MSU-OSU Field Crops Insect Guide: Management of Insects in Small Grains
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How to Use this Guide

This publication is set up as a series of stand-alone tables with information on insect biology, damage, management recommendations, and insecticides registered in Michigan and Ohio on **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 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.

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

Common name	Overwintering stage, location	May	June	July	August	Sept
white grubs, especially European chafer	larvae (grubs), in soil	grubs feed on roots			grubs can destroy new stands by feeding on roots	
cereal leaf beetle	adults, in protected areas near field	larvae feed on leaves		adults feed on leaves		
armyworm	Southern USA, migrate north	larvae feed on leaves first; may clip heads by mid June				
aphids	Southern USA, migrate north	sucking plant sap (on fall planted grain)		sucking plant sap (on spring planted grain)		BYDV spread (fall plantings)
Hessian fly	puparia (flax seed), 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		

Small Grains Table 2: Damage checklist to aid in scouting for insects.

Plant part or timing Type of damage or injury	aphids	armyworm	cereal leaf beetle	fall armyworm	grasshoppers	grass sawfly	Hessian fly	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
Roots								
root hairs missing								x
pruning of whole roots								x
Leaf tissue								
feeding on/ scraping 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 yellowing from feeding	x							
leaf yellowing, reddening from virus	x							
leaves dark bluish-green							x	
field appears whitish or 'frosted'			x					
sticky leaves or head (honeydew)	x							
Stem								
short internodes and stems							x	
stunting of plants							x	
stems cut into small sections						x		
stem breakage, lodging							x	
Head								
awns clipped off		x						
heads clipped off		x				x		
Other								
barley yellow dwarf (BYDV) transmission	x							
large square frass pellets on ground		x						
numerous stem segments on ground						x		

Small Grains Table 3: Life cycle, damage, and pest status of insects in wheat and other small grains

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

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

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

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
aphids *usually English grain aphid, bird cherry-oat aphid, and corn leaf aphid*	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 give birth to multiple live nymphs per day and do not mate to reproduce (known as parthenogenesis). 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 BYDV transmission to winter wheat	Uncommon
armyworm	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, leaving heads on the soil surface	• Nothing specific	Sporadic Outbreaks occur in years with a heavy spring flight from the south
cereal leaf beetle *Historic note: CLB was first found in the US in 1962, in Berrien County Michigan*	The handsome blue and red beetles 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. The oldest larvae, which occur in May, do the most feeding • Fields with heavy feeding on the flag leaf appear white or frosted • Early, heavy feeding can reduce plant growth and yield	• CLB will feed 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 may reduce local parasitoid populations	Uncommon & Localized But may be increasing to 'occasional'

Pest (abbreviation)	Life cycle and Number of generations	Description of Damage	Conditions which favor infestation or damage	Pest Status in MI & OH
grasshoppers *multiple species*	Eggs overwinter in soil. Nymphs emerge in June. Feeding increases 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	• Adults and nymphs chew on leaves, stems, or the head; feeding has a ragged appearance • Parts of leaves or the head may be clipped off	• Undisturbed forage, pasture, and 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	Uncommon
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 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 then 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 a pile of 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	• Maggot rasp the stem and rupture cells, effecting 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 in fall can be stunted or dead by spring, thinning the overall stand; Heads, if present, will be small • Stems infested in spring can be weak and lodge; 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
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 in 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 • Adults of most species do not feed	• June beetle and Euro chafer grubs are more common in fields with sandy soil types	Uncommon When present, often localized to sandy areas

Small Grains Table 4: Management notes, scouting recommendations, and thresholds

Pest (abbreviation)	Notes on non-chemical and chemical management	Scouting recommendation	Spray 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 also 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: See Table 4A for decision criteria
armyworm	• 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 in getting insecticide down into the canopy, but better coverage is balanced by yield loss from wheel tracks. • Insecticides: If caterpillars are present in just a part of the field, or if they are marching from one field to another, a limited spot or border treatment can be made. Remember, 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 on the ground for caterpillars and frass pellets. Record the number and size of larvae. 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 (nearing pupation) spraying is less effective
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 disrupted by 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 for some growers. 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
grasshoppers	• Biological: Blister beetle larvae prey on eggs and many animals 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 spray area to the 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 in the Order Lepidoptera. Instead, they are in the Order Hymenoptera, closely related to bees, wasps, and ants. Thus, insecticides registered 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 & have a dark bar on the head, it is probably too late to treat

Pest (abbreviation)	Notes on non-chemical and chemical management	Scouting recommendation	Spray threshold
Hessian fly	• Variety: Resistant varieties are readily available; these 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 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 planting date and resistant varieties
white grubs	• Biological: Natural enemies usually keep grubs in check Note: it is important to identify grubs to distinguish annual species like European chafer from multi-year species of June beetles	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 spray threshold A density of 4 chafer grubs per ft^2 can reduce stand and biomass. At this level of infestation, consider tillage before fall planting, or plant elsewhere

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

- *Instructions: Presence/absence sampling involves sampling and classifying tillers simply as infested (aphids present) or not. Aphid species or number per tiller does not matter.*
- *Start by picking 25 tillers. Count the number which are infested, then use the first line of the table to determine if you have enough information to make a decision (spray or do not spray) or if you need to sample 5 more tillers. Keep sampling groups of 5 tillers until a decision is reached, or 100 tillers are examined.*

	Cumulative number of infested tillers		
Total number of tillers examined	***Decision made:*** *Stop sampling & don't spray*	***No decision yet:*** *Keep sampling; Pick 5 more tillers*	***Decision made:*** *Stop sampling and 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), plant winter wheat after this date in the fall to avoid egg-laying by Hessian flies, as well as to reduce infestation by grain aphids which may transmit of 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

Small Grains Table 5: Foliar Insecticides to manage insects in wheat and other small grains.

- Insecticides are grouped under their active ingredient(s), which are listed alphabetically. This allows for comparison of products with the same chemistry.
- Application rates are listed for pests which appear on the manufacturer label. The letter under the pest name indicates the label rate from the previous column. If a column is blank, the pest is not on the label.

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**aphids**	**armyworm**	**cereal leaf beetle**	**fall armyworm**	**grasshoppers**	**grass sawfly**	**Hessian fly**	**Pre harvest interval (PHI)** in days	**Precautions and Remarks**
Bt (*Bacillus thuringiensis*) Biobit HP & Xentari Dipel ES Javelin WG	 (a) 0.5 - 2.0 lb (a) 2.0 - 4.0 pints (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 instar) larvae
chlorantraniliprole Coragen Prevathon Vantacor	 (a) 3.5 - 5.0 oz (b) 2.0 - 5.0 oz (a) 14.0 - 20.0 oz (b) 8.0 - 20.0 oz (a) 1.2 - 2.5 oz (b) 0.7 - 1.7 oz		a		a	b			1 grain 1 straw	• Labeled for wheat & barley, millet, oats, rye, sorghum, triticale • Novel mode of action - insect 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 (c) 10 oz	c	a	a	a	a	b	a	30 grain 30 straw 7 hay 7 grazing	• Labeled for wheat & barley, oats, rye, triticale
cyfluthrin Baythroid XL Tombstone Tombstone Helios	 (a) 1.0 - 1.8 oz (b) 1.8 - 2.4 oz	b	b	a	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 • 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	a	b	a	30 grain 30 straw 7 grazing	• Declare is labeled for wheat & barley, oats, rye, triticale • Proaxis is labeled only for wheat, wheat hay, and triticale

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**aphids**	**armyworm**	**cereal leaf beetle**	**fall armyworm**	**grasshoppers**	**grass sawfly**	**Hessian fly**	**Pre harvest interval (PHI)** in days	**Precautions and Remarks**
cyhalothrin (lambda) Grizzly Too Kendo 22.8CS Lamcap II Province II Warrior w/Zeon Tech. Kendo Lambda Cyhalothrin 1EC Lambda-Cy Lambda-Cy Ag LambdaStar Lambda-T Paradigm VC Silencer 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	a	b	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	a	b	b	b		14	• Labeled for wheat & triticale • Aphid control may be 'variable' depending on which species is present
cypermethrin (zeta) Mustang Mustang Maxx	(a) 1.9 - 4.3 (b) 3.4 - 4.3 (a) 1.76 - 4.0 oz (b) 3.2 - 4.0 oz	b	a	a	b	b	b		14	• Labeled for wheat & barley, oats, rye, triticale • Aphid control may be 'variable' depending on which species is present
dimethoate Dimate 4E Dimethoate 400 and 4EC	(a) 0.5 - 0.75 pints (b) 0.75 pints	a				b			35 grain	• Labeled for wheat only • Max 1 point per acre per year • Highly toxic to pollinators
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
pyrethrins Evergreen EC 60-6 PyGanic EC 1.4 II PyGanic Specialty	(a) 2.0 - 12.6 oz (a) 16 - 64 oz (a) 4.5 - 15.6 oz	a	a	a	a	a			0 when sprays dry	• Plant-derived insecticides that knock down insects quickly but have very short residual control. Coverage is critical • Max 10 applications per season, min. 3-day spray interval • PyGanic is OMRI listed for use on organic crops; Evergreen does not have OMRI certification because it contains PBO • Highly toxic to bees exposed to direct treatment; do not apply on or drift onto blooming crops or weeds

Active ingredient Trade Names	**Labelled rate per acre** (unless stated)	**aphids**	**armyworm**	**cereal leaf beetle**	**fall armyworm**	**grasshoppers**	**grass sawfly**	**Hessian fly**	**Pre harvest interval (PHI)** in days	**Precautions and Remarks**
spinosad Blackhawk Tracer	(a) 1.1 - 1.3 oz (b) 1.7 - 3.3 oz (a) 1.5 - 3.0 oz		a 		b 				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 • Max 2 applications per crop