

# Flax on the Farm

## Disease and Environmental Disorder Monitoring and Control

Flax is susceptible to a number of diseases, however economic losses tend to be minimal in most years. This, combined with the fact that many diseases are unique to flax, makes it a great choice for incorporation into rotations.

### Methods of Disease Control

- Chemical
  - Scouting for diseases and the accurate identification of them is critical before making chemical application decisions.
  - 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 four groups of foliar fungicides are registered for use on flax, so chemical rotation is important to reduce the risk of developing 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 staging, re-entry periods, buffer zones, re-cropping and pre-harvest intervals.
  - Using pest control products that are not registered on flax or are applied outside of the recommended pre-harvest interval (PHI) 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 growth of a pathogen.
  - Genetic resistance to plant disease is a good way to reduce the crop's susceptibility to the disease.
  - Host resistance in flax is available for: rust, Fusarium wilt and powdery mildew.
    - All commercially available flax varieties are immune to rust.
    - The majority of flax varieties are rated as moderately resistant to powdery mildew
    - Fusarium wilt resistance of currently available flax varieties ranges from moderately resistant to resistant.
  - No commercially available varieties of flax are genetically resistant to pasmo.
  - Disease resistance ratings of flax varieties can be found in the provincial seed guides:
    - [Alberta](#)
    - [Saskatchewan](#)
    - [Manitoba](#)
  - Host resistance can be overcome through mutation of the pathogen. Adherence to recommended pesticide rates and product rotation is important to reduce the chances of the pathogen reproducing and mutating.
- Cultural
  - Includes mechanical, environmental or other non-chemical or non-biological methods of controlling a disease (e.g. crop rotation).
- 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 collectively referred to as 'beneficials'.

## Integrated Disease Management (IDM)

- Integrated Disease Management is the practice of evaluating all available methods of pest control (chemical, host tolerance/resistance, cultural and biological) and making decisions on which single or combination of methods to use based on economics, environmental safety and efficacy.
- Most diseases are best managed through an integrated approach which includes multiple management strategies. This will improve the effectiveness of disease control and will reduce selection pressure on the pathogen which can lead to the development of fungicide insensitivity.
- This crop management practice has gained prominence in recent years because of public concern over the safety of pesticides and their effect on beneficial organisms.
- Six elements of IDM:
  - Prevention of disease problems
  - Accurate identification and knowledge of diseases, their damage and natural enemies
  - Surveillance of diseases, crop damage, natural enemies and weather conditions
  - Application of economic thresholds
  - Suppression of disease populations
  - Evaluation of results

## Scouting

- Continuous monitoring of diseases and environmental disorders 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 (e.g. humid conditions, crop lodging, heavy weed pressure, etc.).

The accurate identification of diseases and environmental disorders, knowledge about their lifecycles and methods of prevention and control are key to making good crop management decisions. Below are descriptions of the various diseases and environmental disorders that you may come across in your flax crop and the methods that can be used to prevent or control them.

**Table 1. Diseases of flax**

Disease	Causal organism(s)	Characteristics	Symptoms	Cultural control	Chemical control	Economic concern?	Comments	Unique to flax?
Alternaria blight	<i>Alternaria</i> spp.	seed and residue-borne fungus	seedling stage: dark red lesions on seedling leaves and stems, roots with water-soaked brown appearance, older plants: dark red to brown spots on older leaves and flower parts, leaf death, bud death, seed abortion	follow standard flax rotation, control flax volunteers	none	very rarely	seed that is black in colour may be infected with Alternaria	no
Aster yellows	Phytoplasma	bacterial parasite transmitted by aster/six-spotted leaf hoppers ( <i>Macrostelus quadrilineatus</i> ) 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 broadleaved weed species	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 or taller than uninfected plants	seed early, good control of susceptible weeds (e.g. Canada thistle, chickweed, cleavers, dandelion, hawk's beard, redroot pigweed, shepherd's purse, sow thistle, stinkweed, wild mustard) especially perennial and winter annual weeds, seed far from alfalfa	none	very rarely	present every year at low levels, infection occurs early in the season but symptoms do not appear until flowering, symptoms tend to be worse in wet soils, severity of symptoms increases with earlier infections, 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)	leaf puckering/wrinkling, stunted growth, reduced branching	seed early	none	very rarely	virus also infects barley, oats and wheat, disease more severe when plants infected early in the season	no
Fusarium wilt	<i>Fusarium oxysporum</i> f. sp. <i>lini</i>	primarily a soil-borne fungus but can also be residue and seed-borne, enters roots and moves through plant via water-conducting tissues (xylem), infection can occur at any growth stage, spores spread by wind and rain	the classic symptom at any stage is an upper stem bent like a shepherd's crook, early season infection results in seedling death before or shortly after emergence, later season infection causes yellowing of leaves at the top of the plant, wilting (typically only on one side of the plant) and eventually plant death, infected plants often develop a tufted or top-heavy appearance, roots may turn an ashen grey colour	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, Maxim 480FS, Vitaflo	occasionally	currently registered varieties are moderately resistant (MR) or resistant (R), fungus grows best in warm (>23oC) dry soils, spores can survive in soil up to 10 years, inoculum very rapidly builds up in soils, symptoms more evident in warm weather, dead plants remain standing in the field for some time until they gradually decay, can cause 80-100% yield loss if a susceptible variety grown without rotation	yes
Grey mould	<i>Botrytis cinerea</i>	seed-borne fungus, attacks plants at all growth stages	seedling stage: brownish spots on the seedling stem close to the soil surface, wilted plants that fall over and die, older plants: stems turn light brown and become soft, plants parts above infected stem die followed by the death of the whole plant, under humid conditions a fuzzy grey coloured mould will appear on plant tissues	plant a lodging resistant variety, follow recommended fertilizer rates (i.e. avoid over-fertilizing), seed at the low end of the recommended rate, maintain good weed control	none	very rarely	fungus grows best in warm moist conditions	no
Pasmo	<i>Septoria linicola</i>	residue and seed-borne fungus, infects all above-ground plant parts at any growth stage, spores dispersed by wind and rain	circular yellow or greyish-green to brown spots on leaves early in the season, drying and curling of leaves, defoliation, alternating green and brown/black bands on stems (candy cane-like) and lesions on bolls late in the season, premature ripening, boll drop if plants left to stand for a long time before harvest or during heavy rain and wind, from a distance appears as reddish brown patches of lodging plants in the field during ripening	seed early, plant a lodging resistant variety, plant clean seed (i.e. with very little chaff), seed at the lower end of the recommended rate, 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	yes	currently registered varieties are susceptible (S) or moderately susceptible (MS), later maturing varieties often less affected by pasmo, 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, symptoms often not apparent until ripening, infection after seed fill causes no economic losses, seed that is grey in colour may be infected with pasmo, can decrease seed weight	yes
Powdery mildew	<i>Oidium lini</i>	residue-borne fungus, tends to infect plants at later growth stages	begins as powdery white patches on the upper and lower surfaces of leaves which can spread to cover entire leaves causing leaf death and defoliation, 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, follow recommended fertilizer rates (i.e. avoid over-fertilizing), bury infested residue, good control of weeds and flax volunteers	none	rarely	relatively new disease for flax (first observed in 1997), currently registered varieties are moderately susceptible (MS) or moderately resistant (MR), pathogen thrives under warm (20-25oC) humid conditions but does not do well under rainy conditions, has caused yield losses of 20-30% in research plots	yes

**Table 1. Continued**

Disease	Causal organism(s)	Characteristics	Symptoms	Cultural control	Chemical control	Economic concern?	Comments	Unique to flax?
Rust	<i>Melampsora lini</i>	residue-borne fungus, infects all above-ground plant parts, spores spread by wind	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	no	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
Seed rot, seedling blight, root rot	<i>Rhizoctonia solani</i> , <i>Pythium</i> spp., <i>Fusarium</i> spp.	primarily soil-borne fungi but can be seed-borne, infect plants at later stages of development so symptoms often don't appear until after flowering	mushy seeds, seeds that fail to germinate, seedlings that fail to emerge and are brown, soft and water-soaked, seedlings with girdled stems, seedlings with discoloured (red to brown) cotyledons, leaves and stems, stunted roots, discoloured roots (reddish brown), stunted plants, wilted plants, premature ripening, gaps of plants in seed rows	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 <i>Rhizoctonia solani</i> : 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, Maxim 480FS, Vitaflo	rarely	Pythium is more common under cold soil temperatures and excess soil moisture at seeding, Rhizoctonia more common in warm, loose soil, conditions that slow germination and emergence expose seed and seedlings to rot and blight pathogens for longer and increase the chance of seed rot/seedling blight/root rot, yellow seeded flax may be more susceptible due to a thinner seed coat	no
Sclerotinia	<i>Sclerotinia sclerotiorum</i>	soil-borne fungus	water-soaked elongated lesions on stems, stem girdling, premature ripening leading to bleached/grey stems, white mould growth on stems, dark brown/black sclerotia (fruiting bodies) develop inside stems, sclerotia look like mouse droppings	plant a lodging resistant variety, plant clean seed (i.e. sclerotia-free), increase row width, follow recommended seeding and fertilizer rates (i.e. avoid overseeding and overfertilizing), avoid seeding after highly susceptible crops (e.g. borage, canola, sunflower), good control of weedy hosts (e.g. Canada thistle, dandelion, knapweeds, lamb's quarters, redroot pigweed, sow thistles, stinkweed, wild mustard) and broadleaf volunteers, avoid water-logged soils	foliar fungicides- Priaxor, Proline 480 SC	very rarely	petals are the initial site of infection, tends to only occur in heavily 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, most broadleaved crops are susceptible but cereals are not affected	no
Stem break and browning	<i>Aureobasidium pullulans</i> var. <i>lini</i> ( <i>Polyspora lini</i> )	primarily a seed-borne fungus but also residue-borne	water-soaked dark brown spots on early leaves which later develop purple borders, leaf lesions spread to the first node of the stem and may eventually cover a large portion of the stem turning the plant brown, lesions may also be present on bolls, 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 3 year rotation, plant flax crop as far away from previous year's crop as possible, good control of flax volunteers	none	rarely	disease most common in the Parkland regions of AB and SK, fungus grows best under warm wet conditions, harvest losses occur due to plants laying on the ground that can't be picked up by the combine	yes

Compiled from the Diseases of Field Crops in Canada, Field Crop Disease Handbook, Flax the Genus Linum, 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 2. Environmental disorders of flax**

Disorder	Cause	Symptoms	Cultural control	Chemical control	Economic concern?	Comments	Unique to flax?
Boll blight	combination of several different diseases and environmental stresses	bud, flower and/or young boll death, abnormal (e.g. dark, discoloured, shrivelled) seeds inside bolls, fewer than normal or no seeds in bolls	none	none	very rarely	incidence often a result of warm, dry conditions following cold, wet weather	yes
Chlorosis	iron, manganese or zinc deficiency or waterlogged soils	otherwise healthy plants have pale green to yellow leaves with distinct green veins towards the top of the plant, slowed growth, prolonged conditions may cause dieback of the main stem and tillering, delays maturity	plant a resistant variety, seed later, apply deficient micronutrient in a test strip and if crop responds, apply to entire field	none	occasionally	seedlings on cool 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
Frost canker	damage to seedling stem from frost	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	seed later, seed at the higher end of the recommended rate, seed later, follow recommended agronomic practices to produce an even vigorous stand	none	occasionally	severity tends to be worse in low-lying areas, on light soils and when plant stands are thin	no
Heat canker	damage to seedling stem due to extreme soil heating	excessive heating of soil when seedlings are young (<6") 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	seed at the higher end of the recommended rate, follow recommended agronomic practices to produce an even vigorous stand, seed in a north-south direction, seed early, practice conservation tillage	none	occasionally	increased incidence when the soil crusts, plant stands are poor and soils are light in texture and dark in colour	no
Weathering	exposure to the elements and saprophytic (decomposing) fungi and bacteria	greying/fading/ bleaching of stems and bolls, may be accompanied by the presence of black lesions on stems, reduced seed quality	seed flax earlier to limit exposure of the crop to poor weather at the end of the season, plant a variety with bolls that have a smaller opening at the top	none	occasionally	flax seed quality typically not compromised by weathering of plants but in severe cases can cause portions of the boll to stick to the seed making combining challenging, can discolour the seed, decrease seed weight and germination, increase fungal growth on seed and decrease oil content	no

Compiled from the Diseases of Field Crops in Canada, Field Crop Disease Handbook, Flax the Genus Linum, 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
    - [British Columbia](#)
    - [Saskatchewan](#)
    - [Manitoba](#)

**Table 3. Foliar fungicide options for flax**

Active(s)	Product(s)	Crop stage	No. applications allowed	Tank mix partners <sup>o</sup>	Group(s)	pasmo	Sclerotinia
fluxapyroxad, pyraclostrobin	Priaxor	20-50% flowering	2	chlorpyrifos <sup>λ</sup> , Decis 5 EC, Matador 120EC, quizalofop <sup>¶</sup> , Poast Ultra	7, 11	V	√**
picoxystrobin	Acapela	prior to disease development or at 20% flowering*	2-3	Coragen, Assure II	11	V	
prothioconazole	Proline 480 SC	20-50% flowering <sup>§</sup>	1	Decis 5 EC, Lorsban 4E, Matador 120EC	3		V
pyraclostrobin	Headline EC	20% flowering	2	chlorpyrifos <sup>λ</sup> , Decis 5 EC, Matador 120EC	11	V	

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 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

<sup>o</sup>off-label tank mixes supported by the manufacturer

<sup>§</sup>most effective when applied early in the morning before petals fall off

<sup>λ</sup>Citadel 480EC, Lorsban 4E, Lorsban NT, MPower Krypton, Nufos 4E, Pyninex 480EC, Sharphos, Warhawk 480 EC

<sup>¶</sup>Assure II, MPower Quiz, Yuma GL Liquid EC, Contender

### 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>



**For more information contact the following:**

Michelle Beath  
Agronomist  
Saskatchewan Flax Development Commission  
(306) 664-1901  
[michelle@saskflax.com](mailto:michelle@saskflax.com)

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

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

**Useful links:**

1. Pesticides

- Provincial Crop Protection Guides
  - [Alberta](#)
  - [Saskatchewan](#)
  - [Manitoba](#)
- PMRA Pesticide Product Label Search
  - [Online](#)
  - [App](#)
- Resistance Management
  - [Manage Resistance Now](#)
  - [Fungicide Resistance Action Committee](#)

2. Provincial Government Disease Management Websites

- [Alberta](#)
- [Saskatchewan](#)
- [Manitoba](#)

3. Disease Identification, Scouting and Management Information

- General
  - [Diseases of Field Crops in Canada](#)
- Scouting
  - [Scouting for Diseases-Manitoba Agriculture and Resource Development](#)
  - [Plant Disease Scouting 101-Saskatchewan Ministry of Agriculture](#)
  - [Diagnosing Plant Problems-Alberta Agriculture and Forestry](#)
  - [Field Scouting-Alberta Agriculture and Forestry](#)
- Aster Yellows
  - [Aster Yellows Disease-Alberta Agriculture and Forestry](#)
- Fusarium Wilt
  - [Fusarium Wilt in Flax-Manitoba Agriculture and Resource Development](#)
- PasmO
  - [PasmO in Flax-Manitoba Agriculture and Resource Development](#)
- Sclerotinia
  - [Sclerotinia Diseases-Saskatchewan Ministry of Agriculture](#)
- Seedling Blight
  - [Seedling Blight-Alberta Agriculture and Forestry](#)