

## WHEAT INSECTS

**Other Resources Available Through NDSU Extension Service:**

Publications	E493	Aphid Management in Small Grains, Corn and Sorghum (1993)
	E830	The Armyworm and the Army Cutworm (2000)
	E1230	Cereal Leaf Beetle Management (2002)
	PP680	Wheat Stem Infesting Insects in North Dakota (1989)
	E1007	Biology and Management of Barley Thrips (1991)
	E272	Grasshopper Management (1997)
	E188	Wireworm Control (2001)

### APHID

**Wheat aphid descriptions:**

**Greenbug** - pale green with darker stripe down back.

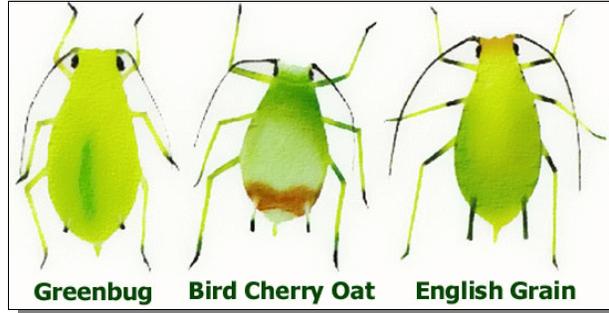
**Bird Cherry Oat Aphid** - olive green, brownish patch at the base of cornicles.

**English Grain Aphid** - bright green with long black cornicles.

The greenbug, English grain aphid and bird cherry oat aphids are the principle species that cause problems in North Dakota small grains. None of these aphids are known to overwinter in North Dakota; they migrate to the region from the South in late spring.

The greenbug is the most injurious because it injects a toxin with its saliva during feeding. The English grain aphid is the most common aphid seen in small grains. Its populations grow rapidly

when feeding on wheat heads. The bird cherry oat aphid feeds primarily on leaves in the lower part of the small grain plant. These aphids transmit barley yellow dwarf virus. When aphid populations are high, the disease can spread through small grain fields. At greatest risk are later planted fields which attract migrating aphids that are moving from more mature fields.



**Thresholds for Wheat: English Grain, Bird Cherry Oat, Greenbug**

To protect small grains from yield loss due to aphid feeding, the treatment threshold is 85% stems with more than one aphid present or 12-15 aphid per stem, prior to complete heading. Field scouting should begin at stem elongation and continue up to the heading stage of wheat. Aphid populations at or above the thresholds during these growth stages will result in economic injury to plants.

The greatest risk of yield loss from aphids feeding on grains is in the vegetative to boot stages. Significant yield reductions after the onset of flowering could not be demonstrated in research published from South Dakota in 1997 (Voss et al., 1997. J of Economic Entomology 90: 1346-1350). Reasons for these conclusions were that: after heading the only major yield component aphids can affect is seed weight; aphids are unable to sustain the very large populations necessary to achieve significant impact on this factor. Other components of yield are determined earlier (number of spikelets - determined at jointing; number of seeds - determined at flowering).

**Russian Wheat Aphid (RWA):**

15% to 20% of tillers infested up to flowering; 20+% infested tillers from flowering to early milk stage

**Note:** A tiller is infested whether it has one or several RWA present. **RWA have only been found in southwest North Dakota during late summer; no economic damage has been reported. No RWA have been reported in North Dakota since the early '90s. Occasionally, RWA have overwintered during mild winters in Montana.**

**Natural Controls:**

Lady beetles, aphid lions, syrphid fly larvae, and parasitoid wasps play a major role in reducing aphid populations. When natural enemies are present in large numbers, and the crop is well developed, farmers are discouraged from spraying fields.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
beta-cyfluthrin Baythroid XL	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
RUP			

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>carbofuran</b> Furadan 4F (Greenbug and RWA only) <i>RUP</i>	0.25	8 fl oz	Apply prior to heads emerging from the boot. Minimum gals required are 10 GPA by ground and 2 GPA by air.
<b>chlorpyrifos + gamma- cyhalothrin</b> Cobalt <i>RUP</i>	0.14 - 0.25 + 0.003 - 0.004	7 - 13 fl oz	PHI = 14 days for forage and hay, 28 days for grain and straw. Do not make more than 2 applications or apply more than 25 fl oz in a single application. Do not feed straw from treated wheat within 30 days of application.
<b>chlorpyrifos</b> Lorsban 4E <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	PHI = 28 days. Do not allow livestock to graze within 14 days of application or feed straw from treated wheat within 28 days of application. Do not make more than 2 applications per season.
<b>chlorpyrifos</b> Warhawk <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	
<b>chlorpyrifos</b> Yuma 4E <i>RUP</i>	0.25 - 0.5	0.5 - 1 pt	
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.028 - 0.038	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>dimethoate</b> Digon 400, Dimethoate 400	0.25 - 0.5	0.5 - 0.75 pt	PHI = 35 days, or graze within 14 days of last application. Do not make more than two applications per season.
<b>lambda-cyhalothrin</b> Lambda-Cy <i>RUP</i>	0.02 - 0.03 (suppression)	2.56 - 3.84 fl oz (suppression)	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai (7.68 fl oz) per acre per season.
<b>lambda-cyhalothrin</b> Taiga Z <i>RUP</i>	0.02 - 0.03 (suppression)	2.56 - 3.84 fl oz (suppression)	
<b>lambda-cyhalothrin</b> Warrior <i>RUP</i>	0.02 - 0.03 (suppression)	2.56 - 3.84 fl oz (suppression)	
<b>malathion</b> Malathion 57EC	0.9 - 1.25	1.5 - 2 pts	PHI = 7 days. Do not apply below 60° F.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.225 - 0.45	12 - 24 fl oz	PHI = 7 days or feed treated forage within 10 days of application.
<b>methyl parathion</b> <i>RUP</i>	0.25 - 1.5	0.5 - 1.5 pt	PHI = 15 days of harvest or grazing. To avoid injury to bees, do not apply during pollen shed if bees are visiting the areas to be treated during foraging hours. Do not enter treated fields within 48 hours after application.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>methyl parathion</b> PennCap-M <i>RUP</i>	0.5 - 0.75	2 - 3 pts	

*RUP* - Restricted use pesticide

## ARMYWORMS

Armyworm outbreaks in North Dakota can occur when large migrations of moths from Southern states occur in late spring and early summer. Moths prefer to lay eggs in moist, shady areas where small grains or grasses have lodged or been damaged by hail or wind. Armyworms feed at night and hide under vegetation or in loose soil during the day. To scout for armyworms in grains, part the plants and inspect the soil for fecal pellets. If pellets or feeding damage is found, look for larvae under plant trash, soil clods or in soil cracks.

### Threshold for Wheat:

Treat when 4 to 5 or more worms per square foot are present.

### Migrating Armyworms:

Treat a couple of swaths ahead of the infestation in the direction of movement to form a barrier strip.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>carbaryl</b> Sevin	1 - 1.5	rate varies by formulation	PHI = 21 days. Do not make more than 2 applications after the boot stage.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt <i>RUP</i>	0.25 - 0.49 + 0.004 - 0.009	13 - 25 fl oz	PHI = 14 days for forage and hay, 28 days for grain and straw. Do not make more than 2 applications or apply more than 25 fl oz in a single application. Do not feed straw from treated wheat within 30 days of application.
<b>chlorpyrifos</b> Lorsban 4E <i>RUP</i>	0.5	1 pt	PHI = 28 days. Do not allow livestock to graze or feed within 14 days of last application. Do not make more than 2 applications per season.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.028 - 0.038	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>gamma-cyhalothrin</b> Proaxis <i>RUP</i>	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 30 days. When applying by air, apply in a minimum of 2 gals of water per acre.
<b>lambda-cyhalothrin</b> Lambda-Cy <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai (7.68 fl oz) per acre per season.
<b>lambda-cyhalothrin</b> Taiga Z <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>lambda-cyhalothrin</b> Warrior	0.02 - 0.03	2.56 - 3.84 fl oz	
<i>RUP</i>			
<b>malathion</b> Malathion 57EC	1.25	2 pts	PHI = 7 days.
<b>methomyl</b> Lannate LV	0.225 - 0.45	12 - 24 fl oz	PHI = 7 days or feed treated forage within 10 days of application.
<i>RUP</i>			
<b>methyl parathion</b> Methyl parathion 8EC	0.5	8 fl oz	PHI = 15 days. Do not enter treated fields within 48 hours of application.
<i>RUP</i>			
<b>methyl parathion</b> PennCap-M	0.5 - 0.75	2 - 3 pts	
<i>RUP</i>			
<b>spinosad (microbial)</b> Entrust (suppression only)	0.05 - 0.1	1 - 2 oz	Do not apply more than 5.6 oz (0.28 lb a.i.) per acre per season. PHI = 21 days for grain and straw harvest or within 3 days of forage or hay harvest.
<b>spinosad (microbial)</b> Success	0.047 - 0.094	3 - 6 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest. Do not apply more than a total of 19 fl oz per acre per season.. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>spinosad (microbial)</b> Tracer	0.031 - 0.094	1 - 3 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest.
<b>zeta-cypermethrin</b> Mustang Max	0.011 - 0.025	1.76 - 4 fl oz	PHI = 14 days of grain, forage, or hay harvest.
<i>RUP</i>			

*RUP* - Restricted use pesticide

## CEREAL LEAF BEETLE

The cereal leaf beetle is an imported insect pest from Europe. This insect has just been found in **Williams and McKenzie counties of North Dakota**. It was first detected in Michigan in 1962, Utah in 1984, and Montana in 1989. The cereal leaf beetle is a serious pest of barley and wheat in Montana. Both adults and larvae of the cereal leaf beetle damage grain crops through their foliar feeding. The larvae are the most damaging stage and the target of control measures. Generally, the newer plant tissue is preferred with feeding occurring on the upper leaf surface causing characteristic elongated slits.

### Monitoring and Treatment Threshold:

The first sign of CLB activity in the spring is adult feeding damage on the plant foliage. While this is the first sign of adult activity, adults are not the target of control. Eggs and larvae are monitored by plant inspection since thresholds are expressed as egg and larvae numbers per plant or per stem. Examine 10 plants per location and select 1 location for every 10 acres of field. Count number of eggs and larvae per plant (small plants) or per stem (larger plants) and get an average number of eggs and larvae, based on the samples you have taken.

Boot stage is a critical point in plant development and impact of cereal leaf beetle feeding damage can be felt on both yield and grain quality. **Before boot stage**, the threshold is: three 3 eggs and larvae or more per plant (including all the tillers present before the emergence of the flag leaf). Larvae feeding in early growth stages can have a general impact on plant vigor. When the flag leaf emerges, feeding is generally restricted to the flag leaf which can significantly impact grain yield and quality. The threshold is decreased **at the boot stage** to: 1 larvae or more per flag leaf.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL	0.008 - 0.014	1.0 - 1.8 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<i>RUP</i>			

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>carbaryl</b> Sevin (XLR Plus, 4F, 4-Oil)	1.0	2 pt	PHI = 21 days for grain or within 7 days of grazing.
Sevin 80S	1.0	1.25 pt	
<b>carbofuran</b> Furadan 4F	0.25	0.5 pt	Apply prior to heads emerging from the boot. Minimum gals required are 10 GPA by ground and 2 GPA by air.
<i>RUP</i>			
<b>chlorpyrifos + gamma-</b> <b>cyhalothrin</b> Cobalt	0.25 - 0.49 + 0.004 - 0.009	13 - 25 fl oz	PHI = 14 days for forage and hay, 28 days for grain and straw. Do not make more than 2 applications or apply more than 25 fl oz in a single application. Do not feed straw from treated wheat within 30 days of application.
<i>RUP</i>			
<b>chlorpyrifos</b> Lorsban 4E	0.5	1 pt	PHI = 28 days. Do not allow livestock to graze or feed within 14 days of last application. Do not make more than 2 applications per season.
<i>RUP</i>			
<b>cyfluthrin</b> Tombstone Tombstone Helios	0.016 - 0.028	1.0 - 1.8 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<i>RUP</i>			
<b>gamma-cyhalothrin</b> Proaxis	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 30 days. Do not apply more than 0.03 lb ai (7.7 oz) per season.
<i>RUP</i>			
<b>lambda-cyhalothrin</b> Lambda-Cy	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai (7.68 fl oz) per acre per season.
<b>lambda-cyhalothrin</b> Taiga Z	0.02 - 0.03	2.56 - 3.84 fl oz	
<i>RUP</i>			
<b>lambda-cyhalothrin</b> Warrior	0.02 - 0.03	2.56 - 3.84 fl oz	
<i>RUP</i>			
<b>malathion</b> Malathion ULV	0.3-0.6	4 - 8 oz	PHI = 7 days. Treatment is most effective at temperatures over 70° F.
<b>methomyl</b> Lannate LV	0.225-0.45	0.75 - 1.5 pt 0.25 - 0.5 lbs	PHI = 7 days, or 10 day to graze. There is a 24-hour re-entry interval.
<i>RUP</i>			
<b>spinosad (microbial)</b> Tracer	0.031 - 0.094	1 - 3 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest.
<b>spinosad (microbial)</b> Success	0.031 - 0.094	2 - 6 fl oz	PHI = 21 days of grain or straw harvest or within 14 days of forage or hay harvest. Do not apply more than a total of 19 fl oz per acre per season.. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>zeta-cypermethrin</b> Mustang Max	0.011 - 0.025	1.76 - 4 fl oz	PHI = 14 days of grain, forage, or hay harvest.
<i>RUP</i>			

*RUP - Restricted use pesticide*

## CUTWORMS

Several cutworm species affect regional crops. In western North Dakota, the pale western cutworm and the army cutworm are important pests of small grains. Eggs of pale western hatch in the spring and larvae feed underground. Eggs of the army cutworm hatch in the fall and spring feeding is above ground. In eastern North Dakota, the Dingy cutworm, *Feltia jaculifera*, overwinters as a partially grown larva and is one of the first cutworm species to cause problems during crop emergence from early to mid-May. The moth of the dingy cutworm is known to lay her eggs on sunflower heads from mid-July through September. Crops following sunflowers in rotation are at greatest risk of injury by this cutworm. Other cutworms, the red-backed, *Exoa ochregaster*, and the darksided, *Exoa messoria*, overwinter as eggs which hatch in mid to late May. Eggs are laid in the fall and survive in weedy, wet, and reduced-tillage areas. Feeding injury by these cutworms normally occurs in late May to early June.

### Management and Thresholds in Wheat:

Treatment is recommended when cutworms number 4 to 5 per square foot.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL  <i>RUP</i>	0.008 - 0.014	1.0 - 1.8 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Maximum number of applications per season = 2. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>chlorpyrifos + gamma-cyhalothrin</b> Cobalt  <i>RUP</i>	0.25 - 0.49 + 0.004 - 0.009	13 - 25 fl oz	PHI = 14 days for forage and hay, 28 days for grain and straw. Do not make more than 2 applications or apply more than 25 fl oz in a single application. Do not feed straw from treated wheat within 30 days of application.
<b>chlorpyrifos</b> Lorsban 4E  <i>RUP</i>	0.5	1 pt	PHI = 28 days. Do not allow livestock to graze within 14 days of application or feed straw from treated wheat within 28 days of application. Do not make more than 2 applications per season. Control may be reduced under high temperatures and dry soil conditions, or if larvae are more than ½ inch long. Suppression only.
<b>chlorpyrifos</b> Warhawk  <i>RUP</i>	0.5	1 pt	
<b>chlorpyrifos</b> Yuma 4E  <i>RUP</i>	0.5	1 pt	
<b>cyfluthrin</b> Tombstone Tombstone Helios  <i>RUP</i>	0.016 - 0.028	1.0 - 1.8 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Maximum number of applications per season = 2. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<b>gamma-cyhalothrin</b> Proaxis  <i>RUP</i>	0.0075 - 0.0125	1.92 - 3.2 fl oz	PHI = 30 days. When applying by air, apply in a minimum of 2 gal water/A.
<b>lambda-cyhalothrin</b> Lambda-Cy  <i>RUP</i>	0.015 - 0.025	1.92 - 3.2 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 days after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai (7.68 fl oz) per acre per season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
lambda-cyhalothrin Taiga Z	0.015 - 0.025	1.92 - 3.2 fl oz	
<i>RUP</i>			
lambda-cyhalothrin Warrior	0.015 - 0.025	1.92 - 3.2 fl oz	
<i>RUP</i>			
zeta-cypermethrin Mustang Max	0.008 - 0.025	1.28 - 4 fl oz	PHI = 14 days of grain, forage, or hay harvest.
<i>RUP</i>			

*RUP* - Restricted use pesticide

## GRASSHOPPERS

In the Northern Plains, grasshopper egg hatch normally begins in late April to early May. Peak hatch occurs about mid-June. Heavy infestations typically occur in areas of low rainfall or during drought years. Outbreaks are usually preceded by several years of hot, dry summers and warm falls. Cool, wet weather increases disease occurrence and delays development of grasshoppers, reducing the overall population.

### Cultural Control Methods:

- Early seeding** - Allows for early establishment and vigorous growth of plants.
- Crop rotation** - Avoid planting in areas of high egg deposits. Fields with late-maturing crops or green plant cover attract adults which then lay eggs.
- Tillage** - Summer fallow will act as a trap crop, attracting females for egg laying. Spring tillage of these sites will reduce successful emergence of nymphs.

### Grasshopper Thresholds: Infestation Ratings

Rating	Nymphs (young hoppers) per square yard		Adults per square yard	
	Margin	Field	Margin	Field
Light	25-35	15-23	10-20	3-7
Threatening	50-75	30-45	21-40	8-14
Severe	100-150	60-90	41-80	15-28
Very Severe	200+	120	80+	28+

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
beta-cyfluthrin Baythroid XL	0.014 - 0.019	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<i>RUP</i>			
carbaryl Sevin	0.5 - 1.5	rate varies by formulation	PHI = 21 days. Do not make more than 2 applications after the boot stage. No limitations on forage. The lower rate (0.5 lb) is suggested for nymphs on small plants or sparse vegetation. The higher rate is suggested for mature grasshoppers.
carbofuran Furadan 4F	0.125 - 0.25	0.25 - 0.5 pt	Apply before heads emerge from boot. Do not make more than 2 applications/season. Use a minimum of 10 gal of finished spray/acre with ground equipment and 2 gal/acre with aerial equipment. Do not feed treated forage to livestock. Do not apply in proximity to waterfowl nesting or feeding areas.
<i>RUP</i>			

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorpyrifos + gamma- cyhalothrin</b> Cobalt	0.14 - 0.25 + 0.003 - 0.004	7 - 13 fl oz	PHI = 14 days for forage and hay, 28 days for grain and straw. Do not make more than 2 applications or apply more than 25 fl oz in a single application. Do not feed straw from treated wheat within 30 days of application.
<i>RUP</i>			
<b>chlorpyrifos</b> Lorsban 4E	0.25 - 0.5	0.5 - 1 pt	PHI = 28 days. Do not allow livestock to graze within 14 days of application or feed straw from treated wheat within 28 days of application. Do not make more than 2 applications per season.
<i>RUP</i>			
<b>chlorpyrifos</b> Warhawk	0.25 - 0.5	0.5 - 1 pt	
<i>RUP</i>			
<b>chlorpyrifos</b> Yuma 4E	0.25 - 0.5	0.5 - 1 pt	
<i>RUP</i>			
<b>cyfluthrin</b> Tombstone Tombstone Helios	0.028 - 0.038	1.8 - 2.4 fl oz	PHI = 30 days. Pre-grazing or foraging interval = 7 days of last application. Maximum of 4.8 fl oz per acre per season. Maximum of 2.4 fl oz per acre between 3-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air.
<i>RUP</i>			
<b>dimethoate</b> Digon 400M, Dimethoate 400	0.38	0.75 pt	PHI = 35 days. Do not allow graze within 14 days of last application. Do not make more than 2 applications per season.
<b>gamma-cyhalothrin</b> Proaxis	0.01 - 0.015	2.56 - 3.84 fl oz	PHI = 30 days. Proaxis may be used in bordering, non-crop areas not hayed or grazed
<i>RUP</i>			
<b>lambda-cyhalothrin</b> Lambda-Cy	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 day after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai (7.68 fl oz) per acre per season.
<i>RUP</i>			
<b>lambda-cyhalothrin</b> Taiga Z	0.02 - 0.03	2.56 - 3.84 fl oz	
<i>RUP</i>			
<b>lambda-cyhalothrin</b> Warrior	0.02 - 0.03	2.56 - 3.84 fl oz	
<i>RUP</i>			
<b>malathion</b> Malathion (ULV)	0.48	8 fl oz/acre (95% concentrate)	Commercial aerial applicators only. PHI = 7 days.
<b>malathion</b> Malathion 57EC	0.9 - 25	1.5 - 2 pts	PHI = 7 days. No time limitation on grazing or straw for dairy or slaughter animals.
<b>methyl parathion</b> PennCap-M	0.5 - 0.75	2 - 3 pts	PHI = 15 days. Do not enter treated fields within 48 hours after application.
<i>RUP</i>			
<b>methyl parathion</b>	0.375 - 0.5	0.75 - 1 pt	
<i>RUP</i>			

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
zeta-cypermethrin Mustang Max	0.02 - 0.025	3.2 - 4 fl oz	PHI = 14 days of grain, forage, or hay harvest.

RUP

RUP - Restricted use pesticide

## HESSIAN FLY

The Hessian fly overwinters as a maggot or pupa in winter wheat, volunteer grain, and wheat stubble. Overwintering maggots pupate and emerge as adults from April to May, infesting fall and spring planted wheat. By June, maggots pupate (flaxseed stage), emerging as adults in August to lay eggs for the overwintering generation.

Managing Hessian Fly:

**Winter wheat planting date** . . . Winter wheat will act as a bridge to get Hessian fly from one season to the next. Delaying planting in the fall should reduce the risk of infestations. Suggested planting dates for ND are: north - August 25 to September 15; south - September 1 to 20.

**Tillage** . . . Burying stubble and destroying volunteer grain after the first killing frost or early in the spring before fly emergence helps suppress adult populations.

**Rotation** . . . Rotate wheat with nonsusceptible crops (oats, corn, soybean, sunflower, flax).

**Resistant varieties** . . . Two South Dakota releases, Guard and Shield, are hard red spring wheats. They are semi-dwarf varieties. Guard is reported to be prone to shattering.

**Chemical control** . . . Thimet and Cruiser are registered as a planting time treatment and as a seed treatment for wheat, respectively. However, population levels of this pest would rarely warrant the need for such treatments in North Dakota.

## ORANGE WHEAT BLOSSOM MIDGE (WHEAT MIDGE)

Though infestation pressure from this insect has declined, it remains an economic concern in North Dakota. Since 1996, wheat midge has been detected in all areas east and north of the Missouri River. A contributing factor to the recent outbreaks was delayed planting of wheat due to excessively wet soils in the spring. Any factor which results in having heading wheat present in the fields during midge emergence will put a wheat crop at risk to infestation.

The adult midge is active from late June to early August. Peak activity is from late June to mid-July. A model using daily temperatures to calculate degree day accumulations allows for a more accurate prediction of local adult emergence. Wheat is attractive for egg laying by midge from the time the head emerges from the boot through flowering. Insecticides for the control of midge are effective on the adult and impact the egg stage; however, control of the orange larvae, which feed on the developing kernels, has not been demonstrated due to protection within the glume.

### Degree Days as a Tool for Wheat Midge Management

Based on data from Canada, the threshold temperature for wheat midge development is 40° F. Observations indicate the following DD accumulations for events in the midge population.

DD	Biological Event
450	the midge breaks the larval cocoon and moves close to soil surface to form the pupal cocoon
1300	10% of the females will have emerged
1475	about 50% of the females will have emerged
1600	about 90% of the females will have emerged

### Identifying Wheat Fields at Risk for Midge Infestation

Based on North Dakota field observations, midge larval infestations were the greatest when heading occurred during peak female emergence (1475 DD). When using 40° F as a threshold for wheat development (*normally wheat development is monitored with 32 degrees*), heading occurs around 1000 - 1100 DD. Using this information, the following midge activity is expected based on degree day accumulations at time of wheat planting. There is a wheat growth and midge emergence model available through the North Dakota Agricultural Weather Network (NDAWN) Internet site and can be found at:

<http://ndawn.ndsu.nodak.edu>

Wheat Midge Degree Days Used as a Guideline for HRSW Risk Assessment
HRSW planted <b>PRIOR</b> to accumulating <b>200 DD</b> will head before wheat midge emerge.
HRSW planted <b>FROM 200 to 600 DD</b> will be heading at the time wheat midge are emerging.
HRSW planted <b>AFTER 600 DD</b> will head after peak emergence and should be at low risk to midge infestation (higher risk of frost, however).

**Thresholds for Wheat:**

Examine wheat heads at dusk (9 p.m. and later when temperatures are above 60° F and wind speed less than 6 mph). The orange-colored adult midge can be seen laying eggs on the wheat heads. Plants are susceptible as the head emerges from the boot. In general, **Hard Red Spring Wheat** treatment is warranted when 1 or more midge are observed for every 4 or 5 heads. **Durum Wheat** treatment is warranted when 1 or more midge are observed for every 7 or 8 wheat heads. Treatments after 50% of the first heads have flowered are not recommended due to reduced levels of efficacy and for the protection of a parasitic wasp that attacks the midge eggs.

**Detecting adult midge:**

Sticky traps may be used to capture adult midges active in wheat fields. A simple trap design would be a white styrofoam plate, attached to the top and bottom of a surveyors flag. The trapping surface can be coated with Tanglefoot® or vegetable oil. The trap can alert an individual to the presence of midge and their identity, but it does not provide information about the need to treat.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>chlorpyrifos + gamma- cyhalothrin</b> Cobalt  <i>RUP</i>	0.25 - 0.49 + 0.004 - 0.009	13 - 25 fl oz	PHI = 14 days for forage and hay, 28 days for grain and straw. Do not make more than 2 applications or apply more than 25 fl oz in a single application. Do not feed straw from treated wheat within 30 days of application.
<b>chlorpyrifos</b> Lorsban 4E  <i>RUP</i>	0.5	1 pt	PHI = 28 days. Do not allow livestock to graze within 14 days of application or feed straw from treated wheat within 28 days of application. Do not make more than 2 applications per season.
<b>chlorpyrifos</b> Warhawk  <i>RUP</i>	0.5	1 pt	
<b>chlorpyrifos</b> Yuma 4E  <i>RUP</i>	0.5	1 pt	
<b>lambda-cyhalothrin</b> Lambda-Cy  <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 30 days. Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 days after last treatment. Do not feed straw to meat or dairy animals within 30 days after last treatment. Do not apply more than 0.06 lb ai (7.68 fl oz) per acre per season.
<b>lambda-cyhalothrin</b> Taiga Z  <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	
<b>lambda-cyhalothrin</b> Warrior  <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	
<b>methyl parathion</b> PennCap-M  <i>RUP</i>	0.5 - 0.75	2 - 3 pts	PHI = 15 days. Do not enter treated fields within 48 hours after application.

*RUP* - Restricted use pesticide

**WHEAT STEM MAGGOT**

The maggot tunnels in stems of wheat, resulting in a white head that can be easily pulled out of the boot. This damage becomes evident after flowering. Infestations rarely exceed 2% and fail to become an economic concern. Crop rotation and destruction of volunteer grain are the most effective methods of reducing maggot populations. No chemical control is recommended or available.

## WHEAT STEM SAWFLY

Sawfly damage occurs annually in North Dakota. This insect primarily affects wheat in the central and western areas of the state. The larvae tunnel in the stem, reducing grain yield by 10% to 14%. Additional loss occurs when infested stems lodge, rendering the grain unharvestable. Larvae overwinter in the wheat stubble making infested sites the source of next year's problems.

### Managing Wheat Stem Sawfly:

**Chemical control** . . . None is currently recommended.

**Harvesting** . . . Swath the most heavily infested fields at 30% to 35% moisture before significant lodging occurs. This requires field surveys to determine infestation levels. Infested stems have a reddish-brown spot below the second or third node. Examine 50 consecutive stems in a drill row from at least two sites (one near the field margin, another near the center). Determine the percent of stems infested at each site. If >6% of the stems are infested, swath to reduce lodging losses within infested sites.

**Fall tillage** . . . A shallow fall tillage to dislodge stubble and leave it on the soil surface can result in 90% mortality of overwintering larvae. Tillage can be limited to areas where surveys indicated infestations within the field or strip.

**Crop rotation** . . non-host crops are oats, flax, sunflower, legumes, and to a lesser extent barley, rye, durum or winter wheat.

**Resistant wheat varieties** . . . Resistant wheats have a solid stem trait which is unsuitable for sawfly development. **Wheat Stem Sawfly Resistant Wheat Variety Descriptions**

Variety	Type <sup>1</sup>	Height	Origin <sup>2</sup>	Year Released	Straw Strength	Maturity	Test Weight	Protein	Yield <sup>3</sup>
<b>Older varieties that were released prior to 1990 (may be difficult to find):</b>									
Cutless	HRS	semidwarf	NDAES	1986	med	med early	high	avg	Med
Glenman	HRS	semidwarf	MAES	1985	strong	med	avg	low	High
Fortuna	HRS	standard	NDAES & MAES	1966	med	med	high	avg	High
Lew*	HRS	standard	MAES & ARS	1976	med	med	high	low	High
Leader	HRS	standard	AC	1981	med	med	high	high	Med
Rambo	HRS	semidwarf	WPB	1986	very strong	med early	high	avg	High
Tioga	HRS	standard	NDAES & ARS	1974	med	med	high	avg	Low
<b>Newer varieties that were released after 1990:</b>									
AC Abbey	HRS	standard	AC	1998	med	med	high	high	High
AC Eatonia	HRS	standard	AC	1996	med	med	high	high	High
AC Lilian	HRS	standard	AC	2006	med	med	high	high	High
Agawam	HWS	semidwarf	WPB		strong	med	high	avg	Very High
Choteau	HRS	semidwarf	MAES	2003	strong	med	avg	high	High
Ernest	HRS	standard	NDAES	1995	med	med	high	high	High
Explorer*	HWS	semidwarf	MAES	2002	strong	med	high	high	High
Genou	HRW	standard	MAES	2004	strong	med	high	high	High
Rampart	HRW	standard	MAES	1996	med	med	high	high	High
Vanguard	HRW	standard	MAES	1995	med	med	avg	high	High

\*indicates semi-solid lines that provide partially resistance.

<sup>1</sup>HRS = Hard Red Spring Wheat, HRW = Hard Red Winter Wheat, HWS = Hard White Spring Wheat..

<sup>2</sup>AC = Agriculture Canada, ARS = Agriculture Research Service (USDA), MAES = Montana Agricultural Experiment Station, NDAES = North Dakota Agricultural Experiment Station, WPB = Western Plant Breeders, Inc.

<sup>3</sup>Yields are relative to sawfly resistant varieties.

## WIREWORMS

Gaucho (imidacloprid) and Cruiser (thiamethoxam) are now labeled for application to barley planting seed for wireworm management. Please refer to the seed treatment section in the introduction for more information.

**Caution:** Do not use treated seed for feed or food purposes. Prevent the contamination of commercial grain by thoroughly cleaning bins, grain augers and trucks that have been used to store, handle and/or home treat seed.