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

INSECT MANAGEMENT IN
OILSEED CROPS

(Canola, flax, mustard, sunflowers)

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Note: For pesticide toxicity to bees see the chapter in this guide on: "Hazards and Safeguards in Applying Insecticides to Crops in Bloom"; the link for this reads “Bee Poisoning”.

ALFALFA LOOPER *Autographa californica* (Speyer)

Alfalfa Looper (canola)

Economic threshold - No thresholds have been determined for the alfalfa looper in canola but check threshold levels for the Bertha armyworm as a guideline.

Chemical Control -

Insecticide	Rate (vol/acre)	Rate (vol/ha)	Preharvest Interval (days)	References
Chlorpyrifos Lorsban 4E /Pyrinex /Nufos /Citadel	0.3 - 0.4 L	0.75-1.0 L	21	1-3
Methomyl Lannate Toss-N-Go	87 - 206 g	216-510 g	8	1-3

References -

1. Dolinski *et al*., Pest. Res. Rep. 1973:136.
2. Jacobson *et al*., Pest. Res. Rep. 1973:137.
3. McDonald, Pest. Res. Rep. 1973:252.

APHIDS

Aphids (canola and flax)

Economic Threshold -

Canola - Control aphids in canola if densities exceed 25 aphids/10 cm shoot tip after flowering (1). To estimate aphid densities, randomly collect a minimum of 20 shoot tips.
Flax - Do not control aphids in flax unless populations exceed 3 aphids/stem at full flowering or 8/stem at early green boll growth stages (3).To estimate aphid densities in flax, sample 25 plants at full bloom or 20 plants at early green boll growth stage (4).

Chemical Control -

Apply to canola only if aphids are found in clusters on the shoot tips.

Insecticide	Crop	Rate (ml/acre)	Rate (ml/ha)	Preharvest Interval (days)	References
Dimethoate Lagon /Cygon	canola flax	344 - 364 177	850-900 437	21	2

References -

1. Sekon and Bakhetia, GCIRC Int. Rapeseed Congress, 1991.
2. Wise, Pest Mgmt. Res. Rep. 1991: 48, 49.
3. Wise and Lamb, Can. Entomol. 127:967-976.

BANDED SUNFLOWER MOTH – see section on SUNFLOWER MOTHS

BEET WEBWORM *Loxostege sticticalis* (Linnaeus)

Beet webworm (canola, mustard and flax)

Economic threshold -

No thresholds have been determined.

Chemical Control -

Insecticide	Crop	Rate (vol/acre)	Rate (vol/ha)	Preharvest Interval (days)	References
Methomyl Lannate Toss-N-Go	canola	87 - 206 g	216-510 g	8	1
Deltamethrin Decis 5EC	canola, mustard	40 - 60 ml	100-150 ml	7	1
	flax	40 - 60 ml	100-150 ml	40	

References -

1. Harris, Pest. Mgmt. Res. Rep. 1990:36.

BERTHA ARMYWORM *Mamestra configurata* Walker

Bertha Armyworm (canola, mustard and flax)

Cultural control -

Flax is less attractive as an egg-laying site to female moths than canola or mustard. Controlling broadleaf weeds such as lamb's quarters will greatly prevent the buildup of larval populations in flax.

Economic Thresholds -

Consult the table below to determine if the economic injury level in canola or mustard is exceeded.

ECONOMIC INJURY LEVELS* FOR BERTHA ARMYWORM

Insecticide Application Cost - $/ac	Expected seed value - $/bushel										
	6	7	8	9	10	11	12	13	14	15	16
	# Larvae/metre^2										
7	20	17	15	13	12	11	10	9	9	8	8
8	23	20	17	15	14	13	11	11	10	9	9
9	26	22	19	17	16	14	13	12	11	10	10
10	29	25	22	19	17	16	14	13	12	11	11
11	32	27	24	21	19	17	16	15	14	13	12
12	34	30	26	23	21	19	17	16	15	14	13
13	37	32	28	25	22	20	19	17	16	15	14
14	40	35	31	27	24	22	20	19	17	16	15
15	43	37	32	29	26	23	22	20	19	17	16

* Based on an average of 20 larvae/m² consuming the equivalent of 65 kg canola seed/ha (1.16 bushels/acre) (7, 8). Thresholds apply to both Argentine and Polish type canola and not to mustards, which are higher because they are a less preferred host (15) and have a greater ability to compensate for feeding damage (16).

Drought stress on canola may result in early dropping of leaves. Lack of leaves may cause more pod feeding by the larvae and affect yield more directly. Also, canola may not compensate as well for tissue loss under stressed conditions. Thus, under moisture stress, economic thresholds for bertha armyworm may be lower than indicated in the above table. Under severe drought stress, dividing the economic thresholds above by 1.48 may give more appropriate economic thresholds.

Chemical Control -

Insecticide	Crop	Rate (vol/acre)	Rate (vol/ha)	Preharvest Interval (days)	References
Deltamethrin Decis 5EC	canola, mustard	40 - 60 ml	100-150 ml	7	9-14
Cypermethrin Ripcord 400EC UP-Cyde	canola	28 - 36 ml 81-113 ml	70 - 90 ml 200-280 ml	30	-
Lambda-cyhalothrin Matador /Silencer	canola, mustard	34 ml	83 ml	7	-

Methomyl Lannate Toss-N-Go	Canola, flax	87 - 206 g 89-109	216-510 g 220-270 g	8	1-6
Chlorpyrifos Lorsban 4E /Pyrinex /Nufos /Citadel	canola, flax	304-405 ml	750 ml – 1L	21	1,4-6
Methamidophos Monitor	canola	230 – 500 ml	575 ml – 1.25 L	10	

Restrictions -

Apply only once per year by air.

Do not apply at water volumes less than 10 L/ha.

Cymbush, Decis, Matador: Apply when temperatures are below 25°C.

References -

1. Putnam, Pest. Res. Rep. 1970:126.
2. McDonald *et al*., Pest. Res. Rep. 1971:177.
3. Peterson *et al*., Pest. Rep. Rep. 1971:143.
4. Lee *et al*., Can. Entomol. 104:1745, 1972.
5. Stewart, Pest. Res. Rep. 1972:166.
6. Harris and Turnbull, Can. Entomol. 107:865, 1975.
7. Bracken and Bucher, J. Econ. Entomol. 70:701, 1971.
8. Bracken and Bucher, Rep. Canola Council of Canada,1981.
9. Derksen and Blouw, Pest. Res. Rep. 1980:121, 122, 123.
10. McVicar and MacKenzie, Pest. Res. Rep. 1980:124.
11. McVicar and Makowski, Pest. Res. Rep. 1980:125.
12. Wise and Kitson, Pest. Res. Rep. 1980:128.
13. Wise and McVicar, Pest. Res. Rep. 1980:129, 130.
14. Wise, McVicar and Kitson, Pest Res. Rep. 1980:131.
15. Ulmer *et al.* Can. Entomol.133: 509-20, 2001.
16. Gavloski and Lamb. Env. Entomol. 1258-67, 2000.

CABBAGE SEEDPOD WEEVIL *Ceutorhynchus assimilis* (Paykull)

Cabbage seedpod weevil (canola and mustard)

Economic threshold -

Control is required at densities of 3 to 4 adult weevils per one 180° sweep net sample (1). Apply by air or ground when crops are in 10 to 20% flowering stage to prevent egg-laying into newly formed pods (1,2). This is the stage when 70% of plants in the field have at least 3 to 10 open flowers.

Cultural Control –

Plant Resistance: Yellow mustard (*Sinapis alba*) is resistant to cabbage seedpod weevil; oriental and brown mustards (*Brassica juncea*) are susceptible to feeding by cabbage seedpod weevil (3).

Trap crops: If a trap crop of *Brassica rapa* is planted at the same time as the main crop of *Brassica napus*,

the *B. rapa* should flower several days earlier and effectively concentrate the weevils, which can be sprayed with an insecticide if needed (4).

Chemical control -

Insecticide	Crop	Rate (ml/acre)	Rate (ml/ha)	Preharvest Interval (days)	References
Lambda-cyhalothrin Matador /Silencer	Canola, mustard	34	83	7	5
Deltamethrin Decis 5EC	Canola, mustard	80	200	7	5

Restrictions -

Spray late in the day to minimize harmful effects to bees and other beneficial insects.
Do not make more than 1 application per year by air

References -

1. Dosdall, 2000 AAFRD Tech. Rep. 98M301, 65 pp.
2. Dosdall *et al.* 2001. Alta. Agr. Agdex 622-21, 4 pp.
3. Cárcamo *et al* 2007. Can. Entomol. 139 : 658-669.
4. Cárcamo *et al* 2007, Crop Protection 26: 1325-1334
5. Cárcamo *et al* 2005, Can. Entomol. 137: 476-87

CLOVER CUTWORM *Discestra trifolii* (Hufnagel)

Clover cutworm (canola, mustard, and flax)

Economic thresholds - Check threshold levels for the Bertha armyworm as a guideline to determine if control measures are needed in canola.

Chemical Control -

Insecticide	Crop	Rate (vol/acre)	Rate (vol/ha)	Preharvest Interval (days)	References
Methomyl Lannate Toss-N-Go	canola	87 - 206 g	216-510 g	8	1
Deltamethrin Decis 5EC	canola, mustard	40 - 60 ml	100-150 ml	7	2-5
	flax	40 - 60 ml	100-150 ml	40	

References -

1. Dixon, Pest. Res. Rep. 1971:176.
2. Catellier and Wise, Pest. Res. Rep. 1982:99.
3. Catellier and Wise, Pest. Res. Rep. 1982:100.
4. McDonald, Pest. Res. Rep. 1975:260.
5. McDonald, Pest. Res. Rep. 1979:354.

CUTWORMS

Cutworms (canola, flax and sunflower): Redbacked (*Euxoa ochrogaster*), Dingy (*Feltia jaculifera*), Army (*Euxoa auxiliaries*), and Pale Western (*Agrotis orthogonia*) cutworms

Economic threshold -

Pale western or redbacked cutworm - Apply an insecticide if densities exceed 4-5 larvae/m² in flax (8) or 10/m² in sunflowers (9). No thresholds have been established in canola but threshold levels in flax can serve as a guideline.

Army cutworm - No thresholds have been determined but larval densities of 5/m destroyed a mustard crop (10).

Cultural Control -

To prevent egg laying by pale western cutworm adults in summerfallow fields, destroy all plant growth in July and allow soil surface to crust until September 15. In areas where redbacked adults are present, avoid weedy growth in August and weedy patches in crops.

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 (11).

Chemical Control -

Insecticide	Crop	Rate (ml/acre)	Rate (ml/ha)	Preharvest Interval (days)	References
Deltamethrin Decis 5EC	flax	80	200	40	6,7
Permethrin Pounce /Perm-UP Ambush	canola, flax sunflowers	73 – 158 57 - 121	180-390 140-300	<6 leaf stage	-
Chlorpyrifos Lorsban 4EC /Pyrinex /Nufos /Citadel	canola, flax sunflowers	354 - 486 486	875-1200 1200	21 42	1-5

Restrictions -

Pounce, Decis: Do not apply at temperatures above 25°C.

References -

1. McDonald, J. Econ. Entomol. 62:30, 1968;65:533, 1972.
2. Askew *et al*., Pest. Res. Rep. 1973:151.

3. McDonald, Pest. Res. Rep. 1974:251.
4. Askew *et al*., Pest Res. Rep. 1974:244.
5. Philip and Dolinski, Pest. Res. Rep.1977:215.
6. McVicar and Wise, Pest. Res. Rep. 1982:113.
7. Wise and Long, Pest. Res. Rep. 1985:95.
8. Ayre, Can. Entomol. 122: 21-28, 1990.
9. NDSU Extension Service #E-1143
10. Jacobsen, J. Econ. Entomol. 55: 408, 1962.
11. Salt and Seamans, 1945. Can. Entomol. 77: 150-155.

DIAMONDBACK MOTH *Plutella xylostella* (Linnaeus)

Diamondback moth (canola and mustard)

Economic Thresholds -

Control required in canola if larvae exceed 100-150/m² in immature to flowering plants and 200-300/m^2 (2-3 larvae/plant) in plants with flowers and pods (2). Sample individual plants by removing plants from field and dislodging larvae by striking plant on a clean surface. A nominal threshold of 25-33% defoliation, with larvae still present on plants, can be applied for canola at seedling stage (5). Threshold at all crop stages may be lower for Polish type canolas than for Argentine type canolas (3) and higher for mustard (5).

Biological Control-

Over a 10 year period (1961-70) in Saskatchewan, 35 to 81% of first generation larvae of the diamondback moth were parasitized by the ichneumonid *Diadegma insularis* and the braconid *Microplitis plutellae,* averaging 68% (6).

Chemical Control -

Insecticide	Crop	Rate (ml/acre)	Rate (ml/ha)	Preharvest Interval (days)	References
Deltamethrin Decis 5EC	canola, mustard	40-60	100-150	7	4
Lamba-cyhalothrin Matador /Silencer	canola, mustard	34	83	7	
Malathion Malathion 500 Malathion 85E	Canola (500 & 85E), mustard (85E)	220- 345 109-168	550-850 270-415	7	1
Chlorpyrifos Lorsban 4E /Pyrinex /Nufos /Citadel	canola	405 - 607	1000–1,500	21	

Restrictions -

deltamethrin: Do not make more than three applications/yr. (Only one application/yr. by air). Do not apply at temperatures above 25°C. Apply in minimum of 11 L water/ha by air.

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

References -

1. Putnam, Pest. Res. Rep. 1962:126.
2. Putnam, unpublished, 1976.
3. Harris, Sask. Agric., Regina, Sask. 1990.
4. Wise and Leader, Res. Rep. 1985:84,85.
5. Gavloski and Lamb, Env. Entomol. 1258-67, 2000
6. Putnam, 1973. Can. J. Plant Sci. 911-914.

FLAX BOLLWORM *Heliothis ononis* (Denis & Schiffermüller)

Flax bollworm (flax)

Economic threshold - Apply an insecticide if 3% or more of bolls are infested. Infestations on flax are generally very rare.

Chemical Control - No insecticides presently are registered.

FLEA BEETLES: Crucifer flea beetle (*Phyllotreta cruciferae*) and Striped flea beetle (*Phyllotreta striolata*)

Flea beetles (canola and mustard)

Cultural control- Damage to canola and mustard (oriental, brown) is greater under conventional tillage than with zero tillage (7,8). In conventional tillage flea beetle damage to seedlings may be reduced by increasing seeding rates to 10 kg/ha and widening row spacings to 25 cm. (8). In zero tillage optimal seeding rates to reduce flea beetle damage are about 8 kg/ha.

Chemical Control -

Seed Treatments

Insecticide	Crop	Rate (vol/kg seed)	References
Thiamethoxam			
Helix*	Canola, mustard	15 ml	9, 10, 13
Helix Xtra*		15 ml	
Clothianidin	Canola		
Prosper*			10, 13

Imidacloprid Gaucho Canola System* Gaucho Platinum*	Canola, mustard	8.3 ml 16.7 ml	5

*For use by commercial seed treaters only.

Foliar Sprays

Insecticide	Crop	Rate (ml/acre)	Rate (ml/ha)	Preharvest Interval (days)	References
Deltamethrin Decis 5EC	Canola, mustard	40 – 60	100 - 150	7	4, 11
Lambda- cyhalothrin Matador /Silencer	Canola, mustard	34	83	7	-
Cypermethrin Ripcord UP-Cyde	Canola	20 56.6	50 140	30	3
Permethrin Pounce Ambush	Canola	36 – 73 28 - 57	90 – 180 70 - 140		12
Malathion Malathion 500 Malathion 85E	Canola (500 and 85E) Mustard (85E)	450 217-346	1120 535-855	7	1, 12
Carbaryl Sevin XLR	Canola	200	500	Seedling application only	2,3, 12

Restrictions -

Sevin XLR: Apply only up to 4 weeks after seedling emergence.
Matador: Apply only one application per year by air.
Ripcord: Avoid application at temperatures above 25°C.
Decis: Do not feed treated crop to livestock. Do not apply at temperatures above 25°C. Do not make more than 3 applications/yr. (Only one application/yr. by air).
Malathion: Do not apply at air temperatures below 20°C. Do not apply when bees are foraging.

Notes -

Yellow mustard seedlings are tolerant to flea beetle attack (6) and should not require treatments with insecticides at seeding.

In greenhouse experiments, *P. cruciferae* had higher mortality and fed less when exposed to seed treatments with thiamethoxam and clothianidin than did *P. striolata* (10).

References -

1. Askew *et al*., Pest Res. Rep. 1974:226,228; 1976:127,129,131; 1977:144.
2. Westdal *et al*., Pest. Res. Rep. 1976:134,136; 1980:115.
3. Romanow *et al*., Pest. Res. Rep. 1977:151; 1982:84; 1983:83.
4. Wise, Pest. Res. Rep. 1983: 95.
5. Wise, Pest. Man. Res. Rep. 1993:26, 1995:32.

6. Brandt and Lamb, Can. J. Plant Sci. 74: 169-76, 1994
7. Milbraith *et al.*, Can. Entomol. 127: 289-93, 1995.
8. Dosdall *et al.*, Crop Protection 18: 217-224, 1999.
9. Antwi *etal.*, J. Econ. Entomol. 100: 1201-1209, 2007.
10. Tansey *et al*., J. Econ. Entomol. 101 : 159-167, 2008.
11. Elliott *et al*., Can. Entomol. 139: 534-544, 2007.
12. Weiss *et al*., J. Econ. Entomol. 84: 1597-1603, 1991.
13. Knodel *et al*. Arthropod Management Tests. 34: F10. 2009.

GRASSHOPPERS

Cultural Control -

· Fall stubble cultivation may reduce egg pod survival.

· Destroying green growth on stubble in the spring at the time hatching may help to starve young grasshoppers.

· Barrier strips of a non-preferred crop like oats next to an infested area at the margin of fields may delay young grasshoppers from feeding on susceptible crops (2).

· Trap crops or weeds in an adjacent summerfallow field can attract grasshoppers where they can be controlled with an insecticide (3).

Chemical Control -

Trade Name	Crop	Rate (vol/acre)	Rate (vol/ha)	Preharvest Interval (days)	References
Carbaryl Eco Bran Bait	Canola	0.8 – 1.6 kg	2 - 4 kg	Seedlings only	-
Deltamethrin Decis 5EC	canola, Flax	40 - 60 ml	100-150 ml	7 40	
Lambda-cyhalothrin Matador /Silencer	canola, flax & mustard	25 - 34 ml (Ground) 34 ml (Air)	63-83 ml	7	-
Cypermethrin Ripcord	Canola	20 – 28 ml	50 – 70 ml	30	
Malathion Malathion 500 Malathion 85E	canola, flax & mustard (85E only)	450 - 680 ml 217-346	1100-1680 ml 535-855	7	1
Chlorpyrifos Lorsban 4E /Pyrinex /Nufos /Citadel	Canola	235 - 354	580-875 ml	21	1
Dimethoate Cygon /Lagon	canola safflowers	340 - 364 ml 222 - 450 ml	850-900 ml 550-1100 ml	21	-

Methamidophos Monitor	Canola	500 ml	1.25 L	10	

Restrictions -

Do not apply when bees are present (with the exception of Eco Bran, which can be applied when bees are foraging).

Apply higher rates when foliage is dense or if grasshopper nymphs are past the third instar stage.

Do not apply Malathion at air temperatures below 20°C or Matador and Decis above 25°C.

References -

1. Charnetski, Pest. Res. Rep. 1975: 210.
2. Olfert, Grasslands and Grassland Health, 2000: 61-70.
3. Olfert, Can. Entomol. 1986: 133-140.

LYGUS BUGS

Lygus bugs (canola, mustard, confectionary sunflowers)

Economic thresholds -

Canola - Thresholds are based on the number of lygus bugs sampled per 10 net sweeps (2). Canola should be sampled as flowering ends (stage 4.4), particularly if precipitation is low. If densities are near but less than the threshold at stage 4.4, canola should be resampled at stage 5.1 (when seeds in the lower pods are full size, translucent). If densities are sufficiently high, control is still warranted at stage 5.2 (seeds in lower pods green).

Lygus bug densities should be determined from a minimum of 15 samples of 10 sweeps or 10 samples of 20 sweeps per field (3). Samples can be collected from along the edge or at right angles from the edge of the field. Research has shown that samples taken along the edge of commercial fields and at various distances into the field all gave similar estimates of plant bug density (3). Sampling along the edge reduces effort during years when thick crop growth impedes access to the field. For edge sampling, the area selected for sampling should be at a crop stage similar to that in the main part of the field.

Application Cost		**End of Flowering (Canola Crop Stages 4.4 - 5.1)[1]**					
$ / ha	**$/ ac**	**Economic Injury Level**					
22	8.00	11	8	7	5	5	4
25	10.00	13	10	8	7	6	5
27	12.00	16	12	10	8	7	6
30	14.00	19	14	11	9	8	7
32	16.00	22	16	13	11	9	8
35	18.00	24	18	15	12	10	9
Canola Price ($/bu)		6.00	8.00	10.00	12.00	14.00	16.00

[1] At crop stages prior to end of flowering, feeding by lygus bugs on canola does not generally result in economic damage

Application Cost		Pod Ripening (Canola Crop Stage 5.2)[1]					
$ / ha	$/ ac	Economic Injury Level					
22	8.00	15	12	9	8	7	6
25	10.00	19	14	11	10	8	7
27	12.00	23	17	14	11	10	9
30	14.00	27	20	16	13	11	10
32	16.00	30	23	18	15	13	11
35	18.00	34	26	20	17	15	13
Canola Price ($/bu)		6.00	8.00	10.00	12.00	14.00	16.00

[1]Crop stages of Harper and Berkencamp (1975):
4.4 is flowering complete, seeds enlarging in lower pods;
5.1 is when seeds in the lower pods are full size, translucent;
5.2 is when seeds in the lower pods are green.

When precipitation is greater than 100 mm from the onset of bud formation to the end of flowering, the plant may partially compensate for damage by lygus bugs (2).

Confectionary sunflowers – Research in North Dakota found that feeding by adult lygus bugs resulted in 32.7 damaged seeds per head (4). Approximately 5% of seeds in a head were damaged per adult. Damage to sunflower heads was approximately twice as severe when infestations occurred at growth stages R4 and R5 compared with stages R6 and R7.
One adult lygus bug per 9 heads can result in economic loss through the reduction of seed quality.
Lygus bug management should be initiated between the R4 to R5.1 stage if adult densities reach the economic injury level (4).
Oilseed Sunflowers - No control needed in oilseed sunflowers.

Chemical Control -

Insecticide	Crop	Rate (ml/acre)	Rate (ml/ha)	Preharvest Interval (days)	References
Deltamethrin Decis 5EC	canola, mustard	60	150	7	1
Lambda-cyhalothrin Matador /Silencer	canola, sunflowers (Matador only)	34	83	7	-
Chlorpyrifos Lorsban 4E /Citadel Pyrinex /Nufos	canola	200 - 400 400	500-1000 1000	21	1

References -

1. Wise, Pest. Res. Rep. 1988: 65, 66.
2. Wise and Lamb, Can. Entomol. 130: 825-36, 1998.
3. Wise and Lamb, Can. Entomol. 130: 837-51, 1998.

4. Charlet. Helia. 26: 83-92, 2003.

RED TURNIP BEETLE *Entomoscelis americana* Brown

Red turnip beetle (canola, mustard)

Cultural Control -

The eggs are layed on the soil late in the summer beneath canola or related plants. They hatch in the spring and the grubs feed on volunteer canola or winter annual weeds such as flixweed and mustards. Destruction of these food plants while the pest is still in the early grub stage may starve larvae. Adults are very mobile and will migrate to canola in summer to feed.

Chemical Control – The only insecticide registered for use on red turnip beetles (carbofuran) is no longer for sale and use is currently being phased out.

ROOT MAGGOTS *Delia* spp.

Root Maggots (canola)

A complex of 5 root maggot species in the genus *Delia* occur in canola field in Western Canada: *D. floralis* (the turnip maggot), *D. radicum* (the cabbage maggot), *D. platura* (seed corn maggot), *D. florilega* (bean seed maggot), and *D. planipalpis*.

Cultural Control -

Variety selection: Comparisons on the level of susceptibility of cultivars of canola and mustard to root maggots demonstrated that varieties of Polish canola (*B. rapa*) were most susceptible, *Brassica napus* (Argentine canola) and *B. juncea* were intermediate in susceptibility, and yellow mustard (*S. alba*) was least susceptible (1,2). *S. alba* has both antibiotic and antixenotic effects on root maggots (7).

Cultivation: Cultivating prior to seeding reduces adult emergence from overwintered pupae (3). Root maggot infestations are greater under zero-till systems than under conventional tillage, but yields under zero tillage usually still exceed those with conventional tillage (5).

Seeding Rate and Row Spacing: Seeding at approximately twice the recommended rate (10 kg/ha) (4), and at a row spacing of 20 or 30 cm (5) reduces damage from root maggots and results in improved yields.

Biological Control –

The rove beetle *Aleochara bilineata* is a predator of root maggot eggs and larvae, and larvae of *A. bilineata* are parasites of root maggot pupae (6). A single adult of *A. bilineata* is capable of consuming an average of 23.8 eggs or 2.6 larvae per day (6).

Chemical Control - No insecticides are registered for control of roots maggots in canola.

References -

1.Griffiths, Proc. GCIRC Congress, 1991:528-535.
2. Dosdall *et al.*, Can. Ent. 126: 251-260, 1994.
3. Dosdall *et al.*, Can. Ent. 128:1157-1165, 1996.
4. Dosdall *et al.*, Can. J. Plant Sci. 76: 169-177.
5. Dosdall and Dolinski. AARI Tech. Rep. 95M723, 1997: 40pp.
6. Read, D.C. 1962. Can. Ent. 94: 417-424.
7. Jyoti *et al*. 2001. J. Econ. Entomol. 94: 942-949.

SUNFLOWER BEETLE *Zygogramma exclamationis* (Fabricius)

Sunflower beetle (sunflowers)

Economic Thresholds -

Control is required in sunflowers with 1 - 2 adults/seedling or 10 - 15 larvae/plant (9). Count larvae in the plant tops where they rest during the day. Sample a minimum of 20 plants to estimate larval densities.

Cultural Control –

Research in North Dakota found that sunflower beetle adult and larval populations decreased as planting date was delayed (10). Delaying planting did not reduce the effectiveness of the parasitic fly *Myiopharus macellus* which attacks the sunflower beetle larvae.

Biological Control-

The tachinid fly *Myiopharus macellus* is an important natural enemy of sunflower beetle larvae (11).

Chemical Control -

Insecticide	Rate (ml/acre)	Rate (ml/ha)	Preharvest Interval (days)	References
Thiamethoxam Cruiser Maxx Sunflowers	A seed treatment. Sunflower seeds can not be treated with Cruiser Maxx Sunflowers in Canada.			
Deltamethrin Decis 5EC	40	100	70	6, 7
Lambda-cyhalothrin Matador / Silencer	17 – 25 (ground) 34 (air)	42 - 63 83	7	-
Cypermethrin Ripcord UP-Cyde	28 40	70 100	70	7, 8
Endosulfan Thidoan 4EC Thionex EC	600	1500	60	1-5

Restrictions -

cyhalothrin-lambda: Only one application by air per year.
cypermethrin: Avoid application at temperatures above 27°C. Only one application by air.
endosulfan: Do not apply more than once per season. Do not feed treated foliage to livestock.
deltamethrin: Do not make more than three applications/yr. (Only one application by air.) Do

not apply at temperatures above 25°C.

References -

1. Kolach, Pest. Res. Rep. 1970:147.
2. Kolach *et al*., Pest. Res. Rep. 1972:141.
3. Palmer and Todd, Pest. Res. Rep. 1973:157.
4. Zirk and Donaghy, Pest. Res. Rep. 1973:158, 1974:247.
5. Askew *et al*., Pest. Res. Rep. 1974:245.
6. Westdal *et al*., Pest. Res. Rep. 1980:130.
7. Romanow and Askew, Pest. Res. Rep. 1983:144.
8. Emilson, Pest. Res. Rep. 1983:141,142,143; 1984:160,161,162,163.
9. Deedat, Ph.D. Thesis, Univ. of Manitoba. 1987:92.
10. Charlet and Knodel. 2003. J. Econ. Entomol. 96: 706-713.
11. Charlet. 1992. J. Econ. Entomol. 85: 766-771.

SUNFLOWER MAGGOTS

Economic Threshold - Larvae of *Strauzia longipennis* burrow inside the stem and can reach densities high enough to cause stem breakage to individual plants. Yield losses have not been found to be high enough to warrant chemical control.

Chemical Control - Insecticide use is ineffective against larvae in the stem.

SUNFLOWER MIDGE *Contarinia schulzi* Gagné

Sunflower Midge (Sunflowers)

Economic Threshold -

Destruction of seeds and distortion of heads can cause serious losses in fields in the Red River Valley of Manitoba. Losses are more severe around field edges. Losses can be estimated by sampling heads and classifying them by the degree of head cupping and the relative area of seed destroyed (1).

Cultural Control -

Some cultivars show some resistance to feeding by sunflower midge (2,3).

Chemical Control -

No chemical control is feasible because the larvae feed within the head.

Reference -

1. Bracken, Can. J. Plant Sci. 71: 81-85.
2. Anderson and Brewer. 1991. J. Econ. Entomol. 84: 1060-1067.

3. North Dakota Field Crop Insect Management Guide – 2009. http://www.ag.ndsu.edu/pubs/plantsci/pests/e1143w1.htm

SUNFLOWER MOTHS

Sunflower moth (*Homoeosoma electellum*) and Banded sunflower moth (*Cochylis hospes*) on sunflowers.

Monitoring -

Pheromone traps can be used to determine when adults of the banded sunflower moth and sunflower moth are present (3).

Methods of determining the economic injury level of the banded sunflower moth based on sampling adult (4) and eggs (5) have been developed.

Economic threshold – The sunflower moths are found mainly in the field margins. Only apply an insecticide in areas where 2-4 SM are found at dusk for every 10 plants (1).

Cultural Control – Research in North Dakota has shown that delaying the planting of sunflowers until late May or early June can reduce levels of damage by banded sunflower moth (2).

Chemical Control - Do not apply an insecticide if insects are not found within 2 weeks of flowering. Apply when 20-50% of the heads are in bloom.

Insecticide	Rate (g/acre)	Rate (g/ha)	Preharvest Interval (days)	References
Bacillus thuringiensis kurstaki Dipel 2X DF (sunflower moth)	127 - 253	315-625	None	-

Restrictions - By air, apply in minimum of 20 L of water per ha.

References -

1. NDSU Extension Service, Pub. # E-1143.
2. Oseto et al. 1989. J. Econ. Entomol. 82: 910-912.
3. Underhill *et al*. 1986. Environ. Entomol. 15: 1063-1066.
4. Charlet and Barker. 1995. Helia. 18: 59-66.
5. Mundal and Brewer. 2008. J. Econ. Entomol. 101: 969-975.

SUNFLOWER SEED WEEVILS

Red (*Smicronyx fulvus*) and gray (*Smicronyx sordidus*) sunflower seed weevils

Economic Threshold -

One to two adults/head in confectionery sunflower and 12-14 adults/head in oilseed sunflowers for plant densities of 45 000 - 55 000/ha (1). Count the number of weevils found on a minimum of 25 plants when the yellow ray petals are beginning to show (2).

Cultural Controls-

Research in North Dakota showed that planting sunflowers in early to mid May will help reduce damage by red sunflower seed weevil (3). However, early planting may increase the risk of damage by other insects on sunflowers.

Chemical Control -

Optimal Spray Timing: Early anthesis, when 30 - 70% of sunflower heads are in early pollen formation, i.e. R-5.1 stage (for example, when 3 - 7/10 plants show ray petals and at least one row of disc flowers). Reinfestation of the field may occur in areas with a high weevil population. Fields at 70% pollen shed stage are no longer susceptible to economic damage (2).

Insecticide	Rate (ml/acre)	Rate (ml/ha)	Preharvest Interval (days)	References
Cypermethrin				
Ripcord	28	70	70	-
UP-Cyde	40	100		
Chlorpyrifos Lorsban 4E /Nufos /Citadel	485	1200	42	-

Note: Apply in minimum 20 L water/ha either by ground or air.

Reference -

1. Peng and Brewer. 1995. Can. Entomol. 127: 561-568.
2. N. Dakota State Univ. Coop. Ext. Serv. Publ. #E-817.
3. Oseto et al. 1987. J. Econ. Entomol. 80 : 190-192.