

# PLANT DISEASE ISSUES: A HEAD'S UP FOR 2005

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## 1. Introduction

In 2004, many regions of Alberta enjoyed better growing conditions than previous years. Unfortunately, these more favourable environmental conditions also led to the appearance of a number of disease issues during the growing season. Some of the main cereal, canola and field pea disease issues that occurred in 2004 are outlined in Table 1, along with key management strategies for these issues. In general, leaf spot diseases were more prevalent in the cereals, while take-all root rot was observed in wheat. Ergot levels in wheat and rye were also a concern in some areas of the province. Stripe rust was observed in wheat from southern to central Alberta. Unfortunately, cool, moist conditions in August and September delayed harvest and led to the development of sooty moulds on a range of crops. In canola, sclerotinia was observed in a number of fields throughout the province, while increased levels of blackleg were observed in some areas. In field pea, mycosphaerella blight and powdery mildew were frequently observed, while a less common disease, downy mildew was reported in some fields.

**Table 1. Main disease issues from 2004 and key management strategies.**

<b>Crop</b>	<b>Disease</b>	<b>Key management strategies</b>
Barley	Net blotch	Rotation to non hosts for at least two years (broad-leafed crops, oats, wheat), resistant varieties, in-crop fungicide application, seed with no or low infection levels coupled with seed treatment
Barley	Scald	Rotation to non hosts for at least one year (broad-leafed crops, oats, wheat), resistant varieties, in-crop fungicide application
Barley	Loose smut (in some varieties)	Uninfected high quality seed, resistant varieties, seed treatments
Barley	Root rots	Rotation to non hosts for at least one to two years (broad-leafed crops, oats), tolerant/resistant varieties, shallow seeding, balanced fertility, seed with no or low infection levels, seed treatments (early season suppression)
Wheat	Leaf spots (Septoria's and tan spot)	Rotation to non hosts for at least one to two years (broad-leafed crops, oats), less susceptible/resistant varieties, in-crop fungicide application, seed with no or low infection levels coupled with seed treatment (the importance of seed-borne Septoria or tan spot is not well-understood in western Canada)



Wheat	Take-all root rot	Rotation to non hosts for at least one year (broad-leafed crops, oats), balanced fertility, seed treatments (mainly early season suppression)
Wheat	Ergot	Rotation to non hosts for at least one year (broad-leafed crops), limit stress factors associated with pollen sterility (balanced fertility, proper herbicide timing), mowing of adjacent grassy areas (limits secondary spread into cereal crop and production of ergot bodies), ergot-free seed, increase seeding rate (reduce tillering and therefore potential period for infection), delay swath/harvest (ergot bodies blown off of cereal heads by wind), selective harvesting (headlands can be more severely affected), grain cleaning (gravity table)
Wheat	Fusarium head blight (FHB)	Rotation to non hosts for at least two years (broad-leafed crops), avoid corn in rotation with small grain cereals, avoid planting next to corn or cereal fields with previous fusarium problems, use less susceptible/resistant varieties, use seed with no or low infection levels (the importance of this will vary depending on the Fusarium species and province) coupled with seed treatment, in-crop fungicide application (suppression), irrigation management (balance crop water needs while avoiding excessive moisture at flowering in cereals, which can favour FHB)
Wheat	Stripe rust	Scouting and in-crop fungicide application
Other cereals	Ergot	See recommendations for wheat
Cereals	Sooty moulds	Options limited. Related to cool, moist conditions that delay harvest and favour mould growth on maturing crop tissue. Avoid leaving the crop in the field (standing or in the swath) for too long
Canola	Sclerotinia	In-crop fungicide application (use risk assessment tools and ensure good crop coverage), rotation to non host crops such as cereals for at least three years (can help, but disease may come from adjacent fields where sclerotinia resting bodies [sclerotia] are present), avoid varieties that lodge excessively, avoid fields with excessive fertility
Canola	Blackleg	Rotation to non host crops for at least 3 years (helps to limit disease and potential appearance of more virulent pathogen races; pathogen may come from adjacent fields where infested residues are present), resistant varieties, clean seed and seed treatment (limits introduction of the blackleg pathogen into fields where it is not present and the spread of more virulent races)
Field peas*	Powdery mildew	Use resistant varieties, timely scouting and in-crop fungicide, early seeding
Field peas*	Mycosphaerella blight	Rotation to non host crops for at least 3 years (helps to limit disease; however, pathogen may come from adjacent fields where infested residues and pathogen survival structures are present), disease-free seed and seed treatments, less susceptible varieties, timely scouting and in-crop fungicide
Field peas*	Downy mildew	Rotation to non host crops for at least 2-3 years, disease-free seed

\* For more detailed information on pulse diseases please contact Drs. Ron Howard, S.F. Hwang, and K-F. Chang (ron.howard@agric.gov.ab.ca; kan.fa.chang@gov.ab.ca; hwang@arc.ab.ca).

## 2. Know what you are dealing with

Planning and the use of information from previous growing seasons will be important for developing an effective plan for on-farm disease management. Routine field scouting will provide information relating to what diseases are present and what impact they are having. However, producers need to keep in mind that the development of a particular disease can be highly dependent on environmental conditions and may vary considerably from year to year. In addition to monitoring their own crops, producers should consider checking local variety demonstration trials as well as talking to their neighbours, local seed growers, extension/industry staff and plant pathologists about regional disease problems. Knowledge gained from scouting and gathering other information can then be used to correctly identify the diseases of concern and the most effective management strategies that can be used. For example, choosing a barley variety with good levels of scald resistance may be of little benefit when the main disease issue is net blotch. Furthermore, confusion between true disease symptoms and leaf discoloration due to nitrogen deficiencies, heat/moisture stress, etc. can lead to the unnecessary application of fungicide. Unfortunately, there still can be confusion between disease symptoms and other factors that can affect crop health and appearance. Producers are encouraged to review the new third edition of "Diseases of Field Crops in Canada", which is a publication from the Canadian Phytopathological Society and can be ordered via their website (<http://www.cps-scp.ca/publications.htm>).



This publication as well as other information from provincial and industry sources will help producers, crop scouts and industry agronomists to correctly identify disease problems during the growing season. Internet search engines such as GOOGLE (<http://www.google.ca/>) can also be used to search for a wide array of websites related to plant diseases and their management.

Statements regarding the importance of knowledge of the plant disease issues that challenge producers are not new. In the book “Farm Economy: Twelve Courses in Agriculture” Howard and Stakman (1921) stressed the importance of knowledge regarding the pathogen(s) of concern with the following quote:

“... It therefore becomes necessary to know what kind of germ is causing a particular disease, and further to know the habits of this particular germ. This is all the more true, since the different kinds of germs may have very different habits, and therefore must be controlled by different methods. It is absolutely necessary therefore for a farmer, before he attempts to control a disease, to know what germ causes the disease and how it acts in order that he may apply his preventative measures at the proper time and in the proper place.”

Knowledge regarding how a pathogen survives and develops will illustrate where strategies in addition to disease resistance and rotation need to be used. An understanding of the diseases of concern will also emphasize that for many diseases, or where multiple diseases can infect the same crop, a diverse approach will be needed where producers use an integrated strategy for disease management.

### **3. So what can we expect for 2005?**

Given the variable nature of disease occurrence and development it can be difficult to predict whether a particular disease will appear, and especially at what level. However, producers can develop a reasonable estimation of what they may expect by looking at what has happened in the past and by having a good understanding of the factors that influence disease risk.

#### **3.1. Plant disease risk factors**

##### **3.1.1. Rotation**

Probably the most important risk factor besides the environment is the lack of rotation to a non host for a suitable period of time. Poor rotations lead to build up of infested crop residues and/or specialized pathogen survival structures, thus increasing the risk of disease. Rotation becomes somewhat less important for diseases that can affect a range of crop species. For example, many of the root rots can move from barley to wheat, while *Fusarium graminearum*, the causal agent of fusarium head blight (FHB), can infect a range of cereal species as well as corn (Mathre 1997; Menzies and Gilbert 2003; White 1999; Wiese 1987). The causal agent of sclerotinia stem rot of canola, *Sclerotinia sclerotiorum*, is also an example of a pathogen that has the ability to attack different crops including most broad-leafed crop and weed species (Purdy 1979, Rimmer et al. 2003). Thus, knowledge regarding the host range for some diseases may be needed to plan effective rotations.

##### **3.1.2. Seed quality and deep seeding**

Several seed issues can lead to an increase in disease risk. High quality, pathogen-free seed that is free from mechanical damage and has good germination and vigour is an important cornerstone of most disease management programs. Quality seed will help to avoid early season disease problems and reduce the risk of introducing potential disease problems via seed-borne pathogens. Mechanical seed damage can predispose seed to seed rots that can kill the seed before it has a chance to germinate. Poor quality seed and deep seeding can also slow down germination and seedling emergence prolonging the exposure of the seedling to potential problems. Furthermore, with deep seeding the seedling will be expending more energy to reach the soil surface and as a consequence may be weakened and less able to fend off attack from various soil-borne pathogens. Problems associated with poor quality seed and deep seeding may lead to a less healthy crop that may be more readily attacked and damaged by leaf diseases during the growing season.



### **3.1.3. History of disease and field location**

Although not an absolute guarantee of what may happen in the future, knowing what diseases have occurred on your farm or in surrounding fields can be important. Knowledge regarding the diseases that commonly appear in your production area will help to identify strategies that can be used. For example, if you had severe barley leaf disease problems last year, producers may want to consider rotating to a different crop or using a different field where the risk of disease is lower. Field location may also be an important consideration for diseases that are wind-borne, where planting next to a field with a history of problems may increase the risk of disease. Examples where field location may be an important consideration include net blotch in barley, fusarium in cereals and corn, and sclerotinia and blackleg in canola. These diseases are caused by pathogens that produce wind-borne spores, which can move from one field to another.

### **3.1.4. Conservation tillage?**

Traditionally, it has been assumed that your risk of disease increased under conservation tillage because most if not all crop residues are left on the soil surface where they can act as a source of disease. However, research conducted over the past decade in western Canada has indicated that an increased disease risk under conservation tillage may not always be the case. Other crop production factors such as environmental variation, crop rotation, seed quality, and choice of variety (level of disease resistance) will have a much larger impact on disease risk compared with the type of tillage system that is used (Anderson et al., 1999; Bailey and Duczek, 1996; Turkington et al., 1998b).

### **3.1.5. Conducive weather**

The most important risk factor influencing the development of plant disease is the weather. Particular weather conditions can have a positive, negative, or neutral influence on disease development. Overall, the most important weather parameter is moisture. In general, frequent showers and high humidity produce conditions that can favour disease development. However, heavy rainfall may not always favour disease, as it tends to wash pathogen spores from the air and off of plants. Temperature can also be important, especially at the extremes. Temperatures that are either low (typically <10oC) or high (typically >30oC) can inhibit or slow down the pathogen's ability to reproduce as well as subsequent disease development. Overall, moderate temperatures (typically 15-25oC) in combination with frequent showers produce conditions that can lead to rapid disease development.

### **3.1.6. Crop variety**

The use of a susceptible variety can increase disease risk if weather conditions are conducive and a disease source is present. Susceptible varieties lack the ability to resist attack and invasion by plant pathogens. As a consequence the productivity of these susceptible plants may suffer as a result of reduced germination and emergence, a restricted ability to absorb and transport water and nutrients, and reduced capacity to capture and use light energy for photosynthesis. Although resistant varieties will reduce disease risk, plant pathogens can adapt and overcome the resistance present in a variety. For example, over the past several years the scald resistance of some barley varieties appears to be breaking down (Turkington et al. 1998a, Xi et al. 2002, 2003). Typically, the breakdown of scald resistance has occurred where a particular resistant barley variety has been grown in the same field for several years. Under these conditions there is a tremendous selection pressure placed on the scald pathogen to develop and/or increase the level of more virulent races able to overcome the disease resistance that is present. Thus, producers growing the same resistant variety year after year or under short rotations may still encounter significant disease levels as a consequence of pathogen adaptation to the crop variety that is being grown.

## What has the Alberta Conservation Tillage Society (ACTS) done for me lately?



## Did you know that ACTS is a founding partner of FarmTech?

Through ACTS promotion of reduced and/or zero tillage soil erosion has been reduced dramatically over the last twenty years. Admittedly, the main cause of reduced tillage was economics. ACTS and Reduced Tillage LINKAGES (RT LINKAGES) have been there to help individuals and groups with details on cropping while reducing or eliminating tillage. Another benefit to reduced tillage is keeping highways and roads safer by eliminating or at least reducing snow and soil drifting.

The ACTS Board of Director's held four formal meetings this past year. The meeting in June at Lethbridge included a meeting with the RT LINKAGES Steering Committee and a couple of their Agronomists. This meeting also included a visit to a couple of farms and the Research Station. The first farm was a zero till operation. Next was a potato operation that grows potatoes in rotation one in four years. They accomplish this by renting land from others and leasing their own three out of four years. They practice reduced tillage and will spread compost if the soil is vulnerable. This family operation has a great appreciation as to the importance of top soil toward their future. Severe wind erosion has resulted for other potato growers in the area who do not share the concern for top soil.

At the Lethbridge Research Station we observed some of Jill Clapperton's work on low input and organic production. We were also shown hundreds of new winter wheat cultivars of which some look quite promising. The crops looked great with four inches of rain by mid June.

### Some areas the ACTS Board of Director's are involved with are:

- **Oil and Gas Remediation and Reclamation Advisory Committee:** ACTS sits on this Committee as an advocate for farmers needs.
- **FarmTech Planning Committee:** One of the main speakers this year will speak about the relationship between the rise and fall of soil and water resources as it relates to the strength and demise of civilizations.
- **Reduced Tillage LINKAGES:** ACTS serves in an advisory capacity and in helping to source monies to maintain five extension Agronomists plus their Team Leader.
- **Soil Conservation Council of Canada:** This is a major source of funding for RT LINKAGES. These are Federal Government funds allocated through the Green House Gas Mitigation Program.
- **Alberta Environmentally Sustainable Agriculture**
- **Saskatchewan Soil Conservation Association**

A personally important result of some of these alliances is RT LINKAGES work on applying liquid manure. Monies from Canada's Green House Gas Mitigation Program, along with the Canadian Pork Council and Alberta Pork, go toward best management practices of manure application. This includes determining methods of odor control, minimal soil disturbance plus tracking effective nutrient management. This should help more people to look upon this livestock by-product as the asset that it is for crop production.

In November at Nisku, ACTS held a strategic planning session just prior to the RT LINKAGES Direct Seeding Conference. This strategic planning meeting included five Past Presidents of ACTS. The facilitator will have a summary for us shortly.

A problem for ACTS is a lack of funds. Memberships are very important to ACTS. For membership, contact Gayle at 1-403-227-6747 or stop by the ACTS booth at FarmTech.

*Sincerely,*

*Ken Wasmuth*

*ACTS President*



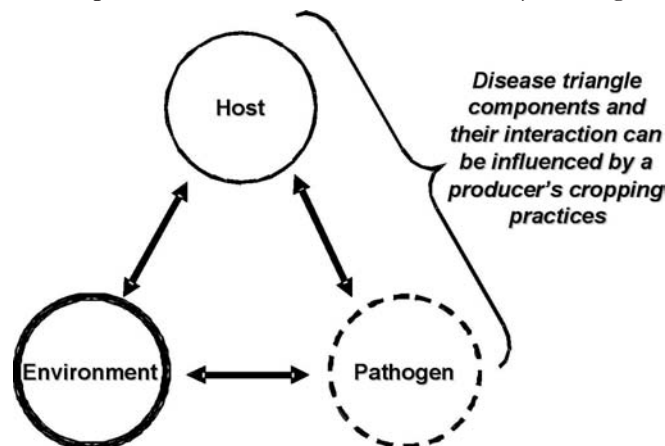
Other plant characteristics besides disease resistance may be important to consider. Varieties that are more prone to lodging or that have less upright growth habits may favour disease development in a number of crops. For example, sclerotinia stem rot can be much more severe where lodging has occurred (Rimmer et al. 2003).

### 3.1.7. Lack of balanced fertility

Fertility requirements are most often associated with overall crop productivity in terms of yield and quality, but fertility can have an impact on disease. Deficiencies in macro- or micronutrients may increase the risk of certain diseases. For example, copper deficiency in wheat may increase pollen sterility, which can lead to more open flowers and a greater risk of ergot infection (Menzies and Gilbert 2003). A balanced fertility program will not only meet the macro and micronutrient needs of your crop, but also helps to promote the growth of a healthy root system and a more vigorous plant that can fight off pathogen attack to a greater extent compared with a nutrient deficient crop. Ultimately, a healthy crop may not be able to prevent a disease from developing, but it will help the plant to tolerate and perhaps compensate for the disease that is present, thus maintaining yield and quality. Although balanced fertility is important, excessive fertilization, especially with nitrogen, may promote the development of a lush and dense crop canopy that produces a microenvironment that favours disease development. To counter any potential increased disease risk that may occur when trying to maximize yields by heavy fertilization, producers should use resistant varieties where available, and consider in-crop fungicide application if appropriate.

## 4. Summary

Overall, risk factors influencing plant disease development relate to the components of the “disease risk triangle”, which is a diagrammatic representation of what is required for a plant disease to occur (Figure 1). The presence of a virulent pathogen in sufficient quantity, the occurrence of favourable weather conditions, and the presence of a susceptible host are all needed for disease to occur. However, the relative importance of each of these components will vary depending on the particular plant disease and agricultural region. By developing a better understanding of how cropping practices influence the host, pathogen, and environment a producer can more effectively assess potential disease risks and identify strategies to limit their impact.



**Figure 1.** The “disease triangle”, a symbolic representation of the interactions among the three components of disease required for plant disease to occur.

## 5. References

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