Fusarium head blight of cereals:
improving management of this difficult disease
Soils and Crops Workshop, March 10th, 2020
Randy Kutcher, Plant Pathologist
Crop Development Centre, University of Saskatchewan
What is Fusarium Head Blight (FHB)?

• An infectious disease of cereals, corn, grasses and some other crops
• Also called scab or tombstone on cereal grains
• Occurs worldwide and from coast to coast in Canada
FHB symptoms, wheat

- bleaching of the whole head or individual spikelets
- may be salmon pink - orange spore masses on the spikelet and glumes.

A. Friskop, North Dakota State University
FHB symptoms, wheat

- tombstone / scab
- shrivelled, light-weight kernels, chalky white colour
- the earlier during anthesis infection occurs the greater the effect
FHB symptoms, barley

- individual spikelets or whole heads affected
- infected spikelets or kernels may be pink, orange or black
- kernels shrunken and thin, often more difficult to identify in barley than in wheat

Courtesy A. Tekauz
Corn approaches one million acres on Prairies

Cool weather resulted in disappointing yields for producers this year, but they don’t appear to be giving up on the crop.

BY ROBERT ARNASON
WINNIPEG BUREAU

SASKATOON — Monsanto made a bold announcement about corn in June 2013, promising to invest $100 million in breeding programs to develop corn hybrids suitable for Western Canada.

The company’s ambition was massive as it set a goal of eight to 10 million acres of corn on the Prairies by 2025.

That’s not going to happen, but Monsanto executives were right about one thing.

Corn is moving west, and there could soon be a million acres on the Prairies.

This year, prairie farmers seeded 928,000 acres of corn, including silage, grazing and grain corn. That’s up 54 percent from 2015, when there were 600,000 acres.

With more hybrids on the market, more farmers believe corn is a realistic option, even in areas hundreds of kilometers from Manitoba’s Red River Valley, which is Western Canada’s traditional corn-growing region.

“There’s a lot of hype; the most hype we’ve had in the area for corn was (this) year,” said Matt Gosling, an agronomist and founder of Premium Ag, a consulting service in Strathmore, Alta.

Farmers around Strathmore are planting corn in September, stalling crop development and grain fill.

Some producers have recorded test weights of 40 pounds per bushel, much lower than the normal 56 lb. per bu.

That’s making it difficult, if not impossible, for producers to sell the crop because buyers won’t accept test weights that are well below average.

A couple of weeks ago, Manitoba’s Corn Growers Association held its annual conference in Saskatoon.

Cott’s Saskatoon presentation focused on the agronomic basics of growing corn — selecting the right hybrid, fertilizer, pests and disease.

One critical piece for new growers is choosing more than one hybrid.

Cott said they should select one that is safe to grow, based on the heat units in their region, and maybe another hybrid that needs more heat units to see if it is suited to their region.

“Definitely (growers) should have more than one on their farm.”

Producers should also consider a split application of nitrogen. The total nitrogen requirement for corn is about 1 lb. per bu. of desired yield, but the crop needs most of its nitrogen four to six weeks after emergence.

Consequently, many Manitoba corn growers are applying 50 to 60 lb. of nitrogen at planting and 50 to 100 lb. in late June or early July.

Grain corn acres increased in 2019, despite the recent setback with yields. This crop was photographed near Roblin, Man., in August. | ROBIN BOOKER PHOTO

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<th>GRAIN CORN ACRES ON THE PRAIRIES</th>
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Source: Statistics Canada, Manitoba Agricultural Services Corp. | WP GRAPHIC

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What causes Fusarium Head Blight (FHB)?

• Caused by a number of *Fusarium* species that can also cause seed decay, seedling blight, and stem and root rot

• *F. graminearum*
  *F. avenaceum*
  *F. culmorum*
  *F. poae*
  *F. sporotrichioides*
DNA of *Fusarium* spp. (µg) per kg dry weight of wheat (Saskatchewan)

Mean of 144 samples from growers’ crop samples, 2014-2016; G. Singh
History in Canada

• 1923 - reported in Manitoba,

• 1984 - localized outbreak in Red River Valley, and under irrigation in Idaho,

• 1993 - record rainfall associated with high *F. graminearum* in MB, ND & MN, observed in durum in SE SK,

• 1996 - 3rd worst year in MB, SW MB a problem area, *F. graminearum* found at high levels in SE SK.
Location of *F. graminearum* on the Prairies 1985

- **black soil zone**
- **dark brown soil zone**
- **brown soil zone**

Canadian Grain Commission
Location of *F. graminearum* on the Prairies 1993

- black soil zone
- dark brown soil zone
- brown soil zone

Canadian Grain Commission
Fusarium graminearum chemotype frequencies in Canada, 1984 to 2004

Ward et al. 2008
Chemotype frequencies of *F. graminearum* isolates collected from durum in Saskatchewan (2014 – 2016)

1984 - 2004; n = 121
- 89.29% (15 ADON)
- 10.71% (3 ADON)

2014 - 2016; n = 178
- 71.30% (15 ADON)
- 28.65% (3 ADON)
FHB, yield and quality losses

• Yield loss
  • 40-50% when severe
• Grade loss
• Mycotoxin contamination
  • Implications for animal & human health and end use market acceptability
• These losses are additive!
Saleability factors

- Fusarium damaged kernels (FDK)
- Mycotoxins
FHB, yield and quality losses

- DON (deoxynivalenol) aka ‘vomitoxin’
- In poultry, ingestion may stunt growth, poor feather development,
- In cattle poor weight gain,
- DON contaminated feed may result in feed refusal and vomiting in livestock, with pigs more sensitive than poultry or cattle
- DON levels >30 parts per million (ppm) occur

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<td>Human Consumption</td>
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<td>All other animals</td>
<td>5 ppm (providing grains don’t exceed 40 percent of diet).</td>
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FHB and swine production

DON-free Ration

Ration with 5 ppm DON
Fusarium head blight (FHB) strategies

• Cultural control – diverse rotations
  - managing infected residue

• Fungicide management of the disease and appropriate use of fungicides
  - increased seeding rates

• Genetically resistant varieties
  - clean seed and seed treatment
  - early seeding may avoid the disease

• **Integrated Pest Management** imperative
FHB, genetic resistance

• ‘Resistant’ cultivars, wheat
  • CWRS marketing class, many varieties are I (intermediate) or MR (moderately resistant), reduced spike symptoms, FDK, DON content
  • CWAD (durum) cultivars are S to MS
  • Better resistance means fewer FDK & less DON
  • Winter wheat may escape infection
CEREAL CROPS

Wheat
Main Characteristics of Varieties

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<th>Sprouting (mg)</th>
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FHB: Head blight (mg)  
REL: Reliability (mg)  
Seed (mg): Seed yield (mg)
FHB, management strategies

- **Escape**
  - early maturity, staggered planting dates
  - subtle differences among varieties in length of flowering period,
Infection in wheat

• infection occurs at anthesis (flowering) in cereals

• flowering starts 2 to 3 days after spike emergence and lasts ~4 - 7 days

• Infection occurs under warm (15-30°C), moist (rain, dew or high relative humidity) conditions
Fungicide application timing: anthesis

Day 0: Start spraying when 75% of the heads on main stems are fully emerged.

Day +2: Flowering begins with yellow anthers in the middle of the heads. Perfect timing!

Stop spraying when 50% of the heads on main stems are in flower.

Day +5: Anthers turn white and dry up when flowering is complete. Too late!

BBCH 59
BBCH 61
BBCH 65
BBCH 69


FHB, chemical control

Fungicide efficacy has been inconsistent, and only suppresses the symptoms, NOT control

• perhaps due to the number of *Fusarium* species
• application equipment (sprayer technology)
• difficulty in timing applications
Seed rate effect on FDK and DON

Saskatoon & Outlook 2016

LSD$(_{0.05}$)
Fungicide timing effect on FDK

Saskatoon & Outlook 2016

Photo credits: G. Singh and Sprayers 101
Fungicide timing effect on DON

DON (ppm)

BBCH_59  BBCH_61  BBCH_65  BBCH_69  BBCH_61+73  Unsprayed  Sprayed

A  B  B  BC  BC  A  C

LSD_{(0.05)}

Saskatoon & Outlook 2016

Photo credits: G. Singh and Sprayers 101
Fungicide products: efficacy of triazole fungicides

Paul et al. 2008
Single vs double nozzles

Expt 1 Tr. 1
5 mph, Single, Conventional

Expt 1 Tr. 3
5 mph, Double, Conventional

69% 31%
49% 51%

Courtesy T. Wolf – Sprayers101
Spray pattern (quality) & boom height

Single forward angled nozzle
Deposit on simulated wheat heads

Deposit volume (L/ha)

12" Boom Height
18" Boom Height
30" Boom Height

Fine
Medium
Coarse

Fine
Medium
Coarse

Coarse

Fine

Courtesy T. Wolf – Sprayers 101 www.usask.ca
Other tools - Fusarium Risk Assessment Maps

https://static1.squarespace.com/static/5c40f31a620b85cf0d073e7b/t/5cdc7d3f7817f743060d2fb1/1557953860589/Fusarium-Management-Guide.pdf
Fungicide control of FHB depends on:

- cultivar,
- pathogen (*Fusarium* species, chemotype),
- application timing,
- the fungicide product and the rate of application
- spray patterns, nozzles, nozzle angles, boom height

**Triazole fungicides** applied at flowering can provide *suppression NOT control*
FHB, control

- Optimize combine settings
  - Inspect crop 18-21 days after flowering
    - Bleaching symptoms will be at peak and give an idea of what to expect at harvest
  - FDK are lighter weight than healthy seeds in wheat
- High air speeds blow out some FDK
FHB, seed treatment

• Effective against seedling blight, but little effect on epidemic development

• Seed cleaning and fungicide treatment usually does not improve quality enough for use as seed (germination and emergence)

• Fusarium survives poorly on seed so germination may improve overwinter
Summary of FHB

• The integrated approach is required and is economically beneficial and stable across environments,
• Follow a diverse crop rotation (minimum of 3 crops) and use resistant cultivars (when available),
• Timely fungicide application using appropriate application conditions (boom height, nozzle orientation, spray volumes), provides reasonable suppression,
• Combining a diverse rotation with resistant cultivars and fungicide (when warranted) is more efficacious than any single approach.
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Thank you for the invitation to speak to you this afternoon