WHEAT FACTS

Insect Management in Wheat and Other Small Grains

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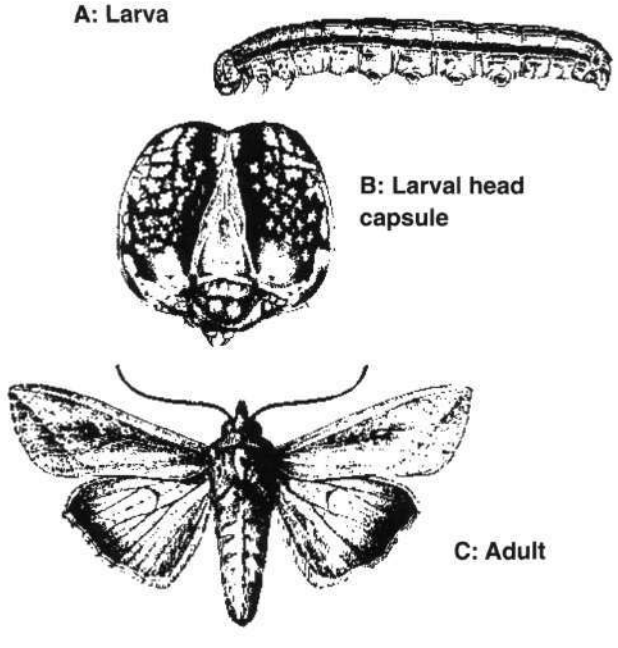
Several insects may infest small grain fields in Michigan. Those most likely to reach pest status are presented here. A description of each insect including life cycle, damage, and appropriate scouting technique is given as well as information regarding biological, cultural, and chemical controls.

This is part of a series of fact sheets related to wheat production (see back cover).

Armyworm



Armyworm[1]

Description

Adult: light brown to tan moth; small white dot in center of each front wing; wingspan 1 1/2 inch.

Egg: small; greenish white.

Larva: hairless; greenish when newly hatched; older larvae vary in color from greenish-brown to black with a narrow, light-colored stripe down the center of the back and broad stripes running the length of the body; three pairs of jointed legs behind the head and five pairs of fleshy legs on the abdomen; 1 1/2 inches long when mature.

Pupa: 3/4 inch long; dark brown; broad at one end, tapered at other.

Life Cycle

Although armyworms are thought to be capable of overwintering in Michigan as mature larvae, it is likely that annual spring migrations into the state from the south are responsible for the presence of the majority of the population. Females lay eggs on the surface of the lower leaves of grasses, especially where dense stands occur. The headlands of small grains are favored sites for egg laying, as are other grassy areas in crop fields. Larvae pass through six instars before pupating. There are two to three generations per year. The first generation is present in late May or early June.

Damage

Typically, the first generation is the most damaging. Look for damage three weeks after adult flight occurs. The larvae eat leaves, stems, awns and will

[1]*Pseudaletia unipuncta* (Haworth), drawings courtesy North Carolina State Extension

clip off heads of wheat and other small grains. In severe infestations, once all the vegetation in one field has been consumed, the larvae will move in a group to fresh vegetation. This "marching" activity is where they get their name. Larvae are active at night and on overcast days. Armyworms can be found near the base of plants and under debris during daylight.

Biological Controls

After the first generation, subsequent armyworm generations are usually kept in check by natural enemies. There are many wasps[2] that parasitize the armyworm. Also, tachinid flies[3] attack the larvae, attaching eggs to the top portion of the armyworm near the front half of the body. The maggots that hatch from these small white eggs chew into the body of the armyworm, killing it within a few days. Predators of the armyworm include birds, spiders and ground beetles. Several pathogens also infect armyworms. Disease spread can be rapid, particularly when armyworm populations are high.

Cultural Controls

Keep unwanted grasses out of crop fields to deny egg-laying females the opportunity to deposit eggs.

Scouting and Treatment Threshold

Chemical treatment in small grains is warranted when there are four or more armyworm larvae per row foot. Refer to Table 1 for a list of chemicals registered for armyworm control.

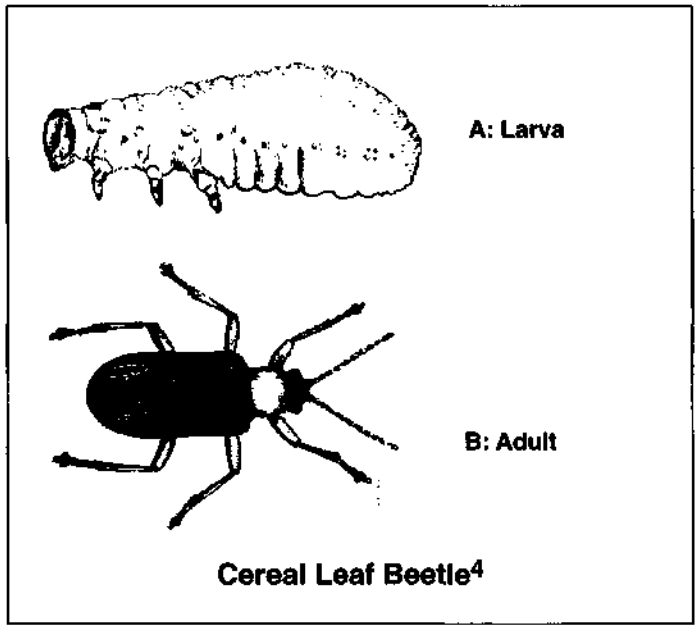
Cereal Leaf Beetle

Description

Adult: 1/6 to 1/5 inch long; shiny, metallic-blue wing covers; black body, head and antennae, and a red pronotum (neck); legs vary from orange to red with black tarsi (feet).

Egg: pinhead size; elongate; bright yellow to dull brown.

Larva: 1/6 to 1/4 inch long; oval; thorax and abdomen covered with mixture of mucus and fecal material, appearing shiny brown to black; actual larva is pale yellow to orange with a black head.



Cereal Leaf Beetle[4]

Pupa: found 1/2 to 2 inches deep in the soil in a cell formed from a combination of mucus and soil.

Life Cycle

The cereal leaf beetle (CLB) was first discovered in the U.S. in Berrien County, Michigan, in 1962. Currently it can be found from Maine to South Carolina, west to Arkansas and Minnesota, also in Montana and Utah.

Adults spend the winter in protected areas such as in stubble, under tree bark and in crevices. In early spring, when temperatures reach the upper 60's (°F), these "winter" adults become active and feed briefly before mating. Oblong eggs are laid singly or in chains and glued to the upper surface of grain leaves. Initially yellow in color, the eggs darken prior to hatch. Soon after hatch the larvae cover all but their heads with their own fecal material, masking their true color and giving them a somewhat sluglike appearance. The larvae feed for about two weeks and have four instars (growth stages). Fullgrown larvae shed the fecal covering, typically in the first part of June in Michigan, and move to the soil to pupate which takes two to three weeks. Pupation may occur on the plant when soil moisture is high.

[2]Ex. *Apanteles* spp., *Meteorus* spp.

[3]Ex. *Winthemia* spp.

[4]*Oulema melanopus* (Linnaeus), drawings courtesy North Carolina State Extension.

Table 1.
Recommended insecticides for controlling armyworm in small grains.*

Insecticide and Formulation	Amount of Formulation to Use / Acre	Active Ingredient (lb / Acre)	Pre-Harvest Interval (days)	Precautions and Remarks	Application and Special Notes
carbaryl (Sevin) formulations including:					Full coverage is not required. 1 gal of spray / acre by air or 10 gal of spray/ acre with ground equipment is sufficient. Apply in the evening when practical.
4 F or XLR Plus	1 to 1½ qt	1 to 1.5	0 forage 21 grain	Wheat only.	
50 W	2 to 3 lb				
80 S	1¼ lb				
Lannate (RUP)					
1.8 L	1 to 2 pt	0.23 to 0.45	7 grain, 10 grazing or feeding		
2.4 LV	¾ to 1½ pt				
90 SP	¼ to ½ lb				
Penncap-M (RUP) (encapsulated methyl parathion)	2 to 3 pt	0.5 to 0.75	15	Do not apply to rye.	
Bt (*Bacillus thuringiensis*)					*Bacillus thuringiensis* product. Apply to small larvae (1st & 2nd instars) and light populations. Full coverage required.
Javelin WG	1 to 1.5 lb		0		
Dipel 2X	0.5 to 2.0 lb				
Biobit FC	2 to 7 pt				

RUP = Restricted Use Pesticide.

**The above chemicals are recommended if economic thresholds are exceeded. Some factors to be considered when reaching a decision regarding the need for chemical control are the life stage and numbers of the pest; the stage, general health and value of the crop; the effect on the natural enemy population; and cost of the treatment.*

"Summer" adults emerge in late June and feed heavily for about three weeks before entering an inactive phase. This summer diapause occurs in sheltered areas. There is one generation per year.

Damage

The adults chew elongate holes between the veins and entirely through the leaves of small grains. Larvae feed between the veins also, but remove everything except the lower epidermis of leaves, producing a frosted appearance in severely damaged fields. Feeding prior to the boot stage reduces plant vigor; after boot the flag leaf may be fed upon, reducing seed set and grain test weight. Damage is more serious when it occurs during early heading versus tillering.

Biological Controls

Several important natural enemies attack cereal leaf beetles including an egg parasitoid[5]which was imported from Europe and distributed throughout the state by county agricultural extension agents in the 1970's. The spotted lady beetle[6] is an important predator, feeding on eggs early in the season. Larval parasitoids include three wasps[7]. A tachinid fly[8] attacks the adult. In combination, the natural enemies of the cereal leaf beetle control this pest in most years.

Cultural Controls

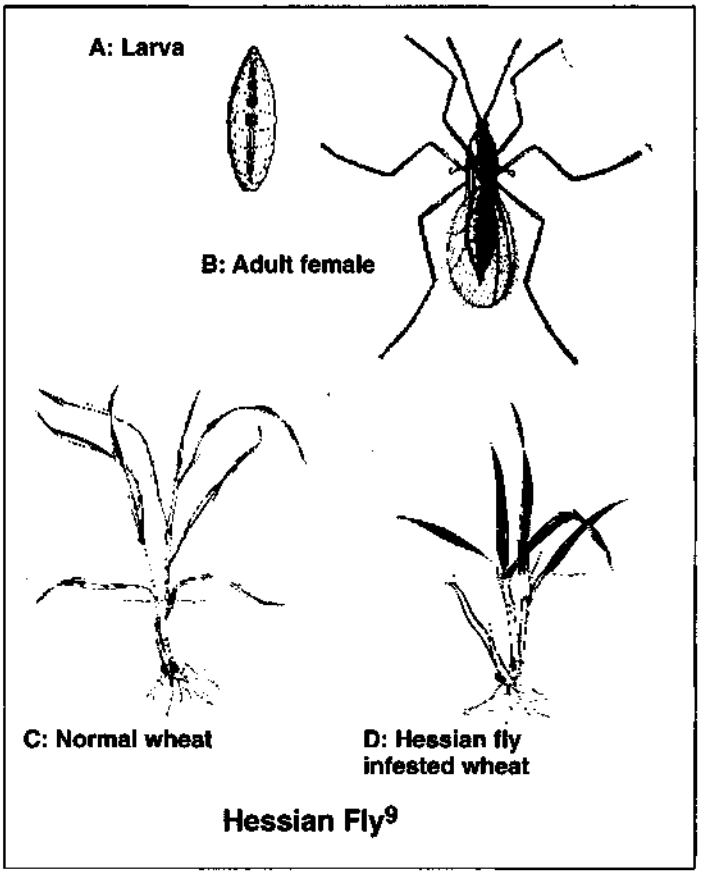
Host plant resistance is dependent on leaf hairiness, with hairy varieties being less desirable to both the adults for egg laying and the larvae for feeding.

Scouting and Treatment Threshold

Look for adult feeding holes in spring after the first warm spell in the 60's. Infestations often start along field borders of winter grains, with adults moving to the preferred spring grains (especially oats) when they become available. The beetles are most active on sunny days. Check adult-damaged fields for eggs and larvae. Count the number of eggs and larvae per 20 stems in 5 areas of the field. The need to manage cereal leaf beetle is based on plant stage, and the number and stage of development of the larvae. Treat when there is a combination of at least three eggs and larvae per stem and when the small larvae can be easily seen on small plants, or where there is one larvae or more per flag leaf in larger plants.

Timing of chemical control for cereal leaf beetle is important. Fields treated too early may be reinfested; waiting too long may result in extensive damage. Applications should be made when small larvae are present. Refer to Table 2 for a list of chemicals registered for cereal leaf beetle control.

Hessian Fly



Hessian Fly[9]

[5]*Anaphes flavipes* (Foerster)

[6]*Coleomegilla maculata lengi* Timberlake

[7]*Tetrastichus julis* (Walker), *Diaparsis carinifer* (Thompson), *Lemophagus curtus* Townes

[8]*Hyalomyodes triangulifer* (Loew)

[9]*Mayetiola destructor* (Say), drawings courtesy North Carolina State Extension.

Table 2.
Recommended insecticides for controlling cereal leaf beetle larvae in small grains.*

Insecticide and Formulation	Amount of Formulation to Use / Acre	Active Ingredient (lb / Acre)	Pre-Harvest Interval (days)	Precautions and Remarks	Application and Special Notes
carbaryl (Sevin) many formulations including: 4 F or XLR Plus 50 W 80 S	1 qt 2 lb 1 ¼ lb	1.0	0 forage, 21 grain	Wheat only.	Full coverage is not required. 1 gal of spray / acre by air or 10 gal of spray / acre with ground equipment is sufficient.
endosulfan (Thiodan, Phaser) 3 EC 50 WP	⅓ to ⅔ qt 1 lb	0.25 to 0.5		Do not graze or feed forage.	Apply before heading.
malathion 5 EC	1 to 1½ pt	0.63 to 0.94	7		
ULV malathion 9.33 lb/gal concentrate	4 to 8 fl oz	0.25 to 0.5	7		
Lannate (RUP) 1.8 L 2.4 LV 90 SP	1 to 2 qt ¾ to 1½ pt ¼ to ½ lb	0.23 to 0.45	7 grain, 10 grazing or feeding		
Furadan (RUP) 4F	½pt	0.25		Do not feed or graze.	Apply before boot stage. Maximum 1 application / season. Do not apply to rye.

RUP = Restricted Use Pesticide.

**The above chemicals are recommended if economic thresholds are exceeded. Some factors to be considered when reaching a decision regarding the need for chemical control are the life stage and numbers of the pest; the stage, general health and value of the crop; the effect on the natural enemy population; and cost of the treatment.*

Description

Adult: less than 1/8 inch, fragile, mosquito-like fly having one pair of wings; females have orange-red abdomen.

Egg: reddish-yellow.

Larva: typical maggot form: headless, legless, spindle-shaped; reddish when newly hatched, turning white to greenish-white; 3/16 inch when fully grown.

Pupa: 3/16 inch; brown; tapered at ends.

Life Cycle

The Hessian fly overwinters as a full grown larva protected within a puparium (hardened larval skin) in stubble, on volunteer wheat or wheat sown prior to the fly-free date. This stage is referred to as the "flaxseed" and can be found between the leaf sheath and stem near or just below ground level. Pupation occurs as temperatures warm and the wheat begins to grow. When the adult emerges the female mates and begins to lay eggs placed end-to-end in grooves on upper surfaces of leaves. The eggs, which can barely be seen with the unaided eye, hatch in 3 to 10 days. Larvae feed for about two weeks before forming a puparium prior to harvest. Summer is passed in this stage. Larvae in puparia pupate in late summer. Flies emerge in late summer and early fall and find small grains to lay eggs on. These eggs hatch and most of the larvae become full grown prior to winter. Generally, there are two generations per year, but additional generations occasionally occur. Adults live only three to four days and are not known to feed.

Damage

Newly hatched larvae migrate down the leaf to feed between the sheath and the stem. The stem is scraped with the mouthparts, and juices which seep from the wound are eaten. The resultant damage is not strikingly obvious and is similar for fall- and spring-infested plants: stunting, lack of tillering, middle shoot often absent, dark bluish-green leaf coloration, leaf thickening, increased leaf rigidity. Severely damaged plants may not survive the winter. As the head of an infested plant begins to fill, the stem often breaks. Wheat is the preferred host with barley and rye also being fed upon, but never oats. Hessian fly maggots do not enter the stem of the plant like some other pests.

Biological Controls

Several wasp parasites[10] are natural enemies of the Hessian fly, aiding in its suppression.

Cultural Controls

Small grains should be planted after the "fly-free" date, i.e., after the female flies have deposited their eggs. Safe planting dates have been determined for each area of the state and are listed in Table 3. Destroying volunteer grains and plowing down infested stubble are critical for reducing fly populations. In addition, varietal resistance can be an important management tool. Although resistant grain varieties are available, each variety is susceptible to one or more Hessian fly biotype. Many biotypes of the Hessian fly currently exist (biotypes A through L, and GP). However, the use of resistant varieties in combination with the destruction of volunteer grains helps to keep the population at low levels.

Scouting and Treatment Threshold

To confirm presence of Hessian fly look for stunted, discolored plants. Pull leaf sheaths away from stem and look for exposed larvae, mature larvae in puparia (flaxseed), or the pupa. There are no economic thresholds set for this insect; insecticide treatments are ineffective. Management depends on preventing infestation by planting wheat following the fly-free planting dates (Table 3).

[10] *Eupelmus* and *Platygaster* species.

Table 3.
Hessian fly-free dates for Michigan small grains.

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

From "Insect Control in Small Grain Crops", MSU Extension bulletin E-0829.

Aphids

General Description

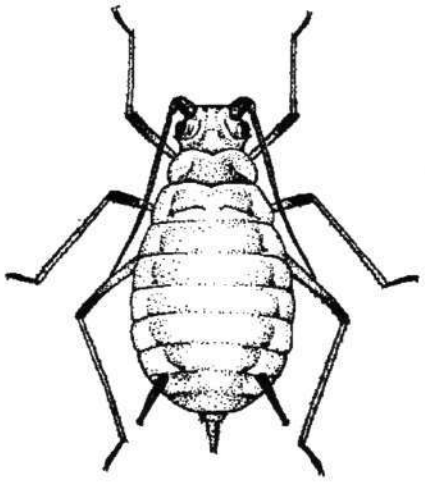
Adult: small (1/16 to 1/8 inch), pear-shaped; soft-bodied; variably colored insects having a pair of projections extending upward from rear of body called cornicles (sometimes described as tail pipes); may be winged or wingless.

Nymph: looks like unwinged adult.

General Life Cycle and Damage

Aphids live in colonies where both winged and wingless forms are found. Their reproductive potential is great with many generations produced during the course of the year. During the majority of the season, females of most species give birth to young aphids rather than laying eggs. Males are typically produced during the latter part of the year and are only required for fertilization of overwintering eggs.

Aphids use their piercing-sucking mouthparts to remove plant sap. All four of the aphids discussed below are vectors of barley yellow dwarf virus, the same virus that causes redleaf of oats. This virus attacks wheat as well.

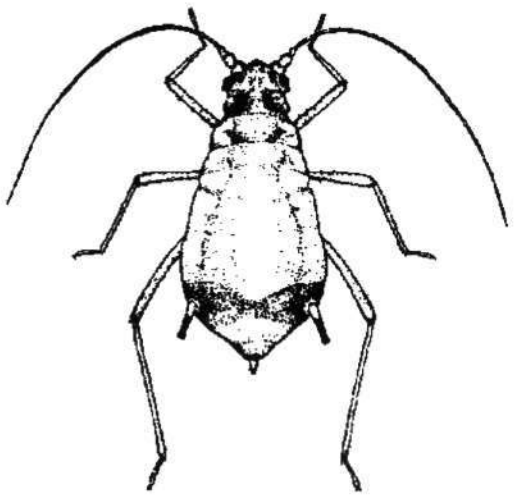


English grain aphid [11]
(bright green with long black cornicles)

English grain aphid: 1/8 inch long; green body; long black antennae (more than half of body length) and cornicles; winged forms have dark projections just behind the head region.

It is unclear if English grain aphids overwinter in Michigan or migrate into the state in the spring. Colonies feed primarily on developing grain heads but also in leaf axils. After grain harvest they move to wild grasses and volunteer grain for the summer. Mating occurs in the fall when males are present. Eggs are laid on small grains.

English grain aphids prefer warmer weather, becoming most abundant as grain matures. They are generally found on larger plants near or on the heads. Their feeding may cause poor seed set and low test weight.



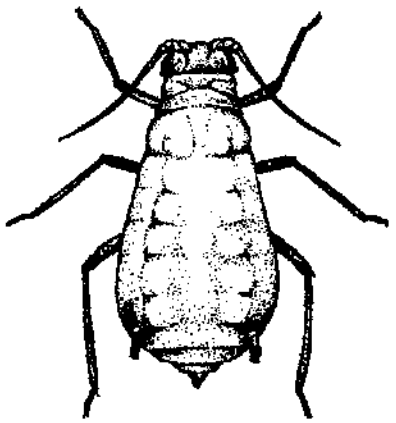
Bird-cherry oat aphid [12]
(olive green, reddish patch at base of cornicles)

Bird-cherry oat aphid (also oat bird-cherry aphid or cherry oat aphid): pale green to almost black; black-tipped legs, cornicles and antennae; reddish spot near tail end between cornicles.

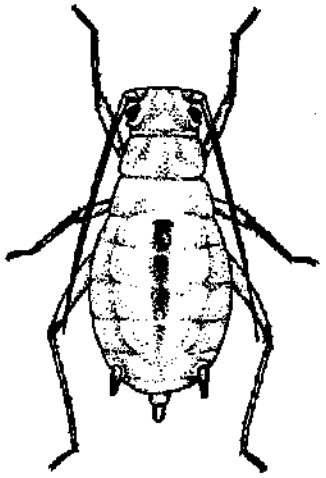
Winter is spent in the egg stage on bird cherry trees. After hatching in the spring, they feed on the buds and young leaves before moving to grasses where they spend the summer. These aphids are present very early in the spring. Bird cherry-oat aphid colonies are usually found on the lower portions of the plant but will move to the boot area as lower leaves die.

11 *Sitobion avenae* (Fabricius), drawing courtesy Virginia Cooperative Extension.

12 *Rhopalosiphum padi* (Linneaus) drawing courtesy Virginia Cooperative Extension.



Corn leaf aphid [13]
(bluish green with black legs, cornicles and antennae)



Greenbug[14]
(pale green with darker stripe down back)

Corn leaf aphid: blue-green; short black antennae (half of body length or less); black legs, feet, cornicles.

Although information is incomplete, there have been no observations of overwintering forms in northern latitudes and it is likely that these aphids migrate into the state from the south in the spring. Corn leaf aphid can be found at low levels throughout the growing season and is most typically found in barley, although corn is the preferred food. Large numbers sometimes build on winter grains planted early, before the Hessian fly-free date for an area.

Greenbug: light green to greenish yellow; dark green line down middle of back; antennae and cornicle tips black. Winged forms are a little larger than wingless ones and have a brownish-yellow head with dark lobes on the back of the region just behind the head.

Greenbugs are carried into Michigan each spring with winds from the southern U.S. Eggs are laid on the leaves of grain. The wingless females which hatch from these eggs give birth to living young which may be either winged or wingless. Many generations are produced in this manner during the summer. Males are produced in the fall.

Early in spring, greenbugs feed on the undersides of leaves, injecting a toxin along with their saliva into the plant while feeding. Infested plants turn yellow and damage can rapidly spread from a localized area outward as the greenbug moves to new plants to feed. Seedlings are especially susceptible to greenbug injury.

Biological Controls

Aphids have many natural enemies which normally keep their numbers below injurious levels. Predators include ladybird beetle adults and larvae, lacewing larvae and syrphid fly larvae. Several wasp parasites specifically attack aphids. These wasps deposit eggs inside the aphid's body, which the larva consumes before emerging as an adult wasp. The aphid carcass or "mummy" can be found on the plant. An exit hole is visible after the new adult wasp emerges.

Cultural Controls

Destroy volunteer grains (especially oats for greenbug). Anything that promotes general plant vigor and quick establishment helps plants to better tolerate aphid feeding.

Scouting and Treatment Threshold

Common grain aphids carry the virus of barley yellow dwarf (called red leaf in oats) from field to field. Unfortunately, control of the aphids does not

[13]*Rhopalosiphum maidis* (Fitch), drawing courtesy Virginia Cooperative Extension.

[14]*Schizaphis graminum* (Rondani), drawing courtesy Virginia Cooperative Extension.

stop transmission of the disease, and the aphids should be controlled with insecticides only when they are numerous enough to directly threaten yield. Recent research conducted in the North Central Region suggests that old thresholds established for aphids on small grains were too high, i.e., plants are actually damaged by lower aphid numbers. The newer treatment threshold is 12-15 aphids per tiller during seedling to boot stage.

A sequential sampling method based on the presence or absence of aphids has been developed to rapidly determine when thresholds exist. Begin by randomly picking 25 tillers from throughout the field. Keep count of the number of tillers that have at least one aphid on them (presence). If 25 or more tillers are found to contain aphids then chemical treatment is warranted. If you find less than 19 tillers with aphids on them, the field is below threshold and no treatment is necessary. Quit sampling and return to the field within a few days for reevaluation. When the number of infested tillers is between 19 and 24, randomly select another 5 stems from throughout the field and compare the number of infested tillers out of the 30 to the "stop limits" listed in Table 4. If the total is greater than the upper stop limit, then treatment is warranted. If the number is less than the lower stop limit, discontinue sampling and return to sample within a few days. Whenever the total is between the two limits, select another 5 stems in the previous manner and compare the new infested tiller total to the stop limits for the appropriate number of tillers sampled. Continue to sample and evaluate until a decision is reached or 100 stems have been sampled. If 84 or more stems were found to be infested out of the 100 stems sampled, a chemical treatment should be applied. Fields larger than 100 acres should be divided in half and scouted as two separate fields.

Although the most serious damage occurs prior to heading, in some cases partial yield loss may be avoided from treating small grains as late as the dough stage. If grain is heading when examined for the first time, a threshold of 25 aphids per head should be used. Refer to Table 5 for a list of chemical treatments for aphid control.

Table 4.
Decision table for incidence count (presence/absence sampling) for cereal aphids in small grains.

No. of tillers examined	Lower stop limit	Upper stop limit
25	19	24
30	23	29
35	28	34
40	32	39
45	36	43
50	41	48
55	45	53
60	49	58
65	54	62
70	58	67
75	62	72
80	67	77
85	71	81
90	76	86
95	80	91
100	if <84 tillers infested, do not treat	otherwise treat with insecticide

From: Elliot, N.C., G.L. Hein and B.M. Shepard. 1994. Chapter 21: Sampling Arthropod Pests of Wheat and Rice. In Handbook of Sampling Methods for Arthropods in Agriculture. CRC Press. Boca Raton, FL. pp. 627-666.

Table 5.
Recommended insecticides for controlling aphids in small grains.*

Insecticide and Formulation	Amount of Formulation to Use / Acre	Active Ingredient (lb / Acre)	Pre-Harvest Interval (days)	Precautions and Remarks	Application and Special Notes
dimethoate (Cygon) 4 EC	½ to ¾ pt	0.25 to 0.38	14 grazing, 35 grain	Use in wheat only. Maximum of 2 applications/ season.	Full coverage is required when using malathion, methyl parathion or parathion. Apply 20 gal or more of spray / acre with ground equipment. The other insecticides are systemic and full coverage is not required; 10 gal of spray / acre is sufficient.
malathion 5 EC	1½ pt	0.94	7		
Lannate (RUP) 1.8 L 2.4 LV 90 SP	1 to 2 pt ¾ to 1½ pt ¼ to ½ lb	0.23 to 0.45	7 grain, 10 grazing or feeding		
Thiodan 3 EC 50 W	1⅓ to 2 pt 1 to 1½ lbs	0.5 to 0.75		Do not feed forage. Do not apply after heads begin to form. Do not exceed 2 applications or 1.0 lb active ingredient/acre/ year.	
Penncap-M (RUP) (encapsulated methyl parathion)	1 to 2 pt	0.25 to 0.5	15	Do not apply to rye	
methyl parathion (RUP) 4 EC	½ to 1½ pt	0.25 to 0.75	15		
Di-Syston (RUP) 15 G	6.7 lb	1	30 grazing or forage, 60 grain	Barley and wheat only. Maximum 2 applications / season.	
Di-Syston (RUP) 8 EC	½ to 1 pt	0.5 to 1	30	**For barley only.** Do not graze. Maximum 2 pt / acre / season.	
Di-Syston (RUP) 8 EC	4 to 12 fl oz	0.25 to 0.75	30	**For wheat only.** Maximum 2 fall and 2 spring applications / season.	

RUP = Restricted Use Pesticide.

**The above chemicals are recommended if economic thresholds are exceeded. Some factors to be considered when reaching a decision regarding the need for chemical control are the life stage and numbers of the pest; the stage, general health and value of the crop; the effect on the natural enemy population; and cost of the treatment.*

This bulletin is part of a series that is being prepared for Michigan wheat producers. Check with your local MSU Extension Office for availability.

- ❑ Wheat variety and seed selection
- ❑ Seeding practices for wheat in Michigan
- ❑ Direct drilling and minimum tillage for wheat
- ❑ Growth stages and wheat management
- ❑ Wheat fertility and fertilization
- ❑ Weed control in wheat
- ❑ **Insect management in wheat and other small grains**
- ❑ Wheat diseases and their control
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