HISTORY OF FHB RESEARCH IN (WESTERN) CANADA

Andy Tekauz

9th CWFHB, Winnipeg MB, Nov 22, 2018

OVERVIEW: FROM CPDS

- *1919 - 1979*
- *1980 - 1992*
- *1993 - 1998*
- *1999 - 2018*

WHY FHB IS 'WHAT IT IS': A MAJOR CEREAL DISEASE

1. Loss of yield
   - fewer, smaller, lighter kernels
2. Loss of grade
   - presence of FDK (e.g. 0.25%, 0.8%)
3. Contamination by DON (end-use compromised)
   - raw grain unsuitable for feeding
   - barley not selected for malting
   - oats not selected for milling
   - processing quality reduced (e.g. flour properties)
   - ethanol and distillers grain
4. Reduced germination when grain is used as seed
5. Loss of export markets due to international tolerance limits

OCCURRENCE OF FHB: 1919 - 1979

- 1919 – First record of FHB (fusarium head blight, head blight, scab) in Canada (E)
- 1920 on – Sporadic reports of FHB/Fusarium in cereal crops or on seed/grain (E+W)
  - 1927/28
  - 1940
  - 1942
  - 1948

CPDS VOL. 8 1927 - 1928

WHEAT SCAB OR HEAD BLIGHT - Gibberella Saubinettii (Mont.) Sacc.

PRINCE EDWARD ISLAND
1927 - This disease caused considerable damage in Huron and Red Fife.

NEW BRUNSWICK
1927 - Isolated infections only observed. Of no serious consequence.

QUEBEC
1928 - One two-per cent infection found in experimental plots at Ste. Anne de la Pocatiere.

MANITOBA
1928 - This disease was very prevalent in Manitoba this year, the warm moist season providing favourable conditions for its development. Plants were attacked by a light general infection varying from a trace to 3 per cent, except in certain low spots where plants were heavily attacked. In plots of Reward at Winnipeg 80 to 100 per cent of the plants were infected.

SASKATCHEWAN
1927 - Traces found at Indian Head and Saskatoon.

1928 - Slight infection found on Marquis wheat at Saskatoon and Trossachs.

CPDS VOL. 20: FHB IN WHEAT IN 1940

HEAD BLIGHT (chiefly *Fusarium* spp.). Slight to moderate infections were observed at Vegreville and in the plots at Lethbridge, Alta. Blighted heads of the *Fusarium* type were fairly common in fields at Melfort, Tisdale, and Pontrillas, Sask. and scabby kernels were present in threshed grain from Indian Head. Material showing blight due to *Helminthosporium sativum* was received from Gronlid and Scott. In Man., 2% of the heads were affected at Roblin, as well as a trace at Binscarth (*Fusarium Scirpi* var. *acuminatum* and *Helminthosporium sativum* isolated)

and at Winnipeg (*F. Poae*, *F. Scirpi* and *F. Scirpi* var. *acuminatum*). About 10% of the heads were said to be affected in winter wheat in western Ontario; isolations were made from two samples, one from Ailsa Craig (*F. graminearum*) and one whose location was not stated (*F. graminearum* and *H. sativum*). Diseased specimens were collected at Ottawa (*F. graminearum* and *F. Poae*). Head blight was virtually absent in Que., N.B., N.S., and P.E.I.; 3% of the heads were affected at Gillespie, N.B. (*F. graminearum*); a trace occurred in Garnet at Truro, N.S., and a trace was present at Charlottetown, P.E.I. (*F. graminearum* and *F. Poae*). The fungi reported within the brackets were isolated and determined by W. L. Gordon.

COMMON ROOT ROT (*Helminthosporium sativum* and *Fusarium* spp.).

CPDS VOL. 21: FHB IN WHEAT IN 1941

HEAD BLIGHT (chiefly *Fusarium* spp.). Trace to slight damage was caused by *Fusarium* spp. in fields at Athabaska and Dewberry, Alta.; slight infection by *Helminthosporium sativum* was found in the plots at Edmonton (A.W. Henry). Blighted heads of wheat yielded the following fungi when isolations were made: Ste. Anne, Man.: Thatcher - *F. graminearum*; Winnipeg: Regent x Thatcher - *F. graminearum* and *F. Scirpi* var. *acuminatum*, Iumillo - *F. Poae*; Kemptville, Ont,: C.T. 129 - *F. avenaceum*; Lennoxville, Que.: Vernal Emmer - *F. graminearum*; Ste. Anne de la Pocatiere: Marquis x Kanred - *F. avenaceum*; Fredericton, N.B.: Coronation - *F. Poae*, *Epicoccum purpurascens*, *Alternaria*, etc. Only a trace of infection was recorded at all locations. This is the first time that *F. gramineaum* was isolated from head blight of wheat in Man., although it was isolated once from a sample of durum wheat seed of the 1939 crop obtained at Oak Bluff, and again once from a sample of common wheat seed of the 1940 crop obtained at Portage la Prairie (W.L. Gordon). In general only traces of head blight were recorded in Que., N.B., and P.E.I.; in some of the plots, however, particularly at Fredericton, N.B., up to 15% of heads were affected.

CPDS VOL. 28: FHB IN WHEAT IN 1948

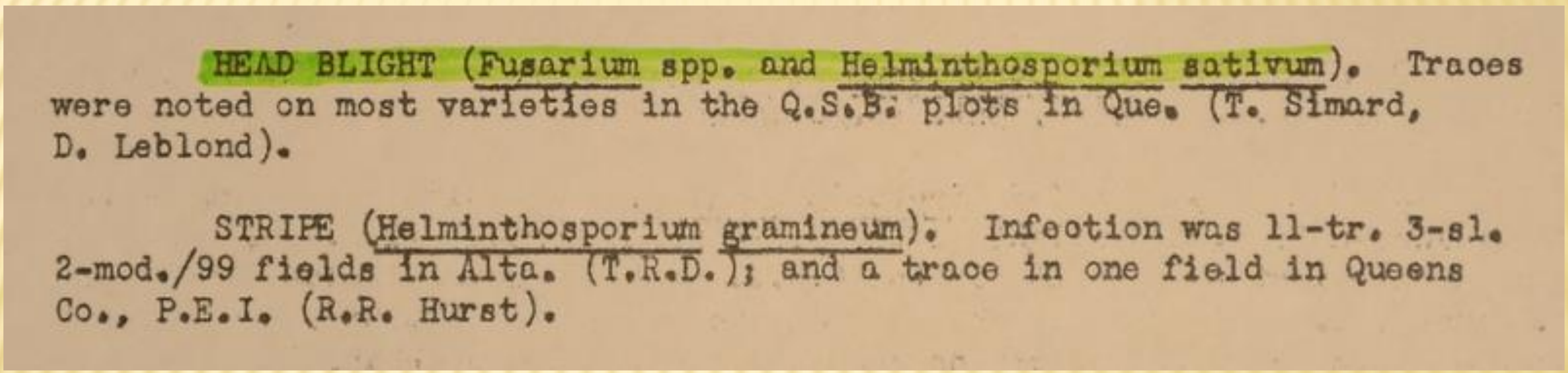
HEAD BLIGHT (Fusarium spp.). Continued most and relatively cool weather during the summer appeared to favour the development of head blight in Man. By the end of July, it was found in moist fields of wheat and barley examined and in 15 of the 25 varieties of the co-operative test of wheat varieties at Winnipeg. Occasionally as many as 5% of the spikes were affected. Of the 6 collections of wheat head blight that were cultured, Fusarium Poae was isolated from one collection, F. Scirpi var. acuminatum from 3, F. culmorum from 2, and F. graminearum and Helminthosporium sativum from one.

Gibberella Zeae, the perfect stage of Fusarium graminearum, was found in profusion on corn stubble of the 1947 crop on the University farm by J.E. Machacek on Aug. 8, 1948. (This collection of perithecia was the second recorded for Man., the first having been reported by Dr. G.R. Bisby in 1923). Formation of perithecia evidently took place between mid-June and early August for perithecia were not found on the same stubble on June 12. Empty perithecia, as well as mature and in some collections immature perithecia, were found on the corn stubble at the same location on Sept. 12. No perithecia were found on corn stubble of the 1948 crop when it was examined in mid-November (W.L. Gordon, J.E. Machacek, W.A.F. Hagborg).

Six other collections of head blight on wheat and one on barley from outside Man. were cultured. The species isolated were as follows: Agassiz, B.C., F. avenaceum; Fort William, Ont., F. culmorum; Appleton, wheat 2 collections F. graminearum and barley F. Poae, Helminthosporium sativum; Normandin, Que., F. graminearum (W.L. Gordon).

Traces of head blight occurred in the plots at Ste. Anne de la Pocatiere, Que. (A. Payette).

CPDS VOL. 28: FHB IN BARLEY IN 1948



HEAD BLIGHT (*Fusarium* spp. and *Helminthosporium sativum*). Traces were noted on most varieties in the Q.S.B. plots in Que. (T. Simard, D. Leblond).

STRIPE (*Helminthosporium gramineum*). Infection was 11-tr. 3-sl. 2-mod./99 fields in Alta. (T.R.D.); and a trace in one field in Queens Co., P.E.I. (R.R. Hurst).

OCCURRENCE: 1980 - 1992

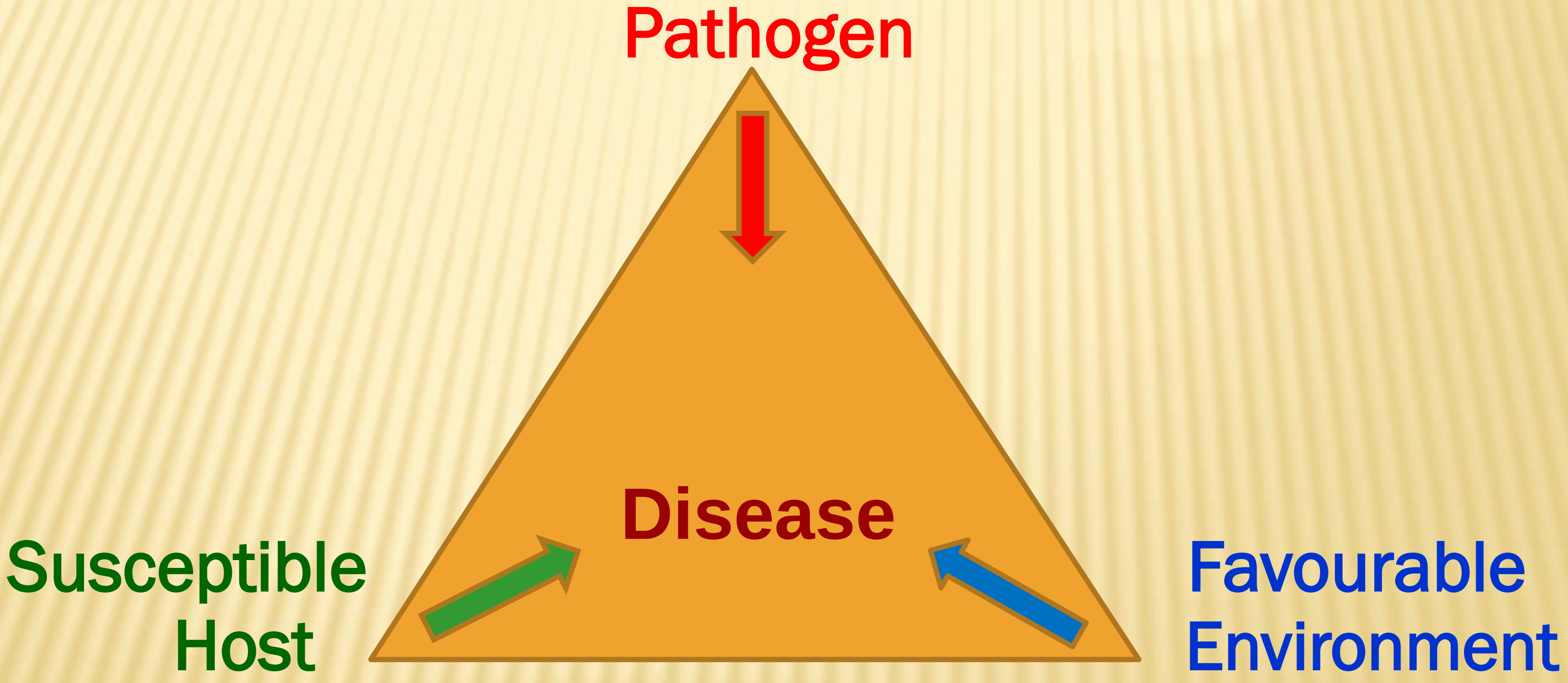
- 1980 – Epidemic of FHB in winter wheat in S-W Ontario
- 1984 – Evidence of FHB seen in two harvest samples of wheat from southern MB (‘tombstone’, Fg)
- 1985 – Additional wheat samples in southeren MB found to be affected by FHB, and subsequently, ‘vomitoxin’
- 1987 – First contemporary survey data of FHB prevalence and severity in a wheat crop (Fg)
- 1991 – FHB widespread on wheat in southern MB with 75% of fields affected and 1/3 having severity/incidence of 10%

OCCURRENCE: 1993 - 1998

- **1993** – Severe epidemic of FHB on wheat in southern MB (and adjacent US states); Fg
- **1994** – A second severe FHB epidemic in MB; barley also found to be affectedFg involved
- **1997** – FHB found at higher levels in central and western MB than previously (Fg)
- **1998** – FHB becomes endemic throughout MB and south-eastern SK
- **1998** – FHB evident in MB winter wheat, an expanding commodity in MB and elsewhwere

PLANT PATHOLOGY '101'

THE PLANT DISEASE TRIANGLE



FIELD SYMPTOMS OF FHB ON BREAD WHEAT

OCCURRENCE: 1999 - 2018

- 1999 on – Comprehensive surveys for FHB continue in western Canada showing varying levels of seasonal severity (Fg, Fp, Fa, Fs)
- 2002 – FHB noted on oat in MB; most fields surveyed putatively affected (Fp, Fg, Fs)
- 2010 – Levels of FHB higher in SK (Fa); Fg levels in seed samples rise dramatically
- 2012 – Second instance of higher FHB and Fg levels in SK

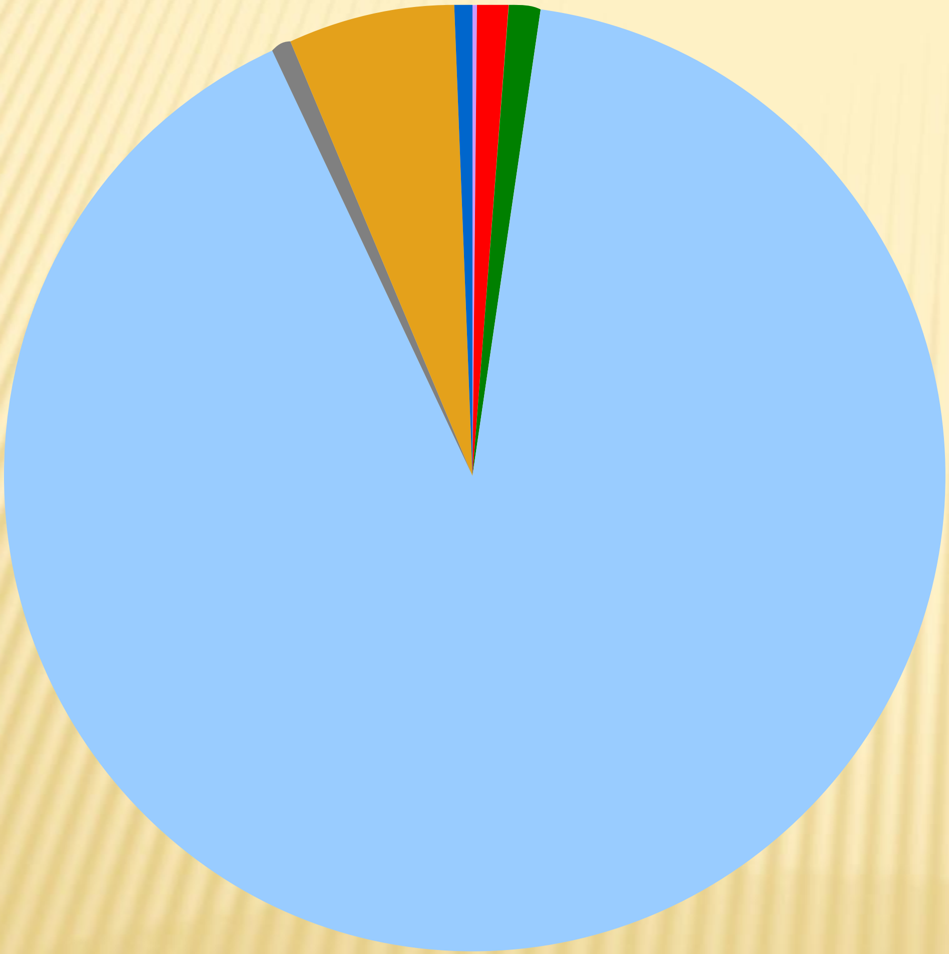
LEVELS OF *FUSARIUM* AND *F. GRAMINEARUM* IN CEREAL SEED SAMPLES SUBMITTED TO SEED-TESTING LABORATORIES IN SK 2005-2013

Year	*Fusarium* mean (%)	*Fg* mean (%)	Total samples	% with *Fg*
2005	7.3	1	726	38
2006	4	0.1	479	21
2007	3.6	0.5	675	30
2008	4.9	0.6	626	40
2009	4.9	0.8	362	42
2010	19	4.2	470	64
2011	6.3	1.1	953	51
2012	11.2	5.6	1981	82
2013	5.8	2.2	1660	73

CPDS – REPORTS OF ANNUAL FHB DISEASE DATA

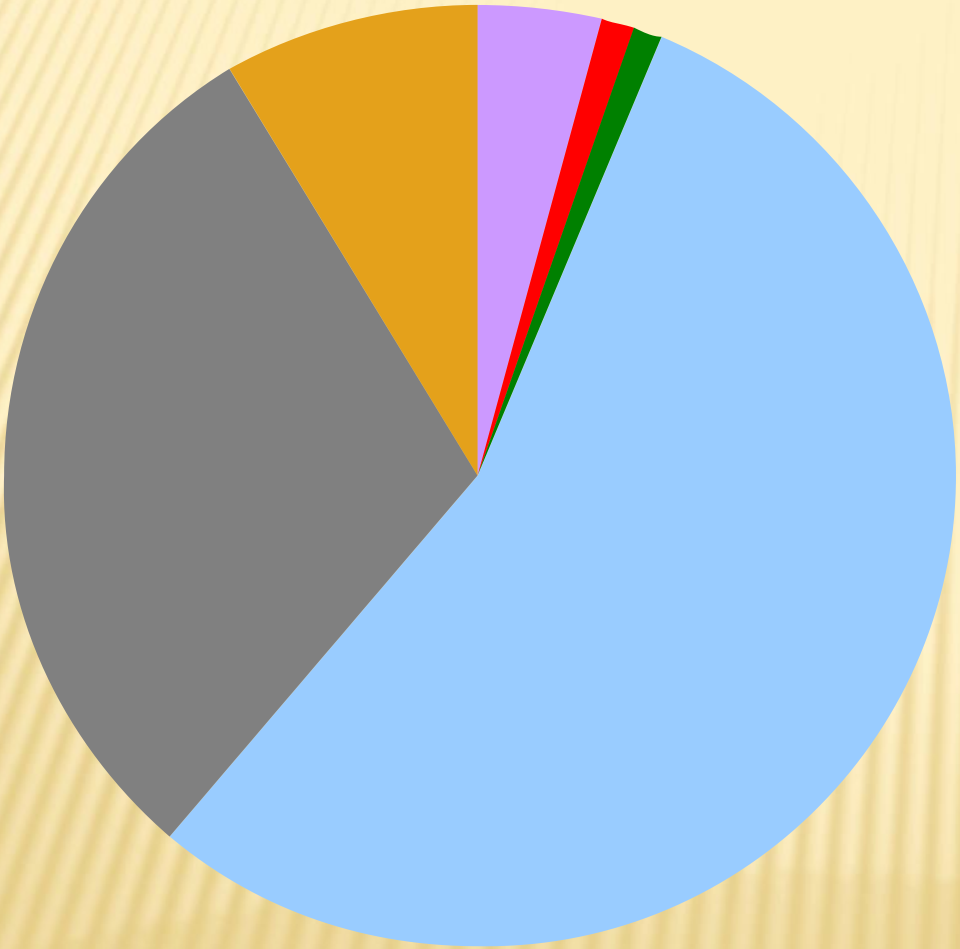
MB wheat FHB surveys	1987	31 yrs
MB barley FHB surveys	1994	24 yrs
MB winter wheat FHB surveys	1998	20 yrs
MB oat FHB surveys	2002	16 yrs
SK wheat FHB surveys	1997	
SK barley FHB surveys	1997	
SK oat FHB surveys	2004	
AB wheat (for 1999-2002)	2002	

RELATIVE FREQUENCY OF *FUSARIUM* SPECIES ISOLATED FROM KERNELS OF SPRING WHEAT IN MANITOBA, 2001-2010



F. avenaceum	**0.2**
F. culmorum	**1.2**
F. equiseti	**1.0**
F. graminearum	**90.8**
F. poae	**0.6**
F. sporotrichioides	**6.0**
Other *Fusarium* spp.	**0.5**

RELATIVE FREQUENCY OF *FUSARIUM* SPECIES ISOLATED FROM KERNELS OF BARLEY IN MANITOBA, 2001-2010



F. avenaceum.	**4.3**
F. culmorum	**0.6**
F. equiseti	**1.0**
F. graminearum	**55.1**
F. poae	**30.4**
F. sporotrichioides	**6.0**
Other *Fusarium* spp.	**0.0**

FUSARIUM
ON CEREAL SEED FROM MANITOBA AND SASKATCHEWAN 2003-2007

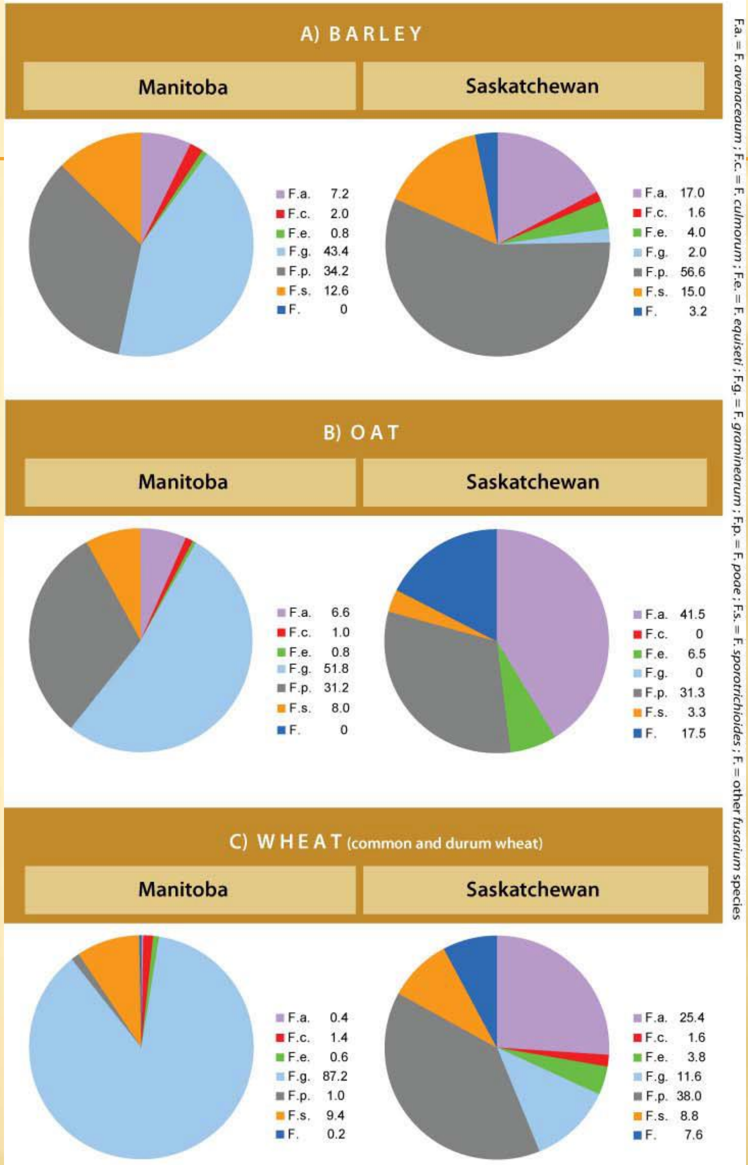


Fig. 2. *Fusarium* species on seed of: a) barley, b) oat and c) spring wheat crops in Manitoba and Saskatchewan, 2003-2007 (2004-2007 for SK oat).

HISTORY OF CPDS

Canadian Plant Disease Survey – Disease Reports

- Vol 1-39 (to 1959) '10th Annual Report of the CPDS'
- Vol 40 (1960) now the 'CPDS'
- Vol 68 (1988) now an AAFC/CPS publication
- Vol 69 (1989) Section Editors appointed
- Vol 77 (1997) now a stand-alone CPS publication
- Vol 79 (1999) Robin Morrall new National Coordinator
- Vol 96 (2016) Morrall and Tekauz 'retire'
- Vol 97 (2017) J Elmhirst (NC) and K Turkington (Cereals)

Typical FHB survey reports published in CPDS
e.g. 2005 data published in Vol. 86 (2006)

Tekauz et al.	FHB in barley in MB in 2005
Xue et al.	Diseases of barley ……Ontario in 2005
Pearse et al.	FHB in barley and oat in SK in 2005
Morrall at al.	Seed-borne *Fusarium* on cereals in SK in 2005
Rioux & Comeau	Apercu des maladies des cereals au Quebec en 2004 et 2005
Tekauz et al.	FHB of oat in MB in 2005
Tamburic-Ilincic & Schaafsma	2005 survey for FHB of oat in ON
Turkington et al.	FHB survey of wheat, AB
Gilbert et al.	2005 survey of FHB of spring wheat in MB
Tekauz et al.	2005 survey for FHB on winter wheat in MB
Xue at al.	Diseases of spring wheat in eastern ON in 2005
Tamburic-Ilincic et al.	2005 survey for FHB of winter wheat in SW ON

IT'S A CENTENNARY CELEBRATION

CPDS is 100 years old!!

SYMPTOMS OF FHB ON OAT

SELECTED RESEARCH PUBLICATIONS - TO 1980

- 1944 Gordon

  The occurrence of Fusarium species in Canada

  I: Species of Fusarium isolated from farm samples of cereal seed in Manitoba

- 1952 Gordon

  The occurrence of Fusarium species in Canada

  II. Prevalence and taxonomy of Fusarium species in cereal seed

W.L. GORDON
CANADIAN JOURNAL OF BOTANY - 1952

THE OCCURRENCE OF *FUSARIUM* SPECIES IN CANADA

II. PREVALENCE AND TAXONOMY OF *FUSARIUM* SPECIES IN CEREAL SEED[1]

BY W. L. GORDON[2]

Abstract

During the present investigation, a total of 1579 seed samples of wheat, 1042 of barley, and 1152 of oats (100 kernels per sample), were examined microbiologically for the presence of *Fusarium*. Of these samples, 402 of wheat, 513 of barley, and 636 of oats originated in the seed inspection districts of Eastern Canada, and 1177 of wheat, 529 of barley, and 516 of oats in those of Western Canada. Isolates of *Fusarium* were obtained from approximately 41.8% of the samples of wheat (1.5% of the kernels), 76.2% of the samples of barley (3.9% of the kernels), and 79.6% of the samples of oats (5.7% of the kernels) that originated in Eastern Canada, whereas only 13.8% of the samples of wheat (0.2% of the kernels), 36.3% of the samples of barley (0.7% of the kernels), and 38.9% of the samples of oats (1.1% of the kernels) from Western Canada yielded *Fusarium*. In classifying the different wild types of *Fusarium* that were obtained from cereal seed the system of taxonomy and nomenclature of Wollenweber and Reinking was chiefly followed, but certain sections of the genus were revised extensively, partly in accordance with Snyder and Hansens' concept of species in this genus. Four new combinations are proposed, namely *F. compactum* (Wr.) n. comb., *F. lateritium* Nees emend. Snyder & Hansen forma *cajani* (Padwick) n. comb., *F. lateritium* Nees emend. Snyder & Hansen forma *crotalariae* (Padwick) n. comb., and *F. oxysporum* Schlecht. emend. Snyder & Hansen var. *redolens* (Wr.) n. comb. A total of 16 species and varieties of *Fusarium*, classified in nine sections of the genus, was isolated from cereal seed during this investigation. These species and varieties are, namely, *F. poae* (Pk.) Wr., *F. sporotrichioides* Sherb., *F. avenaceum* (Fr.) Sacc., *F. arthrosporioides* Sherb., *F. semitectum* Berk. & Rav., *F. equiseti* (Cda.) Sacc., *F. acuminatum* Ell. & Ev., *F. culmorum* (W. G. Sm.) Sacc., *F. graminearum* Schwabe, *F. sambucinum* Fuckel, *F. sambucinum* var. *coeruleum* Wr., *F. lateritium* Nees emend. Snyder & Hansen, *F. moniliforme* Sheld. emend. Snyder & Hansen, *F. oxysporum* var. *redolens* (Wr.) n. comb., and *F. solani* (App. & Wr.) Wr. emend. Snyder & Hansen. *F. poae*, *F. avenaceum*, and *F. acuminatum* were most frequently isolated. *F. concolor* Rg. and *F. sambucinum* f. 6 Wr., that were previously recorded from cereal seed in Manitoba, and three additional species, namely, *F. dimerum* Penz., *F. merismoides* Cda., and *F. nivale* (Fr.) Ces., that may be encountered in the future among isolates from cereal seed in Canada, were also included in this study.

Introduction

In Part I of this series of papers (13) data were presented on the incidence of *Fusarium* species in farm samples of cereal seed produced in Manitoba during the crop years 1937 to 1942. These data showed that *Fusarium* species were encountered in a relatively large percentage of the total number of samples of cereal seed examined but in a relatively small percentage of the kernels. The majority of the species that were isolated from the seed proved to be the same as those species which had been previously shown to be associated with root rots of cereals in Manitoba (12).

[1] *Manuscript received October 20, 1951.*
Contribution No. 1122 from the Division of Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa, Canada.
[2] *Plant Pathologist, Dominion Laboratory of Plant Pathology, Winnipeg, Man.*

PRESENCE OF *FUSARIUM* ON CEREAL SEED 1939-1943

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PRESENCE OF *FUSARIUM* ON CEREAL SEED 1939-1943

Snyder & Hansen, *F. moniliforme* Sheld. emend. Snyder & Hansen, *F. oxysporum* var. *redolens* (Wr.) n. comb., and *F. solani* (App. & Wr.) Wr. emend. Snyder & Hansen. *F. poae*, *F. avenaceum*, and *F. acuminatum* were most frequently isolated. *F. concolor* Rg. and *F. sambucinum* f. 6 Wr., that were previously recorded from cereal seed in Manitoba, and three additional species, namely, *F. dimerum* Penz., *F. merismoides* Cda., and *F. nivale* (Fr.) Ces., that may be encountered in the future among isolates from cereal seed in Canada, were also included in this study.

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SELECTED RESEARCH PUBLICATIONS - 1980s

- 1982 Sutton et al.

  Epidemiology of wheat head blight and ear rot of maize caused by Fusarium graminearum
- 1982 Seaman

  Epidemiology and control of mycotoxigenic fusaria on cereal grains
- 1982 Martin & Johnston

  Effects and control of fusarium diseases of cereal grains in the Atlantic Provinces
- 1982 Couture

  Reaction of spring cereal cultivars to kernel contamination by Fusarium spp
- 1984 Teich & Nelson

  Survey of fusarium head blight and possible effects of cultural practices in wheat fields in Lambton County in 1983

SELECTED RESEARCH PUBLICATIONS - 1980/90s

- 1986 Clear & Abramson

  Occurrence of fusarium head blight and deoxynivalenol (vomitoxin) in two samples of Manitoba wheat in 1984
- 1987 Abramson et al.

  Fusarium species and trichothecene mycotoxins in suspect samples of 1985 Manitoba wheat
- 1990 Clear & Patrick

  Fusarium species isolated from wheat samples containing tombstone (scab) kernels from Ontario, Manitoba and Saskatchewan
- 1992 Wong et al.

  Prevalence, distribution and importance of fusarium head blight in wheat in Manitoba
- 1995 Gilbert & Tekauz

  Effects of fusarium head blight and seed-treatment on germination, emergence and seedling vigour in spring wheat

SELECTED RESEARCH PUBLICATIONS - 1980/90s

- 1995 Wong et al.

  Pathogenicity and mycotoxin production of Fusarium species causing head blight in wheat cultivars varying in resistance
- 1995 Mesterhazy

  Types and components of resistance to Fusarium head blight in wheat
- 1995 Couture et al.

  Incidence of scab in oat cultivars in Quebec in 1995
- 1996 Dexter et al.

  Fusarium head blight: Effect on the milling and baking of some Canadian wheats
- 1996 Clear et al.

  Occurrence and distribution of Fusarium species in barley and oat seed from Manitoba in 1993 and 1994

SELECTED RESEARCH PUBLICATIONS - 1990s

- 1997 Gilbert et al.

  Effect of storage on viability of Fusarium head blight-affected spring wheat seed
- 1997 Clear et al.

  The effect of hull removal and pearling on Fusarium species and trichothecenes in hulless barley
- 1997 McMullen et al.

  Scab of wheat and barley: a re-emerging disease of devastating impact
- 1997 Miedaner

  Breeding wheat and rye for resistance to Fusarium diseases
- 1998 Miller et al.

  Effect of tillage practice on fusarium head blight of wheat
- 1999 Stack

  Return of an old problem: Fusarium head blight of small grains

Selected Research Publications - Early 2000s

- 2000 Tekauz et al.

  Review: Fusarium head blight of barley in western Canada
- 2000 Clear & Patrick

  Fusarium head blight pathogens isolated from fusarium-damaged kernels of wheat in western Canada
- 2000 Gilbert & Tekauz

  Review: Recent developments in research on fusarium head blight of wheat in Canada
- 2001 McCallum et al.

  Vegetative compatibility groups among Fusarium graminearum (Gibberella zeae) isolates from barley spikes in southern Manitoba
- 2002 Abramson et al.

  Moniliformin in barley inoculated with Fusarium avenaceum

SELECTED RESEARCH PUBLICATIONS - EARLY 2000s

- 2002 McCallum & Tekauz

  Influence of inoculation method and growth stage on fusarium head blight in barley
- 2002 Turkington et al.

  Fungal plant pathogens affecting barley and wheat seed from Alberta, 1995 - 1997
- 2003 Inch & Gilbert

  Survival of Gibberrella zeae in Fusarium-damaged wheat kernels
- 2004 Tekauz et al.

  Fusarium head blight of oat – current status in western Canada
- 2004 McCallum at al.

  Reaction of a diverse collection of barley lines to Fusarium head blight
- 2004 Abramson et al.

  HT-2 and T-2 production in barley inoculated with Fusarium sporotrichioides

SELECTED RESEARCH PUBLICATIONS - 2000s

- 2004 McCallum et al.

  Barrage zone formation between vegetatively incompatible Fusarium graminearum (Gibberella zeae) isolates

- 2005 Gilbert at al.

  Effect of heat treatment to control Fusarium graminearum in wheat seed

- 2009 Xue et al.

  Biological control of fusarium head blight of wheat with Clonostachys rosea strain ACM941

- 2010 Gilbert et al,

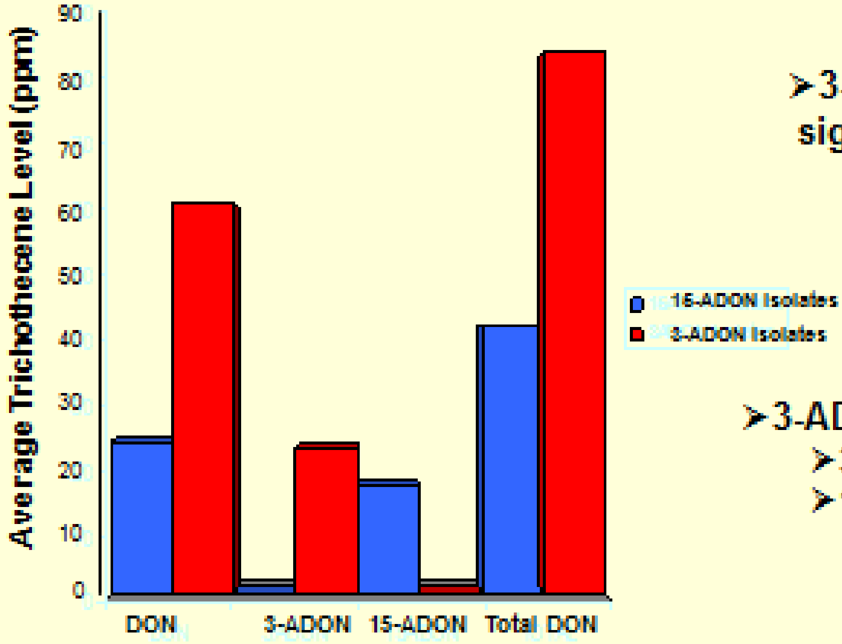
  Relative aggressiveness and production of 3- or 5-acetyl deoxynivalenol by Fusarium graminearum in spring wheat

- 2011 Gilbert & Tekauz

  Strategies for management of fusarium head blight (FHB) in cereals

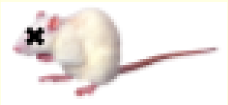
F. GRAMINEARUM CHEMOTYPE COMPARISON

3-ADON Isolates: More Toxin and More Toxic

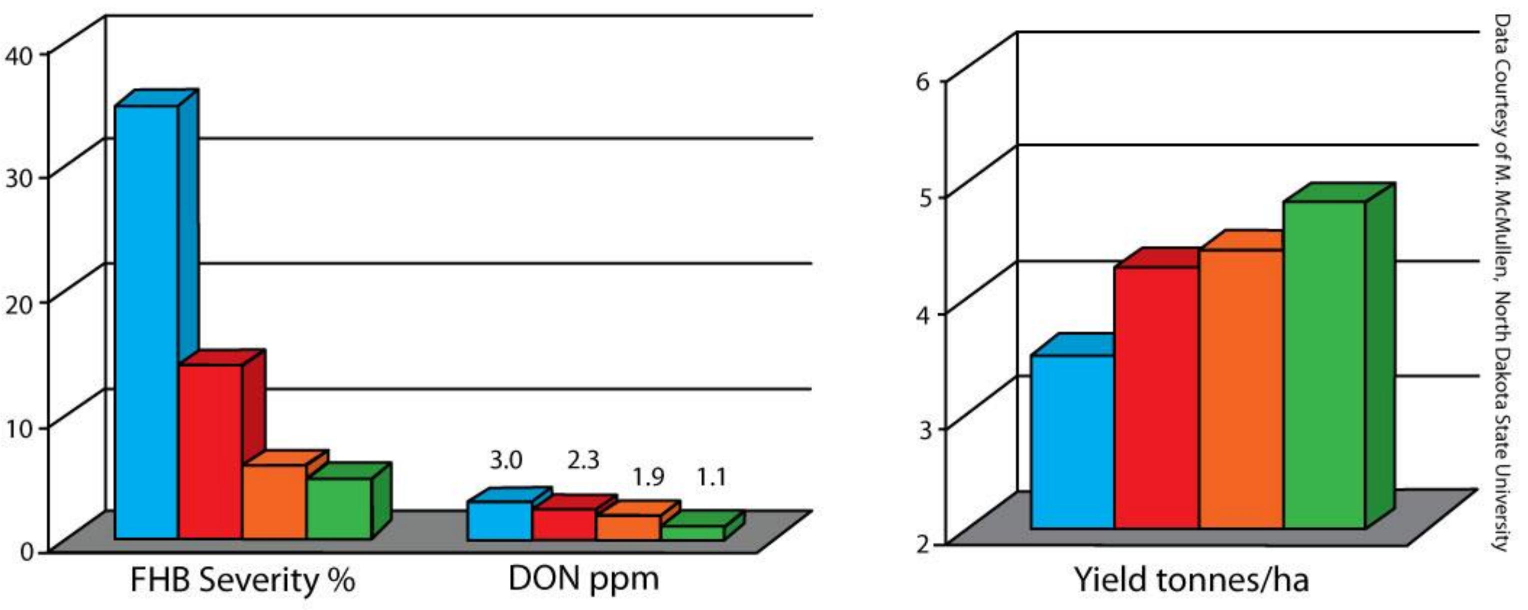


- 3-ADON isolates make significantly ($P < 0.001$) more total DON

- 3-ADON may be more toxic
  - 3-ADON LD_{50} = 49 mg/kg
  - 15-ADON LD_{50} = 113 mg/kg



INTEGRATED APPROACH TO FHB MANAGEMENT



Susceptible 'Monroe' durum planted into wheat stubble

Susceptible 'Monroe' durum planted into canola stubble

Moderately resistant 'Divide' durum planted into canola stubble

Moderately resistant 'Divide' durum planted into canola stubble and treated with foliar fungicide Prosaro (prothioconazole + tebuconazole)

Fig. 3. Effect of integrated managment strategies (varietal selection, rotation, fungicide) on fusarium head blight (FHB) severity, deoxynivalenol (DON) accumulation and yield of durum wheat.

SELECTED RESEARCH PUBLICATIONS - 2000s

- 2011 Haber at al.

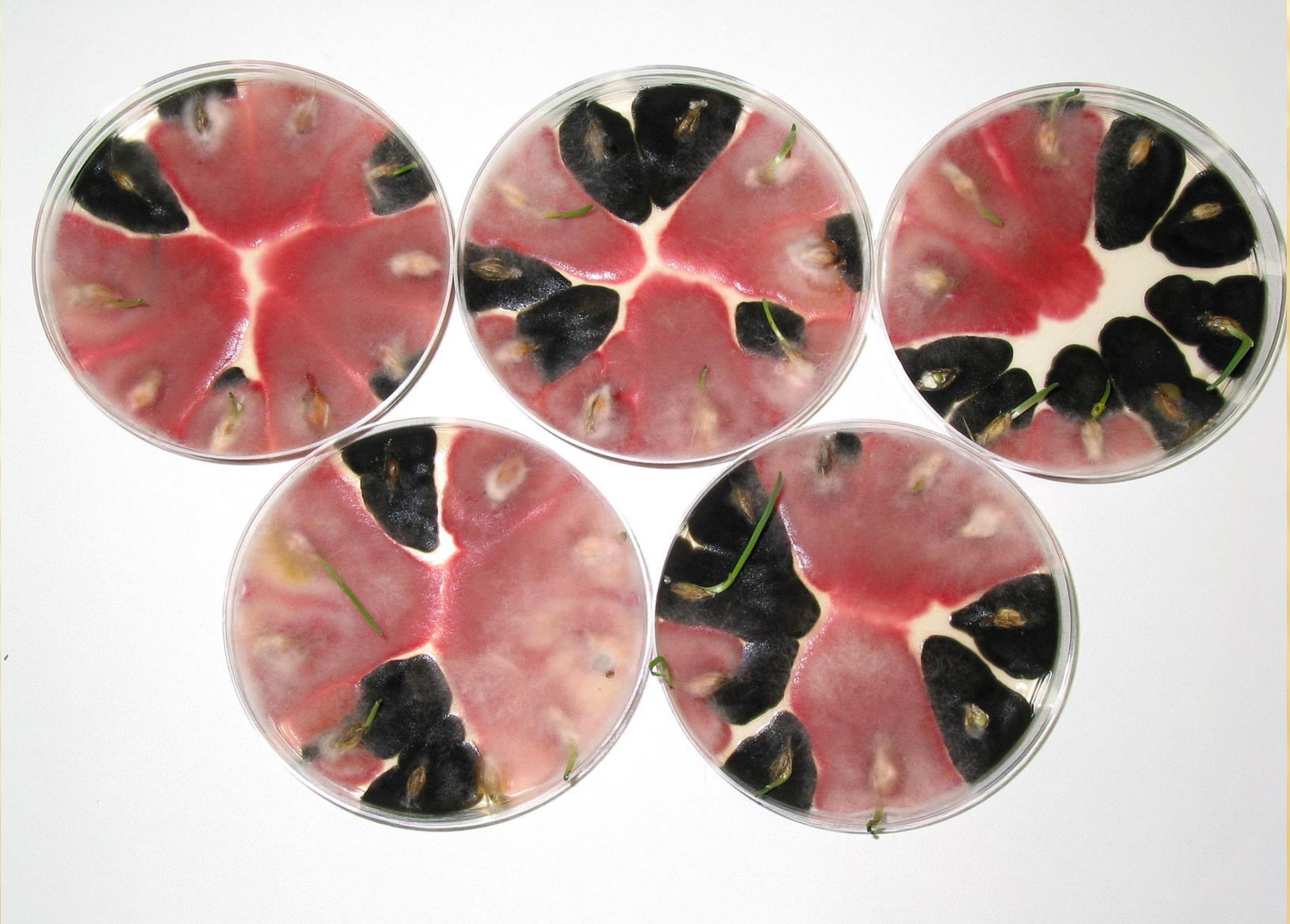
  Epigenetics serves genetics: fusarium head blight (FHB) resistance in elite wheat germplasm
- 2015 Xue et al.

  Timing of inoculation and Fusarium species affect the severity of fusarium head blight on oat
- 2016 Rampitsch at al.

  Inhibition of Fusarium graminearum and other Fusarium species by Cochloibolus sativus in culture and on barley plants
- 2018 Bai et al.

  Wheat resistance to Fusarium head blight

ISOLATION OF FG (AND CS) FROM BARLEY SEED



GRANTING AGENCIES THAT SUPPORTED AND FOSTERED RESEARCH ON FHB IN W CANADA

- WGRF – Western Grains Research Foundation
- ARDI – Agri-Food Research Development Initiative
- ADF – Agricultural Development Fund
- AARI – Alberta Agricultural Research Institute

SUPPORT STAFF AND STUDENTS RE. FHB RESEARCH

Cereal Research Centre
1986 – 2013

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- Penny Pearse
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- Faye Dokken-Bouchard
- Randy Kutcher
- Kelly Turkington

SYMPTOMS OF FHB ON TWO-ROW BARLEY

REGIONAL MEETINGS ON FHB - 1993 TO 1996/7

Plant Pathologists, Breeders, etc.

Fargo, North Dakota	1993
? Minnesota	1994
Brookings, South Dakota	1995
Winnipeg, Manitoba	1996

CANADIAN NATIONAL MEETINGS ON FHB

Canadian Workshops on Fusarium Head Blight

- 1st 1999 Winnipeg MB
- 2nd 2001 Ottawa ON
- 3d 2003 Winnipeg MB
- 4th 2005 Ottawa ON
- 5th 2007 Winnipeg MB
- 6th 2009 Ottawa ON
- 7th 2011 Winnipeg MB
- 8th 2016 Ottawa ON
- 9th 2018 Winnipeg MB

SPONSORS/PARTNERS OF CWFHB

- BASF
- Bayer Crop Science
- Dow AgroSciences
- Syngenta
- Canterra
- CSGA
- Secan
- BMBRI
- Rahr Malting
- Canadian Grain Commission
- Canadian National Millers Association
- Canadian Wheat Board
- Province of Manitoba

EUROPEAN FUSARIUM SEMINAR

The EFS was the *de facto* international meeting on FHB, until the 'Interntional Symposium on FHB', and likely still is (?)

Warsaw,Poland (1st)	1987	
Martina Franca, Italy (4th)	1995	
Szeged, Hungary (5th)	1997	
Poznan, Poland (7th)	2002	
Berlin, Germany		
Orlando, Florida (8th)	2004	(2nd ISFHB)
Szeged, Hungary	2008	(3rd ISFHB)
Radzikow, Poland (11th)	2010	
Bordeaux, France (12th)	2013	
Martina Franca, Italy (13th)	2015	
Tulln, Austria (14th)	2018	

11TH EFS – RADZIKOW (WARSAW) POLAND 2010

SYMPTOMS OF FHB ON SPRING WHEAT

THE VARIETY REGISTRATION SYSTEM IN WESTERN CANADA (HISTORICAL)

1950s - 2018

NRC Associate Committees* - ‘50s, ‘60s, ‘70s
Expert Committees on Grain* - 1978
Prairie Registration Recommending Committees#- 1990
Prairie Grain Development Committee#- 2008

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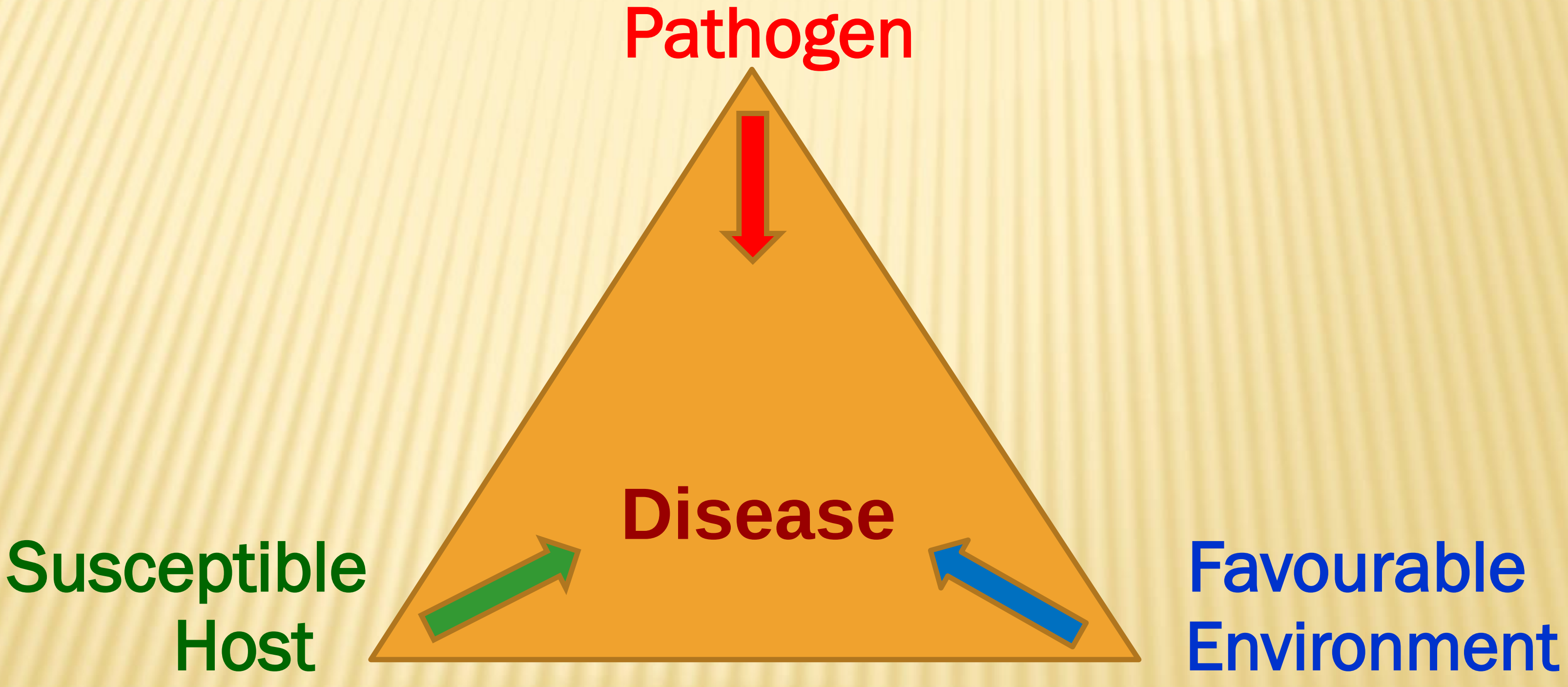
* of Breeding, Diseases, Quality

# of Wheat, Rye and Triticale, Barley and Oat, Oilseeds, Specialty Crops

PLANT PATHOLOGY '101'

THE PLANT DISEASE TRIANGLE



THE VARIETY REGISTRATION SYSTEM IN WESTERN CANADA (CURRENT)

PGDC (Prairie Grain Development Committee)

www.pgdc.ca

- Prairie Registration Committee for Wheat, Rye and Triticale
- Prairie Registration Committee for Oat and Barley
- Prairie Registration Committee for Oilseeds
- Prairie Registration Committee for Pulse and Special Crops
  - Breeding and Agronomy Evaluation Team
  - Disease Evaluation Team
  - Quality Evaluation Team

‘DO NOT OBJECT TO’ GUIDELINES FOR PRIORITY 1 DISEASES OF WHEAT & TRITICALE IN W. CANADA

Disease	CWRS/ CWHW	CPS CWGP	CWAD	SWS	Winter Wheat	Triticale	Spelt
Leaf rust	MR	I	MR	-	I	MR	MR
Stem rust	I	I	MR	-	I	MR	-
Common bunt	I	I	MR	-	I	I	MS
FHB	**I**	**I**	**MS**	**-**	**-**	**MS**	**MS**
Leaf spots	MS	MS	I	-	-	-	MR
Loose smut	MR / MS	MS	MS	-	-	-	-
Stripe rust	-	-	-	MR	-	-	-

PRRCG/PGDC DISEASE EVALUATION TEAM FIRST-YEAR ENTRIES (25) 2008 WESTERN CO-OPERATIVE TWO-ROW BARLEY REGISTRATION TEST

TR Entry	NNB	SNB	SB	(sb)	Scald	(scald)	(ls)	FHB	Stem rust	Surface smuts	CRR	Loose Smut	Sept	Recommendation
08115	+	+	+	+	-	-	+	0	0	+	0	-	-	+
08116	+	0	0	-	-	-	-	0	0	+	+	-	-	0
08117	+	+	0	0	-	-	-	0	0	+	0	-	-	0
08118	-	+	0	0	-	-	0	+	0	+	0	-	-	0
08202	-	+	0	+	-	-	0	-	0	+	0	0	-	-
08203	+	+	+	+	-	-	+	0	0	+ (*)	++	+	-	++
08204	+	+	+	+	-	-	+	0	0	+ (*)	+	+ (*)	-	++
08205	0	+	+	0	-	-	0	0	0	+	+	-	-	0
08206	+	+	+	++	-	-	++	+	0	+	+	n/a	-	++
08207	0	+	+	++	-	-	++	++	0	+	+	+	-	++
08394	-	+	+	0	-	-	-	+	0	+	-	0	-	0/+

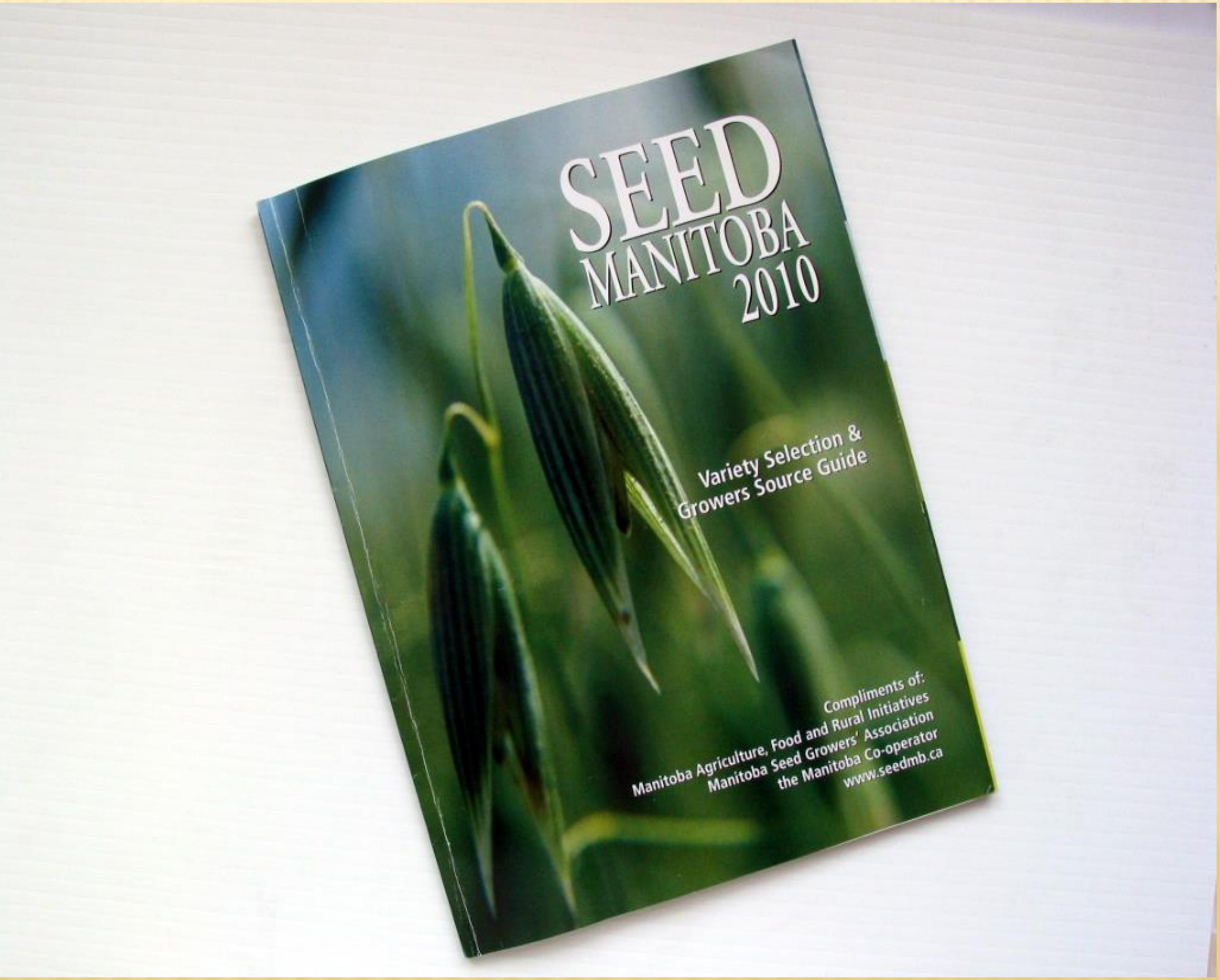
FUSARIUM 'CORN SPAWN' INOCULUM USED IN FIELD TRIALS

Corn kernels infested with species of *Fusarium*, clockwise from top left:

F. graminearum
F. poae
F. sporotrichioides
F. avenaceum

FIELD INOCULATION WITH *FUSARIUM GRAMINEARUM*

SEED GUIDES: *DISEASE MANAGEMENT INFORMATION*



MANITOBA SEED GUIDE - 1974

1974 FIELD CROP RECOMMENDATIONS FOR MB
(WHEAT, N=6)

Wheat Variety Descriptions

Variety	Yield as % of Neepawa	Days to Maturity	Seed Size	Resistance to Lodging	Stem Rust	Leaf Rust	Loose Smut	Bunt
Bread Wheat								
Neepawa	100 1/	91.6	medium	excellent	good	fair	good	fair
Napayo	94	91.3	small	good	good	fair	good	fair
Utility Wheat								
Glenlea	119	93.0	large	excellent	good	good	good	fair
Durum Wheat								
Hercules	111	92.8	large	fair-good	good	good	good	fair
Wascana	114	96.3	large	fair	good	good	good	fair
Wakooma	112	97.0	large	fair	good	good	good	fair

1/ Average 29 station years – All Manitoba – 26.5 cwt/acre (2970 kg/ha)

1984 FIELD CROP RECOMMENDATIONS FOR MB (WHEAT, N=10)

Variety Description

Variety	Yield as % of Neepawa	Relative Maturity	Seed Size	Height	Lodging	Resistance to: Stem Rust	Leaf Rust	Loose Smut	Bunt
Benito	99	99	Small	Medium	Good	Good	V. Good	Good	Fair
Columbus	100	104	Medium	Medium +	Excellent	Fair	Good	Fair	Good
Katepwa	108	100	Medium	Medium	Excellent	Good	Fair	Good	Good
Neepawa	100*	100	Medium	Medium	Excellent	Good	Poor	Good	Fair
Sinton	99	102	Medium	Medium	Excellent	Good	Good	Poor	Fair
Glenlea	115	104	Large	Medium +	Excellent	Good	V. Good	Good	Fair
Arcola	115	102	Large +	Medium	Fair-Good	Good	V. Good	Fair	Good
Coulter	111	102	Large	Medium	Fair-Good	Good	V. Good	Fair	Good
Medora	115	103	Large	Medium +	Good	Good	V. Good	Fair	Good
Wakooma	105	105	Large	Medium +	Fair	Good	V. Good	Fair	Good

*Average 69 station-years — all Manitoba — 2608 kg/ha (38.8 bu/acre).

SEED MANITOBA 1994 (WHEAT, N=22)

Variety Descriptions[1]

Variety	Days to Maturity[2]	Seed Size	Height	Lodging	Resistance to: Stem Rust	Leaf Rust	Loose Smut	Bunt
Canada Western Red Spring								
AC Domain	97	M[3]	M-[4]	VG[5]	G	VG	G	G
AC Minto	97	M+	M	G	G	VG	G	G
CDC Teal	96	M	M-	VG	G	VG	G	F
CDC Merlin	98	M+	M	G	G	G	G	G
Columbus	100	M	M+	G	F	VG	F	G
Invader	99	M+	M	G	G	VG	G	G
Katepwa	97	M	M	G	G	F	G	G
Kenyon	97	M	M	G	G	VG	F	F
Neepawa	97	M	M	G	G	F	G	F
Pasqua	97	M	M	G	G	VG	G	F
Roblin	95	M+	M-	VG	G	G	G	P
Experimental Grades								
Grandin	99	M+	S	VG	G	VG	F	G
Canada Prairie Spring (Red)								
AC Taber	103	M+	S	VG	G	VG	P	G
Biggar	101	M+	S	VG	G	F	P	P
Cutler	94	M+	S	VG	G	F	P	P
Oslo	98	M+	S	VG	G	G	VP	F
Canada Prairie Spring (White)								
Genesis	102	M+	M	P	G	F	F	VP
Canada Western Extra Strong								
Glenlea	99	L	M+	G	G	G	VG	F

SEED MANITOBA 2013 (WHEAT, N=52)

Variety Descriptions

Class/Variety	Site Years Tested	Yield bu/acre	Protein %	Maturity +/- 99 days	Height +/- 37 inches	Spike Awned	Lodging	Sprouting	Resistance Level: Loose Smut	Common Bunt	Leaf Spots[1]	Stem Rust	Leaf Rust	Fusarium[2] Head Blight
Canada Western Red Spring														
5602HR	90	60	14.9	1	0	Y	F	F	R	MR	I	R	R	MR
5603HR	41	60	14.4	2	0	Y	G	VG	MS	I	MR	MR	R	I
5604HR CL	40	58	14.4	-1	-1	Y	G	G	MS	I	MS	R	R	I
AAC Bailey	4	54	14.9	-1	0	N	G	G	MS	MR	I	R	R	I
AAC Redwater	4	59	13.4	-1	-2	Y	G	—	MS	I	MS	R	R	I
AC Barrie	164	55	14.5	0	0	N	G	G	MR	I	MS	MR	MS	I
AC Cadillac	6	58	—	-1	3	N	F	F	R	R	I	R	MR	I
AC Domain	20	55	15.2	-2	-1	N	VG	VG	R	I	S	R	I	MS
Alvena	30	57	14.8	-2	0	N	G	P	MR	I	—	MR	I	MS
Carberry	40	58	14.6	2	-5	Y	VG	F	MR	R	MS	MR	R	MR
Cardale	4	60	13.5	2	-4	Y	VG	F	I	MR	MS	R	R	MR
CDC Abound	38	57	14.4	2	-4	Y	G	F	I	I	MS	R	MS	S
CDC Go	24	61	14.3	-1	-2	Y	G	VP	MS	I	S	R	I	MS
CDC Kernen	27	58	14.7	1	1	Y	G	F	R	I	MS	MR	MR	I
CDC Plentiful	4	57	14.7	-3	-2	N	VG	—	R	I	I	R	R	MR
CDC Stanley	22	57	14.6	0	-1	N	G	G	MR	S	I	R	MR	MS
CDC Thrive	26	54	14.6	-1	0	N	G	P	MR	I	I	MR	I	MS
CDC Utmost VB	15	58	14.6	-1	-1	N	G	G	MS	S	I	MR	R	MS
CDC VR Morris	4	60	14.8	0	0	N	G	—	I	I	I	MR	R	MR
Fieldstar VB	43	60	14.6	0	1	Y	F	VG	I	I	I	MR	R	I
Glenn	45	59	14.6	2	-2	Y	VG	F	I	I	I	R	R	I
Goodeve VB	53	59	14.8	-2	-1	N	VG	G	MR	S	MS	MR	MR	S
Harvest	61	58	14.3	-1	-2	N	VG	VG	MR	S	MS	R	MR	S
Infinity	37	58	15.1	-2	0	N	G	G	MR	MR	MS	MR	MR	S
KANE	78	58	14.6	1	-2	Y	G	VG	MS	I	I	R	R	I
Muchmore	40	59	14.2	2	-6	Y	VG	G	MR	R	MS	R	R	MS

NO. RECOMMENDED CEREAL VARIETIES – 1974 TO 2018

	AB	SK	MB
1974			
Wheat			6
Barley			4
Oat			-
1984			
Wheat	22	15	10
Barley	14	16	6
Oat	9	7	2
2004			
Wheat	68	54	47
Barley	53	48	55
Oat	26	14	17
2018			
Wheat			108
Barley			51
Oat			28 (35)

MB SEED GUIDE 2018: SPRING WHEAT

Number of cultivars rated MR (R)

CWRS	15	(52)
CPS (R)	3	(15)
CNHR	0	(5)
CWSP	3	(14)
CWHWS	0	(6)
CWSWS	0	(5)
CWES	0	(3)
Supported	2	(8)
Totals	23	(108)

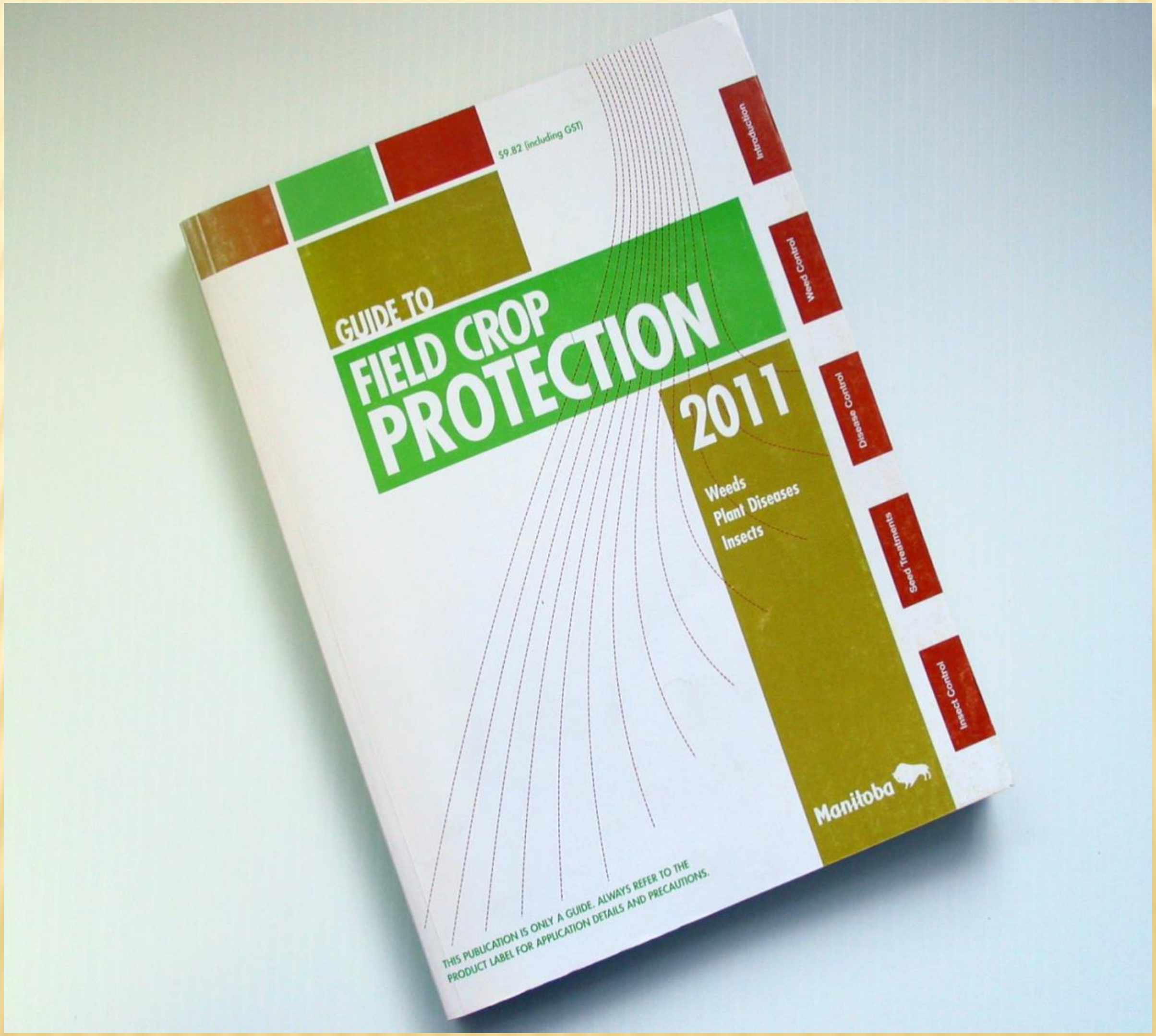
MB SEED GUIDE 2018: BARLEY

Number of Cultivars rated MR

Malting, Accepted	1	(8)
Malting, Other	4	(17)
Food and Feed	4	(22)
Hulless	3	(4)
Total	12	(51)

SYMPTOMS OF FHB ON SIX-ROW BARLEY

DISEASE MANAGEMENT – *FUNGICIDES*



FUNGICIDE MANAGEMENT OPTIONS – 'FOLIAR' FHB*

	Wheat	Barley	Oat
Bravo 500 + *chlorothalonil*	*x*		
Caramba *metconazole*	*x*	*x*	*x*
Folicur *tebuconazole*	*x*		
Proline *prothioconazole*	*x*	*x*	
Prosaro *tebuconazole +* *Prothioconazole*	*x*	*x*	

** All products registered for 'suppression' rather than 'control'*

FHB SYMPTOMS IN BREEDER TEST PLOTS - WHEAT

TYPICAL ABSTRACT OF 150-250 WORDS

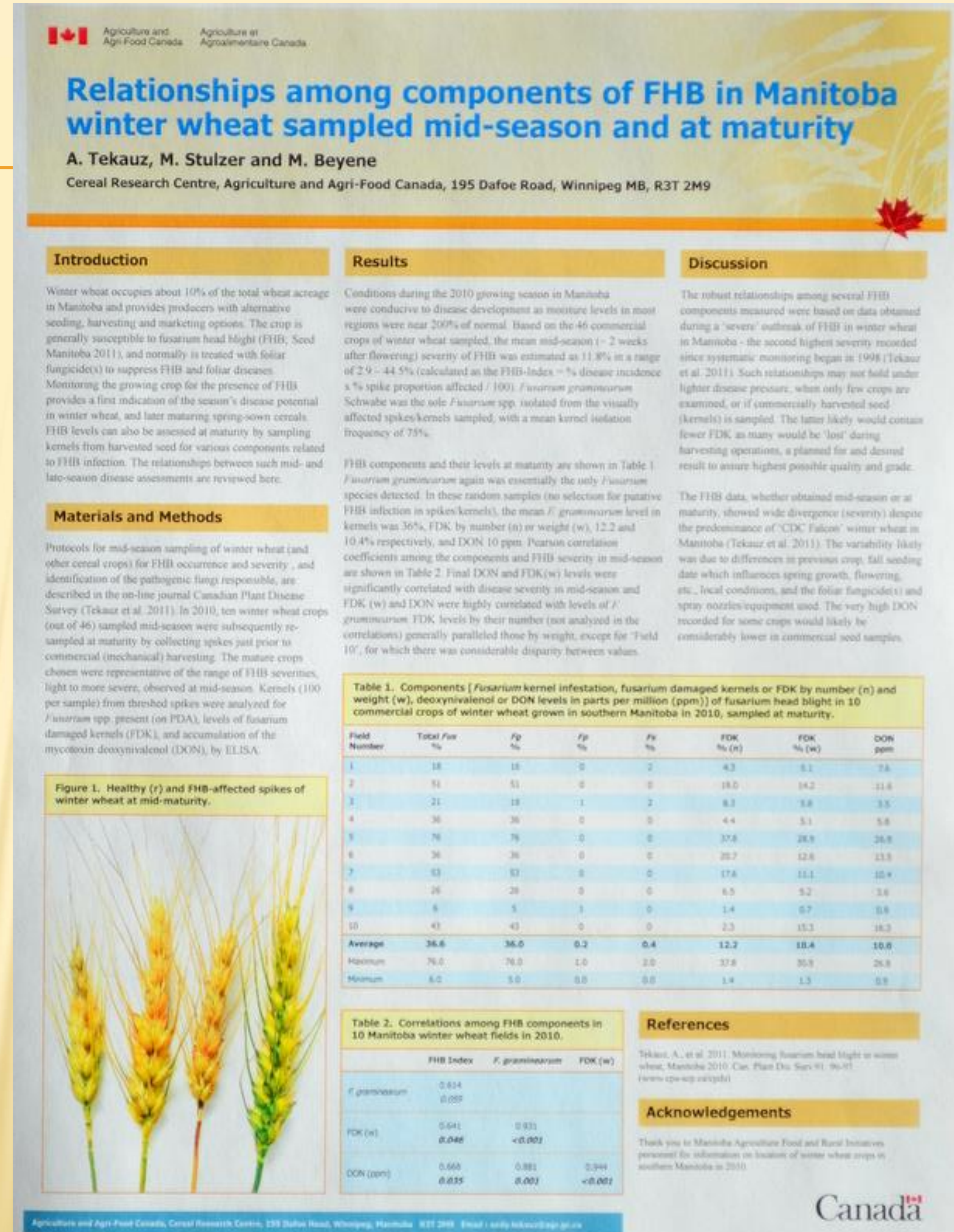
Relationships among components of FHB in Manitoba winter wheat sampled mid-season and at maturity

Andy Tekauz et al. *Cereal Research Centre, Agriculture and Agri-Food Canada, 195 Dafoe Road, Winnipeg MB, R3C 2M9.*

Winter wheat grown in Manitoba is routinely affected by fusarium head blight (FHB). Monitoring for the disease has taken place annually since 1998, typically in mid-season, to signal FHB presence, estimate severity, and identify the causal *Fusarium* fungi. FHB can also be evaluated in harvested grain, as done routinely by the Canadian Grain Commission. To compare and evaluate earlier- and later-derived data sets, in 2010, ten winter wheat crops sampled mid-season were also sampled at maturity, just prior to commercial harvest. At maturity, *Fusarium* species were determined, along with levels of fusarium damaged kernels (FDK) and the mycotoxin deoxynivalenol (DON). Correlations among measured components were evaluated to identify relationships. At mid-season, mean disease severity (Fusarium Head Blight Index or FHB-I) was 17.6% (range 2.8 to 44.5%), and *F. graminearum* the sole causal species detected. In mature kernels (seed), only *F. graminearum* was isolated, mean FDK level was 10.4%, and mean DON 10.0 ppm. DON was highly and significantly correlated with mid-season FHB-I, and with FDK and *F. graminearum* levels in mature kernels. FDK was correlated with FHB-I and *F. graminearum*, and FHB-I with *F. graminearum*. These robust and significant relationships occurred in a year when the mean FHB severity, based on monitoring a total of 46 winter wheat crops, was considerably higher than normal. Such relationships may not hold when FHB is less severe, fewer crops are sampled, or when considering commercial seed lots in which a proportion of FDK, or otherwise lighter kernels, have been 'lost' during harvesting operations.

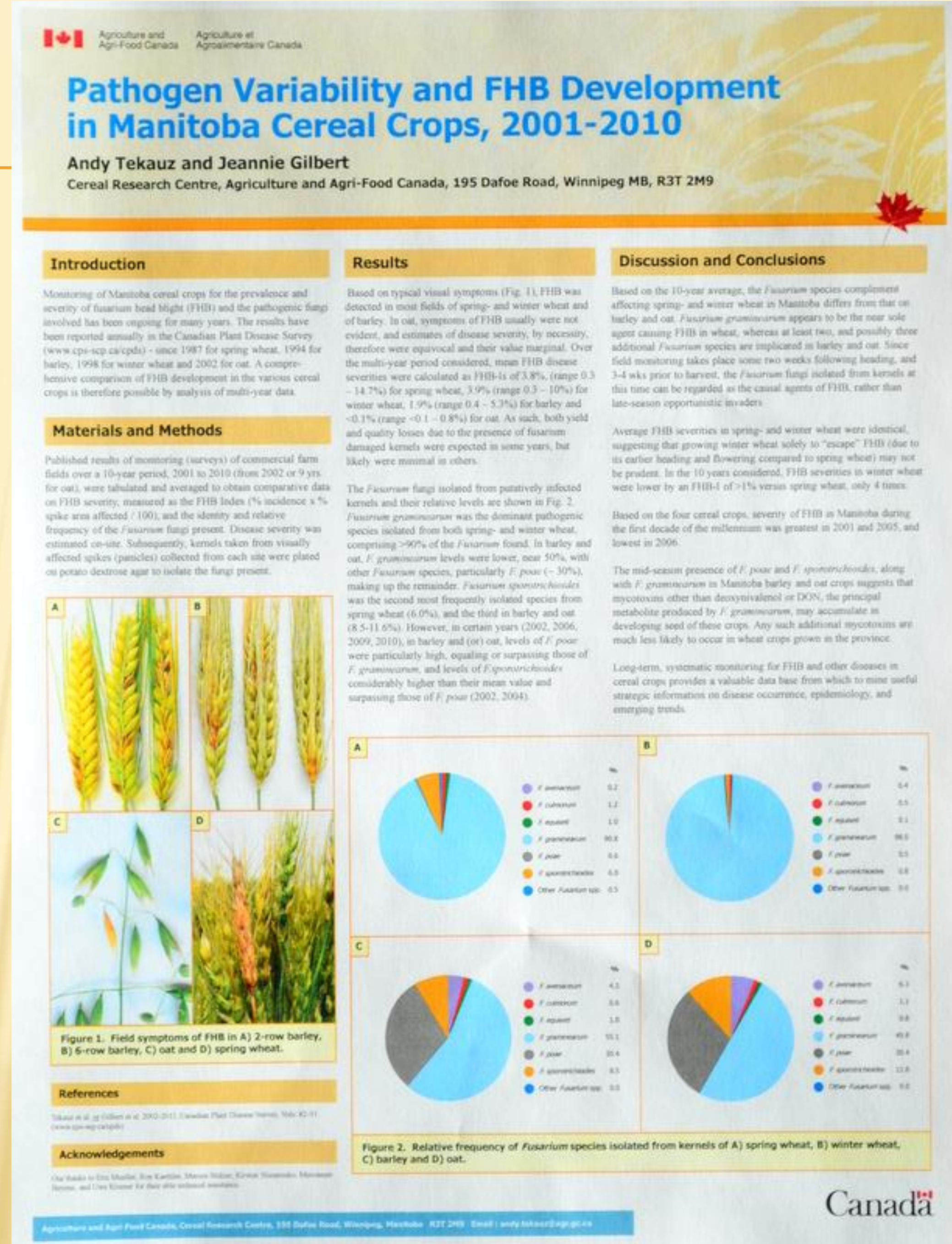
POSTER EXAMPLE #1

TEKAUZ ET AL



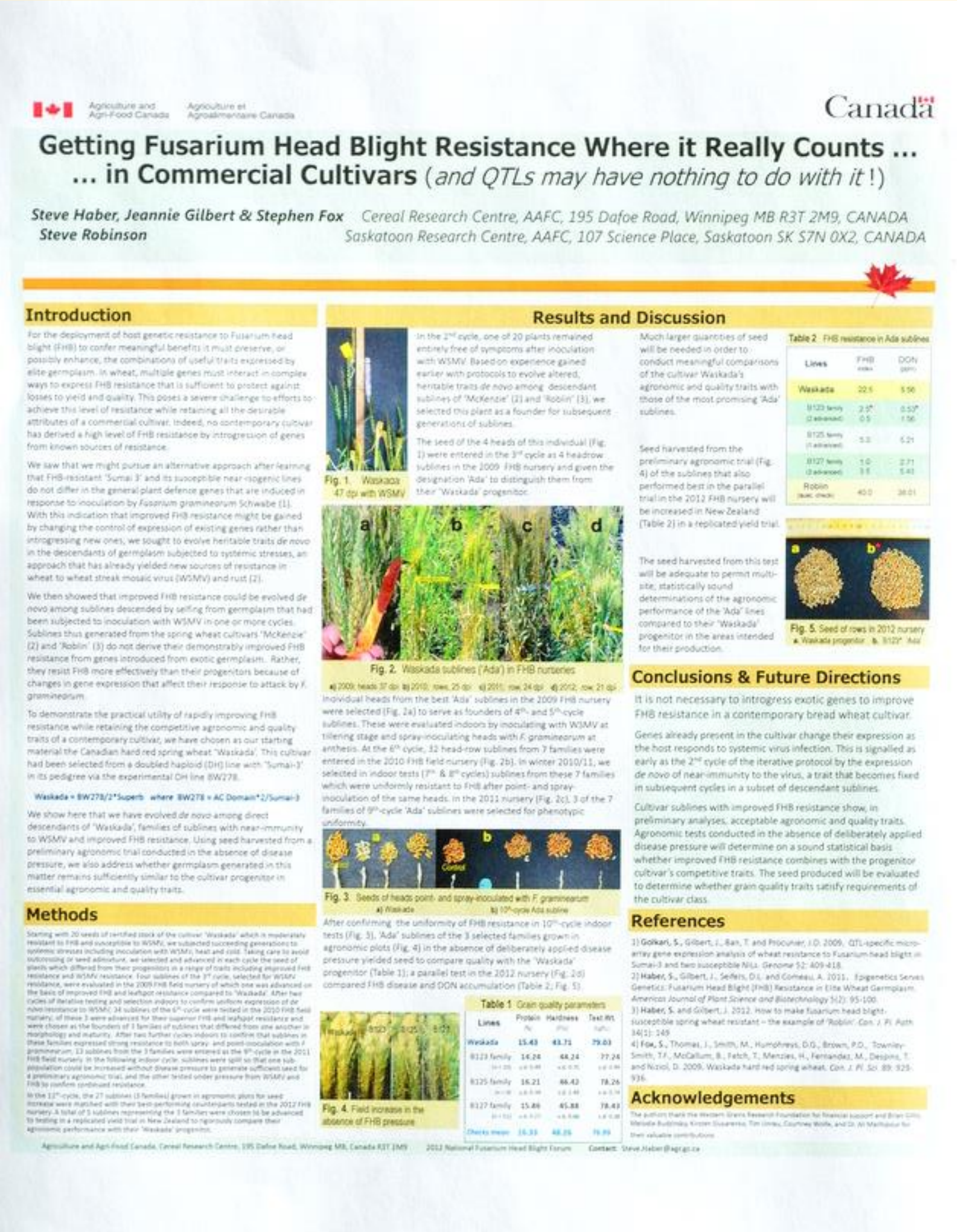
POSTER EXAMPLE #2

TEKAUZ & GILBERT



POSTER EXAMPLE #3

HABER ET AL



THANK- YOU!
GOOD LUCK!

HISTORY OF FHB RESEARCH IN (WESTERN) CANADA

Andy Tekauz

9th CWFHB, Winnipeg MB, Nov 22, 2018