

Michigan State University Extension - Field Crops Insect Guide Management of Insects and Spider Mites in Dry Beans

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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 on dry beans. Pesticide names and rates are current as of the date at the top of the page.

- ✓ **Table 1** is a calendar showing the timing the most common insect pests in Michigan dry beans, from early to late season, while **Table 2** is a checklist of damage symptoms from these insects, to aid in field scouting.
- ✓ **Table 3** provides information on the life cycle of each insect, plus a detailed description of its damage and the conditions that may lead to or favor infestation of dry beans. A rating of pest status (and thus damage potential) is given based on our experience in the state. Most insects in dry beans are either uncommon, or do not increase to damaging levels in a typical year.
- ✓ **Table 4** has information on management of each pest. Many insects are kept in check by natural enemies (biological control) or by adverse environmental conditions. Some pest problems can be reduced by simple changing or avoiding certain agronomic practices. Table 4 gives a scouting and threshold recommendation for each insect. Note that these recommendations vary in 'quality'. Some scouting methods and thresholds are based on research in Michigan or surrounding states; key pests tend to have more research done on management. But many insects are not common or damaging in most typical years; their sampling recommendation and thresholds are based on observations, experience, or a best guess. We note this in the table.
- ✓ Insecticides registered in Michigan on dry beans are listed in **Table 5** (at planting) and **Table 6** (foliar sprays). 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. Label rates are listed in Column 2; pest targets are in columns to the right of column 2. A letter in a pest column means that species is on the label. The letters correspond to application rates. Some insecticides only have a single rate for all dry bean insects ('a'), while others have varying rates ('a', 'b', 'c', etc.) by pest. The final columns list the preharvest interval (PHI) in days and notes on application - for example bee toxicity warnings, minimum recommended spray volumes, or other restrictions.

DRY BEANS Table 1. Timing of damage from common insects and related pests in Michigan dry beans

- Pests are listed by timing of feeding, from early to late-season.
- Key species (ones which sometimes are the target of an insecticide application in Michigan) are highlighted in italicized, bold text.

Common name	Overwintering stage, location	May	June	July	August	September
<i>seedcorn maggot</i>	pupae, in soil	larvae (maggots) feed on seeds and scar cotyledons				
slugs	both eggs and adults, in field	juveniles and adults feed on seedlings				
white grubs	larvae (grubs), underground	larvae (grubs) feed on roots				
aphids (usually black bean & cotton aphids)				nymphs and adults pierce leaves, feed on plant sap		
grasshoppers (several species)	egg clusters, underground			nymphs and adults feed on leaves		
green cloverworm	Southern USA, migrate north			larvae (caterpillars) feed on leaves and pods		
Mexican bean beetle	adults, in protected areas			larvae and adults skeletonize leaves		
<i>potato leafhopper</i>	Southern USA, migrate north			nymphs and adults suck plant sap		
<i>spider mite</i>	adult females, at base of hosts			nymphs and adults pierce plant cells, suck plant sap		
tarnished plant bug	adults, in protected areas			nymphs and adults suck plant sap		
thrips	depends on species			nymphs and adults 'punch' individual cells, suck plant sap		
<i>western bean cutworm</i>	prepupae, underground			larvae (caterpillars) feed on blossoms and developing pods, then chew into beans		
European corn borer	larvae, in corn residue				second generation larvae bore stems & chew into pods, beans	
stink bug	adults, in & around fields				nymphs and adults suck plant sap, pierce developing pods	

DRY BEANS Table 3:

Life cycle, damage, and pest status of insects and related pests in Michigan dry beans

<p><u>Pest status is rated as follows:</u></p> <ul style="list-style-type: none"> • Uncommon: Insect is rare or not in sufficient numbers in dry beans to do economic damage; rarely or never a target for insecticide application in Michigan. • Sporadic: Economic outbreaks occur only in certain years, usually because of unpredictable mass movements from south to north early in the season. • Occasional: Insect is common in low numbers, sometimes increasing in dry beans to damaging levels. • Localized: Insect is an important pest in specific locations under certain conditions, for example, in no-till or muck fields. • Important: A key pest causing economic damage somewhere in Michigan almost every year; often the target of management and insecticide use by growers. 				
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Pest (abbreviation)	Life cycle in Michigan and Number of generations	Description of Damage	Conditions which favor damage	Pest Status in Michigan
aphids	<p>Summer population is all female. Females give birth to live young and do not mate to reproduce (parthenogenesis).</p> <p>Multiple overlapping generations.</p>	<ul style="list-style-type: none"> • All stages suck plant sap from leaves. • Heavy infestation may lead to stunting, curling of leaves, weakening of plants. • Aphids also transmit plant viruses. 	<ul style="list-style-type: none"> • drought stress may be amplified by aphids removing plant sap 	<p>Uncommon</p> <p>Usually present, but numbers rarely high enough to cause damage</p>
bean leaf beetle	<p>Adults overwinter in leaf litter and wooded field margins. Become active in spring; move into alfalfa, then migrate into beans after first alfalfa cutting. Larvae feed underground on roots.</p> <p>1-2 generations per year.</p>	<ul style="list-style-type: none"> • Adults defoliate younger plants, leaving small round holes between major leaf veins. • Adults feed on and scar developing pods which may reduce yield and seed quality. 	<ul style="list-style-type: none"> • adults may move into dry beans if nearby soybean fields were infested in the previous or current season 	<p>Uncommon</p> <p>Usually present, but numbers rarely high enough to cause damage.</p>
European corn borer (ECB)	<p>Mature larvae overwinter in corn residue; pupate late spring. Moths emerge in late May- early June and lay eggs in corn and other crops.</p> <p>Two generations in south & central Michigan, the first in June & the second in late July/ early August. One generation in the UP and northern Michigan.</p>	<ul style="list-style-type: none"> • Larger larvae bore into stem, disrupt water flow, weaken stem. • Larvae also bore into pods, consume seeds and may contaminate harvested beans. 	<ul style="list-style-type: none"> • nearby non-Bt corn production probably increases local ECB risk 	<p>Uncommon</p> <p>Populations suppressed by widespread use of Bt corn</p>
grasshoppers <i>multiple species</i>	<p>Eggs overwinter in soil. Nymphs emerge in June. Amount of feeding increases with size. Females lay groups of eggs in the undisturbed soil in late summer.</p> <p>1 generation per year.</p>	<ul style="list-style-type: none"> • All stages chew on leaves; feeding has a ragged appearance. 	<ul style="list-style-type: none"> • fallow areas and pasture are preferred egg-laying sites • a hot dry summer & fall can lead to a high population the next year 	<p>Uncommon</p> <p>Outbreaks rare</p>
green cloverworm	<p>Adults lay eggs singly on underside of leaves; larvae feed on foliage.</p>	<ul style="list-style-type: none"> • Small caterpillars scrape leaf tissue while older larvae defoliate plants 		<p>Uncommon</p> <p>Usually present, but numbers rarely high enough to cause damage</p>

Pest (abbreviation)	Life cycle in Michigan and Number of generations	Description of Damage	Conditions which favor damage	Pest Status in Michigan
Mexican bean beetle	Adults overwinter in crop debris, woodlots, etc. Adults move into dry beans in early summer and lay eggs. Larvae mature in 3-4 weeks, pupating on leaf surface. Adults emerge in late July into August, lay eggs for a second generation. Second generation larvae feed, pupate in late August, and new adults overwinter.	<ul style="list-style-type: none"> • Larvae and adults strip the epidermis between the veins on the underside of leaves, resulting in window pane damage or a skeletonized (lacy) appearance. Time frame: mid-July into August. • Pod feeding is rare. 	<ul style="list-style-type: none"> • a mild winter increases survival • planting adjacent to fields with high populations the previous year • early-planting (adults attracted to these fields) 	Uncommon
potato leafhopper	Adults are carried into Michigan from the south on weather fronts in May/early June. Females lay eggs inside stems. Nymphs hatch in 7-10 days, begin feeding immediately, and reach adult stage in 2-3 weeks. Multiple overlapping generations.	<ul style="list-style-type: none"> • Adults and nymphs suck plant sap and inject toxic saliva as they feed. The typical symptom is called 'hopperburn'. • Other symptoms include stunting and curling of leaves and poor pod fill. 	<ul style="list-style-type: none"> • PLH damage is worse under dry conditions, and leafhopper survival is probably better 	Sporadic PLH populations are economic in dry beans in some seasons.
seedcorn maggot (SCM)	SCM overwinters as pupae in the soil. Adult flies emerge in early spring and are attracted to lay eggs in disturbed soil with decaying organic matter. Multiple generations.	<ul style="list-style-type: none"> • Tiny larvae (maggots) feed on germinating seed; may cause variable emergence, stand loss, and delayed development. 	<ul style="list-style-type: none"> • cool wet conditions which delays germination • fields with high organic matter from a decaying green cover crop, or weeds, or fresh manure 	Localized Depends on fresh organic matter and cool, wet conditions
slugs	Overwinter as both eggs & adults, Females deposit eggs in soil; these hatch in about one month. Multiple overlapping generations.	<ul style="list-style-type: none"> • Feed on cotyledons & lower leaves. Feeding usually occurs at night. • Substantial defoliation can be tolerated in pre-blooming dry beans, but if the growing point is killed, stands can be significantly reduced. 	<ul style="list-style-type: none"> • planting into heavy crop residue • cool, wet soils which delay germination • poorly closed furrows (=slug highways) 	Localized Depends on residue and cool conditions. Dry beans are usually planted after slug risk is over.
spider mite	Adult females overwinter in field borders and sheltered areas. In spring, they move to new growth, and lay eggs. Mites spread from field to field by crawling or blowing in the wind. Multiple overlapping generations.	<ul style="list-style-type: none"> • Adults & nymphs pierce individual plant cells, resulting in tiny yellow spots called stippling. • Webbing is a sign of a heavy infestation. • Severe damage results in leaf yellowing, death, water loss. 	<ul style="list-style-type: none"> • 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 <i>several species including green, onespotted, & the brown marmorated</i>	Adults overwinter in protected areas. Weeds and early crops like wheat are fed on and colonized first. Note that some stink bug species are beneficial predators of other insects like caterpillars.	<ul style="list-style-type: none"> • Adults and nymphs feed by injecting salivary enzymes into plants and sucking up plant juices. • Feeding on pods can result in aborted or shriveled beans. 	<ul style="list-style-type: none"> • may move into dry beans from adjacent wheat fields as they dry down 	Uncommon Numbers rarely high enough to cause damage
tarnished plant bug (TPB)	Adults overwinter in residue and on field edges. Weeds and early crops like alfalfa are fed on and colonized first.	<ul style="list-style-type: none"> • Adults and nymphs suck plant sap. Tarnished plant bug injects a toxic saliva during feeding. • Feeding on pods can result in aborted or shriveled beans 	<ul style="list-style-type: none"> • may move into dry beans from adjacent alfalfa fields that were recently cut 	Uncommon Numbers rarely high enough to cause damage

Pest (abbreviation)	Life cycle in Michigan and Number of generations	Description of Damage	Conditions which favor damage	Pest Status in Michigan
thrips	<p>Adults and nymphs overwinter in residue. Populations initially build on grasses and in wheat.</p> <p>Note that thrips are an important food source for some of the beneficial insects (such as pirate bugs) that control other pests.</p>	<ul style="list-style-type: none"> • Nymphs and adults feed with a single mandible, using it to puncture plant cells and slurp up the liquid inside. • Punctured cells dry up, resulting in areas of dead cells; under heavy infestation, leaves dry up, curl, or die. 	<ul style="list-style-type: none"> • dry conditions in early summer • may move into dry beans from adjacent wheat fields or grassy borders as they dry down 	<p>Uncommon</p> <p>Usually present, but numbers rarely high enough to cause damage</p>
western bean cutworm (WBC)	<p>Overwinter in pre-pupal stage. Adults emerge in early July; females lay eggs in pre-tassel corn and switch to dry beans as corn matures. Larvae feed on pods at night. In early-September, they drop & burrow into soil to overwinter. Areas with sandy soil appear to have deeper and better overwintering.</p> <p>1 generation per year.</p>	<ul style="list-style-type: none"> • Tiny larvae feed on leaves and then inside blossoms. • Larger larvae drop to the ground & stay under residue or in cracks during the day. They climb into the canopy to feed on pods at night. 	<ul style="list-style-type: none"> • areas with sandy soils (may increase overwintering survival) • adjacent corn which is no longer attractive for egg laying (ie. past tasseling stage) 	<p>Localized</p> <p>Production in Montcalm and surrounding counties + the UP are historic hot spots for WBC</p>
white grubs <i>multiple species</i>	<p>Mature grubs overwinter underground. Adults emerge May-July, depending on species. Eggs laid in soil in the summer. Grubs feed on roots, then move down in soil profile in late fall to overwinter. In spring, grubs feed for a period, then pupate.</p> <p>1 generation per year except June beetle, which has a 2-3 year life cycle.</p>	<ul style="list-style-type: none"> • Larvae (grubs) prune root hairs and sometimes whole roots, causing wilting, water and nutrient deficiency, or plant death. 	<ul style="list-style-type: none"> • planting into fallow fields or pasture • fields near pasture, home lawns • Fields or parts of fields with sandy soil type 	<p>Uncommon</p>

DRY BEANS Table 4: Management notes, scouting recommendations, and thresholds for insects and related pests of dry beans in Michigan.

Pest (abbreviation)	Notes on non-chemical and chemical management	Scouting recommendation	Threshold for spraying
aphids	<ul style="list-style-type: none"> Biological: Predators (such as ladybugs, lacewings, parasitoids) keep populations in check. Under humid conditions, entomopathogenic fungi infect aphids. Environmental: Heavy rainfall and irrigation can wash off aphids. Adequate moisture reduces feeding stress and increases humidity for infection by pathogens. 	Check 100 plants (20 plants x 5 sets)	General guideline – one or more aphid colony (a group of about 30) per plant Rarely justified
bean leaf beetle		Check 100 plants (20 plants x 5 sets)	General guideline – more than 10% of the pods damaged Rarely justified
European corn borer (ECB)	<ul style="list-style-type: none"> Biological: Numerous natural enemies kill ECB eggs and larvae. Predators, egg and larval parasitoids, and pathogens are common. Agronomic: The widespread planting of Bt corn has greatly reduced the European corn borer population in the landscape. 	No specific recommendation Note: Trapping can detect large corn borer flights. Michigan moths respond to Z (Iowa) strain pheromone	None
grasshoppers	<ul style="list-style-type: none"> Biological: blister beetle larvae and other insects prey on eggs, and 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 sprayed area if hoppers invade from a neighboring field or grassy border. 	No specific recommendation Have never seen populations high enough to treat in Michigan.	General guideline - during flowering & pod fill, 15% overall defoliation by leaf-feeding insects, including hoppers.
green cloverworm	<ul style="list-style-type: none"> Biological: many natural enemies keep it in check. 	No specific recommendation Cloverworm can be detected by sweeping or beating plants over a cloth laid between rows	General guideline - during flowering & pod fill, 15% overall defoliation by leaf-feeding insects, including cloverworm
Mexican bean beetle (MBB)	<ul style="list-style-type: none"> Biological: natural enemies feed on eggs and larvae. Agronomic: avoid early planting, as overwintered adults colonize these fields first. Environmental: Hot, dry weather and heavy rainfall are both cited as reducing populations. 	Early-mid July: Scout for # egg masses per meter. Take multiple samples across the field During flowering & pod fill: estimate defoliation	General guideline – 0.5 egg masses per meter/yard or 15% overall defoliation by leaf-feeding insects, including MBB
potato leafhopper (PLH)	<ul style="list-style-type: none"> Biological - a naturally occurring fungal pathogen reduces PLH numbers under favorable conditions, usually later in the year. Insecticides: resistance is not an issue with PLH. 	Check 100 trifoliates from different plants (20 leaves x 5 sets) Count both adults and nymphs	Unifoliolate stage: > 0.5 leafhopper per plant Otherwise: > 1 leafhopper per trifoliolate leaf
seedcorn maggot (SCM)	<ul style="list-style-type: none"> Agronomic: Potential for injury decreases in wet, cool springs when seed germinates slower, or when seed is planted into high organic matter (manured areas, disked or herbicide treated cover crops and weeds). Risk drops after organic matter decomposes. Insecticide: Management is preventative, using a seed treatment in fields where manure was applied or weeds / cover crop were recently killed. 	No specific recommendation	No rescue treatment available. Consider replanting fields or areas with significant stand loss

Pest (abbreviation)	Notes on non-chemical and chemical management	Scouting recommendation	Threshold for spraying
slugs	<ul style="list-style-type: none"> Biological: Some ground beetle species consume slugs. Agronomic: Tillage and crop rotation reduce corn residue (slug habitat). Avoid planting in wet conditions, as open furrows act as slug highways. Insecticide: Slugs are not insects, thus soil insecticides and seed treatments have no impact on them. Some studies suggest that seed treatments actually exacerbate slug populations by killing their ground beetle predators. 	<p>No specific recommendation</p> <p>Walk fields at night or early morning, turning over residue and looking for slime trails</p>	<p>None established</p> <p>A guess: consider applying slug bait if stand is reduced by 5%</p>
spider mite	<ul style="list-style-type: none"> Biological: under humid conditions, a natural fungal pathogen can infect and wipe out mite populations in a matter of days. Some natural enemies eat mites. Agronomic: irrigation mitigates the impact of spider mite feeding and increases humidity for fungal biocontrol, but during a drought, even irrigation isn't enough. Environmental: rainfall has a similar effect as irrigation Insecticide: Insecticide resistance is common in mites. Some insecticides (eg most pyrethroids) sprayed for other insects flare mite populations by killing off natural enemies. Likewise fungicide applications may disrupt fungal pathogens of mites. This is one reason that insurance applications of both are discouraged; be cautious about pesticide applications in dry years. 	<p>Infestations often start on field edges</p> <p>Look for mites on undersides of leaves using hand lens, or tap leaves over a white piece of paper</p> <p>Webbing is present when populations are high</p>	<p>A guess: Treat when mites appear on >25% of the plants and when the first yellowing is seen</p> <p>Mites are difficult to control and spraying is often a losing proposition</p>
stink bugs		No specific recommendation	None established
tarnished plant bug	<ul style="list-style-type: none"> Agronomic: good weed control reduces alternate hosts for plant bugs. 	No specific recommendation	General guideline – One bug or more per plant at first flower to green pod stage
thrips	<ul style="list-style-type: none"> Biological: generally kept in check by predators. Environmental: rainfall or irrigation reduces populations. Insecticides: Onion thrips are killed better by pyrethroids than OPs/ carbamates. <p>A caution about spraying: Thrips can be viewed as semi-beneficial, because they are predators of spider mite eggs. Spraying for thrips may contribute to a spider mite outbreak in the future, especially under dry conditions.</p>	<p>Infestations often start on field edges</p> <p>Look for thrips on undersides of leaves using hand lens. Or tap leaves over a white piece of paper or a paper plate</p>	<p>Threshold used in the high plains:</p> <p>>15 thrips per plant and leaf cupping is present</p>
western bean cutworm	<ul style="list-style-type: none"> Biological: many predators consume eggs and larvae; Trichogramma wasps have been seen in the field in Michigan parasitizing egg masses. 	<p>Sampling beans directly for WBC eggs of larvae is difficult</p> <p>Use bucket-type pheromone traps to detect flight, starting at the end of June. At a cumulative catch of 100-120 moths, scout fields for pod feeding</p>	<p>Action threshold developed in the Great Lakes Region:</p> <p>Treat when >10% of pods are fed-on by WBC larvae</p>
white grubs	<ul style="list-style-type: none"> Biological: Some species are attacked by pathogens. Agronomic: If practical, fall plowing of long-standing fallow fields & pasture prior to planting is recommended. Tillage also exposes grubs to mammals and birds. <p>Note: it is important to identify grubs found in the field to distinguish annual species from June beetles, which remain in fields for multiple seasons.</p>	<p>No specific recommendation</p> <p>Grubs tend to be patchy, especially on sandy knolls & near tree lines</p> <p>Grubs are sometimes detected when plowing in the fall or spring</p>	None established

DRY BEANS Table 5:

Insecticides for use at planting to manage early-season dry bean insects

- Insecticides are grouped under their active ingredient(s), which are listed alphabetically. This allows for easy comparison of products with the same chemistry.
- Application rates are listed for pests which appear on the manufacturer label. The letter under the pest name indicates the label rate from the previous column. If a column is blank, the pest is not on the label.
- Note that insecticide rates per 1000 feet of row are based on a **30-inch row spacing**. See label for specific per-acre rate and gauge-setting charts for narrower row spacing.

Active ingredient Trade Names	Labelled rate(s) per 1000 feet of row or per acre	Rate for			Precautions and Remarks
		seedcorn maggot	slugs	white grubs	
bifenthrin Revere 2.0 Xpedient FC Xpedient Plus Bifender FC Capture 3RIVE3D Bifenture LFC Capture LFR Sniper LFR Ethos XB	(a) 0.15 – 0.30 oz per 1000 ft (= 2.56 - 5.12 oz per acre) (a) 0.17 - 0.34 oz per 1000 ft (= 3.0 - 5.9 oz per acre) (a) 0.19 – 0.46 oz per 1000 ft (= 3.2 - 8 oz per acre) (a) 0.2 - 0.39 oz per 1000 ft (= 3.4 - 6.8 oz per acre) (a) 0.2 - 0.49 oz per 1000 ft (= 3.4 - 8.5 oz per acre)	a		a	<ul style="list-style-type: none"> • Apply T-band or in-furrow • Do not apply more than 0.3 lb per acre per season of all bifenthrin products (soil + foliar) Note: Many of these products can be broadcast soil surface to control black cutworm and armyworm. Note, Ethos XB contains a biological fungicide strain for suppression of early season root diseases.
cypermethrin (zeta) Mustang Mustang Maxx	(a) 0.247 oz per 1000 ft (= 4.3 oz per acre) (a) 0.23 oz per 1000 ft (= 4 oz per acre)			a	<ul style="list-style-type: none"> • Apply T band or in-furrow in a minimum of 2-7 gal per acre
iron phosphate Sluggo	(a) 0.5 – 1.0 lb per 1000 ft (= 20 - 44 lbs per acre)		a		<ul style="list-style-type: none"> • Broadcast using a spreader • Apply bait in evening when slugs feed; product works best when the soil is moist

DRY BEANS Table 6: Foliar Insecticides to manage dry bean insects.

- Insecticides are grouped under their active ingredient(s), which are listed alphabetically. This allows for easy comparison of products with the same chemistry.
- Application rates are listed for pests which appear on the manufacturer label. The letter under the pest name indicates the label rate from the previous column. If a column is blank, the pest is not on the label.
- Insects acronyms: BLB-bean leaf beetle; ECB-European corn borer; GH-grasshopper; GCW-green cloverworm; MBB-Mexican bean beetle; PLH-potato leafhopper; TPB-tarnished plant bug; WBC-western bean cutworm

Active ingredient Trade Names	Labelled rate per acre (unless stated)	Rate for:											Pre harvest interval (PHI) in days	Precautions and Remarks	
		aphids	BLB	ECB	GH	GCW	MBB	PLH	spider	stink bug	TPB	thrips			WBC
abamectin Agri-Mek SC	(a) 1.75 - 3.5 oz								a					7	<ul style="list-style-type: none"> • Ground application recommended (instead of by air) • To avoid the chance of illegal residue, product must be applied with a “non-ionic activator type wetting, spreading or penetrating spray adjuvant” that is approved on dry beans. See label for details • Ground application minimum of 10 gal per acre; higher volume ensures better coverage
acephate Acephate 90 WDG Acephate 90 WSP Acephate 90 Prill Acephate 97UP Acephate 97 WDG	(a) 4 - 8 oz (b) 8 - 17.6 oz (c) 12.8 - 17.6 oz (a) 4.4 - 8.9 oz (b) 8.9 - 17.6 oz (c) 13.3 - 17.6 oz (a) 4 - 8 oz (b) 8 - 16 oz (c) 12 - 16 oz	b	b	c	a	b	b	b			b	b		14	<ul style="list-style-type: none"> • Apply in minimum of 20 gal per acre (ground) or 2 gal per acre (air) • Do not feed treated vines to livestock • WSP formulation is in water soluble packets
bifenazate Acramite 4SC	(a) 16-24 oz								a					7	<ul style="list-style-type: none"> • Apply in minimum of 20 gal per acre (ground) or 7 gal per acre (air) • Max 2 applications per year; 14 days between sprays •

Active ingredient Trade Names	Labelled rate per acre (unless stated)	Rate for:											Pre harvest interval (PHI) in days	Precautions and Remarks	
		aphids	BLB	ECB	GH	G CW	MBB	PLH	spider	stink bug	TPB	thrips			WBC
bifenthrin Bifen 2 Ag Gold Bifenthrin 2EC Bifenture EC Brigade 2EC Fanfare EC, 2EC, and ES Sniper Sniper Helios Tundra EC	(a) 1.6 - 6.4 oz (b) 2.1 - 6.4 oz (c) 5.12 - 6.4 oz	b	b	b	b	a b	b	a	c	b	b	b	b	14	<ul style="list-style-type: none"> Apply in minimum of 10 gal per acre (ground) or 2 gal per acre (air) Maximum 0.3 lb/ acre of active ingredient per season Do not make applications less than 7 days apart Extremely toxic to bees. See labels for details.
bifenthrin + chlorpyrifos Match-Up	(a) 2.05 -16.4 oz (b) 2.7 - 16.4 oz (c) 6.6 - 16.4 oz	b	b	b	b	b	b	a	c	b	b	b	b	14	<ul style="list-style-type: none"> Apply in minimum of 10 gal per acre (ground) or 2 gal per acre (air) Do not make applications less than 14 days apart Extremely toxic to bees. See label for details.
bifenthrin + cypermethrin (zeta) Hero Hero EW Steed	(a) 4.0 - 10.3 oz (b) 10.3 oz (a) 4.5 - 11.2 (b) 11.2 oz (c) 3.5 - 4.7 oz	a c	a c	a c	a c	a c	a c	a c	b	a c	b	b c	a c	21	<ul style="list-style-type: none"> Apply in minimum of 10 gal per acre (ground) or 2 gal per acre (air) Do not make applications less than 7 days apart Max 27.39 oz (Hero), 29.86 (Hero EW) of product per season
bifenthrin + imidacloprid (1:1 ratio) Brigadier Swagger	(a) 3.8 - 5.6 oz (b) 5.6 oz (a) 7.6 - 11.2 oz (b) 11.2 oz	a	b	b	a	b	b	a			a	a		14	<ul style="list-style-type: none"> Apply in minimum of 10 gal per acre (ground) or 2 gal per acre (air) Do not make applications less than 7 days apart Extremely toxic to bees. See label for details.
bifenthrin + imidacloprid (2:1 ratio) Skyraider	(a) 2.1 - 5.6 oz (b) 5.12 - 5.6 oz	a	a	a	a	a	a	a	b	a	a	a	a	14	<ul style="list-style-type: none"> Apply in minimum of 10 gal per acre (ground) or 2 gal per acre (air) Do not make applications less than 7 days apart Extremely toxic to bees. See label for details.
Bt (<i>Bacillus thuringiensis</i>) Biobit HP Dipel DF Dipel ES Xentari DF	(a) 0.5 - 1 lb (a) 0.25 - 1 lb (a) 1 - 2 pints (a) 0.5 - 1.5 lb					a								0	<ul style="list-style-type: none"> Larvae must eat treated foliage to be killed, so good coverage is needed Bt sprays are most effective on small caterpillars Biobit, Dipel DF, and Xentari can be used on organic beans.

Active ingredient Trade Names	Labelled rate per acre (unless stated)	Rate for:											Pre harvest interval (PHI) in days	Precautions and Remarks	
		aphids	BLB	ECB	GH	G CW	MBB	PLH	spider	stink bug	TPB	thrips			WBC
carbaryl Carbaryl 4F Sevin 4F Sevin XLR Plus	(a) 0.5 - 1.0 qt (b) 1.0 qt (c) 1.0 - 1.5 qt		a	c		a	a	b		c	c	b	b	21 beans 14 forage	<ul style="list-style-type: none"> • Applications interval minimum of 7 days • Application to wet foliage or in periods of high humidity may cause plant injury • "May kill honey bees and other bees in substantial numbers". Do not apply when crop or weeds are in bloom. See labels for additional details.
chlorantraniliprole Coragen Prevathon	(a) 2 - 5 oz (b) 3.5 - 7.5 oz (a) 8 - 20 oz (b) 14 - 20 oz			b	a								b	1	<ul style="list-style-type: none"> • Thorough coverage is important; insects must eat treated foliage for optimum control. • See label for specific directions for grasshopper control
chlorantraniliprole + cyhalothrin (lambda) Besiege	(a) 5 - 8 oz (b) 6 - 10 oz (c) 10 oz	b	b	b	b	a	a	b	c	b	b	b	b	21	<ul style="list-style-type: none"> • Apply in minimum of 10 gal per acre (ground) or 5 gal per acre (air) • Do not graze or harvest vines for forage • For mites, suppression only
cyantraniliprole Exirel	(a) 10.0- 20.5 oz			a										7	<ul style="list-style-type: none"> • Label lists suppression of potato leafhopper and thrips • See label statement about 'adverse crop response'
cyantraniliprole + abamectin Minecto Pro	(a) 7.5 - 10 oz			a						a				7	<ul style="list-style-type: none"> • Apply in minimum of 10 gal per acre ground or 5 gal per acre air; ground application recommended for coverage • Label lists suppression of potato leafhopper and thrips • See label statement about 'adverse crop response'
cyfluthrin Baythroid XL Tombstone Tombstone Helios	(a) 0.8 - 1.6 oz (b) 1.6 - 2.4 oz (c) 2.4 - 3.2 oz		c	c	c	c	c	a		b	b			7	<ul style="list-style-type: none"> • Max 6.4 oz / acre per season • Do not feed treated vines or hay to livestock
cyfluthrin + imidacloprid Leverage 360	(a) 2.4 - 2.8 oz	a	a	a	a	a	a	a		a				7	<ul style="list-style-type: none"> • Label lists suppression of stink bugs at high rate • Do not feed treated vines or hay to livestock
cyhalothrin (gamma) Declare Proaxis	(a) 0.77 - 1.28 oz (b) 1.28 - 1.54 oz (a) 1.92 - 3.30 oz (b) 2.56 - 3.84 oz	b	b	b	b	a	a	b		b	b	b	b	21	<ul style="list-style-type: none"> • Do not graze or harvest vines for forage

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		aphids	BIB	ECB	GH	G CW	MBB	PLH	spider	stink bug	TPB	thrips			WBC
cyhalothrin (lambda) Grizzly Too Lamcap II Province II Warrior w/Zeon Grizzly Z Kendo Lambda-Cy Lambda-Cy Ag Lambda Cyhalothrin 1EC LambdaStar Lambda-T Lamcap Paradigm Province Silencer Willowood Lambda-Cy1EC	(a) 0.96 - 1.60 (b) 1.28 - 1.92 (a) 1.92 - 3.2 (b) 2.56 - 3.84	b	b	b	b	a	a	b		b	b	b	b	21	<ul style="list-style-type: none"> • By air, minimum 2 gal water per acre • Max 7.68 oz / acre per season • Do not graze or harvest vines as forage or hay
cypermethrin (alpha) Fastac EC or CS	(a) 2.7 -3.8 (b) 3.2 - 3.9 oz	b	a	a	b	a	a	a		b	a	b		21	<ul style="list-style-type: none"> • Apply in minimum of 10 gal per acre ground or 2 gal per acre air • CS formulation is microencapsulated
cypermethrin (zeta) Mustang Mustang Maxx	(a) 3.0 - 4.3 oz (b) 3.4 - 4.3 oz (a) 2.72- 4.0 oz (b) 3.2 - 4.0 oz	b	a	a	b	a	a	a		b	a	b		21	<ul style="list-style-type: none"> • Apply in minimum of 10 gal per acre (ground) or 2 gal per acre air • Extremely toxic to bees. Do not apply to blooming crops if bees are visiting the field.
dimethoate Dimate 4E Dimethoate 400, 4E, 4EC	(a) 0.5 - 1.0 pt	a	a		a		a	a	a		a			0	<ul style="list-style-type: none"> • Max 2 pints/ acre per year; 14 day retreatment interval • Do not feed treated vines. • Highly toxic to bees
esfenvalerate Asana XL S-FenvaloStar Zyrate	(a) 2.9 - 5.8 oz (b) 5.8 - 9.6 oz				b	b	a	b					b	21	<ul style="list-style-type: none"> • Do not feed or graze livestock on treated vines • See label language about grasshopper control • Highly toxic to bees. See label for details.
flupyradifurone Sivanto HL Sivanto 200 SL Sivanto Prime	(a) 3.5 - 7.0 oz (a) 7 - 10.5 oz (a) 7 - 14 oz	a						a						7	<ul style="list-style-type: none"> • Foliar applications have systemic properties; product moves from deposition point to leaf tips and controls insects on underside of leaves • Apply in minimum of 10 gal per acre ground or 3 gal per acre air

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		aphids	BIB	ECB	GH	GCW	MBB	PLH	spider	stink bug	TPB	thrips			WBC	
imidacloprid Admire Pro Advise Four Alias 4F Montana 4F Nuprid 4F Max Wrangler Nuprid 2SC Pasada 1.6F Prey 1.6F Sherpa	(a) 1.2 oz (a) 1.4 oz (a) 2.8 oz (a) 3.5 oz	a						a							7	<ul style="list-style-type: none"> Highly toxic to bees. See label for details.
methomyl Annihilate LV Corrida 29SL Lannate LV Nudrin LV Annihilate SP Corrida 90WSP Lannate SP Nudrin SP	(a) 0.75 - 3 oz (b) 1.5 - 3 oz (a) 0.25- 1 oz (b) 0.5 - 1 oz	b		b			a	a		*	b	b		14	<ul style="list-style-type: none"> Kills both eggs and larvae of corn borer. See label for specific on timing Highly toxic to bees. See label for details. <p>* The labels for Lannate list brown marmorated stink bug as a target.</p>	
methoxyfenozide Intrepid 2F	(a) 8 - 16 oz			a										7	<ul style="list-style-type: none"> Apply in minimum of 20 gal per acre (ground) in a full canopy or 10 gal per acre (air) See label for information on application timing Endangered species warning on label for applications made in these Michigan counties: Allegan, Monroe, Montcalm, Muskegon, Newaygo, Oceana 	
naled Dibrom 8E	(a) 1 pint (b) 1.5 pint	a				a		a	a	b	a			1		

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spinosyns (spinetoram & spinosad) Entrust Blackhawk Radiant SC Entrust SC Spintor 2SC	(a) 1 - 2 oz (b) 1.5 - 2 oz (a) 1.7-3.3 oz (b) 2.5 - 3.3 oz (a) 3 - 8 oz (b) 5 - 8 oz (a) 3 - 6 oz (b) 4.5 - 6 oz			a											28	<ul style="list-style-type: none"> • Maximum 12 oz / acre per year • Do not make more than two consecutive applications of products with spinetoram or spinosad • For European corn borer, sprays must target eggs and small larvae; see label for information on application timing • For thrips, control improved by adding an adjuvant; see label for details • Do not feed forage to meat or dairy animals
spirotetramat Movento Movento HL	(a) 4 - 5 oz (a) 2 - 2.5 oz	a													7	<ul style="list-style-type: none"> • Movento label also lists suppression of spider mites and some species of thrips
sulfoxaflor Transform WG	(a) 0.75-1.0 oz (b) 1.5 - 2.25 oz	a									b				7	<ul style="list-style-type: none"> • Transform label also lists suppression of thrips and some species of stink bug