Insect Monitoring and Control

Even though flax is susceptible to attack by a number of insects, economic losses tend to be minimal except in a few cases. The only insect pest of flax that is unique to the crop is the flax bollworm. All other pests are generalists, meaning they feed on multiple host species, and prefer crops other crops over flax.

Methods of insect control

- Chemical
  - Scouting for insects and the accurate identification of them is critical before making chemical application decisions.
  - A pest population must be above a certain level to cause economic losses and for chemical control to be worth the time and cost.
  - An economic threshold is the pest population or level of crop damage at which the cost of controlling the pest is equal to the value of the crop that would be destroyed without any control measures. Economic thresholds provide a guide to indicate when chemical control of a pest is economical and are available for the following insect pests of flax (see Table 1):
    - Beet webworm
    - Bertha armyworm
    - Cutworms
    - Flax bollworm
    - Grasshopper
    - Potato aphid
  - To maximize control and prevent the development of resistance, follow best practices for chemical control of insect pests; use the right product at the recommended rate at the proper stage when conditions are optimal.
  - Only three groups of insecticides are available for use on flax, so chemical rotation is important to reduce the risk of the development of resistance.
  - Always follow the most restrictive label directions and use precautions when tank mixing.
  - Consult product labels and provincial crop protection guides for application rates and restrictions related to environmental conditions, personal protective equipment (PPE), water volume, number of applications, application intervals, chemical rotation, tank mixes, crop and pest staging, pest specificity, beneficial insects, re-entry periods, buffer zones, re-cropping and pre-harvest intervals.
  - The use of pest control products that are not registered for use on flax or are applied outside of the recommended pre-harvest interval can result in marketing and trade issues related to maximum residue limits (MRLs).
- Host Tolerance/Resistance
  - Refers to the ability of a plant to suppress, prevent or tolerate the feeding of an insect.
  - Insect tolerance traits are not available in any commercial flax varieties.
- Cultural
  - Includes mechanical, environmental or other non-chemical or non-biological methods of controlling a pest (e.g. seed early to avoid lygus bugs).
- Biological
  - Refers to natural enemies of the pest.
  - Can include parasitoids, predators and diseases.
  - These organisms play a largely behind the scenes role in controlling the populations of many pest species on the Prairies and are often collectively referred to as ‘beneficials’.

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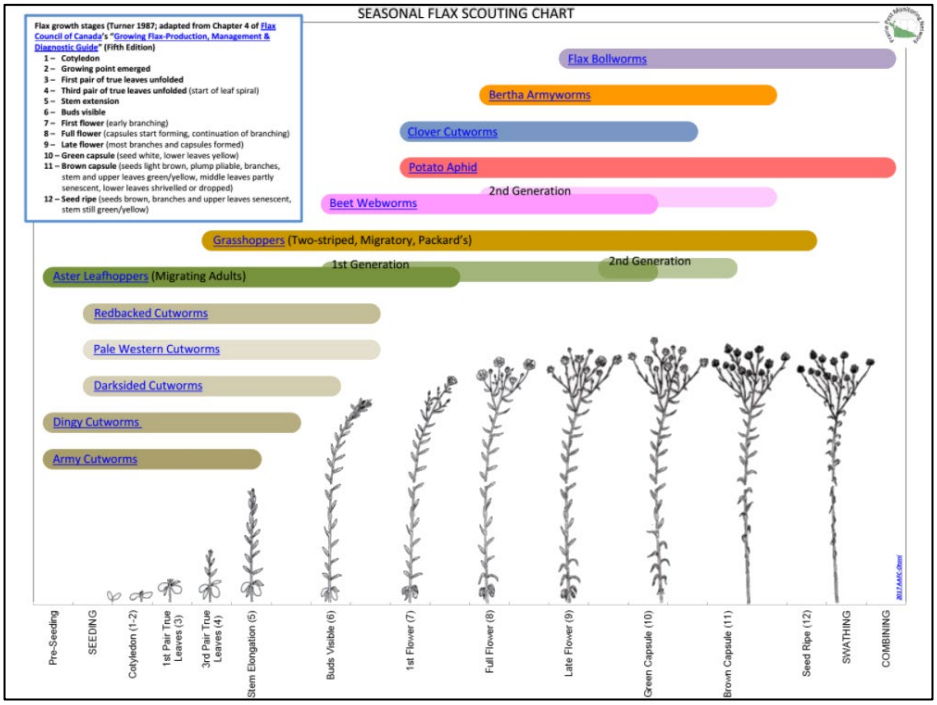
Integrated Pest Management (IPM)

- Integrated Pest Management is the practice of evaluating all available methods of pest control (chemical, cultural and biological) and making decisions on which single or combination of methods to use based on economics, environmental safety and efficacy.
- This crop management practice has gained prominence in recent years because of public concern over the safety of pesticides and their effect on beneficial insects.
- Six elements of IPM:
    - Prevention of pest problems
    - Accurate identification and knowledge of pests, their damage and natural enemies
    - Surveillance of pests, pest damage, natural enemies and weather conditions
    - Application of economic thresholds
    - Suppression of pest populations
    - Evaluation of results

Scouting

- Continuous monitoring of insects throughout the growing season is important for implementing effective control measures.
- Scouting should be done on a weekly basis and more frequently when conditions are favourable for an outbreak or when pest levels are getting close to the economic threshold.
- Sampling methods for insects are dependant on the characteristics of the pest. Refer to the links on page 10 for specifics.

Figure 1. Flax insect scouting chart



Courtesy of the Prairie Pest Monitoring Network. Version with hyperlinks to Field Crop and Forage Pests and their Natural Enemies in Western Canada: http://prairiepestmonitoring.blogspot.com/search/label/Flax

The accurate identification of insects, knowledge about their lifecycles and methods of control are key to making good crop management decisions. For example, a grasshopper is not a pest if it is flying before June, its hind wings are highly visible (i.e. colourful) in flight or if it makes noise in flight or on the ground. Additionally, anticipating what insects to keep an eye out for this season can help to prioritize scouting activities. Below are descriptions of the insects that you may come across in your flax crop and the methods that can be used to control them if necessary.

Insects in Flax in Manitoba in 2019 and Forecast for 2020

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In Manitoba there were 47,203 acres of flax recorded through the crop insurance program in 2019, of this 1,498 was in organic production. Insect issues were generally light in flax in 2019, with grasshoppers being one of the bigger concerns. There are some insects that are good to be checking for annually in flax. This article will focus on 5 insects that will feed on flax; three defoliators and two sap feeders. Where possible, predictions on what levels could be like in 2020 will be provided. Cutworms and grasshoppers are the two insects of greatest risk to flax growers going into the 2020 growing season.

Defoliating Insects to Watch

Cutworms. Cutworms were at high levels in many regions of Manitoba and in many crops in 2019. Some of the species involved, like the redbacked cutworm (*Euxoa ochrogaster*) are generalist, and will feed on a lot of crops. These species can also successfully overwinter in Manitoba. With cutworms, assessing levels of feeding to flax and populations levels of cutworms during the early stages of flax growth is critical, especially in late-May and June. With the levels of cutworms that were present in Manitoba in 2019, plan on scouting for cutworms in flax in 2020.

Grasshopper populations have been noticeably increasing in Manitoba over the last two years. We have had a few drier summers consecutively, which would make it easier for grasshoppers to increase their levels. If we get another drier summer, this trend could continue. Heavy rains in June, as the potential pest species hatch from the overwintering eggs, could set populations back. In 2019 there were reports of some flax fields that had considerable injury from grasshoppers.

Although more generally associated as a potential pest of canola, **bertha armyworm** will feed on many broadleaf plants, including flax. There were some reports of insecticide applications for bertha armyworm on canola in southwest Manitoba in 2019, but none on flax. Bertha armyworm is an insect where the adult stage, which emerges in June and July, is monitored using pheromone-baited traps in all three prairie provinces. This helps determine regionally the risk and level of attention that needs to be given to scouting for the larvae in July and August. It is worthwhile for flax growers to keep alert to what is being forecasted based on the traps, and look for evidence of potential feeding by bertha armyworm while scouting fields. If you suspect bertha armyworms may be present, have a look at the soil and especially under any debris that may be on the soil. The larvae will stay hidden during the day and come up at night to feed.

Sap Feeders

Potato aphids can potentially be of concern in flax, but are not an annual problem. Some years levels remaining relatively low. There were no reports of high populations of aphids on flax in 2019. Potato aphids usually start flying from their winter host plants into flax in late June to early July, and may reach peak densities in late July or early August. In mid August populations naturally drop rapidly in flax fields as winged aphids migrate back to winter host plants.

Lygus bugs can be easily detected in flax at times. The economic impact of Lygus on flax is unclear, however. Adults move into flax from nearby host plants in July when flax produces buds and flowers. Levels can be assessed with a sweep net. Although Lygus bugs can reach high densities in flax, flax is tolerant of their feeding damage under good growing conditions. A study in Manitoba found that under good growing conditions, populations of up to 100 per 10 sweeps were not economical. Whether this tolerance extends to flax growing under less favourable conditions is uncertain.

Don't Forget About Pollinators

Flax is a self-pollinating crop, and inadequate pollination is not usually a factor limiting yield. Honeybees will forage in flax fields, however, so efforts should be taken to minimize harm to bees during flowering.

Assessing the health of the crop and levels of potential pests at least weekly is a good practice. That way you are less likely to lose significant yield should populations of any particular pest get to economic levels.

Photos courtesy of J. Gavloski, Manitoba Agriculture and Resource Development

Flax Insect Pest Outlook for Saskatchewan

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Bertha armyworm populations were lower in 2019 than in 2018. Population densities of these insects typically cycle between maxima and minima every 8-10 years. We will continue to monitor these populations. Bertha trap catches will be posted on the Saskatchewan Ministry of Agriculture website and the Prairie Pest Monitoring Network Blog. High numbers of adults captured can be an indication of local pressures. It'll be important for growers to scout for larvae in late July and August.

Some reports of spraying for damage to pastures associated with **grasshopper** nymphs have come in. Spur-throated and clear wing grasshoppers are currently hatching. These are the species that are typically considered to be pests in Saskatchewan. The economic threshold for grasshoppers in flax in 2 per square meter. The Kindersley region saw populations in excess of 20 per square meter and populations at 10 per square meter were seen on sites in the southeast in 2019. Most of those seen in large numbers in 2019 were the two-striped grasshopper, *Melanopus bivittatus*. Given the sustained dry period, grasshoppers may be released from the diseases that normally limit population growth. Last years' provincial survey still indicated relatively low levels of grasshopper pressure over much of the rest of the province. It'll be very important for growers to monitor for these insects throughout the year, particularly if dry conditions continue and as bolls form.
Last year was characterised by very low **aster leafhopper** populations. Trap catches are indicating another year with little pressure so far.

Few reports of spraying for **cutworms** have come in so far this year. Successive dry years favour outbreaks of pale western cutworm.

Beet webworm, *Loxostege sticticalis*, populations were low last year. Mating and population growth are negatively affected by dry conditions. However, this species is capable of long-distance migrations so predictions of pressures based on local conditions is difficult.

Flax bollworm, *Heliothis ononis*, populations are generally kept down by predators, parasites and disease. Last year saw low numbers and we do not expect a major increase in the coming year.

High winds and prolonged high temperatures (>26°C) can negatively impact **potato aphid**, *Macrosiphum euphorbiae*, populations. The insects fly into fields early July, and peak late July - early August (boll development). Monitoring should occur during this period.

Sporadic reports of **dirt-coloured seed bug**, *Peritrechus convivus*, nymphs in flax were received in 2019. These insects are piercing-sucking feeders and can cause wilting and plant death when in high numbers. They form dense aggregations near the base of plants and can occur at very high numbers. No products are currently registered for controlling this insect in flax.

Table 1. Insect pests of flax

Insect	Characteristics	Crop damage	Natural enemies	Cultural control	Chemical control	Economic concern?	Economic threshold	Comments
Aphid, potato (*Macrosiphum euphorbiae*)	sucking insect, overwinters as eggs on the stems of perennials (particularly roses but also raspberries and strawberries), many generations per year, highest populations typically occur in late July/early August, winged forms appear when populations get too high or a new host plant is required, many generations per year	not typically noticeable because feeds on sap of leaves, stems and bolls, premature desiccation if drought stressed plants infested with high numbers, decreased test weight and fewer seeds per boll	prone to attack by a fungus especially if moist and humid in late June and July, predatory mites, beetles (ladybird, rove), green lacewings, spiders (harvestman, wolf), syrphid/hover flies, bugs (assassin, big-eyed, damsel, minute pirate), wasps (aphid, braconid, chalcid, ichneumonid, trichogrammid), aphid midge, snakeflies	reduce populations of nearby summer hosts weeds (nightshade, ragweed, lamb's quarters, jimsonweed, pigweed, shepherd's purse) and avoid growing near summer host crops (potato, tomato)	dimethoate	yes	3 healthy aphids per main stem at full flower, 8 healthy aphids per main stem at the green boll stage	if aphids appear unhealthy when scouted during full bloom, count again at the green boll stage as this may mean that a natural enemy is effectively controlling the population, can reduce yield by 20% or more when population reaches 50 aphids per plant, yield losses: 0.021t/ha/aphid/plant at full bloom and 0.008t/ha/aphid/plant at the green boll stage, populations highest when warm and dry in July
Armyworm, bertha (*Mamestra configurata*)	climbing cutworm, larva of a noctuid moth, overwinters as pupae, larvae appear in early June, 1 generation per year	feeds on leaves, flowers, developing bolls, the bract-like calyx below late stage bolls and occasionally the stems of bolls, can cause boll drop	susceptible to a viral disease and a fungus, beetles (ground, rove), flies (bee, robber, snipe, tachinid), bugs (assassin, damsel, minute pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), green lacewings, snakeflies, harvestman spiders, birds	crop rotation with non-susceptible crops (cereals, legumes except for peas), good control of weedy hosts (lamb's quarters, kochia, pigweed, Russian thistle, wild mustard), early swathing to reduce larval feeding, fall cultivation to expose pupae to the environment	chlorpyrifos, Coragen, deltamethrin, Matador 120EC, Labamba, Voliam Xpress	rarely	4-5/m2 (nominal), 25-30% stand reduction (nominal)	was a significant pest of flax before canola and mustard were widely grown, tends to only become a problem if nearby canola, mustard or alfalfa fields have been swathed or harvested and the flax field is still green, the most damage occurs when late-instar larvae feed on flowers and newly formed bolls, large infestations typically limited to the Parkland and Peace River regions, populations usually well controlled by adverse weather and/or natural enemies, apply insecticide in late evening or early morning when larvae most active
Bollworm, flax (*Heliothis ononis*)	climbing cutworm, larva of a noctuid moth, overwinters as pupae, larvae appear in early May, 1 generation per year	feeds on the inside of developing bolls and then emerges to feed on other bolls, may feed on foliage if bolls become too ripe	beetles (ground and rove), flies (bee, robber, snipe, stiletto, tachinid), bugs (damsel, minute pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), green lacewings, snakeflies, harvestman spiders, birds	fall cultivation to expose pupae to the environment	Coragen, deltamethrin, Labamba, Matador 120EC	very rarely	3% or more of bolls damaged (nominal)	eggs laid in open flowers, population effectively regulated by diseases, predators and parasitoids in most years, the most damage to flax crops traditionally occurred in western Saskatchewan
Bug, lygus (*Lygus* spp.)	sucking insect, overwinters as adults, 1 or 2 generations/year, sometimes concentrated at field edges	feeds on the sap of stems, leaves, growing points, buds and flowers, causes bud abortion, growing point deformation, stunting and dieback	tachinid flies, bugs (assassin, big-eyed, damsel), wasps (braconid, chalcid, ichneumonid, trichogrammid), lacewings, spiders (jumping, crab)	seed early, good control of weedy hosts (asters, chickweed, dandelion, goldenrod, plantain, redroot pigweed, lamb's quarters, stinkweed, wild mustard)	Decis 5 EC, Voliam Xpress	no	not established	eggs laid in stems and leaves, typically completes one generation on an alternative host before moving to flax, often moves into a flax crop when buds begin to develop, symptoms similar to thrip damage, flax is very tolerant to feeding damage under good growing conditions even when populations are high, late-seeded crops more susceptible to damage, most common species found on flax is the tarnished plant bug
Caterpillar, zebra (*Melanchra picta*)	larva of a noctuid moth, overwinters as larvae, 1 to 2 generations/year	feeds on leaves	beetles (ground and rove), flies (robber, bee, stiletto, tachinid), bugs (assassin, damsel, minute pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), green lacewings, snakeflies, harvestman spiders, birds	none	none registered	very rarely	not established	incidence often corresponds with that of bertha armyworms and variegated cutworms, damage usually isolated to patches along the edges of the field

Table 1. Continued

Insect	Characteristics	Crop damage	Natural enemies	Cultural control	Chemical control	Economic concern?	Economic threshold	Comments
Cutworm, army (*Euxoa auxiliaris*)	above-ground cutworm, larva of a noctuid moth, overwinters as larvae, 1 generation/year	feeds on leaves	susceptible to a viral disease, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachinid), bugs (assassin, damsel, minute-pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), snakeflies, harvestman spiders, birds	seed crops later (after mid-May) to avoid larvae, good weed control in fallow and after harvest will reduce egg laying, spring and fall cultivation to expose larvae to natural enemies	chlorpyrifos, Coragen, deltamethrin, Labamba, Matador 120EC, permethrin	occasionally	4-5/m^2 (nominal), 25-30% stand reduction (nominal)	early seeded crops at high risk because overwinters as larvae, higher populations often present the year after an abnormally dry July followed by a wet fall, 10 or more larvae/m^2 can cause significant damage, apply insecticide in late evening or early morning when larvae most active
Cutworm, armyworm (*Mythimna unipuncta*)	climbing cutworm, larva of a noctuid moth, migratory, adults arrive in mid-April and larvae appear in early June, 2 generations/year	feeds on leaf margins, growing points and flowers	susceptible to a viral disease, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachinid), bugs (assassin, damsel, minute-pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), snakeflies, harvestman spiders, birds	good control of grassy weeds before adults arrive and prior to seeding	chlorpyrifos, Coragen, deltamethrin, Labamba, Matador 120EC	no	4-5/m^2 (nominal), 25-30% stand reduction (nominal)	first generation causes the greatest damage, apply insecticide in late evening or early morning when larvae most active
Cutworm, clover (*Discestra trifolii*)	climbing cutworm, larva of a noctuid moth, overwinters as pupae, larvae appear in mid to late June, 2 generations/year	feeds on leaves	susceptible to a viral disease and fungal diseases, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachinid), bugs (assassin, damsel, minute-pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), snakeflies, harvestman spiders, birds	crop rotation with non-susceptible crops (cereals, legumes), good control of weedy hosts (flixweed, mustards, shepherd's purse, stinkweed, wild radish), early swathing to reduce larval feeding, fall cultivation to expose pupae to the environment	Coragen, deltamethrin, Labamba, Matador 120EC	rarely	20-30/m^2	also known as the nutmeg moth, flax is a major host, first generation most critical to control, apply insecticide in late evening or early morning when larvae most active
Cutworm, darksided (*Euxoa messoria*)	climbing cutworm, larva of a noctuid moth, overwinters as eggs, larvae appear in late April, 1 generation/year	feeds on leaves and stems, older larvae may sever stems	susceptible to a viral disease and fungal diseases, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachinid), bugs (assassin, damsel, minute-pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), snakeflies, harvestman spiders, birds, small rodents	none	chlorpyrifos, Coragen, deltamethrin, Labamba, Matador 120EC, permethrin	rarely	5-6/m^2	look very similar to the redbacked cutworm, apply insecticide in late evening or early morning when larvae most active
Cutworm, dingy (*Feltia jaculifera*)	climbing cutworm, larva of a noctuid moth, overwinters as larvae, 1 generation/year	feeds on leaves and occasionally stems	susceptible to a viral disease and fungal diseases, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachinid), bugs (assassin, damsel, minute-pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), snakeflies, harvestman spiders, birds	good weed control in fallow and after harvest will reduce egg laying, spring and fall cultivation to expose larvae to natural enemies	Coragen, deltamethrin, Labamba, Matador 120EC	rarely	25-30% stand reduction (nominal)	can't be avoided by early seeding because larvae present until mid-July, apply insecticide in late evening or early morning when larvae most active
Cutworm, early (*Euxoa tristicula*)*	subterranean cutworm, larva of a noctuid moth, overwinters as eggs, larvae appear in late April, 1 generation/year	feeds on leaves of seedlings before they emerge, feeds on leaves and severs the stems of newly emerged seedlings	susceptible to a viral disease and fungal diseases, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachinid), bugs (assassin, damsel, minute-pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), snakeflies, harvestman spiders, birds	none	Coragen, deltamethrin, Labamba, Matador 120EC	rarely	4-5/m^2 (nominal), 25-30% stand reduction (nominal)	
Cutworm, pale western (*Agrotis orthogonia*)*	subterranean cutworm, larva of a noctuid moth, overwinters as eggs, larvae appear in late April, 1 generation/year,	feeds on roots and leaves of seedlings before they emerge, feeds on leaves and severs the stems of newly emerged seedlings	susceptible to a viral disease, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachinid), bugs (assassin, damsel, minute-pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), snakeflies, harvestman spiders, birds	weed free fallow fields from July to mid-September and good in-crop weed control significantly reduces egg laying, cultivation of soil and keeping free of plant growth for a period of 10 days after cutworms have hatched can reduce larval populations	chlorpyrifos, Coragen, deltamethrin, Labamba, Matador 120EC, permethrin	yes	4-5/m^2	preferred host is cereals so monitor volunteer cereals for presence early in the season, larval parasitism very common and effective at controlling many outbreaks, apply insecticide in late evening or early morning when larvae most active

Table 1. Continued

Insect	Characteristics	Crop damage	Natural enemies	Cultural control	Chemical control	Economic concern?	Economic threshold	Comments
Cutworm, redbacked (*Euxoa ochrogaster*)*	above-ground cutworm, larva of a noctuid moth, overwinters as eggs, larvae appear in late April, 1 generation/year	feeds on leaves of seedlings before they emerge, feeds on leaves and severs the stems of newly emerged seedlings	susceptible to a viral disease and fungal diseases, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachinid), bugs (assassin, damsel, minute-pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), snakeflies, harvestman spiders, birds	weed free fallow fields from August to mid-September and good in-crop weed control significantly reduces egg laying	chlorpyrifos, Coragen, deltamethrin, Labamba, Matador 120EC, permethrin	yes	4-5/m^2	a population of 12 larvae/m^2 can cause 10% yield loss and a population of 32 larvae/m^2 can destroy a flax field, apply insecticide in late evening or early morning when larvae most active
Cutworm, variegated (*Peridroma saucia*)	climbing cutworm, larva of a noctuid moth, migratory and overwinter as pupae, adults arrive in mid-April and larvae appear at the end of May, 2 to 3 generations/year	feeds on leaves, buds, flowers and bolls	susceptible to a viral disease and fungal diseases, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachinid), bugs (assassin, damsel, minute-pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), snakeflies, harvestman spiders, birds	good weed and volunteer host control, fall cultivation to expose pupae to the environment	chlorpyrifos, Coragen, deltamethrin, Matador 120EC	no	4-5/m^2 (nominal), 25-30% stand reduction (nominal)	apply insecticide in late evening or early morning when larvae most active
Grasshopper	chewing insect, overwinters as eggs that begin to hatch when the soil temperature reaches 4.5°C, 1 generation/year	feeds on buds, flowers and the stems of bolls, can cause bolls to drop, young grasshoppers can cause damage to seedlings	susceptible to a fungus, a microsporidian, thread worms, nematodes, mites, wolf spiders, flies (bee, flesh, muscoid, tangled vein, robber, stiletto, tachinid), wasps, beetles (blister, ground), field crickets, birds, small rodents, coyotes	fall cultivation may decrease egg survival, destruction of green growth on stubble at time of egg laying may significantly decrease young grasshopper populations, barrier strips of a non-preferred crop (e.g. oats, peas) may delay crop feeding, trap crop may attract grasshoppers and allow for effective chemical control, early seeding, good control in nearby crops will reduce the risk	Coragen, deltamethrin, lambda-cyhalothrin, malathion, Voliam Xpress	yes	2/m^2 if boll drop occurring, 15 adults/m^2 otherwise	grasshoppers present prior to May will not cause economic damage to the crop, tends to only feed on flax late in the season when other food sources dwindle, most damage caused by 3rd to 5th nymphal stages, 19 grasshoppers/m^2 can cause 22% yield loss, winged adults cause boll drop, adults are more resistant to chemicals than earlier instars, most effective chemical control when the majority are in the 3rd or 4th nymphal stage, most common species attacking flax is the two-striped grasshopper, parasites may control populations up to 60% depending on environmental conditions, cool wet weather in spring and heavy rainfalls may kill young nymphs
Leafhopper, aster (*Macrosteles quandrilineatus*)	sucking insect, adults migrate into Canada from the US in the spring via southerly winds, transmits the pathogens causing aster yellows and crinkle diseases, 2 generations/year	not typically noticeable because feeds on plant sap (refer to disease table for symptoms of aster yellows and crinkle diseases)	spiders (harvestman, jumping, wolf), predatory mites, bugs (assassin, damsel), wasps (chalcid, ichneumonid, trichogrammid), green lacewings	seed early, seed far from alfalfa, good control of perennial weeds	none registered	rarely	not established	also called the six-spotted leaf hopper, low levels of infection occur every year
Seed bug, dirt-coloured (*Peritrechus convivus*)	piercing-sucking insect, overwinters as adults, 1 or 2 generations/year, sometimes concentrated at field edges	nymphs feed on stems and leaves of seedlings, adults feed on seeds beneath the soil surface	Collops beetles?	none	none registered	yes	not established	the first significant damage to flax since the late 60s was reported in 2017, 2018 and 2019, nymphs and adults can be present in large densities, often associated with low-lying areas that were previously covered with water, broad host range
Thrips (*Frankliniella tritici*, *Thrips tabaci* and *T. nigropilosus, T. vulgatissimus*)	rasping-sucking insect, overwinter as adults or larvae in plant debris or adults migrate into Canada from the US in the spring via southerly winds, several generations per year	feeds on the sap of young leaves, growing points, buds and flowers, causes bud abortion, stunted growth, silvering of leaves, twisted leaves, deformation of the growing point and very upright main stem	ladybird beetles, anthocorid bugs, predatory thrips	sow after cereals and not peas or mustard	none registered	rarely	not established	easily drowned by heavy rain, readily reproduce in warm dry weather, highly attracted to the colour white, symptoms similar to damage caused by lygus bug
Variegated fritillary (*Euptoieta claudia*)	larva of a migratory brush-footed butterfly, rarely overwinters in Western Canada, 2 generations/year	feeds on leaves, flowers and seeds, may cause boll drop	flies (robber, tachinid), bugs (assassin, damsel), wasps (braconid, chalcid, ichneumonid, trichogrammid), green lacewings, snakeflies, spider (crab, harvestman, jumping), birds	none	none registered	very rarely	not established	populations hardly ever high enough to cause economic losses

Table 1. Continued

Insect	Characteristics	Crop damage	Natural enemies	Cultural control	Chemical control	Economic concern?	Economic threshold	Comments
Webworm, beet (*Loxostege stricticalis*)	larva of a crambid snout moth, overwinters as larvae and pupae, 2 generations/year	feeds on leaves, stems and flowers, removes patches of bark from stems and branches	beetles (ground, rove), flies (bee, robber, snipe, stiletto, tachinid), bugs (assassin, damsel, minute pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), green lacewings, snakeflies, spiders (crab, harvestman, jumping), birds	the process of harvesting kills a large number of larvae, good weed control of preferred weeds (lamb's quarters, Russian thistle) within and surrounding the crop	deltamethrin	rarely	10-11/m^2	spins web among the leaves on upper parts of plants, prefers weeds (lamb's quarters, Russian thistle) to flax, causes more damage in hot, dry years, only the 2nd larval generation causes crop damage and these appear in mid-July, may migrate in large 'armies' in July and August if populations very high, apply insecticide only if a significant number of bolls are being damaged
Wireworm (*Agriotes* spp.)	larva of a click beetle, overwinter as adults and larvae, 1 generation per year	feeds on germinating seeds and the underground parts of young seedlings	susceptible to a fungus and bacteria diseases, nematodes, beetles (ground, rove), stiletto flies, small rodents, birds	shallow cultivation in spring to expose eggs and injur larvae, seed early, increase seeding rate, use an onrow packer, follow seeding practices that promote rapid germination and seedling growth, rotate with non-susceptible crops (e.g. legumes, buckwheat, mustard), keep summer fallow brown in June and July to starve first-year larvae, cultivate summer fallow in mid to late July to damage larvae and pupae	none registered	very rarely	not established	populations have significantly increased in recent years due to the loss of effective insecticides and the transition to conservation tillage, average larval lifespan is 3 to 5 years but they can live up to 11 years, later stage larvae can live off of humus in the soil if no plants present, symptoms of feeding damage can be mistaken for cutworm damage or poor germination/emergence

Compiled from the following publications: Cutworm Pests of Crops on the Canadian Prairies, Field Crop and Forage Pests and their Natural Enemies in Western Canada, Flax The Genus Linum, Grasshopper Identification and Control Methods, Growing Flax, Insect Management in Oilseed Crops in Western Canada, Insects of Canola, Mustard and Flax in Canadian Grasslands and NDSU Flax Insect Pest Management.

*the most common species of cutworm affecting flax in Western Canada

Flax Disease Survey

A Saskatchewan flax disease survey is planned for 2020, but this year permission to survey fields must be granted by landowners. If you are interested in supporting provincial pest survey efforts please sign up here: https://ca.surveygizmo.com/s3/50060966/Pest-Monitoring-Sign-up

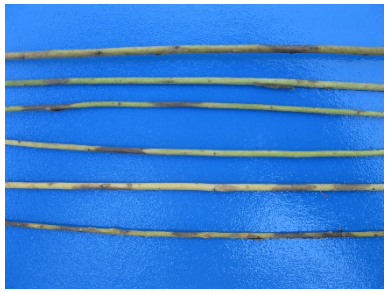

Table 2. Insecticide options for flax

Active(s)	Product(s)	No. applications allowed[σ]	Tank mix partners[¶]	Group(s)	aphids, potato	bollworm, flax	bug, lygus	armyworm, bertha	caterpillar, zebra	cutworm, army	cutworm, armyworm	cutworm, clover	cutworm, darksided	cutworm, dingy	cutworm, early	cutworm, pale western	cutworm, redbacked	cutworm, variegated	fritillary, variegated	grasshoppers	leafhopper, aster	seed bug, dirt-coloured	thrips	webworm, beet	wireworm
chlorantraniliprole	Coragen*	3	Acapela, Assure II, MCPA ester and amine	28		√		√		√	√	√	√	√	√	√	√	√		√					
chlorpyrifos	various[§]	1	Headline EC, Priaxor, Proline 480 SC**	1B				√		√	√		√			√	√	√							
deltamethrin	Decis 5 EC, Poleci 2.5 EC	3	Buctril M, Centurion**, MCPA, Headline EC**, Pardner, Priaxor**, Proline 480 SC**	3A		√	√**	√**		√	√	√	√	√	√	√	√	√		√				√	
dimethoate	Cygon 480-AG, Cygon 480 EC, Lagon 480 E	1		1B	√																				
lambda-cyhalothrin	Labamba, Matador 120EC, Silencer 120 EC	3	Headline EC**, Priaxor**, Proline 480 SC**	3A		√**		√**		√**	√**	√**	√**	√**	√**	√**	√**	√**		√					
lambda-cyhalothrin, chlorantraniliprole	Voliam Xpress	3		3A ,28			√	√												√					
malathion	Malathion 85E, Malathion 500	1		1B																√					
permethrin	384EC, Perm-UP	none listed		3A						√			√			√	√								

Compiled from the 2020 AB, SK and MB crop protection guides. Check product labels for application rates and restrictions (environmental conditions, PPE, water volume, number of applications, application intervals, chemical rotation, tank mixes, crop and pest staging, pest specificity, beneficial insects, re-entry periods, buffer zones, re-cropping and pre-harvest intervals).
*safe for bees and many beneficials
**certain products only
[σ]ground application only. Check product label for aerial application restrictions.
[¶]registered and off-label tank mixes supported by the manufacturer
[§]Citadel 480EC, Lorsban 4E, Lorsban NT, MPower Krypton, Nufos 4E, Pyrinex 480EC, Sharphos, Warhawk 480 EC

- If you need help identifying an insect (or weed, disease or environmental disorder) in your flax crop you can:
  - Speak to a Crop or Pest Specialist at your regional Provincial Ministry of Agriculture Office
  - Consult your Agronomist
  - Submit a plant or insect sample to a Provincial Laboratory
    - British Columbia
    - Saskatchewan
    - Manitoba

For more information on insect pests of flax contact the following:

Michelle Beaith
Agronomist
Saskatchewan Flax Development Commission
(306) 664-1901
michelle@saskflax.com

Dane Froese
Industry Development Specialist – Oilseeds
Manitoba Agriculture and Resource Development
(204) 750-2840
dane.froese@gov.mb.ca

Cory Jacob
Provincial Specialist, Oilseed Crops
Saskatchewan Ministry of Agriculture
(306) 787-4668
cory.jacob@gov.sk.ca

Useful links:

1. Pesticides
   - Provincial Crop Protection Guides
     - Alberta
     - Saskatchewan
     - Manitoba

   - PMRA Pesticide Product Label Search:
     - Online
     - App

   - Pesticide resistance
     - Manage Resistance Now

2. Provincial Government Pest Management Websites
   - Alberta
   - Saskatchewan
   - Manitoba

3. Insect Scouting, Identification and Management Information
   - General
     - Field Crop and Forage Pests and their Natural Enemies in Western Canada: Identification and Management-Agriculture and Agri-Food Canada
     - University of Manitoba Pest & Crop Management App:
       - Google Play
       - App Store
     - Insect Management in Oilseed Crops in Western Canada-Western Forum on Pest Management
     - Economic Thresholds of Insect Pests-Saskatchewan Ministry of Agriculture

   - Scouting
     - Sweep Net Scouting Tips-Field Heroes
     - Field Scouting-Alberta Agriculture and Forestry
     - Scouting for Aphids-Field Heroes
     - Scouting for Bertha Armyworm-Field Heroes
     - Protocol for Monitoring Adults and Larvae of Bertha Armyworm-Prairie Pest Monitoring Network
     - Scouting for Cutworm-Field Heroes
     - Cutworm Monitoring and Collection-Prairie Pest Monitoring Network
     - Monitoring for Grasshoppers-Prairie Pest Monitoring Network
     - Lygus Bug Monitoring Protocol-Prairie Pest Monitoring Network

- Cutworms
    - Cutworm Pests of Crops on the Canadian Prairies-Agriculture and Agri-Food Canada
    - Cutworms in Field Crops-Manitoba Agriculture and Resource Development
    - Armyworms-Manitoba Agriculture and Resource Development

- Grasshoppers
    - Grasshopper Identification & Control Methods to Protect Crops and the Environment-Agriculture and Agri-Food Canada
    - Grasshopper-Alberta Agriculture and Forestry
    - Grasshoppers-Saskatchewan Ministry of Agriculture
    - Grasshoppers: Identification, Monitoring and Management-Manitoba Agriculture and Resource Development
    - Grasshopper Monitoring and Control in British Columbia-BC Ministry of Agriculture

- Bertha armyworm
    - Bertha Armyworm-Alberta Agriculture and Forestry
    - Bertha Armyworm-Saskatchewan Ministry of Agriculture
    - Bertha Armyworm-Manitoba Agriculture and Resource Development

- Lygus bugs:
    - Lygus Bugs in Field Crops-Manitoba Agriculture and Resource Development

- Aphids:
    - Aphids on Flax-Manitoba Agriculture and Resource Development

- Wireworms
    - Wireworms on Crops in the Canadian Prairies-Manitoba Agriculture and Resource Development

4. Beneficial Insects
- Field Heroes
- Pest and Predators Podcast Episode 1-Field Heroes/Real Agriculture
- Natural Enemies of Pests Associated with Prairie Crops-Agriculture and Agri-Food Canada
- Natural Enemies of Field Crop Insect Pests in Alberta-Alberta Agriculture and Forestry
- Maximizing the Value of Beneficial Insects on the Farm: Predators and Parasitoids-Manitoba Agriculture and Resource Development
- Biological Control Website-Cornell University

5. Pest Monitoring Reports and Reporting Tools
- Prairie Pest Monitoring Network Blog
- Alberta Insect Pest Monitoring Network
- Alberta Agriculture and Forestry Cutworm Reporting Tool
- Manitoba Crop Pest Updates

6. Pesticides and Pollinators
- Protecting Pollinators during Pesticide Spraying-Agriculture and Agri-Food Canada
- Hazards and Safeguards in Applying Insecticides to Crops in Bloom-Western Forum on Pest Management
- Protecting and Supporting Pollinators-Manitoba Agriculture and Resource Development
- How to Reduce Bee Poisoning from Pesticides-Pacific Northwest Extension