**Western Committee on Crop Pests Guide to Integrated Control of Insect Pests of Crops**

# INSECT MANAGEMENT IN
# CEREAL CROPS AND GRAIN CORN

**John Gavloski**; Manitoba Agriculture, Food and Rural Initiatives
and **Owen Olfert**; Agriculture and Agri-Food Canada

Last Updated: February 2013

## APHIDS (Homoptera: Aphididae)

**Economic Thresholds:** 12 – 15 aphids / stem prior to the soft dough stage.

**Damage -**

**English grain aphid (*Sitobion avenae*) -** 70/head reduced kernel weights of wheat in the milk and early dough stages by 8%. Populations of aphids decreased rapidly as the heads matured. (l,5)

**Oat-birdcherry aphid (*Rhopalosiphum padi*)** carrying barley yellow dwarf virus reduced yields of dry forage and protein of oats and barley by over 50%. The viruliferous aphids reduced height of barley and oats, the number of tillers of barley, and the leaf width of oats. (2) Herta barley infected with barley yellow dwarf virus transmitted by grain aphids had an average loss of 65% in the weight of seeds per infected head. (3)

**Greenbug (*Schizaphis graminum*) -** 20 to 30 aphids on seedling plants can reduce yield by as much as 60%. Higher populations can kill plants. Greenbugs inject toxin into plant. The toxin and feeding damage leaves, retard root growth, cause stunting, abnormal tillering, and improper filling of heads. (6)

**Corn leaf aphid (*Rhopalosiphum maidis*) -** Heavy infestations on barley caused severe damage before boot stage but no effect if infested after the boot stage. (5)

**Cultural control -**

Greenbug has been observed to settle in greater numbers in fields with more bare soil and less cover, for example with straw residue. (7)

**Biological Controls-**

For aphids found on cereal crops, a study in Manitoba found that the number eaten by one lady beetle in 24 hours depended on the species of lady beetle and the species of aphid eaten. One female transverse lady beetle, *Coccinella transversoguttata*, ate 168-176 oat-birdcherry aphids in 24 hours, whereas one parenthesis lady beetle, *Hippodamia parenthesis*, consumed 50-67 English grain aphids in 24 hours. (8)

Rain and wind may decrease populations of aphids on cereal crops. (9)

**Chemical control -**

| Insecticide | Rate / ha | Rate / acre | Preharvest Interval (Days) | References |
|---|---|---|---|---|
| **BARLEY, OATS, RYE & WHEAT** | | | | |
| **Malathion** | | | | |
| Malathion 500 | 1.48-1.98 L | 0.60-0.8 L | 7 | - |
| Malathion 85E | 1.10-1.35 L | 0.45-0.54 L | 7 | |
| **Dimethoate** | | | | |
| Cygon (barley, oats, and wheat only) | 0.425 L | 0.17 L | 2 | 1 |
| **CORN ONLY** | | | | |
| **Endosulfan** | | | | |
| Thiodan, Thinoex | 2.75 L | 1.11 L | 50 | |

**Restrictions –**

malathion: Do not apply at air temperatures below 20°C.

**References –**

1. Harper, 1973. J. Econ. Entomol. 66: 1326.
2. Man. Dep. Agric., Publ. 227.
3. Minn. Dep. Agric., Minn. Pest Rep., 1976.
4. N. Dak. Dep. Agric., N. Dak. Pest Rep., 1977.
5. Wells and MacDonald, 1961. Can. J. Plant Sci. 41: 866.
6. Kieckhefer and Kantack, 1980. J. Econ. Entomol. 73: 582.
7. Brooks, H.L. Kansas State University Agricultural Experiment Station, 1989.
8. Malyk and Robinson. 1971. The Manitoba Entomologist. 89-95.
9. Malyk and Robinson. 1971. The Manitoba Entomologist. 79-88.

## ARMYWORMS *Mythimna unipuncta* (Haworth) (Lepidoptera: Noctuidae)

**Monitoring –** Adults: Pheromone lures are available to attract and capture male armyworm moths using either sticky traps (1) or bucket traps (2).
Larvae: Check the soil surface for armyworms, and the plants for feeding, when monitoring in mid-June through early-August. At each stop shake plants and carefully check soil surface for dislodged larvae. During the day larvae may be under plant trash, soil clods or in soil cracks. Check the backs of armyworms for parasite eggs.

**Threshold –**

A nominal threshold is four unparasitized larvae, smaller than 2.5 cm (1 inch) per square foot.For armyworms migrating into the field: Treat a couple of swaths ahead of the infestation in the direction of movement to form a barrier strip.

A study in Arkansas found that at boot and anthesis stages, wheat can sustain up to 75% defoliation by armyworms with little loss in yield, and even at populations that resulted in 75% defoliation head cutting was negligible (3).

**Biological Controls-**

In Ontario, 23 species of primary parasites were reared from armyworms (4); 16 of these species were Hymenoptera and 7 species were Diptera. Fifteen of these species were commonly observed.

**Chemical Control –**

| Insecticide | Rate / ha | Rate / acre | Preharvest Interval (days) | References |
|---|---|---|---|---|
| **BARLEY, OATS AND WHEAT** | | | | |
| **Spinetoram**<br>Delegate | **100 – 200 g** | **40-81 g** | **21** | |
| **Lambda-cyhalothrin**<br>Matador, Silencer | 83 ml | 34 ml | 28 | |
| **Carbaryl**<br>Sevin XLR Plus | 2.5-5.25 L | 1.01-2.12 L | 14 Wheat, Oats<br>28 Barley | 5 |
| **Methomyl**<br>Lannate | 270-540 g | 0.1093-0.2185kg | 20 | 5 |
| **Malathion**<br>Malathion 500<br>Malathion 85E | 1.5-2 L<br>1.10-1.35 L | 0.60-0.80 L<br>0.45-0.54 L | 7<br>7 | 5 |
| **Chlorpyrifos**<br>Lorsban, Pyrinex, Nufos, Citadel | 875 mL-1.2 L | 0.354-0.486 L | 60 | |
| **RYE** | | | | |
| **Spinetoram**<br>Delegate | **100 – 200 g** | **40-81 g** | **21** | |
| **Carbaryl**<br>Sevin XLR Plus | 2.5-5.25 L | 1.01-2.12 L | 14 | 5 |
| **Malathion**<br>Malathion 500<br>Malathion 85E | 1.5-2 L<br>1.10-1.35 L | 0.60-0.80 L<br>0.45-0.54 L | 7<br>7 | 5 |
| **CORN** | | | | |
| **Chlorantraniliprole**<br>Coragen | 250 – 375 ml | 101 – 152 ml | 14 | |
| **Lambda-cyhalothrin**<br>Matador, Silencer | 83 ml | 34 ml | 14 (silage)<br>21 (field corn) | |

**Restrictions** –

malathion: Do not apply at air temperatures below 20°C.
methomyl: Apply to corn as soon as young larvae appear and then at 3 to 5 day intervals.

**References** –

1. Turgeon et al. 1983. Environ. Entomol: 891-894.
2. Hendrix and Showersi. 1990. J. Econ. Entomol. 596-598.
3. Steinkraus and Mueller. 2003. J. Entomol. Sci. 431-438.
4. Guppy. 1967. Can. Entomol. 94-106.
5. Smith, Pest. Res. Rep., 1976:177.

## BROWN WHEAT MITE *Petrobia latens* (Müller)

**Cultural Control –**

Summerfallow; rotation with non-cereal crops. Mites cause greatest injury to grain stress by water requirements. Mite damage is reduced by timely irrigation (2).

**Chemical Control –**

| Insecticide | Rate(g or L/ha) | Rate (g or L/acre) | Preharvest Interval (days) | References |
|---|---|---|---|---|
| **Chlorpyrifos**<br>Lorsban, Pyrinex, Nufos, Citadel | 0.625 L | 0.225 L | 60 | 1 |

**References –**

1. Byers and Charnestski, Pest. Res. Rep. 1987:144.
2. Summers and Godfrey, UC IPM Guidelines, Pub 3339, 2000

## CEREAL LEAF BEETLE *Oulema melanopus* L.(Coleoptera: Chrysomelidae)

**Biological Control-**

The larval parasitoid *Tetrastichus julis* (Walker) (Hymenoptera: Eulophidae) has been released and established in many areas of the Canadian prairies where cereal leaf beetle is present (1).

**Chemical Control-**

| Insecticide | Rate / ha | Rate / acre | Preharvest Interval (days) | References |
|---|---|---|---|---|
| **WHEAT, BARLEY, OATS, RYE** | | | | |
| **Malathion**<br>Malathion 500<br>Malathion 85E | <br>550 ml – 1.1 L<br>1075 ml | <br>223 – 445 ml<br>435 ml | <br>7<br>7 | |

**Refernces-**

1. Kher et al. Prairie Soils and Crops Journal. 2011. 32-41.

## CORN EARWORM *Helicoverpa zea* (Boddie) (Lepidoptera: Noctuidae)

**Monitoring** – Adults: Pheromone lures and traps are available to attract and capture male corn earworm moths.

## Cultural Control-

Resistant Cultivars – Some cultivars of Bt corn are resistant to feeding by corn earworm.

**Chemical Control –**

| Insecticide | Rate / ha | Rate / acre | Preharvest Interval (days) | References |
|---|---|---|---|---|
| **CORN ONLY** | | | | |
| **Chlorantraniliprole**<br>Coragen | 250 – 375 ml | 101 – 152 ml | 14 | |
| **Lambda-cyhalothrin**<br>Matador, Silencer | 83 – 188 ml | 34 ml – 76 ml | 14 (silage)<br>21 (field corn) | |
| **Cypermethrin**<br>Ripcord | 175 ml | 70 ml | 5 | |
| **Carbaryl**<br>Sevin XLR Plus | 2.5-4.0 L | 1.01-1.6 L | 1 | |
| **Malathion**<br>Malathion 85E | 1.10-1.35 L | 0.45-0.54 L | 5 | |
| **Endosulfan**<br>Thionex EC<br>Thiodan | <br>2.75-4 L<br>2.75-4.25 L | <br>1.11-1.62 L<br>1.11-1.72 L | <br>50<br>50 | |

## CUTWORMS Lepidoptera (Noctuidae)

Cutworms: Redbacked (*Euxoa ochrogaster*), Pale western (*Agrotis orthogonia*) and Army (*Euxoa auxiliaris*) cutworms

**Thresholds –**

Pale western cutworm at 8.4 larvae/$m^2$ caused 25% loss in wheat and at 30/$m^2$ caused 100% loss. Control is usually justified when larvae exceed 3-4/$m^2$.

Nominal thresholds for redbacked and army cutworm are somewhat higher at 5-6/$m^2$. Well established fall-seeded crops or spring seeded crops with good moisture conditions can tolerate higher numbers.

**Cultural Control –**

Reduce egg laying by pale western cutworm adults in summerfallow fields by destroying all plant growth in July and allowing field to crust until 15 September. Severely infested fields should be treated before reseeding. In areas where redbacked cutworms are a problem, destroy weedy growth on fallow fields prior to August.

Studies and observations from Alberta show that pale western cutworm populations can be reduced by cultivating the soil and keeping it free of all plant growth for a 10-day period after the cutworms had hatched and before the crop was seeded (9).

**Chemical Control** –

| Insecticide | Rate / ha | Rate / acre | Preharvest Interval (days) | References |
|---|---|---|---|---|
| **WHEAT, BARLEY, OATS** | | | | |
| **Deltamethrin**<br>Decis | 200 ml | 80 ml | 31 (oats)<br>40 (barley, wheat) | 3-6,8,11 |
| **Cypermethrin**<br>Ripcord (wheat and barley only) | 175 ml | 70 ml | 21 | |
| **Permethrin**<br>Pounce, Perm-UP<br>Ambush | 180-390 ml<br>140-300 ml | 73-158 ml<br>57-121 ml | Treat prior to 6-leaf stage | 1,2,6-9, 11, 12 |
| **Chlorpyrifos**<br>Lorsban, Pyrinex, Nufos, Citadel | .875-1.2 L | 0.354-0.486 L | 60 | 1-6,8, 9, 11,12 |
| **RYE** | | | | |
| **Permethrin**<br>Pounce, Perm-UP<br>Ambush | 180-390 ml<br>140-300 ml | 73-158 ml<br>57-121 ml | Treat prior to 6 leaf stage | |
| **CORN** | | | | |
| **Lambda-cyhalothrin**<br>Matador, Silencer | 83 ml | 34 ml | 14 | |
| **Cypermethrin**<br>Ripcord | 175 ml | 70 ml | 21 | |
| **Permethrin**<br>Pounce, Perm-UP<br>Ambush | 180-390 ml<br>140-300 ml | 73-158 ml<br>57-121 ml | Treat prior to 6 leaf stage | |
| **Chlorpyrifos**<br>Lorsban, Pyrinex, Nufos, Citadel | 2.4 L Pre-Plant treatment<br>1.2-2.4 L Seedling treatment | 0.971 L Pre-Plant treatment<br>0.486-0.971 L Seedling treatment | 70 | 1-6,8,11 |

It may take several days for optimum control using insecticides. Not all cutworms will surface to feed on any given night and come in contact with the insecticide on the soil and plants. One of the reasons is that during moulting periods (between larval stages) the cutworms are inactive (10).

Use low rates when larvae are small, high rates later in the season or under dry conditions. Apply in evening if possible. Rain following application is beneficial.

**Restrictions** –

chlorpyrifos: Apply only once per season; do not apply to rye.

Deltamethrin: Do not graze fields. Apply only once per season for cutworms. Do not use at temperatures above 25°C.

**References** –

Army Cutworm

1. McDonald, 1979. J. Econ. Entomol. 72: 277.

Pale Western Cutworm
2. McDonald, 1981. J. Econ. Entomol. 74: 45.
3. Wise et al., Pest. Res. Rep. 1982:183,184
4. Wise, Pest. Rep. 1983:174.
5. Wise, Pest. Rep. 1984:189.
6. Charnetski and Byers, Pest. Res. Rep. 1985:185.
7. Hill and Byers, Pest. Res. Rep. 1985:183,186.
8. Byers and Charnetski, Pest. Res. Rep. 1986:129.
9. Salt and Seamans, 1945. Can. Entomol. 77: 150-155.
10. Byers *et al*. 1992. J. Econ. Entomol. 85: 1146-1149.
Redbacked Cutworm
11. McDonald, 1981. J. Econ. Entomol. 74: 593-596.
12. Philip and Dolinski. Pest. Res. Rep. 1977: 215-216.

## EUROPEAN CORN BORER *Ostrinia nubilalis* (Hübner) (Lepidoptera: Crambidae)

**Monitoring-** Pheromone-baited traps can be used to determine the onset and duration of European corn borer flight, and for initiating surveys of egg masses and shot hole damage (3). There are 2 pheromonal forms of the European corn borer, the Z or Iowa strain and the E strain. In the Canadian prairies, the European corn borer responds to the pheromone of the Iowa strain (4). Delta-type traps were the most satisfactory of several tested for capturing moths under prairie conditions (4).

**Economic Thresholds** –

Economic threshold (Corn borers / plant)

| **Control Costs[1] ($/Acre)** | **Crop Value ($ / Acre)** | | | | | |
|---|---|---|---|---|---|---|
| | **150** | **200** | **250** | **300** | **350** | **400** |
| 6 | 1.00 | 0.75 | 0.60 | 0.50 | 0.43 | 0.38 |
| 9 | 1.50 | 1.12 | 0.90 | 0.75 | 0.64 | 0.56 |
| 12 | 2.00 | 1.50 | 1.20 | 1.00 | 0.86 | 0.75 |
| 15 | 2.50 | 1.88 | 1.50 | 1.25 | 1.07 | 0.94 |
| 18 | 3.00 | 2.25 | 1.80 | 1.50 | 1.29 | 1.13 |
| 21 | 3.50 | 2.63 | 2.10 | 1.75 | 1.50 | 1.32 |
| 24 | 4.00 | 3.01 | 2.40 | 2.00 | 1.72 | 1.51 |
| 27 | 4.50 | 3.38 | 2.70 | 2.25 | 1.93 | 1.70 |

[1]Control costs = insecticide price ($/acre) and application costs ($/acre).

These thresholds are based on a 5% yield loss per corn borer per plant on average. If the majority of larvae have borer into the stalk, do not apply insecticide, as they are ineffective once the larvae have entered the stalk.

Economic injury levels have been developed for European corn borer on corn grown for silage, however these studies were performed in Wisconsin where there are 2 generations of European corn borer (2).

**Cultural Control-**

Resistant Cultivars - Cultivars of Bt corn (which express proteins from *Bacillus thuringiensis*) are resistant to feeding by European corn borer. If planting cultivars of Bt corn, a refuge of non-Bt cultivars is required to be planted to reduce the odds of European corn borer developing resistance to Bt corn. Growers of Bt corn are also required to monitor their crop for the presence of European corn borer and any feeding damage. Details of the scouting requirements can be found at: http:www.cornpest.ca/lib/protocols.cfm

A table of registered *Bt* corn products in Canada (as of September 2011) is available at: http://www.cornpest.ca/index.cfm/bt-corn/registered-bt-hybrids/

Stalk Management – Primary tillage such as chisel plowing or moldboard plowing in the fall can reduce overwintering populations. Mowing corn stalks after harvest can reduce overwintering populations up to 85% (1).

**Chemical Control –**

| Insecticide | Rate / ha | Rate / acre | Preharvest Interval (days) | References |
|---|---|---|---|---|
| ***Bacillus thuringiensis***<br>Dipel 2X DF | 560-1120 g | 0.23-0.45 kg | 0 | |
| **Chlorantraniliprole**<br>Coragen | 250 – 375 ml | 101 – 152 ml | 14 | |
| **Lambda-cyhalothrin**<br>Matador, Silencer | 83 - 187 ml | 34 - 76 ml | 14 (silage)<br>21 (field corn) | |
| **Deltamethrin**<br>Decis | 250-300 ml | 100-120 ml | N/A | |
| **Cypermethrin**<br>Ripcord<br>UP-Cyde | <br>175 ml<br>280 ml | <br>70 ml<br>113 ml | <br>5<br>5 | |
| **Carbaryl**<br>Sevin XLR Plus | 2.5–4.0 L | 1.01-1.6 L | 1 | |
| **Malathion**<br>Malathion 85E | 1.10-1.35 L | 0.45-0.54 L | 5 | |

**Reference –**

1. Schaafsma et al. 1996. J. Econ. Entomol. 89: 1587-1592.
2. Myers and Wedberg. 1999. J. Econ. Entomol. 92: 624-630.
3. Palaniswamy et al. 1990. Can. Ent. 122: 1211-1220.
4. Struble et al. 1987. Can. Ent. 119: 291-299.

## GRASSHOPPERS (Orthoptera: Acrididae)

Pest species:

Species that may damage cereal crops and grain corn in Western Canada include the migratory (*Melanoplus sanguinipes*), twostriped (*Melanoplus bivittatus*), Packard (*Melanoplus packardii*), and clearwinged (*Camnula pellucida*) grasshoppers. The redlegged and blackwinged (Carolina) grasshoppers are rarely pests, but are known to feed on corn, wheat and barley. Do not control grasshoppers unless damage is apparent and thresholds are exceeded. Avoid control actions until hatching of the pest species is nearly complete (usually after ca. June 5). Crop damage is more rapid in warm, dry weather and if the crop is drought-stressed.

Non-pest species:

Do not control any grasshoppers seen before late May or any grasshopper with red, yellow or orange hindwings (seen when flying).

**Economic Thresholds** – (refers to non-irrigated crops during warm, dry weather, June 1 – harvest))

| Control | Field No./$m^2$ | Roadside No./$m^2$ |
|---|---|---|
| Control not usually required | 0-6 | 0-12 |
| May be Required | 7-12 | 13-24 |
| Control usually Required | 13+ | 25+ |

**Damage-**

Two-striped grasshoppers at 5/$m^2$ from boot stage to maturity reduced yield of wheat by 25%. (6)

Ten grasshoppers/0.l $m^2$ caged over wheat at 4-leaf stage destroyed the wheat in 72 hours. (4)

One grasshopper nymph/plant reduced yield by 25-44%. 11-27 /$m^2$ caused no damage, 45/$m^2$ caused 27-43% loss in cage tests (5); 8/$m^2$ clipped 20% of mature heads of wheat, and 16/$m^2$ reduced yields by 23%, 65%, and 62% in 1975. (l)

**Cultural Control** –

- No tillage methods will provide crop protection but fall stubble cultivation has reduced egg pod survival in some cases.
- Barrier strips of a non-preferred crop like oats, seeded at the margin of a field next to an infested area, may slow down young hoppers from invading susceptible crops. (16)
- Destroying green growth on stubble in the spring at the time of hatching may help to starve the young hoppers.
- Traps strips of weeds or barley, left in a summerfallow field adjacent to cropped land, attracts migrating hoppers to the strip where they can be controlled efficiently with insecticides. (17)

**Chemical Control** –

| Insecticide | Rate / ha | Rate / acre | Preharvest Interval (days) | References |
|---|---|---|---|---|
| **WHEAT, BARLEY, OATS** | | | | |
| **Spreadable Bran Baits** | | | | |
| **Carbaryl**<br>Eco bran | 20-40 kg | 0.8-1.6 kg | 14 (oats, wheat)<br>28 (barley) | |
| **Nosema locustae**<br>Nolo Bait | Minimum of 1.12 kg | Minimum of 0.45 kg | 0 | |
| **Sprays** | | | | |
| **Deltamethrin**<br>Decis 5EC | 100-150 ml (ground);<br>150 ml (air) | 40-60 ml (ground)<br>60 ml (air) | 31 (oats)<br>40 (wheat, barley) | 6,8,15,18,19 |
| **Cypermethrin**<br>Ripcord (young grasshoppers only) (wheat and barley only) | 50-70 ml | 20-28 ml | 30 (wheat)<br>45 (barley) | |
| **Lambda-cyhalothrin**<br>Matador, Silencer (young grasshoppers | 63-83 ml (ground),<br>83 ml (aerial) | 25-34 ml (ground)<br>34 ml (aerial) | Do not apply within 28 days of harvest or 14 | - |

| | | | | |
|---|---|---|---|---|
| only) | | | days of livestock foraging | |
| **Carbaryl**<br>Sevin XLR Plus | 1.25-2.5 L | 0.5-1.01 L | 14 (wheat, oats)<br>28 (barley) | 18, 19 |
| **Malathion**<br>Malathion 500<br>Malathion 85E | 1.7 L<br>1.10-1.35 L | 0.68 L<br>0.45-0.54 L | 7<br>7 | |
| **Chlorpyrifos**<br>Lorsban, Pyrinex, Nufos, Citadel | 580-875 ml | 235-354 ml | 60 | 5,6,7,13,14 |
| **Dimethoate**<br>Lagon / Cygon 480EC | Nymphs: 550 ml<br>Adults: 850 ml-1 L | Nymphs- 0.22 L<br>Adults- 0.34-0.40 L | 2 – 28 (see labels) | 4 |
| **RYE** | | | | |
| **Spreadable Bran Baits** | | | | |
| **Carbaryl**<br>Eco bran | 20-40 kg | 0.8-1.6 kg | 14 | |
| **Nosema locustae**<br>Nolo Bait | Minimum of 1.12 kg | Minimum of 0.45 kg | 0 | |
| **Sprays** | | | | |
| **Carbaryl**<br>Sevin XLR Plus | 1.25-2.5 L | 0.5-1.01 L | 14 | |
| **Malathion**<br>Malathion 500<br>Malathion 85E | 850<br>1.10-1.35 L | 0.69 L<br>0.45-0.54 L | 7<br>7 | |
| **Dimethoate**<br>Lagon / Cygon 480EC | Nymphs: 550 ml<br>Adults: 850 ml-1 L | Nymphs- 0.22 L<br>Adults- 0.34-0.40 L | 2 – 28 (see labels) | 4 |
| **CORN** | | | | |
| **Spreadable Bran Baits** | | | | |
| **Carbaryl**<br>Eco bran | 20-40 kg | 0.8-1.6 kg | 1 | |
| **Nosema locustae**<br>Nolo Bait | Minimum of 1.12 kg | Minimum of 0.45 kg | 0 | |
| **Sprays** | | | | |
| **Carbaryl**<br>Sevin XLR | 1.25-2.5 L | 0.50-1.01 L | 1 | |

**Restrictions –**

Sevin XLR: Crop protection reduced under light canopy cover.

Decis and Matador: Do not make more than 3 applications per year (only two applications per year by air). Best control is obtained if application is made when the grasshoppers are in the 2 – 4 nymphal stage.

Malathion: Do not apply at air temperatures below 20°C.

**References –**

1. Jacobson and Farstad, 1941. Can. Entomol. 73: 158.
2. Man. Dep. Agric. Bull., Agdex 605.
3. Pickford and Mukerji, 1974. Can. Entomol. 106: 1219.
4. Holmes et al., 1965. J. Econ. Entomol. 58: 77.

5. Charnetski, Pest. Res. Rep. 1975 : 210.
6. McDonald, Pest. Res. Rep. 1974:7.
7. Rourke and Baudic Fehr, Pest. Res. Rep. 1985:171,176.
8. Stephen and Hagborg, Pest. Res. Rep. 1985:172.
9. Johnson et al., Pest. Res. Rep. 1985:174.
10. Reichardt et al., Pest. Res. Rep. 1986:124.
11. Stephen et al., Pest. Res. Rep. 1986:148.
12. Wise and Scholtz, Pest. Res. Rep. 1986:149.
13. Mackasey et al., Pest. Res. Rep. 1986:147.
14. Rourke and Buth, Pest. Res. Rep. 1986:125.
15. Johnson et al., 1986. J. Econ. Entomol. 79:181-188.
16. Olfert, Grasslands and Grassland Health. 2000: 61-70.
17. Olfert, 1986. Can. Entomol. 118: 133-140.
18. Wise and Long, Pest. Res. Rep. 1985: 180.
19. Leader, Durling and Mader. Pest. Res. Rep. 1986: 153.

## HESSIAN FLY *Mayetiola destructor* (Say) (Diptera: Cecidomyiidae)

**Economic Threshold:** Not established.

**Damage** – Death of individual wheat and barley tillers or of the entire plant may result if numerous larvae are present (more than several per plant). Flaxseed-shaped puparia may be found at the base of plants.

**Cultural Control** –

- Never plant wheat in the same field 2 years in a row in areas where Hessian flies are a problem.
- Winter wheat planted in September will likely be free of Hessian flies.
- Eliminating or reducing volunteer wheat host plants may reduce fly population.
- Early seeded spring wheat is less susceptible to stem breakage caused by Hessian fly than later seeded wheat (1). Crop damage in Manitoba was found to be highest when spring wheat was sown in the first two weeks in June and was caused by the feeding of second generation larvae.
- The spring wheat cultivar Superb is partially resistant to Hessian fly (2,3).

**Chemical Control -**

- No insecticides are registered for the control of Hessian flies in cereals.

**References -**

1. Wise, 2007. Proc. Ent. Soc. Man. 63: 8-22.
2. Wise, Pest Man. Res. Rep. 2003:134-135.
3. Wise *et a*l. 2006. Can. Entomol. 138: 638-646.

## SAY STINK BUG *Chlorochroa sayi* (Heteroptera: Pentatomidae)

**Economic Thresholds** –

l/head of wheat causes losses exceeding 30%. (l)

**Chemical Control** –

| Insecticide | Rate (g or L/ha) | Rate (g or L/acre) | Preharvest Interval (days) | References |
|---|---|---|---|---|
| **Dimethoate**<br>Cygon, Lagon | 550 mL | 223 mL | 21 | 2 |

**References** –

1. Jacobson, Cargill Crop. Bull. 15: 35, 1940.
2. Jacobson and McDonald, Pest. Res. Rep. 1964: 209.

## SEED CORN MAGGOT *Delia platura* (Meigen) (Diptera: Anthomyiidae)

**Chemical Control** –

| Insecticide | Rate | Preharvest Interval (days) | References |
|---|---|---|---|
| **CORN ONLY** | | | |
| **Thiamethoxam**<br>Cruiser Extreme 250 | - | | |
| **Clothianidin**<br>Poncho 250 | 0.25 mg of Poncho 600 per kernel | | |
| **Diazinon**<br>Agrox CD<br>Agrox B-2<br>Diazinon 50W | <br>50 g/25 kg of seed<br>-<br>20 g/ 300 ml water/ 4L of seed | | |

## SPIDER MITES

Spider mites (on corn)

**Chemical Control** –

| Insecticide | Rate / ha | Rate / acre | Preharvest Interval (days) | References |
|---|---|---|---|---|
| **Corn** | | | | |
| **Spiromesifen**<br>Oberon | 400 – 600 ml | 162 – 243 ml | Green forage – 5<br>Grain or stover - 30 | |

## THRIPS (Thysanoptera: Thripidae)

Thrips (on barley, oats, and wheat)

**Monitoring-**

A sequential sampling plan has been developed for barley thrips on barley (1). Adult barley thrips are counted on the top 2 leaf sheaths of barley on a minimum of 9 plants.

Decision limits[a] for cumulative counts of barley thrips adults on the top 2 leaf sheaths of barley.

| No. barley plants sampled | No treatment required | Treatment required |
|---|---|---|
| 9 | 32 | 85 |
| 18 | 80 | 154 |
| 27 | 130 | 221 |
| 36 | 181 | 287 |

[a]If the cumulative count is less than or equal to the lower limit, an insecticide treatment is not recommended.. If the cumulative count is greater than or equal to the upper limit, an insecticide application is recommended. Values between limits indicate a decision cannot be made and another 9 samples must be taken.

**Economic Threshold-**
Research from North Dakota found that one adult barley thrips (*Limothrips denticornis*) per stem of barley resulted in a loss of 0.4 bushels per acre (2).
Treat when thrips are equal to or greater than the number calculated by:
Threshold (Thrips/stem) = (Cost of Control ÷ expected $ value per bushel)/0.4
Insecticide treatments for barley thrips on barley are only economical when applied before heading is complete (3).

**Chemical Control –**

| Insecticide | Rate / ha | Rate / acre | Preharvest Interval (days) | References |
|---|---|---|---|---|
| **WHEAT, BARLEY & OATS** | | | | |
| **Methomyl**<br>Lannate | 300 g | 0.1214 kg | 20 | |
| **Dimethoate**<br>Lagon / Cygon | 1 L | 0.40 L | 7 – 21 (see labels) | 4 |

**References -**

1. Bates *et al*. 1991. J. Econ. Entomol. 1630-1634.
2. Bates *et al*. 1991. NDSU Extension Service : E-1007
3. Post. 1958. Dakota Farmer. 30-31.
4. Butts, Pest. Res. Rep. 1985:144.

## WHEAT MIDGE *Sitodiplosis mosellana* (Géhin) (Diptera: Cecidomyiidae)

**Economic Threshold -**
For yield only: 1 adult midge per 4 to 5 heads. At this level of infestation, common and durum spring wheat yields will be reduced by approximately 15% if the midge is not controlled.
To maintain optimum grade: 1 adult midge per 8 to 10 wheat heads during the susceptible stage.

**Damage –**
Research in Saskatchewan found that infestations of 30, 60 and 90% of kernels infested reduced spring wheat yields by 40, 65 and 80% (1).

**Cultural Control –**

- Rotate Crops – Continuous wheat cropping encourages higher wheat midge populations.

- Midge Tolerant Wheat – the Canadian Western Red Spring wheat varieties AC Goodeve, AC Unity (2), AC Fieldstar, AC Shaw, AC Vesper, CDC Utmost and the CWES variety AC Glencross are resistant to feeding by wheat midge (3), and are sold as variety blends with 10% susceptible wheat mixed in. The CWRS varieties Waskada (4) and 5602HR are less susceptible to damage because of either oviposition deterrence or poor establishment on the seed. Waskada is the refuge variety for the variety blends AC Unity VB, and AC Fieldstar VB.
- Seed alternate crops including barley.
- Farming practices which promote greater crop uniformity during heading and flowering (uniform seeding depth, higher seed rates to reduce tillering) reduce midge kernel damage but may not eliminate the need for chemical control.

**Chemical Control –**

| Insecticide | Rate (g or L/ha) | Rate (g or L/acre) | Preharvest Interval (days) | References |
|---|---|---|---|---|
| **WHEAT ONLY** | | | | |
| **Chlorpyrifos** Lorsban, Pyrinex, Nufos, Citadel | 0.83-1 L | 0.336-0.405 L | 60 | 5,6, 7,8,9 |
| **Dimethoate** Cygon, Lagon | 1 L | 0.40 L | 21 | 5,6,8,9 |

When applied 3 to 6 days after oviposition begins, chlorpyrifos provides ca. 20-30% better kernel protection than carbofuran (presently deregistered) or dimethoate. Sprays should be applied in the late afternoon or evening when temperatures exceed 15°C and the wind speed is less than 10 km/ha. To obtain full benefits from insecticidal sprays, thorough coverage of the wheat heads is essential. In general, application methods which improve the uniformity and amount of spray deposited on wheat heads (higher water volumes, finer spray droplets, $45^0$ nozzle orientation) provide better kernel protection and subsequent grade or yield improvements. Use the higher rate of Lorsban 4E for aerial application, with water volumes of 20-35 L/ha.

**References -**

1. Olfert et al., 1985. Can. Entomol. 117:593-598.
2. Fox et al. 2010. Can. J. Plant Sci. 90: 71-78.
3. Wise et al., 2008. Pest Man. Res. Rep. 100-102.
4. Fox et al. 2009. Can. J. Plant Sci. 89: 929-936.
5. Dexter et al., 1987. Can. J. Plant Sci. 67:697-712.
6. Elliot, 1988. Can. Entomol. 120:615-626.
7. Wise and Leader, Pest. Res. Rep. 1985:181-182.
8. Sask. Ag. Midge Bull. 1988. 2 pp.
9. Elliot, 1988. Can. Entomol. 120:941-954.

## WHEAT STEM SAWFLY *Cephus cinctus* Norton (Hymenoptera: Cephidae)

**Economic Thresholds -**

Control required if 10-15% of crop in previous year is cut by sawfly. Infested stems of wheat averaged 17% (11-22%) loss in yield. (1)

**Cultural Control -**

Solid-stem wheat varieties (such as the hard red spring wheat varieties AC Lillian, AC Abbey, and AC Eatonia) can reduce damage by wheat stem sawfly larvae compared to susceptible varieties (2, 3, 4), however the level of control can vary depending on environmental conditions. Early swathing will reduce losses.

**Chemical Control -**

No insecticides are registered for wheat stem sawfly.

**References -**


1. Holmes, 1977. Can. Entomol. 109:1591.
2. Beres et al., 2007. J. Econ. Entomol. 79-87.
3. DePauw et al., 1994. Can. J. Plant Sci. 821-823.
4. DePauw et al., 2005. Can. J. Plant Sci. 397-401.


## WHITE GRUBS (Coleoptera: Scarabaeidae)

**Chemical Control –**

| Insecticide | Rate | Preharvest Interval (days) | References |
|---|---|---|---|
| **CORN ONLY** | | | |
| **Clothianidin**<br>Poncho 600 | 33.3 mL per 80,000 unit of seed | - | - |

**Restrictions-**

Poncho 250 is toxic to wild birds and wild mammals when used as a seed treatment. Do not expose treated seeds on the soil surface. Any spilled or exposed seeds should be incorporated into the soil or otherwise cleaned-up from the soil surface.

## WIREWORMS (Coleoptera: Elateridae)

**Cultural Control -**

Shallow seeding into moisture and firm packing may reduce damage.

**Chemical Control –**

| Insecticide | Rate | Preharvest Interval (days) | References |
|---|---|---|---|
| **WHEAT, BARLEY, OATS and RYE** | | | |
| **Thiamethoxam**<br>Cruiser Maxx Vibrance Cereals Seed Treatment | 325 – 650 ml per 100 kg of seed | - | |
| **Imidacloprid**<br>Raxil WW (wheat, barley and oats only) | | | |
| **CORN** | | | |
| **Thiamethoxam** | | | |

| | | | |
|---|---|---|---|
| Cruiser Extreme 250 | | - | |
| **Clothianidin**<br>Poncho 250 | 0.25 mg of Poncho 600 per kernel | - | - |
| **Imidacloprid**<br>Sombrero | 0.16 mg per kernel | | |

Wireworms exposed to neonicotinoid insecticides (clothianidin, thiamethoxam, imidacloprid) become intoxicated long enough for the crop to become established, but the wireworms may fully recover later in the season.
Some neonicotinoid insecticides may result in wireworms moving to the soil surface where they may be at greater risk of desiccaton or predation (1).
The efficacy of insecticides for wireworm control may be affected by the species of wireworm present (2).

**References -**

1. Vernon et al. 2008. J. Econ. Entomol. 365-374.
2. van Herk et al. 2007. J. Entomol. Soc. Brit. Columbia. 55-63.