Fusarium head blight in Saskatchewan in 1998

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Fusarium head blight (FHB), also known as scab or tombstone has caused very limited damage to cereals in the past in Saskatchewan. There are several *Fusarium* species that could cause this disease. Beginning in 1993, an important cereal pathogen, *F. graminearum,* began to be detected in a few Saskatchewan wheat samples, almost exclusively along the Manitoba border.

Symptoms of FHB are water-soaked brownish spots on the glumes, with a salmon pink fungal growth often present along the edge of the glumes or at the base of the spikelet. Premature death or bleaching of infected spikelets is a classic symptom This is particularly striking on immature heads where one or more spikelets or the entire head may be affected.

Infected wheat kernels, referred to as Fusarium damaged kernels (FDK), are smaller than normal, shriveled and bleached in appearance, and accompanied by a white to light pink mould. In barley, however, symptoms of FHB are less obvious, making detection of the disease more difficult.

High humidity conditions for at least 12 h are required for infections of heads. Temperatures of around 25°C are optimum for infection by *F. graminearum.* Although infections can occur at any time during seed development provided environmental conditions are right, cereals are most susceptible to FHB at anthesis. Infections at this time result in the greatest damage.

Ground cereal residues colonized by *Fusarium* spp. serve as the main source of inoculum for head infections. Reduced tillage might thus be a contributing factor to disease development.

Table 1 . Canadian Grain Commission tolerances (% by weight) for Fusariurn damaged kernels (wheat) and Fusarium mould (barley) as of February 1999.

CWRS'			CWAD					Barley				
#1	#2	#3	#1	#2	#3	#4	#5	Special Select	Standard Select	General Select	Purpose	Sample
0.25	*2*	*2*	*0.5*	*0.5*	*2*	*2*	*5*	Nil	0.2	0.2	1	>1

[1] CWRS: Canada Western Red Spring; CWAD: Canada Western Amber Durum.

FHB causes reductions in yield and quality of wheat and barley, and possible accumulation of mycotoxins. Deoxynivalenol (DON) is the most common toxin associated with F. graminearum Due to processing effects and potential food safety concerns, tolerance levels in the top grades of wheat are very low (Table 1 and Clear, 1999). Most malting companies will reject barley with detectable amounts of DON. In addition, infected seed may have reduced germination and seedling vigour.

Field surveys of producers' fields and post-harvest seed surveys

In 1997, a province-wide survey (Celetti et al., 1998) revealed that FHB was found mostly in the eastern part of the province. In 1998, a similar survey was conducted in collaboration with extension agrologists to determine the distribution of this disease and determine its possible spread.

The incidence of FHB was assessed in 142 wheat (hard red spring, Canada Prairie Spring and durum) and 68 barley fields, covering 19 crop districts (CD) across Saskatchewan (Fig. 1). Heads from 50 plants, at milk to dough stages, were sampled randomly from cereal fields and sent to the Crop Protection Lab, Regina, for disease assessment, pathogen isolation and identification. A disease index (percent number of heads affected x mean severity of infection/lOO) was determined for each field. An average FHB index for infected fields in each CD, and for CDs grouped by soil zone (Zone I in Brown, II in Dark Brown and III in Black/Grey soil), was calculated.

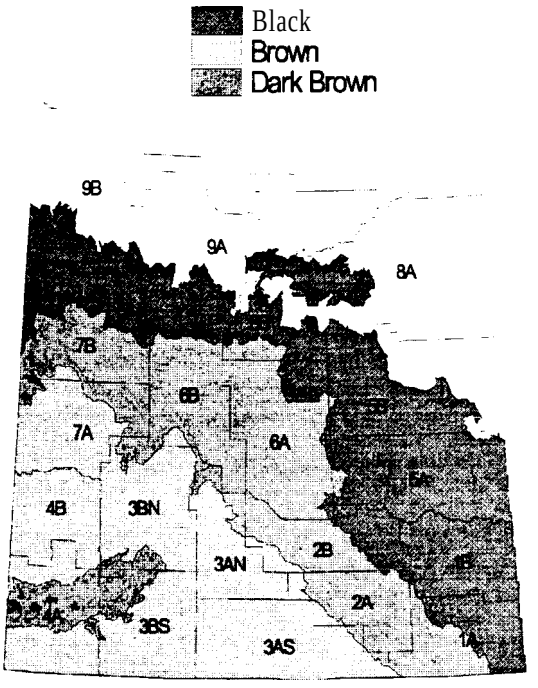

Fig. 1. Saskatchewan crop districts and soil zones

FHB was more commonly found in 1998 than in 1997 (Celetti et al., 1998). Development of FHB is very dependent on moisture during and after flowering. This past summer most areas in the province experienced high amounts of precipitation at the end of June and beginning of July. Most cereal crops were flowering at that time, especially those seeded early. FHB was found in most crop districts surveyed, although mostly at low levels (Table 2). The percentage of fields where FHB was found was 55% for wheat and 59% for barley. The average FHB index for infected fields was lower in barley (1.4) than in wheat (2.8). The highest FHB levels were found in eastern districts and in the northwest. Overall, the number of fields infected, and the average FHB index for those fields, was lowest in Zone I (Brown soil) in the southwest, and highest in Zone III (BlacWGrey soil) (Table 3).

Table 2 .Number of wheat (common and durum) and barley fields where FHB was found in 1998, and average FHB index for each crop district in SK.

	Crop district															
	1A	1B	2A	2B	3A	3B	4B	5A	5B	6A	6B	7A	7B	8A	8B	9A	9B
Wheat (common and durum)																	
#fields/ total fields	7/12	6/6	3/6	9/17	1/2	2/15	2/6	4/4	7/9	8/13	3/8	1/7	5/8	5/7	2/5	2/5	11/12
FHB index	3.7	1.6	1.4	1.4	0.2	1.5	0.5	8.7	8.6	4.1	1.1	0.2	2.0	0.3	0.4	0.9	1.7
Barley																	
#fields/ total fields	2/4	2/2	2/2	2/5	0/3	0/4	1/2	4/4	5/7	2/4	2/2	0/2	2/4	8/10	1/3	4/4	4/6
FHB index	1.9	0.4	0.3	0.4	- -		0.1	1.5	0.7	0.5	0.6	-	0.3	0.5	1.5	0.4	8.0

Table 3 .Percent wheat (common and durum) and barley fields infected with FHB in SK in 1998, and average FHB index for each soil zone.

Crop	Zone I[1]	Zone II	Zone III
Wheat (common and durum)			
% fields infected	20	55	77
FHB index	0.7	2.5	3.4
Barley			
% fields infected	9	57	78
FHB index	0.1	0.7	1.8

[1] Zone I: Brown soil; II: Dark Brown Soil; and III: Black/Grey soil.

The results of this survey are in agreement with a post-harvest survey of wheat, conducted by the Canadian Grain Commission, in which 13,647 Saskatchewan wheat samples in 1997 and 1998 were examined for the presence of FDK. This survey indicated that even though the southeast (CD's 1 A, lB, 5A) had a significant increase in FHB over previous years, FHB as a whole continues to be low in the province (Table 4).

Table 4 Percentage of SK wheat samples with Fusarium damaged kernels by crop district, in 1997 and 1998.

	Crop district																	
Year	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B	6A	6B	7A	7B	8A	8B	9A	9B
1997	5.1	0.5	2.1	0.8	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.0
1998	24.2	22.8	2.8	0.9	0.0	0.0	0.0	0.0	10.4	4.3	1.2	0.7	0.0	0.0	1.7	0.4	2.1	0.5

In the field survey, the most frequently isolated *Fusarium* spp. from kernels from heads with FHB symptoms were *F. poae* (53% in wheat, 85% in barley), *F. graminearum* (32% in wheat, 20% in barley) and *F. sporotrichioides* (24% in wheat, 23% in barley), with *F. avenaceum* and *F. culmorum* found at lower levels (<10%). The latter two were only found in Zones II and III. In wheat, *F. graminearum* was isolated more frequently from Zone III (41%) than from II (28%) (Femandez and Holzgang, 1999).

The Canadian Grain Commission seed surveys have shown that *F. graminearum* has been the most common species isolated from FDK in Saskatchewan since 1997, and that areas with the highest levels of damage (Table 3) are those where *F. graminearum* has become the dominant FHB pathogen (Table 5).

Table 5 Percentage of Fusarium damaged kernels infected by *F. graminearum in 1996-98.*

	Crop district							
Year	1A,1B	2A,2B	3A,3B	5A,5B	6A,6B	7A,7B	8A,8B	9A,9B
1996	57.0	16.3	9.3	12.2	3.4	2.7	19.6	1.4
1997	75.3	28.3	24.6	15.8	7.6	0.0	6.0	0.0
1998	97.6	77.9	36.7	62.2	22.8	46.8	13.1	5.8

Strategies for control of FHB in Saskatchewan:

Choosing varieties

Unfortunately, none of the currently registered wheat or barley cultivars are resistant to FHB. Hard red spring wheat cultivars are in general less susceptible than CPS, durum and winter wheat. Oats are the most resistant to this disease. Among the hard red spring wheat cultivars, AC Barrie, AC Cora, Katepwa, AC Majestic, McKenzie and AC Cadillac appear to sustain less damage than the rest. Two-row barleys are in general more tolerant than 6-row barleys. Among the 2-row the most tolerant cultivars are AC Metcalfe and AC Oxbow. The 6-row cultivars Argyle and Tankard, and the hulless variety CDC Silky are also more tolerant then the rest in their groups.

Crop rotations

Until new cultivars with genetic resistance to FHB become available, management of this disease in areas where F. graminearum has been detected must rely on the use of less susceptible cultivars, and on cultural practices. Under average weather conditions in Saskatchewan, a rotation with a non-cereal crop for at least one year would help to reduce the inoculum levels of this pathogen.

Clean seed and seed treatment

In areas where FHB has not been a problem planting clean seed may serve to delay introduction of F. *graminearum* to uninfected fields. A seed treatment effective against *Fusarium* with a fungicide such as Vitaflo 280, should be used when uncertain if the seed is free from F. *graminearum* and to prevent seedling blight also caused by *Fusarium* However, these measures will not prevent the possible development of FHB later in the season since inoculum for FHB comes from infected residue on the soil surface.

Harvest "blow out" and post-harvest cleaning

As for any disease, it is recommended that producers inspect their crops for development of symptoms, particularly if humidity during flowering has been high. If infection of a wheat crop occurs, producers should consider blowing out enough of the Fusarium damaged kernels at harvest to improve the grade. By adjusting air velocities and combine openings, the number of infected kernels in the harvested grain can be reduced. The objective is to blow only as much of the lighter diseased kernels over the back of the combine as necessary. However, the effect that the infected seeds remaining on the ground will have on the development of FHB in subsequent crops is not known. Cleaning the grain after harvest may also reduce grade losses and toxin content. However, even after removal of infected kernels, there might still be some DON toxin left in the grain.

Stopping the spread of FHB

It is not known whether F. *graminearum* will become an important pathogen in Saskatchewan beyond the southeast. However, the potential losses from this disease warrant efforts to continue to monitor and control it. It is important that producers check their cereal fields and harvested grain for the presence of Fusarium infections. Detection of F. *graminearum* before it builds up to more serious levels will increase the effectiveness of cultural control measures. But more importantly, avoiding introduction of the pathogen through infected seed to uninfected fields may prevent or at least delay its further spread.

Ongoing and future research on FHB in Saskatchewan

There is extensive research being conducted in the province on this important disease. Identification of sources of resistance to FHB and its incorporation into adapted germplasm is being done at the Semiarid Agricultural Research Centre in Swift Current, in collaboration with the Cereal Research Centre in Winnipeg, and at the University of Saskatchewan. Other projects include an annual disease survey to monitor the incidence and spread of FHB in cereal crops across the province, and a project to determine if Fusarium spp. causing cereal root rots in SK are the same ones responsible for FHB, and whether roots could thus serve as a reservoir for inoculum for head infections (Femandez and Holzgang, 1999). Lastly, in 1999, a close examination of producers' fields where FHB has been found will be initiated to investigate the role that crop production factors, such as crop rotation, tillage, fertility, seed source, seed treatment and cultivar, among others, might play in disease development. These three projects are being funded by Agriculture Development Fund.

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