall can lead to high populations the following year	Uncommon Outbreaks rare
green cloverworm	Overwinters in the south. Moths migrate north in the spring, arriving in May/June. Eggs laid on underside of leaves. Larvae feed on leaves and pupate there. A second generation occurs in late summer.	• Larvae defoliate plants, eating the leaf tissue between the veins; plants can appear tattered	• Nothing specific	Uncommon Outbreaks rare

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
Japanese beetle adults	Larvae (grubs) feed on roots of many hosts, and overwinter. Adults emerge mid-summer and feed on hundreds of hosts, including soy. Adults may persist into fall. Eggs laid in the soil in July-Sept. 1 generation per year	• Beetles feed between the veins of leaves, leaving a skeletonized appearance • A pheromone draws beetles together to feed & mate, so leaf injury may look dramatic. Don't be fooled - damage is often patchy & limited to upper leaves on field edges	• Field edges near favorite hosts (wild grape, ornamentals) or turf/lawns with a high grub infestation may have more beetles	Occasional JB is common in Michigan & Ohio soy fields, but we have yet to see a field that justified spraying
seedcorn maggot (SCM)	Pupae overwinter in soil. Adult flies emerge in early spring, laying eggs in disturbed soil with decaying organic matter. Larvae (maggots) feed on decaying matter and newly planted seeds. Several generations per year	• Larvae feed on germinating seeds, resulting in variable emergence, stand loss, delayed development • Plants that do emerge often have scarring on cotyledons • Damage can occur over a large part of field	• Cool, wet conditions which delay germination • Recently (w/in 2 weeks) incorporated fresh manure or green organic matter such as cover crops, weeds	Localized Occurs under certain field conditions
silver-spotted skipper	Pupae overwinter. Adults emerge in May and lay eggs on several hosts, including soy. Small caterpillars cut and fold a section of leaf to make a shelter; larger larvae roll several leaves together. Older instars are distinctive with a yellow body, constricted red 'neck', oversized head, and orange eye spots. 2 generations per year	• Larvae feed on leaves around their shelter	• Nothing specific	Uncommon But larvae are weird-looking and often are noticed during scouting
slugs & snails	Slugs overwinter as eggs & adults, so both may be present at planting. Females deposit eggs in soil; these hatch in about one month. Multiple overlapping generations	• Feed on seeds, cotyledons, & leaves, usually at night • Heavy feeding on young plants may inhibit stand development	• No or reduced till • Planting into heavy stubble, crop residue • Cool, wet conditions which delay germination • Poorly-closed furrows, AKA slug buffet lines	Localized Occurs under certain field conditions
soybean aphid (SBA)	Eggs overwinter on buckthorn trees. Females move from buckthorn to soybeans in spring; depending on the planting date, fields can miss being colonized at this time. Aphids - all female - reproduce quickly, giving live birth to nymphs. During the summer, winged migrants invade new fields. In the fall, aphids return to buckthorn to mate and lay eggs. Multiple overlapping generations	• All stages suck plant sap, removing water and nutrients. • Large infestations can impact yield by reducing pod number, beans per pod, and bean size , plus cover plants with sticky honey dew and sooty mold • In sandy fields, top-down symptoms of K deficiency (yellow leaf margins, leaf cupping, stunting) can occur • SBA also transmits soybean mosaic virus. This virus does not limit yield in our area, but discoloration of seed can occur	• Late-planted or double-cropped fields may be overwhelmed by summer migrants and end up with • Potassium deficiency or drought stress • Drought stress enhances damage & reduces onset of aphid-killing fungi	Occasional to Important SBA was a key pest after its discovery in our area the 2000s. Infested fields over threshold are now much less common.
soybean gall midge	First documented in Nebraska in 2011, now spreading east. Larvae overwinter in soil, then pupate in spring. Adults (tiny flies) don't feed, but lay eggs at the base of soy plants. The larvae are bright orange maggots when mature. They feed on stems and drop off plants to pupate. 2 generations per season?	• Larvae feed at the base of plants from V3 - reproduction • Signs of infestation include brown, discolored stems; wilting, broken, or lodged plants; and dead plants • Damage often is first seen in rows on the field edge	• Infestation usually heaviest on edges next to last-year's soybean	None This pest has not yet been found in Michigan or Ohio. Distribution: NE + IA, MN, MO, SD

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
soybean looper	One of the most abundant pests of soybean in the southern U.S. Adults migrate from the south, arriving mid to late season (July/ August).	• Larvae defoliate plants and in rare cases feed on pods	• Nothing specific	Uncommon We have never seen high populations in our area
spider mites *two-spotted*	Adults overwinter in field borders and sheltered areas. In spring, adults move to new growth, lay eggs on underside of leaves. Mites spread from field to field by crawling or blowing in the wind. Multiple overlapping generations	• Adults & nymphs pierce and dehydrate individual plant cells, resulting in tiny yellow spots ('stippling') • Severe damage results in leaf yellowing, leaf death/drop, and water loss • Webbing is a sign of a heavy infestation	• Prolonged hot, dry weather favors outbreaks and enhances the impact of feeding • Infestations often start on dusty edges of fields	Sporadic Outbreaks occur in hot, dry seasons
stink bugs *multiple species*	Adults overwinter and emerge in spring to complete a generation on weeds, clover, wheat. Sampling in Michigan shows that bugs move into soybean after wheat harvest. Egg masses are laid on soybean leaves. Adults and nymphs feed by injecting digestive enzymes and sucking plant juices from stems, leaves and pods, but especially tender growth	• Pod feeding can result in shriveled, deformed, smaller, or discolored beans. In some specialty beans like those grown for natto, stink bug punctures may not be apparent until processing. • Punctures also are entry points for plant pathogens • Stink bug feeding can be related to 'stay green' syndrome	• For brown stink bug - fields near wheat • For the invasive brown marmorated stink bug - fields near woods or buildings	Occasional, in bulk soybean Important, in edible specialty beans Note: some stink bug species are beneficial predators
thistle caterpillar *AKA painted lady butterfly*	Adult butterflies migrate from the south, arriving in June. Eggs are laid on many hosts, including beans. Caterpillars feed on leaves and pupate on the plant. 2 generations per year	• Caterpillars web leaves together to make a distinctive shelter, then feed in and around the structure.	• Nothing specific	Uncommon Outbreaks rare, but webbed leaves & spikey colorful larvae are noticed during scouting
thrips *several species*	Soybean thrips migrate from the south, but other species may be local. Eggs are inserted into plant tissue. Juveniles and adults both feed on (suck) leaf tissue.	• Thrips feed in a unique way using a single mandible to 'punch' into and rupture individual plant cells, then suck up the contents; ruptured cells collapse • Leaves with a lot of damaged cells have a silvery appearance • Thrips also transmit soybean vein necrosis disease	• Prolonged hot, dry weather favors outbreaks and enhances the impact of feeding	Uncommon Thrips are very abundant on soybeans, but rarely cause damage
webworm *garden & alfalfa webworm*	Overwinters as a pupa. Moths emerge and lay eggs on many crops and weeds. Caterpillars tie leaves together with webbing and feed in a silk-lined shelter. 2 generations per year	• The tied shelter can have both windowpane damage and defoliation; under a heavy infestation, leaves may be entirely skeletonized, dry out and turn brown	• Patchy infestations can occur in areas with pigweed (a favorite host) or near alfalfa	Uncommon
white grubs - annual *including Japanese beetle, Asiatic garden beetle (AGB)*	Adults emerge June-July. Eggs laid in soil July-August. Grubs feed on roots until the fall, then move down in soil profile to overwinter. 1 generation per year	• Mature grubs overwinter in fields; feed on cotyledons and roots of seedlings at planting • May reduce stand or increase variability • Japanese beetle adults feed on soybean (see JB in list)	• Fields or parts of fields with >80% sand (AGB) • planting into fallow fields or pasture, or field margins near turf	Localized We have seen stand loss from AGB in sandy soy fields in southern MI & northern OH

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
white grubs - June beetle	Adults emerge in May/June, move and mate at dusk (often come to lights). Eggs laid in soil. Grubs feed for three summers, with 2nd and 3rd stage grubs causing the most damage to roots. Between summers, larvae move to a lower depth in soil. Late in the 3rd summer, grubs pupate underground; adults overwinter until next spring. 1 generation takes three years	• Grubs may be present for the entire season, feeding on roots and cotyledons of seedling as well as roots of larger plants • At planting, may reduce stand and uniformity; later in season, symptoms include wilting, water and nutrient deficiency, or plant death	• Sandy fields or parts of fields • Planting into fallow fields & pasture	Uncommon & Localized In Michigan, there have been a few cases of stand loss in sandy fields in the Thumb
wireworm *multiple species*	Wireworms are the immature form of click beetles. They spend up to six years in the immature stage. Overlapping generations.	• Feed on newly planted soybean seed & roots	• Planting into long-standing fallow fields & pasture	Uncommon & Localized Occurs under certain field conditions

Soybean Table 4: Management notes, scouting recommendations, and thresholds.

For chewing insects in soybean, a general defoliation threshold is used for the combination of species usually present in fields. See the end of this table for information to aid in estimating this defoliation.

Pest	Notes on non-chemical and chemical management	Scouting recommendation	Spray threshold
bean leaf beetle (BLB)	• Environment: Extended periods of subfreezing winter temperatures can increase death of overwintering beetles	For general detection of beetles, use a sweep net To estimate defoliation, visually examine whole plants (minimum of 20) from various locations in a field	General defoliation guideline for insects: • Veg stages: 40% • R1-R6 (pod fill): 15% Threshold for pod feeding: 10% + beetles still present
caterpillars	*The leaf-feeding caterpillars (cloverworm, earworm, skipper, soybean looper, thistle caterpillar, velvetbean caterpillar, webworm) do similar damage and can be grouped together for management recommendations* • Biological: Natural enemies keep most species in check	To estimate defoliation, visually examine whole plants (minimum of 20) from various locations in a field	General defoliation guideline for insects: • Veg stages: 40% • R1-R6 (pod fill): 15%
cutworm *including black and variegated cutworm*	• Biological: Ground beetles and parasitoids kill larvae • Agronomic: Good weed control and timely cover crop termination reduce likelihood of infestation • Insecticide: Rescue (post-planting) treatments are effective and preferred, as cutworm is uncommon in soybean	Walk fields to check stand. Larvae feed at night and on overcast days. During the day, dig around base of plants to locate them Pheromone traps for black cutworm can and aid in timing of scouting	Guideline - treat if reduction in stand count is unacceptable based on target plant population (soy can compensate for some stand loss)
grasshoppers *several species including redlegged & differential*	• Biological: Blister beetle larvae prey on eggs, while insects, birds, and mammals eat nymphs & adults. Fungal pathogens kill eggs and nymphs under wet spring conditions • Agronomic: Tillage reduces survival of eggs and newly hatched nymphs • Insecticide: May be able to limit spray area if hoppers invade from a neighboring field or grassy border	No specific recommendation	General defoliation guideline for insects: • Veg stages: 40% • R1-R6 (pod fill): 15%
green cloverworm	*See "caterpillars" above*		
Japanese beetle adults	• Insecticide: May be able to limit spray area to the edge, since beetles often congregate there	To estimate defoliation, visually examine whole plants (minimum of 20) from various locations in a field	General defoliation guideline for insects: • Veg stages: 40% • R1-R6 (pod fill): 15%
seedcorn maggot (SCM)	• Agronomic: Delay planting at least 2 weeks into disced cover crops, weeds, manure, or heavy residue. It is especially important to avoid early (April) planting under these circumstances when cold soils delay emergence • Agronomic: Problems almost never occur in no-till fields • Insecticide: Management is essentially preventative. If choosing to plant early and into a recently tilled field, an insecticide seed treatment can help, but may not be 100% effective if the maggot population is high	No specific recommendation	No rescue treatment available. Consider replanting fields or areas with significant stand loss. An insecticide seed treatment is not recommended for replant situations (SCM risk has passed)
silver-spotted skipper	*See "caterpillars" above*		

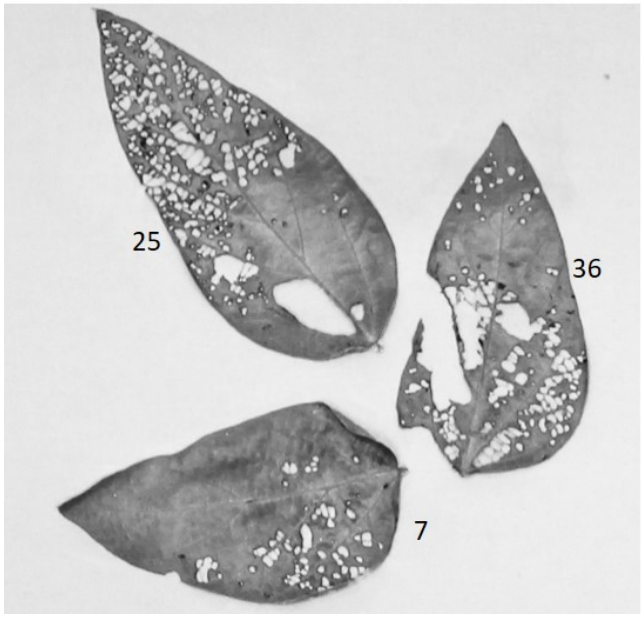
Pest	Notes on non-chemical and chemical management	Scouting recommendation	Spray threshold
slugs & snails	• Biological: Some ground beetle species consume slugs • Agronomic: Tillage and crop rotation reduce residue (slug habitat); avoid planting in wet conditions, as open furrows act as slug buffet lines • Insecticide: Slugs are not insects; soil insecticides and neonicotinoid seed treatments (NSTs) do not kill them. In fact, NSTs can increase slug problems because slug-eating ground beetles are killed by the insecticide	No specific recommendation Place shingles in fields before planting to detect slugs, which hide under them during the day	None established Consider treating and replanting fields or areas with significant stand loss
soybean aphid (SBA)	• Biological: Numerous predators and several species of parasitoids keep SBA in check in recent years. Later in the season, aphids are also controlled by insect-killing fungi • Agronomic: In fields with sandy soils, adequate potassium levels reduce SBA risk and yield loss • Insecticides: Timing and coverage are key. Do not spray early (below the threshold); this disrupts natural enemies and aphid numbers can rebound. Insecticide resistance is reported in aphid populations in some western states, and insurance or early sprays created these resistance issues. If the threshold is reached, do use nozzles which provide good coverage and a high enough water volume to achieve excellent coverage	Begin scouting at end of June. Pick a minimum of 30 whole plants, spreading the sampling out. Count the total # of SBA on each (including '0s'). Calculate the average # per plant. For quicker sampling, use the "Speed Scouting" technique developed by Iowa State University	Economic threshold: • R1-R5: 250 per plant • After R5: don't treat Factors to consider: * Spraying may be unnecessary if there are a lot of predators, or tiny white aphids, or fungus-killed aphids
soybean gall midge	• Agronomic: Infestations start on field edges adjacent to previous year's soybean. **Gall midge has not been found yet in Michigan or Ohio. If you suspect it, contact a local Extension Educator.**	In edge-rows with wilted, broken, or dead plants, split base of plants to check for black tissue and bright orange maggots	None established
soybean looper	*See "caterpillars" above*		
spider mites *two-spotted*	• Biological: Under humid conditions, a natural fungal pathogen can infect and wipe out mites in a matter of days. Some natural enemies consume mites • Agronomic: Irrigation reduces the impact of spider mite feeding and increases humidity for fungal pathogens, but in a prolonged drought, even irrigation isn't enough • Environmental: Rainfall has a similar effect as irrigation • Insecticide: Insecticide resistance is common in spider mite. Some insecticides (including most pyrethroids) sprayed to control insects flare mite populations by killing natural enemies. Also, fungicides may flare mites by disrupting natural fungal pathogens. Therefore, insurance applications of both are discouraged; in other words, be cautious about pesticide applications in dry years	Infestations often start on field edges. Confirm mites are present by tapping leaves over a paper plate or piece of paper (black construction paper works well) Also look for stippling and leaf yellowing, drying, & drop	Guideline: Treat when stippling is widespread on lower leaves and progressing into the middle canopy Factors to consider: * Will the forecast remain hot and dry? * Is good coverage possible? * Yield loss from running over beans?
stink bugs *multiple species*	• Biological: Several parasitoids attack egg masses or bugs	Use a sweep net to take 5 sets of 20 sweeps across the field	Guideline: 40 stink bugs in 100 total sweeps
thistle caterpillar	*See "caterpillars" above*		
thrips *(several species)*	• Biological: Many small-sized natural enemies (pirate bugs, predatory mites, predatory thrips) build up their populations by feeding on thrips. Interesting, some thrips provide biological control by feeding on spider mite eggs! • Agronomic: Thrips develop in small grain fields first, and may move into soybeans after dry-down • Insecticides: Seed treatments may control thrips for a few weeks after soy emergence. However, this removes a source of prey to build natural enemy populations in soy	Pick leaves from several locations in the field, from the mid-canopy Use a hand lens to count the total number of thrips per leaf	Guideline: 8 thrips per leaf We have seen 'sprayable' numbers only once, in the 2012 drought.
webworm	*See "caterpillars" above*		

Pest	Notes on non-chemical and chemical management	Scouting recommendation	Spray threshold
white grubs *including Japanese beetle, Asiatic garden beetle (AGB), and June beetle*	• Biological: Some species are attacked by pathogens • Agronomic: If practical, fall plowing of at-risk fields is recommended. For Asiatic garden beetle in southern Michigan and northern Ohio, planting later may avoid most feeding. • Insecticide: Grubs have 'eaten through' seed treatments in some cases. Rescue treatments are not available Note: it is important to identify grubs in the field to distinguish annual species from June beetles, which remain in fields for multiple seasons.	No specific recommendation Grubs tend to be patchy, especially in the sandiest parts of fields. Fields with a history of grubs can be checked with a shovel in early spring.	No rescue treatment available. Consider replanting fields or areas with significant stand loss.
wireworm	• Agronomic: Depending on species, wireworms remain in the larval stage for 1 to 6 years, thus they are favored by undisturbed soil. If practical, fall plowing of long-standing fallow & pasture prior to planting is recommended • Insecticides: Seed treatments may be helpful. Rescue treatments are not available	No specific recommendation	No rescue treatment available. Consider replanting fields or areas with significant stand loss.

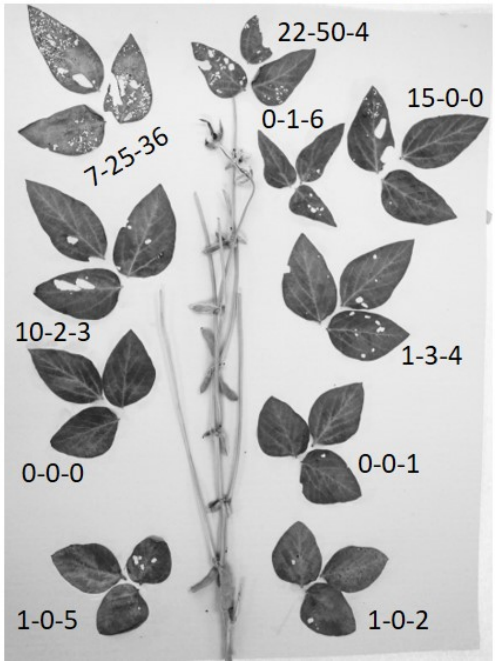
Soybean Figure 1: Estimating defoliation

Defoliation thresholds in soybean are based on an overall estimate of feeding on whole plants across the field, not on defoliation on a field edge or on the worst parts of a plant. Soybean has a great capacity to compensate for defoliation because lower leaves can 'pick up the slack' for damage to upper leaves. The plant below was pulled apart and % defoliation measured by leaflet with a scanner. Defoliation on the three leaflets of the worst leaf (left) averages 23% which is at 'threshold'. This is misleading because defoliation averaged across the 30 leaflets of the whole plant (right) is only 7%, a much truer estimate that is well below threshold.

Misleading defoliation based on the Worst leaf (3 leaflets): Avg: 23%



Whole Plant (30 leaflets): Avg: 7%



SOYBEAN Table 5: Foliar insecticides registered in Michigan and Ohio to manage soybean insects and related pests, with preharvest intervals and precautions.

- Insecticides are listed alphabetically by active ingredient(s), with trade names below. Thus, similar pesticides are grouped together for easy comparison.
- Letters under each pest indicate which rate to use, from the previous column. If a letter is not given, that pest is not on the label.
- Note: The caterpillar category includes cloverworm, earworm, silver-spotted skipper, soybean looper, thistle caterpillar, velvetbean caterpillar, and webworm. These are grouped together because they defoliate soybeans in the same way.

Active ingredient Trade Names	**Labelled rate(s) per acre** (unless stated)	**bean leaf beetle**	**caterpillars**	**cutworm**	**grasshoppers**	**Japanese beetle**	**slugs & snails**	**soybean aphid**	**spider mite**	**stink bugs**	**thrips**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
abamectin Agri-Mek SC	(a) 1.75 - 3.5 oz								a			28	• Apply when spider mites are first observed • To avoid illegal residues, product must be mixed with a specific spray adjuvant. See label for details • For best control, apply by ground instead of air • Maximum two sequential applications of an abamectin product • Do not allow livestock to graze or harvest treated vines as feed
acephate Acephate 90 Prill Acephate 90 WDG Acephate 90 WSP Acephate 97 UP Acephate 97 WDC Orthene 97	 (a) 0.28 - 0.56 lbs (b) 0.56 - 1.1 lbs (c) 0.83 - 1.1 lbs (a) 0.25 - 0.5 lbs (b) 0.5 - 1.0 lbs (c) 0.75 - 1.0 lbs	c	c		a			c		b	a	14	• Do not graze or use treated vines for hay or forage
afidopyropen Sefina also see *cypermethrin + afido.*	(a) 3.0 oz							a				7	• Controls sucking pest by disrupting feeding & other behaviors, creating 'zombie' aphids that die a slow death • Do not graze or feed soybean hay or forage
Bacillus thuringiensis - Bt Agree WG Biobit HP Javelin WG Xentari	 (a) 0.25 - 2.0 lbs (a) 0.5 - 2.0 lbs (a) 0.25 - 1.5 lbs (a) 0.5 - 2.0 lbs		a									n/a	• Biological insecticides that must be eaten to be effective, so coverage is important • Most effective against young larvae (early instars) • Check label for rates for specific caterpillars and pest pressure • Can be used in organic production
bifenthrin Bifen 2 Ag Gold Bifenture EC Bifenthrin 2EC Brigade 2EC Discipline 2EC Fanfare EC, 2EC, & ES	 (a) 2.1 - 6.4 oz (b) 5.12 - 6.4 oz	a	a	a	a	a		a	b	a	a	18	• Do not make applications less than 30 days apart

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bifenthrin continued Sniper Sniper Helios Tundra EC Bifender FC	(a) 2.4 - 7.4 oz (b) 5.9 - 7.4 oz												
bifenthrin + bio-fungicide *(Bacillus amyloliquefaciens)* Ethos XB	(a) 2.8 - 8.5 oz (b) 6.8 - 8.5 oz	a	a	a	a	a		a	b	a	a	18	• The biological fungicide in this formation is labeled for suppression of white mold and several other foliar pathogens • Do not make applications less than 30 days apart
bifenthrin + cypermethrin Steed Hero Hero EW	(a) 2.5 - 3.5 oz (b) 3.5 - 4.7 oz (a) 2.6 - 6.1 oz (b) 4.0 - 10.3 oz (c) 10.3 oz (a) 2.8 - 6.7 oz (b) 4.5 - 11.2 oz (c) 11.2 oz	b	b	a	b	b		b	c	b	b	21	• Do not graze or harvest treated vines for livestock feed
bifenthrin + imidacloprid Brigadier Skyraider Swagger	(a) 5.1 - 6.1 oz (a) 2.1 - 6.0 oz (b) 5.12 - 6.0 oz (a) 7.6 - 12.2 oz (b) same for mites	a	a	a	a	a		a	b	a	a	21	• Do not make applications less than 30 days apart
carbaryl Carbaryl 4L Sevin 4F Sevin XLR Plus	(a) 0.5 - 1.5 qts	a	a	a		a				a	a	21	• Check label for specific rates for various pest species • Bee warning. May kill honeybees. If application can't be avoided and the crop is blooming, limit application to within 2 hrs of sunrise or sunset. Notify beekeepers within 1 mile, 48 hrs prior • Do not apply this product w/ 2-4D herbicide (= crop injury)
chlorantraniliprole Coragen Prevathon	(a) 3.5 - 5.0 oz (a) 14 - 20 oz		a		a							1	• Novel mode of action - insect are paralyzed & stop feeding. Must be applied before populations reach damaging levels • Check labels for specific species, as they differ: Coragen = earworm, armyworm. Prevathon = earworm, armyworm, loopers, cloverworm, velvetbean caterpillar & hoppers

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chlorantraniliprole + lambda-cyhalothrin Besiege	(a) 5.0 - 10.0 oz (b) 10 oz	a	a	a	a	a		a	b	a	a	30	• Check label for specific rate ranges (5-8 oz, 8-10 oz) for various pest species • Spider mites - 'suppression only' • Do not graze or feed treated plants
cyfluthrin Tombstone Tombstone Helios	(a) 0.8 - 1.6 (b) 1.6 - 2.8 (c) 2.0 - 2.8	b	b	a	c	b		c		b	a	45	• 15d PHI to feed green forage • Helios formulation has UV protection for extended residual
cyfluthrin (beta) Baythroid XL	(a) 0.8 - 1.6 (b) 1.6 - 2.8 (c) 2.0 - 2.8	b	b	a	c	b		c		b	a	21	• 15 day PHI to feed green forage and hay
cyfluthrin + imidacloprid Leverage 360	(a) 2.8 oz	a	a	a	a	a		a		a	a	21	• 15 day PHI to feed green forage and hay
cyhalothrin (gamma) Declare Proaxis	(a) 0.77 - 1.28 oz (b) 1.28 - 1.54 oz (a) 1.92 - 3.2 oz (b) 3.2 - 3.84 oz	a	a	a	b	b		a		b	a	45	• Do not graze or feed treated foliage to livestock
cyhalothrin (lambda) Grizzly Too Kendo 22.8CS Lamcap II Province II Warrior II w/ Zeon Tech. Kendo Lambda-Cyhalothrin 1EC Lambda-Cy EC, 1EC, & AG Lambda-T LambdaStar Paradigm VC Silencer	(a) 0.96 - 1.60 oz (b) 1.60 - 1.92 oz (a) 1.92 - 3.20 oz (b) 3.20 - 3.84 oz	a	a	a	b	b		a		b	a	30	• Do not graze or harvest treated area for forage or hay
cypermethrin (alpha) Fastac CS & Fastac EC	(a) 1.3 - 3.8 oz (b) 3.2 - 3.8 oz	a	a	a	b	a		a		b	b	21	• Do not graze or harvest treated area for forage or hay

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cypermethrin (zeta) Mustang Mustang Maxx	(a) 1.4 - 4.3 oz (b) 3.4 - 4.3 oz (a) 1.28 - 4.0 oz (b) 3.2 - 4.0 oz	a	a	a	b	a		a		b	b	21	• Do not graze or harvest treated area for forage or hay
cypermethrin + afidopyropen Renestra	(a) 6.8 oz	a	a	a	a	a		a		a	a	21	• Afidopyropen controls sucking pests by disrupting feeding & other behaviors, creating 'zombie' aphids that die a slow death • Do not graze or feed hay and forage
deltamethrin Delta Gold	(a) 1.0 - 1.5 oz (b) 1.5 - 2.4 oz	b	b	a	b	b		b		b		21	• Do not graze or harvest treated area for forage or hay
dimethoate Dimate 4E Dimethoate 4EC and 400	(a) 1 pint	a			a			a	a			21	• Highly toxic to bees and other pollinators. Do not apply to blooming crops if bees are present • Do not graze or feed within 5 days of last application
esfenvalerate Asana XL S-Fenvalostar Zyrate	(a) 2.9 - 5.8 oz (b) 5.8 - 9.6 oz	b	a	b	b	b		b		b		21	• Do not graze or feed livestock on treated fields • See labels for additional information about tank mixes with OP (organophosphate) insecticides for soybean aphid control
etoxazole Zeal SC Zeal Pro	(a) 2.0 - 6.0 oz (a) 11.5 - 34.6 oz								a			Do not apply after **R5**	• Kills eggs and mites • Minimum 20 gal per acre ground or 3 gal per acre air • Maximum **1 application per year**; Do NOT apply after the R5 stage • Do not graze or feed treated area
flupyradifurone Sivanto HL Sivanto 200SL Sivanto Prime	(a) 3.5 - 7.0 oz (a) 7.5 - 10.5 oz (a) 7.0 - 14.0 oz							a				21	• Systemic insecticide, particularly effective on sucking pests
imidacloprid Admire Pro Advise Four Alias4F Montana4F Nuprid4F Max Wrangler Nuprid 2SC Prey 1.6 Sherpa	(a) 1.3 oz (a) 1.5 oz (a) 3.0 oz (a) 3.75 oz	a				a		a				21	• Thorough coverage is needed

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indoxacarb Steward	(a) 4.6 - 11.3 oz		a									21	• Use higher rate for higher population or spraying in dense canopy • Do not graze or feed livestock on treated fields • Also labeled for suppression of stink bugs
iron phosphate Sluggo	(a) 22-44 lbs						a					n/a	• Sluggo is a bait that must be eaten to kill slugs • Apply in evening. Scatter pellets using a broadcast spreader & use a higher rate for severe infestations or after long periods of rain • OMRI certified for use in organic fields
metaldehyde Deadline GT Deadline M-Ps	(a) Max 13.3 lbs (a) Max 10 lbs						a					n/a	• **NOT registered on soy in Michigan - only for use in Ohio** • Deadline is a bait and must be eaten to kill slugs • Growth stages V4-R1: no application after pod formation • Apply in evening as a band between rows
methomyl Annihilate LV Lannate LV Nudrin LV Annihilate SP Corrida 90WSP Lannate SP Nudrin SP	(a) 0.4 - 1.5 pints (a) 0.125 - 0.5 lbs	a	a					a			a	14	• Rates vary by insect and by 'severity' of infestation; check labels for details • The Lannate label lists brown marmorated stink bug • PHI 3 days for forage, 12 days for hay
methoxyfenozide Intrepid 2F	(a) 4 - 8 oz		a									14	• Apply when first signs of feeding damage appear • PHI for hay and forage, 7 days
permethrin Perm-Up 25DF Pounce 25WP Arctic 3.2EC PermaStar Ag Perm-Up 3.2EC	(a) 3.2 -12.8 oz (b) 6.4 - 12.8 oz (a) 2.0 - 4.0 oz (b) 2.0 - 8.0 oz	a	b	a		a						60	• Rates range higher for several caterpillar species; check label • Do not graze or harvest treated area for forage or hay
pyrethrins Evergreen EC 60-6 PyGanic EC 1.4 II PyGanic Specialty	(a) 2.0 - 12.6 oz (a) 16 - 64 oz (a) 4.5 - 15.6 oz	a	a	a	a	a		a		a	a	0 when sprays dry	• Plant-derived insecticides that knock down insects quickly but have very short residual control. Coverage is critical • Max 10 applications per season, min. 3-day spray interval • PyGanic is OMRI listed for use on organic crops; Evergreen is not OMRI certified because it contains PBO • Highly toxic to bees exposed to direct treatment; do not apply on or drift onto blooming crops or weeds •

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spinetoram Radiant SC	(a) 2.0 - 4.0 oz		a									28	• Time applications to target small larvae • Some (not all) caterpillar species are listed on the label
spinosad Blackhawk Tracer	(a) 1.1 - 2.2 oz (a) 1.0 - 2.0 oz		a									28	• Time applications to target small larvae • Not all caterpillar species are listed on the label • Do not feed treated forage or hay
sulfoxaflor Transform WG	(a) 0.75 - 1.0 oz							a				7	• Translaminar product, moves within leaf to target sucking pests • Label lists 'suppression' of stink bugs at a 2-2.25 oz rate