Fusarium Head Blight of Barley and Wheat

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Alberta

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Introduction

Fusarium head blight (FHB), also known as scab or tombstone, is a fungal disease of wheat (including durum), barley, oats and other small cereal grains and corn. FHB affects kernel development, reducing yield and grade, and may contaminate grain with a fungal toxin (mycotoxin) produced in infected seeds.

Infection of the harvested grain and/or mycotoxin production negatively affects livestock feed, the baking and milling quality of wheat, biofuel (ethanol) production, and the malting and brewing qualities of malt barley.

While caused by several species of the Fusarium genus, *Fusarium graminearum* (*F. graminearum or Fg)* is the species that causes the most serious damage. FHB is favoured by warm, humid conditions during flowering and early stages of kernel development.

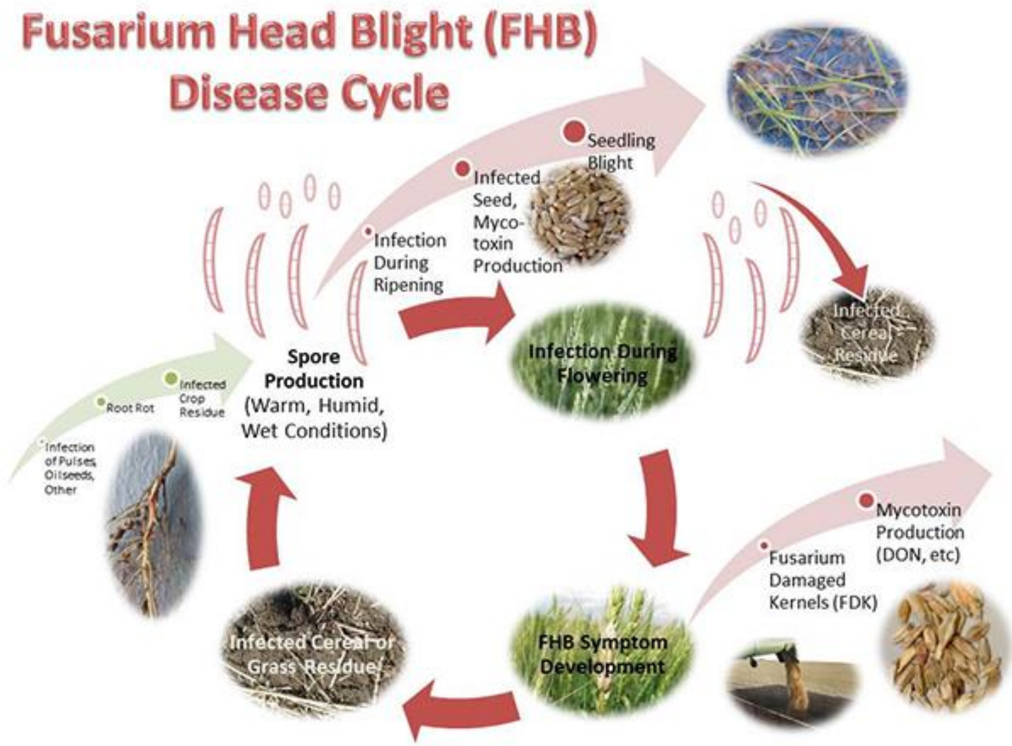
Canadian Grain Commission grading standards allow very little tolerance of FHB in the top grades of cereal grains. In 1999, *F. graminearum* was declared a pest under the *Alberta Agricultural Pests Act*.

Fusarium head blight disease cycle

The pathogen causing FHB overwinters in crop debris/residues of small grain cereals and corn located on or in the soil. The pathogen can also cause root and crown rot of other crops such as pulses and oilseeds. It overwinters on all these infected residues, including infected seed that can re-infect an emerging seedling.

Warm, moist weather promotes spore formation on the infected crop residue, and the spores spread by wind to infect florets at the flowering stage of the cereal crop. A second, rain-splashed, spore stage can form on infected head tissue. Disease development accelerates when air temperatures around 25 degrees C are associated with precipitation, or very high humidity, for 36 hours.

While seedlings can become infected at emergence by planting infected seed, this usually causes seedling blight that does not necessarily lead to FHB or damage to kernels. However, this infected residue, resulting from seed-to-seedling transmission, allows the pathogen to overwinter on the field surface and may result in spore production and re-infection if a cereal is grown the following year.



History of fusarium head blight in Canada

The Canadian Grain Commission provides the following information.

The Canadian situation:

- Eastern Canada
  - 1919: first FHB report
- Western Canada – Manitoba
  - 1923: first FHB report on corn
  - 1948: first FHB report on cereals
- Outbreaks in the 1920's, early 1980's, 1990's and 2000's
- Severe outbreak in Manitoba in 1993 (about 50 per cent of Roblin wheat variety infected)
- Greater than $1B in losses since 1990s
- FHB disease spread slowly westward into Alberta.

The Alberta situation:

- 1989: first report of *F. graminearum* in soft white spring wheat in southern Alberta
- 1994: *Fg* found in central Alberta
- 1995: *Fg* found in irrigated areas of southern Alberta
- 1997: First report of *Fg* from Edmonton and the Peace regions
- 2001: 33 *Fg* positive (+) samples
- 2002: 82 of 191 samples from southern AB tested positive for *Fg*
- 2003 onward: Annual detections of *Fg* in Alberta
- 2007: 0.05 per cent of survey samples tested positive for *Fg*
- 2010: 11.1 per cent of survey samples tested positive for *Fg*
- 2015: 14.7 per cent of survey samples tested positive for *Fg*
- 2016: 26.5 per cent of survey samples tested positive for *Fg*

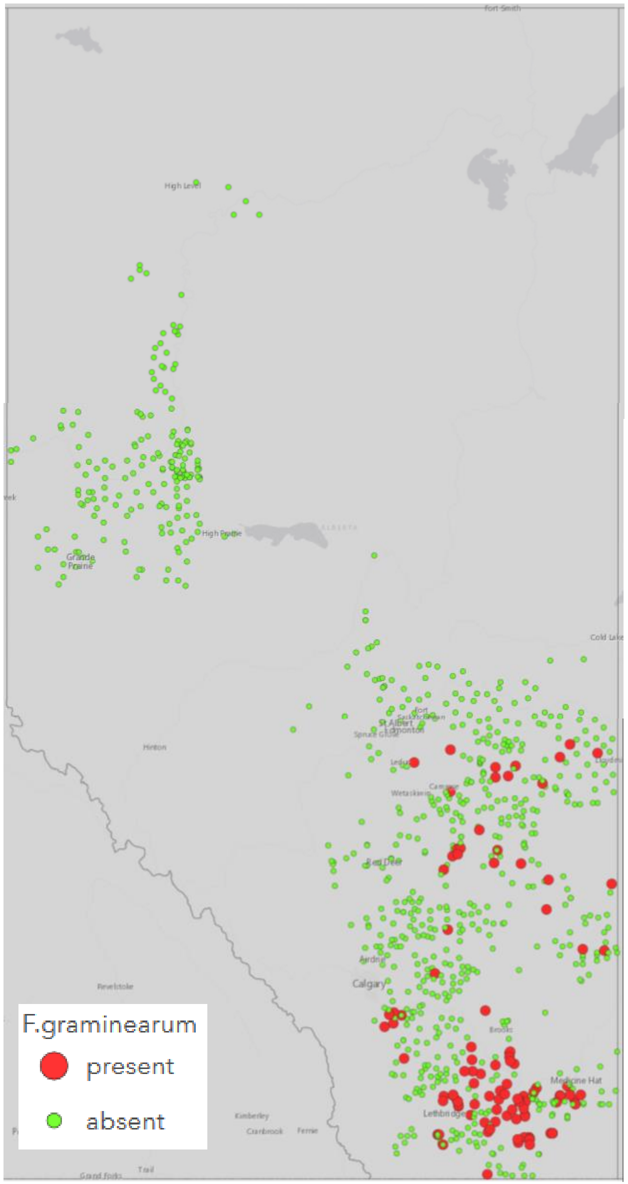
Fusarium head blight concerns in Alberta

Outbreaks of FHB in wheat or barley and other grains generally occur in the more humid regions of North America. Over the last several years, FHB has been the most serious cereal disease of the eastern Canadian Prairies, Eastern Canada, and the Midwest USA. In eastern Saskatchewan and Manitoba, *Fusarium graminearum* species is normally responsible for FHB.

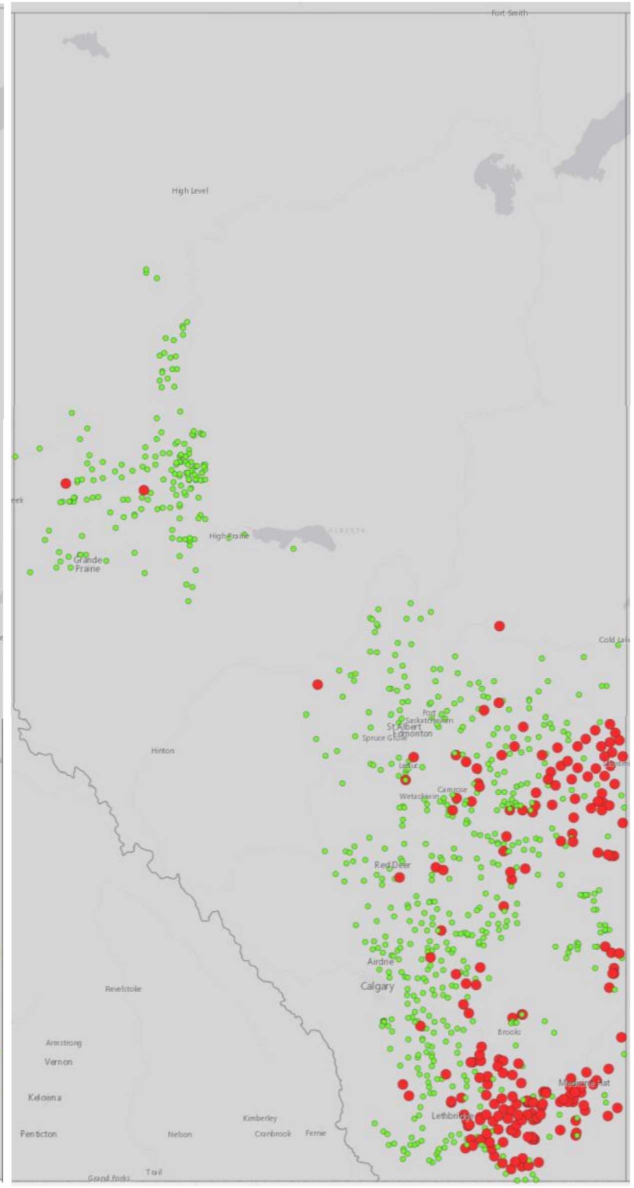
In Alberta, results regarding the occurrence of *F. graminearum,* based on testing by a range of private and public organizations using different methodologies and involving a range of plant tissues (e.g. seed, heads, crowns, and nodes), have been consistent.

Until the last few years *F. graminearum* was either not detected, or infrequently detected in grain, seed and crop residues from central to northern Alberta. In contrast, *F. graminearum* was more frequently detected in grain, seed, cereal residues, corn residues, and head tissues from fields in southern Alberta, especially under irrigated production. However, over the period from 2001 to 2013 this pathogen was detected with increasing frequency, especially in southern Alberta.

Outside of southern Alberta during this period, other less damaging species of Fusarium were typically associated with FHB symptoms. However, since 2013, *F. graminearum* is more frequently detected in regions of Alberta outside of southern Alberta. For example, the number of counties in Alberta reporting *F. graminearum* in 2001 was nine, but the number jumped to 13, 22 and 26 in 2010, 2015 and 2016 respectively.



2015


2016

F. graminearum is listed as a pest in the regulations of the *Agricultural Pests Act.* The control measures to prevent establishment and spread of a pest are enforced under the authority of the *Act* by the local municipal authority.

After extensive public consultation, the province developed the *Alberta Fusarium graminearum Management Plan,* which went into effect Oct. 1, 2002. The plan outlines beneficial management practices for meeting the threat of this disease, while still sustaining all sectors of the agriculture industry in Alberta.

One of the foundational practices to prevent the spread of a seed-borne pest is to use disease-free seed. For this reason a laboratory certificate showing that seed was tested and found to be non-detectable for *F. graminearum* must accompany all cereal and corn intended for use as seed in Alberta. See Alberta Agriculture and Forestry's *Fusarium graminearum* Management Plan

Fusarium head blight symptoms

FHB in wheat is recognized in the field by premature bleaching of one or more infected spikelets in the cereal plant's head (Figure 1). Infected spikelets are visibly apparent on green heads during the early milk to hard dough stages (Figure 2). Symptoms in wheat include the production of orangish/pink, spore-bearing structures at the base of the glumes (Figure 3). Partially bleached heads are most common. During wet weather, there may be whitish, occasionally pinkish, fluffy fungal growth on infected heads in the field. Symptoms in barley are much less distinct and the brownish discolouration of FHB infected barley spikelets can easily be confused with hail damage or the extended symptoms of other barley diseases like spot blotch, kernel smudge, etc. (Figure 4).

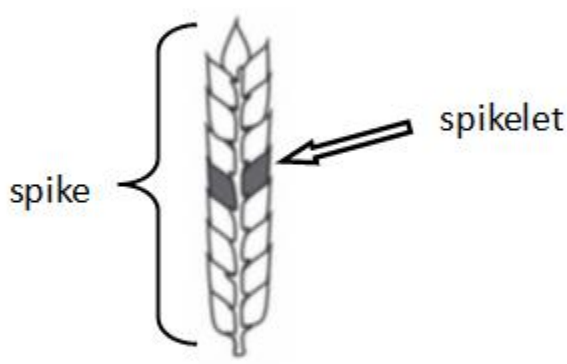


Figure 1. Cereal head (spike and spikelet).

Figure 2. Fusarium graminearum *infection in wheat: note the bleached heads (Picture courtesy of Michael Harding, Alberta Agriculture and Forestry).*

Figure 3. FHB infected wheat head. Note orangish/pinkish spore bearing structures at base of glume (Picture courtesy of Kelly Turkington, Agriculture and Agri-Food Canada).

Figure 4. Premature brown discolouration of infected spikelets in barley (Picture courtesy of Kelly Turkington, Agriculture and Agri-Food Canada).

Diseased wheat spikelets may contain visibly affected kernels. The grading term given to visibly affected wheat seeds is “fusarium damaged kernels” (FDK), whereas in barley, this is called “fusarium mould”.

FDK in wheat are shrunken, shriveled and typically chalky white coloured (Figures 5 and 6). Fusarium severity in wheat is based on a sample’s percentage of FDK by weight. Figure 7 shows a wheat sample with 4 per cent FDK. Fusarium mould on barley is an orangish/pink or black encrustation of the seed surface (Figure 8).

During the period of very early kernel development in wheat, FHB can cause yield reduction due to a reduced amount of kernels being developed. FHB infections occurring slightly later cause visibly shrunken, chalky white or discoloured kernels, often referred to as tombstones. Later developing kernels may not appear damaged, however, may continue to have elevated infection levels and the presence of mycotoxin.

Much of the severely infected wheat is lightweight and may be blown out the back of the combine during harvest. Although most FDK result from infections occurring during flowering, creating lightweight kernels, the grain infected after the flowering stage may be heavy enough to be harvested along with healthy grain. The fungus may eventually kill the developing seed at about the soft dough stage. Symptoms of fusarium mould in barley or oats are usually sparse, making it difficult to determine if grain has been infected.

Figure 5. The shriveled, chalky coloured kernels are called FDK (fusarium damaged kernels). Infection occurred during flowering (Picture courtesy of Kelly Turkington, Agriculture and Agri-Food Canada).

Figure 6. Lighter, earlier infected kernels (left side of picture) blow out back of combine. No symptoms on later infected kernels (right side of picture) however, these can enter seed source and be re-planted, producing fusarium seedling blight (Picture courtesy of Kelly Turkington, Agriculture and Agri-Food Canada).

Figure 7. Wheat with four per cent FDK (Picture courtesy of Kelly Turkington, Agriculture and Agri-Food Canada).

Figure 8. Symptoms of FHB infection in barley are not as distinctive as with wheat and can be confused with other diseases that cause darkened kernels. In this heavily F. graminearum *infected sample, the DON levels reached 15 ppm (Picture courtesy of Kelly Turkington, Agriculture and Agri-Food Canada).*

Other cereal disease infections, like tan spot and septoria blight in wheat, have been confused with FDK. The only way to distinguish kernels infected with these pathogens from those infected by *Fusarium* species is to have the seed tested by a reputable seed laboratory.

Using corn in rotation with small cereal grains has been shown to increase the FHB problem, although corn is not an essential link in the disease cycle. All cereal and corn residue can help the fungus overwinter and will act as a disease inoculum source in the spring. Due to the greater physical size and structure of the corn plant, corn stubble has the capability of containing huge amounts of Fusarium fungi inoculum that may infect small grain heads, causing FHB in barley and wheat.

Fusarium head blight mycotoxins

While causing yield reduction and stopping kernel development, wheat and barley infected by FHB may also contain mycotoxins such as deoxynivalenol (DON), also known as vomitoxin. This toxin is produced primarily by *F. graminearum* species and in conjunction with infection of grain, causes downgrading in grain quality and issues with market acceptability.

DON is a poisonous compound that accumulates in the head (grain and chaff) of cereal crops. Little, if any, DON is present in the straw and leaves of the plant.

This mycotoxin and seed infection negatively affects the baking and milling quality of wheat, biofuel (ethanol) production, and the malting and brewing qualities of malt barley.

DON is one of the least toxic mycotoxins. The toxicity of DON is such that animals or humans do not die from ingesting it. However, livestock consuming high levels of DON may experience reduced feed intake, reduced immune response and reproductive dysfunction.

The Canadian Grain Commission has established maximum tolerated levels of FDK for various grades of wheat and the Canadian Food Inspection Agency has established maximum tolerated levels of mycotoxins in grains used for food and feed.

Different chemical forms (chemotypes) of the mycotoxin (DON) can be produced that influence toxicity. Two different chemotypes exist within the *F. graminearum* population in Western Canada: 3-acetyl DON (3-ADON) and 15-acetyl DON (15-ADON). Chemotypes play a role in disease severity according to the amount of spore production and toxicity of DON produced.

The 3-ADON chemotype is more aggressive and produces more DON than 15-ADON. While historically 15-ADON has been the dominant *F. graminearum* chemotype on the Prairies, 3-ADON has been increasing over the last two decades.

The new 3-ADON chemotype produces more DON toxin based on the percentage of Fusarium damaged kernels. The older, 15-ADON chemotype was known to produce about one per cent of DON toxin for every one per cent FDK; however, the newer 3-ADON chemotype produces higher levels of DON for every per cent of FDK.

This shift in chemotype is being monitored by the Canadian Grain Commission and modifications in grading tolerances are made accordingly.

While the potential increase of FHB on the prairies is dependent upon warming weather patterns, more intensive farming practices and the movement of infected seed, a change in chemotype also plays a role in disease incidence and severity. This puts more emphasis on the need for effective and vigilant disease management.

FDK and DON impacts on wheat quality and bread-making performance

Most DON in wheat is located in the seed coat or bran. For bread-making, shrunken FDK are removed to improve flour quality and reduce DON content, causing an overall yield loss.

Infections due to FHB negatively affects bread and pasta quality due to enzymes in infected tombstone wheat kernels that break down protein, consequently reducing gluten strength.

Limits on allowable DON in cereal products intended for human consumption have been put in place by several importing countries. See grading tolerances for Fusarium-damaged wheat near the end of this document.

DON impacts on barley end-use acceptability

A suspicion of fusarium mould in malting barley can lead to rejection. Several malt companies have a zero tolerance for DON in barley. See grading tolerances for FHB fusarium mould in malt, food and general purpose barley near the end of this report. Infection of barley with FHB may also result in quality issues during the malting and brewing process leading to a reduction in alcohol production and other quality attributes.

DON impacts on livestock

Maximum tolerated levels of DON in livestock feed are one part per million for swine, dairy cattle and horses, and five parts per million for beef cattle, sheep and poultry.

Given that not all damaged kernels contain DON, visual inspection is not a satisfactory analysis. FHB-contaminated grain intended for livestock feed should be tested at a credible feed testing lab.

Careful rationing is required to retain DON levels within an acceptable level and livestock health should be constantly monitored. See additional information at this Manitoba web-site, Feeding *Fusarium* Contaminated Grain to Livestock.

Preventing mycotoxin risk to cereal producers

While producers should always apply protective procedures to avoid hazards of grain dust, danger of respiratory problems is heightened when exposure includes grain dust infected by FHB mycotoxin.

Management of fusarium head blight

It is critical to use a combination of agronomic strategies to manage FHB, including the following:

- **Crop rotation:** To reduce the buildup of infested crop residues, rotating away from cereals to non-host crops, including canola, pulses and forage legumes, should be considered for at least two years. This will allow enough time for infested residue to decompose before the next cereal crop is planted.

- **Variety selection**: Although few cereal varieties are resistant, using the least susceptible varieties will help to reduce the risk of FHB and perhaps the potential for buildup of *F. graminearum*. Producers in areas of higher risk should select varieties that exhibit some level of FHB resistance. In general, the level of FHB susceptibility decreases from durum wheat to CPS wheat to hard red spring wheat to barley and to oat. Winter wheat often escapes FHB infection because it flowers before Fusarium spores are present. While oat is the least susceptible, due to often being used for human food processing, there is a very low FDK tolerance. For more information on FHB reactions of registered cereal varieties see the Varieties of Cereal and Oilseed Crops for Alberta document.
- **Use clean seed**: Where possible, producers must avoid planting seed that is infected with *F. graminearum*. Seed of susceptible crop species must be tested by a seed testing laboratory and only seed with non-detectable levels of *F. graminearum* is to be used for seeding purposes. Although infected seed can cause seedling blight, it typically does not directly give rise to head blight symptoms in one growing season. The fungus will move from the infected seed to the root, crown and stem base tissues of the plant that develops from the infested seed, therefore, creating potential sources of infested residue that can impact subsequent crops. Buildup of the pathogen would also be favoured by growing successive host crops continuously or in short rotations, and disease-conducive weather.
- **Seed treatment**: Although unable to prevent infection later in the growing season, seed treatment helps prevent seedling blights caused by FHB and other seed and soil-borne pathogens. Therefore, prior to planting a cereal crop, treat the seed with a registered fungicide that includes FHB on the label list of diseases that are controlled.
- **Increase seeding rate**: Increasing seeding rate causes less tillering leading to a more uniform and shorter overall flowering period which minimizes the length of time during which heads are susceptible to FHB infection. Less tillering means less variation in crop growth stage, which may improve overall fungicide performance. Less tillering and a shorter flowering period also reduces the time that irrigation should be avoided (during the flowering period) when the pathogen infects wheat and barley crops.
- **Stagger planting dates between fields**: Humid weather during flowering in wheat or heading in barley favours Fusarium infection. Vary seeding dates to avoid having all cereal fields flowering at the same time.
- **Irrigation management**: If possible, limit irrigation just prior to and during the flowering period to reduce humid conditions in the crop canopy which would otherwise favour FHB

infection. For further information on using irrigation management to minimize FHB, see the following:

Alberta Agriculture and Forestry factsheet:
Fusarium head blight and irrigation

Selected slides from the M.D. of Taber's FHB web link:
Managing Fusarium Head Blight in Southern Alberta - (pdf 158 Kbytes)

- **Fungicide application**: In-crop fungicide application may be considered, but can be inconsistent and only provides FHB disease suppression. Disease symptoms form later in the growing season and are not visible at spraying time. See the Provincial Crop Protection Guide for registered fungicides. Strobilurin fungicides (group 11) should not be used for FHB management because they may cause increased DON contamination in harvested grain.

  The period of time that a cereal plant is susceptible to FHB infection is short. Therefore, the spray window is also short (approximately seven days). Warmer weather conditions narrow the spray window while cooler conditions widen the spray window.

  FHB fungal spores infect the cereal plant by entering openings created where tiny flower parts, referred to as anthers, form on the cereal head. Wheat flowers after the head is fully emerged from the boot while barley begins flowering as the head emerges from the boot. Tiny yellow anthers initially form in the middle of a head, ultimately developing over the full length of the head and finally turning from yellow to white as they age and dry out before blowing away. For fungicide application purposes, a field is considered to be at "full flower" when 50 per cent of the heads on main stems are flowering.

  Under ideal growing conditions, the length of time from when the wheat head is just emerging from the boot to the beginning of flowering is three days, so begin scouting closely when the head begins to emerge from the boot.

  The spray window begins when most of the wheat heads on the main stems are fully emerged from the boot and continues through the time when yellow anthers form on the heads until 50 per cent of the heads on main stems are in flower.

  Barley begins to flower in the boot, however, so wait until most of the barley heads have emerged from the boot before spraying.

  Ultimately, good head coverage prior to infection is critical for improving fungicide efficacy for both wheat and barley, thus waiting until all heads are out of the boot may be advisable.

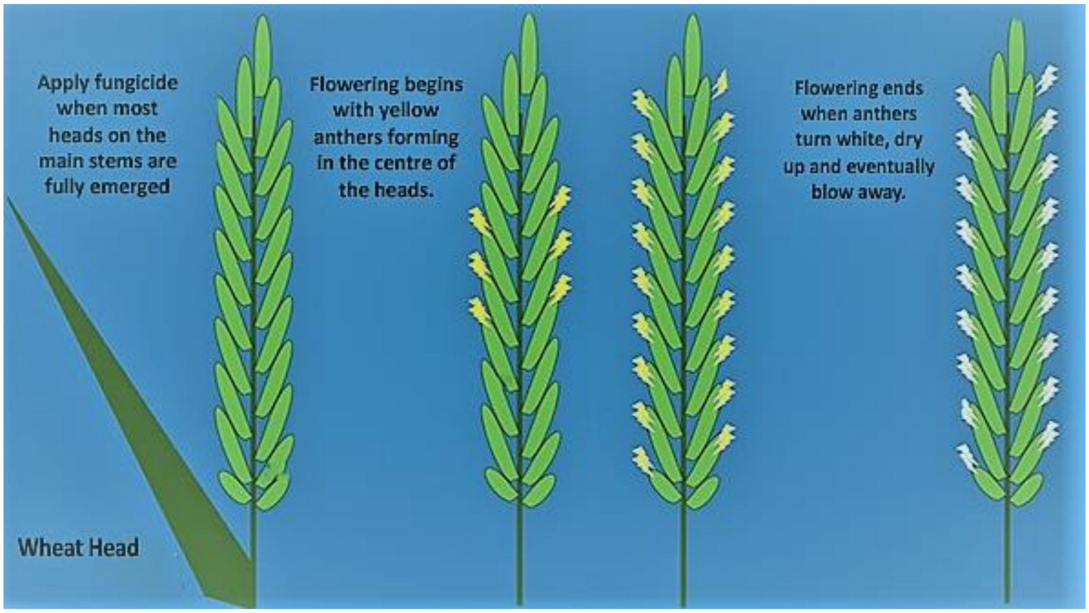


Figure 9. Full head emergence and flowering stages of wheat. (Diagram adapted from Saskatchewan Ministry of Agriculture)

Weather-based FHB risk forecast maps are currently being developed by Alberta Agriculture and Forestry to assist growers with making a spraying decision and for more accurate timing of a fungicide application.

This forecasting tool provides local and hourly FHB risk levels using near-real-time weather data that growers can correspond with the correct heading stage for appropriate fungicide application timing: Fusarium Head Blight Infection Risk Report. This tool can be used to evaluate the real-time environmental risk of FHB, at any location in the province, as the crop begins to head and flower. Knowing the risk of temperature and rainfall to drive infection and disease development may be useful in making fungicide application decisions.

Dr. Tom Wolf's (AgriMetrix Research & Training) fungicide spray recommendations for FHB are:

- Angle nozzles forward or use a double nozzle (forward and back)
- Greater angles are better
- Use coarse sprays
- Maintain low boom height

    - Fast travel speeds are fine for vertical targets (cereal heads)
    - Water: recommend 15+ gallons per acre (70+ litres per acre).

Dr. Tom Wolf: Keys to Successful Fusarium Fungicide Application
Dr. Tom Wolf: Fusarium Head Blight Fungicide Application Tips

For more information on fungicide application see:

Fungicide Efficacy and Timing Questions on Fusarium Head Blight
Fungicide Spray Recommendations for Fusarium Head Blight Fungicide Efficacy

- **Scout for symptoms:** Search for premature bleaching of one or more wheat spikelets (Figures 1 and 3) at the late milk to early dough stage. For spring seeded cereals, this typically occurs during the last part of July or early August. Once symptoms are present it is too late to apply a fungicide, however, keeping a record of this information is valuable for your FHB disease management plan in subsequent growing seasons. Symptoms in barley are much less distinct than wheat (Figure 4). Send suspicious looking cereal head samples to a laboratory to determine whether affected heads contain FHB infection and to determine whether the *Fusarium* species is *F. graminearum* or one of the less damaging FHB species, or possibly another disease that resembles Fusarium symptoms. Symptoms may also appear in threshed grain as FDK or discolouration, which should also be sent to a lab to determine *Fusarium* species. See laboratory suggestions in the next section.
- **Harvest management (combine adjustment)**: Adjust fans to blow out lightweight infected wheat kernels, which may not be an option for infected barley and oat kernels that are not typically shrunken or shrivelled. While a majority of wheat kernels are lightweight, wheat kernels infected well after flowering and up to the soft dough stage of kernel development may be too heavy to blow out. While there is some risk of having more wheat heads and straw pieces in the grain sample, some growers adjust the sieves to a more wide-open setting. A wider sieve setting slows the rearward flow of the grain mass that aids cleaning and separation of lightweight kernels due to a more vertically directed air blast. Thoroughly clean equipment used to harvest infected fields before moving to clean fields.
- **Harvest travel speed**: Slower combine ground speed results in less material on the cleaning sieve and allows more time for the increased air blast to separate good kernels from lightweight, infected wheat kernels.

- **Consider harvesting early**: Under moist weather conditions, FHB fungal growth and DON production continue to develop and spread in grain over 19 per cent moisture content. Therefore, if inclement weather is forecasted, consider harvesting early, however, be aware that higher moisture grain is heavier, which reduces the effectiveness of blowing out lightweight wheat kernels.

- **Post-harvest management**: Thorough chopping and uniform spreading of infected cereal straw will encourage decomposition and reduce pathogen survival. Research conducted over the last 20-30 years has found the impact of tillage to be variable, especially the typical forms of conventional tillage practiced in Alberta. Although moldboard ploughing may help, it is detrimental to soil health and increases the risk of erosion. Moreover, FHB is still an issue in areas that utilize moldboard ploughing.

- **Storage aeration and drying:** Infected wheat should be aerated soon after storage to reduce grain temperature and fans should be turned on periodically thereafter as air temperatures decrease until the infected wheat is 5°C. If necessary, dry infected grain to 14 per cent moisture content or lower. Drying temperatures should not exceed 60°C to retain milling quality.

- **Separate storage:** Bin more infected grain separately if FHB levels vary between fields or within a field,

- **Gravity table and colour sorter:** Although not entirely effective, gravity tables and optical colour sorters are able to separate out severely infected FDK to facilitate a grade increase. Although a gravity table is lower-cost, some FDK are missed while some healthy kernels are eliminated. FDK colour varies from white to pink to black, which can complicate and slow a colour sorting process. A practice of using a gravity table first to clean the grain followed by colour sorting is being applied, however, time and cost of grain cleaning increases. *Both colour sorters and near infrared technology (NIT), that determines the presence of chemical characteristics (DON) via light response, have considerable potential to increase the quality of a grain sample with Fusarium infection. These technologies will likely become more common as these technologies become more advanced, familiar and cheaper.*

- **Control volunteers:** Control volunteer cereals and grassy weeds on infested land, including headlands.

- **Handling feed grain and grain spillage:** Feed grain represents a risk for introducing *F. graminearum* due to the sheer volume of feed grain brought into Alberta. It is known that *F. graminearum* on infected grain is killed during passage through the digestive system of cattle. Feed grain must be handled responsibly to ensure that all infected grain is fed to cattle. Grain spillage should be avoided. Infected spilled grain should be cleaned up and composted, reaching a temperature of 60 degrees C for at least two weeks, which kills *F. graminearum*.

- **Careful feed grain loading/unloading:** Infected grain must not be allowed to come in contact with the soil, which would allow *F. graminearum* to establish a foothold in roadsides or fields. Unloading sites must be covered or equipped with drop socks and wind fences to ensure that infected grain does not blow onto nearby soil. Trucks, or any vehicles, used to haul feed grain must be securely tarped. Trucks must be cleaned thoroughly at the unloading site and all remaining grain composted.
- **Feed grain storage:** Limit the storage of feed grain/grain products in uncovered piles or in direct contact with the soil. Moisture contacting this grain can promote the growth and development of *F. graminearum.* Sites where infected grain/grain products were stored should be properly cleaned up and leftover grain composted.
- **Hay and straw management:** Grass hay and straw from areas infested with *F. graminearm* can carry the pathogen and should be handled in accordance with the best management practices applied for feed grain. Grass hay represents a lower risk than straw because hay should all go through the cattle, which kills *F. graminearum*. Caution should be used when spreading infested livestock bedding straw in fields, which puts the FHB pathogen in contact with the soil. If the bedding straw is not collected and composted in early spring, any *F. graminearum* present may become established in the field or field edges.

Laboratory testing for fusarium head blight

Seed samples can be sent to the Canadian Grain Commission or to a reputable private laboratory for testing. Several labs test for the general presence of any of the *Fusarium* species on seed, grass hay or cereal straw and the identification and differentiation of *Fusarium* species, including *Fusarium graminearum,* causing the infection. DON level in harvested grain can also be tested.

For a simple test to determine if a grain, hay or straw sample has *F. graminearum* or not (for example, determining between *F. graminearum* and other FHB species or between FHB and other crop diseases), a PCR testing method detects the presence of the DNA of *F. graminearum*.

While a PCR test is able to detect low levels of *F. graminearum* and seed surface infections, it does not provide a quantitative amount. A petri plate test method detects the amount of *F. graminearum* in a sample by percent and is important as a follow-up to a positive PCR test. Some labs will perform the PCR test first, and then follow up with a plate test on any positive samples, however, check with the lab to ensure what testing will be performed.

To test vomitoxin (DON) amount, an ELISA (enzyme-linked immunosorbent assay) test method is used that is expressed in parts per million (PPM). On average, 1 percent FDK (if caused by *F. graminearum* or *F. culmorum*) will produce 1 ppm DON, although it can range from 0.5 to four ppm. Thus, five per cent FDK in wheat will give, on average, five ppm DON.

All of these test methods are relatively cheap ($30 to $70) and greatly assist with FHB management and feeding decisions. As with any test, sampling is critical. Without a good, representative sample, test results will not accurately reflect the bulk from which the samples were taken.

Canadian Grain Commission testing

The Canadian Grain Commission (CGC) offers FHB DON (vomitoxin) and falling number tests. CGC has a "Harvest Sample Program" for no cost to growers who sign up for the program. Enrollment allows you to receive a Harvest Sample kit annually that contains envelopes for sending your crop samples. Results are available through a grower's online account within 15 business days after receipt of a sample. For more details and to sign-up for this free program call 1-800-853-6705 or email harvest-recolte@grainscanada.gc.ca. While the CGC accepts samples up to November each year, they encourage you to send your samples as soon as harvest is complete.

Private seed testing labs

Private labs test for FHB incidence and severity. Lab test results are for *Fusarium* species detection, *F. graminearum* amount (percentage), and DON (vomitoxin) amount expressed in parts per million (ppm).

BioVision Seed Labs located in Sherwood Park and Grande Prairie
Sherwood Park: Phone: 1-800-952-5407; Email: BioVision.SherwoodPark@sgs.com
Grande Prairie: Phone: 1-877-532-8889; Email: BioVision.GrandePrairie@sgs.com

20/20 Seed Labs Inc. located in Nisku.
Phone: 1-877-420-2099.

Precision Seed Testing located in Beaverlodge.
Phone: 780-354-2259.

Seed Check Technologies Lab
Phone: 1-780-980-8324

Grading tolerances for fusarium-damaged wheat and barley

Allowable levels of fusarium-damaged kernels in western Canadian wheat at primary elevators

Class and Grade	% Fusarium damaged kernels (FDK) (% by weight)
Canada Western Red Spring/Canada Northern Hard Red	
No. 1	0.25
No. 2	0.8
No. 3	1.5
Feed	4
Canada Western Amber Durum	
No. 1	0.5
No. 2	0.5
No. 3	2
No. 4	2
No. 5	4
Canada Western Extra Strong	

No. 1	1
No. 2	1
Feed	4
Canada Western Soft White Spring	
No. 1	1.5
No. 2	1.5
No. 3	1.5
Feed	4
Canada Prairie Spring White and Red	
No. 1	1.5
No. 2	1.5
Feed	4
Canada Western Red Winter	
No. 1	0.8
No. 2	1
No. 3	1.5
Feed	4

Canada Western Hard White Spring	
No. 1	0.25
No. 2	0.8
No. 3	1.5
Feed	4
Canada Western Special Purpose	
No. 1	1.0
No. 2	4

Samples containing more than five percent fusarium-damaged kernels will grade “Wheat, Sample CW Account Fusarium Damage”. Samples containing more than 10 percent fusarium-damaged kernels will grade “Wheat, Commercial Salvage”. To find out what is considered an FDK in wheat, contact your nearest Canadian Grain Commission (CGC) Service Centre or Regional Centre; or call: 1-800-853-6705; Email: contact@grainscanada.gc.ca.

Allowable levels of fusarium mould in western Canadian barley at primary elevators

Class, Grade, Type	Fusarium Mould (% by weight)
Canada Western Malting	
Select Malting, 2 and 6 row, Covered and Hulless	0.2
Canada Western Food	
Select Food, 2 and 6 row, Covered and Hulless	0.5
Canada Western General Purpose	
No. 1 Covered and Hulless	1.0
No. 2 Covered and Hulless	1.0

To find out what is considered fusarium mould in barley, oats or other small grain cereals, contact your nearest CGC Service Centre or Regional Centre; or call: 1-800-853-6705; Email: contact@grainscanada.gc.ca

Further fusarium head blight information

Contact the **Ag-Info Centre** toll free at 310-FARM (3276) or 1-866-882-7677.

Videos

Keys to Successful Fusarium Fungicide Application – video duration 6:05 minutes
Fusarium Head Blight Fungicide Application Tips – video duration 4:37 minutes

Stop Fusarium Before it Stops You – video duration: 4:25 minutes

Fusarium Management – video duration: 30 minutes

Websites

Alberta Agriculture and Forestry

Alberta Fusarium Graminearum Management Plan

About Fusarium Head Blight

Fusarium Head Blight and Irrigation Management

Varieties of Cereal and Oilseed Crops for Alberta

Alberta Crop Protection Guide

Canadian Grain Commission

Fusarium Head Blight in Western Canada

FHB Maps

FHB Graphs

Manitoba Agriculture, Food and Rural Initiatives

Dealing with Fusarium Head Blight

Feeding Fusarium Contaminated Grain to Livestock

Saskatchewan Ministry of Agriculture

Fusarium Head Blight

Fusarium Head Blight and Mycotoxins

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