Flax on the Farm

Insect and Disease Monitoring and Control

Even though flax is susceptible to attack by a number of insects and diseases, economic losses tend to be minimal except in a few cases. This combined with the fact that many diseases are unique to flax, make it a great choice for incorporation into rotations.

Methods of insect and disease control

- Chemical
    - Scouting for insects and diseases 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 less than the value of the crop that would be destroyed without any control measures. Therefore, economic thresholds provide a guide to indicate when chemical control of a pest is economical.
    - Follow best practices for chemical control of insects and diseases. Using the right product at the right stage during the right conditions and at the right rate will maximize the efficiency of control and prevent the development of resistance.
    - Only four groups of insecticides and fungicides are registered for use on flax, so chemical rotation is important to reduce the risk of the development of resistance.
    - 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, sequential applications, 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 that are applied outside of the recommended pre-harvest interval can result in marketing and trade issues related to maximum residue limits (MRLs).
- Cultural
    - Includes mechanical, environmental or other non-chemical or non-biological methods of controlling a pest.
- 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.

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.
- With general public concern over the safety of pesticides and their effect on beneficial insects, this crop management practice has gained prominence in recent years.
- 6 elements of IPM:
    - Prevention of pest problems

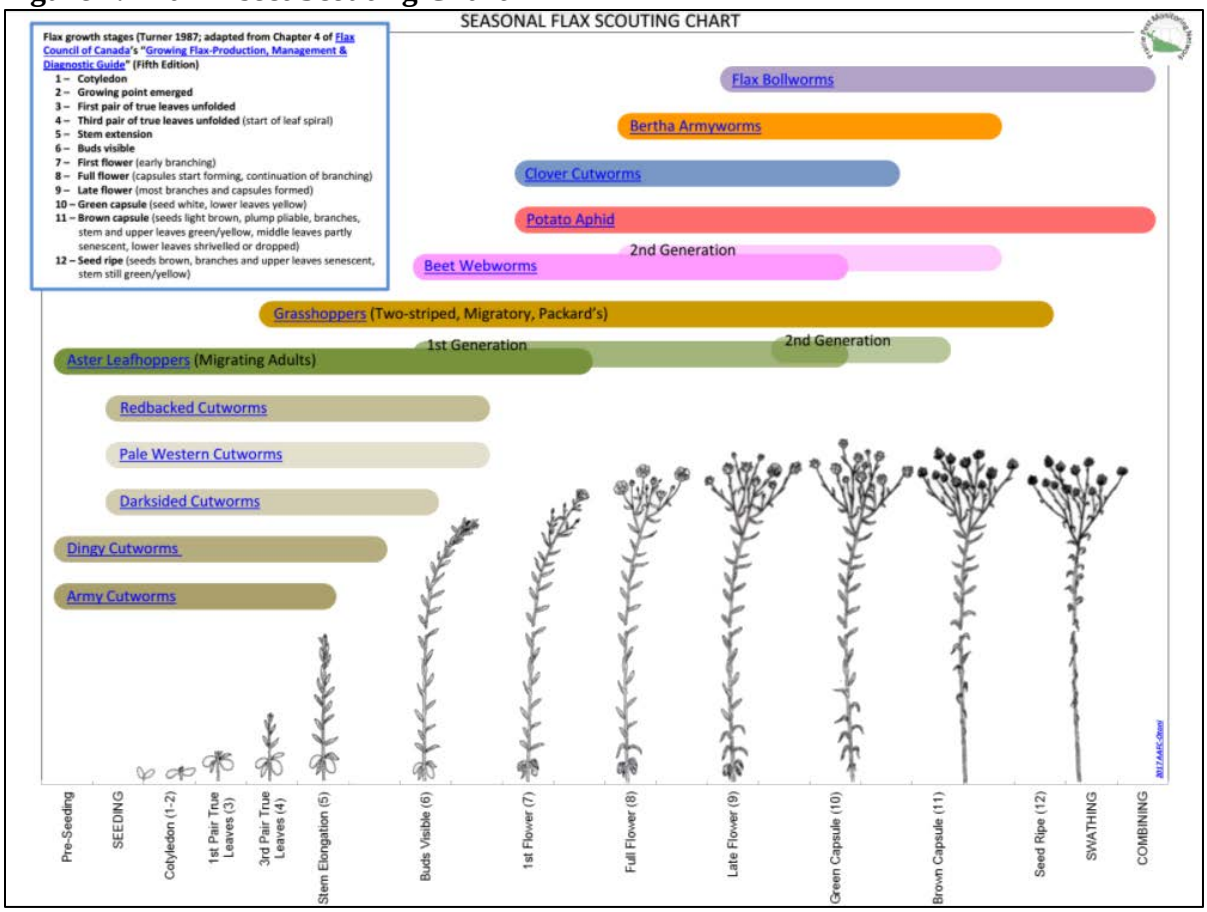
- Accurate identification and knowledge of pests, their damage and natural enemies
- Surveillance of pests, pest damage, natural enemies and weather conditions
- Application of economic thresholds
- Suppression of pest populations
- Evaluation of results

Scouting

- Continuous monitoring of insects and diseases throughout the growing season is important for the effective implementation of 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. Specifics can be found in the provincial crop protection guides and field guides listed on the last page of this article.

The accurate identification of insects and disease, knowledge about their lifecycles and methods of control are key to making good crop management decisions. Below is a flax insect scouting chart, as well as descriptions of the various insects, diseases and environmental disorders that you may come across in your flax crop and the methods that can be used to control them.

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

Table 1. Insect pests of flax

Insect	Economic concern?	Characteristics	Crop damage	Economic threshold	Natural enemies	Cultural control	Chemical control	Comments
Aphid, potato	yes	sucking insect, overwinters as eggs on rose stems, 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	3 healthy aphids per main stem at full flower, 8 healthy aphids per main stem at the green boll stage	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	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% when population reaches 50 aphids per plant
Armyworm, bertha	rarely	climbing cutworm, larva of a noctuid moth, overwinters as pupae, larvae appear in early June, 1 generation per year	feeds on flowers, developing bolls, the bract-like calyx below late stage bolls and occasionally the stems of bolls, can cause boll drop	4-5/m^2 (nominal)	beetles (ground, rove), flies (bee, robber, snipe, tachnid), 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), early swathing to reduce larval feeding, fall cultivation to expose pupae to the environment	chlorpyrifos, Coragen, deltamethrin, Lannate, Matador 120EC, Voliam Xpress,	used to be 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, or if the flax field is very weedy
Bollworm, flax	very rarely	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 emerge to feed on other bolls	3% or more of bolls damaged (nominal)	beetles (ground and rove), flies (bee, robber, snipe, stiletto, tachnid), 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, Matador 120EC	eggs laid in open flowers, population effectively regulated by diseases, predators and parasitoids in most years
Bug, lygus	no	sucking insect, overwinters as adults, 1 or 2 generations/year, sometimes concentrated at field edges	feeds on the sap of buds and flowers	not established	tachnid flies, bugs (assassin, damsel), wasps (chalcid, ichneumonid, trichogrammid), jumping spiders	none	Voliam Xpress	flax is very tolerant to feeding damage under good growing conditions even when populations are high, most common species found on flax is the tarnished plant bug
Caterpillar, zebra	very rarely	larva of a noctuid moth, overwinters as larvae, 1 to 2 generations/year	feeds on leaves	not established	beetles (ground and rove), flies (robber, bee, stiletto, tachnid), bugs (assassin, damsel, minute pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), green lacewings, snakeflies, harvestman spiders, birds	none	none registered	incidence often corresponds with that of bertha armyworms and variegated cutworms, damage usually isolated to patches along the edges of the field
Cutworm, army	occasionally	above-ground cutworm, larva of a noctuid moth, overwinters as larvae, 1 generation/year	feeds on leaves	4-5/m^2 (nominal)	susceptible to a viral disease, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachnid), 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	Coragen, chlorpyrifos, deltamethrin, Matador 120EC, permethrin	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
Cutworm, armyworm	no	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	4-5/m^2 (nominal)	susceptible to a viral disease, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachnid), bugs (assassin, damsel, minute-pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), snakeflies, harvestman spiders, birds	good control of grassy weeds before adults arrive	Coragen, deltamethrin, Matador 120EC, chlorpyrifos	first generation causes the greatest damage

Table 1. Continued

Insect	Economic concern?	Characteristics	Crop damage	Economic threshold	Natural enemies	Cultural control	Chemical control	Comments
Cutworm, clover	rarely	climbing cutworm, larva of a noctuid moth, overwinters as pupae, larvae appear in mid to late June, 2 generations/year	feeds on leaves	4-5/m^2 (nominal)	susceptible to a viral disease, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachnid), 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, Matador 120EC	flax is a major host, first generation most critical to control
Cutworm, darksided	rarely	climbing cutworm, larva of a noctuid moth, overwinters as eggs, larvae appear in late April, 1 generation/year	feeds on leaves and stems	5-6/m^2	susceptible to a viral disease, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachnid), bugs (assassin, damsel, minute-pirate), wasps (braconid, chalcid, ichneumonid, trichogrammid), snakeflies, harvestman spiders, birds, small rodents	none	Coragen, deltamethrin, Matador 120EC, permethrin, chlorpyrifos	look very similar to the redbacked cutworm
Cutworm, dingy	rarely	climbing cutworm, larva of a noctuid moth, overwinters as larvae, 1 generation/year	feeds on leaves and occasionally stems	25-30% stand reduction	susceptible to a viral disease, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachnid), 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, Matador 120EC	can't be avoided by early seeding because larvae present until mid-July
Cutworm, pale western	Yes	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	4-5/m^2	susceptible to a viral disease, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachnid), 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	Coragen, deltamethrin, Matador 120EC, permethrin, chlorpyrifos	preferred host is cereals so monitor volunteer cereals for presence early in the season, larval parasitism very common and effective at controlling many outbreaks
Cutworm, redbacked	yes	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	4-5/m^2	susceptible to a viral disease, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachnid), 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	Coragen, deltamethrin, Matador 120EC, permethrin, chlorpyrifos	
Cutworm, variegated	no	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	4-5/m^2 (nominal)	susceptible to a viral disease, beetles (ground, rove), flies (robber, bee), flies (snipe, stiletto, tachnid), 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	Coragen, deltamethrin, Matador 120EC, chlorpyrifos	
Grasshopper	yes	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	2 per m^2 if boll drop occurring (nominal)	susceptible to a fungus, wolf spiders, flies (bee, robber, stiletto, tachnid), birds, small rodents, coyotes	good control in nearby crops will reduce the risk	Coragen, deltamethrin, lambda-cyhalothrin, malathion, Voliam Xpress	grasshoppers present prior to May will not cause economic damage to the crop, adults are more resistant to chemicals than earlier instars, tends to only feed on flax late in the season when other food sources become scarce

Table 1. Continued

Insect	Economic concern?	Characteristics	Crop damage	Economic threshold	Natural enemies	Cultural control	Chemical control	Comments
Leafhopper, aster	rarely	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)	not established	spiders (harvestman, jumping, wolf), predatory mites, bugs (assassin, damsel), wasps (chalcid, ichneumonid, trichogrammid), green lacewings	none	none registered	also called the six-spotted leaf hopper, low levels of infection occur every year
Variegated fritillary	very rarely	larva of a migratory brush-footed butterfly, rarely overwinters in Western Canada, 2 generations/year	feeds on leaves, flowers and seeds	not established	flies (robber, tachnid), bugs (assassin, damsel), wasps (braconid, chalcid, ichneumonid, trichogrammid), green lacewings, snakeflies, spider (crab, harvestman, jumping), birds	none	none registered	populations hardly ever high enough to cause economic losses
Webworm, beet	rarely	larva of a crambid snout moth, overwinters as larvae and pupae, 2 generations/year	feeds on foliage, stems and flowers	10-11/m^2 (nominal)	beetles (ground, rove), flies (bee, robber, snipe, stiletto, tachnid), 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	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, apply insecticide only if a significant number of bolls are being damaged,
Wireworm	very rarely	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	not established	susceptible to a fungus, beetles (ground, rove), flies (stiletto)	seed early, follow seeding practices that promote rapid germination and seedling growth, keep summer fallow brown in June and July to starve larvae	none registered	populations have significantly increased in recent years due to the loss of effective insecticides and the transition to conservation tillage

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, Growing Flax and Insect Management in Oilseed Crops in Western Canada.

Table 2. Currently registered insecticides for flax

Group	Active(s)	Product	Target insect(s)	Crop stage	Tank mix partners	Comments
1A	methomyl	Lannate Toss-N-Go	bertha armyworm	all		
1B	chlorpyrifos	Chlorpyrifos 480 EC	darksided, redbacked, variegated, pale western, and army cutworms, armyworm, bertha armyworm	all	Proline 480 EC (Lorsban only)	
		Citadel 480EC				
		Fosban 480 EC				
		Lorsban 4E				
		Lorsban NT				
		MPOWER Krypton				
		Nufos 4E				
		Pyrinex 480EC				
		Sharphos				
		Warhawk 480 EC				
	dimethoate	Cygon 480	potato aphid	late flowering to early green boll		
		Cygon 480-AG				
		Cygon 480 EC				
		Lagon 480 E				
	malathion	Malathion 85E	grasshoppers	all		do not apply when bees present
		Malathion 500				
3A	deltamethrin	Decis 5 EC	cutworms, grasshoppers, clover cutworm, beet webworm	all	Buctril M, MCPA, Headline EC (Decis only), Proline 480 SC (Decis only)	
		Poleci 2.5 EC				
	lambda-cyhalothrin	Matador 120EC	cutworms (Matador only), grasshoppers	all	Proline 480 EC (Matador only)	
		Silencer 120 EC		all		
	permethrin	Ambush	army, black, darksided, pale western, redbacked, white cutworms	up to and including 5-leaf		will only control surface feeding or climbing stages
		Pounce 384EC				
		Perm-UP				
3A, 28	lambda-cyhalothrin, chlorantraniliprole	Voliam Xpress	lygus, grasshoppers, bertha armyworm	all		
28	chlorantraniliprole	Coragen*	cutworms, grasshoppers, bertha armyworm	all	Acapela	

Adapted from the 2018 AB, SK and MB crop protection guides. Check product labels for application rates and restrictions (environmental conditions, PPE, water volume, number of applications, tank mixes, crop and pest staging, pest specificity, beneficial insects, re-entry periods, buffer zones, and pre-harvest intervals).
*safe for bees

Table 3. Diseases of flax

Disease	Causal organism(s)	Characteristics	Economic concern?	Symptoms	Cultural control	Chemical control	Comments	Specific to flax?
Aster yellows	Phytoplasma	bacterial parasite transmitted by aster/six-spotted leaf hoppers blown in from the US via southerly winds, moves through the plant via the sugar-conducting tissues (phloem), overwinters in the roots of alfalfa and perennial weed species	very rarely	deformed flower parts that look like leaves and set no seed, uppermost sections of stems turn pale green to yellow, may affect single branches or entire plants, infected plants often stunted	seed early, good control of perennial weeds, seed far from alfalfa	none	infection occurs early in the season but symptoms do not appear until flowering, symptoms tend to be worse in wet soils, epidemics in 1957 and 2012 due to unusually early leafhopper migrations during abnormally warm springs	no
Crinkle	Oat blue dwarf virus (OBDV)	virus transmitted by aster/six-spotted leaf hoppers blown in from the US via southerly winds, moves through the plant via the sugar-conducting tissues (phloem)	very rarely	leaf puckering/wrinkling, stunted growth, reduced branching	seed early	none	virus also infects barley, oats and wheat	no
Fusarium wilt	*Fusarium oxysporum* f. sp. *lini*	soil, residue and seed-borne fungus, enters roots and moves through plant via water-conducting tissues (xylem), infection can occur at any growth stage, spores spread by wind and rain	occasionally	early season infection results in seedling death before or shortly after emergence, later season infection causes yellowing of leaves, wilting (typically only on one side of the plant), stem bent like a shepherd's crook	plant a resistant variety, plant clean seed (i.e. with very little chaff), seed early, seed at the higher end of the recommended rate, practice a 1 in 4 year rotation, never seed flax after flax, avoid using trifluralin on previously infected fields due to significant negative impact on the emergence of the subsequent flax crop, good control of flax volunteers	seed treatments-Insure Pulse, Vitaflo	currently registered varieties are moderately resistant (MR) or resistant (R), fungus grows best in warm soil, spores can survive in soil up to 10 years, innoculum very rapidly builds up in soils	yes
Pasmo	*Septoria linicola*	residue and seed-borne fungus, infects all above-ground plant parts at any growth stage, spores dispersed by wind and rain	yes	circular brown spots on leaves early in the season, defoliation, alternating green and brown/black bands on stems (candy cane-like) late in the season, premature ripening, boll drop if plants left to stand for a long time before harvest, during ripening appears as reddish brown patches of lodging plants in the field from a distance	plant a lodging resistant variety, plant clean seed (i.e. with very little chaff), seed at the lower end of the recommended rate, seed early, follow recommended fertilizer rates, practice a 1 in 5 year rotation, plant flax crop as far away from previous year's crop as possible, maintain good weed and volunteer flax control	foliar fungicides-Acapela, Headline EC, Priaxor	currently registered varieties are susceptible (S) or moderately susceptible (MS), stem lesions can weaken stems causing lodging, grows best in humid conditions (warm and moist), can cause yield losses up to 60% if a foliar fungicide is not applied, infection after seed fill causes no economic losses, seed that is grey in colour may be infected with pasmo	yes
Powdery mildew	Oidium lini	crop residue-borne fungus, tends to infect plants at later growth stages	rarely	begins as powdery white spots on leaves which can spread to cover entire leaves causing leaf death, can also infect stems and pedicels (individual flower stems) which in severe cases will cause stem breakage and boll drop	grow a moderately resistant (MR) variety, plant clean seed (i.e. with very little chaff), seed early, practice a 1 in 4 year rotation, bury infested residue, good control of flax volunteers	none	relatively new disease for flax (first observed in 1997), currently registered varieties are moderately susceptible (MS) or moderately resistant (MR), pathogen thrives under warm (20-25°C) humid conditions but does not do well under rainy conditions, has caused yield losses of 20-30% in research plots	yes
Root rot	*Rhizoctonia solani*, *Pythium* spp., Fusarium spp.	soil-borne fungi, infect plants at later stages of development so symptoms often don't appear until after flowering	rarely	wilted plants, premature ripening, stunted roots, discoloured roots	do not seed deeper than necessary, plant high quality (i.e. not damaged) seed, seed at the high end of the recommended rate, practice a 1 in 4 year rotation, specifically for Rhizoctonia solani: seed early, do not seed after legumes or sugar beet, do not sow on summerfallow, pack after seeding, practice conservation tillage	seed treatments-Insure Pulse, INTEGO Solo, Vitaflo	same fungi that cause seed rot and seedling blight	no
Rust	*Melampspora lini*	crop residue-borne fungus, infects all above-ground plant parts, spores spread by wind	no	inconspicuous yellow pustules on the cotyledons and lower leaves of seedlings, large orange powdery pustules on the leaves, stems and bolls of older plants that eventually turn black, can lead to defoliation and stem girdling	plant a resistant variety, plant clean seed (i.e. with very little chaff), seed early, practice a 1 in 4 rotation, bury infested residue, good control of weeds and flax volunteers, plant flax crop as far away from previous year's crop as possible	none	was the most economically important disease of flax until the introduction of resistant varieties in the 1970s, caused yield losses from 25 to 50%, all currently registered varieties are resistant, growing a non-resistant variety may lead to the erosion of the current level of varietal resistance due to the development of new races, pathogen prefers high humidity, warm days and cool nights and higher soil temperatures,	yes

Table 3. Continued

Disease	Causal organism(s)	Characteristics	Economic concern?	Symptoms	Cultural control	Chemical control	Comments	Specific to flax?
Sclerotinia	*Sclerotinia sclerotiorum*	soil-borne fungus	very rarely	water-soaked elongated lesions on stems, stem girdling, premature ripening leading to bleached/grey stems, dark brown/black sclerotia (fruiting bodies) develop inside stems, sclerotia look like mouse droppings	plant a lodging resistant variety, follow recommended seeding and fertilizer rates, avoid water-logged soils	foliar fungicides- Priaxor, Proline 480 SC, Serenade Max	tends to only occur in significantly lodged flax under high moisture conditions, flax crop is not a significant source of the disease the following year because the survival rate of the sclerotia is low compared to those produced on other crops	no
Stem break and browning	*Aureobasidium pullulan* var. *lini* (*Polyspora lini*)	crop residue and seed-borne fungus	rarely	water-soaked spots on early leaves which later develop purple margins, leaf lesions spread to the first node of the stem and may eventually cover a large portion of the stem, plants often fall over when in bud or early flower stage due to a canker at the first node	seed early, do not plant seed harvested from an infected field, practice a 1 in 4 year rotation, plant flax crop as far away from previous year's crop as possible, good control of flax volunteers	none	harvest losses occur due to plants laying on the ground that can't be picked up by the combine, disease most common in the Parkland regions of AB and SK	yes

Compiled from the Diseases of Field Crops in Canada, Guidelines for the Control of Plant Diseases in Western Canada and Growing Flax publications, as well as from personal communications with Dr. Khalid Rashid.

Table 4. Currently registered foliar fungicides for flax

Group	Active ingredient	Fungicide	Disease(s) controlled	Crop stage	Tank mix partners	Comments
3	prothioconazole	Proline 480 SC	Sclerotinia	20-50% flowering	Decis 5 EC, Lorsban 4E, Matador 120EC	most effective when applied early in the morning before petals fall off
11	picoxystrobin	Acapela	Pasmo	prior to disease development or at 20% flowering	Coragen	
11	pyraclostrobin	Headline EC	Pasmo	20% flowering*	Decis 5 EC	
7, 11	fluxapyroxad, pyraclostrobin	Priaxor	Pasmo, Sclerotinia**	20-50% flowering		
44	Bacillus subtilis	Serenade Max	Sclerotinia	20-30% flowering and 50% flowering		most effective when applied early in the morning before petals fall off

Adapted from the 2018 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, sequential applications, tank mixes, crop staging, re-entry periods, buffer zones, re-cropping and pre-harvest intervals).

*approximately 7 to 10 days after the initiation of flowering

**suppression only of Sclerotinia

Table 5. Environmental disorders of flax

Disorder	Cause	Economic concern?	Symptoms	Cultural control	Chemical control	Comments	Specific to flax?
Boll blight	combination of several different diseases and environmental stresses	very rarely	bud, flower and/or young boll death	none	none	incidence often a result of warm, dry conditions following cold, wet weather	yes
Chlorosis	iron, manganese or zinc deficiency	occasionally	otherwise healthy plants have pale green to yellow leaves with distinct green veins, prolonged conditions may cause dieback of the main stem and tillering, delays maturity	plant a resistant variety, apply deficient micronutrient in a test strip and if crop responds, apply to entire field	none	wet, calcareous soils most susceptible, plants typically grow out of the condition once the soil dries out, AC Emerson is the most tolerant variety, soil and plant tissue samples can be sent to an accredited lab for determination of which micronutrient is lacking, research has shown that addition of the deficient micronutrient is rarely profitable	no
Heat canker	damage to stem due to extreme soil heating	occasionally	excessive heating of soil when seedlings are young damages the stem, may lead to seedling death or development of scar tissue (swollen, rough and cracked) near the soil surface which later causes plants to fall over and to tiller, plants often topple over after a high wind, plants will die if growing point damaged by the canker	follow recommended seeding rates, seed in a north-south direction, seed early, practice conservation tillage	none	increased incidence when the soil crusts, plant stands are poor and soils are light and dark	no
Frost canker	damage to stem from frost	occasionally	frost damage to seedlings at the soil surface may kill young seedlings or lead to the development of scar tissue (swollen, rough and cracked) near the soil surface which later causes plants to fall over and to tiller, plants will die if growing point damaged by the canker	follow recommended seeding rates	none	severity tends to be worse in low-lying areas, on light soils and when plant stands are thin	no

Compiled from the Diseases of Field Crops in Canada, Guidelines for the Control of Plant Diseases in Western Canada and Growing Flax publications.

- If you need help identifying an insect, 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
    - Saskatchewan: https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/programs-and-services/crops-programs/crop-protection-laboratory-services)
    - Manitoba: https://www.gov.mb.ca/agriculture/crops/crop-diagnostic-services/index.html

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Useful links:

Provincial Crop Protection Guides:

- Alberta: https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex32
- Saskatchewan: http://www.publications.gov.sk.ca/details.cfm?p=77706
- Manitoba: https://www.gov.mb.ca/agriculture/crops/guides-and-publications/#gfcp

PMRA Pesticide Label Mobile App: https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/registrants-applicants/tools/pesticide-label-search.html

Cutworm Pests of Crops on the Canadian Prairies:
http://publications.gc.ca/collections/collection_2017/aac-aafc/A59-42-2017-eng.pdf

Field Crop and Forage Pests and their Natural Enemies in Western Canada:
http://publications.gc.ca/collections/collection_2015/aac-aafc/A59-23-2015-eng.pdf

Diseases of Field Crops in Canada: https://phytopath.ca/publications/5479-2/

Prairie Pest Monitoring Network blog: http://prairiepestmonitoring.blogspot.ca/

Field Heroes: http://www.fieldheroes.ca/

University of Manitoba pest ID app:
https://play.google.com/store/apps/details?id=ca.umanitoba.ipm&hl=en

Alberta Agriculture and Forestry cutworm reporting tool:
https://www1.agric.gov.ab.ca/$Department/pestmon.nsf/CutwormWebSubmission