Updated Dec 2025

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PEST MANAGEMENT GUIDE for FIELD CROPS INSECTS

Dr. Chris DiFonzo, MSU & Dr. Kelley Tilmon, OSU

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

College of Agriculture and Natural Resources
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- Michigan: https://www.canr.msu.edu/field_crops/insect-guides
- Ohio: https://aginsects.osu.edu/extension-publications/msuosu-ipm-guide

MSU-OSU Field Crops Insect Pest Management Guide

Updated November 2025

Authors

Chris DiFonzo
Field Crops Entomologist
Michigan State University
Department of Entomology
288 Farm Lane
East Lansing, MI
difonzo@msu.edu

Kelley Tilmon
Field Crops Entomologist
The Ohio State University
Department of Entomology
1680 Madison Ave
Wooster, OH
tilmon.1@osu.edu

How to Use this Guide

This publication is set up as a series of chapters with information on biology, damage, management recommendations, and insecticides related to insect pests in field crops in Michigan and Ohio. Chapters cover field corn, soybean, wheat and other small grains, alfalfa and grass forage, and (for Michigan growers) dry beans and sugar beet. Each chapter stands alone, focusing on a particular crop. This was done so that we can update information frequently without changing the entire publication and you can download or print only the sections you need.

In the preparation of this guide, we checked state databases and consulted labels for each of the pesticides listed in the crop chapters; we made every effort to include correct information and to list most of the commonly-used products for Michigan and Ohio. However, labels do change over time. Always read the labels of the products you use to reconfirm application rate, precautions, PPE, pre-harvest intervals, and other key pieces of information prior to spraying.

Users are the best source of feedback on this guide. If you see information that is not correct or complete, or products which are not listed, please contact us so that we can update the guide accordingly.

The rest of this introduction has the following information:

Introduction Figure 1: How to read the insecticide tables in this bulletin – a made-up example!

Active ingredients (AI) are listed alphabetically. Insecticides are listed by Trade Name under each AI to allow for comparison or substitution of products.

See Table 1 to cross reference active ingredients x insecticide.

A letter under an insect indicates it is on the label
• The specific letter corresponds to use rates in column 2.

Compare PHIs between products

A few of the important statements on the label

Active ingredient Trade names	Labeled rate per acre	caterpillars	cutworm	grasshoppe	spider mite	stink bugs	Pre - harvest Interval (PHI) in days	Precautions and Remarks
abamectin Big-Ten SC	(a) 1.7 - 3.5 oz				a		28	• Apply when spider mites are first observed
bifenthrin Brutus Buckeye	(a) 3.5 - 5.0 oz (a) 7.0 - 10 oz	a	a	a		a	18	• Do not make applications less than 30 days apart
chlorantraniliprole O-Hi Advanced	(a) 14 oz (b) 20 oz	a		b			1	• Must be applied before insects reach damaging levels
cyhalothrin (lambda) Izzo AG Green-UP WDG Lansing LV Scarlet 4F Spartan Izzo Extra Spartan Maxx	(a) 3 oz (b) 6 oz (a) 1 oz (b) 2 oz	a	a	b		b	30	• Do not graze or harvest vines as forage or hay

An AI with one trade name with a single rate (a) for one pest, spider mite

An AI with two trade names, each with its own single rate (a) for multiple insects
- For example, for cutworm the rate per acre is 3.5-5.0 oz of Brutus and 7.0-10 oz of Buckeye

An AI with one trade name but different use rates, (a) and (b), for different pests
- For example, the rate per acre is (a) 14 oz for caterpillars and (b) 20 oz for grasshoppers

An AI with many trade names, grouped by use rates; products in a group are similar and interchangeable
- For example, for cutworm use (a) 3 oz of Izzo Ag or 1 oz of Izzo Extra. Use the higher rate (b) for hoppers
- If you can't find Izzo Extra, Spartan Maxx is a similar product

Introduction Table 1: Active ingredient(s), registrants, and EPA registration numbers for insecticides in the MSU-OSU Field Crops Insect Pest Management Guide

TABLE 1 **Trade name**	**Active** **Ingredient (s)**	**Registrant/ Company**	**EPA Registration #**
Abba Ultra	abamectin	AMVAC	5481-621
Acephate 90 Prill	acephate	ADAMA	66222-123
Acephate 90 WDG	acephate	Loveland	34704-1051
Acephate 90 WSP	acephate	Loveland	34704-862
Acephate 97 UP	acephate	UPL NA	70506-8
Acephate 97 WDG	acephate	ADAMA	66222-266
Acramite 4SC	bifenazate	UPL NA	400-514
Admire Pro	imidacloprid	Bayer CropScience	264-827
Advise Four	imidacloprid	WinField United	228-528-1381
Agree WG	Bt aizawai	Certis USA	70051-47
Agri-Mek SC	abamectin	Syngenta	100-1351
Alias 4F	imidacloprid	ADAMA	66222-156
Annex LFR	bifenthrin	TENKOZ Inc	279-3302-55467
Annihilate LV	methomyl	MacDermid Ag Solutions	400-597
Annihilate SP	methomyl	MacDermid Ag Solutions	400-598
Arctic 3.2EC	permethrin	WinField United	1381-187
Argyle OD	bifenthrin acetamiprid	UPL NA	70506-346
Asana XL	esfenvalerate	Valent	59639-209
Avaunt eVo	indoxacarb	FMC	279-9629
Aztec 4.67G	tebupirimphos cyfluthrin	AMVAC	5481-9028
Aztec HC	tebupirimphos cyfluthrin	AMVAC	5481-577
Baythroid XL	cyfluthrin (beta)	Bayer CropScience	264-840
Belay	clothianidin	Valent	59639-150
BeLeaf	flonicamid	FMC	71512-10-279
Besiege	chlorantraniliprole cyhalothrin (lambda)	Syngenta	100-1402
Bifen 2 Ag Gold	bifenthrin	WinField United	83222-1
Bifender FC	bifenthrin	Vive Crop Protection	89118-2
Bifenthrin 2EC	bifenthrin	Aceto Ag Chem Corp	2749-556
Bifenture 10DF	bifenthrin	UPL NA	70506-227
Bifenture EC	bifenthrin	UPL NA	70506-57
Bifenture LFC	bifenthrin	UPL NA	70506-305
Blackhawk	spinosad	Corteva Agriscience	62719-523
Brigade 2EC	bifenthrin	FMC Corporation	279-3313

TABLE 1 **Trade name**	**Active Ingredient (s)**	**Registrant/ Company**	**EPA Registration #**
Brigadier	bifenthrin imidacloprid	FMC Corporation	279-3332
Capture 3RIVE 3D	bifenthrin	FMC Corporation	279-3467
Capture LFR	bifenthrin	FMC Corporation	279-3302
Carbaryl 4L	carbaryl	Drexel	19713-49
Carbaryl 4L	carbaryl	Loveland	34704-447
Coragen	chlorantraniliprole	FMC Corporation	279-9606
Corrida 90 WSP	methomyl	Sinon USA	82557-2
Counter 20G (Smartbox, Lock'N Load, or Smart Cartridge)	terbufos	AMVAC	5481-562
Deadline Bullets	metaldehyde	AMVAC	5481-507
Deadline GT	metaldehyde	AMVAC	6836-350-5481
Deadline MPs	metaldehyde	AMVAC	5481-507
Declare	cyhalothrin (gamma)	FMC Corporation	279-3571
Defcon 4.67G	tebupirimphos cyfluthrin	Helena	5481-9028-5905
Delta Gold	deltamethrin	WinField United	264-1011-1381
Denim	emamectin benzoate	Syngenta	100-903
Diamond	novaluron	ADAMA	66222-35
Dibrom 8E	naled	AMVAC	5481-479
Dimate 4E	dimethoate	WinField United	9779-273
Dimethoate 400	dimethoate	Loveland & FMC Corp	34704-207
Dimethoate 4EC	dimethoate	Drexel	19713-231
Dipel 10G	Bt kurstaki	Valent Biosciences	73049-14
Dipel DF	Bt kurstaki	Valent Biosciences	73049-39
Dipel ES	Bt kurstaki	Valent Biosciences	73049-17
Discipline 2EC	bifenthrin	AMVAC	5481-517
Durham 7.5	metaldehyde	AMVAC	5481-103
Elevest Insect Control	bifenthrin chlorantraniliprole	FMC Corporation	279-9652
Empower 2	bifenthrin	Helena	5905-548
Endigo ZC	cyhalothrin (lambda) thiamethoxam	Syngenta	100-1276
Endigo ZCX	cyhalothrin (lambda) thiamethoxam	Syngenta	100-1458
Entrust	spinosad	Corteva Agriscience	62719-282
Entrust SC	spinosad	Corteva Agriscience	62719-621
Ethos Elite LFR	bifenthrin	FMC Corporation	279-9651
Ethos XB	bifenthrin	FMC Corporation	279-3473
Evergreen EC 60-6	pyrethrins	MGK	1021-1770

TABLE 1 **Trade name**	**Active Ingredient (s)**	**Registrant/ Company**	**EPA Registration #**
Exirel Insect Control	cyantraniliprole	FMC Corporation	279-9615
Fanfare 2EC	bifenthrin	ADAMA	66222-99
Fanfare EC	bifenthrin	ADAMA	66222-261
Fanfare ES	bifenthrin	ADAMA	66222-236
Fastac CS	cypermethrin (alpha)	BASF Ag Products	7969-364
Fastac EC	cypermethrin (alpha)	BASF Ag Products	7969-298
Ferroxx Slug & Snail Bait	sodium ferric EDTA	Neudorff	67702-33
Ferroxx AQ	iron phosphate	Neudorff	67702-49
Force 6.5G	tefluthrin	Syngenta	100-1625
Force 10G HL Smartbox, SmartCartridge	tefluthrin	AMVAC	100-1615-5481
Force EVO	tefluthrin	Syngenta	100-1610
Fyfanon ULV Ag	malathion	FMC Corporation	279-3540
Grizzly Too	cyhalothrin (lambda)	WinField United	100-1295-1381
Hero	bifenthrin cypermethrin (zeta)	FMC Corporation	279-3315
Hero EW	bifenthrin cypermethrin (zeta)	FMC Corporation	279-3329
Index Liquid At-Plant	chlorethoxyfos bifenthrin	AMVAC	5481-587
Intrepid 2F	methoxyfenozide	Corteva Agriscience	62719-442
Intrepid Edge	methoxyfenozide spinetoram	Corteva Agriscience	62719-666
Invertid 2F	methoxyfenozide	Loveland	34704-1107
Javelin WG	Bt kurstaki	Certis USA	70051-66
Kendo 22.8CS	cyhalothrin (lambda)	Helm Agro	74530-54
Kendo Insecticide	cyhalothrin (lambda)	Helm Agro	74530-38
Kilter	Imidacloprid cyhalothrin (lambda)	NuFarm	228-717
Lambda-Cy	cyhalothrin (lambda)	UPL NA INC. Inc	70506-121
Lambda-Cy Ag	cyhalothrin (lambda)	WinField United	83222-42
Lambda-Cy. 1EC	cyhalothrin (lambda)	Nufarm	228-708
LambdaStar	cyhalothrin (lambda)	LG Life Sciences	71532-20-91026
Lambda-T	cyhalothrin (lambda)	Helena	100-1112-5905
Lamcap II	cyhalothrin (lambda)	Syngenta	100-1295
Lannate LV	methomyl	Corteva Agriscience	352-384
Lannate SP	methomyl	Corteva Agriscience	352-342
Lanveer LV	methomyl	Innvictis	89167-91-89391
Leverage 360	imidacloprid cyfluthrin	Bayer CropScience	264-1104
Malathion 5	malathion	WinField United	9779-5

TABLE 1 **Trade name**	**Active Ingredient (s)**	**Registrant/ Company**	**EPA Registration #**
Malathion 5EC	malathion	Drexel	19713-217
Minecto Pro	cyantraniliprole abamectin	Syngenta	100-1592
Montana 4F	imidacloprid	Rotam North America	83100-21-83979
Movento	spirotetramat	Bayer CropScience	264-1050
Movento HL	spirotetramat	Bayer CropScience	264-1188
Mustang	cypermethrin (zeta)	FMC Corporation	279-3126
Mustang Maxx	cypermethrin (zeta)	FMC Corporation	279-3426
Nirvana Complete	bifenthrin	Innvictis	89168-129-89391
Nirvana RTU	bifenthrin	Innvictis	91234-177-89391
Nudrin LV	methomyl	Rotam North America	83100-27-83979
Nudrin SP	methomyl	Rotam North America	83100-28-83979
Nuprid 2SC	imidacloprid	Nufarm	228-572
Nuprid 4F Max	imidacloprid	Nufarm	228-528
Nurizma	broflanilide	BASF Ag Products	7969-423
Oberon 2SC	spiromesifen	Bayer CropScience	264-719
Onager	hexythiazox	Gowan	10163-277
Orthene 97	acephate	AMVAC	5481-8978
Paradigm VC	cyhalothrin (lambda)	WinField United	33270-41
Permastar AG	permethrin	LG Life Sciences	71532-15-91026
Perm-UP 25DF	permethrin	UPL NA	70506-66
Perm-UP 3.2EC	permethrin	UPL NA	70506-9
Pounce 1.5G	permethrin	FMC Corporation	279-3059
Pounce 25WP	permethrin	FMC Corporation	279-3051
Prevathon	chlorantraniliprole	FMC Corporation	279-9612
Prey 1.6	imidacloprid	Loveland	34704-894
Proaxis	cyhalothrin (gamma)	FMC Corporation	279-3583
Province II	cyhalothrin (lambda)	TENKOZ Inc	100-1295-55467
Provoke	imidacloprid	Innvictis	89168-23-89391
PyGanic EC 1.4 II	pyrethrins	MGK	1021-1771
Pyganic 5.0 II	pyrethrins	Valent / MGK	1021-1772
Radiant SC	spinetoram	Corteva Agriscience	62719-545
Ravage	cyhalothrin (lambda)	Innvictis	89168-16-89391
Ravage II	cyhalothrin (lambda)	Innvictis	89167-119-89391
Reaper 0.15EC	abamectin	Loveland	34704-923
Reaper Clearform	abamectin	Loveland	34704-1078
Renestra	cypermethrin afidopyropen	BASF Ag Products	7969-436
Reveal Reveal EndurX	bifenthrin	Innvictis	89168-19-89391

TABLE 1 **Trade name**	**Active Ingredient (s)**	**Registrant/ Company**	**EPA Registration #**
Ridgeback	sulfoxaflor bifenthrin	Corteva Agriscience	62719-749
Savoy	acetamiprid bifenthrin	Innvictis	89168-74-89391
Sefina	afidopyropen	BASF Ag Products	7969-391
Sevin 4F	carbaryl	Tessenderlo Kerley	61842-38
Sevin XLR Plus	carbaryl	Tessenderlo Kerley	61842-37
S-fenvalostar	esfenvalerate	LG Life Sciences	71532-21-73006
Shenzi 400SC	chlorantraniliprole	UPL NA	70506-607
Sherpa	imidacloprid	Loveland	34704-983
Silencer	cyhalothrin (lambda)	ADAMA	66222-104
Sivanto 200SL	flupyradifurone	Bayer CropScience	264-1141
Sivanto HL	flupyradifurone	Bayer CropScience	264-1198
Sivanto Prime	flupyradifurone	Bayer CropScience	264-1141
Skyraider	bifenthrin imidacloprid	ADAMA	66222-247
Sluggo	iron phosphate	Certis USA	67702-3-70051
SmartChoice 5G	chlorethoxyfos bifenthrin	AMVAC	5481-561
Smartchoice HC	chlorethoxyfos bifenthrin	AMVAC	5481-579
Sniper	bifenthrin	Loveland	34704-858
Sniper Helios	bifenthrin	Loveland	34704-858
Sniper LFR	bifenthrin	Loveland	34704-1089
Spear-Lep	GS-omega/kappa- Hxtx-Hv1a	Vestaron	88847-6
Spintor 2SC	spinosad	Corteva Agriscience	62719-294
Steed	bifenthrin cypermethrin (zeta)	FMC Corporation	279-3380
Steward EC	indoxacarb	FMC Corporation	279-9596
Stifle SC	etoxazole	AMVAC	5481-651
Swagger	bifenthrin imidacloprid	Loveland	34704-1045
Tombstone	cyfluthrin	Loveland	34704-912
Tombstone Helios	cyfluthrin	Loveland	34704-978
Tracer	spinosad	Corteva Agriscience	62719-267
Transform WG	sulfoxaflor	Corteva Agriscience	62719-625
Tundra EC	bifenthrin	WinField United	1381-196
Vantacor	chlorantraniliprole	FMC Corporation	279-9656
Warrior II w/ Zeon Tech.	cyhalothrin (lambda)	Syngenta	100-1295
Willowood Lambda-Cy1EC	cyhalothrin (lambda)	Willowood LLC	87290-24

TABLE 1 **Trade name**	**Active** **Ingredient (s)**	**Registrant/ Company**	**EPA Registration #**
Wrangler	imidacloprid	Loveland	34704-931
Xentari Biological	Bt aizawai	Valent Biosciences	73049-40
Xpedient Plus V	bifenthrin	AMVAC	5481-609
Zeal	etoxazole	Valent	59639-123
Zeal Pro	etoxazole	Valent	59639-241
Zeal SC	etoxazole	Valent	59639-202
Zyrate	esfenvalerate	Rotam North America	71532-21-83979

Introduction Table 2: RUP status, signal words, reentry intervals for workers, and modes of action numbers to aid in choosing among insecticides in the Insect Pest Management Guide

- **Restricted Use Pesticides (RUPs)** can be applied only by certified applicators
- **Signal words** rate acute (short term) toxicity. Rarely, there is no signal word on a label. From low to high, the signal words are caution, warning, and danger
- A **Reentry interval (REI)** is the minimum time in hours between a pesticide application and workers entering a field without additional protective clothing. This time frame is usually in the Ag Use Requirements box on each label. REIs are particularly important in field crops like sugar beets and seed corn which may need detasseling, thinning, or weeding
- **Mode of action classification numbers** are set by the Insecticide Resistance Action Committee (IRAC). Insecticides with the same number have the same mode of action and may need to be rotated with insecticides in different groups to delay resistance

TABLE 2 **Pesticide trade name**	**Restricted use (RUP)**	**Signal Word**	**REI (hours)**	**Mode of action classification**
Abba Ultra	yes	warning	12	6
Acephate 90 Prill, WDG & WSP	no	caution	24	1B
Acephate 97 UP & WDG	no	caution	24	1B
Acramite 4SC	no	caution	12	20D
Admire Pro	no	caution	12	4A
Advise Four	no	caution	12	4A
Agree WG	no	caution	4	11A
Agri-Mek SC	yes	warning	12	6
Alias 4F	no	caution	12	4A
Annex LFR	yes	warning	12	3A
Annihilate LV & SP	yes	danger	48	1A
Arctic 3.2EC	yes	caution	12	3A
Argyle OD	yes	warning	12	3A, 4A
Asana XL	yes	warning	12	3A
Avaunt eVo	no	caution	12	22A
Aztec 4.67G & HC	yes	warning	48	1B, 3A
Baythroid XL	yes	warning	12	3A
Belay	no	caution	12	4A
BeLeaf	no	caution	12	29
Besiege	yes	warning	24	3A, 28
Bifen 2 Ag Gold	yes	warning	12	3A
Bifender FC	yes	warning	12	3A
Bifenthrin 2EC	yes	warning	12	3A
Bifenture 10DF	yes	caution	12	3A, 4A
Bifenture EC	yes	warning	12	3A
Bifenture LFC	yes	caution	12	3A
Blackhawk	no	caution	4	5
Brigade 2EC	yes	warning	12	3A

TABLE 2 **Pesticide trade name**	**Restricted use (RUP)**	**Signal Word**	**REI (hours)**	**Mode of action classification**
Brigadier	yes	warning	12	3A, 4A
Capture 3RIVE 3D	yes	caution	12	3A
Capture LFR	yes	warning	12	3A
Carbaryl 4L	no	caution	by crop	1A
Coragen	no	none	4	28
Corrida 90 WSP	yes	danger	48	1A
Counter 20G (various)	yes	danger	48	1B
Deadline (various)	no	caution	12	none
Declare	yes	caution	24	3A
Defcon 4.67G	yes	warning	48	1B, 3A
Delta Gold	yes	danger	12	3A
Denim	yes	danger	48	6
Diamond	no	warning	12	15
Dibrom 8E	yes	danger	48	1B
Dimate 4E	no	warning	by crop	1B
Dimethoate 400 & 4EC	no	warning	by crop	1B
Dipel 10G, DF, & ES	no	caution	4	11A
Discipline 2EC	yes	warning	12	3A
Durham 7.5 Granules	no	caution	12	none
Elevest Insect Control	yes	caution	12	3A, 28
Empower 2	yes	caution	24	3A
Endigo ZC & ZCX	yes	warning	24	3A, 4A
Entrust	no	caution	4	5
Entrust SC	no	none	4	5
Ethos Elite LFR	yes	warning	12	3A
Ethos XB	yes	caution	12	3A
Evergreen EC 60-6	no	caution	12	3A
Exirel Insect Control	no	caution	12	28
Fanfare 2EC, EC, & ES	yes	warning	12	3A
Fastac CS	yes	caution	12	3A
Fastac EC	yes	danger	12	3A
Ferroxx Slug & Snail Bait	no	caution	0	none
Ferroxx AQ	no	caution	4	none
Force 6.5G	yes	caution	48	3A
Force 10G HL	yes	warning	48	3A
Force EVO	yes	danger	48	3A
Fyfanon ULV Ag	no	caution	by crop	1B
Grizzly Too	yes	warning	24	3A
Hero & Hero EW	yes	caution	12	3A
Index Liquid At-Plant	yes	danger	48	1B, 3A

TABLE 2 **Pesticide trade name**	**Restricted use (RUP)**	**Signal Word**	**REI (hours)**	**Mode of action classification**
Intrepid 2F	no	caution	4	18
Intrepid Edge	no	caution	4	5, 18
Invertid 2F	no	caution	4	18
Javelin WG	no	caution	4	11A
Kendo / Kendo 22.8 CS	yes	warning	24	3A
Kilter	yes	danger	24	3A, 4A
Lambda-Cy & Lambda-Cy Ag	yes	warning	24	3A
Lambda-Cyhalothrin 1EC	yes	warning	24	3A
LambdaStar	yes	danger	24	3A
Lambda-T	yes	warning	24	3A
Lamcap II	yes	warning	24	3A
Lannate LV & SP	yes	danger	48	1A
Lanveer LV	yes	danger	48	1A
Leverage 360	yes	caution	12	3A, 4A
Malathion 5 & 5EC	no	warning	by crop	1B
Minecto Pro	yes	warning	12	6, 28
Montana 4F	no	caution	12	4A
Movento / Movento HL	no	caution	24	23
Mustang Maxx	yes	warning	12	3A
Nirvana Complete & RTU	yes	warning	12	3A
Nudrin LV & SP	yes	danger	48	1A
Nuprid 2SC & 4F Max	no	caution	12	4A
Nurizma	no	caution	12	30
Oberon 2SC	no	caution	12	23
Onager	no	caution	12	10A
Orthene 97	no	caution	24	1B
Paradigm VC	no	caution	24	3A
Permastar AG	yes	caution	12	3A
Perm-UP 25DF	yes	warning	12	3A
Perm-UP 3.2EC	yes	caution	12	3A
Pounce 1.5G & 25WP	yes	caution	12	3A
Prevathon	no	none	4	28
Prey 1.6	no	caution	12	4A
Proaxis	yes	caution	24	3A
Province II	yes	warning	24	3A
Provoke	no	caution	12	4A
PyGanic EC 1.4 II & 5.0 II	no	caution	12	3A
Radiant SC	yes	caution	4	5
Ravage	yes	warning	24	3A
Ravage II	yes	warning	24/48	3A

TABLE 2 **Pesticide trade name**	**Restricted use (RUP)**	**Signal Word**	**REI (hours)**	**Mode of action classification**
Reaper 0.15EC & Clearform	yes	warning	12	6
Renestra	yes	warning	12	3A, 9D
Reveal/ Reveal EndurX	yes	warning	12	3A
Ridgeback	no	warning	24	3A, 4C
Savoy	yes	warning	12	3A, 4A
Sefina	no	caution	12	9D
Sevin 4F or XLR Plus	no	caution	by crop	1A
S-fenvalostar	yes	warning	12	3A
Shenzi 400SC	no	caution	4	28
Sherpa	no	caution	12	4A
Silencer	yes	warning	24	3A
Sivanto 200SL, HL, & Prime	no	caution	4	4D
Skyraider	yes	warning	12	3A, 4A
Sluggo	no	caution	0	n/a
SmartChoice 5G	yes	danger	48	1B, 3A
SmartChoice HC	yes	warning	48	1B, 3A
Spear-Lep	no	caution	4	32
Sniper / Sniper Helios & LFR	yes	warning	12	3A
Spintor 2SC	no	none	4	5
Steed	yes	warning	12	3A
Steward EC	no	caution	12	22
Stifle SC	no	caution	12	10B
Swagger	yes	danger	12	3A, 4A
Tombstone	yes	danger	12	3A
Tombstone Helios	yes	warning	12	3A
Tracer	no	none	4	5
Transform WG	no	danger	24	4C
Tundra EC	yes	warning	12	3A
Vantacor	no	none	4	28
Warrior II w/ Zeon	yes	warning	24	3A
Willowood Lambda-Cy 1EC	yes	warning	24	3A
Wrangler	no	caution	12	4A
Xentari Biological	no	caution	4	11A
Xpedient Plus V	yes	warning	12	3A
Zeal (various)	no	caution	12	10B
Zyrate	yes	warning	12	3A

Introduction Table 3: Target sites and modes of action for insecticides in field crops. Modes of action are based on the classification scheme developed by the Insecticide Resistance Action Committee (IRAC) at irac-online.org. If an insecticide is followed by the word "part", that indicates it is a mixture of active ingredients with different modes of action.

IRAC number and group	***Target site*** **• Mode of action**	**Example active ingredient(s)**	**Example trade name(s)**
1A carbamates	*Nervous system* • Bind to the acetylcholinesterase enzyme, preventing it from 'cleaning' the gap between nerves. Death from overstimulation of nerves. The effect is brief, compared to OPs (below).	carbaryl methomyl	Carbaryl Corrida Lannate Lanveer Nudrin Sevin
1B organophosphates (OPs)	*Nervous system* • Bind to the acetylcholinesterase enzyme similar to carbamates, but the effect is longer-lasting. This usually makes OPs more hazardous than carbamates.	acephate chlorethoxyfos dimethoate malathion tebupirimphos terbufos	Aztec (part) Counter Dibrom Dimethoate Index (part) Malathion Smartchoice (part)
3A pyrethrins & pyrethroids	*Nervous system* • Disrupt sodium channels along the nerve axon, resulting in continuous firing of nerves. • Pyrethrins are botanical insecticides extracted from chrysanthemum. Some products may carry an organic registration. • Pyrethroids are chemically based on these molecules but are NOT used in organic crops. • Performance of pyrethrins & some pyrethroids is increased by adding a synergist to the formulation.	<u>botanical:</u> pyrethrin <u>conventional:</u> bifenthrin cyfluthrin ƛ-cyhalothrin λ-cyhalothrin cypermethrin esfenvalerate permethrin tefluthrin	<u>botanical:</u> Pyganic <u>conventional:</u> Arctic Asana Aztec (part) Baythroid Besiege (part) Bifenture Brigade Capture Elevest (part) Empower Force Hero Lambda-Cy Mustang Perm-Up Pounce Proaxis Silencer Tombstone Warrior

IRAC number and group	***Target site*** **• Mode of action**	**Example active ingredient(s)**	**Example trade name(s)**
4A neonicotinoids	*Nervous system* • Hyper-stimulate nerves by binding to their nicotinic acetylcholine receptors in the synapse. The binding is better to insect receptors than to mammalian receptors.	clothianidin imidacloprid thiamethoxam	Admire Belay Brigadier (part) Cruiser Leverage (part) Nuprid Poncho
4C sulfoximines 4D butenolides	*Nervous system* • Bind to nicotinic acetylcholine receptors in the synapse, but have a different structure than 4A, neonicotinoids.	sulfoxaflor flupyradifurone	Transform Sivanto
5 spinosyns	*Nervous system* • Bind to nicotinic acetylcholine receptors in the synapse, but in a different way than neonicotinoids.	spinosad spinetoram	Entrust IntrepidEdge (part) Radiant Spintor Tracer
6 avermectins	*Nervous system* • Block the transmission of signals in nerve and muscle cells, causing paralysis, by increasing the effect of glutamate at insect glutamate-gated chloride channels (mammals don't have glutamate-gated channels).	abamectin	Abba Ultra Agri-Mec Denim Reaper Minecto Pro (part)
9D pyropenes	*Chordotonal stretch receptors* • Disrupt proteins in the neurons of insect chordotonal stretch receptors under the cuticle which are important in hearing, movement, balance, and flight. Ultimately insects stop feeding and other behaviors for survival.	afidopyropen	Renestra Sefina
10A 10B mite growth inhibitors	*Growth inhibitor* • Not well understood. Disrupts synthesis of chitin (a key component of the mite exoskeleton) during development. Impacts eggs and nymphs, but not adults.	hexythiazox etoxazole	Onager Stifle Zeal

IRAC number and group	***Target site*** **• Mode of action**	**Example active ingredient(s)**	**Example trade name(s)**
11A Bacillus thuringiensis (Bt)	*Midgut membrane* • Cry proteins bind to specific receptors in the gut. Gut contents leak into body cavity & insect dies slowly of septicemia.	Bt kurstaki Bt aizawai	Agree Dipel Javelin Xentari (also Bt crops)
15 benzoylureas	*Chitin biosynthesis* • Inhibits an enzyme involved in the synthesis of chitin, the major component of the insect exoskeleton. Immatures cannot molt properly.	novaluron	Diamond
18 diacylhydrazines	*Ecdysone (hormone) receptor* • Causes lepidopteran larvae (caterpillars) to molt prematurely, which is lethal to them.	methoxyfenozide	Intrepid Intrepid Edge (part) Invertid
20D bifenazate	*Mitochondria* • Inhibits the process of respiration, so that cells can't utilize energy. Paralysis and eventual death.	bifenazate	Acramite
22A oxadiazines	*Nervous system* • Block sodium channels and thus disrupt signals along nerve axon. Insects cannot feed or move.	indoxacarb	Avaunt Steward
23 tetronic & tetramic acid derivatives	*Growth inhibitor* • Inhibits the enzyme acetyl coenzyme A carboxylase, which is important in lipid biosynthesis. Results include slow development, reduced egg production, and death.	spiromesifen	Movento Oberon
28 diamides	*Nervous system* • Activate ryanodine receptors on muscles, causing them to contract. Leads to paralysis then death.	chlorantraniliprole	Besiege (part) Coragen Elevest (part) Exirel Minecto Pro (part) Prevathon Shenzi Vantacor

IRAC number and group	***Target site*** **• Mode of action**	**Example active ingredient(s)**	**Example trade name(s)**
29 flonicamid	*Chordotonal stretch receptors* • Disrupt proteins in the neurons of insect chordotonal stretch receptors under the cuticle which are important in hearing, movement, balance, and flight. Ultimately insects stop feeding and other behaviors for survival.	flonicamid	Beleaf
30 GABA-gated chloride channel modulators	*Nervous system & muscles* • Interferes with the receptor for GABA, a neurotransmitter which normally blocks or calms nerve signals. This causes overexcitation of the nervous system, convulsions, and death.	broflanilide	Nurizma
32 Nicotinic acetylcholine receptor allosteric modulators	*Nervous system* • Peptides bind to and overexcite nicotinic acetylcholine receptors, leading to paralysis & death. Products must be combined w/ a Bt insecticide so the peptides can leave the gut and move to the target site.	GS-omega/kappa HXTX-Hv1a	Spear-Lep bioinsecticide
Not classified Aldehydes	*Mucus cells* • Irreversibly destroys mucus producing cells, leading to death.	metaldehyde	Deadline Durham
Not classified Iron phosphate	*Digestive tract* • Interferes with calcium metabolism in the gut. Snails & slugs stop eating and die.	iron phosphate	Ferroxx AQ Sluggo
Not classified sodium ferric EDTA	*Oxygen transport* • Interacts with hemocyanin, the oxygen transport protein in slugs. Slugs suffocate and die.	sodium ferric EDTA	Ferroxx

Management of Insect Pests of Alfalfa and Grass Hay in Michigan and Ohio
Updated: November 2025

Chris DiFonzo, Field Crops Entomologist
Michigan State University
Department of Entomology
288 Farm Lane
East Lansing, MI
difonzo@msu.edu

Kelley Tilmon, Field Crops Entomologist
The Ohio State University
Department of Entomology
1680 Madison Ave
Wooster, OH
tilmon.1@osu.edu

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 **alfalfa and grass hay.** Pesticide names and rates are current as of the date in the heading.

- ✓ **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 on the crop are listed in **Table 5** (alfalfa) and **Table 6** (grass hay). 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.

Table 1: Timing of damage from insect pests of alfalfa and grass hay in Michigan and Ohio

- Pests are listed from early to late-season. Key species are highlighted in bold text.

Common name	Overwintering stage, location	April / May	June	July	August	Sept
alfalfa weevil	adults, in protected areas	larval defoliation		(adults present)		
clover root curculio	adults, in protected areas		egg laying	larval feeding on roots		
white grubs	larvae (grubs), underground	damage to stand from root feeding				
true armyworm	Southern USA, migrates north	caterpillars feed on grasses in mixed stands or pasture				
potato leafhopper	Southern USA, migrates north	avg arrival ~20 May	overlapping generations of nymphs and adults suck plant sap from alfalfa leaves and stems			
spittlebug	eggs, on residue	nymphs suck plant sap		adults suck plant sap		
plant bugs	adults or eggs, in protected areas		nymphs and adults suck plant sap from alfalfa leaves and stems			
aphids (usually pea aphid)	eggs?		nymphs and adults suck plant sap from alfalfa leaves and stems			
caterpillars (multiple species)	depends on species		caterpillars feed on leaves of legumes, grass, or both			
grasshoppers (multiple species)	egg clusters, underground			nymphs, then adults, feed on leaves		
blister beetles (multiple species)	larvae, in soil cells			adult beetles feed on alfalfa leaves and blossoms		
fall armyworm	Southern USA, migrates north				caterpillars defoliate alfalfa and mixed stands	
winter cutworm	larvae, under residue				caterpillars defoliate alfalfa late into fall; active in winter	

Table 2: Damage checklist to aid in scouting for insect pests of alfalfa and grass hay in Michigan and Ohio

Plant part or timing Type of damage or injury	alfalfa weevil	aphids	blister beetles	caterpillars	clover root curculio	fall armyworm	grasshoppers	plant bug	potato leafhopper	spittlebug	true armyworm	white grubs	winter cutworm
Leaves													
small holes in leaves	x			x		x							
tip feeding	x												
large holes			x	x		x	x						x
irregular, ragged leaf feeding				x		x	x						
skeletonized 'frosted' appearance	x												x
complete defoliation - alfalfa						x							x
complete defoliation - grasses						x					x		
generalized leaf yellowing		x						x					
yellow leaf margins (hopperburn)									x				
red leaf margins									x				
leaves cupped or crinkled		x						x	x				
leaf drop									x				
sticky leaves or sooty mold		x											
spittle masses										x			
webbed, rolled leaves				x									
Roots													
root hairs missing												x	
pruning of whole roots												x	
chewing scars on taproots					x								
chewed furrows on taproots					x								
girdling of the taproot					x								
Stand													
stand thinning or weediness					x	x						x	
stand loss					x	x						x	
Other													
reduced forage quality									x				
shorter stand life	x				x				x			x	
cantharidin toxin in cut hay			x										

Table 3: Life cycle, damage, and pest status of insect pests of alfalfa and grass hay in Michigan and Ohio

Terms to describe the pest status of each insect. Ratings apply to Michigan and Ohio.

- **Rare**: Unusual, typically goes unnoticed. May not even be present
- **Uncommon**: Usually present but well-below damaging levels. An outbreak once a generation.
- **Occasional**: Present in most fields, sometimes in high numbers. An outbreak once a decade.
- **Important**: Present in most fields, potentially increasing to damaging levels every season. A common target of scouting, management programs, or insecticide use.
- **Sporadic:** Damaging levels occur after favorable weather patterns (such as drought) or mass movement from south to north during the season
- **Localized**: Damaging levels occur in specific locations under specific agronomic conditions, for example in no-till production or in older stands.

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
alfalfa weevil	Adults (and some eggs) overwinter and become active when temps reach 48°F (~ 200 degree days). Adults lay eggs in stems. There are 4 larval stages, with 80% of the feeding done by the 4th / last instar. By mid-June, development is complete, and weevils pupate in spun cocoons on the plant or in residue. Adults feed for a few weeks, then go into summer dormancy in protected areas outside the field. They re-emerge to feed for a time in late summer and early fall. One generation per year	• Small larvae feed in the folded terminals, chewing small holes. Older larvae feed on leaves throughout the plant • From a distance, heavily skeletonized foliage appears white, like frost damage • Repeated or heavy damage can reduce stand life by 1-2 yrs or lead to weed infestations	• Weevil populations build over time in older stands because adults overwinter nearby. New fields can be infested quickly if they are adjacent to older stands	Important Pest status seems to be increasing, unclear if bio-control levels have changed
aphids *usually pea aphid, a big species which may be yellow, green, or pink*	Assumed overwintering as eggs. Summer population is all female. Females give birth to 12-14 live young per day and do not mate to reproduce. Multiple overlapping generations	• All stages suck plant sap from stems and leaves • Heavy infestation can lead to stunting, curling of leaves, and weakening of plants • Huge numbers can slow regrowth after cutting	• Nothing specific	Uncommon Unusual outbreak in central MICH in 2023
blister beetle	Eggs are laid in the soil. Larvae of most species feed on grasshopper eggs and thus are 'beneficial' in some sense. Larvae overwinter and adults emerge in spring. The beetles are distinctive with a round head, narrow 'neck', and loose wings that may not cover the abdomen. Multiple species are found in fields in the region.	• The body fluid of live and dead blister beetles has cantharidin, a chemical which blisters the mouth and digestive tract of livestock. Horses are very susceptible & can die after eating hay contaminated when beetles are incorporated into bales at harvest • Cantharidin dose varies by blister beetle species	• Grasshopper outbreaks (thus a dry season) often precedes a bad blister beetle year in alfalfa • Beetles may be attracted to, and aggregate on, flowering alfalfa or weeds later in the season	Uncommon and Sporadic Usually an issue during or after a dry season
caterpillars *cloverworm, loopers, earworm*	Many species of caterpillars are found in legume forages. Some overwinter in the region, others migrate from the south.	• Caterpillars feed on leaves and stems; a few species roll or web leaves	• Nothing specific	Uncommon

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
clover root curculio	Adults overwinter and become active in early spring. Small larvae feed on root nodules, and larger larvae on lateral and taproot. Pupation is in soil. Adults feed for a few weeks, then go into summer dormancy. They re-emerge to feed for a time in late summer and early fall. One generation per year	• Feeding by small larvae on root nodules could reduce N fixation • Larger larvae create scars, tunnel roots, and girdle the taproot. The injury reduces nutrient flow and creates entry points for root pathogens • Damage accumulates each season. May reduce stand life	• Older stands, as injury accumulates • New seedings near older stands may be killed by beetles moving out of the older field	Rare and Localized
fall armyworm (FAW)	FAW is a tropical species that cannot survive freezing temperatures. Adult moths migrate north, arriving mid to late season. Eggs are laid on leaves. Larvae climb plants to feed during the day. Pupation in soil. 1-3 generations, if it is warm enough in the late season. Larvae CANNOT overwinter in our area.	• Larvae prefer grasses but will eat legumes. Feeding starts on leaf margins; all leaves and small stems can be consumed under heavy infestations, leaving non-host weeds as the only vegetation in the field • Mass numbers may move into a field from adjacent crops (corn, wheat), ditches, or turf	• Strong winds from the SW carry moths northward • Warm conditions in late summer into fall can lead to several generations • Grass hay or mixed stands are likely more attractive for egg laying	Uncommon and Sporadic A late-season outbreak in 2021 was the worst in ~30 years
grasshoppers *multiple species*	Eggs overwinter in the soil. Nymphs emerge in June. Feeding increases as they grow. Females lay groups of eggs in the undisturbed soil in late summer. 1 generation per year	• Adults and nymphs chew on leaves; feeding has a ragged appearance	• Undisturbed pastures and forage fields are preferred egg-laying sites • A dry summer can lead to an outbreak the following year	Uncommon in alfalfa Sporadic in pastures. Usually after a dry season
plant bugs *e.g alfalfa plant bug, lygus bug, & fleahopper*	Alfalfa plant bugs overwinter as eggs, while Lygus adults overwinter in residue and on field edges. Weeds and early-season crops like alfalfa are preferred hosts. Probably one generation	• In legume forage, adults and nymphs suck plant sap; leaves may be curled or stunted • In legumes grown for seed, feeding damages blossoms and seeds, reducing germination	• Nothing specific	Uncommon
potato leafhopper (PLH)	Adults are carried into the region from the south on weather fronts in late May. Females insert eggs in stems. Nymphs hatch in 7-10 days, begin feeding immediately, and reach the winged adult stage in 2-3 weeks. Multiple overlapping generations	• Adults and nymphs lacerate and suck on leaves and stems, damaging cells and blocking vascular tissue • The classic symptom of feeding is tip yellowing or 'hopper burn' (this symptom may be red in some legumes) • Other symptoms include stunting and curling of leaves • Long term impacts = yield & quality loss, shorter stand life	• New seedings are very vulnerable • PLH damage is worse under dry conditions, and leafhopper survival is probably better as well	Sporadic and Important problematic later in the season if populations become well-established early
spittlebug *meadow and two-lined*	Eggs hatch in spring. Nymphs of Meadow SB feed near the soil surface on forage plants or weeds and move higher as they grow. Two-lined SB, a species expanding north into our region, feeds on roots or stems near the soil surface for its entire juvenile stage. Nymphs of both species excrete and live in a spittle mass which protects them from predation and drying out. Adult spittlebugs lay eggs in late summer. One generation per year	• Adults and nymphs feed on dilute xylem sap moving from the roots into the plant. They must remove a lot of fluid to get nutrients • Early-season feeding by nymphs can result in plant stress, stunting, bunchy top growth, and yield loss • Losses ranging from 10-40% are reported for first-cutting, especially if combined with alfalfa weevil damage	• Nymphs are present early in the season, so first cutting alfalfa is usually the most affected stage	Uncommon

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
true armyworm (TAW)	Adult moths migrate into the region in early spring. Eggs are laid on grassy weeds or crops, where larvae (caterpillars) feed. Larvae pupate in the soil and adult moths emerge in a week. 2 to 3 generations per year	• Prefer to feed on the grass portion of mixed stands or in pastures, but will feed on legumes if forced to • Mass numbers may move into a field from adjacent crops (corn, wheat), ditches, or turf	• Nothing specific	Sporadic Outbreaks occur in years with a heavy spring flight from the south
white grubs *multiple species*	Adults (scarab beetles) emerge May-July, depending on species. Eggs are laid in the soil in the summer. Grubs feed on organic matter and roots, then move down in soil profile in late fall to overwinter. In spring, annual grub species feed for a period, then pupate. June beetle grubs have a longer life cycle and may continue to feed for several more years.	• Larvae (grubs) in general prune roots, causing wilting, deficiencies, or plant death • June beetle and European chafer feed in grass hay or pasture, creating dead areas • Asiatic garden beetle has been found in parts of alfalfa fields with a thin stand	• Populations of many grub species are higher in fields or parts of fields with sandy soil	Uncommon
winter cutworm *The adult moth is the large yellow underwing* *The official larval name of the caterpillar, the winter cutworm, was coined in MI*	Winter cutworm is a European species which was first recorded in Canada in 1979. Moths lay eggs in the summer. Caterpillars feed on numerous hosts. The cold-tolerant larvae feed well into fall. In winter, they sometimes crawl on the snow surface on sunny winter days. Larvae resume feeding very early in spring. Pupation occurs underground in May. One generation per year	• During outbreaks, larvae can defoliate alfalfa stands in fall. In mixed stands, they prefer to feed on alfalfa first • Late-season feeding reduces stubble that traps snow (thus increasing winter injury) and depletes root reserves (reducing spring growth) • New alfalfa seedings planted with an oat companion crop are attractive to moths for egg laying and may be thinned	• Nothing specific	Uncommon Michigan was the first state to document economic damage by this insect in forage crops

Table 4: Management notes, scouting recommendations, and thresholds for insect pests of alfalfa and grass hay in Michigan and Ohio

A 15-inch sweep net is a must for alfalfa, especially to monitor weevil and potato leafhopper. A supplier for nets in the region is Great Lakes IPM in Vestaburg MI. Visit https://www.greatlakesipm.com/

Pest (abbreviation)	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
alfalfa weevil	• Biological: Multiple egg, larval, and adult parasitoids (some introduced from the weevil's native range in Europe) often provide good, free control. Numerous predators eat weevils, and a fungal pathogen kills larvae under humid conditions • Agronomic: If alfalfa is within 10 days of harvest, early cutting is the preferred way to reduce larval numbers while keeping numerous weevil parasitoids in the system. Check regrowth for survivors.	A sweep net is useful to detect weevil larvae Starting in early May, walk a pattern in the field & pick 50-100 stems into a sweep net or bucket; target older stands, since weevils overwinter locally	Threshold: • If it is more than 2 weeks until cutting: 40% of stems with feeding • On regrowth, after early cutting: 6-8 larvae per ft^2
aphids *usually pea aphid*	• Biological: Aphids are attacked by numerous predators (ladybugs, lacewings, syrphid fly larvae) & parasitoids which keep populations in check. Under humid conditions, entomopathogenic fungi wipe out aphids too • Host plant resistance: Most alfalfa varieties have some resistance to pea aphid • Environmental: Adequate moisture (rainfall or irrigation) reduces feeding stress and increases humidity for infection by fungal pathogens. Pea aphid populations tend to decline in mid-season when temps exceed 85°F	Sweep netting can detect aphids colonizing fields Check plant stems for aphids, count # per stem	Guideline for alfalfa x plant height: • < 10 inches: At least 50 aphids per stem • Over 10 inches: 100 aphids per stem Spraying is rarely justified, as biocontrol often kicks in
blister beetle	• Agronomic: Beetles often aggregate on blossoms, so cut alfalfa prior to bloom. Crimping forage during harvest can kill beetles, so if they are present, cut forage and give them time to escape before baling • Agronomic: First and second cutting hay has a lower chance of beetle contamination than later cuttings • Insecticides: Chemical control is difficult since residue must last through harvest. Furthermore, dead beetles killed by insecticide may still end up harvested into bales	No specific recommendation Walk fields prior to harvest to check for aggregations of beetles	No specific recommendation
caterpillars *cloverworm, earworm, loopers*	• Biological: Many predators feed on caterpillars • Agronomic: If alfalfa is within 10 days of harvest, early cutting is the preferred way to reduce caterpillar numbers. Check regrowth for survivors	No specific recommendation	No specific recommendation Use guidelines for FAW or TAW
fall armyworm (FAW)	• Biological: Predators and parasitoids kill larvae • Agronomic: If alfalfa or hay is within 10 days of harvest, early cutting is the preferred way to reduce larval numbers. Check regrowth for survivors • Insecticides: Applications are most effective on small larvae (less than ¾ inch). If caterpillars are invading from an adjacent field, a limited border treatment can save money • Pesticide resistance: Note that pyrethroids may not be very effective on FAW, since it colonizes from the south where it is sprayed in multiple crops	No specific recommendation. To detect flight into the region, use bucket pheromone traps starting in mid-July Fall seedings are particularly vulnerable & a priority for scouting	Guideline for small (< ¾ inch) larvae: 2-3 per square ft
grasshoppers	• Biological: Blister beetle larvae eat eggs. Insects, birds, and mammals eat nymphs & adults. Fungal pathogens kill eggs and nymphs under moist, cool conditions	No specific recommendation	Guideline for hay or pasture x plant height • 6 inches: 8 per square yard • over 6 inches: 16 per square yard

Pest (abbreviation)	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
plant bugs *alfalfa plant bug, lygus bug, fleahopper*	• Agronomic: When alfalfa is cut, adult plant bugs may move in large numbers into neighboring fields. This can be a problem for susceptible crops like sugar beet or some vegetables which may need to be monitored	No specific recommendation	None Spraying is not recommended
potato leafhopper (PLH)	• Biological - A naturally occurring fungal pathogen kills PLH under favorable conditions, usually infecting by mid-August • Agronomic: If alfalfa is within 10 days of harvest, early cutting is the best way to manage PLH. Many eggs and nymphs will die. Check regrowth for survivors and treat only if over threshold • Host plant resistance: PLH-resistant hairy varieties trap nymphs and repel adults. The level of resistance varies plant by plant but overall, resistant stands can tolerate more leafhoppers than regular alfalfa • Insecticides: Detailed dynamic thresholds which vary with plant height, spray cost, and hay value are available in extension bulletins or online	Using a sweep net, take 5 sets of 20 sweeps. Count the total # of PLH (adults and nymphs) Hint: Mark the net handle with inches and use it to measure the stand height	Economic threshold for alfalfa, based on #PLH in 100 sweeps: • < 3 inch = 20 • 4-7 inch = 50 • 8-11 inch = 100 • > 12 inch = 200 For resistant varieties: • New seeding, use the regular threshold • Older stands, use 3x the regular threshold
spittlebug *meadow and two-lined*	• Biological: Spittle masses protect nymphs from predation • Agronomic: Nymphs usually pupate before first cutting, so early cutting may be less of an option for control	No specific recommendation	Threshold: 1 or more spittle mass per stem
true armyworm (TAW)	• Biological: Predators, a tachinid parasitoid, and fungal pathogens all kill armyworm larvae • Agronomic: If alfalfa is within 10 days of harvest, early cutting is preferred to reduce larval numbers. Check regrowth for survivors • Insecticides: If caterpillars are invading a forage crop from an adjacent field, a limited border treatment can be made	No specific recommendation Feeding occurs at night or on cloudy days - check for larvae or big frass pellets on the ground	Guideline for mixed stands or pasture: 4 to 6 larvae per ft^2 Note: For mixed stands, both alfalfa and grass hay must be on the label
white grubs	• Biological: Natural enemies, pathogens, birds, and rodents all kill grubs. • Agronomic: Fields and parts of fields that are sandy tend to support higher grub populations, while numbers are low elsewhere. Note: it is important to identify grubs to distinguish annual species like European chafer and Asiatic garden beetles from multiyear species of June beetles	In poor stands, use a shovel to check for grubs and root pruning Target the sandy parts of fields	None established There are no rescue treatments in alfalfa or hay and limited options in pasture
winter cutworm	• Biological: During outbreaks, numerous insects, birds, and mammals were recorded to feed on caterpillars • Insecticides: If caterpillars are invading a forage crop from an adjacent field, a limited border treatment can be made	No specific recommendation	None established use guideline for FAW: 2 to 3 per square foot

Table 5: Foliar Insecticides to manage insect pests of alfalfa in Michigan and Ohio

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry.
- Application rates are listed for pests which appear on the manufacturer label. If a column is blank, the pest is not on the label. The letters in the pest columns refer to the label use rate from column two
- **NOTE: An insecticide must be registered on both alfalfa and grass to be used on intentionally-mixed stands**

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**alfalfa weevil**	**aphids**	**blister beetle**	**caterpillars**	**fall armyworm**	**grasshoppers**	**plant bugs**	**potato leafhopper**	**spittlebug**	**true armyworm**	**winter cutworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remarks**
Bacillus thuringiensis (Bt) Agree WG Dipel DF / Xentari Dipel ES Javelin WG	(a) 1.0 - 2.0 lbs (a) 0.5 - 2.0 lbs (a) 1.0 - 4.0 pints (a) 0.25 - 1.5 lbs				a	a					a		0	• Labeled for alfalfa, clover, & many nongrass forage crops • Bts are biological insecticides that must be eaten to kill, so coverage is important. Applications must be made when larvae are small. Labels list specific larval size recommendations • Check labels for varying rates on specific caterpillar species • Some products can be used in organic production
carbaryl Carbaryl 4L Sevin 4F Sevin XLR Plus	(a) 0.5 - 1.0 quart (b) 1.0 quart (c) 1.0 - 1.5 quart (d) 1.5 quart	d		a	c	c		c	b		c	c	7 harvest & grazing	• Labeled for "alfalfa, clover, birdsfoot trefoil" • On dense growth apply in 25-40 gal water for good coverage • Max 1.5 quarts per cutting • May temporarily bleach tender foliage • Bee caution: Do not apply to blooming crops or weeds
chlorantraniliprole Coragen Prevathon Shenzi 400SC Vantacor	(a) 3.5 - 7.5 oz (b) 2.0 - 5.0 oz (a) 14.0 - 20.0 oz (b) 8.0 - 20.0 oz (a) 1.7 – 3.8 oz (b) 1.0 – 2.5 oz (a) 1.2 - 2.5 oz (b) 0.7 - 1.7 oz				a	a	b				a		0	• Labeled for "non-grass animal feeds" including alfalfa • Max 1 application per cutting • See Prevathon label for specific adjuvants and spray timings related to grasshopper control
chlorantraniliprole + cyhalothrin (lambda) Besiege	(a) 5.0 - 8.0 oz (b) 6.0 - 10.0 oz	b	b	b	a b	b	b	b	a	b	b	a	1 forage 7 dry hay	• Labeled for alfalfa • Max 1 application per cutting • Pest note: Check labels for specific rates x caterpillar species • Spray when bees are not foraging (early morning or evening)

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**alfalfa weevil**	**aphids**	**blister beetle**	**caterpillars**	**fall armyworm**	**grasshoppers**	**plant bugs**	**potato leafhopper**	**spittlebug**	**true armyworm**	**winter cutworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remarks**
cyfluthrin Baythroid XL Tombstone Tombstone Helios	(a) 0.8 - 1.6 oz (b) 1.6 - 2.8 oz (c) 2.0 - 2.8 oz	b			a b	b	c	b	a	a	b	a	7 grazing harvest	• Labeled for alfalfa (for mixed stands, see Table 6) • Check labels for specific rates x caterpillar species • Fall armyworm = control of 1st & 2nd instars only, less than ¼ inch • Helios formulation has UV protection for extended residual
cyhalothrin (gamma) Declare Proaxis	(a) 0.77 - 1.28 oz (b) 1.02 - 1.54 oz (a) 1.92 - 3.20 oz (b) 2.56 - 3.84 oz	b	b	b	a b	b	b	b	a	b	b	a	1 forage 7 hay	• Labeled for alfalfa (pure stands) • Check labels for specific rates x caterpillar species • Spray when bees are not foraging (early morning or evening)
cyhalothrin (lambda) Warrior II w/Zeon Tech. Grizzly Too Kendo 22.8CS Lamcap II Province II Ravage II Grizzly Z Kendo Ravage Lambda Cyhalothrin 1EC Lambda-Cy Lambda-Cy Ag Lambda Star Lambda-T Paradigm VC Silencer Willowood Lambda-Cy1EC	(a) 0.96 - 1.60 oz (b) 1.28 - 1.92 oz (a) 1.92 - 3.20 oz (b) 2.56 - 3.84 oz	b	b	b	a b	b	b	b	a	b	b	a	1 forage 7 hay	• Many labels specify use on alfalfa (pure stands) only • Spray when bees are not foraging (early morning or evening) • Fall armyworm: Some labels indicate control of 1st & 2nd instars only • See label for mandatory info on spray drift management, buffer strips, and protecting aquatic habitats
cypermethrin (alpha) Fastac EC or CS	(a) 2.2 - 3.8 oz (b) 2.8 - 3.8 oz	a	a		a	b	b	b	a	a	b	a	3	• Labeled for alfalfa (not labeled for grasses)
cypermethrin (zeta) Mustang Maxx	(a) 2.24 - 4.0 oz (b) 2.8 - 4.0 oz	a	a		a	b	b	b	a	a	b	a	3	• Labeled for alfalfa and "nongrass animal feeds" like clover, trefoil, lupine, etc.
dimethoate Dimate 4E Dimethoate 400 and 4EC	(a) 0.5 - 1.0 pint		a				a	a	a				10	• Labeled for alfalfa (not labeled for grasses) • Max one application per cutting • Highly toxic to bees. Do not apply if bees are visiting the treated area when crop or weeds are in bloom
flonicamid BeLeaf 50SG	(a) 2.8 oz		a					a					14	• Labeled for alfalfa • Narrow mode of action targets aphids on contact & ingestion. Aphids stop feeding, but remain on plant until they dry up

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**alfalfa weevil**	**aphids**	**blister beetle**	**caterpillars**	**fall armyworm**	**grasshoppers**	**plant bugs**	**potato leafhopper**	**spittlebug**	**true armyworm**	**winter cutworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remarks**
Flupyradifurone Sivanto HL Sivanto 200 SL Sivanto Prime	(a) 3.5 - 7.0 (a) 7.0 - 10.5 oz (a) 7.0 - 14.0 oz		a						a				7	• Labeled for alfalfa (not labeled for grasses) • Systemic insecticide, effective on sucking pests
GS-omega/kappa-Hxtx-Hv1a Spear-Lep	(a) 1 - 2 pts				a	a					?	?	0	• Novel mode of action which may be useful on resistant Leps. MUST be applied in conjunction with a low dose of Bt (see label for details). The Bt damages the caterpillar gut allowing Spear-Lep to enter the body to nervous system • Fun fact, this product is derived from spider venom
Indoxacarb Steward	(a) 4.6 - 11.3 oz (b) 6.7 - 11.3 oz	b			b		a						7	• Labeled for alfalfa • Max 11.3 oz per cutting
methomyl Annihilate LV Nudrin LV Lannate LV Lanveer LV Annihilate SP Corrida90WSP Lannate SP Nudrin SP	(a) 1.5 - 3.0 pts (b) 3 pts (a) 0.5 - 1.0 lb (b) 1 lb	b	a		a	a		a			a		7	• Labeled for alfalfa • Do not apply to dormant/ semi-dormant alfalfa when the daily temp is < 50°F
methoxyfenozide Intrepid 2F	(a) 4 - 10 oz				a	a					a		0 grazing 3 or 7 hay depends on rate, see label	• Labeled for non-grass forages (alfalfa, clover, lupin, etc.) • Max 1 application per cutting and 32 oz per year • Must begin applications at first sign of feeding damage
permethrin Perm-Up 25DF Pounce 25WP Arctic 3.2 PermaStar AG Perm-Up 3.2EC	(a) 3.2 - 12.8 oz (b) 6.4 - 12.8 oz (a) 2 - 8 oz (b) 4 - 8 oz	b	a		a	a		b	b	b		a	0 or 14 depends on rate, see label	• Labeled for alfalfa. Do not apply to mixed stands with grasses or other legumes • Spray when bees are not foraging (early morning or evening)
pyrethrins Evergreen EC 60-6 Pyganic EC 1.4 II Pyganic 5.0	(a) 2.0 - 12.6 oz (a) 16 - 64 oz (a) 4.5 - 15.6 oz	a	a	a	a	a	a	a	a	a	a	a	0 when sprays dry	• Plant-derived insecticides that knock down insects quickly but have short residual control. Coverage is critical • PyGanic is OMRI listed for organic crops but Evergreen is not • Highly toxic to bees exposed to direct treatment. Do not apply on or drift onto blooming crops or weeds
sulfoxaflor Transform WG	(a) 0.75- 1.0 oz (b) 1.5 - 2.75 oz		a					b					7	• Labeled for alfalfa. Moves within leaf to target sucking pests

Table 6: Foliar Insecticides to manage insect pests of grass hay and pastures in Michigan and Ohio

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry
- Application rates are listed for pests which appear on the manufacturer label. If a column is blank, the pest is not on the label. The letters in the pest columns refer to the label use rate from column two
- **NOTE: An insecticide must be registered on both alfalfa and grasses to be used on intentionally-mixed stands**

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**caterpillars**	**fall armyworm**	**grasshoppers**	**spittlebug**	**true armyworm**	**white grubs**	**winter cutworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remarks**
Bacillus thuringiensis (Bt) Agree WG Dipel DF Javelin WG Xentari	(a) 1.0 - 2.0 lbs (a) 0.5 - 2.0 lbs (a) 0.25 - 1.5 lbs (a) 0.5 - 2.0 lbs	a				a			0	• Labeled for grass forage, fodder, hay • Bts are biological insecticides that must be eaten to kill. Coverage important. Applications must be made when larvae are small • Check labels for varying rates on specific caterpillar species • Can be used in organic production
carbaryl Carbaryl 4L Sevin 4F Sevin XLR Plus	(a) 1.0 - 1.5 quart	a	a			a			14 grazing 14 harvest	• Labeled for pastures and grasses grown for forage, fodder, and hay • Bee caution: Do not apply to blooming crops or weeds
chlorantraniliprole Coragen Prevathon Shenzi 400SC Vantacor	(a) 3.5 - 7.5 oz (b) 2.0 - 5.0 oz (a) 14.0 - 20.0 oz (b) 8.0 - 20.0 oz (a) 1.7 – 3.8 oz (b) 1.0 – 2.5 oz (a) 1.2 - 2.5 oz (b) 0.7 - 1.7 oz	a	a	b		a			0	• Labeled for pasture and "grass forage, fodder, and hay... that will be fed on or grazed by livestock". • See Prevathon label for specific adjuvants and spray timings for grasshopper control
chlorantraniliprole + cyhalothrin Besiege	(a) 5.0 - 8.0 oz (b) 6.0 - 10.0 oz	b	b	b	b	b		a	0 grazing 7 harvest	• Labeled for pasture and "grass grown for hay or silage"

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**caterpillars**	**fall armyworm**	**grasshoppers**	**spittlebug**	**true armyworm**	**white grubs**	**winter cutworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remarks**
cyfluthrin Baythroid XL Tombstone Tombstone Helios	(a) 1.6 - 1.9 oz (b) 2.6 - 2.8 oz	a b	b	b	a	a		a	0 grass 7 mixed stands	• Labeled for grass, "grass for hay", "grass in mixed stands with alfalfa" • Check labels for rate x caterpillar species • Fall armyworm = control of 1st & 2nd instars only, less than ¼ inch • Helios formulation has UV protection for extended residual
cyhalothrin (gamma) Declare	(a) 0.77-1.28 oz (b) 1.02 - 1.54 oz	a b	b	b	b	b		a	0 grazing & forage 7 dry hay	• Labeled for pasture and "grass grown for hay or silage"
cyhalothrin (lambda) Warrior II w/Zeon Tech. Grizzly Too Kendo 22.8CS Lamcap II Province II Ravage II Grizzly Z Kendo Lambda Cyhalothrin 1EC Lambda-Cy Lambda-Cy Ag Lambda Star Lambda-T ParadigmVC Ravage Silencer Willowood Lambda-Cy1EC	(a) 0.96 - 1.60 oz (b) 1.28 - 1.92 oz (a) 1.92 - 3.20 oz (b) 2.56 - 3.84 oz	b	b	b	b	b		a	0 grazing & forage 7 dry hay	• Labeled for pasture and "grass grown for hay or silage"
cypermethrin (zeta Mustang Maxx	(a) 2.24 - 4.0 oz (b) 2.8 - 4.0 oz	a	b	b	a	b		a	0 hay & forage	• Labeled for pasture, grass forage, and hay
methoxyfenozide Intrepid 2F	(a) 4 - 8 oz		a			a			0 grazing 7 hay	• Labeled for grass forage, fodder, and hay • Max 1 application per cutting and 32 oz per year • Must begin applications at first sign of feeding damage
pyrethrins Evergreen EC 60-6 Pyganic EC 1.4 II Pyganic 5.0	(a) 2.0 - 12.6 oz (a) 16 - 64 oz (a) 4.5 - 15.6 oz	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 • PyGanic is OMRI listed for organic crops, but Evergreen is not • Highly toxic to bees exposed to direct treatment; do not apply on or drift onto blooming crops or weeds
spinosad Blackhawk Tracer	(a) 1.1 - 2.2 oz (a) 1.0 - 2.0 oz	a	a			a		a	0 forage 3 hay	• Labeled for pastures, and grass crops • Must target egg hatch and small larvae

Management of Insect Pests of Field Corn in Michigan and Ohio
Updated: November 2025

Chris DiFonzo, Field Crops Entomologist
Michigan State University
Department of Entomology
288 Farm Lane
East Lansing, MI
difonzo@msu.edu

Kelley Tilmon, Field Crops Entomologist
The Ohio State University
Department of Entomology
1680 Madison Ave
Wooster, OH
tilmon.1@osu.edu

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 **field corn**. 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 field corn, from early to late season.

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

- ✓ **Table 3** has information on the life cycle of each pest, 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. 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 on the table.

- ✓ Insecticides registered in Michigan and Ohio on field corn 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 for easy comparison or substitution of one product for another. Use rates and pests are listed in columns 2 and 3. A letter under a pest indicates that species is on the label (i.e. the label claims control of that insect). The letter itself corresponds to the use rate in column 2. Some insecticides are applied at a single rate for all insects (‘a’), while rates for other insecticides vary by insect (‘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.

Table 1: Timing of damage from insect pests of corn in Michigan and Ohio

- 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	Asiatic garden Euro Chafer				
		Japanese beetle				
		June beetle				
seedcorn maggot	pupae, in soil	larval damage				
wireworm	larvae, in soil	larval damage				
flea beetle	adults, on field edge	adult feeding				
slugs & snails	both eggs and adults, in field	feeding on seedlings	feeding on lower leaves			
billbug	adults, on field edges	adult feeding	larval feeding - root crown			
sandhill crane	-----	birds pull out & consume seeds				
black cutworm	Southern USA, migrate north	larvae feed on leaves and cut off plants at the base				
true armyworm	Southern USA, migrate north	1st generation larvae feed on leaves	2nd generation larvae may defoliate plants			
corn rootworm	eggs, underground		larvae feed on roots	adult beetles clip silks and feed on ear tip		
corn blotch leafminer	adult flies		larvae mine leaf tissue			
grasshoppers (multiple species)	egg clusters, underground			nymphs, then adults, feed on foliage		
European corn borer	5th instar, in crop residue		1st generation larvae feed on leaf and stalk	2nd generation larvae feed on leaf, ear, stalk		
Japanese beetle adult	larvae (grub), underground			adult beetles clip silks		
corn earworm	Southern USA, migrate north				larvae feed in the ear	
fall armyworm	Southern USA, migrate north			larvae feed on leaves and then in ears		
western bean cutworm	prepupae, underground			larvae feed on tassels and silks, then on the ear tip and kernels		
stink bug	adults, nymphs(?), in & around fields		feed on young corn leaves		feed on juicy kernels	
corn leaf aphid	Southern USA, migrate north			multiple generations feed on plant sap		
spider mite	adult females, at base of hosts			multiple generations pierce plant cells		
sap or picnic beetles	pupae & adults, crop residue				adults & larvae feed in ear tips	

Table 2: Damage checklist to aid in scouting for insect pests of corn in Michigan and Ohio

Plant part or timing Type of damage or injury	aphids	billbug	black cutworm	corn earworm	corn leafminer	corn rootworm larvae	corn rootworm adults	European corn borer	fall armyworm	flea beetle	grasshoppers	Japanese beetle adult	sap beetle	seedcorn maggot	slugs & snails	spider mite	stink bug	true armyworm	western bean	wireworm	white grubs
Stand (emergence)																					
seeds fed-on														x	x					x	
gaps in row			x											x	x					x	x
wilted or cut plants			x																	x	
hole through base of plant			x																	x	
seedling top cut-off straight			x																		
variable plant stages, heights																					x
Leaf tissue																					
slimy or shiny trails															x						
scraping of top layer of leaf							x			x					x						
leaf mining					x																
shot-, pin-, or round holes								x													
parallel oblong holes		x															x				
small hole in midrib								x													
skeletonized between veins							x					x									
irregular leaf feeding			x	x					x		x							x			
severe defoliation, midrib left											x							x			
stippling (tiny yellow spots)																x					
purpling deficiency symptom																					x
brown ‘crispy’ dead leaves	x															x					
sticky leaves or sooty mold	x																				
webbing																x					

Plant part or timing Type of damage or injury	aphids	billbug	black cutworm	corn earworm	corn leafminer	corn rootworm larvae	corn rootworm adults	European corn borer	fall armyworm	flea beetle	grasshoppers	Japanese beetle adult	sap beetle	seedcorn maggot	slugs & snails	spider mite	stink bug	true armyworm	western bean	wireworm	white grubs
Tassels																					
fed-on				x															x		
broken								x													
sticky or with sooty mold	x																				
Stalks																					
tunneling into stalk								x													
stalk breakage								x													
lodging, goosenecking						x															
Roots																					
brown tracks, scarring						x															
root hairs missing						x															x
pruning of whole roots						x															x
Ear																					
silk clipping				x			x					x							x		
feeding on ear tip				x				x	x				x						x		
scraping of kernel surface								x											x		
tunneling into side									x										x		
tunneling in shank								x													
ear drop								x													
shriveled kernels																	x				
poor pollination / ear fill	x						x														x
brown frass, messy or pellets				x					x									x	x		
white frass, powdery								x													

Table 3: Life cycle, damage, and pest status of insect pests of corn in Michigan and Ohio

Terms to describe the pest status of each insect. Ratings apply to Michigan and Ohio.

- **Rare**: Unusual, typically goes unnoticed. May not even be present
- **Uncommon**: Usually present but well-below damaging levels. An outbreak once a generation.
- **Occasional**: Present in most fields, sometimes in high numbers. An outbreak once a decade.
- **Important**: Present in most fields, potentially increasing to damaging levels every season. A common target of scouting, management programs, or insecticide use.
- **Sporadic:** Damaging levels occur after favorable weather patterns (such as drought) or mass movement from south to north during the season
- **Localized**: Damaging levels occur in specific locations under specific agronomic conditions, for example in no-till production or in older stands.

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
aphids *Usually the corn leaf aphid*	The summer population is female. Females do not mate to reproduce (parthenogenesis)They also give birth to live young. Multiple overlapping generations. Large numbers of winged migrants may build up on corn in southern states and be carried south to north, raining out over fields in MI and OH.	• Aphids suck plant sap (water and nutrients) from leaves • In rare outbreaks (plants covered with aphids) leaf death sometimes occurs • Aphids secrete sticky honey dew as a waste product. Sticky leaves get coated with black sooty mold growth - mostly cosmetic, but photosynthesis is reduced if mold is severe • Sticky honeydew on tassels & fresh silks may inhibit pollen shed & pollination. If severe, this can impact ear-fill and thus yield	• Plant stress under dry conditions may be exacerbated if feeding from high numbers of aphid removes a lot of water. Lack of rainfall also leaves sticky honeydew on plants • Insurance use of insecticides and fungicides can favor aphids, since their natural enemies and fungal pathogens may be killed	Uncommon Populations are rarely high enough to cause damage The most recent infestation in Southern MICH and Ohio in 2024 resulted from an intense migration from the south.
billbug	Adults overwinter along field borders and emerge during corn planting, usually walking to corn. Eggs laid in soil or in holes chewed in stalk. Larvae feed on roots & root crown. Adults emerge between midsummer and fall 1 generation per year	• Adults cut slits in the whorl, resulting in extensive tillering • Another symptom of feeding is oblong shot-holing that appears as leaves unfurl • Larvae can damage root crown by feeding	• Continuous corn • No / reduced tillage • Field edges • Fields with heavy nutsedge infestation (alternate host)	Rare No recent reports of significant numbers in this region
corn blotch leafminer (CBL)	Flies lay eggs on leaf surface. Larvae (maggots) tunnel between leaf layers, creating mines that widen as larvae grow. Mature larvae chew out of the leaf and drop to the soil to pupate. Several generations per summer	• Females create numerous tiny pinholes wounds • In heavy infestations, entire leaf is mined by multiple larvae • Mined foliage dries up and shrivels, giving plants a frosted appearance	• Highest levels in Michigan were observed in muck fields	Rare
corn earworm (CEW)	Moths move north into Michigan and Ohio in July or August. Eggs are laid on silks or upper leaves. Larvae (caterpillars) feed on leaves, then on silks and ears. Larvae drop and pupate in soil. Overwintering is not successful in our region.	• Larval feeding can damage tassel, silks, kernels in ear • Ear injury is associated w/ invasion of other insects and ear molds that produce mycotoxins	• Late-planted fields which are silking during egg-laying	Uncommon Rarely impacts field corn in the region, but a major pest of sweet corn

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
corn rootworm (CRW)	Eggs overwinter in the soil and hatch in late May-early June. Larvae feed on corn roots for about three weeks and pupate in soil. Adults begin to emerge in early July and feed through the summer. Eggs laid in soil of corn fields, except in areas with the rotation-resistant variant of western corn rootworm, which will lay eggs in soybean and other crops. 1 generation per year	Larvae • Root scars, tunneling, severe pruning of nodes of roots • Plant stress & yield loss from poor water & nutrient uptake • Lodging and goose necking of plants results in harvest issues Adults: • Scraping of leaf surface • Silk-clipping • Feeding on the ear tip	• Continuous corn provides by far the biggest risk for CRW root damage • Volunteer corn from the previous season attracts adults to lay eggs in soybean. This can lead to root damage in rotated corn • Late-planted corn may attract adults to feed on silks and impact pollination	Larval damage: Important & Localized *in continuous corn production* Adult beetles consuming silks: Occasional & Localized *in continuous corn & sometimes adjacent rotated corn fields*
cutworm *Mostly black cutworm but also dingy, sandhill, and variegated*	Adult moths migrate north in early spring. Eggs laid on low-growing weeds or crop residue. Small larvae first feed on weeds, then shift to corn after herbicide is applied. Larvae hide during the day, & feed at night. Pupation in soil. Several generations per season, but the 1st is most damaging.	• Small larvae create shot-holes in leaves • Older larvae feed on leaves (variegated), tunnel into base of stalk (black) or cut seedlings off (black), reducing stand	• Low, dense weeds are egg-laying sites • No-till fields • Fields with high crop residue • Planting into cover crops or wet areas • Late-planted corn	Sporadic Outbreaks occur after a heavy spring flight from the south
European corn borer (ECB)	Mature larvae overwinter in corn residue and pupate late spring. Moths emerge in late May- early June. Females lay egg masses on the undersides of corn leaves. Larvae feed on all above-ground parts of plants. Pupation in stalk (1st gen) or residue (2nd gen). Two generations in south & central Michigan & all of Ohio, the first in June & the second in late July/ early August. One generation in northern Michigan and its upper peninsula.	• Small larvae scrape leaf surface (windowpaning) or chew through whorl, resulting in shot-holing damage • Larger larvae bore into midrib & stalk, disrupting water flow, weakening stalk, or causing breakage • Both shank boring (ear drop) and direct kernel feeding reduces yield • Ear injury is associated with infection of ear molds that produce mycotoxins. Stalk boring is associated with stalk rot, breakage, and ear drop	• Areas with a high % of non-Bt corn • Early planted (taller) fields at risk for 1st generation • late-planted fields at risk for 2nd generation Note: Besides field corn, hosts include sweet corn, snap & dry beans, potato, tomato, peppers	Occasional & Localized *in non-Bt corn* Used to be important, but region-wide outbreaks are suppressed due to widespread planting of Bt hybrids
fall armyworm (FAW)	FAW is a tropical species that cannot survive freezing temperatures. Adult moths migrate north, arriving in mid to late season. Eggs are laid on corn leaves. Larvae feed in whorl or in the ear. Pupation in soil. 1-3 generations at end of season, if temp is warm enough. Larvae cannot overwinter in our area.	• Leaf damage to whorl-stage corn • Kernel feeding (part of the caterpillar complex feeding in the ear) and subsequent risk of ear molds	• Late-planted corn is attractive to moths for egg-laying • Edge rows may be damaged by larvae marching from infested grassy edge, pasture, or forages	Uncommon in MI Sporadic in Ohio
flea beetle	Adults overwinter and emerge in the spring. Eggs are laid in soil around corn plants. Larvae feed and pupate in soil. Several generations per year	• Adults feed on upper leaf surface, leaving white scraping or scratches. Direct damage is rarely a concern • Infected adults transmit Stewart's wilt bacteria during feeding. This isn't a problem in field corn but Stewart's causes yield loss in susceptible inbred lines used for seed production	• Mild winters favor survival of over-wintering beetles (and thus Stewart's wilt bacteria). If the avg daily temp for Dec/Jan/ Feb is >90, flea beetle survival may be high.	Occasional *as a vector in seed corn* Rare *in field corn*

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
grasshoppers *several species*	Eggs overwinter in soil. Nymphs emerge in June. Amount of feeding increases with size. 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	• Fallow areas and pastures that border fields are preferred egg-laying sites • A hot summer & fall can lead to a high population the following season	Uncommon Outbreaks rare
Japanese beetle adults	Larvae (grubs) feed underground on roots of many hosts. Adults emerge mid-summer, and feed on corn leaves, silks, and pollen, plus on hundreds of other hosts. Eggs laid in soil in July -September 1 generation per year	• Feeding skeletonizes leaves but damage isn't economic • Also clips silks, similar to rootworm adults. Severe clipping can reduce pollination	• populations often higher on field edges, especially near turf and grassy areas	Uncommon
sap beetle *= picnic beetle*	Adults overwinter. Eggs are laid on or near decaying and fermenting stuff. Thus, adults are attracted to ear tips with insect damage, insect poop, and mold growth. Larvae feed in ear and pupate in soil. Several generations per season	• Larvae and adults are secondary pests in ears fed on by other insects like rootworm adults or caterpillars. Sap beetles create additional damage and areas for ear mold infection	• Ears opened and injured by other insects (such as CEW, ECB, WBC) • Cool, wet weather late in the season, which enhances ear mold growth	Uncommon
seedcorn maggot (SCM)	Overwinter as pupae in soil. Adult flies emerge in early spring, laying eggs in tilled or disturbed soil with decaying organic matter. Larvae (maggots) feed on decaying matter and germinating seeds. Several generations per year, only the first causing damage in field corn	• Larvae feed on germinating seeds which can result in variable emergence and stand loss. • Damage often occurs over a large part of field	• Tillage • Recently (w/in 2 weeks) incorporated organic matter such as alfalfa, green cover crops, weeds, or fresh manure • Cool, wet weather which delays emergence • Peak egg laying near planting time	Localized Occurs under specific field and environmental conditions
slugs & snails	Slugs overwinter as eggs & adults, so both are present at planting. Eggs laid in soil in spring hatch in about one month and these slugs feed through the summer	• Feeding on germinating seeds, cotyledons, & lower leaves as the plant grows. Feeding up on plants tends to occur at night • Heavy feeding on small corn plants may slow development or reduce stand	• No or reduced-till • Planting into heavy stubble, crop residue • Cool, wet weather delaying emergence • Poorly-closed furrows act as slug buffet lines	Localized (but increasing) Occurs under specific field conditions
spider mites (two-spotted)	Adults overwinter in field borders and other sheltered areas. In spring, adults move to new growth and lay eggs on undersides of leaves. Mites spread from field to field by crawling or blowing in the wind. Multiple overlapping generations	• Adults & nymphs pierce individual plant cells, creating tiny yellow spots (stippling) • Severe damage results in leaf yellowing, death, water loss • Webbing is a sign on a heavy infestation	• Prolonged hot, dry weather favors outbreaks and increases the impact of mite feeding • Infestations often start on dusty edges of fields	Sporadic Outbreaks occur in hot, dry seasons
stink bugs *several species*	Adults and nymphs feed by injecting salivary enzymes into plants and sucking up plant juices	• Feeding in V4-V5 corn creates characteristic pattern of circular holes with yellow margins as the whorl unrolls • In severe case, plants may be twisted, growing point can die • Ear feeding can cause aborted or shriveled kernels	• No-till corn • Rye cover crop or weeds which were killed by herbicide	Uncommon

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
true armyworm (TAW)	Adult moths migrate into Michigan in early spring. Eggs of the 1st generation are laid on weedy grasses before corn emerges and on small grains like wheat. In corn, small larvae first feed on weeds then shift to the crop after herbicide is applied. Larvae in wheat move into nearby crops, including corn, in June as wheat dries down. Larvae pupate in the soil and adults emerge in a week. 2nd generation moths lay eggs in weedy or cover-cropped corn in July, or move in to corn from adjacent infested hay fields. 2 to 3 generations per year, the first is usually the most damaging.	• Larvae feed on leaf margins, sometimes completely defoliating plants, leaving only the midrib • Corn plants usually recover if growing point is not injured, but a severe infestation can defoliate a field in several days	• Adjacent areas where eggs were laid, such as field margins, small grains (1st gen) or hay fields • Heavy weed growth or a cover crop are favored egg laying sites within a field. Organic fields are often very susceptible	Sporadic Outbreaks usually occur after a heavy spring flight from the south.
western bean cutworm (WBC)	Overwinter in pre-pupal stage. Adults emerge in July. Females key in on late whorl & pre-tassel stage corn for egg laying. Larvae feed first on tassels and silks, then in the ear. Feeding ends in early- to mid-September when caterpillars drop and burrow into soil. 1 generation per year	• Larger larvae feed in the ear, usually at the tip, but sometimes directly through the husk into the side • In rare, heavy infestations, there can be multiple caterpillars per ear • Feeding damage allows other insects like sap beetles to infest. Damaged ears also have an increased risk of ear mold infection and quality reduction from mycotoxins	• Fields in the pre-tassel stage • Areas with sandy soils which increase the overwintering survival of larvae • Areas where both corn and dry beans (an alternate host) are grown	Important and often Localized Corn stage during flight is often key to infestation
white grubs - Asiatic garden beetle (AGB)	Mature grubs overwinter in field. Adults emerge in June, move and mate at dusk (come to lights). Females attracted to low-growing canopy for egg laying (for ex, soybean or potato). Grubs feed on roots from July-fall, then move down in soil profile in late fall to overwinter. Feeding resumes in the spring until pupation. 1 generation per year. See free AGB pocket guide at: https://aginsects.osu.edu/news/new-agb-pocket-field-guide-available	• Grubs feed on cotyledons and roots, reducing stand and plant uniformity. In severe cases, stand loss has been documented • Adults feed on ornamentals plus some veg & fruit crops. Adults do not appear to feed on corn leaves	• Previous crop of soybean, potato, alfalfa, or late season infestations of weeds like marestail • Fields or portions of fields with a sandy (> 80% sand) profile	Localized Damage in field crops is currently limited to counties in northern Ohio and Indiana, and southern Michigan
white grubs - European chafer	Mature grubs overwinter in field. Adults emerge in June and mate at dusk near a landmark (ex, tall tree). Grubs feed on roots from July into fall then move down in soil profile in late fall. 1 generation per year	• Grubs feed on cotyledons and roots, reducing stand and uniformity • Adults do not feed	• Corn following soybeans • Field edges near lawns, golf courses, tree lines • Fields or portions of fields with sandy (> 80% sand) soil • Spring populations tend to be higher after a dry summer	Uncommon and Localized *No recent reports of losses from EC grubs in corn*

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
white grubs - **Japanese beetle (JB)**	Mature grubs overwinter in field. Adults emerge in July-August. Eggs laid in soil July-Sept. Grubs feed on root from July-fall then move down in soil profile in late fall. 1 generation per year	• Grubs feed on cotyledons and roots, reducing stand and uniformity • Adults also feed on corn (see JB adults)	• Planting into fallow fields or pasture • Fields near pasture, lawns, ornamentals • Spring populations are higher after a wet summer	Uncommon
white grubs - **multiple species of June beetle**	Adults emerge in May/June, move and mate at dusk (come to lights). Eggs laid in soil. Grubs feed for three summers, with the 3rd (last) stage causing the most damage to roots. Between summers, larvae move to a lower depth in soil. Late in the third summer, grubs pupate underground. Adults emerge the following spring, some years in very large numbers. 1 generation takes three years	• Prune cotyledons prior emergence, reducing stand • Prune root hairs and sometimes whole roots, causing wilting, water and nutrient deficiency, or plant death	• Planting into fallow fields & pasture • Fields near pasture, home lawns, tree borders	Uncommon
wireworm	Wireworms are the immature form of click beetles. They spend up to six years underground in the immature stage. Overlapping generations	• Feed on newly planted corn seeds & roots • May tunnel straight through the base of seedlings below the soil surface	• Planting into long-standing fallow fields and pasture	Uncommon & Localized Related to field history

Table 4: Management notes, scouting recommendations, and thresholds for insect pests of corn in Michigan and Ohio

Pest	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
aphids	• Biological: Predators (such as ladybugs, lacewings, parasitoids) usually keep populations in check. Under humid conditions, entomopathogenic fungi kill 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 (5 plants x 20 sets)	Tassels covered w/ aphids & honeydew on 50% of VT stage plants & field is under moisture stress. Rarely justified in Michigan or Ohio
billbug	• Agronomic: Crop rotation (adult billbugs are slow and don't move far) and tillage reduce populations. Control of sedges removes an alternate host • Insecticide: Note that granular soil insecticides applied at planting for another insect will control billbug	No specific recommendation	No specific recommendation We have never seen infestations in Michigan in Ohio
corn blotch leafminer	• Biological: Numerous wasp parasitoids attack larvae • Insecticide: Not effective because larvae are protected in leaf mines. Spraying also disrupts parasitism.	None	none Not justified in Michigan or Ohio
corn earworm	• Biological: Several predators attack eggs and larvae • Agronomic: Planting early or on-time avoids egg-laying • Insecticide: Spraying to protect the ear is generally not effective • Seed selection: Some Bt corn hybrids provide control. See Table 7 in this corn chapter for details	None	None Not an economic pest of field corn in Michigan or Ohio
corn rootworm larvae	• Agronomic: Crop rotation is by far the most effective way to control CRW. Eliminating volunteer corn in the rotational crop is important to achieving larval reduction • Environmental: Wet conditions during egg hatch usually reduce populations in a field (but this can also negatively impact root growth). Adequate soil moisture and nutrients promote good root growth later in the season and help plants recover from larval feeding • Seed selection: Some Bt corn hybrids provide control. See Table 7 in this corn chapter for details	Scout fields for beetles to predict the need for an insecticide or a Bt trait the <u>following season</u> • In continuous corn: Check 100 plants after adult emergence (20 plants x 5 sets)	1 beetle per plant Threshold indicates that CRW control is needed next season. Plant Bt corn, use a soil insecticide, or rotate the field out of corn
corn rootworm adults	• Agronomic: Crop rotation is by far the most effective way to reduce larval, and thus adult, populations	Check 100 plants (20 plants x 5 sets) for silk clipping by CRW & Japanese beetle	Silks clipped shorter than ½ inch before/ during pollination, <u>and</u> adults are still feeding
cutworm	• Biological: Ground beetles and parasitoids kill larvae • Agronomic: Good weed control and timely cover crop termination prior to planting reduce likelihood of infestation • Insecticide: Rescue (post-planting) treatments are effective and preferred, as populations vary by year & location • Seed selection: Some Bt corn hybrids provide black cutworm control. See Table 7 in this corn chapter for details	Walk fields to determine % wilted or cut plants Dig around base of plants to confirm cutworm larvae are present Note: Pheromone traps can indicate flight and aid in timing of scouting	> 5% plants cut or damaged
European corn borer	• Biological: Numerous natural enemies eat larvae. Egg and larval parasitoids and pathogens are common • Agronomic: Early-planted fields are most at risk for 1st generation infestation while late-planted fields are most at risk for 2nd generation. Plowing and shredding stalks reduce overwintering larval numbers to some extent, but not enough to make a difference in the next season • Insecticide: Spray timing is critical because larvae eventually tunnel into midribs and stalks, out of reach from sprays.	• <u>1st Generation</u>: count # of plants (20 plants x 5 sets) with windowpane or shot hole damage. Unroll whorls to check for live larvae • <u>2nd Generation</u>: count # of plants (20 plants x 5	General guidelines: <u>1st Generation</u>: > 50% of plants with damage and live larvae still present in whorls <u>2nd Generation</u>: > 50% of plants

Pest	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
European corn borer continued	Percent control is usually higher for applications against 1st generation ECB on whorl stage corn than against 2nd generation larvae in the ear zone. • Seed selection: Bt corn hybrids provide excellent control of corn borer. See Table 7 in this corn chapter for details *Note: To see ECB trapping data online in the summer, visit the 'Great Lakes and Maritimes Pest Monitoring Network'*	sets) with egg masses on undersides of leaves Note: Trapping can aid in timing of scouting. ECB in Michigan and Ohio respond to the Z (Iowa) strain pheromone	with egg masses Economic thresholds varying by expected yield, spray cost, and market price are calculated using worksheets available in extension pubs
fall armyworm	• Biological: Parasitized by several wasp and fly species • Insecticide: Spraying to protect the ear is generally not effective • Seed selection: Some Bt corn hybrids control fall armyworm. See Table 7 in this corn chapter for details	Check 100 plants (20 plants x 5 sets) for larvae, feeding, and frass	> 50% of plants infested with small (under 1 inch) larvae
flea beetle	• Agronomic: Most corn hybrids are resistant to Stewart's Wilt disease transmitted by flea beetles. Avoid early planting of susceptible inbred lines used in seed production. • Environmental: Cold winters reduce the survival of beetles and thus the incidence of Stewart's Wilt	<u>In seed corn production</u> Check 100 plants (20 plants x 5 sets) for beetles	<u>On susceptible inbreds</u> 5 or more beetles per plant, up to the four-leaf stage
grasshoppers	• Biological: Blister beetle larvae and other insects prey on eggs. 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	General guideline: 5 or more hoppers per plant We have never seen populations high enough to treat in Michigan or Ohio
Japanese beetle adults	• Biological: Predation and parasitism by other insects on adult beetles is likely low, although vertebrates eat them • Agronomic: Adults move around the landscape, so tillage and other practices in nearby fields do not have much impact	Check 100 plants (20 plants x 5 sets) for silk clipping by the combo of Japanese beetle & CRW	Silks clipped shorter than ½ inch (usually in tandem w/ rootworm adults)
seedcorn maggot (SCM)	• Agronomic: Potential for injury decreases with 1) shallow seeding into warm soil and 2) delaying of planting until herbicide-killed or disced cover crops and weeds decompose • Agronomic: Problems rarely occur in no-till fields • A degree day model predicts when peak flight & egg-laying will occur based on MSU weather station data. See this site: https://enviroweather.msu.edu/crops/corn • 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. Note that granular soil insecticides, applied at planting for another insect, will help to control SCM	No specific recommendation To assess risk of SCM before planting, check the degree day model listed in the previous column	No rescue treatment is available. Consider replanting fields or areas with significant stand loss
slugs & snails	• Biological: Some insects consume slugs, like ground beetles and firefly larvae • Agronomic: Fields with a history of slug damage could be planted early, so the crop is further along by the time slug feeding starts. Tillage and crop rotation reduce corn residue (slug habitat). Zone tillage and row cleaners help to dry a band along the row and may quicken crop growth. Avoid planting in wet conditions, as open furrows act as slug highways • Insecticide: Slugs are not insects, so soil insecticides and seed treatments have no impact on them. Some studies suggest that seed treatments make slug problems worse by killing ground beetle predators	No specific recommendation Walk fields at night or early morning, turning over residue and looking for slime trails	None established A guess - Consider applying a slug bait (molluscicide) if stand is reduced by 5%

Pest	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
spider mites (two-spotted)	• 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 irrigation still isn't enough. • Environmental: Rainfall can have a similar effect as irrigation • Insecticide: Insecticide resistance is common in mites. Some insecticides (including most pyrethroids) 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 insecticide and fungicides are discouraged. Be especially cautious about applications in dry seasons	Infestations often start on field edges Look for mites on undersides of leaves using hand lens or tap leaves over a piece of paper Webbing is present when population is very high	A guess: At least a third of plants have mites and leaves are yellowing Factors to consider: *the mite population is still growing *the forecast remains hot and dry *corn is pollinating *there is low humidity under the canopy *excellent coverage is possible
stink bugs	• Agronomic: Proper adjustment of planter to close the furrow, so overwintered stink bugs cannot feed on the growing point early in the season	No specific recommendation	None established We have never seen populations high enough to treat in Michigan or Ohio
true armyworm	• Biological: Often controlled by predators and parasitoids • Agronomic: Good weed control (especially grassy weeds) and timely cover crop termination prior to planting reduce likelihood of infestation • Insecticide: May be able to limit spray to the field edge if larvae invade from a neighboring field or grassy border • Seed selection: Some Bt corn hybrids provide armyworm control. See Table 7 in this corn chapter for details *Note: To see armyworm trapping data online in the summer, visit the 'Great Lakes and Maritimes Pest Monitoring Network'*	Check 100 plants (20 plants x 5 sets) for larvae, feeding, or frass. Target fields that had a cover crop or heavy weed pressure early During the day, larvae hide in the whorl, at base of plants, or under crop residue	<u>Seedlings:</u> 10% stand loss <u>Whorl stage:</u> 25% of plants with <u>≥</u>2 larvae per whorl OR 75% of plants with 1 larva Treat only if larvae are less than 1.25 inch
western bean cutworm	• Biological: Many predators consume eggs and larvae, and tiny parasitoids attack eggs • Insecticides: Adding an insecticide to a fungicide spray simply as insurance is discouraged, unless the field is over threshold for WBC. But if a tank mix is being done anyway, default to the optimal timing for the disease target (ear molds, tar spot, etc). WBC control may not be as good, but fungicides are expensive, and proper timing is critical for disease control • Seed selection: Only Bt corn hybrids with the Vip3A trait provide effective control of WBC. Corn with all other Bt traits should be managed for WBC just like non-Bt corn. See Table 7 in this corn chapter for details *Note: To see WBC trapping data online in the summer, visit the 'Great Lakes and Maritimes Pest Monitoring Network'*	To detect first flight, use pheromone bucket traps starting at end of June Just after peak flight, check 100 plants (20 plants x 5 sets) weekly for egg masses on leaves and young larvae in the tassel or silks. Target pre-tassel and just-tasseling fields for scouting	In the Great Lakes Region: 5% of plants with egg masses or small larvae. This is a <u>cumulative</u> threshold - add % infestation from one week to the next towards the 5% threshold
white grubs	• Biological: Some species are attacked by pathogens. • Agronomic: Fall plowing of long-standing fallow fields & pasture prior to planting is recommended. Tillage also exposes grubs to mammal and bird predation. For Asiatic garden beetle in southern Michigan and northern Ohio, delaying planting may avoid most grub feeding • Insecticide: Granular soil insecticides, applied at planting for another insect, may have some effect on grubs. Seed treatments often have mixed results, especially on Asiatic garden beetle. There are no rescue treatments *Note: it is important to identify grubs to distinguish annual species from species of June beetle, which remain in fields for multiple seasons*	Sampling methods aren't well-defined. Use a shovel to check 1x1 ft^2 sections in fall or spring. Grubs tend to be patchy, especially on sandy knolls or near tree lines Grubs may be detected while plowing in fall or spring, especially when birds follow tillage equipment	<u>June beetle:</u> 1 grub per ft^2 <u>Annual grubs</u> European chafer, 2 grubs per ft^2 Japanese beetle and Asiatic garden, use chafer threshold

Pest	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
wireworm	• Agronomic: Depending on species, wireworms remain in the larval stage for 1-5 years, thus they are favored by undisturbed soil. Fall plowing of long-standing fallow fields & pasture prior to planting is recommended • Insecticide: Granular soil insecticides, applied at planting for another insect, will have some effect on wireworms. Seed treatments protect seed, but not seedlings. Rescue treatments are not effective	Sampling must be done 2-3 weeks before planting using wireworm bait traps (described online or in extension pubs). This method is often impractical	At least 1 wireworm per bait trap Otherwise, consider using a soil insecticide or seed treatment in fields coming out of fallow, pasture, alfalfa, or that have a history of wireworm

Table 5: Soil/at-plant insecticides to manage insect pests of corn in Michigan and Ohio

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry.
- Application rates are listed for pests which appear on the label. If a column is blank, the pest is not on the label. The letters in the pest columns refer to the use rate from column two.
- 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	**Use rate(s)** per 1000 feet of row or per acre	**cutworm**	**rootworm larvae**	**white grubs**	**seedcorn maggot**	**slugs & snails**	**wireworm**	**Precautions and Remarks**
bifenthrin (granular) Empower2	(a) 6.4 - 8 oz T-band per 1000 ft (= 3.4 - 8.7 lbs/acre) (b) 8 oz per 1000 ft (= 8.7 lbs/acre)	a	b	a	a		a	• Do not apply as a T-band application, unless you can incorporate granules into top 1 inch of soil using tines or chains • The rootworm rate controls light to moderate larval pressure
bifenthrin (liquid) Bifen2 AgGold Bifenthrin 2EC Bifenture EC Brigade 2EC Discipline 2EC Fanfare EC, 2EC, ES Reveal & Reveal EndurX Sniper & Sniper Helios	(a) 0.15 - 0.30 oz per 1000 ft (= 2.6 - 5.2 oz/acre) (b) 0.30 oz per 1000 ft (= 5.12 oz/acre)	a	b	a	a		a	• Apply as a 5 to 7 inch T-band over the open seed furrow • In-furrow pop-up fertilizer may be applied alone or in tank mixes with bifenthrin See label for instructions • Some labels say 'Do not apply to soil with >30% crop residue' • See label for separate instructions on applying with pre-plant incorporated (PPI) or pre-emerge (PRE) herbicides
Xpedient Plus V Tundra EC	(a) 0.15 - 0.60 oz per 1000 ft (= 2.6 - 10.24 oz/acre) (b) 0.30 - 0.75 oz per 1000 ft (= 5.2 - 12.8 oz/acre)							*Note: Bifenture LFC and Capture LFR labels specifically support a rate of 8.5 oz per acre to control Asiatic garden beetle grubs in Michigan and Ohio. However, bifenthrin has only low to moderate efficacy on AGB.*
Bifender FC	(a) 0.17 - 0.67 oz per 1000 ft (= 2.9 - 11.6 oz/acre) (b) 0.34 - 0.84 oz per 1000 ft (= 5.9 - 18.2 oz/acre)							
Annex LFR Sniper LFR	(a) 0.20 - 0.39 oz per 1000 ft (= 3.4 - 6.8 oz/acre) (b) 0.39 - 0.49 oz per 1000 ft (= 6.8 - 8.5 oz/acre)							
Bifenture LFC Capture LFR Nirvana RTU	(a) 0.20 - 0.78 oz per 1000 ft (= 3.4 - 13.6 oz/acre) (b) 0.39 - 0.98 oz per 1000 ft (= 6.8 - 17.0 oz/acre)							
Capture 3RIVE3D	(a) 0.23 - 0.92 oz per 1000 ft (= 4 - 16 oz/acre) (b) 0.46 - 0.92 oz per 1000 ft (= 8 - 16 oz/acre)							
bifenthrin + fungicide Nirvana Complete	(a) 0.57 - 0.75 oz per 1000 ft (= 10 – 13 oz/acre)	a	a	a	a		a	• Similar to bifenthrin alone but contains the fungicide pyraclostrobin • Rate of bifenthrin in combo is equivalent to the high rate in bifenthrin-only products

Active ingredient Trade Names	**Use rate(s)** per 1000 feet of row or per acre	**cutworm**	**rootworm larvae**	**white grubs**	**seedcorn maggot**	**slugs & snails**	**wireworm**	**Precautions and Remarks**
bifenthrin + biofungicide Ethos XB Ethos Elite LFR	(a) 0.2 - 0.98 oz per 1000 ft (= 3.4 - 17.0 oz/acre) (b) 0.39 - 0.98 oz per 1000 ft (= 6.8 - 17.0 oz/acre) (a) 0.20 – 0.98 oz per 1000 ft (= 3.5 – 17.1 oz/acre) (b) 0.49 -0.98 oz per 1000 ft (= 8.5 – 17.1 oz/acre)	a	b	a	a		a	• Apply T-band or in-furrow • Similar to bifenthrin alone, but contains a biological fungicide for suppression of early season root diseases (apply in-furrow for disease control) XB: *Bacillus amyloliquefaciens* Elite: *Bacillus velezensis & subtilis strains* See label for instructions on PPI or PRE tank mixing with herbicides for cutworm control
bifenthrin+ **cypermethrin (zeta)** Hero Hero EW	 (a) 4.0 - 10.3 oz/acre (a) 4.5 - 11.2 oz/acre	a		a	a		a	• Apply in-furrow or as a 3 to 4 inch T-band for seedcorn maggot, grubs, and wireworm Apply on the soil surface in a 5 to 7 inch band or broadcast for cutworms • See label for max use rates for all bifenthrin products combined
brofanilide Nurizma	(a) 0.05 – 0.07 oz		a	a	a		a	• <u>Apply in-furrow only</u> thru spray nozzles or microtubes into open seed furrow. Product must be covered immediately • High potential for movement with water. Avoid applying if rain forecast within 48 hrs • See 2ee recommendation for reduced application volume of 3 gal/ acre
chlorethoxyfos **+ bifenthrin** Index At-Plant Liquid Smartchoice HC (Smartbox) Smartchoice 5G (Smartbox / Lock'N Load)	 (a) 0.44 - 0.72 oz (b) 0.65 - 0.72 oz (a) 1.0 - 1.67 oz (b) 1.5 - 1.67 oz (a) 3.0 – 3.5 oz (b) 4.5 – 5.0 oz	a	b	a	a		a	• Apply in-furrow only (do not apply T-band or other banded application) • Must be applied with enclosed tractor cab and closed handling system, e.g., a Dosatron, modified Raven system (Index), Smartbox or Lock'N Load system (Smartchoice) • Rotational interval is 30 days for all crops except corn • Index has a special 2ee label for Asiatic garden beetle control in MI and OH
cyfluthrin Baythroid XL Tombstone Tombstone Helios	(a) 2.0 - 2.8 oz per 1000 ft (= 35 - 49 oz/acre)				a		a	• Apply in water or in pop-up fertilizer, in open furrow ahead of closing wheel • Do not mix with fertilizers containing zinc • Application may suppress white grubs
cyhalothrin (lambda) LambdaStar Lambda-Cy Lambda-T Lambda Cy 1EC Kendo Paradigm VC Ravage Silencer Grizzly Too Lamcap II Province II Warrior II	(a) 0.66 oz per 1000 ft (= 11.5 oz/acre) (a) 0.33 oz per 1000 ft (= 5.75 oz/acre)	a	a	a	a		a	• Apply in-furrow, as a T-band, or as a 7-inch band behind the press wheel
iron phosphate Ferroxx AQ Sluggo	(a) 20 - 44 lbs/acre					a		• Formulation includes bait to attract slugs • Pellets must be broadcast across field • Apply in evening before slugs are active
metaldehyde Deadline GT Deadline Bullets & MPs Durham Granules 7.5	<u>Max rate per application</u> (a) 33.3 lbs/acre (a) 25 lbs/acre (a) 13.3 lbs/acre					a		• Formulations include bait to attract slugs • Apply in evening just before slugs are active, especially after rain or irrigation • GT formulation has uniform prills ideal for blending with dry fertilizer • Limit of 3 applications per season, up to the VT growth stage • Fatal to some domestic animals (dogs)

Active ingredient Trade Names	**Use rate(s)** per 1000 feet of row or per acre	**cutworm**	**rootworm larvae**	**white grubs**	**seedcorn maggot**	**slugs & snails**	**wireworm**	**Precautions and Remarks**
permethrin Pounce 1.5G Arctic 3.2EC Permastar Ag Perm-Up 3.2EC	(a) 8 oz per 1000 ft (=8.7 lbs/acre) (a) 0.3 oz per 1000 ft (= 6 oz/acre)	a			a		a	• Apply in-furrow, band, or T-band • Check label for specific instructions for pre-emergence or pre-plant incorporated applications
sodium ferric EDTA Ferroxx Slug & Snail Bait	(a) 5 – 20 lbs/ acre					a		• Apply uniformly with a granular spreader
tebupirimphos + cyfluthrin Aztec 4.67G Defcon 4.67G Aztec HC for SmartBox or SmartCartidge	(a) 3 oz per 1000 ft (= 3.27 lbs/acre) (a) 1.5 oz per 1000 ft (= 1.63 lbs/acre)	a	a	a	a		a	• Apply in-furrow or as a T-band for of all pests except cutworm. For cutworm, apply as a T-band or band behind the press wheel. Incorporate as instructed
tefluthrin Force 6.5G Force 10G Smartbox or SmartCartidge Force EVO	(a) 1.8 - 2.3 oz /1000 ft (= 2.0 -2.3 lbs) (a) 1.25 - 1.5 oz /1000 ft (= 1.4 - 1.6 lbs/ acre) (a) 0.46 - 0.57 oz per 1000 ft (= 8-10 oz/acre)	a	a	a	a		a	• Apply in-furrow (optimal method for all pests except cutworm) or as a T-band • See label for specific instructions on how to make and incorporate applications of granular formulations at cultivation within 30 days of seedling emergence
terbufos Counter 20G Lock'N Load, Smartbox, or SmartCartidge	(a) 4.5-6 oz per 1000 ft (4.9-6.5 lbs/acre)		a	a	a		a	• Apply in-furrow or as a 7-inch band over the row • If crop debris prevents proper placement of granules, in-furrow application is recommended. In-furrow application also reduces run-off from rain • Also controls flea beetle and corn nematodes, and may suppress cutworm • DO NOT use an ALS-inhibiting herbicide if Counter has been applied at planting

Table 6: Foliar Insecticides to manage insect pests of corn in Michigan and Ohio

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry
- Application rates are listed for pests which appear on the label. If a column is blank, the pest is not on the label. The letters in the pest columns refer to the label use rate from column two

Active ingredient Trade Names	**Use rate(s)** per acre (unless specified)	**aphids**	**cutworm**	**Euro corn borer**	**fall armyworm**	**flea beetle**	**grasshoppers**	**Japanese beetle**	**rootworm adults**	**spider mite**	**stink bugs**	**true armyworm**	**western bean cutworm**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
***Bacillus thuringiensis* (Bt)** Agree WG Dipel DF, Xentari Dipel ES Javelin WG Dipel 10G	(a) 1.0 - 2.0 lbs (a) 0.5 - 2.0 lbs (a) 1.5 - 4.0 pints (a) 0.25 - 1.5 lbs (a) 10 lbs granules applied into whorl			a	a							a	*	0	• Selective biological insecticide to control caterpillars. Larvae must eat treated foliage to be controlled, so good coverage is important. Must be targeted on small (1st or 2nd stage) larvae • The type of Bt differs by formulation: *Bt aizawai* = Agree and Xentari and *Bt kurstaki* = all other products • All can be used on organic crops, except Dipel ES * Western bean cutworm is on the Dipel ES label. Corn earworm (not on this table) is on many Bt labels as well
bifenthrin Bifenthrin 2EC Bifenture EC Brigade 2EC Discipline 2EC Fanfare EC, 2EC, & ES Sniper & Sniper Helios Reveal & Reveal EndurX Tundra EC Bifender FC Nirvana RTU	(a) 2.1 - 6.4 oz (b) 5.1 - 6.4 oz (a) 2.4 - 7.4 oz (b) 5.9 - 7.4 oz (a) 2.8 – 8.5 oz (b) 6.8 – 8.5 oz	a	a	a	a	a	a	a	a	b	a	a	a	30	• Do not apply as a ULV (ultralow volume) application • See label for specific instructions for spider mite control • Check label for Bee Warning
bifenthrin + fungicide Nirvana Complete	(a) 13 oz	a	a	a	a	a	a	a	a	a	a	a	a	30	• Combo product with pyraclostrobin fungicide. Similar precautions to bifenthrin alone. Bifenthrin rate is equivalent to the high rate in bifenthrin-only products. • See label for the list of leaf diseases controlled
bifenthrin + biofungicide Ethos XB	(a) 2.8 - 8.5 oz (b) 6.8 - 8.5 oz	a	a	a	a	a	a	a	a	b	a	a	a	30	• Contains a biological fungicide strain *Bacillus amyloliquefaciens*. Otherwise, similar to bifenthrin alone

Active ingredient Trade Names	**Use rate(s)** per acre (unless specified)	**aphids**	**cutworm**	**Euro corn borer**	**fall armyworm**	**flea beetle**	**grasshoppers**	**Japanese beetle**	**rootworm adults**	**spider mite**	**stink bugs**	**true armyworm**	**western bean cutworm**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
bifenthrin + chlorantraniliprole Elevest	(a) 4.8 – 9.6 oz (b) 5.6 – 9.6 oz (c) 7.7 – 9.6 oz	a	a	b	b	a	a	a	a	c	a	b	a	30	• Max 3 applications per year with a minimum of 7 days between treatments in field corn and 1 day in seed corn • For most ear-feeding pests, apply at beginning of silking and repeat as needed. For ECB & WBC, apply at egg hatch • For spider mite and grasshoppers, see label for specific recommendations to improve performance • Highly toxic to fish & aquatic life & to bees exposed directly
bifenthrin+ cypermethrin (zeta) Hero Hero EW Steed	(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 (a) 2.5 - 3.5 oz (b) 3.5 - 4.7 oz	b	a	b	b	a	b	b	b	c	b	b	a	30 grain 30 graze 60 forage	• Do not apply as a ULV (ultralow volume) application • Do not apply if heavy rainfall is imminent • Spider mite is not listed on the Steed label • Check label for Bee Warning
bifenthrin + sulfoxaflor Ridgeback	(a) 4.5 – 13.8 oz (b) 11.0 – 13.8 oz	a	a	a	a	a	a	a	a	b	a	a	a	30	• Do not apply "3 days before bloom & until after seed set" • Do not apply as a ULV (ultralow volume) application
carbaryl Carbaryl 4L Sevin 4F Sevin XLR Plus	(a) 1 - 2 qts (b) 1.5 - 2 qts (c) 2 qts		c	b	a	a		a	a			a	c	14 silage 14 graze 48 grain	• REI = 24 hours with an exception of 21 days for workers detasseling seed corn • Check label for Bee Warning
chlorantraniliprole Coragen Prevathon Shenzi 400SC	(a) 3.5 - 5.0 oz (a) 14 - 20 oz (a) 1.7 - 3.8 oz			a	a							a	a	14	• Novel mode of action. Insects are paralyzed & stop feeding. Must be applied before populations reach damaging levels. See label for specifics • Do not make more than 2 sequential applications
chlorantraniliprole + lambda-cyhalothrin Besiege	(a) 5 - 10 oz (b) 6 - 10 oz		a	b	b	b	b	b	b		b	b	a	21	• Minimum 7 days between applications • Check labels for specifics on maximum application rates for products containing gamma & lambda cyhalothrin
cyfluthrin / beta cyfluthrin Baythroid XL Tombstone Tombstone Helios	(a) 0.8 - 1.6 oz (b) 1.6 - 2.8 oz (c) 2.8 oz		a	b	c	a	c	b	b		b	b	b	21 grain 21 fodder 0 forage	• Check label for Bee Warning

Active ingredient Trade Names	**Use rate(s)** per acre (unless specified)	**aphids**	**cutworm**	**Euro corn borer**	**fall armyworm**	**flea beetle**	**grasshoppers**	**Japanese beetle**	**rootworm adults**	**spider mite**	**stink bugs**	**true armyworm**	**western bean cutworm**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
cyhalothrin (gamma) Declare Proaxis	(a) 1.0 - 1.5 oz (b) 1.5 oz (a) 1.92 - 3.2 oz (b) 2.56 - 3.84 oz	b	a	b	b	b	b	b	b		b	b	a	21 grain 21 silage	• Check labels for specifics on max application rates of products containing gamma & lambda-cyhalothrin • Highly toxic to bees. Do not apply to pollinating corn or drift on flowering weeds if bees are visiting field
cyhalothrin (lambda) Kendo LambdaStar Lambda-Cy Lambda-T Lambda Cyhalothrin 1EC ParadigmVC Ravage Silencer Warrior II w/ Zeon Tech. Grizzly Too Lamcap II Province II Ravage II	(a) 1.92 - 3.20 oz (b) 2.56 - 3.84 oz (a) 0.96 - 1.60 oz (b) 1.28 - 1.92 oz		a	b	b	b	b	b	b		b	b	a	21	• For armyworm, only small caterpillars (1st & 2nd stage or ¼ inch) are controlled • Check labels for specifics on maximum application rates for products containing gamma & lambda cyhalothrin • Check label for Bee Warning
cypermethrin (alpha) Fastac CS Fastac EC	(a) 1.3 - 2.8 oz (b) 1.8 - 3.8 oz (c) 2.7 - 3.8 oz (d) 3.2 - 3.8 oz	c	a	c	d	c	c	c	c		c	d	b	30 grain 60 forage	• Do not use other products containing cypermethrin or zeta-cypermethrin during the same season as this product • Check label for Bee Warning
cypermethrin (zeta) Mustang Maxx	(a) 1.3 - 2.8 oz (b) 1.8 - 4.0 oz (c) 2.7 - 4.0 oz (d) 3.2 - 4.0 oz	c	a	c	d	c	c	c	c		c	d	b	7	• Check label for Bee Warning
deltamethrin Delta Gold	(a) 1.0 - 1.5 oz (b) 1.5 - 1.9 oz	b	a	b	b	a	a	b	b		b	b		12 silage 12 graze 21 grain	
dimethoate Dimate 4E Dimethoate 4EC & 400	(a) 1 pint	a					a		a	a				14 silage 28 grain	• Max 1 pint per year • Use 20-40 GPA of water • REI = 48 hours with an exception of 4 days for workers detasseling seed corn • Do not apply during pollen shed if bees are visiting field
esfenvalerate Asana XL S-Fenvalostar Zyrate	(a) 2.9 - 5.8 oz (b) 5.8 - 9.6 oz (c) 7.8 - 9.6 oz	b	b	c		b	b	b	b			b	a	21 grain 1 seed	• Check label for Bee Warning

Active ingredient Trade Names	**Use rate(s)** per acre (unless specified)	**aphids**	**cutworm**	**Euro corn borer**	**fall armyworm**	**flea beetle**	**grasshoppers**	**Japanese beetle**	**rootworm adults**	**spider mite**	**stink bugs**	**true armyworm**	**western bean cutworm**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
etoxazole Zeal or Zeal WSP Zeal SC Stifle SC	(a) 1 - 3 oz (a) 2 - 6 oz									a				21	• Make applications at least 14 days apart • For resistance management, alternate with a miticide with a different mode of action
flupyradifurone Sivanto 200SL Sivanto HL Sivanto Prime	(a) 7.0 - 10.5 oz (a) 3.5 - 7.0 oz (a) 7.0 - 14.0 oz	a												7 forage 21 grain	• A systemic insecticide, effective on sucking pests (aphids listed as well as whiteflies)
GS-omega/kappa-Hxtx-Hv1a Spear-Lep	(a) 1 – 2 pts		a	a	?							?	?	0	• Novel mode of action. MUST be applied in conjunction with a low dose of Bt insecticide (see label for details). Bt damages the caterpillar gut, allowing Spear-Lep to enter the body • Species with a '?' are not listed on the label, but Spear-Lep probably has the same activity on them • Fun fact, this product is derived from spider venom
hexythiazox Onager	(a) 10-24 oz									a				30	• Limit of 1 application per year
indoxacarb Steward	(a) 6.0 - 11.3 oz			a	a								a	14 grain 1 forage 1 silage	• Label also claims suppression of stink bugs and Japanese beetles
malathion Malathion 5 and 5EC Fyfanon ULV Ag	(a) 1.5 pints (a) 4-8 oz	a					a		a					7	• REI = 12 hours with an exception of 3 days for workers detasseling seed corn • Aphids are not listed on the Fyfanon ULV label
methomyl Annihilate LV Lannate LV Lanveer LV Nudrin LV Annihilate SP Corrida 90WSP Lannate SP Nudrin SP	(a) ¾ - 1½ pints (a) ¼ - ½ pints	a		a	a	a			a			a		21 grain 3 forage 21 stover	• Check label for Bee Warning
methoxyfenozide Intrepid 2F Invertid 2F	(a) 4 - 16 oz			a								a	a	21	• Unique mode of action causes caterpillars to molt prematurely. Only controls larvae. Apply when first signs of feeding damage appear. Needs uniform coverage • Endangered species warning for use in these Michigan counties: Allegan, Monroe, Montcalm, Muskegon, Newaygo, Oceana. Visit EPA's Bulletins Live! Two

Active ingredient Trade Names	**Use rate(s)** per acre (unless specified)	**aphids**	**cutworm**	**Euro corn borer**	**fall armyworm**	**flea beetle**	**grasshoppers**	**Japanese beetle**	**rootworm adults**	**spider mite**	**stink bugs**	**true armyworm**	**western bean cutworm**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
methoxyfenozide + spinetoram Intrepid Edge	(a) 4 – 12 oz			a								a	a	28	• Unique modes of action. Only controls larvae. Apply when first signs of feeding damage appear. Needs uniform coverage • Endangered species warning for use in these Michigan counties: Allegan, Monroe, Montcalm, Muskegon, Newaygo, Oceana. Visit EPA's Bulletins Live! Two
permethrin Perm-Up 25DF Pounce 25WP Arctic 3.2EC Permastar Ag Perm-Up 3.2EC	(a) 6.4 - 9.6 oz (b) 3.2 - 6.4 oz (a) 4 - 6 oz (b) 2 - 4 oz		a	a	a	a			a			a	b	30 grain 0 forage	
permethrin (granular) Pounce 1.5G	(a) 6.7 - 10 lbs		a	a	a							a		30 grain 0 forage	• Broadcast by air or with ground equipment, directing granules into the whorl
pyrethrins Evergreen EC 60-6 PyGanic EC 1.4 II PyGanic 5.0	(a) 2.0 - 12.6 oz (a) 16 - 64 oz (a) 4.5 - 15.6 oz	a	a	a	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 • PyGanic is OMRI listed for organic use, Evergreen is not • Highly toxic to bees exposed to direct treatment. Do not apply on or drift onto blooming crops or weeds
spinetoram Radiant SC	(a) 3 - 6 oz			a	a							a	a	28 grain 3 forage 1 seed	• For resistance management, no more than 2 consecutive applications of spinetoram or spinosad
spinosad/ spinosyns Blackhawk Entrust Entrust SC Tracer	(a) 1.67 - 3.3 oz (b) 2.2 - 3.3 oz (a) 0.5 – 2 oz (b) 1-2 oz (a) 1.5 -6 oz (b) 3-6 oz (a) 1 - 3 oz (b) 2 - 3 oz			a	a							a	b	28 grain 7 forage 1 seed	• Time sprays with peak egg hatch. Frequent retreatments may be needed every few days, but for resistance management, rotate to other modes of action. See labels for specific recommendations • PHI for forage is 7 days (Blackhawk) or 3 days (Tracer)

Active ingredient Trade Names	**Use rate(s)** per acre (unless specified)	**aphids**	**cutworm**	**Euro corn borer**	**fall armyworm**	**flea beetle**	**grasshoppers**	**Japanese beetle**	**rootworm adults**	**spider mite**	**stink bugs**	**true armyworm**	**western bean cutworm**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
spiromesifen Oberon 2SC	(a) 5.7 - 16 oz									a				5 silage 30 grain	• Max 17 oz per acre and 2 applications per year • Make applications at least 14 days apart • Active against all mite stages, including eggs • Complete coverage is important. Adjuvants may be used to improve coverage
sulfoxaflor Transform WG	(a) 0.75 - 1.5 oz	a												14 grain 7 grazing 7 forage	• Translaminar product, moves in leaf to target sucking pests • "Do not apply product 3 days before bloom or until after seed set"

Table 7: Shortened version of the Handy Bt Trait Table with efficacy ratings for Michigan and Ohio

- Control ratings reflect the situation only in Michigan and Ohio, which may differ from other states
- The full national version of the Bt Trait Table is at https://www.texasinsects.org/bt-corn-trait-table.html

Trait packages	Bt proteins in the trait package regular text = caterpillar Bts *italics text = corn rootworm Bts*	Efficacy ratings by species (as of Nov. 2025) X = effective (marketed as very good/ excellent control) R = potential for resistance in local population or southern migrants						
		black cut-worm	ear-worm	Euro. corn borer	fall army-worm	true army-worm	western bean cutworm	corn root-worm
AcreMax	Cry1Ab Cry1F	x	R	x	R		R	
AcreMax Leptra	Cry1Ab Cry1F Vip3A	x	x	x	x	x	x	
AcreMax Xtra	Cry1Ab Cry1F *Cry34/35Ab1*	x	R	x	R		R	R
AcreMax Xtreme	Cry1Ab Cry1F *Cry34/35Ab1 mCry3A*	x	R	x	R		R	R
Agrisure Above	Cry1Ab Cry1F	x	R	x	R		R	
Agrisure Total	Cry1Ab Cry1F *Cry34/35Ab1 mCry3A*	x	R	x	R		R	R
Agrisure Viptera 3110	Cry1Ab Vip3A	x	x	x	x	x	x	
Agrisure Viptera 3111	Cry1Ab Vip3A *mCry3A*	x	x	x	x	x	x	R
Duracade	Cry1Ab Cry1F *eCry3.1Ab mCry3A*	x	R	x	R		R	R
Duracade Viptera	Cry1Ab Cry1F Vip3A *eCry3.1Ab mCry3A*	x	x	x	x	x	x	R
Duracade Viptera Z3	Cry1Ab Cry1A.105 Cry2Ab2 Vip3A *eCry3.1Ab mCry3A*	x	x	x	x	x	x	R
Durastak	Cry1Ab Cry1F *Cry34/35Ab1 eCry3.1Ab mCry3A*	x	R	x	R			R
Durastak Viptera	Cry1Ab Cry1F Vip3A *Cry34/35Ab1 eCry3.1Ab mCry3A*	x	x	x	x	x	x	R
Intrasect	Cry1Ab Cry1F	x	R	x	R		R	
Leptra	Cry1Ab Cry1F Vip3A	x	x	x	x	x	x	
PowerCore	Cry1A.105 Cry2Ab2 Cry1F	x	R	x	x		R	
PowerCore Ultra	Cry1A.105 Cry2Ab2 Cry1F Vip3A	x	x	x	x	x	x	
QROME	Cry1Ab Cry1F *Cry34/35Ab1 mCry3A*	x	R	x	R		R	R
SmartStax	Cry1A.105 Cry2Ab2 Cry1F *Cry3Bb1 Cry34/35Ab1*	x	R	x	x		R	R
SmartStax PRO	Cry1A.105 Cry2Ab2 Cry1F *Cry3Bb1 Cry34/35Ab1 dvSnf7*	x	R	x	x		R	x
Trecepta RIB Complete	Cry1A.105 Cry2Ab2 Vip3A	x	x	x	x	x	x	
Viptera	Cry1Ab Cry1F Vip3A	x	x	x	x	x	x	
Viptera Z3	Cry1Ab Cry1A.105 Cry2Ab2 Vip3A	x	x	x	x	x	x	
Vorceed Enlist	Cry1A.105 Cry2Ab2 Cry1F *Cry3Bb1 Cry34/35Ab1 dvSnf7*	x	R	x	x		R	x
VT Double PRO/ VT2	Cry1A.105 Cry2Ab2		R	x	x			
VT Triple PRO/ VT3	Cry1A.105 Cry2Ab2 *Cry3Bb1*		R	x	x			R
VT4 PRO	Cry1A.105 Cry2Ab2 Vip3A *Cry3Bb1 dvSnf7*	x	x	x	x	x	x	x

Management of Insect Pests of Soybean in Michigan and Ohio
Updated: November 2025

Chris DiFonzo, Field Crops Entomologist
Michigan State University
Department of Entomology
288 Farm Lane
East Lansing, MI
difonzo@msu.edu

Kelley Tilmon, Field Crops Entomologist
The Ohio State University
Department of Entomology
1680 Madison Ave
Wooster, OH
tilmon.1@osu.edu

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** (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 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.

Table 1: Timing of damage from insect pests of soybean in Michigan and Ohio

- 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	larvae (maggot) damage germinating plants				
wireworm	larvae, in soil	larvae damage roots				
slugs & snails	both eggs and adults, in field	feeding on seedlings and lower leaves of bigger plants				
black cutworm	Southern USA, migrate north	larvae feed on leaves and also off cut plants				
bean leaf beetle	adults, woodlots & residue		chew small holes in leaves		chew holes in leaves & pods	
soybean aphid	eggs, on buckthorn trees		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-defoliating caterpillars (multiple species)	beet armyworm, webworm, yellow woolly bear - pupae All others: Southern USA, migrate north		larvae feed 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 beetle adults	larvae (grubs), underground			adults skeletonize leaves, 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. *To date, not found in MI or OH*		
thrips	depends on species			adults and nymphs 'punch' and suck plant cells		
stink bug	adults, in & around fields			adults and nymphs pierce pods & beans		

Table 2: Damage checklist to aid in scouting for insect pests of soybean in Michigan and Ohio

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 (windowpane feeding)										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 sooty mold coating											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 in pod				x	x								x					x			
discolored beans															x						
shriveled, aborted beans															x						
Other																					
virus transmission	x										x						x				

Table 3: Life cycle, damage, and pest status of insect pests of soybean in Michigan and Ohio

Terms to describe the pest status of each insect. Ratings apply to Michigan and Ohio.

- **Rare**: Unusual, typically goes unnoticed. May not even be present
- **Uncommon**: Usually present but well-below damaging levels. An outbreak once a generation.
- **Occasional**: Present in most fields, sometimes in high numbers. An outbreak once a decade.
- **Important**: Present in most fields, potentially increasing to damaging levels every season. A common target of scouting, management programs, or insecticide use.
- **Sporadic:** Damaging levels occur after favorable weather patterns (such as drought) or mass movement from south to north during the season
- **Localized**: Damaging levels occur in specific locations under specific agronomic conditions, for example in no-till production or in older stands.

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 the ground around plants. 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 weedy 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 red-legged & 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 common egg-laying sites. Hoppers move into field edges from these areas • A dry summer & fall can lead to high numbers the following year	Uncommon Outbreaks rare
green cloverworm	GCW overwinters roughly south of a line from Ft Wayne IN – Findlay OH. It recolonizes the rest of our area in early spring. Eggs are laid on undersides of leaves and larvae feed on foliage. When disturbed, they flop around and wriggle violently. 2 generations per season	• Larvae defoliate plants, eating the leaf tissue between the veins. Plants can appear tattered	• Strong weather systems from the south may carry large numbers north in the spring.	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 in mid-summer and feed on hundreds of hosts, including soybean. 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 (with high grub infestation) may have more beetles and damage	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 (mid-April in OH & southern MI), laying eggs in tilled / disturbed soil with decaying organic matter. Larvae (maggots) feed primarily on decaying matter, but also on seeds and emerging seedlings. Several generations per year. The first (damaging) generation is done by mid-May in Ohio and in central/ southern Michigan.	• Larvae feed on germinating seeds, resulting in variable emergence, stand loss, and delayed development • Plants that do emerge often have scarring on cotyledons • Damage can occur over a large part of field Note: maggots may be present when seeds rot for another reason such as pathogens or wet conditions	• Tillage • Recently (w/in 2 weeks) incorporated organic matter such as alfalfa, green cover crops, weeds, or fresh manure • Cool, wet weather which delays emergence • Peak egg laying near planting time in mid-April (MI)	Localized Occurs under specific 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 Larvae are weird-looking and get noticed during scouting, but they are harmless.
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 slow stand development or even cause stand loss	• No or reduced till • Planting into heavy stubble, crop residue • Cool, wet weather which delays emergence • Stand loss can occur when furrows are poorly-closed as slugs enter and feed down the slot	Localized Occurs under specific 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, females and a generation of males return to buckthorn. This is the only time mating occurs, between males and the daughters of the females. Eggs are laid near buds on buckthorn. 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, and 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 are often overwhelmed by summer migrants, resulting in heavy infestation • K deficiency leads to heavy infestation because aphids grow faster, reproduce sooner & more • Drought stress enhances damage & reduces onset of aphid-killing fungi	Occasional to Important *SBA was a major pest for a decade after its discovery in the 2000s. But currently in MI and OH, fields that are over threshold are uncommon due to high levels of biocontrol*

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
soybean gall midge **NOTE**: there is a **similar-looking native midge** (an orange maggot) that feeds on white mold!	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. Mature larvae are bright orange maggots. They feed on stems and drop off plants to pupate. 2 generations per season?	• Larvae feed at the base of plants in the early vegetative through reproductive stages • 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 Current (2025) distribution: IA, MN, MO, ND, NE, and SD **This pest is NOT PRESENT YET in Michigan or Ohio**
soybean looper	One of the most abundant pests of soybean in the southern US. 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 popula-tions in our area
spider mites *two-spotted*	Adults overwinter in field borders and sheltered areas. In spring, adults move to new growth and lay eggs on the undersides 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 an outbreak 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* Note: some stink bug species are predators of other insects	Adults overwinter and emerge in spring to complete a generation on weeds, clover, & wheat. Sampling in Michigan shows that bugs tend to move into soybean fields after wheat is harvested. Egg masses are laid on soybean leaves. Adults and nymphs feed by injecting digestive enzymes and sucking plant juices from stems, leaves and pods.	• 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 like natto
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 and fold leaves together to make a distinctive shelter, then feed in and around the structure	• Nothing specific	Uncommon Outbreaks are rare, but webbed leaves & the 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 an outbreak and enhances the impact of thrips feeding •Thrips develop in small grain fields first and may move into adjacent soybeans after dry-down	Uncommon Thrips are very abundant on soybeans, but rarely cause damage
webworm *garden & alfalfa webworm*	Overwinter as pupae. 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 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

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
white grubs - annual *including Japanese beetle, Asiatic garden beetle (AGB)*	Adults emerge in June into July, depending on species. Eggs are laid in soil during July-August. Grubs feed on roots through the fall, then move down in soil profile to overwinter. 1 generation per year	• Mature grubs overwinter in fields, then feed again the next spring on cotyledons and roots of seedlings at planting time • May reduce stand or increase variability • Japanese beetle adults feed on soybean leaves (see Japanese beetle in list)	• Fields or parts of fields with >80% sand (AGB) • Planting into fallow fields or pasture, or field margins near turf (JB)	Localized We have seen soybean stand loss from AGB in sandy fields in southern MI & northern 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 seeds & roots	• Planting into long-standing fallow fields & pasture	Uncommon & Localized

Table 4: Management notes, scouting recommendations, and thresholds for insect pests of soybean in Michigan and Ohio

The defoliation recommendation in this guide was updated recently based on results from a grower-funded regional research project in the Midwest. **For details on assessing defoliation, see the pages following this table.**

Pest	Notes on non-chemical and chemical management	Scouting recommendation	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, use the leaflet method described on the pages following this table	Overall defoliation threshold: • V stages - R2: 30% • R3 - R5: 10% • R6: 15% Threshold for pod feeding: 10%
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	For general detection, use a sweep net To estimate defoliation, use the leaflet method described on the pages following this table	Overall defoliation threshold: • V stages – R2: 30% • R3 - R5: 10% • R6: 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 red-legged & 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 To estimate defoliation, use the leaflet method described on the pages following this table	Overall defoliation threshold: • V stages - R2: 30% • R3 - R5: 10% • R6: 15%
green cloverworm	*See "caterpillars"*		
Japanese beetle adults	• Insecticide: May be able to limit spray area to the edge, since beetles often congregate there	To estimate defoliation, use the leaflet method described on the pages following this table	Overall defoliation threshold: • V stages - R2: 30% • R3 - R5: 10% • R6: 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 (mid-April) planting under these circumstances when cold soils delay emergence • Agronomic: SCM almost never infests 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 it may not be very effective if the maggot population is high. Stand loss can still occur when treated seed is used • A degree day model predicts when peak flight & egg-laying will occur based on MSU weather station data. See this site: https://enviroweather.msu.edu/crops/corn	No specific recommendation To assess potential risk of SCM before planting, check the degree day model listed in the previous column	No rescue treatment. Consider replanting fields or areas with significant stand loss An insecticide seed treatment is not recommended when replanting, as SCM risk has passed
silver-spotted skipper	*See "caterpillars"*		

Pest	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
slugs & snails	• Biological: Some ground beetle species consume slugs • Agronomic: Tillage and crop rotation reduce residue (slug habitat). Row cleaners can sweep away residue and create a warm band of soil above the seed bed • Agronomic: Avoid planting in wet conditions that leave open furrows which serve as slug buffet lines • Insecticide: Slugs are not insects, so 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. <u>Do not</u> spray early (populations below the threshold). This disrupts natural enemies and aphid numbers can quickly rebound. Insecticide resistance is reported in aphid populations in western states - insurance or early sprays created the problem. If the threshold is reached, use nozzles which provide good coverage and a high enough water volume to achieve excellent coverage	Begin scouting at end of June. Sample a minimum of 30 whole plants, taking several paces between them. Count & record the total # of SBA on each, including '0s'. A tally counter makes it much easier to count. Then calculate the average # per plant *[In practical terms, if the top-third of every plant is covered with several hundred juicy green healthy-looking aphids, this is likely threshold]* For quicker sampling, google the "Speed Scouting" technique developed by Iowa State University	Economic threshold: • R1-R5: 250 per plant • After R5: <u>don't treat</u> You have ~7 days to treat after reaching threshold, as lag time was built into the threshold <u>Factors to consider</u>: * Are there numerous predators beginning to control the aphids? *Are there fungus-killed aphids, which suggests population is about to crash? * Are the aphids tiny 'white dwarves' which indicates a decreasing population?
soybean gall midge	• Agronomic: Infestations start on field edges adjacent to previous year's soybean **Gall midge has not been found in MI or OH. If you suspect it, contact one of the authors or an Extension Educator.**	Split bases of wilted, broken, or dead plants in edge-rows. Check for black tissue and bright orange maggots	**Gall midge has not yet been found in Michigan or Ohio**
soybean looper	*See "caterpillars"*		
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 will flare mite populations by killing natural enemies. Fungicides may also flare mites by disrupting natural fungal pathogens. Therefore, insurance applications of both are discouraged and be extra cautious about pesticide applications in dry seasons.	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 yellowing of leaves	Guideline: Treat when stippling is widespread on lower leaves and progressing into the middle canopy <u>Factors to consider</u>: * Will the forecast remain favorable for mites, i.e. hot & dry? * Is excellent spray coverage possible? * Will there be 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"*		

Pest	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
thrips *(several species)*	• Biological: Many small-sized natural enemies (pirate bugs, predatory mites, predatory thrips) build their populations by feeding on thrips. Interesting, some thrips provide biological control by feeding on spider mite eggs! • 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, during the terrible 2012 drought
webworm	*See "caterpillars"*		
white grubs *including Japanese beetle, Asiatic garden beetle (AGB), and June beetle*	• Biological: Grubs are eaten by other insects, birds, and rodents; infected by several pathogens; and attacked by several species of beneficial nematodes • 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 many 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, often in the sandiest parts of fields. Fields with a history of grubs can be checked with a shovel in early spring	No rescue treatment is 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 is available Consider replanting fields or areas with significant stand loss

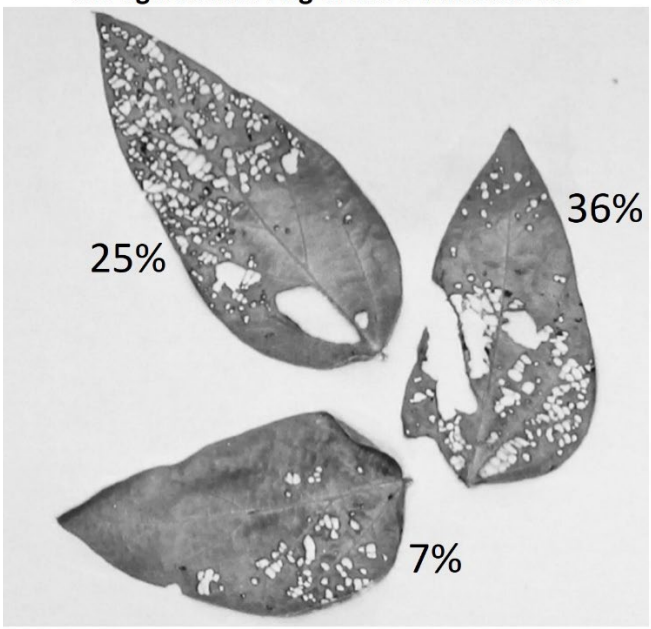
See the following pages for information on assessing defoliation

Insect defoliation in soybean

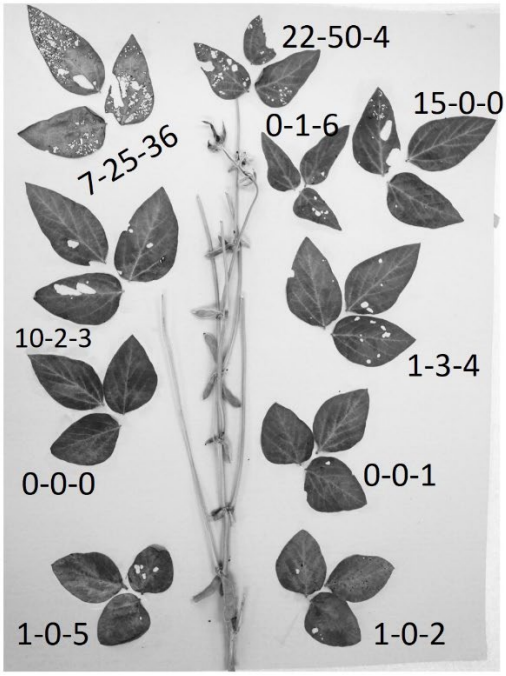
Soybean is attacked by many defoliators, including bean leaf beetle, Japanese beetle, looper, cloverworm, and grasshoppers. Management decisions are based on the combination of their feeding.

There is a tendency to overestimate insect defoliation by limiting scouting to field edges (where insects like Japanese beetle accumulate) or by focusing the eye on the most-heavily damaged leaves (usually ones at the top of a plant). In the example below, a scanner was used to measure % defoliation accurately for each leaflet on a whole plant. The three leaflets on the most-damaged leaf (left) averaged 23% defoliation. But the true average defoliation for the whole plant (right), based on all 30 leaflets, was only 7%.

Misleading defoliation estimate based on the ugliest leaf. Avg of the 3 leaflets: 23%



Whole plant estimate (30 leaflets): 7%



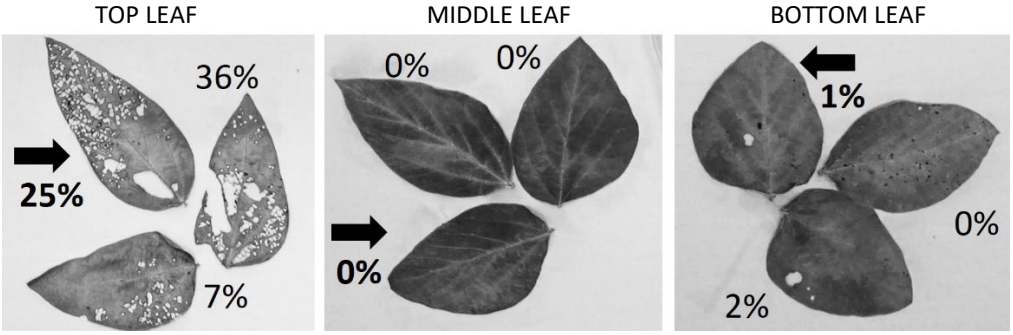
When defoliation is determined properly by assessing feeding on whole plants across an entire fields, few soybean fields reach threshold in Michigan or Ohio. Even if some insect feeding is present on upper leaves or edge plants, soybeans have a high capacity to compensate for defoliation because lower leaves or neighboring undamaged plants 'pick up the slack'. The following page gives a recommended method to measure defoliation when scouting fields.

The Leaflet Method to Assess Defoliation

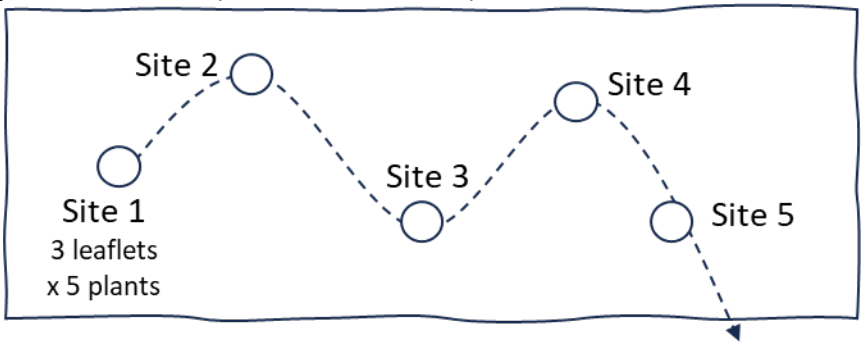
You need a small container or bag to collect leaflets + a way to take data/ calculate an average

[start at least 20 feet beyond the field edge]

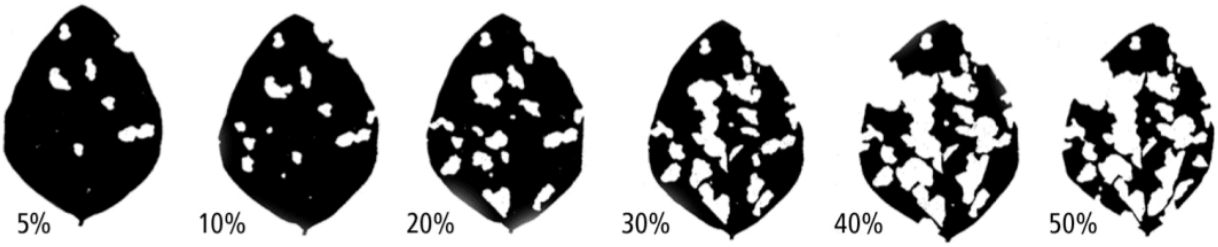
1. Pick a trifoliate leaf from the bottom, middle and top of a plant, as in the pictures below. From each leaf, discard the least- and most-damaged leaflet and keep only the three leaflets with the 'middle' amount of defoliation (arrows below). Don't rate defoliation yet, simply throw away the leaflets with least and most feeding, based on your quick visual impression.



2. Sample four more plants, 10 paces apart, for a total of 15 leaflets at this site (5 plants x 3 leaflets). Then repeat the process at four more sites across the field, as in the diagram below. Your total sample is 75 leaflets (15 leaflets x 5 sites).



3. Estimate and record the % defoliation for each leaflet. This is easiest done outside the field. Estimates can be made visually (the scale below helps to visualize different levels of feeding) or digitally using a phone app like Bioleaf https://www.quantitative-plant.org/software/bioleaf.



4. Finally, average the scores from the 75 leaflets to get an estimated % defoliation for the field.

Table 5: Soil/at-plant insecticides to manage insect pests of soybean in Michigan and Ohio

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry.
- Application rates are listed for pests which appear on the manufacturer label; If a column is blank, the pest is not on the label. The letters in the pest columns refer to the label use rate from column two.
- 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	**seedcorn maggot**	**slugs & snails**	**white grubs**	**Precautions and Remarks**
bifenthrin Xpedient Plus V	(a) 0.15 – 0.30 oz per 1000 ft (= 2.56 - 5.12 oz per acre)	a		a	• Apply as a band over row on soil surface, T-banded over an open furrow, or in-furrow; see label for PRE and PPI instructions • Many are formulated to mix directly w/ fertilizer or PRE herbicide applications Note: Many of these products can be broadcast on the soil surface to control cutworm species and armyworms
Bifender FC	(a) 0.17 - 0.34 oz per 1000 ft (= 3.0 - 5.9 oz per acre)				
Capture 3RIVE3D	(a) 0.19 – 0.46 oz per 1000 ft (= 3.2 - 8 oz per acre)				
Bifenture LFC Capture LFR Nirvana RTU Sniper LFR	(a) 0.2 - 0.39 oz per 1000 ft (= 3.4 - 6.8 oz per acre)				
bifenthrin + biofungicide Ethos XB Ethos Elite LFR	(a) 0.2 - 0.49 oz per 1000 ft (= 3.5 - 8.5 oz per acre)	a		a	• Similar to bifenthrin alone, but contains a biological fungicide for suppression of early season root diseases (apply in-furrow for disease control): XB: *Bacillus amyloliquefaciens* Elite: *Bacillus velezensis & subtilis* • Apply T-band or in-furrow. See label for PRE and PPI instructions and for other row spacings
bifenthrin + fungicide Nirvana Complete	(a) 0.29 – 0.75 oz per 1000 ft (= 5.0 – 13.0 oz per acre)	a		a	• Combo product with the fungicide pyraclostrobin - similar precautions to bifenthrin alone. The rate of bifenthrin is similar to the high rate in bifenthrin-only products
cypermethrin (zeta) Mustang Maxx	(a) 0.23 oz per 1000 ft (= 4 oz per acre)			a	• Apply T band or in-furrow in a minimum of 2-7 gal per acre
iron phosphate Ferroxx AQ	(a) 4.0 – 15.0 lbs per acre		a		• Sluggo is a bait that must be eaten to kill slugs • Apply in the 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
Sluggo	(a) 20 - 44 lbs per acre				
metaldehyde Deadline Bullets	(a) Max 10 lbs per acre		a		• **Metaldehyde baits are NOT registered for use on soybean in Michigan - only for use in Ohio!** (yes, this is an unusual restriction) • Deadline is a bait and must be eaten to kill slugs • Growth stages V0-R1: no application after R1 • Apply in the evening as a band between rows. • Avoid applying before a rain or irrigation, which can dissolve the pellets
Deadline GT	(a) Max 13.3 lbs per acre				
Deadline M-Ps	(a) Max 10 lbs per acre				
Durham Metaldehyde 7.5	(a) Max 5.3 lbs per acre				
sodium ferric EDTA Ferroxx Slug & Snail Bait	(a) 5 – 20 lbs/acre		a		• Broadcast uniformly using a spreader • Non-toxic to pets and wildlife

Table 6: Foliar insecticides to manage insect pests of soybean in Michigan and Ohio

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry
- Application rates are listed for pests which appear on the label. If a column is blank, the pest is not on the label. The letters in the pest columns refer to the use rate from column two
- Note: The caterpillar category includes cloverworm, earworm, silver-spotted skipper, soybean looper, thistle caterpillar, velvetbean caterpillar, and webworm. These are combined 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**	**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
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
acetamiprid + bifenthrin Savoy EC	(a) 2.5 – 5.0 oz	a	a				a				30	• Use of a non-ionic surfactant, crop oil or seed oil is recommended to improve coverage, uptake, and pest control • Soy looper not listed. Label lists fewer species than bifenthrin alone
afidopyropen Sefina	(a) 3.0 oz						a				7	• Controls sucking pest by disrupting feeding and other behaviors, creating 'zombie' aphids that die a slow death
Bacillus thuringiensis - Bt Agree WG Xentari Dipel DF Javelin WG	(a) 0.25 - 2.0 lbs (a) 0.5 - 2.0 lbs (a) 0.5 – 1.0 lbs (a) 0.25 - 1.5 lbs		a								0	• Bts must be eaten to kill and are most-effective against young larvae (early instars), so coverage is critical • Check label for rates for specific caterpillars and pest pressure • Some can be used in organic production • Note, the Dipel DF label indicates it should be tank mixed with a pyrethroid (the reason for this is not given)

Active ingredient Trade Names	**Labelled rate(s) per acre** (unless stated)	**bean leaf beetle**	**caterpillars**	**cutworm**	**grasshoppers**	**Japanese beetle**	**soybean aphid**	**spider mite**	**stink bugs**	**thrips**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
bifenthrin (liquid) Bifen2 AgGold Bifenture EC Bifenthrin 2EC Brigade 2EC Discipline 2EC Fanfare EC / 2EC/ ES Reveal & Reveal EndurX Sniper & Sniper Helios Tundra EC Bifender FC Nirvana RTU	(a) 2.1 - 6.4 oz (b) 5.12 - 6.4 oz (a) 2.4 - 7.4 oz (b) 5.9 - 7.4 oz (a) 2.8 - 8.5 oz (b) 6.8 - 8.5 oz	a	a	a	a	a	a	b	a	a	18	• Do not make applications less than 30 days apart
bifenthrin (dry) Bifenture 10DF	(a) 5.3 – 16.0 oz (b) 12.8 – 16.0 oz						a	b			18	• Dry (wettable powder) formulation • At the high rate (16 oz) use at least 10 gal per acre
bifenthrin + biofungicide *(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	• Combo product with a bio fungicide labeled for suppression of white mold and several other foliar pathogens. Similar precautions to bifenthrin alone
bifenthrin + fungicide Nirvana Complete	(a) 13 oz	a	a	a	a	a	a	a	a	a	18	• Combo product with pyraclostrobin fungicide. Similar precautions to bifenthrin alone. Bifenthrin rate is equivalent to the high rate in bifenthrin-only products
bifenthrin + acetamiprid Argyle OD	(a) 6.0 - 9.0 oz (b) 7.0 - 9.0 oz	a	a	a	a	a	a	b	a	a	30	• A spray adjuvant, such as a non-ionic surfactant or methylated seed oil, is recommended to improve coverage and plant uptake
bifenthrin + chlorantraniliprole Elevest	(a) 4.8 - 9.6 oz (b) 5.6 - 9.6 oz (c) 7.7 - 9.6 oz	a	b	a	a	a	a	c	b	a	18	• For aphids and spider mites, coverage is essential • For grasshoppers, performance improved by adding methylated seed oil • Highly toxic to fish & aquatic life and to bees exposed directly
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 foliage for livestock feed

Active ingredient Trade Names	**Labelled rate(s) per acre** (unless stated)	**bean leaf beetle**	**caterpillars**	**cutworm**	**grasshoppers**	**Japanese beetle**	**soybean aphid**	**spider mite**	**stink bugs**	**thrips**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
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	• Highly toxic to bees • Do not make applications less than 30 days apart
bifenthrin + sulfoxaflor Ridgeback	(a) 4.5 – 13.8 oz (b) 6.9 – 13.8 oz (c) 11.0-13.8 oz	a	a	a	a	a	b	c	a	a	18	• Highly toxic to bees • 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/ 2-4 D herbicide (can result in crop injury)
chlorantraniliprole Coragen Prevathon Shenzi 400SC	(a) 3.5 - 5.0 oz (a) 14 - 20 oz (a) 1.7 – 3.8 oz		a		a						1	• Novel mode of action; insects are paralyzed & stop feeding. Must be applied before populations reach damaging levels. See label for specifics. • Check labels for specific species targets, as they differ: Coragen = earworm, armyworm. Prevathon & Shenzi = earworm, armyworm, loopers, cloverworm, velvetbean caterpillar & hoppers
chlorantraniliprole + lambda-cyhalothrin Besiege	(a) 5.0 - 10.0 oz	a	a	a	a	a	a		a	a	30	• Check label for specific rate ranges (5-8 oz, 8-10 oz) for various species • May 'suppress' spider mites • Do not graze or feed treated foliage to livestock
clothianidin Belay	(a) 3 - 6 oz	a				a	a		a		21	• Do not use Belay in fields where neonicotinoid treated seed was used, until 45 days after planting. Max 0.2 lb clothianidin per acre per year. • Bee hazard warning. Toxic to bees for up to 5 days after application. Do not apply during flowering & see label for other pollinator precautions. • Do not graze or feed treated foliage to livestock
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 seed 15 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 seed 15 hay & forage	

Active ingredient Trade Names	**Labelled rate(s) per acre** (unless stated)	**bean leaf beetle**	**caterpillars**	**cutworm**	**grasshoppers**	**Japanese beetle**	**soybean aphid**	**spider mite**	**stink bugs**	**thrips**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
cyfluthrin + imidacloprid Leverage 360	(a) 2.8 oz	a	a	a	a	a	a		a	a	21 seed 15 hay & forage	
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) Warrior II w/ Zeon Tech. Grizzly Too Kendo 22.8CS Lamcap II Province II Ravage II Lambda-Cyhalothrin 1EC Lambda-Cy EC, 1EC, & AG Lambda-T LambdaStar Kendo Paradigm VC Ravage 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
cypermethrin (zeta) Mustang Maxx	(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 & 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

Active ingredient Trade Names	**Labelled rate(s) per acre** (unless stated)	**bean leaf beetle**	**caterpillars**	**cutworm**	**grasshoppers**	**Japanese beetle**	**soybean aphid**	**spider mite**	**stink bugs**	**thrips**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
emamectin benzoate Denim	(a) 8 – 12 oz		a								28	• Controls only caterpillars. Target small larvae, up to a ½ inch. May need to make at least 2 applications if egg-laying occurs over an extended period • 'Suppresses' spider mite, defined as erratic control from good to poor • Do not graze, harvest, or feed vines for livestock
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
etoxazole Stifle SC Zeal SC Zeal Pro	(a) 2.0 - 6.0 oz (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 by ground or 3 gal per acre by 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 Montana 4F Nuprid 4FMax Provoke 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
Imidacloprid + lambda cyhalothrin Kilter	(a) 1.9 – 3.2 oz (b) 3.2 – 3.8 oz	a	a b	a	b	a	a		b	a	30	• Bee hazard warning – see label for pollinator precautions • See label for rates for specific caterpillar species • Do not graze, feed, harvest treated forage, straw, or hay
indoxacarb Steward	(a) 4.6 - 11.3 oz		a								21	• Use higher rate for higher pest population or spraying a dense canopy • Also labeled for suppression of stink bugs • Do not graze or feed livestock on treated fields

Active ingredient Trade Names	**Labelled rate(s) per acre** (unless stated)	**bean leaf beetle**	**caterpillars**	**cutworm**	**grasshoppers**	**Japanese beetle**	**soybean aphid**	**spider mite**	**stink bugs**	**thrips**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
methomyl Annihilate LV Lannate LV Lanveer LV Nudrin LV Annihilate SP Corrida90WSP Lannate SP Nudrin SP	(a) 0.4 - 1.5 pints (a) 0.125 - 0.5 lbs	a	a				a			a	14 seed 12 hay 3 forage	• Rates vary by insect and by 'severity' of infestation, check labels for details • The Lannate label lists brown marmorated stink bug
methoxyfenozide Intrepid 2F Invertid 2F	(a) 4 - 8 oz		a								14 seed 7 hay & forage	• Unique mode of action on Leps causes caterpillars to molt prematurely • Will only control larvae; apply when first signs of feeding damage appear • Also labeled for various armyworm species • Endangered species warning for these Michigan counties: Allegan, Monroe, Montcalm, Muskegon, Newaygo, Oceana. Visit EPA's 'Bulletins Live!Two' website before application & follow the use limitations given
methoxyfenozide + spinetoram Intrepid Edge	(a) 4.0 – 6.4 oz		a								28	• Unique modes of action specific to Leps • Will only control larvae; apply when first signs of feeding damage appear • Also labeled for various armyworm species • Endangered species warning for these Michigan counties: Allegan, Monroe, Montcalm, Muskegon, Newaygo, Oceana. Visit EPA's 'Bulletins Live!Two' website before application & follow the use limitations given
novaluron Diamond	(a) 6 - 12 oz (b) 9 - 12 oz		a		b				a		30	• Controls only Lepidopteran larvae (caterpillars) and small nymphs of stink bugs & grasshoppers. Applications must be made early in insect life cycle • Do not feed treated vines to livestock
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 5.0	(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 short residual control, so coverage is critical • PyGanic is OMRI listed for use on organic crops, but Evergreen is not • Highly toxic to bees exposed to direct treatment; do not apply on or drift onto blooming crops or weeds
spinetoram Radiant SC	(a) 2.0 - 4.0 oz		a								28	• Time applications to target small larvae • Not all caterpillar species are listed on the label

Active ingredient Trade Names	**Labelled rate(s) per acre** (unless stated)	**bean leaf beetle**	**caterpillars**	**cutworm**	**grasshoppers**	**Japanese beetle**	**soybean aphid**	**spider mite**	**stink bugs**	**thrips**	**Pre-harvest interval (PHI) in days**	**Precautions and Remarks**
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
thiamethoxam + lambda cyhalothrin Endigo ZC Endigo ZCX	(a) 3.5 – 4.0 oz (b) 4.0 - 4.5 oz	b	a	a	b	b	a		b	a	30	• Highly toxic to bees exposed to direct treatment. Do not apply on or drift onto blooming crops or weeds • Stink bug control may require multiple applications • Do not graze or harvest soybean for livestock forage, straw, or hay

Management of Insect Pests of Wheat in Michigan and Ohio
Updated: November 2025

Chris DiFonzo, Field Crops Entomologist
Michigan State University
Department of Entomology
288 Farm Lane
East Lansing, MI
difonzo@msu.edu

Kelley Tilmon, Field Crops Entomologist
The Ohio State University
Department of Entomology
1680 Madison Ave
Wooster, OH
tilmon.1@osu.edu

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 **wheat and other small grains.** 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 both 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.

Table 1: Timing of damage from insect pests of wheat in Michigan and Ohio

- 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 (in particular, European chafer)	larvae (grubs), in soil	grubs feed on roots			grubs can destroy new stands by feeding on roots (Euro chafer will feed into late October)	
wheat curl mite	nymphs & adults, on hosts in and around fields	Mites suck plant juices from leaves, primarily on new growth				Infest new stands. May spread viruses
cereal leaf beetle	adults, in protected areas near fields	larvae feed on leaves		adults feed on leaves		
true armyworm	Southern USA, migrate north	larvae feed on leaves and may clip heads after they form				
aphids (multiple species)	Southern USA, migrates north	suck plant sap (on fall planted grain)		suck plant sap (on spring planted grain)		BYDV spread (fall plantings)
Hessian fly	puparia on plants	larvae feed on lower stem				larvae feed on seedlings
grass sawfly	pupae, underground		caterpillars feed on wheat stems			
grasshoppers (multiple species)	egg clusters, underground			nymphs, then adults, defoliate plants		
fall armyworm	Southern USA, migrate north				larvae feed on leaves and strip plants under high infestations	

Table 2: Damage checklist to aid in scouting for insect pests of wheat in Michigan and Ohio

Plant part or timing Type of damage or injury	aphids	cereal leaf beetle	fall armyworm	grasshoppers	grass sawfly	Hessian fly	true armyworm	wheat curl mite	white grubs
Stand (emergence)									
wilted or stunted plants									x
gaps in row									x
fewer, or dead, tillers						x			x
widespread stand loss or thinning			x						x
Roots									
root hairs missing									x
pruning of whole roots									x
Leaf tissue									
Scraping of the leaf surface		x							
skeletonizing		x							
irregular leaf feeding			x	x	x		x		
severe defoliation			x	x			x		
stems stripped of all leaves			x				x		
leaf edges curled inward								x	
new leaf trapped in previous leaf								x	
leaf yellowing from feeding	x								
leaf yellowing, reddening from virus	x							x	
leaves dark bluish-green						x			
field appears whitish or 'frosted'		x							
sticky leaves or head from honeydew	x								
Stem									
short internodes and stems						x			
stunting of plants						x			
small lengths of cut stems on ground					x				
stem breakage, lodging						x			
Head									
awns clipped off							x		
heads clipped off					x		x		
Other									
barley yellow dwarf (BYDV) transmission	x								
wheat streak mosaic transmission								x	
large square frass pellets on ground			x				x		
numerous stem segments on ground					x				

Table 3: Life cycle, damage, and pest status of insect pests of wheat in Michigan and Ohio

Terms to describe the pest status of each insect. Ratings apply to Michigan and Ohio.

- **Rare**: Unusual, typically goes unnoticed. May not even be present
- **Uncommon**: Usually present but well-below damaging levels. An outbreak once a generation.
- **Occasional**: Present in most fields, sometimes in high numbers. An outbreak once a decade.
- **Important**: Present in most fields, potentially increasing to damaging levels every season. A common target of scouting, management programs, or insecticide use.
- **Sporadic:** Damaging levels occur after favorable weather patterns (such as drought) or mass movement from south to north during the season
- **Localized**: Damaging levels occur in specific locations under specific agronomic conditions, for example in no-till production or in older stands.

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
aphids *multiple species: English grain aphid, bird cherry-oat aphid, corn leaf aphid, and greenbug*	English grain & corn leaf aphids probably move from the south, but bird cherry-oat aphid may be able to overwinter locally. The summer population is all female. Females do not mate to reproduce and give birth to multiple live nymphs per day. Multiple overlapping generations	• All stages suck plant sap from stems, leaves, and the head, removing water and nutrients • Heavy infestations are rare, but may stress plants and coat leaves and heads in sticky honeydew • Grain aphids, especially the bird cherry-oat aphid, transmit barley yellow dwarf virus. In winter wheat, infection is more serious if it occurs in fall	• A warm fall can extend aphid activity and result in more BYDV transmission to winter wheat	Occasional
cereal leaf beetle *Historic note: CLB was first found in the USA in 1962 in Berrien Co. Michigan*	The handsome blue and red adults overwinter in tree lines, wooded areas, and leaf litter near last year's wheat fields. Beetles colonize small grains in the early spring, laying eggs on leaves. The slug-like larvae feed by scraping the leaf surface, then pupate underground. Newly-emerged adults feed for a short period on small grains, grasses, or corn leaves, then become inactive for the rest of the summer. They move to an overwintering spot in fall. 1 generation per year	• Larvae scrape or skeletonize long strips of leaf. Older larvae, which occur in May, do the most feeding • Fields with heavy feeding on the flag leaf appear white or frosted • Heavy feeding can reduce plant growth and yield	• CLB feeds on all small grains, but spring-planted cereals are preferred over fall-planted • Late-planted fields in the fall, or thin stands, may attract more beetles in spring • Hot spots can be impressive & tend to be on field edges near tree lines where adults overwinter • Tillage and insecticide sprays will local parasitoid populations	Occasional & Localized Status upgraded from 'uncommon' in 2022 as we received more reports of issues
fall armyworm (FAW)	FAW is a tropical species. Adult moths migrate north, arriving mid to late summer. Eggs laid on leaves. Larvae feed on plants during the day. Pupation in soil. 1-3 generations, if the fall is warm. Larvae cannot overwinter in our area.	• Present later in the season, and thus a risk to winter wheat and fall-planted cover crops • Feeding starts on leaf margins. All leaves and small stems can be consumed under heavy infestations	• Strong winds from the SW carry moths northward • Warm conditions in late summer into fall can lead to several FAW generations	Uncommon and Sporadic A late-season outbreak in 2021 was the worst in ~30 years
grasshoppers	Eggs overwinter in soil. Nymphs emerge in June. Feeding increases	• Adults and nymphs chew on leaves, stems, or the head;	• Undisturbed forage, pasture, and	Uncommon

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
multiple species	with size, with large nymphs and adults consuming the most. Females lay groups of eggs in the undisturbed soil in late summer. 1 generation per year	feeding has a ragged appearance • Parts of leaves or the head may be clipped off	field margins are preferred egg-laying sites, so damage may be greater on edges near these habitats • A dry summer can lead to higher populations the following year	
grass sawfly	Sawflies are in the Order Hymenoptera, related to bees and wasps. Adults emerge in spring and lay eggs in April - early May. Larvae resemble Lepidoptera caterpillars but have 8 pairs of fleshy prolegs down the length of the body (vs. 5 pairs for armyworm). Larvae are bright to light green. Older larvae have a distinct dark stripe like a raccoon mask between the eyes. In June, larvae drop to the ground and remain underground to pupate and overwinter. 1 generation per year	• Larvae feed on leaves, but more importantly they tend to clip heads; a single caterpillar may clip 10-12 heads before dropping to the ground • After clipping a head, larvae often continue to chop off pieces of the stem, apparently to feed on the fresh ends. This results in stem pieces littering the ground	• On the East Coast, outbreaks tend to happen after an abnormally warm spring, which leads to more egg laying	Uncommon
Hessian fly	For winter wheat, adult flies emerge in fall and lay eggs on young plants. The mobile first stage maggots settle under leaf sheaths or in the crown to feed. Larvae are full grown before winter, overwintering in a protective shell (puparium) resembling a flax seed. Pupation occurs in spring, and adults emerge to infest wheat during stem elongation. Maggots of this generation feed and pupate under leaf sheathes. Pupae remain in wheat stubble until adult emergence in fall. 1 generation per year	• Maggots rasp the stem and rupture cells, affecting plant growth around the feeding site. Leaf blades on damaged tillers are wide, erect, and darker green or bluish in color compared to healthy plants • Tillers infested <u>in fall</u> can be stunted or dead by spring, thinning the overall stand. Heads, if present, will be small • Stems infested <u>in spring</u> can be weak and lodge over. Heads may be smaller or poorly filled	• Wheat fields planted near or into stubble of a previous wheat crop, a field with a wheat cover crop or volunteer wheat, or a wildlife plot. All of these are sources of infestation • Continuous no-till Note: Hessian fly is not an issue in oats or rye	Rare in Michigan Uncommon in Ohio
true armyworm (TAW)	Adult moths migrate north in early spring and lay eggs on small grains like wheat. Larvae develop in wheat and may move into neighboring crops, including corn. Larvae pupate in the soil and adults emerge in a week. 2 to 3 generations per year; the 1st generation is most damaging	• Larvae feed from the ground up, often eating the flag leaf last. Large numbers can totally defoliate a field, then move into a neighboring crop • Larvae also clip heads off, especially if most foliage is gone. This results in heads on the soil surface	• Specific weather patterns carry moths northward in the spring	Sporadic Outbreaks occur in years when a heavy spring flight comes from the south
wheat curl mite	The tiny, white immatures and adults overwinter on wheat and alternate hosts, surviving brief exposures down	• Mites pierce and suck leaves, especially of new growth. Feeding causes the leaf edge	• Volunteer wheat provides a green bridge for mites to	Unknown

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
Note: curl mites are essentially microscopic, thus difficult to see with a hand lens in the field	to 0°F. In spring, eggs are laid on the host. A generation is completed in as little as 8-10 days under favorable (77°F) conditions. Mites cannot survive long off the plant, so when the wheat crop begins to dry, they move to the head and flag leaf to get picked up and moved for miles on wind currents. Field edges may be colonized first. Alternate hosts include corn, foxtail, and barnyard grass (plus volunteer wheat), until winter wheat is planted in the fall. In corn, mite feeding causes distinctive 'kernel red streak'. Multiple, overlapping generations	to curl inward. Mites live in the curl. Emerging leaves may get 'stuck' in the previous leaf's roll. As leaves mature, mites move to younger leaves • The most important impact is as a vector of a complex of viral diseases - wheat streak mosaic (WSMV), Triticum mosaic, and High Plains wheat mosaic	survive between July and fall planting • Planting before the fly-free date enables mites to colonize the new crop from alternate hosts • Hot, dry weather • Hail prior to harvest increases volunteer wheat	However, wheat streak mosaic was frequently found in recent surveys of Michigan wheat fields
white grubs *especially European chafer*	Adults (scarab beetles) emerge May-July, depending on species. Eggs are laid in the soil in the summer. The C-shaped larvae, or grubs, feed on organic matter and roots, then move down in the soil profile in late fall to overwinter (note that Euro chafer grubs feed late into the fall). In spring, annual grub species like chafer feed for a period, then pupate. June beetle grubs have a longer life cycle and may continue feeding for several seasons.	• Larvae (grubs) prune roots, causing wilting, deficiencies, or plant death. Euro chafer attacks winter wheat late into the fall and again in spring. June beetles may be present throughout the year • Heavy populations can thin or destroy areas of small grains; entire fields of winter wheat have been destroyed in the fall by European chafer • The adult beetles of most species do not feed	• June beetle and Euro chafer grubs are more common in fields with sandy soil types	Occasional When present, often localized to sandy parts of fields

Table 4: Management notes, scouting recommendations, and thresholds for insect pests of wheat in Michigan and Ohio

Pest (abbreviation)	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
aphids	• Biological: Aphids are attacked by numerous predators (ladybugs, lacewings, syrphids) & parasitoids which usually keep populations in check. These beneficials then move into neighboring crops later in the season. Under humid conditions, entomopathogenic fungi wipe out aphids • Agronomic: Planting after the Hessian fly 'fly safe' date in the fall reduces aphid infestation and BYDV transmission in winter wheat • Environmental: Adequate moisture (rainfall or irrigation) reduces aphid feeding stress and increases humidity for infection by fungal pathogens	Direct sampling: Count aphids on 100 tillers and calculate the average number per tiller Presence/absence method: Determine the number of tillers with aphids ('presence')	Direct sampling: 12-15 aphids per tiller in seedling to boot stage Presence/absence method: See Table 4A for instructions and the decision criteria
cereal leaf beetle	• Biological: After CLB was found in the US in the 1960s, it was the target of a highly successful biological control program. The parasitoids released by the USDA reduced CLB across the Midwest and they continue to provide free control, unless they are disrupted by unnecessary spraying • Insecticides: Do not add an insecticide to a fungicide spray simply as insurance, since this disrupts biocontrol. This practice may be why CLB is reemerging as a pest. Since infestations often start on field edges, limit treatment to that area to preserve local parasitoid numbers	Scout 20 plants in at least 5 sites in the field. Count the number of adult beetles, yellow eggs, and larvae	• Before boot: 3 or more eggs and/or larvae per stem • At heading: 1 or more larvae per stem
fall armyworm (FAW)	• Biological: Predators and parasitoids kill larvae • Agronomic: Planting after the Hessian fly 'fly safe' date in the fall should avoid FAW infestation • Insecticides: Applications are most effective on small larvae (less than ¾ inch)	No specific recommendation Note: To detect FAW flight into the region, use bucket pheromone traps	• Rough Guideline: 2 or more larvae per foot of row
grasshoppers	• Biological: Blister beetle larvae prey on eggs and many insects, rodents, and birds eat nymphs and adults. Fungal pathogens kill eggs and nymphs under moist, cool conditions • Agronomic: Tillage reduces survival of eggs and newly hatched nymphs • Insecticide: May be able to limit sprays to the field edge if hoppers invade from a neighboring field or grassy border	No specific recommendation Estimate number of hoppers per yd^2	Rough Guideline: • On the edge: > 15 nymphs or > 8 adults per yd^2 • Within a field: > 3 hoppers per yd^2
grass sawfly	• Insecticides: Although they resemble caterpillars, sawflies larvae are not Lepidoptera (butterflies and moths). Instead, they are in the Order Hymenoptera, closely related to bees, wasps, and ants. Thus, insecticides effective for caterpillar control may not work as well on sawflies	No specific recommendation	Untested guideline: Use a threshold of >2 larvae/ ft^2 at heading for the combo of armyworm and sawfly larvae Note: If larvae are >1 inch long & have a dark bar on their head, it is probably too late to treat
Hessian fly	• Variety: Resistant varieties are readily available which disrupt maggot feeding • Agronomic: Plant after the 'fly-safe' date for your area. Most egg-laying flies will have died out by this time. See Table 4B for dates by Michigan and Ohio county • Agronomic: Do not plant winter wheat near (within 400 yds) fields with wheat stubble. Tillage of wheat residue kills or buries puparia. Controlling volunteer wheat in harvested fields reduces egg laying sites • Agronomic: If using a grass cover crop in your system, choose rye or oats, which are not a host for Hessian fly	In fall: Check stems for symptoms ~ 3 weeks after emergence In spring: Check for broken stems	No thresholds are established Manage Hessian fly using a combination of planting date and resistant varieties

Pest (abbreviation)	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
true armyworm (TAW)	• Biological: Predators, a tachinid parasitoid, and fungal pathogens kill armyworm larvae • Insecticides: Protect the flag leaf from feeding, but if it is gone, treatments may be justified if the stem is still green and contributing to filling the head. Spraying with a ground rig is often more effective than aerial application, but better coverage is balanced by yield loss from wheel tracks • Insecticides: If caterpillars are present in a limited part of a field, or if they are marching from one field to another, a limited spot or border treatment can be made • Soybeans are a non-host and do not need to be sprayed	Scout at least 5 sites in the field for leaf feeding and small larvae. Larvae hide during the day, so shake plants and check the ground to record their number and size Note: Pheromone traps aid in timing of scouting	Before heading: 4 or more larvae / ft^2 At heading 2 or more larvae/ ft^2 • If heads are being clipped, lean towards spraying • If larvae are > 1 inch they are nearing pupation and spraying is less effective
wheat curl mite	• Agronomic: Control volunteer wheat 2-3 weeks prior to planting and plant after the fly-safe date to reduce the green bridge for mites and wheat streak mosaic virus (WCMV) • Varieties: Some varieties are resistant to WSMV infection • Insecticides: Not effective in controlling wheat curl mite	No specific recommendation	No threshold
white grubs	• Biological: Natural enemies and pathogens kill grubs Note: it is important to identify grubs to species to distinguish annual species like European chafer from multi-year species of June beetle	No specific recommendation In poor stands, use a shovel to check for grubs and root pruning. Grubs tend to be patchy, especially in sandy fields	No threshold A density of 4 chafer grubs per ft^2 can reduce stand and biomass. In such fields, consider tillage before planting in fall or shift wheat elsewhere

Small Grains Table 4A: Presence/ absence decision table for aphids in wheat

Presence/absence sampling involves classifying tillers simply as infested (aphids present) or not. The aphid species and the number per tiller do not matter. When infestations are either low or high, this method quickly determines if a spray is warranted.

Instructions

- Pick 25 tillers and count the number infested with aphids.
- Use the first line of the table to determine the next step. If the infestation is low (18/25 tillers infested), stop sampling and check the field in a week. If the infestation is high (25/25 tillers infested), stop sampling and spray. Otherwise, keep going and sample 5 more tillers.
- Keep sampling groups of 5 tillers and using the new total until a decision is reached.

Total number of tillers examined	**Cumulative number of infested tillers**		
	Decision made *Stop sampling & do not spray*	***No decision yet*** *Keep sampling. Pick 5 more tillers*	***Decision made*** *Stop sampling & spray*
25	< 18	19 - 24	25
30	< 22	23 - 29	30
35	< 27	28 - 34	35
40	< 31	32 - 39	40
45	< 35	36 - 43	44 - 45
50	< 40	41 - 48	49 - 50
55	< 44	45 - 53	54 - 55
60	< 48	49 - 58	59 - 60
65	< 53	54 - 62	63 - 65
70	< 57	58 - 67	68 - 70
75	< 61	62 - 72	73 - 75
80	< 66	67 - 77	78 - 80
85	< 70	71 - 81	82 - 85
90	< 75	76 - 86	87 - 90
95	< 79	80 - 91	92 - 95
100	< 84	84 - 100 tillers = spray	

Small Grains Table 4B: Hessian fly 'fly-safe' dates for Michigan and Ohio

Based on your location (county), winter wheat should be planted after this date to avoid egg-laying by Hessian fly and to reduce infestation by grain aphids which transmit barley yellow dwarf virus

MICHIGAN			
County	**Date**	**County**	**Date**
Alcona	Sept 6	Monroe	Sept 21
Allegan	Sept 20	Montcalm	Sept 15
Alpena	Sept 9	Montmorency	Sept 7
Antrim	Sept 4	Muskegon	Sept 18
Arenac	Sept 13	Newaygo	Sept 15
Barry	Sept 18	Oakland	Sept 16
Bay	Sept 14	Oceana	Sept 16
Benzie	Sept 16	Ogemaw	Sept 10
Berrien	Sept 23	Osceola	Sept 10
Branch	Sept 19	Oscoda	Sept 7
Calhoun	Sept 19	Otsego	Sept 6
Cass	Sept 22	Ottawa	Sept 19
Charlevoix	Sept 3	Presque Isle	Sept 8
Cheboygan	Sept 4	Roscommon	Sept 7
Claire	Sept 12	Saginaw	Sept 16
Clinton	Sept 17	Sanilac	Sept 15
Crawford	Sept 6	St. Clair	Sept 16
Eaton	Sept 16	St. Joseph	Sept 23
Emmet	Sept 4	Shiawassee	Sept 16
Genesee	Sept 17	Tuscola	Sept 15
Gladwin	Sept 12	Van Buren	Sept 22
Grand Traverse	Sept 8	Washtenaw	Sept 18
Gratiot	Sept 15	Wayne	Sept 18
Hillsdale	Sept 19	Wexford	Sept 9
Huron	Sept 13		
Ingham	Sept 17		
Ionia	Sept 16		
Iosco	Sept 7		
Isabella	Sept 11		
Jackson	Sept 16		
Kalamazoo	Sept 20		
Kalkaska	Sept 5		
Kent	Sept 18		
Lake	Sept 13		
Lapeer	Sept 15		
Leelanau	Sept 8		
Lenawee	Sept 25		
Livingston	Sept 16		
Macomb	Sept 18		
Manistee	Sept 13		
Mason	Sept 13		
Mecosta	Sept 12		
Midland	Sept 15		
Missaukee	Sept 9		

OHIO			
County	**Date**	**County**	**Date**
Adams	Oct 4	Licking	Sept 29
Allen	Sept 26	Logan	Sept 28
Ashland	Sept 26	Lorain	Sept 23
Ashtabula	Sept 22	Lucas	Sept 22
Athens	Oct 2	Madison	Sept 30
Auglaize	Sept 27	Mahoning	Sept 25
Belmont	Sept 29	Marion	Sept 27
Brown	Oct 3	Medina	Sept 24
Butler	Oct 1	Meigs	Oct 3
Carroll	Sept 27	Mercer	Sept 27
Champaign	Sept 29	Miami	Sept 29
Clark	Sept 29	Monroe	Sept 30
Clermont	Oct 3	Montgomery	Sept 30
Clinton	Oct 2	Morgan	Oct 1
Columbiana	Sept 26	Morrow	Sept 27
Coshocton	Sept 28	Muskingum	Sept 29
Crawford	Sept 26	Noble	Sept 30
Cuyahoga	Sept 23	Ottawa	Sept 22
Darke	Sept 29	Paulding	Sept 24
Defiance	Sept 23	Perry	Sept 30
Delaware	Sept 28	Pickaway	Oct 1
Erie	Sept 23	Pike	Oct 3
Fairfield	Sept 30	Portage	Sept 24
Fayette	Oct 1	Preble	Sept 30
Franklin	Sept 30	Putnam	Sept 25
Fulton	Sept 22	Richland	Sept 26
Gallia	Oct 4	Ross	Oct 2
Geauga	Sept 23	Sandusky	Sept 23
Greene	Sept 30	Scioto	Oct 4
Guernsey	Sept 29	Seneca	Sept 24
Hamilton	Oct 3	Shelby	Sept 28
Hancock	Sept 25	Stark	Sept 26
Hardin	Sept 26	Summit	Sept 24
Harrison	Sept 28	Trumbull	Sept 23
Henry	Sept 23	Tuscarawas	Sept 28
Highland	Oct 3	Union	Sept 28
Hocking	Oct 1	Van Wert	Sept 26
Holmes	Sept 27	Vinton	Oct 3
Huron	Sept 24	Warren	Oct 2
Jackson	Oct 3	Washington	Oct 2
Jefferson	Sept 28	Wayne	Sept 26
Knox	Sept 28	Williams	Sept 22
Lake	Sept 22	Wood	Sept 23
Lawrence	Oct 5	Wyandot	Sept 26

Table 5: Foliar Insecticides to manage insect pests of wheat (and where indicated, other small grains) in Michigan and Ohio

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry
- Application rates are listed for pests which appear on the label. If a column is blank, the pest is not on the label. The letters in the pest columns refer to the label use rate from column two

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**aphids**	**cereal leaf beetle**	**fall armyworm**	**grasshoppers**	**grass sawfly**	**Hessian fly**	**true armyworm**	**Pre harvest interval (PHI)** in days	**Precautions and Remarks**
Bt (*Bacillus thuringiensis*) Xentari, Dipel DF Dipel ES Javelin WG	(a) 0.5 - 2.0 lbs (a) 2.0 - 4.0 pts (a) 1.0 - 1.5 lbs			a				a	0	• Labeled for wheat & barley, millet, oats, rye, triticale • Selective biological insecticide to control caterpillars. Larvae must eat treated foliage to be controlled so good coverage is important. Must be targeted on small (1st & 2nd stage) larvae, less than ¼ inch
chlorantraniliprole Coragen Prevathon Shenzi 400SC Vantacor	(a) 3.5 – 7.5 oz (b) 2.0 - 5.0 oz (a) 14.0 - 20.0 oz (b) 8.0 - 20.0 oz (a) 1.7 – 3.8 oz (b) 1.0 – 2.5 oz (a) 1.2 - 2.5 oz (b) 0.7 - 1.7 oz			a	b			a	1 grain 1 straw	• Labeled for wheat & barley, millet, oats, rye, sorghum, triticale • Novel mode of action. Insects are paralyzed & stop feeding. Must be applied before populations reach damaging levels
chlorantraniliprole + cyhalothrin (lambda) Besiege	(a) 6 oz - 10 oz (b) 8 oz - 10 oz	a	a	a	a	b	a	a	30 grain 30 straw 7 hay 7 grazing	• Labeled for wheat & barley, oats, rye, triticale • Check label for rates by aphid species
cyfluthrin Baythroid XL Tombstone Tombstone Helios	(a) 1.0 - 1.8 oz (b) 1.8 - 2.4 oz	b	a	b	b	b		b	30 grain 30 straw 3 grazing	• Baythroid - labeled for wheat & barley, oats, rye, triticale; Tombstone labeled only on wheat • Fall armyworm = control of 1st & 2nd instars only, less than ¼ inch • Helios formulation has UV protection for extended residual
cyhalothrin (gamma) Declare Proaxis	(a) 1.02 - 1.54 oz (b) 1.28 - 1.54 oz (a) 2.56 - 3.84 oz (b) 3.20 - 3.84 oz	a	a	a	a	b	a	a	30 grain 30 straw 7 grazing	• Declare is labeled for wheat & barley, oats, rye, triticale while Proaxis is labeled only for wheat and triticale

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**aphids**	**cereal leaf beetle**	**fall armyworm**	**grasshoppers**	**grass sawfly**	**Hessian fly**	**true armyworm**	**Pre harvest interval (PHI)** in days	**Precautions and Remarks**
cyhalothrin (lambda) Grizzly Too Kendo 22.8CS Lamcap II Province II Ravage II Warrior II w/Zeon Tech. Kendo Silencer Lambda Cyhalothrin 1EC Lambda-Cy Lambda-Cy Ag LambdaStar Lambda-T Paradigm VC Ravage Willowood Lambda-Cy1EC	(a) 1.28 - 1.92 (b) 1.60 - 1.92 (a) 2.56 - 3.84 oz (b) 3.20 - 3.84 oz	a	a	a	a	b	a	a	30 grain 30 straw 7 grazing 7 feed	• Labeled for wheat & barley, oats, rye, and triticale • Aphid control is variable with species • Fall armyworm: some labels indicate control of 1st & 2nd instars only
cypermethrin (alpha) Fastac EC or CS	(a) 1.8 - 3.8 oz (b) 3.2 - 3.8 oz	b	a	b	b	b		a	14	• Labeled for wheat & triticale • Aphid control may be 'variable' depending on which species are present
cypermethrin (zeta) Mustang Mustang Maxx	(a) 1.9 - 4.3 oz (b) 3.4 - 4.3 oz (a) 1.76 - 4.0 oz (b) 3.2 - 4.0 oz	b	a	b	b	b		a	14	• Labeled for wheat & barley, oats, rye, triticale • Aphid control may be 'variable' depending on which species are present
dimethoate Dimate 4E Dimethoate 400 & 4EC	(a) 0.5 - 0.75 pints (b) 0.75 pints	a			b				35 grain	• Labeled for wheat only
flupyradifurone Sivanto HL Sivanto 200 SL Sivanto Prime	(a) 3.5 - 7.0 oz (a) 7.0 - 10.5 oz (a) 7.0 - 14.0 oz	a							21 grain 21 straw	• Labeled for wheat & barley, millet, oats, rye, triticale • Systemic insecticide, particularly effective on sucking pests
GS-omega/kappa-Hxtx-Hv1a Spear-Lep	(a) 1 – 2 pts								0	• Novel mode of action. MUST be applied in conjunction with a low dose of Bt insecticide (see label for details). The Bt damages the caterpillar gut, allowing Spear-Lep to enter the body • Fun fact, this product is derived from the venom of an Australian spider

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**aphids**	**cereal leaf beetle**	**fall armyworm**	**grasshoppers**	**grass sawfly**	**Hessian fly**	**true armyworm**	**Pre harvest interval (PHI)** in days	**Precautions and Remarks**
pyrethrins Evergreen EC 60-6 Pyganic EC 1.4 II Pyganic 5.0	(a) 2.0 - 12.6 oz (a) 16.0 – 64.0 oz (a) 4.5 - 15.6 oz	a	a	a	a			a	0 when sprays dry	• Labeled for all cereal grains • Plant-derived insecticides that knock down insects quickly but have very short residual control. Coverage is critical • Pyganic is OMRI listed for use on organic crops but Evergreen is not
spinosad Blackhawk Tracer	(a) 1.1 - 1.3 oz (b) 1.7 - 3.3 oz (a) 1.5 - 3.0 oz		a	b				a	21 grain 21 straw 3 hay	• Labeled for wheat & barley, millet, oats, rye, triticale • For armyworm, time applications to coincide w/ egg hatch & small larvae • Application may suppress grasshoppers
sulfoxaflor Transform WG	(a) 0.75 - 1.5 oz	a							14 grain 14 straw 7 hay	• Labeled for wheat & barley, oats, rye, triticale

Management of Insect Pests of Dry Beans in Michigan
Updated November 2025

Prepared by:
Chris DiFonzo, Field Crops Entomologist
Department of Entomology
288 Farm Lane
East Lansing, MI
difonzo@msu.edu

Scott Bales, Dry Bean Systems Specialist
Saginaw Valley Research & Extension Center
9923 Kruger Rd
Frankenmuth, MI
balessco@msu.edu

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** 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 on the crop 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 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.

Table 1. Timing of damage from insect pests of dry beans in Michigan

Pests are listed from early to late-season. Key species are highlighted in bold text.

Common name	Overwintering stage, location	May	June	July	August	September
seedcorn maggot	pupae, in soil	larvae (maggots) feed on seeds and scar cotyledons				
slugs & snails	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 (multiple 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		
potato leafhopper	Southern USA, migrate north			nymphs and adults suck plant sap		
spider mite	adult females, at the base of hosts			nymphs and adults pierce plant cells, suck plant sap		
Lygus or 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		
western bean cutworm	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	

Table 2: Damage checklist to aid in scouting for insect pests of dry beans in Michigan

Plant part or timing Type of damage or injury	aphids	European corn borer	grasshoppers	green cloverworm	Mexican bean beetle	plant bug	potato leafhopper	seedcorn maggot	slugs & snails	spider mite	stink bugs	thrips	western bean cutworm	white grubs
Stand (emergence)														
seeds fed-on								x	x					x
gaps in row								x	x					x
wilted or cut plants														x
Leaves														
slimy or shiny trails									x					
scraping of leaf surface					x				x					
skeletonizing between veins					x									
irregular leaf feeding			x	x										
severe defoliation			x	x	x									
generalized leaf yellowing	x					x				x				
yellow leaf margins (hopperburn)							x							
tiny yellow spots (stippling)										x		x		
leaves cupped, crinkled	x					x	x			x		x		
sticky leaves or sooty mold	x													
fine webbing										x				
leaf drop, death							x			x		x		
Stems														
boring into stem		x												
powdery frass		x												
Roots														
root hairs missing														x
pruning of whole roots														x
Pods and beans														
large holes chewed into pod		x	x										x	
small holes chewed into pod		x		x									x	
beans fed on in pod		x	x										x	
shriveled, aborted beans						x					x			
Other														
virus transmission	x													

Table 3: Life cycle, damage, and pest status of insect pests of dry beans in Michigan

Terms to describe the pest status of each insect. Ratings apply to Michigan and Ohio.

- **Rare**: Unusual, typically goes unnoticed. May not even be present
- **Uncommon**: Usually present but well-below damaging levels. An outbreak once a generation.
- **Occasional**: Present in most fields, sometimes in high numbers. An outbreak once a decade.
- **Important**: Present in most fields, potentially increasing to damaging levels every season. A common target of scouting, management programs, or insecticide use.
- **Sporadic:** Damaging levels occur after favorable weather patterns (such as drought) or mass movement from south to north during the season
- **Localized**: Damaging levels occur in specific locations under specific agronomic conditions, for example in no-till production or in older stands.

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in Michigan
aphids	Summer population is all female. Females give birth to live young and do not mate to reproduce (parthenogenesis). Multiple overlapping generations	• All stages suck plant sap from leaves • Heavy infestation may lead to stunting, curling of leaves, weakening of plants • Aphids also transmit plant viruses	• Drought stress may be made worse by aphids removing plant sap	Uncommon Usually present, but numbers not enough to cause damage
bean leaf beetle	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. 1-2 generations per year	• Adults defoliate younger plants, leaving small round holes between major leaf veins • Adults feed on and scar developing pods, reducing yield and seed quality	• Adults may move into dry beans, if adjacent soybean fields were infested in the previous or current season	Uncommon Usually present, but numbers rarely high enough to cause damage
European corn borer (ECB)	Mature larvae overwinter in corn residue and pupate in late spring. Moths emerge in late May-early June and lay eggs in corn and other crops. 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.	• Older larvae bore into stem, disrupt water flow, weaken stem • Larvae also bore into pods, consume seeds, and contaminate harvested beans	• Nearby non-Bt corn production probably increases local ECB risk	Uncommon Populations suppressed by widespread use of Bt GMO corn
grasshoppers *multiple species*	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. 1 generation per year	• All stages chew on leaves; feeding has a ragged appearance	• Fallow areas and pasture are preferred egg-laying sites • A hot dry summer & fall can lead to a high population the next year	Uncommon Outbreaks rare, usually after a dry season
green cloverworm	Adults lay eggs singly on the undersides of leaves. Larvae feed on foliage.	• Small caterpillars scrape leaf tissue while older larvae defoliate plants.		Uncommon Usually present, but numbers rarely high enough to cause damage

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or 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.	• Larvae and adults strip the leaf surface between the veins on the underside of leaves, resulting in windowpane damage or a skeletonized (lacy) appearance. Time frame: mid-July into August. • Pod feeding is rare	• A mild winter increases survival • Planting adjacent to fields with high populations the previous year • Early-planting (adults attracted to these fields)	Uncommon and Localized
potato leafhopper (PLH)	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	• Adults and nymphs lacerate and suck on leaves and stems, damaging cells and blocking vascular tissue; the classic symptom of feeding is tip yellowing or 'hopper burn' • Other symptoms include stunting and curling of leaves and poor pod fill	• PLH damage is worse under dry conditions, and leafhopper survival is probably better too	Sporadic *later in season*: Important, if populations become well-established
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	• Tiny larvae (maggots) feed on germinating seed. May cause variable emergence, stand loss, and delayed development.	• Cool wet conditions which delay germination • Tillage of fields with high organic matter from a decaying green cover crop, or weeds, or fresh manure	Sporadic and Localized Depends on presence of fresh organic matter and cool, wet conditions
slugs & snails	Slugs overwinter as both eggs & adults; females deposit eggs in soil; these hatch in about one month. Multiple overlapping generations	• Feeding on cotyledons & lower leaves; feeding usually occurs at night • Substantial defoliation can be tolerated in pre-bloom dry beans, but if the growing point is killed, stands can be significantly reduced	• Planting into heavy crop residue • Cool, wet soils which delay germination • Poorly closed furrows give access to seed	Localized Depends on residue and cool conditions. Dry beans are usually planted after slug risk is past.
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	• Adults & nymphs pierce individual plant cells, resulting in tiny yellow spots called stippling • Webbing is a sign of heavy infestation • Severe damage results in leaf yellowing, death, water loss	• Prolonged hot, dry weather favors an outbreak and enhances the impact of feeding • Infestations often start on dusty edges of fields	Sporadic Outbreaks occur in hot, dry seasons
stink bug *several species including green, one-spotted, & the brown marmorated*	Adults overwinter in protected areas. Weeds and early crops like wheat are fed on and colonized first. Stink bug eggs, laid in small clusters, often sport a small 'crown'. Nymphs and adults live and feed in the crop together. Note - some stink bug species are beneficial predators of other insects like caterpillars	• 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	• May move into dry beans as adjacent wheat fields 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.	• 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	• 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 and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in Michigan
thrips	Adults and nymphs overwinter in residue. Populations initially build up on grasses and in wheat. Note that thrips are an important food source for some of the beneficial insects, such as pirate bugs, that control other pests.	• 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	• Dry conditions in early summer • May move into dry beans from adjacent wheat fields or grassy borders that are drying down	Uncommon Usually present, but numbers rarely high enough to cause damage
western bean cutworm (WBC)	Overwinter in pre-pupal stage. Adults emerge in mid-late 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 over-winter. Areas with sandy soil appear to have deeper and better overwintering. 1 generation per year	• 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	• Areas with sandy soil, where over-wintering survival is higher • Adjacent corn which is no longer attractive for egg laying (past the pretassel stage)	Occasional - Important Montcalm and surrounding counties + the UP are historic hot spots for WBC
white grubs *multiple species*	Mature grubs overwinter under-ground. 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. 1 generation per year except June beetle, which has a 2-3 year life cycle	• Larvae (grubs) prune root hairs and sometimes whole roots, causing wilting, water and nutrient deficiency, or plant death	• Planting into fallow fields or pasture • Fields near home lawns or pasture • Fields or parts of fields with sandy soil type	Uncommon

Table 4: Management notes, scouting recommendations, and thresholds for insect pests of dry bean in Michigan

Pest (abbreviation)	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
aphids	• 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	• Environment: Extended periods of cold winter temperatures may increase kill of overwintering beetles.	Check 100 plants (20 plants x 5 sets)	General guideline: More than 10% of the pods damaged Rarely justified
European corn borer (ECB)	• 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	• Biological: Blister beetle larvae and other insects prey on eggs. 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	• Biological: Many natural enemies keep cloverworm 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)	• Biological: Predators 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 to 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)	• 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	Unifoliate stage: > 0.5 leafhopper per plant Otherwise: > 1 leafhopper per trifoliate leaf
seedcorn maggot (SCM)	• Agronomic: Potential for injury increases in wet, cool springs when seed germinates slower, or when seed is planted into tilled fields where fresh green material (cover crops or weeds) have been worked in. Risk drops after organic matter breaks down. Risk is very low in no-till fields. • Insecticide: Management is preventative, using a seed treatment in tilled fields where weeds and cover crop were recently killed or manure applied.	No specific recommendation	No rescue treatment is available. Consider replanting fields or areas with significant stand loss

Pest (abbreviation)	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
slugs & snails	• 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	No specific recommendation Walk fields at night or early morning, turning over residue and looking for slime trials	None established A guess: Consider applying a molluscicide (slug bait) if stand is reduced by 5%
spider mite	• 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 (including most pyrethroids) flare mite populations by killing off natural enemies. Likewise, fungicide applications may disrupt fungal pathogens of mites. Insurance applications of both are discouraged; be cautious about pesticide applications in dry years	Infestations often start on field edges Look for mites on the undersides of leaves using hand lens, or tap leaves over a black piece of paper Webbing is present when populations are high	A guess: Treat when mites appear on >25% of the plants and yellowing is first seen Mites are difficult to control. Spraying is often a losing proposition
stink bugs	• Biological: Several parasitoids attack egg masses or bugs	No specific recommendation	None established
tarnished plant bug	• 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	• Biological: Generally kept in check by predators. • Environmental: Rainfall or irrigation reduces populations. • Insecticides: Onion thrips are killed better by pyrethroids than OPs/ carbamates 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	Infestations often start on field edges Look for thrips on the undersides of leaves using hand lens. Or tap leaves over a white piece of paper or a paper plate	Threshold used in the High Plains: >15 thrips per plant and leaf cupping is present (this threshold has not been tested in MI or OH)
western bean cutworm	• Biological: Many predators consume eggs and larvae; tiny Trichogramma wasps have been seen in the field in Michigan parasitizing egg masses	Sampling beans directly for WBC eggs of larvae is difficult 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	Action threshold developed In the Great Lakes Region: Treat when >10% of pods are fed on by WBC larvae
white grubs	• 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. Note: It is important to identify grubs to species distinguish annual species from multi-year species of June beetles	No specific recommendation Grubs tend to be patchy, and in sandy parts of fields Grubs are sometimes detected when plowing in the fall or spring	None established

Table 5: Soil/at-plant insecticides to manage insect pests of dry beans in Michigan

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry.
- Application rates are listed for pests which appear on the label. If a column is blank, the pest is not on the label. The letters in the pest columns refer to the use rate from column two.
- 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	**seedcorn maggot**	**slugs & snails**	**white grubs**	**Precautions and Remarks**
bifenthrin Xpedient Plus V Bifender FC Capture 3RIVE3D Bifenture LFC Capture LFR Nirvana RTU Sniper LFR	(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		a	• Apply as a band over row on soil surface, T-banded over an open furrow, or in-furrow; see label for PRE and PPI instructions • Many are formulated to mix directly w/ fertilizer or PRE herbicide applications Note: Many of these can be broadcast on the soil surface to control **cutworm** and **armyworm**.
bifenthrin + biofungicide Ethos XB Ethos Elite LFR	(a) 0.2 - 0.49 oz per 1000 ft (= 3.4 - 8.5 oz per acre)	a		a	• Similar to bifenthrin alone, but contains a biological fungicide for suppression of early season root diseases: XB: *Bacillus amyloliquefaciens* Elite: *Bacillus velezensis & subtilis strains* • Apply T-band or in-furrow; see label for PRE and PPI instructions and for other row spacings
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	• Apply T band or in-furrow in a minimum of 2-7 gal per acre
iron phosphate Ferroxx AQ Sluggo	(a) 4.0 – 15.0 lbs per acre (a) 20 - 44 lbs per acre		a		• Broadcast using a spreader • Apply bait in evening when slugs feed; product works best when the soil is moist
sodium ferric EDTA Ferroxx Slug & Snail Bait	(a) 5 – 20 lbs/acre		a		• Broadcast uniformly using a spreader • Apply higher rate if infestation is severe • Non-toxic to pets and wildlife

Table 6: Foliar Insecticides to manage insect pests of dry beans in Michigan

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry
- Application rates are listed for pests which appear on the label. If a column is blank, the pest is not on the label. The letters in the pest columns refer to the label use rate from column two

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**aphids**	**bean leaf beetle**	**Euro corn borer**	**grasshopper**	**green cloverworm**	**Mex bean beetle**	**plant bugs**	**potato leafhopper**	**spider mite**	**stink bugs**	**thrips**	**western bean cutworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remark**
abamectin															
Abba Ultra	(a) 4 - 8 oz									a				7	• Ground application recommended (instead of air), at minimum 10 gal per acre. • Abba Ultra label indicates 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
Agri-Mek SC	(a) 1.75 - 3.5 oz														
Reaper 0.15EC Reaper Clearform	(a) 8 - 16 oz														
acephate															
Acephate 90WDG Acephate 90WSP	(a) 4 - 8 oz (b) 8 - 17.6 oz (c) 12.8 - 17.6 oz	b	b	c	a	b	b	b	b			b		14	• Minimum 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
Acephate 90 Prill	(a) 4.4 - 8.9 oz (b) 8.9 - 17.6 oz (c) 13.3 - 17.6 oz														
Acephate 97UP Acephate 97 WDG Orthene 97	(a) 4 - 8 oz (b) 8 - 16 oz (c) 12 - 16 oz														
Bacillus thuringiensis (Bt)															
Agree Dipel ES Javelin Xentari DF	(a) 0.5 - 2.0 lbs (a) 1 - 2 pints (a) 0.25 - 1.5 lbs (a) 0.5 - 1.5 lb					a								0	• 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
bifenazate															
Acramite 4SC	(a) 16-24 oz									a				7	• 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)	**aphids**	**bean leaf beetle**	**Euro corn borer**	**grasshopper**	**green cloverworm**	**Mex bean beetle**	**plant bugs**	**potato leafhopper**	**spider mite**	**stink bugs**	**thrips**	**western bean cutworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remark**
bifenthrin Bifen2AgGold Bifenthrin 2EC Bifenture EC Brigade 2EC Fanfare EC, 2EC, & ES Reveal & Reveal Endurx 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	b	a	c	b	b	b	14	• Extremely toxic to bees. See labels for details
Nirvana RTU	(a) 2.1 – 8.5 oz (b) 2.8 – 8.5 oz (c) 2.8 – 8.5 oz														
bifenthrin + biofungicide Ethos XB	(a) 2.8 - 8.5 oz	a	a	a	a	a	a	a	a	a	a	a	a	14	• Combination product with the biological fungicide strain *Bacillus amyloliquefaciens* - otherwise similar in activity and precautions to bifenthrin alone.
bifenthrin + pyraclostrobin Nirvana Complete	(a) 13 oz	a	a	a	a	a	a	a	a	a	a	a	a	14	• Combination product with fungicide - similar precautions to bifenthrin alone. Bifenthrin rate is similar to high rate in bifenthrin-only products
bifenthrin + chlorantraniliprole Elevest	(a) 4.8 – 9.6 oz (b) 5.6 – 9.6 oz (c) 7.7 – 9.6 oz	b	b	b	a	a	b	c	a	c	b	b	b	14	• For spider mites, coverage is essential • For grasshoppers, performance improved by adding methylated seed oil • Highly toxic to fish and aquatic life & to bees
bifenthrin +cypermethrin 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	b	a c	b	a c	b c	a c	21	• Highly toxic to bees
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	a	b	a	a	a	14	• Do not make applications less than 7 days apart • Extremely toxic to bees. See label for details
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	• Extremely toxic to bees. See label for details

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**aphids**	**bean leaf beetle**	**Euro corn borer**	**grasshopper**	**green cloverworm**	**Mex bean beetle**	**plant bugs**	**potato leafhopper**	**spider mite**	**stink bugs**	**thrips**	**western bean cutworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remark**
bifenthrin + sulfoxaflor Ridgeback	(a) 5.5 – 13.8 oz (b) 11.0 – 13.8 oz	a	a	a	a	a	a	a	a	b	a	a	a	14	• Do not make applications less than 14 days apart • Max 2 consecutive applications per crop
carbaryl Carbaryl 4L 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	c	b		c	b	b	21 beans 14 forage	• 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
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	• Thorough coverage is important; insects must eat treated foliage for optimum control • See label for specific directions for grasshopper control
chlorantraniliprole + cyhalothrin Besiege	(a) 5 - 8 oz (b) 6 - 10 oz	b	b	b	b	a	a	b	b		b	b	b	21	• Do not graze or harvest vines for forage • 'suppression' of spider mites
cyantraniliprole Exirel	(a) 10.0- 20.5 oz			a										7	• 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	• 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	b	a		b		*	7	• Do not feed treated vines or hay to livestock * Western bean cutworm is not on the current labels, but cyfluthrin is labeled for WBC in corn
cyfluthrin + imidacloprid Leverage 360	(a) 2.4 - 2.8 oz	a	a	a	a	a	a	a	a					7	• 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	• Do not graze or harvest vines for forage

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**aphids**	**bean leaf beetle**	**Euro corn borer**	**grasshopper**	**green cloverworm**	**Mex bean beetle**	**plant bugs**	**potato leafhopper**	**spider mite**	**stink bugs**	**thrips**	**western bean cutworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remark**
cyhalothrin (lambda) Grizzly Too Lamcap II Province II Ravage II Warrior II w/Zeon Tech. Lambda Cyhalothrin 1EC Lambda-Cy Lambda-Cy Ag LambdaStar Lambda-T Kendo Paradigm VC Ravage 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	• 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	a		b	b	*	21	• CS formulation is microencapsulated * western bean cutworm is not on the current labels, but cypermethrin is labeled for WBC in corn
cypermethrin (zeta) Mustang Maxx	(a) 2.72- 4.0 oz (b) 3.2 - 4.0 oz	b	a	a	b	a	a	a	a		b	b	*	21	• Extremely toxic to bees. Do not apply to blooming crops if bees are visiting the field * western bean cutworm is not on the current labels, but cypermethrin is labeled for WBC in corn
dimethoate Dimate 4E Dimethoate 400 and 4EC	(a) 0.5 - 1.0 pt	a	a		a		a	a	a	a				0	• Max 2 pints/ acre per year; 14-day retreatment interval • Do not feed treated vines to livestock • 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	• 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	• Foliar applications have systemic properties. Product moves from deposition point to leaf tips and controls insects on underside of leaves
GS-omega/kappa-Hxtx-Hv1a Spear-Lep	(a) 1 – 2 pts			a		a							?		• Novel mode of action. MUST be applied with a low dose of Bt insecticide (see label for details). Bt damages the caterpillar gut, allowing Spear-Lep to enter the body • WBC is not on the label, but Spear-Lep probably has a similar activity on them

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**aphids**	**bean leaf beetle**	**Euro corn borer**	**grasshopper**	**green cloverworm**	**Mex bean beetle**	**plant bugs**	**potato leafhopper**	**spider mite**	**stink bugs**	**thrips**	**western bean cutworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remark**
imidacloprid Admire Pro	(a) 1.2 oz	a							a					7	• Highly toxic to bees. See label for details
Advise Four Alias 4F Montana 4F Nuprid 4FMax Provoke Wrangler	(a) 1.4 oz														
Nuprid 2SC	(a) 2.8 oz														
Prey 1.6F and Sherpa	(a) 3.5 oz														
imidacloprid + cyhalothrin Kilter	(a) 1.9 – 2.5 oz (b) 2.5 – 3.8	b	b	b	b	a	a	b	b		b	b	*	21	• Highly toxic to bees. See label for details • Do not graze livestock in treated areas or harvest vines * WBC is not on label, but cyhalothrin alone is effective for WBC control. Use the higher rate
indoxacarb Avaunt eVo Steward	(a) 3.5 – 6.0 (a) 6.7 - 11.3 oz			a										7	• For ground application use minimum 20 gal per acre
methomyl Annihilate LV Corrida 29SL Lannate LV Lanveer LV Nudrin LV	(a) 0.75 - 3 oz (b) 1.5 - 3 oz	b		b			a	b	a		*	b		14	• Kills both eggs and larvae of corn borer. See label for specific on timing • Highly toxic to bees. See label for details * Lannate lists brown marmorated stink bug as a target
Annihilate SP Corrida 90WSP Lannate SP Nudrin SP	(a) 0.25- 1 oz (b) 0.5 - 1 oz														
methoxyfenozide Intrepid 2F Invertid 2F	(a) 8 - 16 oz			a									*	7	• Apply in a minimum of 20 gal per acre (ground) in a full canopy or 10 gal per acre (air) • See label for info on specific application timing • Endangered species warning for use in these MI counties: Allegan, Monroe, Montcalm, Muskegon, Newaygo, Oceana. Access EPA's 'Bulletins Live! Two' * Also labeled for various armyworm species. Western bean cutworm not on the label, but likely is effective

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**aphids**	**bean leaf beetle**	**Euro corn borer**	**grasshopper**	**green cloverworm**	**Mex bean beetle**	**plant bugs**	**potato leafhopper**	**spider mite**	**stink bugs**	**thrips**	**western bean cutworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remark**
naled Dibrom 8E	(a) 1.0 pint (b) 1.5 pint	a				a		a	a	a	b			1	
pyrethrins Evergreen EC 60-6 PyGanic EC 1.4$_{II}$ PyGanic EC 5.0$_{II}$	(a) 2.0 - 12.6 oz (a) 16 - 64 oz (a) 4.5 - 15.6 oz	a	a	a	a	a	a	a	a		a	a	a	0 when sprays dry	• Plant-derived insecticides that knock down insects quickly but with short residual control. Coverage is critical • PyGanic is OMRI listed for organic crops, Evergreen is not • Highly toxic to bees exposed to direct treatment; do not apply on or drift onto blooming crops or weeds
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								b		28	• 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	• 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	• Moves within the leaf to target sucking pests • Label also lists 'suppression' of thrips & some stink bugs

Management of Insect Pests of Sugarbeet in Michigan
Updated November 2025

Prepared by:
Chris DiFonzo
Field Crops Entomologist
Department of Entomology
288 Farm Lane
East Lansing, MI
difonzo@msu.edu

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 **sugarbeets.** 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 beets, 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 on the crop 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 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.

Table 1. Timing of damage from insect pests of sugarbeet in Michigan

- Pests are listed from early to late-season. Key species are highlighted in bold text.

Common name	Overwintering stage, location	April-May	June	July	August into September
springtails	in soil and residue	damage to seedlings			
cutworm (several species)	Winter cutworm: larvae in residue Black cutworm: migrates north	feeding on seedlings			
white grubs	larvae (grubs), underground	root damage to seedlings		larval damage to tap root by June beetle species	
wireworm	larvae in soil	root damage to seedlings		larval damage to tap root	
spinach leafminer	pupae in soil	leaf mining by larvae			
flea beetle	adults, in residue & protected areas	feeding by adults on leaves (shot holing)			
sugarbeet root aphid	on roots of lambsquarters		multiple generations puncture root cells to feed on plant sap		
armyworm	Southern USA, migrate north		caterpillars feed on foliage		
grasshoppers (multiple species)	egg clusters, underground		nymphs, then adults, feed on foliage		
webworms (beet, garden, alfalfa)	larvae or pupae in soil		caterpillars feed on foliage (timing depends on species)		
aphids on leaves (several species)	depends on species			multiple generations pierce leaves to feed on plant sap	
Japanese beetle	grubs in soil			adults feed on leaves	
leafhoppers (several species)	depends on species			nymphs and adults pierce leaves to feed on plant sap	
spider mite	adult females, at the base of hosts			multiple generations pierce plant cells to feed	
lygus bug (tarnished plant bug)	adults, in residue & protected areas			nymphs and adults pierce leaves to feed on plant sap	
thrips	depends on species			adults and nymphs 'punch' and suck plant cells	
woolly bears & zebra caterpillars	depends on species			caterpillars feed on foliage	

Table 2: Damage checklist to aid in scouting for insect pests of sugarbeet in Michigan

Plant part or timing Type of damage or injury	aphids (on leaves)	armyworm	cutworms	flea beetle	grasshoppers	Japanese beetle	leafhoppers	lygus bug	spider mite	spinach leafminer	springtails	sugarbeet root aphid	thrips	webworm	white grub	wireworm	woolly/ zebra caterpillar
Stand (emergence)																	
stand loss / gaps in row											x				x	x	
wilted or cut plants			x												x	x	
Stand (later in season)																	
wilting or dead plants												x					
Leaves																	
scraping of leaf surface											x						
leaf mining										x							
shot- or pin holes				x							x						
irregular leaf feeding		x	x		x									x			
skeletonizing between veins						x								x			x
defoliation		x			x	x								x			x
leaf curling	x						x	x									
sticky honeydew	x																
yellowing of leaf tips, margins								x									
tiny yellow spots (stippling)							x		x				x				
generalized leaf yellowing							x		x								
wilted plants			x									x			x	x	
webbing									x					x			
Roots																	
roots pruned or cut															x	x	
chewing into tap root															x	x	
white, waxy coating												x					

Table 3: Life cycle, damage, and pest status of insect pests of sugarbeet in Michigan

Terms to describe the pest status of each insect. Ratings apply to Michigan

- **Rare**: Unusual, typically goes unnoticed. May not even be present
- **Uncommon**: Usually present but well-below damaging levels. An outbreak once a generation.
- **Occasional**: Present in most fields, sometimes in high numbers. An outbreak once a decade.
- **Important**: Present in most fields, potentially increasing to damaging levels every season. A common target of scouting, management programs, or insecticide use.
- **Sporadic:** Damaging levels occur after favorable weather patterns (such as drought) or mass movement from south to north during the season
- **Localized**: Damaging levels occur in specific locations under specific agronomic conditions, for example in no-till production or in older stands.

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in Michigan & commentary
aphids *on leaves* *On roots, see sugarbeet root aphid*	Summer population is all female. Females do not mate to reproduce and give birth to live young. Multiple overlapping generations	• All stages suck plant sap from leaves • Heavy infestation may lead to stunting, curling of leaves, weakening of plants	• Drought stress may be made worse by aphids removing plant sap	Uncommon Often present, but numbers rarely high enough to cause damage
armyworm	Adult moths migrate into Michigan in early spring. Eggs are laid on low-growing weeds, in grassy field margins, or in pasture or wheat.	• Caterpillars defoliate beets • Feeding often occurs at night • Larvae may march from one field to another (hence the name 'army')	• Weedy fields • Beets adjacent to infested pasture, corn, or wheat (tho beets are not a preferred host)	Uncommon Infestations of wheat and corn occur after a heavy spring flight from the south
cutworm - black	Adult moths migrate into Michigan in early spring. Eggs are laid on low-growing weeds or crop residue. Larvae often hide during the day & feed at night. Pupation in soil.	• Young larvae feed on leaves • Extensive damage occurs when older larvae cut at or below soil surface, leading to wilting and death of plants	• Fields with a weed problem or planted to a cover crop (egg-laying site for moths) • No-till fields	Uncommon Outbreaks occur after a heavy spring flight from the south
cutworm - winter	Cold-tolerant larvae overwinter in residue and thatch. They may be active very early in the season. Pupates in the soil in spring. New moths emerge and lay eggs in June.	• Larvae feed on seedlings and leaves • During rare outbreaks, large numbers of larvae sometimes move in a wave across a road or field	• Unknown	Uncommon
flea beetle *several species*	Adults overwinter in crop residue. They emerge in spring and feed on weeds and crops, including beets.	• Adult beetles chew small round holes in leaves	• Weedy fields or borders	Uncommon Shot holing is noticeable, but rarely enough to cause concern
grasshoppers *several species*	Eggs overwinter in soil. Nymphs emerge in June. Their feeding increases as they grow. Females lay groups of eggs in undisturbed soil in late summer. 1 generation per year	• All stages eat leaves. Feeding has a ragged appearance	• Adjacent fallow areas or pasture, where eggs are laid • A hot dry summer & fall can lead to a high population the following year	Uncommon Often present, but outbreaks are rare in Michigan
Japanese beetle	Larvae (grubs) overwinter. Adults typically begin to emerge in July, feed, mate, and lay eggs in soil. Adults may be active into early fall.	• Adult beetles feed on numerous host plants, including beets. Feeding has a skeletonized appearance	• Nothing specific	Uncommon Present, but not at damaging levels

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in Michigan & commentary
leafhoppers	Several species feed on beets. Adults lay eggs in plant stems.	• Both adults and nymphs suck plant sap. Symptoms under high populations include leaf curling and yellowing	• Nothing specific	Uncommon Present, but not at damaging levels
lygus bug *including tarnished plant bug*	Adults overwinter in residue and on field edges. Weeds and early crops like alfalfa are fed on and colonized first. There are multiple generations during the summer.	• Adults and nymphs inject toxic saliva during feeding and suck plant sap • Fed-on leaves turn yellow or brown at tips and edges. Damaged plants may wilt • Damage to beets is difficult to recreate or quantify. When symptoms appear, the feeding happened days earlier.	• Movement into beets may coincide with cutting of adjacent alfalfa fields or with dry down of weeds on field edge	Localized Numbers may be higher in fields adjacent to alfalfa
spider mites	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	• Adults & nymphs pierce individual plant cells, resulting in tiny yellow spots called stippling • Webbing is a sign of a significant infestation • Severe damage results in leaf yellowing or death, water loss	• Prolonged hot, dry weather favors an outbreak & enhances the impact of feeding • Infestations often start on dusty edges of fields	Sporadic Outbreaks occur in hot, dry seasons
spinach leafminer	Pupae overwinter and flies emerge in spring. Females lay eggs on beet leaves. Larvae (maggots) feed, then drop to the soil surface to pupate. Multiple generations, but only the first is important on sugarbeet.	• Larvae create distinctive, winding mines as they feed internally in the leaf	• Nothing specific	Occasional Mining is noticeable, but rarely enough to cause concern
springtails	Springtails are common arthropods related to insects. They break down crop residue or feed on fungi. They are considered an indicator of good soil health, but when populations are high their feeding may damage beet seedlings.	• Nymphs and adults scrape or scar cotyledons just as they emerge from the soil • Heavy feeding is reported to destroy seedlings and reduce stand	• Planting into heavy residue, particularly corn stalks, where numbers are high • Moist conditions & slow emergence after planting	Occasional Damage is rare unless numbers are very high
sugarbeet root aphid (SBRA)	Females overwinter locally in soil or on roots of weeds (especially lambsquarter), moving onto beets planted in the same field. Winged forms can also move to new fields. Summer population is all female. Females reproduce without mating and give birth to live young. Multiple overlapping generations	• All stages suck plant sap from roots. Aboveground symptoms include wilting, yellowing, and stunting. The pattern of damaged plants in the field is often elliptical • Root aphids cover themselves in a protective layer of wax, which can reduce water and nutrient uptake by beet roots • Moderate infestations can reduce yield, sugar content, and recoverable sugar even if above-ground symptoms are lacking	• Aphids overwinter on roots of certain weeds, especially lambsquarters, pigweed, & kochia • Dry conditions help root aphids spread, as soil cracks allow them to access roots • Drought also enhances the impact of SBRA root feeding	Occasional and Localized SBRA persists on alternate weed hosts. Infested areas show up in beet fields in dry seasons. Recent issues with SBRA appear to relate to certain beet varieties.
thrips	Adults and nymphs overwinter in residue. Populations initially build up on grasses and in wheat. Thrips are an important food source for beneficial insects (such as pirate bugs) that control other pests.	• 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 dead spots. Under heavy infestation, leaves dry up, curl, or die	• Dry conditions in early summer • Adults may move into beets from adjacent wheat fields or grassy borders as they dry down	Uncommon Usually present, but numbers are rarely high enough to cause damage

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in Michigan & commentary
webworms *several species*	Larvae overwinter. Adult moths emerge in spring and lay eggs on many hosts. Beet webworm caterpillars occur in June and again in August.	• Caterpillars spin webs and feed on beet leaves, usually near the leaf base	• Weedy fields, as moths may lay eggs on some of the weed species present	Uncommon
white grubs - *several species*	Mature grubs overwinter under-ground. Adults emerge May to July, depending on species. Eggs laid in soil in the summer. Grubs feed on roots, then move down the soil profile in late fall to overwinter. In spring, grubs feed for a period, then pupate. 1 generation per year except for June Beetle with a multiyear life cycle	• Larvae (grubs) prune root hairs or whole roots of small plants • On larger plants, grubs chew into or sever the tap root, causing wilting, water and nutrient deficiency, and even plant death	• Planting after a grass sod or fallow • Sandy fields or parts of fields	Uncommon and Localized Often related to fields or parts of fields with sandy soil
wireworm *several species*	Wireworms are the larval stage of click beetles. Adults are harmless Depending on species, wireworms spend several years in the larval stage feeding on seeds, roots, and tubers.	• Larvae feed on germinating seeds, seedlings, and on the growing tap root • A heavy infestation may reduce stand	• Planting after fallow or pasture or into a field with grass control issues last season • Cool, wet weather that delays crop development • Sandy fields or parts of fields	Uncommon I've never seen a severe infestation in Michigan.
woolly bear and zebra caterpillars	Depends on species, but larvae are present in July and August	• Larvae feed on leaves	• Nothing specific	Uncommon High numbers may be noticed in some years, but are not damaging

Table 4: Management notes, scouting recommendations, and thresholds for insect pests of sugarbeet in Michigan

Pest	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
aphids *on leaves* *On roots, see sugarbeet root aphid*	• Biological: Predators (such as ladybugs, lacewings, and parasitoids keep populations in check. Under humid conditions, entomopathogenic fungi infect and kill aphids • Environmental: Heavy rainfall and irrigation may wash off aphids. Adequate moisture reduces feeding stress and increases humidity for infection by pathogens	Check 100 plants (20 plants x 5 sets)	Rough guideline: one colony (group of ~30 aphids) per plant Rarely justified in Michigan
armyworm	• Biological: Predators and parasitoids can reduce numbers. Under humid conditions, entomopathogenic fungi infect larvae • Agronomic: Good weed control reduces egg laying in a field • Insecticides: A border treatment may be possible if armyworms are moving into beets from an adjacent field	No specific recommendation Edges of fields are at greater risk	Rough guideline: 25% or more defoliation by leaf-feeding insects Beets aren't a preferred host
cutworm - black	• Biological: Ground-dwelling predators (beetles) likely provide some control • Agronomic: Good weed control reduces egg laying	Check 100 plants (20 plants x 5 sets), for cutting and wilting. Dig around base of cut plants to confirm larvae	5% of plants cut
cutworm - winter	• Biological: Ground-dwelling predators (such as beetles) and birds likely to provide some control	Same as black cutworm	5% of plants cut A rare, odd outbreak occurred in 2007
flea beetle	• Agronomic: Good weed control reduces alternate hosts	Check 100 seedlings (20 plants x 5 sets) for feeding damage. Newly-emerged plants are most vulnerable	Rough guideline: 25% of seedlings with feeding damage
grasshoppers	• Biological: Blister beetle larvae prey on eggs, while insects, birds, and mammals eat nymphs & adults. Natural 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	Rough guideline: 25% or more defoliation by leaf-feeding insects I have never seen populations high enough to treat in Michigan
Japanese beetle	• Agronomic: Tillage reduces survival of overwintering grubs	No specific recommendation	Rough guideline: 25% or more defoliation by leaf-feeding insects
leafhoppers	• No specific guidelines	No specific recommendation	None I have never seen populations high enough to treat in Michigan
lygus bug	• Insecticides: Spraying is not very effective at managing Lygus. By the time damage (yellowing) is seen on older leaves, the feeding occurred potentially many days before, and the insects may not even be present	Check 100 plants (20 plants x 5 sets) for bugs or for the distinctive yellowing Note: Lygus are fast and hard to scout	Rough guideline: 1 bug per plant or when significant yellowing occurs on new growth

Pest	Notes on non-chemical and chemical management	Scouting recommendation	Threshold
spider mite	• 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 (including most pyrethroids) will flare mite populations by killing off natural enemies. Likewise, fungicide applications may disrupt fungal pathogens of mites. Insurance applications of both are discouraged. Be cautious about pesticide applications in dry years	Infestations often start on field edges Look for mites on undersides of leaves using hand lens or tap leaves over a black piece of paper Webbing is present when populations are high	A guess: Treat when mites appear on >25% of the plants and first yellowing is seen Mites are difficult to control. Spraying is often a losing proposition
spinach leafminer	• Insecticide: Sprays are most effective when applied just before or during egg hatch	Check 100 small plants (20 plants x 5 sets) for leaf mines	Treat if 50% or more of plants have egg masses and small mines are present
springtails (foliar)	• Agronomic: Tillage to incorporate and destroy crop residue in the fall prior to planting beets • Insecticide: No sugarbeet insecticides specifically list foliar-feeding springtails on the label, although some probably provide control. Note that the manufacturer is not responsible for poor performance	No specific recommendation	None established If the stand is severely damaged, follow guidelines for making a replant decision
sugarbeet root aphid (SBRA)	• Agronomic: Control of alternate weed hosts, especially lambsquarters, helps to reduce the local population in a field • Varieties: The majority, if not all, beet varieties grown in Michigan are rated as SBRA resistant. The accuracy of the rating is uncertain. In 2024, significant infestations were reported in some fields on resistant beets. • Cultural: Clean equipment when moving between fields. • Insecticides: Soil insecticides are not very effective at managing this pest	No specific recommendation Look for aphids and wax on roots in areas with wilted beets	None established Use resistant varieties if SBRA is known to be present in a field
thrips	• Biological: Generally kept in check by predators • Environmental: Rainfall or irrigation reduces populations • Insecticides: 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	Infestations often start on field edges Look for thrips on leaf undersides using a hand lens or tap leaves over a piece of paper	None established
webworm	• Biological: Many parasites and predators attack caterpillars	No specific recommendation. Check leaves in several locations in the field	Rough guideline: small larvae present on 50-75% of leaves
white grubs	• 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 Note: It is important to identify grubs found in the field to distinguish annual species from multiyear June beetle species	No specific recommendation Grubs tend to be in sandy parts of fields. They may be detected when plowing in the fall or spring, or if birds follow tillage equipment	None established
wireworm	• Agronomic: Tillage and longer rotations can reduce wireworm infestations	No specific recommendation	None established
woolly bears & zebra caterpillar	• Nothing specific	No specific recommendation	Rough guideline: 25% or more defoliation by leaf-feeding insects

Table 5: Soil/at-plant insecticides to manage insect pests of sugarbeet in Michigan

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry
- Application rates are listed for pests which appear on the manufacturer label; if a column is blank, the pest is not on the label. The letters in the pest columns refer to the label use rate from column two
- 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	**cutworms**	**root aphid**	**slugs**	**white grub**	**wireworm**	**Precautions and Remarks**
cypermethrin (zeta) Mustang Maxx	(a) 4.0 oz per acre	a			a	a	• For cutworm, apply on soil surface or broadcast in 3-5 gal water • For grubs and wireworm, apply in-furrow or in a 3-4 inch T-band over the open furrow
esfenvalerate Asana XL S-FenvaloStar Zyrate	(a) 0.45 oz per 1000 ft	a					• Apply in-furrow, T-band or banded
iron phosphate Ferroxx AQ Sluggo	(a) 20-44 lbs per acre			a			• Broadcast pellets; use higher rate for heavy infestations. For best results, apply bait in the evening and on moist soil
sodium ferric EDTA Ferroxx	(a) 5-20 lbs per acre			a			• Broadcast pellets; use higher rate for heavy infestations • Slugs stop feeding, slowly die
terbufos Counter 20G (Lock'N Load, Smartbox, or SmartCartidge)	(a) 3 - 6 oz per 1000 ft		*		a	a	• Apply banded or 'modified' in-furrow (2-3 inches behind the seed after some soil has covered the seed); do not let granules directly contact seed, as injury may occur • Higher rate may also suppress cutworms and sugar beet cyst nematode * See label for banded postemergence use against sugarbeet root aphid. Note the 90-day pre-harvest interval for this application.

Table 6: Foliar insecticides to manage insect pests of sugarbeet in Michigan

- Insecticides are grouped by active ingredient(s), which are listed alphabetically, allowing for easy comparison of products with the same chemistry
- Application rates are listed for pests which appear on the manufacturer label. If a column is blank, the pest is not on the label. The letters in the pest columns refer to the label use rate from column two
- 'Caterpillar' column includes woolly bear, saltmarsh, thistle, & zebra caterpillars

Active ingredient Trade Names	**Labelled rate per acre**	**aphids (foliar)**	**armyworm**	**caterpillars**	**cutworms**	**flea beetle**	**grasshopper**	**leafhopper**	**lygus bug**	**spider mite**	**spinach leafminer**	**springtails**	**thrips**	**webworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remarks**
Bacillus thuringiensis (Bt) Agree WG* Javelin WG Xentari DF	(a) 0.5 - 2.0 lb (a) 0.25 - 1.5 lb (a) 0.5 - 1.5 lb		a	a	a									a	0	• Bt is a selective biological insecticide to control caterpillars. Larvae must eat treated foliage to be controlled so good coverage is important. Must be targeted on small (1st - 2nd stage) larvae. • All are certified for organic production * The Agree WG label only lists armyworm
carbaryl Carbaryl 4L Sevin 4F Sevin XLR Plus	(a) 1.0 - 1.5 quarts		a		a	a								a	28	• Max 3 quarts per acre • For cutworm, effective on species feeding on top of plant • Toxic to bees - do not apply if weeds in field are in bloom
cyantraniliprole Dupont Exirel Exirel	(a) 13.5 - 20.5 oz (b) 10.0 - 20.5 oz	a	b		b	a							*		1	• Thorough coverage is essential; application for aphid control requires an effective adjuvant (see label) *Application may suppress thrips
chlorantraniliprole Vantacor	(a) 1.2 - 2.5 oz		a								a				1	• Use higher rate in dense canopy or under rainy / high temp conditions • 2ee label for leafminer, but suppression only
cypermethrin (alpha) Fastac CS Fastac EC*	(a) 2.2 - 3.8 oz	a	a		a	a	a								50	• Minimum spray volume 2 gal by air and 10 gal by ground • Do not graze or harvest treated tops for feed • Fastac CS is a microencapsulated formulation * Fastac EC does not list aphids & armyworm on the label
cypermethrin (zeta) Mustang Maxx	(a) 2.24 - 4.0 oz	a	a	a	a	a	a	a	a		a			a	50	• Aphid control depends on species
esfenvalerate Asana XL S-FenvaloStar Zyrate	(a) 5.8 - 9.6 oz		a	a	a	a	a	a							21	

Active ingredient Trade Names	**Labelled rate per acre**	**aphids (foliar)**	**armyworm**	**caterpillars**	**cutworms**	**flea beetle**	**grasshopper**	**leafhopper**	**lygus bug**	**spider mite**	**spinach leafminer**	**springtails**	**thrips**	**webworm**	**Pre harvest interval (PHI) in days**	**Precautions and Remarks**
methomyl Annihilate LV Lanveer LV Lannate LV Nudrin LV Annihilate SP Corrida 90WSP Lannate SP Nudrin SP	(a) 0.75 - 3.0 pints (b) 1.5 pints (a) 0.25 - 1 lbs (b) 0.5 lb			a	b	a								a	21 beets 30 tops	• Highly toxic to bees; be careful about drifting onto nearby crops or application on blooming weeds • See label for set-back requirements from surface water
methoxyfenozide Intrepid 2F	(a) 8 - 16 oz		a	a	a									a	7	• Minimum spray volume 10 gal by air and ground • Cutworms, suppression only • Narrow spectrum, targets caterpillars. Novel mode of action disrupts molting. Spray timing is critical; applications need to be made at egg hatch or just as feeding starts • Endangered species warning for use in Montcalm Co. Michigan. Access EPA's 'Bulletins Live! Two' web site
naled Dibrom 8E	(a) 1 pint	a	a				a	a	a	a					2	• See label for setback requirements from surface water
pyrethrins Evergreen EC 60-6 PyGanic EC 1.4 II PyGanic 5.0	(a) 2.0 - 12.6 oz (a) 16 - 64 oz (a) 4.5 - 15.6 oz	a	a	a	a	a	a	a	a			a	a	a	0 when sprays dry	• Plant-derived insecticides that knock down insects quickly but have short residual control. Coverage is critical • Highly toxic to bees exposed to direct treatment; do not apply on or drift onto blooming crops or weeds
spinosyns **(spinetoram & spinosad)** Radiant SS	(a) 6 - 8 oz		a			a							a		7	• Must target egg hatch or small larvae • Flea beetles - suppression only. Thrips control is improved by adding an adjuvant as detailed on the label. Be careful using oil-based adjuvants in sugarbeet tank mixes.
spirotetramat Movento Movento HL	(a) 5 - 9 oz (a) 2.25-4.5 oz	a													28	• Systemic - moves through plant into leaves and roots; systemic activity may be limited in cold or dry weather when plant isn't actively growing • Minimum spray volume 5 gal by air and 15 gal for ground; see label for recommendation to add an adjuvant • Also controls root aphid and suppresses cyst nematode