INSECT MANAGEMENT IN
CEREAL CROPS AND GRAIN CORN

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APHIDS

Economic Thresholds -

12 – 15 aphids / stem prior to the soft dough stage.

Damage -

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

English grain aphid - 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)

Bird cherry oat aphid 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 - 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)

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)

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 500E	1.11-2.74 L	0.45-1.11 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.

ARMYWORMS

Economic thresholds –

Control usually necessary when numbers exceed 10/m^2. (1)

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.

Chemical Control –

Insecticide	Rate / ha	Rate / acre	Preharvest Interval (days)	References
BARLEY, OATS AND WHEAT				
Lambda-cyhalothrin Matador	83 ml	34 ml	28	
Carbaryl Sevin XLR	2.5-5.25 L	1.01-2.12 L	14 Wheat, Oats 28 Barley	2
Methomyl Lannate	270-540 g	0.1093-0.2185kg	20	2
Malathion Malathion 500 Malathion 500E	1.5-2 L 2.25-2.75 L	0.60-0.80 L 0.45-1.11 L	7 7	2
Chlorpyrifos Lorsban, Pyrinex, Nufos, Citadel	875 mL-1.2 L	0.354-0.486 L	60	
RYE				
Carbaryl Sevin XLR	2.5-5.25 L	1.01-2.12 L	14	2
Malathion Malathion 500 Malathion 500 E	1.5-2 L 2.25-2.75 L	0.60-0.80 L 0.45-1.11 L	7 7	2
CORN				
Lambda-cyhalothrin Matador	83 ml	34 ml	14	

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. Man. Dep. Agric., Pub 227.
2. Smith, Pest. Res. Rep., 1976:177.

BROWN WHEAT MITE

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 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

CORN EARWORM

Chemical Control –

Insecticide	Rate / ha	Rate / acre	Preharvest Interval (days)	References
CORN ONLY				
Lambda-cyhalothrin Matador, Silencer	83 ml	34 ml	14	
Cypermethrin Ripcord	175 ml	70 ml	5	
Carbaryl Sevin XLR	2.5-4.0 L	1.01-1.6 L	1	
Malathion Malathion 500E	2.25-2.75 L	0.91-1.11 L	5	
Endosulfan Thionex EC Thiodan	2.75-4 L 2.75-4.25 L	1.11-1.62 L 1.11-1.75 L	50 50	

CUTWORMS

Cutworms: Army, Pale western and Redbacked cutworms

Economic 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. Economic 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. Attempts to starve the cutworms, particularly pale western cutworm, by delaying seeding often fail. In areas where redbacked cutworms are a problem, destroy weedy growth on fallow fields prior to August.

Chemical Control –

Insecticide	Rate / ha	Rate / acre	Preharvest Interval (days)	References
WHEAT, BARLEY, OATS				
Deltamethrin Decis	200 ml	80 ml	31 (oats) 40 (barley, wheat)	3-6,8,9
Cypermethrin Ripcord (wheat and barley only)	175 ml	70 ml	21	
Permethrin Pounce, Perm-UP	180-390 ml	73-158 ml	Treat prior to 6-leaf stage	1,2,6-10
Chlorpyrifos Lorsban, Pyrinex, Nufos, Citadel	.875-1.2 L	0.354-0.486 L	60	1-6,8-10
RYE				
Permethrin Pounce, Perm-UP	180-390 ml	73-158 ml	Treat prior to 6 leaf stage	
CORN				
Lambda-cyhalothrin Matador	83 ml	34 ml	14	
Cypermethrin Ripcord	175 ml	70 ml	21	
Permethrin Pounce, Perm-UP	180-390 ml	73-158 ml	Treat prior to 6 leaf stage	
Chlorpyrifos Lorsban, Pyrinex, Nufos, Citadel	2.4 L Pre-Plant treatment 1.2-2.4 L Seedling treatment	0.971 L Pre-Plant treatment 0.486-0.971 L Seedling treatment	70	1-6,8,9

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.
Redbacked Cutworm
9. McDonald, 1981. J. Econ. Entomol. 74: 593.
10. Philip and Dolinski. Pest. Res. Rep. 1977: 215-216.

EUROPEAN CORN BORER

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.

Cultural Control-

Resistant Cultivars - Cultivars of Bt corn are resistant to feeding by European corn borer. If using cultivars of Bt corn, a refuge of at least 20% of the corn acres planted to non-Bt cultivars should be planted to reduce the odds of European corn borer developing resistance to Bt corn.

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%.

Chemical Control –

Insecticide	Rate / ha	Rate / acre	Preharvest Interval (days)	References
Bacillus thuringiensis Dipel 2X DF	560-1120 g	0.23-0.45 kg	0	
Lambda-cyhalothrin Matador, Silencer	83 ml	34 ml	14	
Deltamethrin Decis	250-300 ml	100-120 ml	N/A	
Cypermethrin Ripcord UP-Cyde	175 ml 280 ml	70 ml 113 ml	5 5	
Carbaryl Sevin XLR	2.5–4.0 L	1.01-1.6 L	1	
Carbofuran Furadan	1.1 L	0.445 L	7	
Malathion Malathion 500E	2.25-2.75 L	0.91-1.11 L	5	

Reference –

17. Anonymous, Agdex 605 – 622, Manitoba Agriculture.

GRAIN STINK BUG

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 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.

GRASSHOPPERS

Pest species:

Species that may damage cereal crops and grain corn in Western Canada include the migratory, twostriped, Packard, and clearwinged 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 Eco bran	20-40 kg	0.8-1.6 kg	14 (oats, wheat) 28 (barley)	
Nosema locustae Nolo Bait	Minimum of 1.12 kg	Minimum of 0.45 kg	0	
Sprays				

Deltamethrin Decis 5EC	100-150 ml (ground); 150 ml (air)	40-60 ml (ground) 60 ml (air)	31 (oats) 40 (wheat, barley)	6,8,15,18,19
Cypermethrin Ripcord (young grasshoppers only) (wheat and barley only)	50-70 ml	20-28 ml	30 (wheat) 45 (barley)	
Lambda-cyhalothrin Matador, Silencer (young grasshoppers only)	63-83 ml (ground), 83 ml (aerial)	25-34 ml (ground) 34 ml (aerial)	Do not apply within 28 days of harvest or 14 days of livestock foraging	-
Carbaryl Sevin XLR	1.25-2.5 L	0.5-1.01 L	14 (wheat, oats) 28 (barley)	18, 19
Malathion Malathion 500 Malathion 500E	1.7 L 2.25-2.75 L	0.68 L 0.91-1.11 L	7 7	
Chlorpyrifos Lorsban, Pyrinex, Nufos, Citadel	580-875 ml	235-354 ml	60	5,6,7,13,14
Dimethoate Lagon / Cygon 480EC	Nymphs: 550 ml Adults: 850 ml-1 L	Nymphs- 0.22 L Adults- 0.34-0.40 L	2 – 28 (see labels)	4
RYE				
Spreadable Bran Baits				
Carbaryl Eco bran	20-40 kg	0.8-1.6 kg	14	
Nosema locustae Nolo Bait	Minimum of 1.12 kg	Minimum of 0.45 kg	0	
Sprays				
Carbaryl Sevin XLR	1.25-2.5 L	0.5-1.01 L	14	
Malathion Malathion 500 Malathion 500E	850 1.5-2 L	0.69 L 0.91-1.11 L	7 7	
Dimethoate Lagon / Cygon 480EC	Nymphs: 550 ml Adults: 850 ml-1 L	Nymphs- 0.22 L Adults- 0.34-0.40 L	2 – 28 (see labels)	4
CORN				
Spreadable Bran Baits				
Carbaryl Eco bran	20-40 kg	0.8-1.6 kg	1	
Nosema locustae Nolo Bait	Minimum of 1.12 kg	Minimum of 0.45 kg	0	
Sprays				
Carbaryl 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 application 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

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.

SEED CORN MAGGOT

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

THRIPS

Thrips (on barley, oats, and wheat)

Economic Threshold-

Insecticide treatments are only effective when applied before heading is complete.
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

Chemical Control –

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

References -

1. Butts, Pest. Res. Rep. 1985:144.

WHEAT MIDGE

Economic Threshold -

For yield only: 1 adult midge per 4 to 5 heads. At this level of infestation, 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 –
Infestations of 30, 60 and 90% reduced spring wheat yields by 40, 65 and 80%
(3) (primarily Saskatchewan).

Cultural Control –

- Rotate Crops – Continuous wheat cropping encourages higher wheat midge populations.
- 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	2,3,5
Dimethoate Cygon, Lagon	1 L	0.40 L	21	2,3,5

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. Dexter et al., 1987. Can. J. Plant Sci. 67:697-712.
2. Elliot, 1988. Can. Entomol. 120:615-626.
3. Olfert et al., 1985. Can. Entomol. 117:593-598.
4. Wise and Leader, Pest. Res. Rep. 1985:181-182.
5. Sask. Ag. Midge Bull. 1988. 2 pp.

WHEAT STEM SAWFLY

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, 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.

WHITE GRUBS

Insecticide	Rate	Preharvest Interval (days)	References
CORN ONLY			
Clothianidin 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

Cultural Control -

Shallow seeding into moisture and firm packing may reduce damage. Crop rotation to non-susceptible crops may reduce damage.

Chemical Control –

Insecticide	Rate	Preharvest Interval (days)	References
WHEAT AND BARLEY			
Thiamethoxam Cruiser Maxx Cereals	-	-	
CORN			
Thiamethoxam Cruiser Extreme 250		-	
Clothianidin Poncho 250	0.25 mg of Poncho 600 per kernel	-	-

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.