

# The Biology & Control of Diseases in Alfalfa Seed Production

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## Introduction:

Thank you for inviting me to speak once again at the annual conference of the Saskatchewan Alfalfa Seed Producers Association. I was asked to speak at this conference two years ago, and since then, there has not been much new advancement in the area of plant disease control in forage crops although research is still underway. Since I spoke two years ago, there have been two seasons of wet and cool conditions so disease issues are once more on the forefront of your minds.

An alfalfa crop is exposed to a variety of pests and adverse conditions during its lifespan. Establishing a healthy stand is essential for a high-yielding crop that can compete well with weeds. For seed production, it is even more critical to produce a vigorous stand and diseases have been found to be a significant constraint to seed development in wet years. Disease control with fungicides may not always be an economical solution, so it is necessary to implement a number of practices to maintain low disease pressure.

I am going to break my presentation today into two parts: (A) The diseases of alfalfa and the conditions that favour them; and (B) how to control those diseases, including new fungicide registrations. I am looking forward to the producer panel discussion this afternoon so the 'theories' of plant disease can be put to the field test.

## A. DISEASES OF ALFALFA AND THE CONDITIONS THAT FAVOUR THEM

Disease problems are dependent on environmental conditions and health of the crop, so you must plan accordingly:

Conditions	Disease
Poor conditions during seedling establishment; Infected seed / poor seed quality; Deep seeding	✓ Seed rot ✓ Damping off / Seedling blight - <i>Pythium</i> , <i>Phytophthora</i> (wet) - <i>Rhizoctonia</i> , <i>Fusarium</i> (dry)

Heavily cut, grazed or burned; Frost; Poor drainage; Low fertility	✓ <u>Crown rot</u> * ✓ Winter kill
Poor snow cover	✓ <u>Crown rot</u> ✓ Winter kill
Early and abundant snow fall early in fall; Irrigation/fertilizer delays fall dormancy	✓ Snow moulds
Moist and cool conditions (rain-splash; humid and dense canopies)	✓ <u>Blossom blight</u> ✓ <u>Leaf spots</u> ✓ Anthracnose ✓ Downy mildew
Irrigation	✓ <u>Verticillium wilt</u> ✓ Bacterial wilt ✓ Nematodes (Eastern Canada)

\* The diseases underlined are the ones I will focus on today.

## I. Blossom Blight

There are two pathogens responsible for causing blossom blight disease in alfalfa. The first, *Sclerotinia sclerotiorum*, is a fungus that is common in the black soil zone and causes white mould or sclerotinia stem rot on a variety of broad-leaf crops including canola, pea, borage and sunflower. The fungus over-winters as small, black sclerotia bodies in the soil or seed. The sclerotia germinate apothecia (small mushroom-like structures) under prolonged wet soil conditions which release spores into the crop canopy.

The second fungus causing blossom blight is *Botrytis cinerea*. This pathogen commonly causes seed rots or seedling blights of many crops so it is well-established in agricultural soils. Spores are produced on infected residue and are blown with the wind onto their host crop.

The spores of both pathogens infect alfalfa blossoms, causing abortion of florets and reduced seed development. Early symptoms are often hard to detect and often the loss isn't even noticed until it is too late to apply fungicides for control (see disease management section). Symptoms will be first observed in areas where a dense, moist crop canopy is favoured, such as low-lying or sheltered areas.

Yield losses due to blossom blight can be as high as 50 to 100% under extended cool, wet conditions. In Saskatchewan, blossom blight was first identified in 1993 when severe losses occurred due to cool, wet weather during the bloom stage. From 1994 to 1999, the disease was found in localized areas only and did not result in significant yield loss. In 2000, early infections were prevalent but dry conditions followed and reduced the impact of the disease. From 2001 to 2003, risk of blossom blight has been low due to dry conditions in most alfalfa production regions. However, the risk of blossom blight has increased in the last two years. In 2005, blight developed late in the season after rain was received in late-August and September. In addition to adverse harvest conditions, blossom blight likely played a role in reducing seed development and yield in 2005.

Blossom blight will not be a problem in all years, which is why disease forecasting is so important. Risk is higher when using rotations with canola and borage, but risk decreases if conditions become hot and dry.

## II. Leaf Spots of Alfalfa

There are a number of leaf spot diseases affecting alfalfa, but the most common one in seed production is spring black stem, caused by *Phoma medicaginis*. This presentation will focus on spring black stem, but most leaf spotting pathogens have a similar disease cycle and are controlled in the same way. These diseases are common in the black soil zones of Saskatchewan where more rainfall is typically received during the growing season. In 2004 and 2005, more leaf spots were observed in seed production fields.

Spring black stem symptoms can occur on leaves, crowns and seed pods as well as on the stem. Early symptoms appear as small black spots, often referred to as “tar spots”, on the lower leaves and stems. These spots expand rapidly and coalesce into larger lesions during moist periods, which leads to reduced photosynthetic area of the leaf and can cause girdling of the stem, limiting flow of nutrients and water. The reduced plant productivity leads to leaf drop and reduced seed yield. In addition, the disease can attack the developing seed pod, which may lead to splitting of the pods and seeds infected with the fungus.

The fungus causing spring black stem over-winters in the crown tissue, on alfalfa residue, and in seed. Spores are produced on infected residue in the fall and spring during periods of cool, wet weather and are spread by rain-splash and wind on the plant.

Some of the other common leaf diseases observed in alfalfa include: yellow leaf blotch (*Leptotrochila medicaginis*), lepto leaf spot (*Leptosphaerulina trifolii*), common leaf spot (*Psuedopeziza medicaginis*), anthracnose (*Collectotrichum trifolii*) and downy mildew (*Peronospora trifoliorum*). Environmental problems such as drought, frost damage or nutrient deficiencies can manifest themselves as symptoms similar to leaf diseases. If you aren't sure about what is causing the spots on your leaves, contact your local agri-retailer agronomist or the provincial diagnostics laboratory (787-8130).

### **III. Root & Crown Rots**

There are a number of pathogens present in agricultural soils that cause seed rot, seedling blights and root/crown rots of many crops. Some of the common pathogens on alfalfa are *Fusarium*, *Rhizoctonia*, *Sclerotinia*, *Pythium*, *Phytophthora*, *Phoma* and *Aphanomyces*. The disease enters through the stem or crown buds, then into the crown. Root and crown rots are associated with inadequate drainage, poor fertility, frost, and injury to the crown from insect feeding, harvesting or grazing. Plants can tolerate some damage to the crown and will compensate, but good stand establishment and healthy root systems are critical for a high-yielding, weed-free perennial seed crop. Plants with diseased crowns are more susceptible to adverse weather conditions and infected stands often decline within three years.

Many of the crown-rotting pathogens are favoured by cool, wet soils—the same conditions that delay the plant's metabolism. However, in warm dry soils such as experienced in 2003, other root rots like rhizoctonia are favoured. Rhizoctonia infection is characterized by reddish-brown lesions or cankers on the crown tissue. Severe infections lead to stunting, leaf drop and plant death. Infected plants often occur in patches in the field, following a pattern of dry soil conditions.

Control of root and crown rots is difficult because no fungicides will be effective on below ground plant parts once the crop is established. Seed treatments help prevent loss only during seed germination and emergence. Crop rotation, limiting stress to the crop and maintaining soil fertility will provide protection as well.

### **IV. Verticillium Wilt**

Verticillium wilt is caused by the fungus *Verticillium albo-atrum*. It is a vascular wilt disease, meaning that the pathogen invades the water-conducting vessels of the plant resulting in reduced water and nutrient uptake. This leads to flagging of the plant under warm conditions, and wilting and yellowing of lower leaves and shoots.

The pathogen over-winters in crop residue, crowns and seed. Verticillium wilt is favoured by high moisture levels and is typically only found in fields that are under irrigation. The pathogen can be spread between fields by harvest equipment or other mechanical contact, alfalfa hay and residue, seed, wind, irrigation and insects. Limiting disease spread via these mechanisms is fundamental for disease control.

***It is important to note that Verticillium wilt has not been identified in the alfalfa seed production areas of Saskatchewan.***

## **B. HOW DO YOU MANAGE ALFALFA DISEASES FOR SEED PRODUCTION?**

To maximize on stand longevity and economics, it is necessary to delay disease entry into your alfalfa crop. Once a disease is present, a certain amount of loss has already occurred and there will be additional cost to control the disease.

Disease management requires an **Integrated Pest Management (IPM)** approach:

- i. Cultivar selection & seed quality
- ii. Fungicide seed treatments
- iii. Crop rotation
- iv. Good agronomics
- v. Foliar fungicides

If you are already a successful alfalfa seed producer, then you have been using IPM!

### **i. Cultivar Selection & Seed Quality**

Refer to Saskatchewan Agriculture & Food's Forage Crop Production Guide for the most up-to-date information on varieties. Almost all current varieties have resistance to bacterial wilt; many have resistance to verticillium wilt; and some have resistance to crown rot and downy mildew. However, there are no varieties with resistance to blossom blight or the various leaf spot diseases. Remember that the term "resistance" does not necessarily mean immunity to the disease. If environmental conditions are favourable and the pathogen is abundant, disease can develop even on cultivars that are rated as resistance.

Most disease pathogens can also be spread in or with the seed. Do not assume that pedigreed seed is disease free. *The Seeds Act* includes standards for genetic purity, freedom from weed seeds and germination, but does not have standards for seed-borne diseases (with the exception of ergot/sclerotia bodies in all grains and loose smut in barley). Before buying seed, ask where the seed was from, if any disease problems were observed in the field and if any disease tests have been conducted in an accredited laboratory.

### **ii. Seed Treatment Fungicides**

Currently there are limited options for seed treatments, but more are being requested through the minor use registration process (see table below). Seed treatments are considered cost effective and necessary insurance for such a valuable crop. If using seed inoculants (i.e. nitrogen-fixing rhizobia), refer to the label for proper mixing instructions. As well, remember that seed treatments will not protect against soil-borne pathogens that attack plants beyond the establishment stage.

Product Name:	Active ingredient:	Diseases controlled:	Crop:
Apron FL / Allegiance FL  \$9.01 - \$21.54 / 100 kg of seed (Rate of 46-110 mL / 100 kg seed)	metalaxyl (systemic activity)	Control of seed rots and seedling blights caused by <i>Pythium</i> and <i>Phytophthora</i> species common in cool, damp soils	<b>Alfalfa</b> ; Sainfoin; Vetch; Clover; Bird's-foot trefoil.  <i>* Also registered for forage grasses</i>
Maxim 480 FS  <i>Available to commercial seed treaters only</i>	fludioxonil (contact activity)	Control of seed decay and damping off ( <i>Fusarium</i> spp. on label; will control other species as well, but NOT <i>Pythium</i> )	<b>New registration:</b> <b>Alfalfa</b> , sanfoin, clover, trefoil, vetch, etc.  <i>* Also registered for forage grasses</i>
Thiram 75 WP  \$14.36 / 100 kg seed (Rate of 360 g/100 kg)	thiram (contact activity)	Control of various seed rot ( <i>Fusarium</i> , <i>Rhizoctonia</i> ) and damping off ( <i>Pythium</i> ) pathogens	Alfalfa  <i>* Also registered for forage grasses</i>

### iii. Crop Rotation

The general rules are to keep at least four years between alfalfa crops and to control volunteer alfalfa in those interim years. This is most effective for leaf spot pathogens, since they are specific to alfalfa only. To help manage blossom blight, do not plant alfalfa into a field that had broadleaf crops (i.e. canola, peas, mustard, borage) within the last two years.

### iv. Good Agronomics

It is necessary to consider all agronomic practices when thinking about disease control. Although you can not dictate the weather, you can keep the crop as healthy as possible so it can withstand adverse conditions and pest attacks. Good agronomic practices include:

#### Stand establishment

- Plant winter-hardy varieties
- Maintain well-drained soils
- Do not damage crowns when cutting for forage, grazing or burning

### **Sanitation**

- Remove debris from seed (ergot, sclerotia, leaf and stem pieces)
- Spring burning to remove residue
- Control volunteers and weeds
- If cutting for forage, do not move from older stands to younger stands
- Removing foliage for hay is beneficial as removes disease inoculum as well (better if more than one cut per season)

### **Fertility**

- A healthy crop is better able to withstand disease and winterkill
- Avoid excessive fall N fertilizer
- Reduce snow moulds
- Reduce dense leaf growth that favours leaf spots

### **Insect control**

- Reduce injury to plants and spread of disease

## **v. Scouting for Disease & Foliar Fungicides**

Currently, there are few foliar fungicides registered in seed alfalfa for disease control (see table below). The good news is that a new product just received registration (Headline EC) and there are more on the horizon through the minor use registration program.

Disease development and spread are highly weather dependent so applying foliar fungicides in dry years and/or when early symptoms are not evident is not necessary and certainly not economical. Unfortunately, there are clear cut thresholds for leaf spotting diseases in alfalfa. You must scout early for symptoms (vegetative stage) and make your decision based on disease risk and the weather forecast. For blossom blight, a test kit has been developed that aids in the decision to spray. The kit includes plates containing growth media on which blooms are cultured to determine the presence of the fungi. The economic threshold is to spray fungicide if 60-80% of the blooms are infected and the forecast is for rain. These kits are still available if you order them prior to June 20. For more information, contact Bruce Gossen (Agriculture & Agri-Food Canada, Saskatoon) at 306-956-7259 or [gossenb@agr.gc.ca](mailto:gossenb@agr.gc.ca).

The SK Alfalfa Seed Producers Development Commission is funding research through Keith Head & Associates Ltd. with nine farmer co-operators in order to look at disease control using fungicides and forecasting models (refer to Keith's presentation also in these proceedings).

Product Name:	Active ingredient:	Diseases controlled:	Crop:
Dithane DG Rainshield NT  \$5.25 / acre (at 0.6 kg rate)	mancozeb (contact activity)	Leaf spot and stem spot diseases. Apply 1st application prior to 50% bloom; repeat 7-10 days later for maximum of 3 applications. (May provide some control of blossom blight in alfalfa)	Alfalfa (seed production only)
Headline EC  \$16.57 / acre (at 0.16 L rate)	pyraclostrobin (systemic activity)	Common leaf spot ( <i>Pseudopeziza medicaginis</i> ); likely to control other leaf spots as well. Apply at beginning of flowering (10-30% bloom) or at the onset of disease. Only 1 application per year. Do not apply by air.	<b>New registration:</b> Alfalfa (seed production only)  * Also registered for forage grasses grown for seed
Benlate  ~ \$32 / acre <i>Withdrawn from market</i>	benomyl (systemic and contact activity)	Blossom blight (sclerotinia and botrytis); Apply at early bloom through to full bloom; not more than 2 applications per season	Alfalfa grown for seed

**Where to get more information on plant diseases:**

- SK Agriculture and Food (SAF)'s **Ag Knowledge Centre**: 1-866-457-2377
- Forage production information on SAF website: <http://www.agr.gov.sk.ca>
- Penny Pearse, SAF provincial plant disease specialist (306) 787-4671  
[ppearse@agr.gov.sk.ca](mailto:ppearse@agr.gov.sk.ca)
- SAF's Crop Protection Lab for disease diagnosis and culturing. Phone (306)787-8130; or attain the form online at:  
[http://www.agr.gov.sk.ca/docs/about\\_us/department\\_info/Forms/Crop\\_Protection Diagnostic\\_Form.pdf](http://www.agr.gov.sk.ca/docs/about_us/department_info/Forms/Crop_Protection_Diagnostic_Form.pdf)
- ***Diseases of Field Crops in Canada, 2003*** (textbook includes good information on identification, photos and control of forage crops); call Penny to order (25\$)
- Pest Management Research Reports: [http://www.carc-crac.ca/english/ECIPM/ecipm\\_1.htm](http://www.carc-crac.ca/english/ECIPM/ecipm_1.htm)
- Canadian Plant Disease Survey: <http://www.cps-scp.ca/cpds.htm>
- ***Compendium of Alfalfa Diseases, 2nd Ed.*** American Phytopathological Society; order on-line: <http://www.apsnet.org/>