

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

Insect Management In Forage Crops in Western Canada

(Alfalfa, clovers (sweet, red, alsike), forage grasses (timothy, etc.), pastures and rangelands)

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This document is only a guide. Always refer to the product label for application details and precautions before using an insecticide. Labels for any insecticide in this guide can be found on the website of the Pest Management Regulatory Agency at: <https://pr-rp.hc-sc.gc.ca/lr-re/index-eng.php>

Alfalfa Blotch Leafminer

Agromyza frontella (Rond.) (Diptera: Agromyzidae)

Economic Thresholds

Alfalfa hay crops
- 40% of leaflets show pinhole feeding (OMAFRA)

Alfalfa seed crops
- unknown

Biological Control -

A species of parasitic wasp, *Dacnusa dryas* (Nixon), has kept the leafminer in check in eastern Canada in most localities and years (1). Chemical control of the pest may decimate populations of this biocontrol agent.

Chemical Control –

Active ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	References
Malathion Malathion 85E	Alfalfa	1.345 L	0.544 L	7	
Dimethoate Cygon 480-AG, Lagon, Diamante 4	Alfalfa	0.55 L	0.223 L	2 (Cygon 480-AG) 10 (Lagon, Diamante 4)	-

Note: Insecticides should be applied no later than the pinhole stage of feeding, usually in mid- to late May.

Restrictions -

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crop in bloom	Do not apply during bloom, or during the 5 day period before blooming. See Section in Guide regarding hazard to bees.
dimethoate	Use a minimum water volume of 200 L/ha with ground equipment. Do not apply more than once per season. Ground and aerial application is permitted.
malathion	Do not apply to alfalfa in bloom. Apply when 75% of foliage shows feeding damage. 2 applications per cut to a maximum of 4 applications per year with a 14 day interval between applications. Greatest efficacy at air temperatures above 20°C. Use a minimum water volume of 275 L/ha. Repeat application may be necessary. Some products are restricted to ground application only; others may be applied by ground or air.

References –

- 1) Heimpel and Meloche. 2001. The Great Lakes Entomologist. 34 (1): 17-26.

Alfalfa Caterpillar

Colias eurytheme Boisduval (Lepidoptera: Pieridae)

Various lepidopteran larvae feed on legume and grass forages, usually with little impact because populations are kept low by natural biological controls. Normal forage harvesting disrupts larval life cycles by preventing many larvae from maturing. Alfalfa caterpillar occurs fairly frequently in alfalfa on the prairies, but has not been recorded as causing economic harm (1).

Economic thresholds – unknown

Chemical control – No insecticides registered.

Reference -

1. Beirne, Mem. Entomol. Soc Can. No. 78, 1971.

Alfalfa Looper

Autographa californica (Speyer) (Lepidoptera: Noctuidae)

Economic Thresholds

No economic thresholds have been established for alfalfa, as outbreaks are irregular.

Biological Control -

The alfalfa looper is usually held in check by its natural parasites and predators, and by viral diseases that kill the larvae before they can pupate.

Cultural Control -

Early cutting may give satisfactory control because larvae cannot survive on dried alfalfa forage. Alfalfa should be inspected within 2 to 3 days after cutting to determine if loopers are feeding on regrowth. Insecticide application in alfalfa is rarely warranted.

Chemical Control – No insecticides registered.

Alfalfa Weevil*Hypera postica* (Gyll.) (Coleoptera: Curculionidae)**Economic Thresholds**

Alfalfa hay crops – Larger alfalfa plants are able to withstand larger densities of alfalfa weevil larvae (1). Suggested economic thresholds for alfalfa weevil in alfalfa hay crops are: (2)

- Alfalfa less than 30 cm - 1 larva per stem.
- Alfalfa 30 to 40 cm - 2 larvae per stem.
- Three larvae per stem is generally economical to control regardless of height of the crop.

Alfalfa seed crops:

- 20-25 larvae/sweep or 35-50% leaf tips show damage (2).
- 2-3 larvae/stem using bucket-shake method (7)

Biological Control -

The parasitic wasps *Bathyplectes curculionis* (Hymenoptera: Ichneumonidae), *Oomyzus incertus* (Hymenoptera: Eulophidae) and *Microctonus colesi* (Hymenoptera: Braconidae) are present in some regions of the Canadian prairies (3). Chemical control of pest insects may decimate populations of these biocontrol agents.

Cultural Control -

Cut the first hay crop early. If damage reappears in new growth, insecticide application may be necessary.

Chemical Control –

Resistance to lambda-cyhalothrin (a pyrethroid insecticide) by alfalfa weevil is widespread in some western U.S. states (4), and rotating mode of action groups, applying chemical controls only when economic thresholds have been met, and utilizing cultural control tactics have been suggested as methods to slow the further development of resistance. Resistance to pyrethroids has also been reported in seed crops in southern Alberta (Mori et al. unpublished data).

Active ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	References
Chlorantraniliprole Coragen MaX Coragen	Alfalfa, clovers	125 – 167 ml 375 - 500 ml	50.6 – 67.5 ml 152 – 202 ml	0 0	
Acetamiprid Assail	Seed alfalfa	170 g	69 g	1	
Deltamethrin Decis 100 EC Advantage deltamethrin Poleci	Alfalfa	100 - 125 ml 200 - 250 ml 400 – 500 ml	41 – 51 ml 81 – 101 ml 162 – 202 ml	20	5, 6
Lambda-cyhalothrin Matador, Silencer, Labamba, Zivata	Alfalfa	83 ml	34 ml	Do not feed treated crop/ seed screenings to livestock	-

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Malathion Malathion 85E	Alfalfa	1.1-1.345 L	0.445-0.544 L	7	
Dimethoate Lagon, Cygon 480-AG, Diamante 4 (reduction only)	Alfalfa	425 ml	172 ml	2 (Cygon 480-AG), 10 (Lagon, Diamante 4)	-

Forage Crop If application is made to heavy growth, 110-220 L water/ha may be required for adequate coverage.

Seed Crop Chlorantraniliprole, deltamethrin, and λ - cyhalothrin are less toxic to pollinators than other products. Keep leafcutting bees off the crop until the cyhalothrin- λ dries completely or at least 24 hours following deltamethrin application.

Restrictions -

crop in bloom Do not apply insecticide when bees are pollinating. See Section in Guide regarding hazard to bees.

chlorantraniliprole Suppression only. Do not make more than one application per cutting. Recommended to wait one day between application and feeding to livestock. Not registered specifically for alfalfa seed production. Ground application only.

deltamethrin For use on seed crops only. Avoid application when daytime temperatures are greater than 25°C. One application per year. Apply by ground only. 100-300 L of water per ha

dimethoate For reduction of alfalfa weevil larvae. Do not apply when alfalfa is in bloom or during the 5 day period before blooming. Remove cattle before spraying. Maximum 2 applications per season with a minimum 7 day interval between applications. Water volume for ground application: 200 L per ha. Ground or aerial application is permitted.

lambda-cyhalothrin Do not feed treated crop to livestock. Allow a 7 day interval between treatments. Do not use more than 3 applications per season. Alfalfa seed from treated crops must not be used for production of alfalfa sprouts. Ground or aerial application of Matador is permitted. Do not make more than 1 application of 83 mL/ha of the allowed seasonal total by air. Ground application only for Silencer and Zivata.

malathion Some products list control of alfalfa weevil larvae only. Greatest efficacy at air temperatures above 18°C. Apply when 75% of leaves show feeding damage. Do not apply when alfalfa is in bloom. 2 applications per cut to a maximum of 4 applications per year, with a minimum application interval of 14 days. Ground or aerial application.

References -

1. Hintz et. al. 1976. Journal of Economic Entomology. 69: 749-754.
2. Philip et al. Field crop and forage pests and their natural enemies in Western Canada: Identification and management field guide. 2018.
3. Soroka et al. 2020. The Canadian Entomologist. 152: 663-701.
4. Rodbell et al. 2022. Journal of Economic Entomology. 115 : 2029-2040.

5. Charnetski and Schaber, Pest. Res. Rep. 1980:160.
6. Charnetski, Pest. Res. Rep. 1983:154.
7. Evans, Utah State University, Fact Sheet No. 58, 1989.

Armyworms including armyworm *Mythimna unipuncta*, (Haworth) (Lepidoptera: Noctuidae), fall armyworm *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) and others

Armyworms can cause severe damage to cereal and grass crops or pastures in outbreak situations, but such years are often interspersed with several years of little damage. Infestations can be quite localized. Armyworm (*Mythimna unipuncta*) moths are annual migrants to the prairies from the United States.

Economic thresholds – In forage grasses, a nominal threshold is when five or more larvae (smaller than 2.5 cm) per square foot are found. In seedling crops, two to three larvae (smaller than 2.5 cm) per square foot may warrant control.

Biological control - Many species of parasitoids and predators, as well as bacterial and fungal diseases and even birds feed on armyworms. The control of such natural enemies may come too late however, to reduce economic damage in high infestations (1)

Chemical control –

IPM status of insecticides – Chlorantraniliprole is not harmful to some beneficial insects, such as parasitic Hymenoptera (2).

Active ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	Reference
Chlorantraniliprole Coragen MaX Coragen (for armyworm)	Forage grasses, pastures and rangelands	83 – 125 ml 250 – 375 ml	34 – 51 ml 101 – 152 ml	0	

Restrictions -

Chlorantraniliprole – Ground application only.

Reference -

1. Beirne, Mem. Entomol. Soc Can. No. 78, 1971.

Beet Webworm *Loxostege sticticalis* (L.) (Lepidoptera: Crambidae) and other webworms

Beet webworm has a wide host range, often preferring to feed on weeds in a crop than the crops itself. It is a sporadic pest that causes damage only in some years in some locations. Normal forage harvesting disrupts life cycles of Lepidoptera such as beet webworm by preventing many larvae from maturing.

Economic thresholds – unknown

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Cultural control – Destroying weeds early in the season helps to keep webworm numbers low. Early cutting of hay fields kills many of the larvae (1).

Chemical control – None registered in forage crops.

Reference -

1. Alfalfa Seed and Leafcutter Bee Production and Marketing Manual. 2017. Alfalfa Seed Commission of Alberta.

Blister Beetle

Epicauta spp., *Lytta* spp. (Coleoptera: Meloidae)

Damage, although usually localized, can occur quickly and mainly in dry situations when grasshoppers are present. Larvae of some species of blister beetles, such as *Epicauta* spp., eat grasshopper eggs, while larvae of *Lytta* feed in the nests of solitary bees.

Chemical control- No insecticides are registered for blister beetles in forage crops.

Bromegrass Seed Midge

Contarinia bromicola (Marik & Agaf.) (Diptera: Cecidomyiidae)

Cultural Control -

Thorough burning of stubble and trash in early spring or before regrowth in late summer provides some control. (1-2) Parasitism by a species of *Tetrastichus* (Eulophidae) can vary from 30% to 75% (3).

References -

1. Knowles, Forage Notes 18(2), 1973; 19(2), 1974.
2. Neuman and Manglitz, Agric. Expt. Sta., Univ. Neb., Res. Bull. 252, 1972.
3. Curry, Knowles and Waddington, Can. Entomol. 115:(1) 75-79, 1983.

Clover Thrips

Haplothrips leucanthemi Schr. (Thysanoptera: Phlaeothripidae)
(red clover seed fields)

Economic Thresholds -

Damage is insignificant until 50-80 thrips/raceme are present. (1) Threshold levels occur only during years of early spring drought on dryland.

Reference -

1. Craig, unpublished data 1987, Agriculture and Agri-Food Canada, Saskatoon.

Cutworms

(Lepidoptera: Noctuidae)

Army cutworm (*Euxoa auxiliaris*)
Dingy cutworm (*Feltia jaculifera*)

Glassy cutworm (*Apamea devastator*)

Chemical Control –

IPM status of insecticides – Chlorantraniliprole is not harmful to some beneficial insects, such as parasitic Hymenoptera (1).

Insecticide	Crop	Rate (ml/ha)	Rate (ml/acre)	Preharvest Interval (days)	References
Chlorantraniliprole Coragen Max	Alfalfa, clovers, forage grasses	83	34	0	

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 (2).

References -

1. Brugger *et al.* 2010. Pest Management Science. 66: 1075-1081.
2. Byers *et al.* 1992. J. Econ. Entomol. 85: 1146-1149.

European Skipper	<i>Thymelicus lineola</i> (Ochs.) (Lepidoptera: Hesperidae)
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On timothy

Chemical control-

IPM status of insecticides – *Bacillus thuringiensis kurstaki* is specific in killing larvae of Lepidoptera, and will not harm populations of beneficial insects.

Active ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	Reference
<i>Bacillus thuringiensis</i> Dipel 2X-DF	Timothy	0.140-0.275 kg	0.057-0.111 kg		
Bioprotec CAF		0.55 – 0.7 L	0.22 – 0.28 L	0	
Bioprotec PLUS		0.35 – 0.44 L	0.14 – 0.18 L	0	

Restrictions -

Bacillus thuringiensis Apply at first signs of infestation when larvae are small. May be applied up to the day of harvest. Ground application only for Bioprotec CAF and Bioprotec PLUS.

Grasshoppers Orthoptera: Acrididae on alfalfa, clover, forage grasses, pastures and rangelands

Economic Thresholds –

Pastures and rangelands: Nymphs – 45 to 60 per m²,
5th instar and adults – 15 to 20 per m².

Chemical Control –

IPM status of insecticides – **Eco Bran Bait** will preserve most beneficial insects (1).

Chlorantraniliprole is not harmful to some beneficial insects, such as parasitic Hymenoptera (2).

Reduced Agent and Area Treatments (RAATs): Grasshoppers on rangelands may be managed by applying certain insecticides in treated swaths, which alternate with untreated swaths. This can reduce the cost of control and amount of insecticide used, while resulting in effective control (3, 4).

Active ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	Referenc e
Spreadable Bran Baits					
<i>Nosema locustae</i> Nolo Bran Bait	alfalfa, forage grasses, rangelands and pastures	minimum 1.12 kg	minimum 0.453 kg	0	-
Carbaryl bran bait Eco Bran	Forage grasses. Pastures and rangelands.	2.0-4.0 kg	0.81 - 1.62 kg	Forage grasses: 1-2 Pastures and Rangelands: 1- entry of beef cattle or other livestock, 2- entry of dairy cattle.	-
Sprays					
Chlorantraniliprole Coragen Max Coragen	alfalfa, clovers, forage grasses, rangeland and pastures	42 – 83 ml 125 – 250 ml	17 – 34 ml 51 – 101 ml	0	-

lambda-cyhalothrin Matador, Silencer, Labamba, Zivata	alfalfa, forage grasses (on timothy for seed production only.	0.063-0.083 L	0.025-0.034 L	Alfalfa: Do not feed treated crop to livestock. Forage grasses: 14	-
Deltamethrin Decis 100 EC, Advantage deltamethrin, Poleci	alfalfa (Decis 100 EC only; seed production only), rangeland and pastures	50 – 75 ml 100- 150 ml 200- 300 ml	20.2 – 30.4 ml 40 – 60 ml 81 – 121 ml	20 (alfalfa) N/A (rangeland and pastures)	-
Carbaryl Sevin XLR	forage grasses, rangeland and pastures	1.2-3.5 L	0.49-1.42 L	1 (beef cattle) 2 (dairy cattle)	-
Malathion Malathion 85E	alfalfa, clovers, rangeland and pastures	1.10- 1.345 L (alfalfa and clovers) 0.83 L (pastures)	0.445 – 0.544 L (alfalfa and clovers) 0.336 L (pastures)	Alfalfa and clovers - 7 Pastures – see restrictions below	-

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Dimethoate Lagon, Cygon 480 AG Diamante 4	alfalfa, clovers (Lagon and Diamante 4 only), forage grasses, pastures	Alfalfa: 0.55 L (nymphs) 0.85-0.90 L (adults)	Alfalfa: 0.22 L (nymphs) 0.34-0.36 L (adults)	Alfalfa: 10 (Lagon), 28 (Cygon 480- AG, Diamante 4)	5-8
		Clovers: 425 ml – 1 L	Clovers: 172 – 405 ml	Clovers: 2- 28 (see label)	
		Forage grasses: 0.42- 0.55 L (nymphs) 0.85-1.0 L (adults)	Forage grasses: 0.17-0.22 L (nymphs) 0.34-0.40 L (adults)	Forage grasses: 2-28	
		Pastures: 0.55 L (nymphs) 0.85-1.0 L (adults)	Pastures: 0.22 L (nymphs) 0.34-0.41 L (adults)	Pastures: 2 (low rate) 7-28 (high rates)	

Note: Use lower rates on younger grasshoppers. Best control is achieved when product is applied to young grasshoppers. If insect pressure is high spraying a 15 m strip around the field may aid in control.

Restrictions -

crop in bloom Do not apply to crops in bloom. See Section in Guide regarding hazard to bees.

Nosema lacustae Grasshopper death will begin in 3-6 weeks; the pathogen will remain in the grasshopper population for several years. Ground or aerial application.

carbaryl
bran bait Apply by ground only. Rain shortly after application will decrease efficacy of product. Repeat applications only as necessary but not more frequently than once a week during periods of heavy infestation and once every two weeks during moderate to low infestation. Presence of product on flowering crops such as alfalfa and clover will not harm foraging honey or leafcutter bees.

carbaryl Remove cattle from area while spraying. Maximum 2 applications per year. Sevin XLR - ground application only.

lambda-cyhalothrin Do not use more than 3 applications per year. Air or ground application, but do not make more than 1 application by air per year. Do not use alfalfa seed from treated crops for production of alfalfa sprouts. Allow 7 days between applications. Timothy for seed – apply by ground only. Use sufficient water for thorough coverage, 100 to 200 L/ha by ground sprayer.

deltamethrin Do not make more than three applications per year, with a maximum of two aerial applications. Use higher rates for older insects and/or dense crop canopy.

dimethoate Do not apply during bloom. When spraying honey-producing crops (alfalfa, red clover, and alsike) spray at least 5 days before bloom appears and do not

introduce hives until full bloom. Follow provincial forecast. Remove cattle before spraying. Ground or aerial application.

malathion Greatest efficacy at air temperatures above 20°C. In pastures and rangelands do not apply to fields occupied by dairy animal, but may be grazed or harvested on the day of treatment. No application within 7 days of harvest or pasturing of alfalfa, clovers. Do not apply to alfalfa in bloom. Apply when 75% of foliage shows feeding damage. Repeat as necessary.

References –

1. George *et al.* 1992. Environmental Entomology. 21: 1239-1247.
2. Brugger *et al.* 2010. Pest Management Science. 66: 1075-1081.
3. Lockwood and Schell. J. Orthoptera Research.1997: 19-32.
4. Lockwood et al., Int. J. Pest Manag. 2000. 29-42.
5. Holmes et al., J. Econ. Entomol. 58:77, 1965.
6. Banham, Pest. Res. Rep. 1964:134.
7. McDonald and McKinlay, Pest. Res. Rep. 1964:132.
8. Dolinski et al., Pest. Res. Rep. 1973:185.

Leafhoppers (Hemiptera: Cicadellidae), including **Potato Leafhopper** *Empoasca fabae* (Harris)

Many species of leafhopper are present in prairie forage crops but damage either by direct feeding or by disease transmission is rare. However, in some areas of the eastern North America leafhoppers are rated among the most serious pests of alfalfa. Potato leafhopper damage symptoms appear as stunting as well as yellowing of the leaves in a v-shaped pattern starting at the tip of a leaflet. Damage is most severe in new seedings and in regrowth in hot, dry weather.

Economic thresholds – vary with commodity prices and application costs. Historic thresholds are: if alfalfa is <9 cm in height, the economic threshold for potato leafhoppers is 0.2 adults/sweep, <15 cm=0.5 adult PLH, <25 cm= 1.0 adult PLH, and <36 cm=2.0 adult PLH/sweep. (1)

Cultural Control –

Cut the first hay crop early.
Some alfalfa cultivars have resistance to leafhoppers (2).

Chemical Control –

Active ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	Reference
Afidopyropen Sefina	Alfalfa, clovers	0.2 – 0.4 L	0.08 – 0.16 L	0	
Flupyradifurone Sivanto Prime	Alfalfa	500-750 ml	202-304 ml	7	

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Lambda-cyhalothrin Matador, Silencer, Labamba, Zivata	Alfalfa	0.083 L	0.034 L	Do not feed treated crops to livestock	-
Malathion Malathion 85E	Alfafa, clovers	1.1 – 1.345 L	0.445-0.554 L	7	-
Dimethoate Cygon 480-AG, Lagon, Diamante 4	Alfalfa	0.425 L	0.172 L	2 (Cygon 480- AG), 10 (Lagon, Diamante 4)	-

Restrictions

- crop in bloom Do not apply to crops in bloom. See Section in Guide regarding hazard to bees.
- dimethoate Remove cattle before spraying. Use sufficient water for good coverage. Repeat only if necessary. Ground or aerial application. Do not apply during the blooming period or during the 5-day period before blooming. Maximum 2 applications per year
- lambda-cyhalothrin Allow a 7 day interval between treatments. Do not use more than 3 applications per season. Alfalfa seed from treated crops must not be used for production of alfalfa sprouts. Matador and Labamba -ground or aerial application; Silencer and Zivata – ground application only. Do not make more than 1 application of 83 mL/ha of the allowed seasonal total by air.
- malathion Greatest efficacy at air temperatures above 20°C. Apply when 75% of foliage shows feeding damage. Repeat as necessary – 2 applications maximum per cut, 4 applications per year. Ground or aerial application.

Reference –

1. Metcalf and Luckmann. 1994. Introduction to Integrated Pest Management. pp 469-504.
2. Alfalfa Variety Ratings 2024. National Alfalfa and Forage Alliance.

Lesser Clover Leaf Weevil *Hypera nigrirostris* (F.) (Coleoptera: Curculionidae)

Economic thresholds

Red clover

- third and fourth instar larval densities greater than 3 per five shoots could damage up to 50% of buds and flower heads (1)

Chemical control - in established red clover fields for seed production only

Active ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	Reference
Deltamethrin	Red clover				
Decis 100 EC	seed	125 ml	51 ml	n/a	-
Advantage Deltamethrin	production	250 ml	101 ml	n/a	
Poleci		500 ml	202 ml	n/a	

Restrictions

crop in bloom Do not apply insecticide when bees are pollinating. See Section in Guide regarding hazard to bees.

deltamethrin For suppression. Do not make more than two applications per year. Apply two times at a 14 day interval, at early vegetative and when crop is budding. Do not use treated crop for feed or forage. Restricted entry interval 12 hours. Ground application only. Water volume 100-300 L per ha.

Reference -

1. Weiss and Gillott, Can. Entomol. 125:831-837, 1993.

Pea Aphid *Acyrtosiphon pisum* Harr. (Hemiptera: Aphididae) and other aphids

Economic Thresholds -

1430 aphids/sweep did not reduce the forage yield of irrigated alfalfa. (2)

Caged alfalfa initially infested with 100-200 aphids/plant produced less forage and had lower carotene contents than uninfested plants. (4)

100 - 200 aphids/ 180° sweep when seed crop is drought-stressed, plants are wilting, and seed is still developing (before mid-August)

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Cultural Control -

On irrigated alfalfa, control may be unnecessary if adequate water is provided to the plants (2).

Some cultivars of alfalfa are resistant to pea aphids (11).

Biological Control -

High winds, heavy rain and hail can cause pea aphid numbers to decline drastically.

Predators such as lady beetles (Coccinellidae) and others, parasitic wasps, and entomopathogenic diseases often cause aphid population crashes to occur, especially late in the season.

Chemical Control –

IPM status of insecticides – **Flonicamid** is a systemic insecticide with selective activity as a feeding blocker against sucking insects. It has no harmful effects on natural enemies of aphids such as green lacewings (5), lady beetles (5), minute pirate bugs (6), or parasitoids such as Aphelinidae (7).

Flupyradifurone is taken up by plant tissue and mainly translocated in the xylem. Aphids stop feeding shortly after ingesting it and die two days later (8). Flupyradifurone appears to have no adverse effects on honey bee colonies when applied following label directions (9).

In laboratory experiments on **afidopyropen** with natural enemies of aphids, afidopyropen was not toxic to lady beetles or minute pirate bugs, and was only moderately toxic to *Aphelinus certus* (Hymenoptera: Aphelinidae) (10).

Active ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	Reference
Afidopyropen Sefina	Alfalfa, clovers	200 ml	81 ml	0	
Flonicamid Carbine, Beleaf 50 SG	Alfalfa, clovers	120-160 g	49-65 g	7	-
Flupyradifurone Sivanto Prime	Alfalfa	0.5-0.75 L	0.202-0.304 L	7	
Lambda-cyhalothrin Matador, Silencer, Labamba, Zivata	Alfalfa	0.083 L	0.034 L	Do not feed treated crops to livestock	-
Malathion Malathion 85E	Alfalfa, clover	1.1 – 1.345 L	0.445-0.544 L	7	-
Dimethoate Lagon, Cygon 480-AG, Diamante 4	Alfalfa	0.425 L	0.172 L	2 (Cygon 480- AG), 10 (Lagon, Diamante 4)	1, 3

Note: Ensure thorough coverage. Treat if population is large enough to stunt plants or if heavily infested hay is to be dehydrated.

Restrictions -

Do not apply when pollinators are present. See Section in Guide regarding hazard to bees.

dimethoate Remove cattle before spraying. Maximum number of applications per season - two. Ground or aerial application.

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flonicamid	Maximum of three applications per season; minimum of 7 day interval between applications. Do not use alfalfa seed from treated crops for human or animal consumption. Minimum water volume of 100 L per ha.
lambda-cyhalothrin	Maximum of three applications per season; minimum of 7 day interval between applications. Do not use alfalfa seed from treated crops for human consumption. Air or ground application of Matador or Labamba, Ground application only for Silencer or Zivata.
malathion	Do not apply to alfalfa in bloom. Remove cattle before spraying. Greatest efficacy at air temperatures above 20°C. Application by ground or air.

References -

1. Harper, Can. Entomol. 110:891, 1978.
2. Hobbs et al., Can. Entomol. 93:801, 1961.
3. McDonald and Harper, Can. Entomol. 110:213, 1978.
4. Harper and Lilly, J. Econ. Entomol. 59:1426, 1966.
5. Garzón et al., Chemosphere. 132: 87-93, 2015.
6. Barbosa et al. Ecotoxicology 26: 589-599, 2017.
7. Frewin et al. Pest Manage. Sci. 68: 202-208. 2012.
8. Nauen et al. Pest. Manage. Sci..71: 850–862. 2015.
9. Campbell et al. J. Econ. Entomol. 109: 1967–1972. 2016.
10. Koch et al., Pest Management Science. 76 : 375-383. 2020.
11. Alfalfa Variety Ratings 2024. National Alfalfa and Forage Alliance.

Plant Bugs (Hemiptera: Miridae) in Alfalfa Seed Fields

Including: Lygus bugs (*Lygus* spp.), Alfalfa plant bug (*Adelphocoris lineolatus*), Superb plant bug (*Aelphocoris superbus*), and Obscure plant bug (*Plagiognathus obscurus*).

Economic Thresholds -

Alfalfa seed: 8 lygus bugs/sweep or 4 alfalfa plant bugs/sweep or 5 nymphs/sweep of any or all species of plant bugs, when the alfalfa is in bud or in bloom. (7-9)

Chemical application should be timed so that the majority of nymphs are third instars or older.

Cultural Control -

Burning of alfalfa stubble and debris in early spring controls all species except lygus bugs. (3, 5, 15, 16).

Biological Control -

Heavy rain can reduce numbers of lygus nymphs (17). *Peristenus* wasps parasitize lygus and alfalfa plant bugs to varying degrees in the spring and summer (18), but their impact seems insufficient to keep them below thresholds.

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Chemical Control -

Active ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	References
Flonicamid Carbine, Beleaf 50SG	Alfalfa	200-300 g	81-121 g	7	
Novaluron Rimon	Alfalfa	0.835 L	0.338 L	14	-
Acetamiprid + novaluron Cormoran	Alfalfa	0.751-0.900 L	0.304-0.364 L	14	
Acetamiprid Assail/Aceta	Alfalfa	87-170 g	35-69 g	1	-
Lambda- cyhalothrin Matador, Silencer, Labamba, Zivata	Alfalfa	83 ml	34 ml	Do not feed treated crop to livestock	-
Deltamethrin Decis 100 EC Advantage deltamethrin Poleci	Alfalfa	100 – 125 ml 200 - 250 ml 400 - 500 ml	41 – 51 ml 81 - 101 ml 162 - 202 ml	20 20 20	10-14
Malathion Malathion 85E	Alfalfa	1.10-1.345 L	0.445-0.544 L	7	-
Dimethoate – Cygon 480-AG, Lagon, Diamante 4	Alfalfa	1.1 L	0.445 L	10 Cygon 480-AG) 28 (Lagon, Diamante 4)	1, 6

Restrictions –

- nolvaluron** For alfalfa seed production only. For control of plant bug nymphs only. Avoid application to crops in bloom if bees are in the area. Use only on pure stands of alfalfa to be harvested for seed. Do not allow livestock to graze treated fields. Do not use treated crops or crop residue for livestock feed. Alfalfa seed from treated fields may not be used for growing sprouts for human or animal consumption. Ground application only. No more than 1670 mL/ha per season. Maximum 2 applications per year.
- acetamiprid** Seed production only. Control of alfalfa plant bug, suppression of Lygus bug. Apply prior to bloom up to the time when 50% of seed pods are ripe. Begin when adults and/or 4th-5th instar nymphs have reached economic thresholds. Use the higher rate for heavier infestations. Maximum 3 applications per season. Do not apply more than once every 7 days. Do not cut treated fields for hay/forage or graze treated fields. Do not exceed a total of 357 g active ingredient (510 g product) per ha per season. Ground application only.

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- deltamethrin Seed production only. Do not feed treated forage within 90 days of harvest. Do not apply more than once annually. Use higher rates when alfalfa weevils are present. Not recommended for alfalfa plant bug control. Apply in 100-300 L/ha water. Ground application only.
- lambda-cyhalothrin Do not graze or feed treated crop to livestock. Allow 7 days between application. Do not use more than 3 applications per year. Do not use alfalfa seed from treated crops for production of alfalfa sprouts. Aerial and ground (Matador and Labamba) or ground only (Silencer and Zivata) application. If the alfalfa is in bloom and bees are in the crop, apply lambda-cyhalothrin in late evening when bees are not foraging.
- malathion Greatest efficacy at air temperatures above 20°C. Apply when 75% of foliage shows damage. Do not apply to alfalfa in bloom. 2 applications per cut to a maximum of 4 applications per year. Ground or aerial application permitted.
- dimethoate Do not graze or harvest for forage within 28 days following treatment. Ground or aerial application. Allow at least 10 days before placing leaf cutting bees in the field. Do not apply more than once per season. Do not apply during blooming, nor during the 5-day period before the crop blooms.

References -

1. Craig, Pest. Res. Rep. 1971:167.
2. Kolach and Senkow, Pest. Res. Rep. 1972:151.
3. Lilly and Hobbs, Can. J. Plant Sci. 42:53, 1962.
4. Craig, Pest. Res. Rep. 1973:168.
5. Craig, Agric. Can. Publ. 1935, 1973.
6. Harper, Can. Entomol. 110:891, 1978.
7. Craig and Lasiuk, Pest. Res. Rep. 1971:167.
8. McMahon, Rep. B.C. Agron. Assoc. 1950:58.
9. Sorenson, Utah Agric. Expt. Sta. Bull. 284,1939.
10. Charnetski and Schaber, Pest. Res. Rep. 1980:161.
11. Charnetski, Pest. Res. Rep. 1983:154.
12. Butts, Pest. Res. Rep. 1981:149; 1983:156.
13. Butts and Lippert, Pest. Res. Rep. 1982:166.
14. Cattellier and Wise, Pest. Res. Rep. 1982:167.
15. Schaber and Entz, J. Econ. Entomol. 81:668-672, 1987.
16. Craig, Pest. Res. Rep. 1980:163.
17. Day, *Trans. Am. Entomol. Soc.* 132: 445-450, 2006.
18. Fernández et al. *Biocon. Sc. & Technolo.* 28 : 702-717, 2018.

Plant Bugs (Hemiptera: Miridae) in Forage Grasses

Plant bugs such as *Capsus cinctus* Kolenaty, the rice leaf bug (*Trigonotylus caelestialium* (Kirk)), and others (See Silvertop of Grasses below)

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Chemical Control -

Active Ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	Reference
Dimethoate Cygon 480-AG, Lagon, Diamante 4	Forage grasses	0.425 L	0.172 L	2	1

Restrictions -

dimethoate Do not graze, forage, or harvest 2 days after treatment. Ground or aerial application.

References -

1. Okuda, Pest. Res. Rep. 1988 p.134.

Pteromalus venustus Walker (Hymenoptera: Pteromalidae),
a parasite of Leafcutting bees

This small wasp of European origin, known as *Pteromalus* among alfalfa seed growers can significantly reduce populations of leafcutting bees during storage. An average of 32 eggs can be laid on a single egg but only half emerge as adults (1). Parasitism starts in the field and another 2 generations may take place during the incubation period and substantially reduce populations of the leafcutting bees (1).

Cultural Control -

Control methods include prevention of parasitism in the field though the use of tight robust nesting material to protect bee larvae and the use of black light water traps in the incubators (2). There is also interest among producers in manipulating storage temperatures in the fall to break parasite diapause and starve them during the winter.

Chemical Control -

There are no effective chemicals registered for *Pteromalus* control.

Pyrethrin aerosol cans or timed dispensers were used with some success, but there is a risk of bee mortality (3). Furthermore, a recent re-evaluation decision has restricted access to certain pyrethrin products.

References -

1. Hobbs and Kronic, Can. Entomol. 103: 674-685. 1971
2. Goerzen, SASPA, ext. pub. 2011
3. Goerzen, Sask. Alf. Seed Prod. Assoc. (SASPA) Ext. Pub. 2001-032001

Silvertop of Grasses

Diverse causal agents. Insects associated with silvertop include grass plant bugs (e.g., *Capsus* species, *Trigonotylus* spp., *Irbisia* spp., *Labops* spp., others), thrips such as *Anaphothrips* species, and grain mites such as *Siteroptes graminum*. Diseases such as *Fusarium* have also been implicated.

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Economic Thresholds -

Thresholds will vary according to seed prices, which fluctuate wildly. In general, grass fields exhibiting 10% or more silvertop should have remedial action taken the following year. Silvertop, once evident, cannot be treated or reversed in the current season.

Cultural Control -

Post-harvest burning or burning in the spring prior to new growth will destroy many plant bug eggs and adults. Do not burn creeping red fescue fields in the Peace River region because of potential damage to the subsequent seed crop. In this region, burn only after the last seed harvest and prior to entering a rejuvenation cycle. Low-mowing (below 3 cm) and removal of straw following harvest also decreases the incidence of silvertop.

Chemical Control -

At present, certain formulations of dimethoate are registered for control of plant bugs in forage crops (See Plant Bugs in Forage Grasses above).

References -

1. Peterson and Vea, J. Econ. Entomol. 64:247-251, 1971
2. Kamm and Fuxa, J. Range Management 30:385-387, 1977
3. Okuda, Pest. Res. Rep. 1988:134.

Seed Chalcids (Hymenoptera: Eurytomidae) including:

alfalfa seed chalcid *Bruchophagus roddi* (Guss.), clover seed chalcid *B. gibbis* (Boh.), trefoil seed chalcid *B. platypterus* (Wlkr), and sainfoin seed chalcid *Eurytoma brychidi* (Wlkr.)

Seed chalcids do not affect legume forage production, but can cause up to 50% reduction in seed yield. Dryland crops suffer worse damage than irrigated fields. Likewise, damage is worse following a hot, dry summer.

Shallow cultivation of seed fields in the fall or early spring can bury many chalcid-infested seeds. Combine tailings and screenings should not be left in the field. Sow certified, chalcid-free seed.

References -

1. Soroka and Spurr, Can. Entomol. 130: 1-11, 1998.

Spider Mites:

Twospotted Spider Mite *Tetranychus urticae* Koch (Trombidiformes: Tetranychidae) and others

Spider mite populations can increase rapidly and cause damage in hot, dry conditions, usually towards the end of summer.

Economic Thresholds -

Unknown for Canadian prairies. In clover seed crops in Idaho, mite control is recommended in June or July when 25% of the leaves show feeding injury. (1)

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Biological Control -

Mite populations are usually kept in check by low temperatures and rain, fungal diseases and predators such as lady beetles, predacious thrips and especially predacious mites.

Chemical Control – in alfalfa grown for seed

Active ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	Reference
Malathion Malathion 85E	Alfalfa	1.1-1.345 L	0.445-0.544 L	7	-
Spiromesifen Oberon	Alfalfa	0.5-1.0 L	0.202-0.405 L	n/a	-

Restrictions -

malathion Greatest efficacy at air temperatures above 20°C. Do not apply to alfalfa in bloom. Apply when 75% of foliage shows feeding damage. Repeat as necessary. Ground or air application.

spiromesifen Three applications may be required for control. Treat at minimum 7 day intervals. Do not apply when pollinators are actively foraging in the treatment area; apply before pollinators are placed in a field or after they have been removed. Ground and aerial application is permitted. Maximum allowed per crop season: 3 L/ha. Minimum application volume: 100 L/ha - ground; 50L/ha – aerial application.

References -

1. Baird, Homan and Bolz. 2002.

Spittlebugs:

Meadow spittlebug *Philaenus spumaris* (L.) (Hemiptera: Cercopidae)

Spittlebugs are only an occasional pest of alfalfa, and not normally a cause for concern. Adults do not damage alfalfa. When nymphs hatch they form a spittle mass which is used to prevent desiccation and to protect from predators.

Economic Thresholds -

Unknown for Canadian prairies. In Wisconsin, an average of 1 spittlebug nymph/stem is necessary before control should be considered. (1)

Chemical Control -

Active ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	Reference
Malathion Malathion 85E	Alfalfa	1.1-1.345 L	0.445-0.544 L	7	-

Insect Management in Forage Crops

Restrictions –

- malathion - Greatest efficacy at air temperatures above 20°C. Do not apply to alfalfa in bloom. Apply when 75% of foliage shows feeding damage. Repeat as necessary. Ground or air application.

References -

1. Baird, corn.agronomy.wisc.edu/Management/pdfs/IPMManual_2_Alfalfa.pdf page 10

Sweetclover Weevil <i>Sitona cylindricollis</i> Fahr. (Coleoptera: Curculionidae)
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Economic Thresholds (7) -

In seedling sweet clover crops:

- 1 weevil adult/5 seedlings in cotyledon stage under slow growth conditions.
- 1 weevil adult/3 seedlings in cotyledon stage under normal growth conditions.

In newly-emerging 2nd year sweet clover:

- 9-12 weevil adults/plant.

Cultural Control -

Seedling stands:

- Locate new seedlings as far as possible from 2nd-year clover.

First-year stands in late summer:

- Defoliation of 1st-year clover by close-cutting, grazing, or weevil feeding during the critical period of mid-August to mid-September will severely reduce 2nd-year yield. Swath companion grain crops high.

Second-year stands:

- Second year clover will usually outgrow weevil damage; insecticide application is rarely necessary. Sweet clover silage and hay fields should be cultivated as soon as possible after the crop is taken; this kills the new-generation weevil larvae in the soil. (6,7)

Chemical Control -

- In sweet clover seedling crops apply insecticide when very young seedlings are noticeably damaged by weevil feeding. In first-year clover in late summer and fall, apply insecticide to crop margins where weevils are concentrated.

Active ingredient Product	Crop	Rate /ha	Rate /acre	Preharvest Interval (days)	Reference
Dimethoate Cygon 480-AG, Lagon, Diamante 4	Sweet clover	0.850-1.1 L	0.344-0.445 L	28	1-5
Malathion Malathion 85E	Sweet Clover	0.735-1.22 L	0.445-0.544 L	7	-

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Restrictions –

- | | |
|------------|--|
| dimethoate | Do not apply within 28 days of grazing or harvesting for forage. Maximum of 2 applications per year. Ground or aerial application. |
| malathion | Greatest efficacy at air temperatures above 20°C. Spray field margins of first-year clover in late summer or early fall when adult migration is underway. Remove cattle when treating; cattle may be returned immediately after treatment. Maximum of 2 applications per year. Ground or aerial application. |

References -

1. Craig, Pest. Res. Rep. 1971:179.
2. Craig, Pest. Res. Rep. 1964:136.
3. Craig, Pest. Res. Rep. 1965:135.
4. Swailes and McDonald, J. Econ. Entomol. 58:988, 1965.
5. Craig, Pest. Res. Rep. 1968: 150.
6. Bird, 80th Annual Rep., Entomol. Soc. Ont., 1949.
7. Craig, Can. Entomol. 110:883, 1978.