

# **Alberta *Fusarium graminearum* Management Plan**



**Developed by the Alberta Fusarium Action Committee**

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# Fusarium Overview

## What is it?

Fusarium head blight (FHB), caused by *Fusarium graminearum* and/or several other *Fusarium* species, is a serious fungal disease of wheat, barley, oats and corn.

## Where did it come from?

FHB was first recognized as a fungal disease in North America about 120 years ago. Repeated severe epidemics of FHB occurred from 1915 through the 1920s. The first report of FHB in Canada was in 1919. Again in the 1940s, FHB erupted in eastern Canada and the east-central USA. FHB was less frequently encountered during the 1950s, 60s and 70s, but in the early 80s, there were major outbreaks of the disease in eastern Canada, in Manitoba and in the US wheat states from North Dakota to Kansas. A severe outbreak in Manitoba in 1993 brought the problem to prominence for the Canadian Prairies.

## Why has it spread?

Outbreaks can be traced to several causes: widespread planting of highly susceptible varieties, existence of colonized residue from previous crops (especially with short rotations), presence of corn in rotations with small grains and weather favourable for infection.

## Why is it of concern?

FHB causes problems in two ways: first, it reduces yield and grade by producing fusarium-damaged kernels (FDK), and secondly, it can have a significant negative effect on the quality of grain intended for the feed, malting, milling, biofuel (ethanol) and brewing industries. FDK may contain fungal toxins (mycotoxins), such as deoxynivalenol (DON or vomitoxin), that are poisonous to livestock and humans above certain threshold levels. Furthermore, FDK may produce poor quality malt and flour, and it can reduce alcohol yields during fermentation.

## What is it costing the agricultural industry?

Losses in Canada have ranged from \$50 million to \$300 million annually since the early 1990s. Direct and secondary economic losses due to FHB for all crops in the Northern Great Plains and central USA were estimated to be \$2.7 billion from 1998 to 2000 alone.

## What is being done about it?

In 1999, *F. graminearum*, the most aggressive of the *Fusarium* species causing FHB, was added as a declared pest to Alberta's *Agricultural Pest Act*. In late 2002, after an extensive public consultation process, Alberta Agriculture and Rural Development released the first comprehensive Alberta *Fusarium graminearum* Management Plan.

## What is the current state of FHB in Alberta?

*F. graminearum* has been present at very low levels in Alberta since 1989. However, it has been increasing in incidence and severity in southern Alberta. In 2010 and 2011, FHB resulted in grade reductions due to the presence of FDKs, especially in durum and highly susceptible red spring and soft

white wheat varieties grown under irrigation. Fortunately, FHB and *F. graminearum* are much less common in the rest of the province at this time. Changes in chemotype of the pathogen have occurred in the eastern Prairies, but the new “3ADON” chemotype remains at a relatively low level in Alberta at this time. In 2010, about 10 per cent of the *F. graminearum* isolates collected during the provincial FHB survey were the 3ADON type.

**“We’re dealing with one of the most insidious plant diseases in Canada, a double-barreled problem that hits the grain industry with a one-two punch of yield and quality losses in the field, and contaminates grain with mycotoxins that render it unfit for both human food and livestock feed.”**

*Dr. Gordon Dorrell - Agriculture and Agri-Food Canada*

# Objective of the Alberta *Fusarium graminearum* Management Plan

**Limit the introduction, escalation, spread and economic impact of *F. Graminearum* in Alberta**

## Regulatory Status

- *F. graminearum* is a declared pest under Alberta's *Agricultural Pests Act*. This Act is the legislative authority for enforcement of control measures for named pests in Alberta.
- Under the *Alberta Agricultural Pests Act*, the owner or occupant of land has the responsibility of taking measures to prevent the establishment of a pest on any land or property and to control or destroy all pests on the land or property.
- Section 22c of the *Agricultural Pests Act* states: "No person shall for propagation purposes acquire, sell, distribute or use any seed, root, tuber or other vegetable material containing a pest."
- Pest inspectors are appointed by the local municipality or by the Minister of Agriculture and Rural Development. By virtue of the office, an Agricultural Fieldman is a pest inspector under the *Alberta Agricultural Pests Act*. Pest inspectors have the power to enter land at a reasonable hour, without permission, to inspect for pests and collect samples.
- Enforcement of pest control measures is the responsibility of the municipal authority. The Agricultural Fieldman is responsible for enforcing pest control measures in their respective municipality.
- It is important to understand that the control measures outlined in this management plan represent guidelines intended to assist producers and municipalities across the province to comply with the *Agricultural Pests Act*.
- **Municipalities have the authority to enhance the standard for any named pest within their own jurisdiction.**
- **FAILURE TO FOLLOW THE RECOMMENDATIONS IN THIS PLAN MAY RESULT IN ENFORCEMENT UNDER THE ALBERTA AGRICULTURAL PESTS ACT.**

# Importance of Having a Management Plan

## Mycotoxin Production

***F. graminearum* produces mycotoxins, including deoxynivalenol (DON) and zearalenone. The presence of these mycotoxins reduces the marketability of grain.**

- Livestock and poultry are susceptible to DON. Zearalenone has estrogenic effects, and depending on the concentration, ingestion can result in reproductive dysfunctions.
- Lightweight, shriveled, fusarium-damaged kernels (FDK) may contain high concentrations of DON. Levels as high as 30 parts per million (ppm) in wheat and barley have been detected in other provinces.
- In non-ruminants, such as hogs, contamination of feed grain with as little as 1 ppm of DON can result in reduced feed consumption and, consequently, a reduction in growth. At concentrations of 5 ppm or more, feed refusal can occur. Young pigs are more susceptible to the effects of DON and may exhibit feed refusal, vomiting and reduced weight gain with dietary concentrations of less than 1 ppm. Most hog producers have a zero tolerance for DON in the feed they use.
- Adult beef cattle can tolerate higher levels of DON without known detrimental effects. Some studies have shown that cattle can feed on grain that has up to 12 ppm of DON, but calves and pregnant cows may have problems at lower levels of contamination.
- Agriculture and Agri-Food Canada guidelines for acceptable feed are 1 ppm of DON for swine, dairy cattle and horses, and 5 ppm for beef cattle, sheep and poultry.
- The presence of compounds associated with DON will also affect the production of beer. The compounds affect the taste of beer and may cause gushing or excess foaming. Most malting companies now have a zero tolerance for DON and test for it before purchasing grain stocks.
- Bread making is also affected by the fungi-forming DON. Flour changes colour and the bread does not rise normally. The baking process does not destroy DON.
- The presence of DON in food products is increasingly being regulated, and tolerance limits have been established in many countries.
- Several methods, both chemical and physical, have been studied as potential methods of detoxifying DON. Unfortunately, there is no easy, economical way to reduce the toxicity of the mycotoxin-contaminated kernels.

## Risk of Spread

**The presence of a virulent pathogen in sufficient quantity, a susceptible host and a favourable environment are requirements for the development of disease.**

- Survey information currently available indicates that *F. graminearum* is being found with increasing frequency in southern Alberta, and in 2010 and 2011, its presence resulted in downgrading of wheat due to the presence of FDKs. However, *F. graminearum* is still relatively rare in the central and northern regions of the province.

- On a medium- to long-term basis, short distance (field to field) spread of *F. graminearum* can introduce newer types of this pathogen (e.g. the 3ADON chemotype) into Alberta, as well as influencing further spread within Alberta.
- The long distance spread of wind-borne ascospores is improbable. Dispersal of ascospores occurs over relatively short distances. Ascospore survival is significantly reduced after exposure to natural UV radiation from the sun. Long distance spread could potentially occur via movement of infested residues attached to various types of equipment that are routinely used in farm fields. Erosion of soil containing bits of Fusarium-infected crop residues may also be a method of dispersal, but would be less important compared with infected grain, straw or stalks, or significant amounts of infested soil and/or stubble on tillage equipment.
- Alberta's environment is not a barrier to the spread of *F. graminearum*. Recent modeling research predicts that the potential range of FHB caused by *F. graminearum* may include the entire prairie region, but is of special concern in higher rainfall regions, such as the Parkland Zone. Irrigated regions were also predicted to be at risk from this pathogen, which has been confirmed given the recent development of damaging levels in irrigated fields.
- FHB is a disease of economic importance in southern Alberta, especially under irrigation and potentially in wetter regions elsewhere in Alberta, e.g. central Alberta.
- Once the pathogen establishes, it will readily overwinter on infected crop residue.
- ***F. graminearum* is a seed-borne pathogen and infected seed or feed, along with infested crop residues such as straw, represent the greatest risks of introducing or spreading *F. graminearum* within areas of Alberta where the pathogen is not commonly found, i.e. non-irrigated regions of central and northern Alberta.**

## Economic Impact

FHB caused by *F. graminearum* has been a serious disease in Manitoba and eastern Saskatchewan for over a decade. Losses are estimated to be in the millions of dollars annually.

**In 2004, an economic assessment of the potential cost to Alberta crop production was based on matching Alberta crop districts with Manitoba crop districts with similar projected FHB risk levels. Given annual variability in disease development in these similar risk areas in Manitoba, projected average annual costs over a modeled nine-year period in Alberta could range from \$3 million to as high as \$49 million.** The risk analysis also suggested that total losses could possibly be as high as \$64 million.

- The greatest projected economic losses could possibly occur in central and east-central Alberta and in the irrigated districts of southern Alberta.
- CWRS wheat and barley are expected to experience the greatest losses due to their extensive acreages.
- Over the modeled nine-year period, projected per acre costs (grade and yield reductions combined) due to *F. graminearum* under irrigation ranged up to \$30 to \$50 per acre and \$52 to \$132 per acre for

CWRS and durum wheat, respectively, depending on the crop district and modeled year. Under dryland production, the maximum per acre costs were lower, but could range up to \$50 per acre depending on the crop district and modeled year.

- In 2009, grade reductions in southern Alberta due to the presence of FDK were estimated to have cost affected growers approximately \$30 to \$39 per acre in durum, \$10 per acre in SWS and \$9 to \$33 per acre for CWRS, depending on the crop district. These estimates did not include reductions in yield, which would have also occurred.

## Best Management Practices (BMP)

### 1. Best Management Practices Approach for Cereal and Corn Production.

**Objective: For cereal and corn producers, limit the introduction, escalation, spread and economic impact of *F. graminearum* in Alberta.**

- a. Always use healthy seed with no detectable levels of *F. graminearum* to avoid introducing the pathogen into your production area. Request a seed health report that shows testing results specifically for *F. graminearum*. Organic producers should test multiple random samples from a seed lot to ensure that the seed is non-detectable for *F. graminearum*.
- b. Prior to planting, treat all cereal and corn intended for use as seed in Alberta with a registered fungicide that includes the genus *Fusarium* on the label list of fungi that are controlled.
- c. Continuous or short rotation cereals or corn allow for a buildup of *F. graminearum* on infested residues. Leave at least two years between host crops (e.g. all small grain cereals, corn).
- d. Avoid corn in rotation with small grain cereals. Corn is also a host of *F. graminearum*, where it causes seed rots, seedling blight, root rot, stalk rot and ear rot.
- e. Field location can be an important consideration as *F. graminearum* can move from one field to the next. If practical, avoid planting small grain cereals immediately adjacent to cereal or corn fields where elevated levels of *F. graminearum* are known or suspected to occur.
- f. Increase seeding rates to promote a more uniform stand, reduced tillering and a shorter flowering period for the crop. This approach helps reduce the period the crop is flowering, which is the growth stage most at risk for infection. Moreover, more uniform flowering of plants may help improve fungicide performance because most, if not all, of the crop will be at the key growth stage for application.
- g. Stagger planting dates to avoid having all cereals on the farm flowering synchronously and potentially being exposed to weather conducive to disease development at the same time. Humid weather during flowering (anthesis) in wheat or heading in barley favours infection.
- h. Grow varieties with the best available levels of resistance; however, this practice will not completely eliminate the risk of FHB. Consult annual variety guides for more information.



- i. Producers growing small grain cereals under irrigation may be able to reduce the risk of head and seed infection by careful water management. Irrigation should be limited for 5 to 10 days as the crop is entering the flowering stage to help prevent humid conditions that favour infection. Excessive irrigation during the flowering period can greatly increase the risk of FHB and resulting yield losses, grade reduction and mycotoxin contamination. In addition, it is recommended that producers consider increasing seeding rates, which helps to reduce tiller formation and shorten the flowering period for the entire crop, thereby limiting the time that irrigation should be reduced.
- j. When an elevated risk of FHB is suspected, growers should consider the use of a well-timed fungicide application for FHB management. Consult the current edition of Alberta Agriculture's *Crop Protection* guide, Agdex 606-1, for more details. Factors related to an elevated FHB risk include the following: short intervals between successive cereal crops, planting into or next to fields with the presence of *F. graminearum*-infested cereal or corn residue, use of a susceptible cereal variety, and/or where irrigation is being used or where weather conditions favour inoculum production and host infection.
- k. In mature crops where FHB has occurred, growers are advised to adjust their combines to blow out fusarium-damaged wheat kernels (which are lighter than the other seeds) and infected chaff as a way of improving the grade and reducing toxin levels in harvested grain, especially for wheat.
- l. Thorough chopping and uniform spread and distribution of straw may encourage more rapid decomposition of infested crop residue.
- m. Remove any loose crop residue from all equipment before leaving an infested field.
- n. Control volunteer cereals and grassy weeds on infested land, including headlands.

## **2. Best Management Practices for cereal, corn and grain products that may contain *F. graminearum* and intended for use as feed, bedding or industrial uses.**

**Objective: For cereal and corn producers, limit the introduction, escalation, spread and economic impact of *F. graminearum* in Alberta intended for use as feed, bedding or industrial uses.**

The following BMPs are the recommended control measures to be followed for handling *F. graminearum*-infested cereal, corn and grain products at unloading, loading, storage, feeding and industrial sites. These measures will also help minimize the spread of weed seeds.

**NOTE - Grain products include screenings, pellet feed and silage as well as straw for bedding, feeding, mulching or soil reclamation.**

- a. If *F. graminearum*-infested grain will be used as livestock feed, grain samples should be checked for mycotoxin levels (specifically deoxynivalenol) through a lab analysis. Knowledge of mycotoxin levels will provide guidance as to whether the grain is suitable for feeding, especially for more sensitive animals, such as swine.
- b. Limit the storage of feed grain/grain products in uncovered piles or in contact with the soil. Sites where grain/grain products were stored should be properly cleaned up.
- c. For loading/unloading sites handling feed grain, both a wind fence and drop sock should be considered when loading or unloading grain to prevent grain/grain product dust blow-off from the loading/unloading site. A covered loading/unloading facility is preferred.

- d. Feed grain and grain products should be unloaded in such a manner that spillage does not occur. Grain and grain products should have only limited or zero contact with soil.
- e. All modes of transport of feed grain and straw products should be securely covered to prevent spillage during transport. All trailers and grain cars transporting grain should be sound and leak-proof to eliminate grain loss. Avoid buying and/or transporting infested straw!
- f. All transport vehicles/units hauling untested grain and grain products should have the box/trailers/cars thoroughly swept clean of any residual grain/grain products and have gates closed before being allowed to leave the unloading site. The sweepings may be fed or composted so that the grain/straw reaches a temperature of 60 to 70oC for two weeks.
- g. Where practical, feed grain/grain products should not come in contact with the soil during feeding. Range feeding livestock is not recommended, while bunk feeding is the preferred method.
- h. Feed grain/grain products and straw suspected of being infested with *Fusarium graminearum* can be fed to finishing cattle, which will aid in elimination of the pathogen, or they can be composted where compost temperatures reach 60 to 70 oC for at least two weeks. If feed grain/grain products are spilled at any time during the feeding/handling process, consider recovering and composting.

## Responsibilities

### 1. Alberta Agriculture And Rural Development (AARD) Pest Surveillance Branch

- Co-ordinate the Alberta *F. graminearum* Management Plan.
- Provide training, regulatory support and consultation to inspectors enforcing the Alberta *Agricultural Pests Act* and Regulation.
- Prepare and provide technical information on *F. graminearum* management recommendations to inspectors and field staff.
- Provide training in disease identification and management.
- Evaluate the Alberta *F. graminearum* Management Plan in consultation with the Fusarium Action Committee as required.
- Facilitate surveillance activities in conjunction with stakeholders from various levels of government and industry.
- Co-ordinate provincial awareness activities for FHB.

### 2. Agricultural Service Boards (ASB)

- Provide support and resources to the Agricultural Fieldmen in carrying out their duties.
- Agricultural Fieldmen will monitor their respective municipalities for *F. graminearum*.
- Enforce control measures as necessary to meet the objectives of the Alberta *Agricultural Pests Act* and Regulation.

- Provide recommendations and information to farmers on FHB prevention and control based on the Alberta *Fusarium graminearum* Management Plan and other relevant sources of information.
- Conduct field surveys and maintain records of infestations if found.

### **3. Landowner/Occupant, Seed/Grain/Feed Processors and End Users**

- Take responsibility to control, destroy or prevent the establishment of *F. graminearum* as outlined in the Alberta *Agricultural Pests Act* and Regulation.
- Observe and practice all management practices to meet the objectives of the Alberta *F. graminearum* Management Plan.

### **4. Oil, Gas, Construction And Trucking Industries**

- Observe and practice all management practices to meet the objectives of the Alberta *F. graminearum* Management Plan.

### **5. Fusarium Action Committee**

- Provide a forum to represent the interests and views of Alberta’s agricultural industry regarding the management of *F. graminearum*.
- Recommend management strategies for *F. graminearum* for inclusion in the Alberta *F. graminearum* Management Plan.
- Educate Alberta’s crop and livestock industries about *F. graminearum* and the threat it represents to producers, processors and other stakeholders.
- Will review and evaluate the Alberta *F. graminearum* Management Plan in consultation with AARD as required.

## **Fusarium Action Committee Members**

- Alberta Association of Agricultural Fieldmen (AAAF)
- Provincial Agriculture Service Boards (ASB) Committee
- Alberta Association of Municipal Districts and Counties (AAMD&C)
- Alberta Seed Growers Association (ASGA)
- Association of Alberta Co-op Seed Cleaning Plants
- Alberta Grains Council
- Alberta Corn Committee
- Western Canadian Wheat Growers’ Association
- Canadian Seed Trade Association (CSTA)
- Alberta Beef Producers
- Alberta Barley Commission