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Strategies to reduce the impact of fusarium head blight and stripe rust in irrigated wheat

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Canada

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 - **Canadian Meteorological Centre, Meteorological Service of Canada**
- **Irrigated Crop Production Update – 2010**
 - **Shelley Woods**

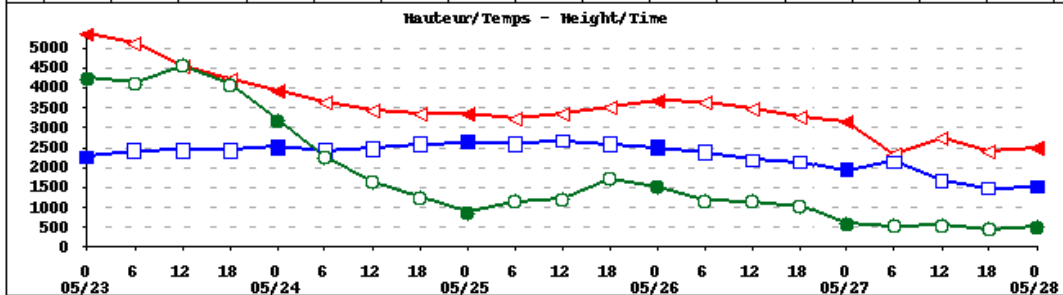
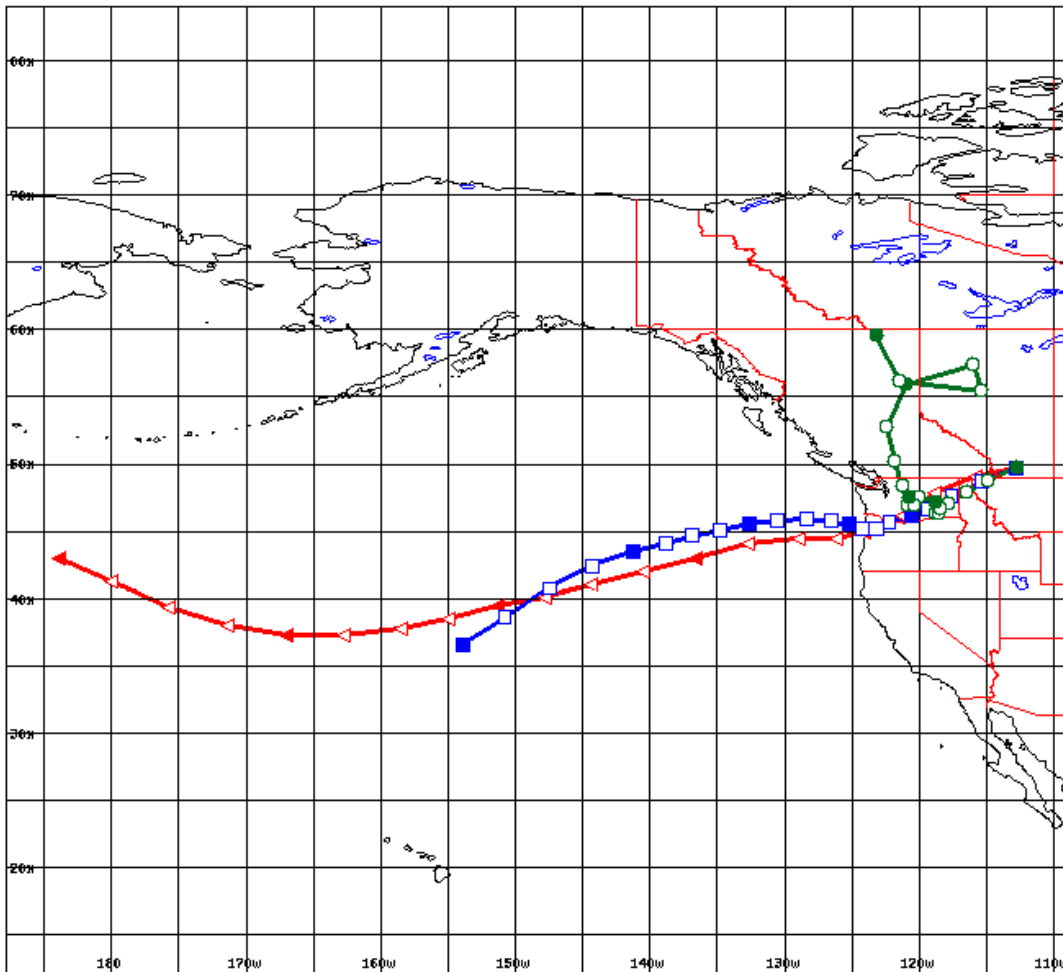
Government
of Alberta ■


Stripe rust of wheat

- **Varies from year to year**
- **Typically establishes on winter wheat**
 - **Mainly an issue for susceptible cultivars**
 - **Moves to spring cvs.**
- **Key strategies**
 - **Resistant varieties, and timely crop scouting and foliar fungicide if needed**



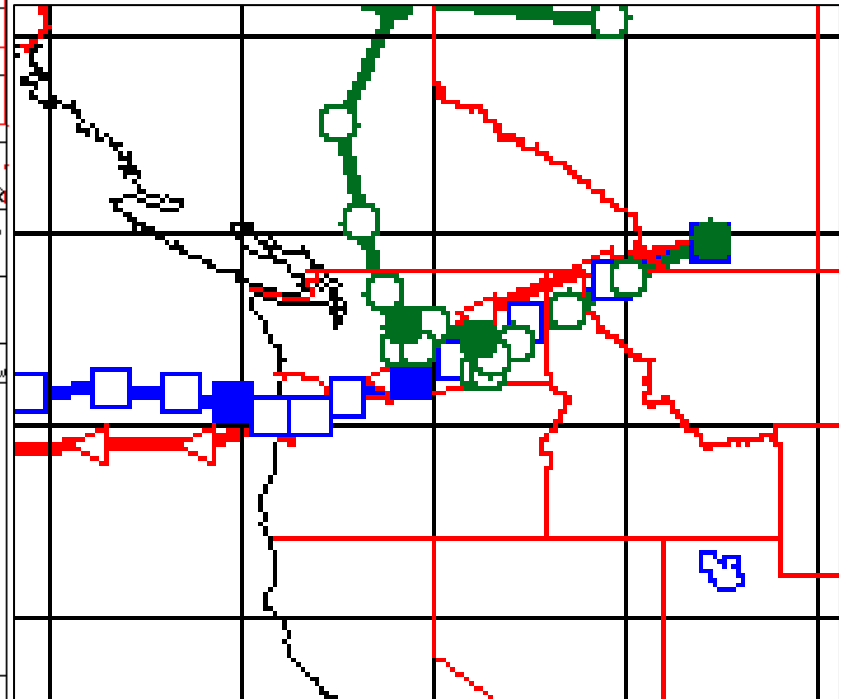
Reverse trajectory from eastern Washington State to Lethbridge, AB, May 28, 2007




Service Météorologique du Canada
Meteorological Service of Canada

Prevision de retrotrajectoires
 Back trajectory forecasts
LETHBRIDGE_AB
 Arrivee / Arrival : 20070528 0000 UTC
 A / At : 49.42 N 112.49 W
 : 49.700 N 112.817 W
 Intervalle / Interval : 3 Hrs

Hauteurs (M) au-dessus de la surface
 All heights (M) above surface
 ▲ 2500.00 ASL
 ■ 1500.00 ASL
 ● 500.00 ASL



Outbreaks of fusarium head blight caused by *Fusarium graminearum*

- **Dr. B. Stack, NDSU, WGRF
Research Magazine January
2004**

– Historical outbreaks of FHB can be traced to several causes

- **Widespread planting of highly susceptible cultivars**
- **Presence of colonized residue from previous crops**
- **Presence of corn in rotation with small grains**
- **Weather favourable for infection**



Why the concern about fusarium head blight caused by *Fusarium graminearum*?

- **Yield loss**
- **Grade loss**
- **Quality loss**
- **Mycotoxin contamination**
 - Implications for
 - Animal & human health
 - End use market acceptability
 - Tolerance levels may be ↓ed
- **These losses are additive!**
- **FHB is difficult to control**



Fusarium graminearum and swine production



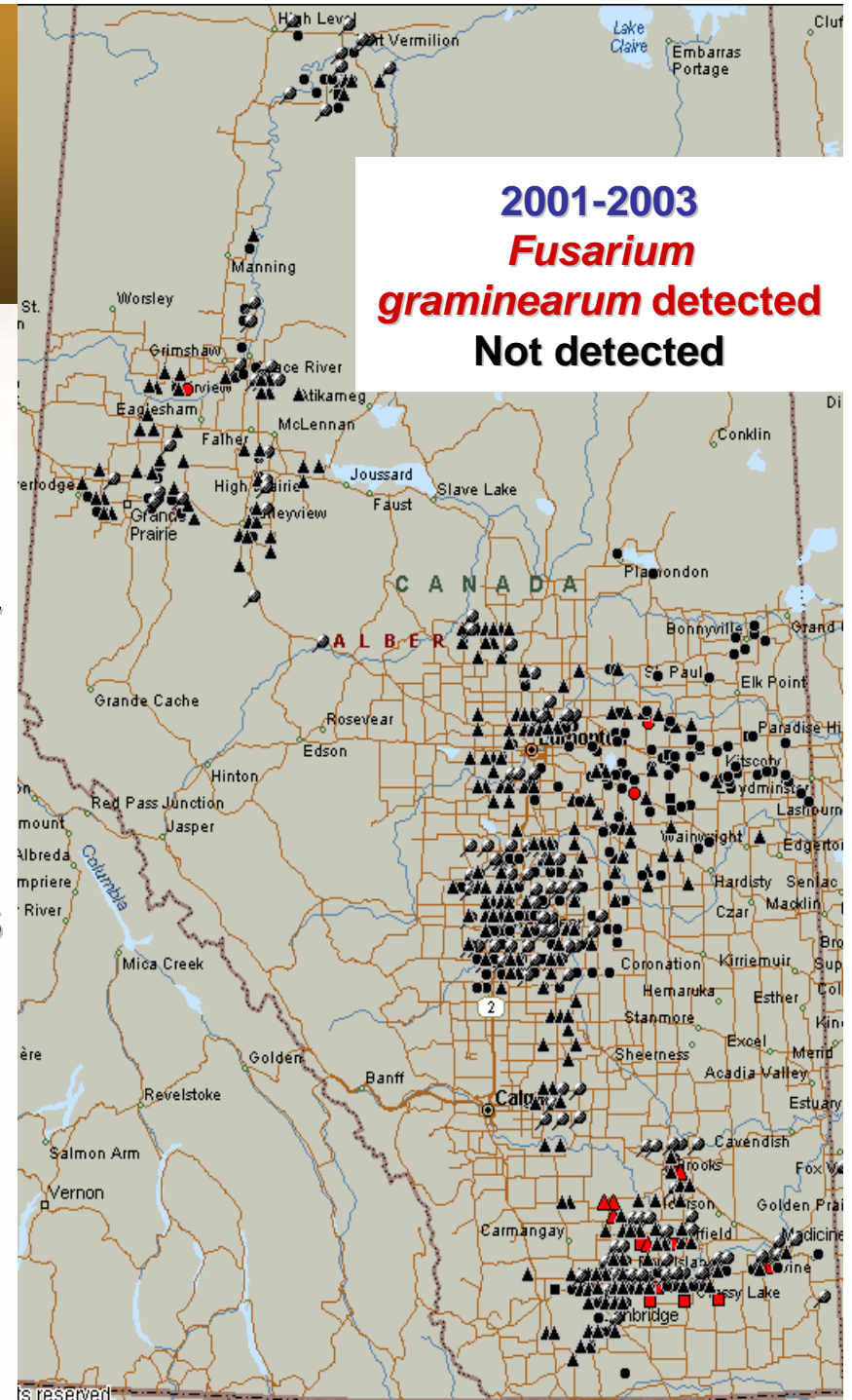
0 ppm DON

The image shows two piglets in a concrete pen. One piglet is standing on the left, facing right, and appears healthy. The other piglet is lying down on the right, facing left, and appears to be dead or severely ill. The floor is concrete and shows some dark staining near the dead piglet.

5 ppm DON

Detection of *Fusarium graminearum* in Alberta, 2001 to 2003

- ***F. graminearum***
 - Not commonly found
 - Plant residues and heads with symptoms
 - Central AB and the Peace River region
 - Mostly other *Fusarium* spp.
 - More commonly associated with residues and heads in some southern Alberta fields
 - *Fusarium graminearum* is becoming established on corn and some cereal residues
- **Consistent with other survey reports**
 - CGC and seed testing labs



Frequency of *Fusarium* spp. infesting cereal node tissues in the central, southern and Peace River regions of Alberta, 2003.

Year, region, and <i>Fusarium</i> spp.	Total number of fields	Mean % of fields from which each <i>Fusarium</i> spp. was †		% node infection per field		
		Detected	Not detected	Average	Min.	Max.
2003						
central Alberta	52					
<i>F. graminearum</i>		0.0	100.0	0.0	0.0	0.0
<i>F. pseudograminearum</i>		13.5	86.5	1.2	0.0	28.0
<i>F. avenaceum</i>		88.5	11.5	26.8	0.0	88.0
<i>F. culmorum</i>		53.8	46.2	9.0	0.0	64.0
Peace River region	33					
<i>F. graminearum</i>		3.0	97.0	0.1	0.0	4.0
<i>F. pseudograminearum</i>		0.0	100.0	0.0	0.0	0.0
<i>F. avenaceum</i>		90.9	9.1	22.8	0.0	64.0
<i>F. culmorum</i>		78.8	21.2	21.8	0.0	96.0
southern Alberta	43					
<i>F. graminearum</i>		4.7	95.3	1.2	0.0	46.7
<i>F. pseudograminearum</i>		30.2	69.8	4.5	0.0	57.7
<i>F. avenaceum</i>		27.9	72.1	3.6	0.0	32.1
<i>F. culmorum</i>		65.1	34.9	13.4	0.0	60.7

Frequency of *Fusarium* spp. infesting corn node tissues in the central and southern regions of Alberta, 2003.

Year, region, and <i>Fusarium</i> spp.	Total number of fields	Mean % of fields from which each <i>Fusarium</i> spp. was †		% node infection per field		
		Detected	Not detected	Average	Min.	Max.
2003						
central Alberta	31					
<i>F. graminearum</i>		0.0	100.0	0.0	0.0	0.0
<i>F. pseudograminearum</i>		6.5	93.5	0.2	0.0	4.0
<i>F. avenaceum</i>		87.1	12.9	13.4	0.0	52.0
<i>F. culmorum</i>		54.8	45.2	12.6	0.0	64.0
southern Alberta	13					
<i>F. graminearum</i>		100.0	0.0	27.7	4.0	60.0
<i>F. pseudograminearum</i>		0.0	100.0	0.0	0.0	0.0
<i>F. avenaceum</i>		7.7	92.3	0.3	0.0	4.0
<i>F. culmorum</i>		92.3	7.7	26.4	0.0	45.8

CGC Harvest Survey: Production characteristics of *Fusarium graminearum* +ve samples from Alberta

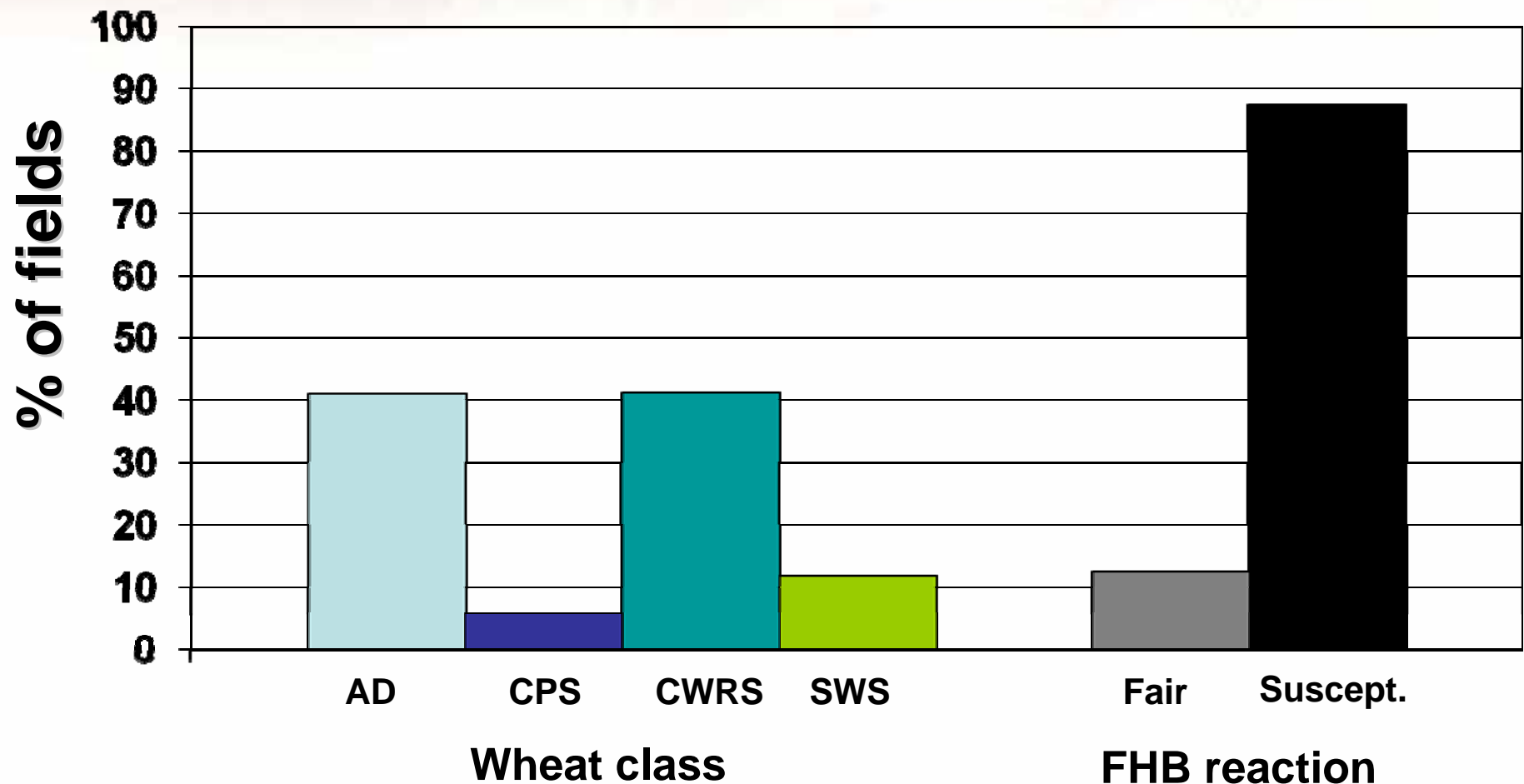
- Thousands of producer samples are submitted to the Canadian Grain Comm.
- Objective
 - To anonymously assess the characteristics of *F. graminearum* positive (*Fg*+ve) wheat fields collected from Alberta producers
 - To develop a better understanding of potential factors contributing to the appearance and development of *F. graminearum* in Alberta



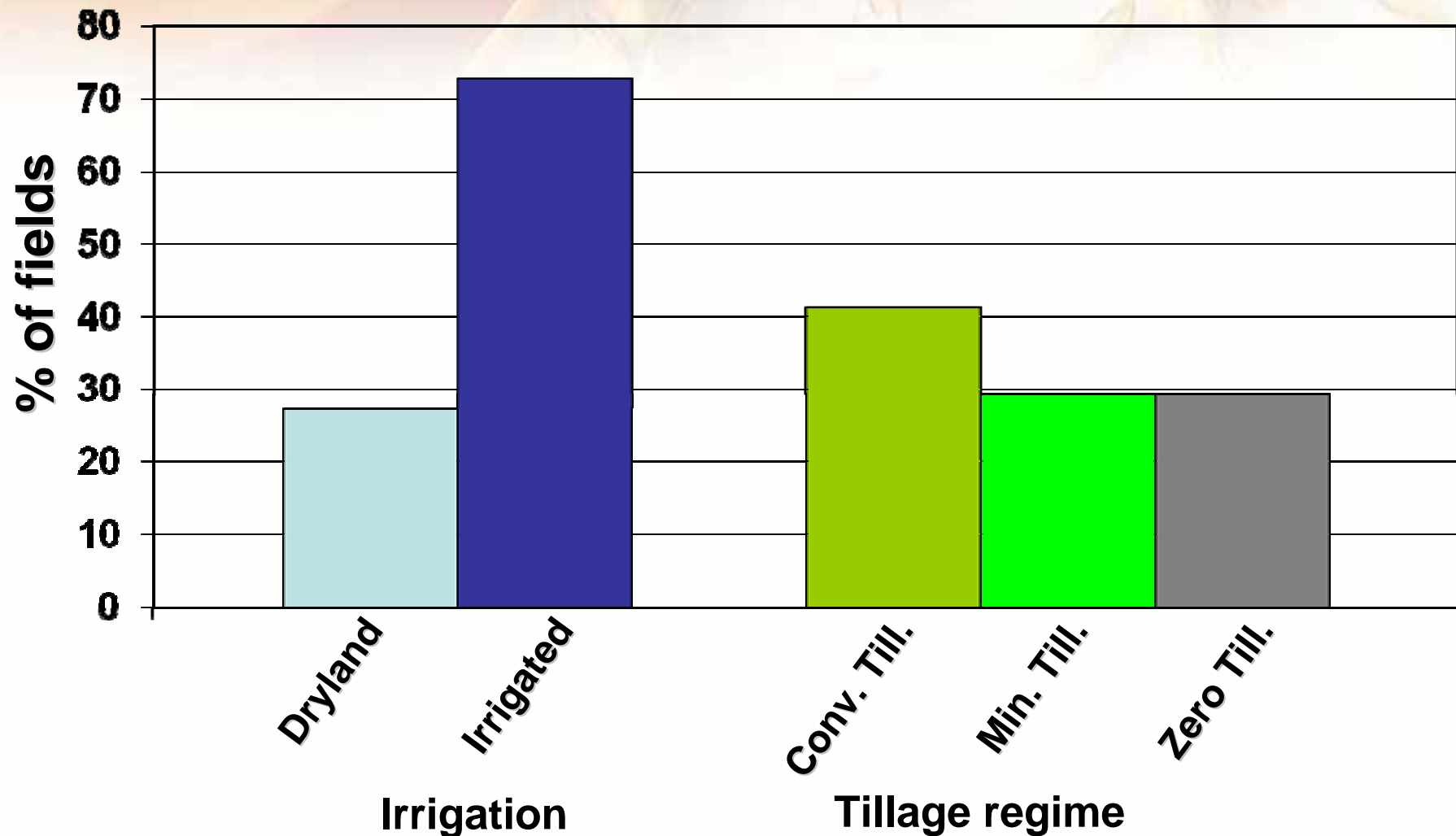
Materials and Methods

- **In 2002 and 2003**
 - In total, 94 and 65 *Fg*+ve samples were found, respectively
 - 40 and 45 Alberta producers contacted, respectively
 - Where contact information was available
 - FDK level and associated causal agents available for each sample
- **Each producer**
 - Sent a request to participate in a survey
 - Producers interested in cooperating filled out an accompanying survey form
 - Survey forms returned to R.M. Clear, CGC Winnipeg
 - All information and correspondence was strictly confidential

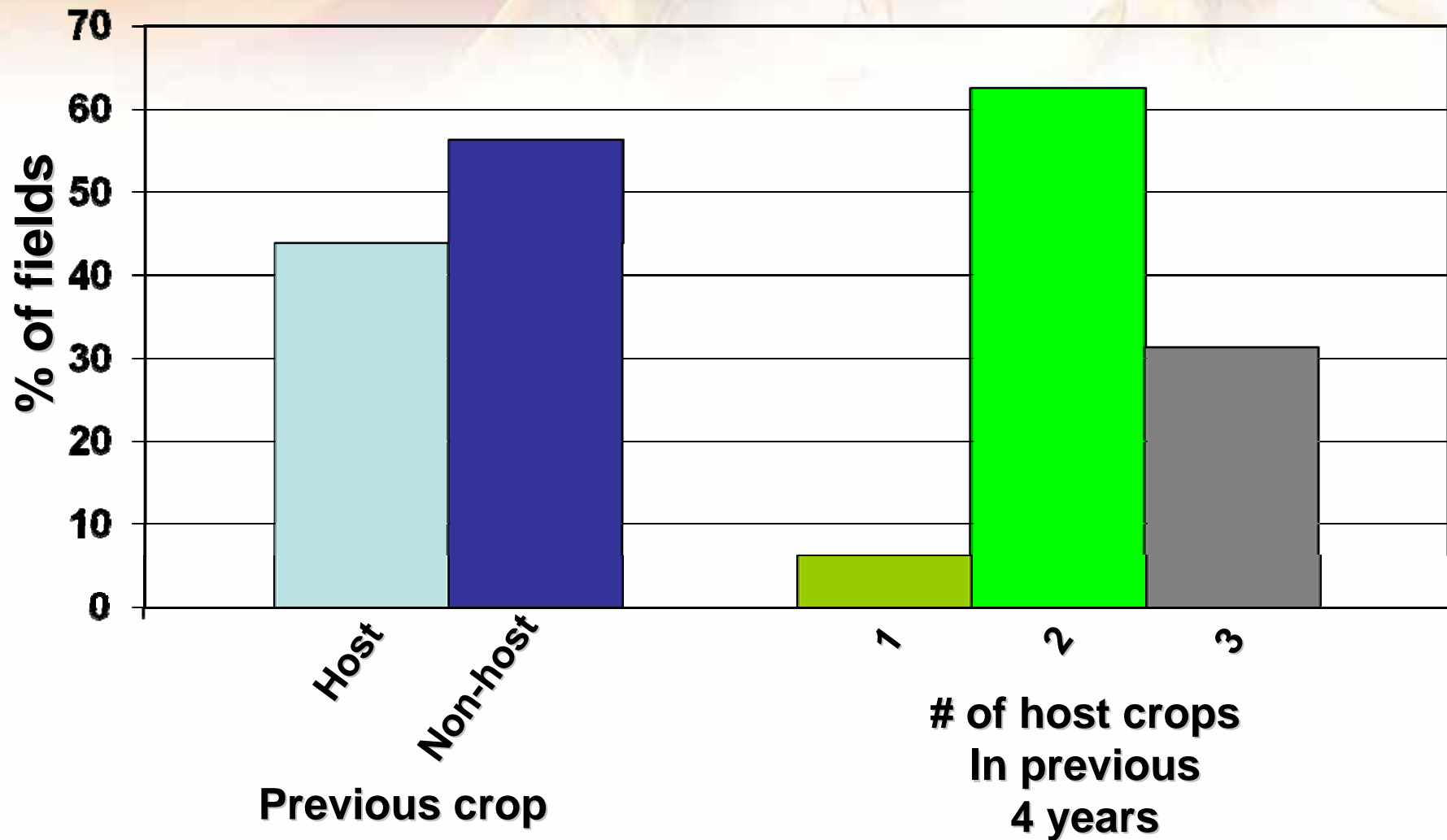
Wheat class and FHB reaction for 17 *F. graminearum* +ve fields identified as part of the CGC new crop survey, 2002



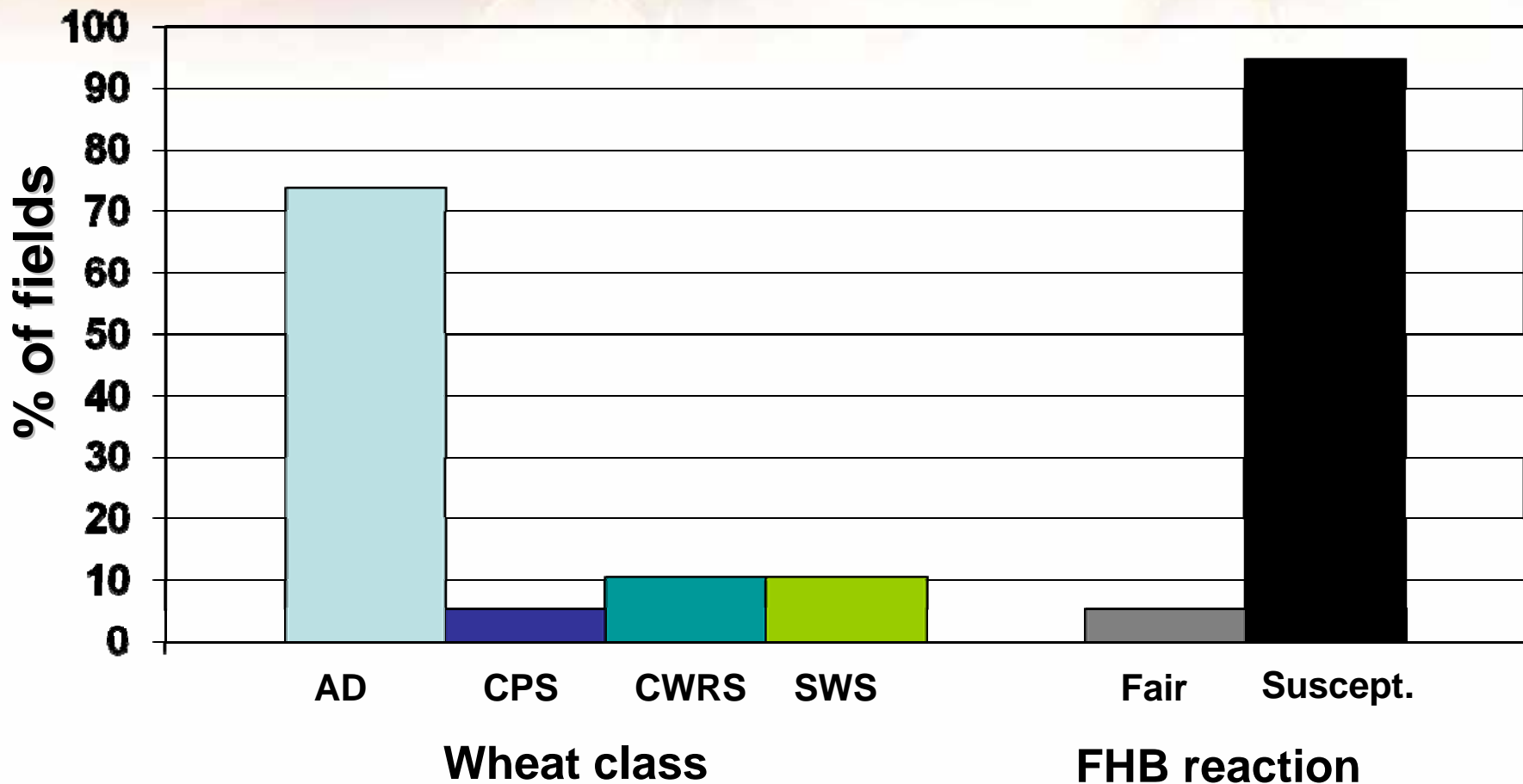
Irrigation and tillage regimes for 17 *F. graminearum* +ve fields identified as part of the CGC new crop survey, 2002



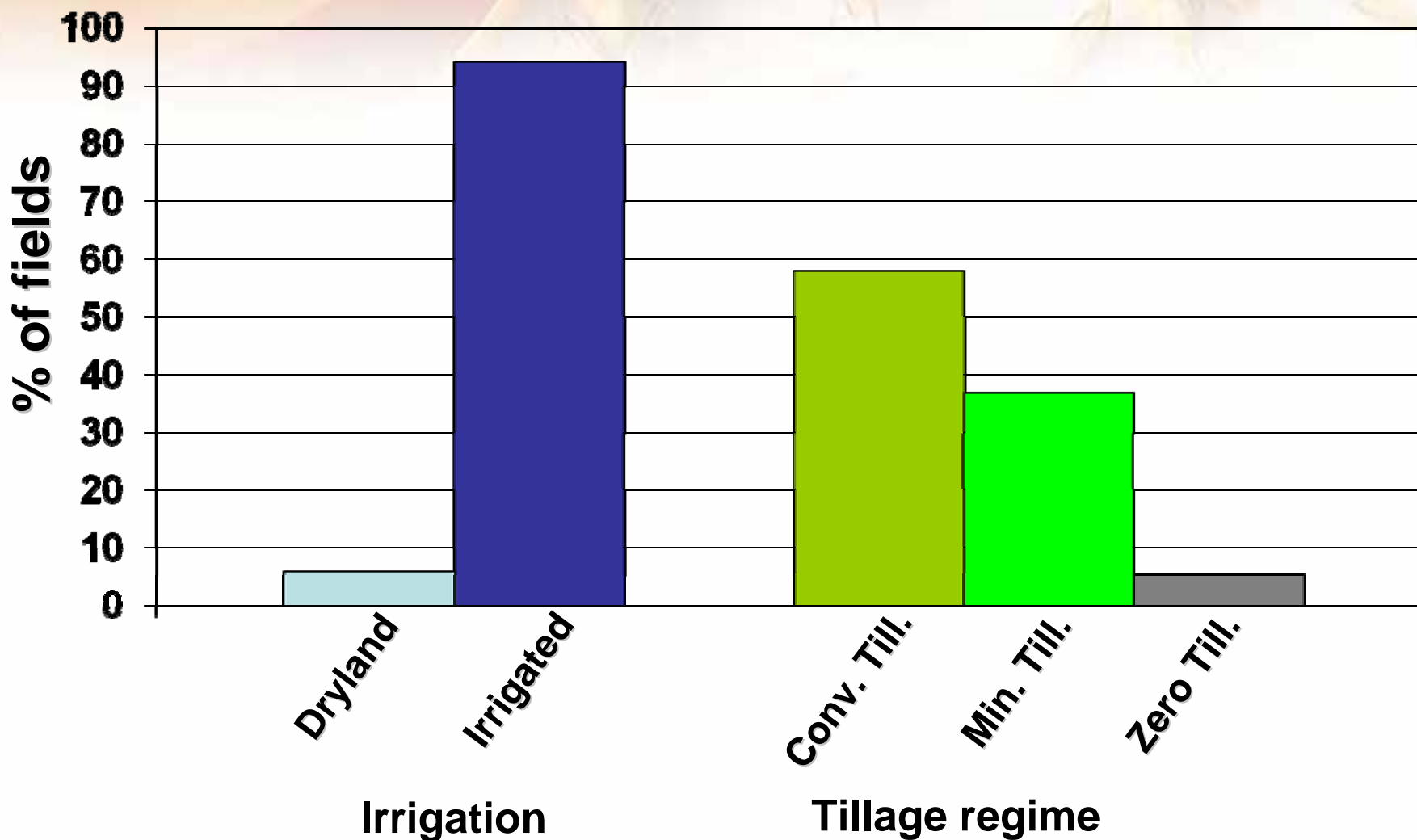
Crop rotations for the 17 *F. graminearum* +ve fields identified as part of the CGC new crop survey, 2002



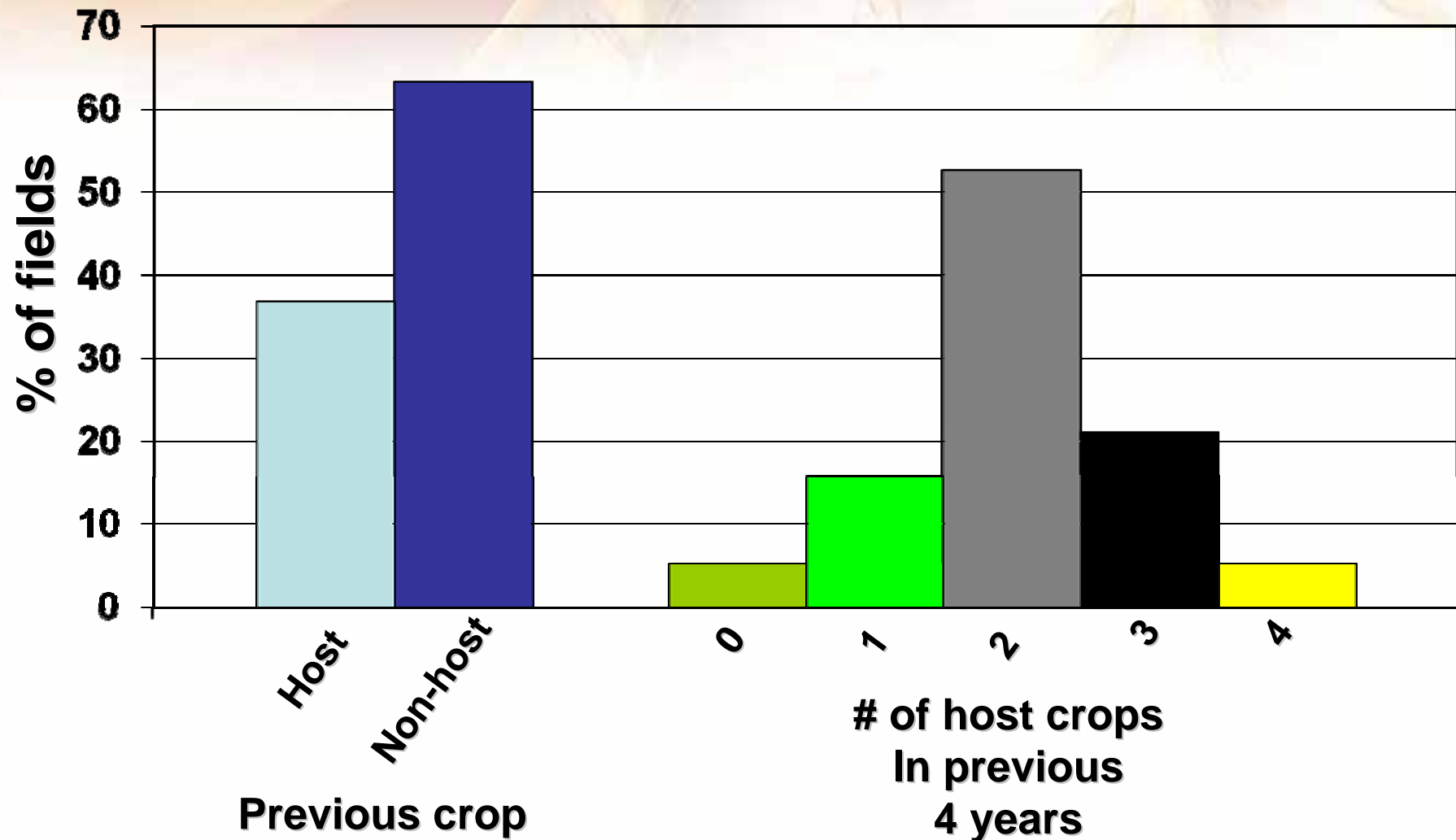
Wheat class and FHB reaction for 19 *F. graminearum* +ve fields identified as part of the CGC new crop survey, 2003



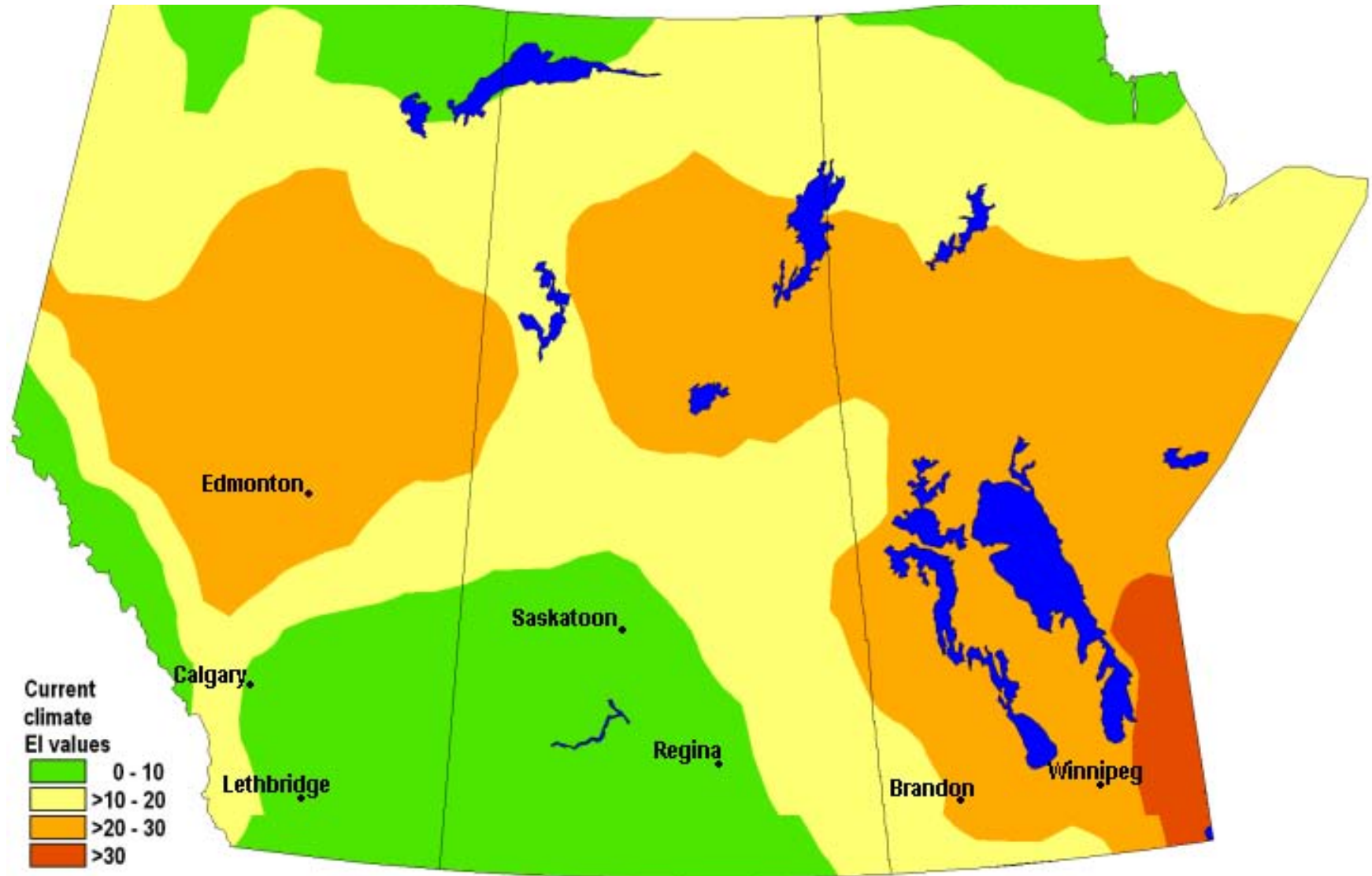
Irrigation and tillage regimes for 19 *F. graminearum* +ve fields identified as part of the CGC new crop survey, 2003



Crop rotations for the 19 *F. graminearum* +ve fields identified as part of the CGC new crop survey, 2003



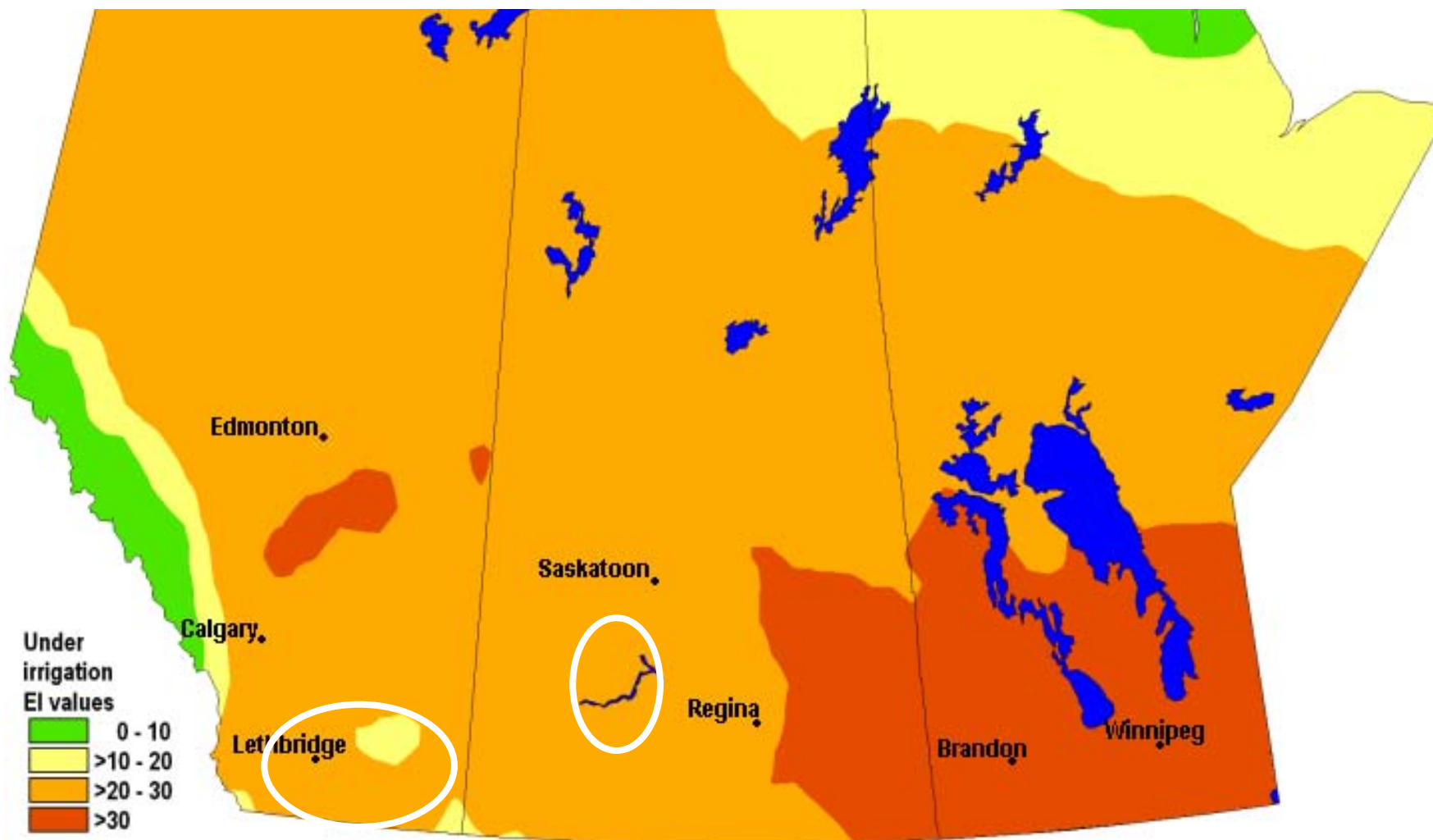
Ecoclimatic Index Values: Dryland FHB Threat Scenario



<=10 – Limited occurrence, >10 to 20 – Generally not economic (limited impact), >20 to <=30– Economic, >30 – Chronic economic impact

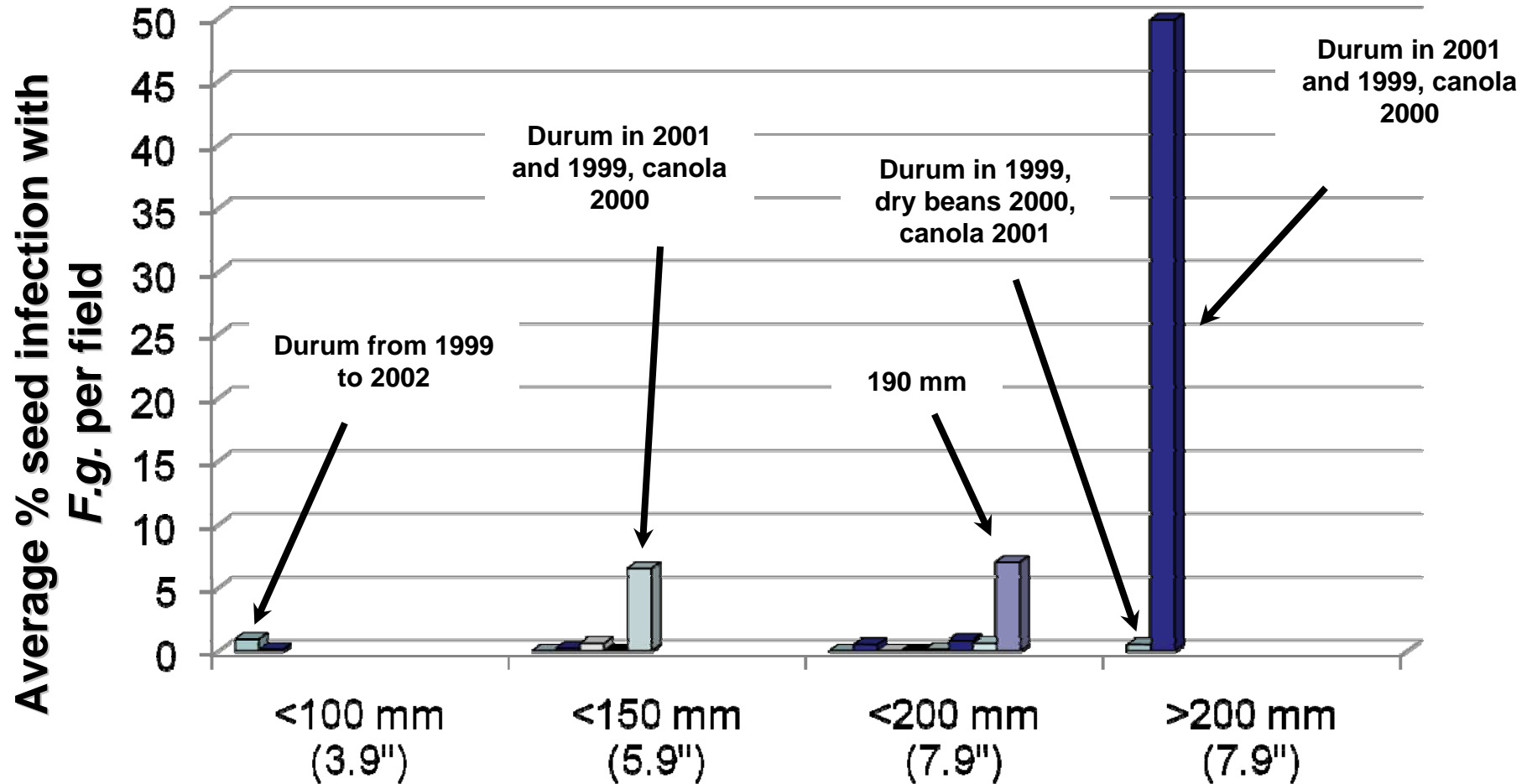
Ecoclimatic Index Values: Irrigated FHB Threat Scenario

(irrigation regime of 4 mm per day was followed for June and July, which is typically the period of highest water use and thus irrigation demand)

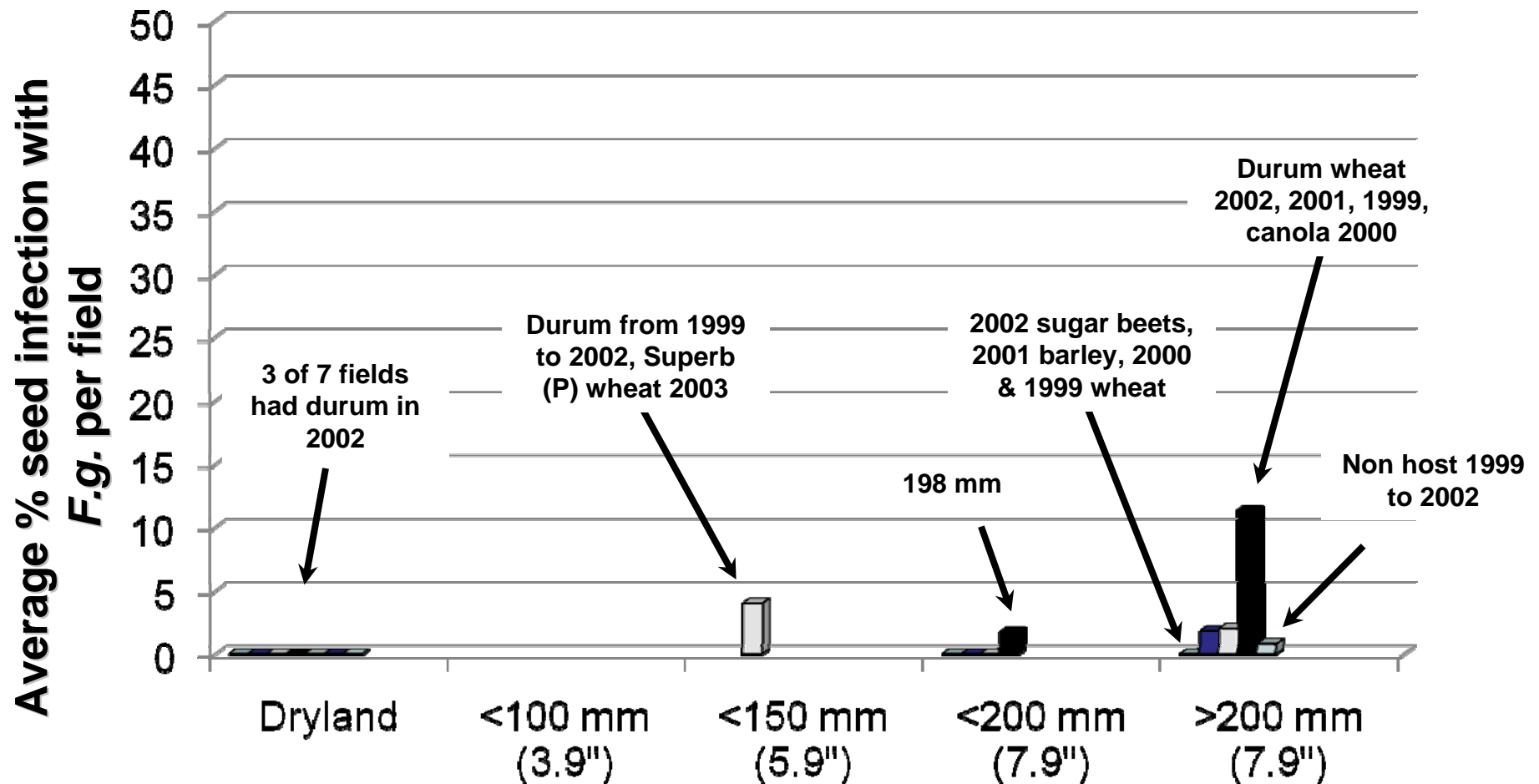


<=10 – Limited occurrence, >10 to 20 – Generally not economic (limited impact), >20 to <=30 – Economic, >30 – Chronic economic impact

Percentage seed infection with *F. graminearum* and irrigation amounts, 2002



Percentage seed infection with *F. graminearum* and irrigation amounts, 2003



Irrigation and fusarium head blight

- **Research from AB and MB (Turkington et al.)**
 - Limit irrigation around flowering
- **Increase seeding rates**
- **Guidelines from A. Efetha, AARD Brooks**
 - Meet crop water needs
 - Reduce FHB risk
- **Irrigation management**
 - Unique opportunity
 - Integrate with other strategies



Examples of FHB Management Strategies

1. Reduce inoculum quantity

Crop rotation

Residue management

Irrigation scheduling

2. Prevent dispersal

Tillage to bury inoculum

3. Prevent infection if inoculum present:

Resistant cultivars

Fungicides (or Biologicals)

Irrigation scheduling

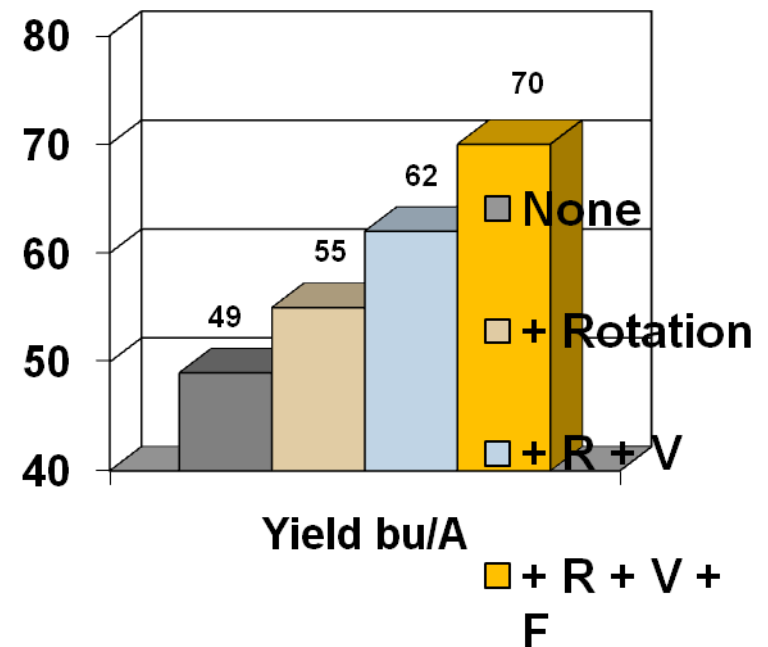
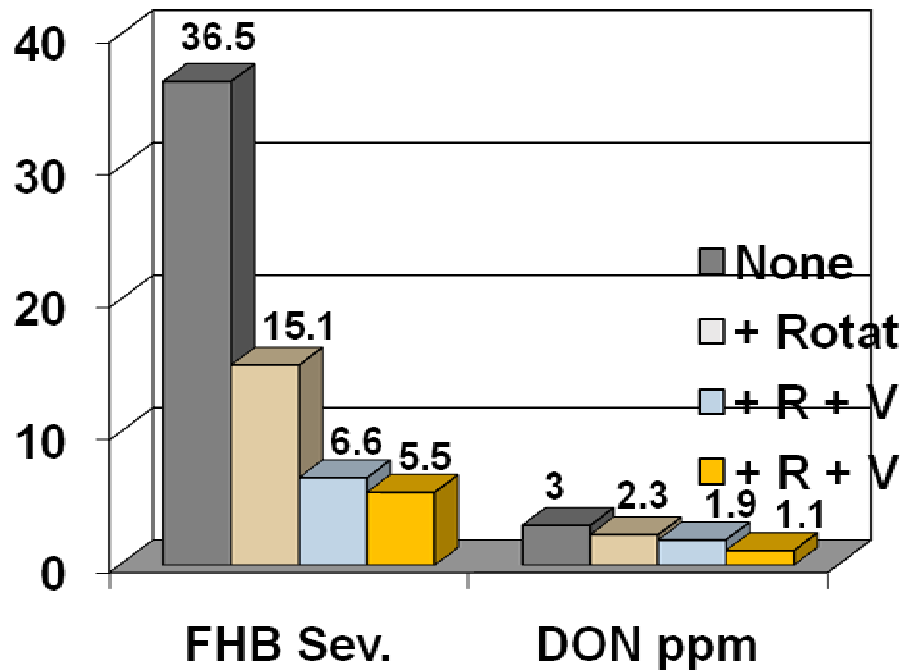
From M. McMullen, NDSU

Single vs Multiple Strategies

“Multiple strategies generally have had more success than a single strategy, but few studies have shown quantitative effects of multiple strategies” (Champeil, et al. 2004. Plant Science 166:1389-1415)

“Use of a single strategy has often failed in the presence of favorable weather for an FHB epidemic” (McMullen, ND experience)

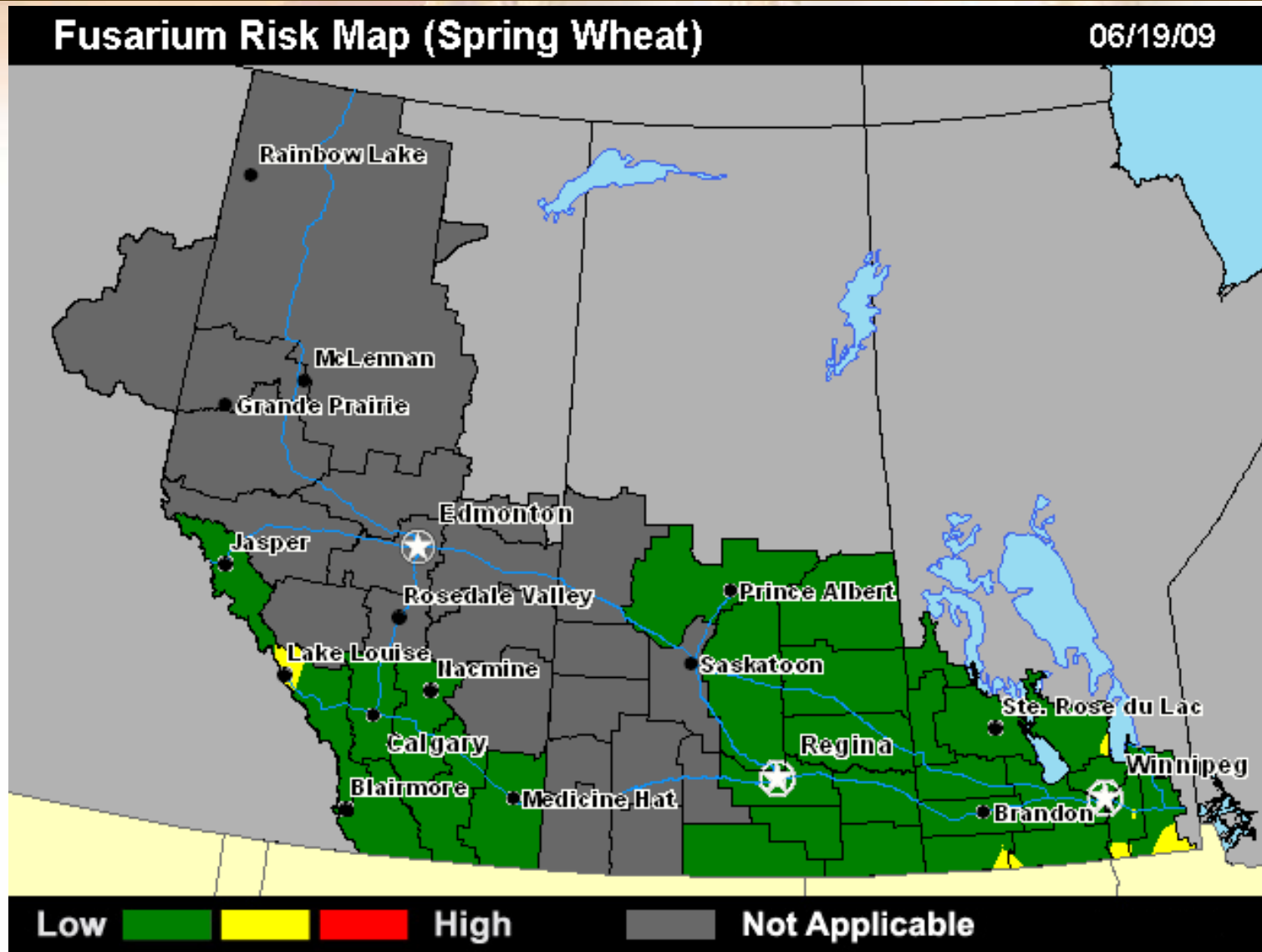
2007 Example: Durum Integrated Study, ND, 3 strategies



None = wheat on wheat, Monroe susceptible variety and no fungicide
 + R = Rotation = Canola previous crop
 + V = More resistant variety = Divide
 + F = Fungicide trt added = Prosaro

Data from Scott Halley, Langdon REC

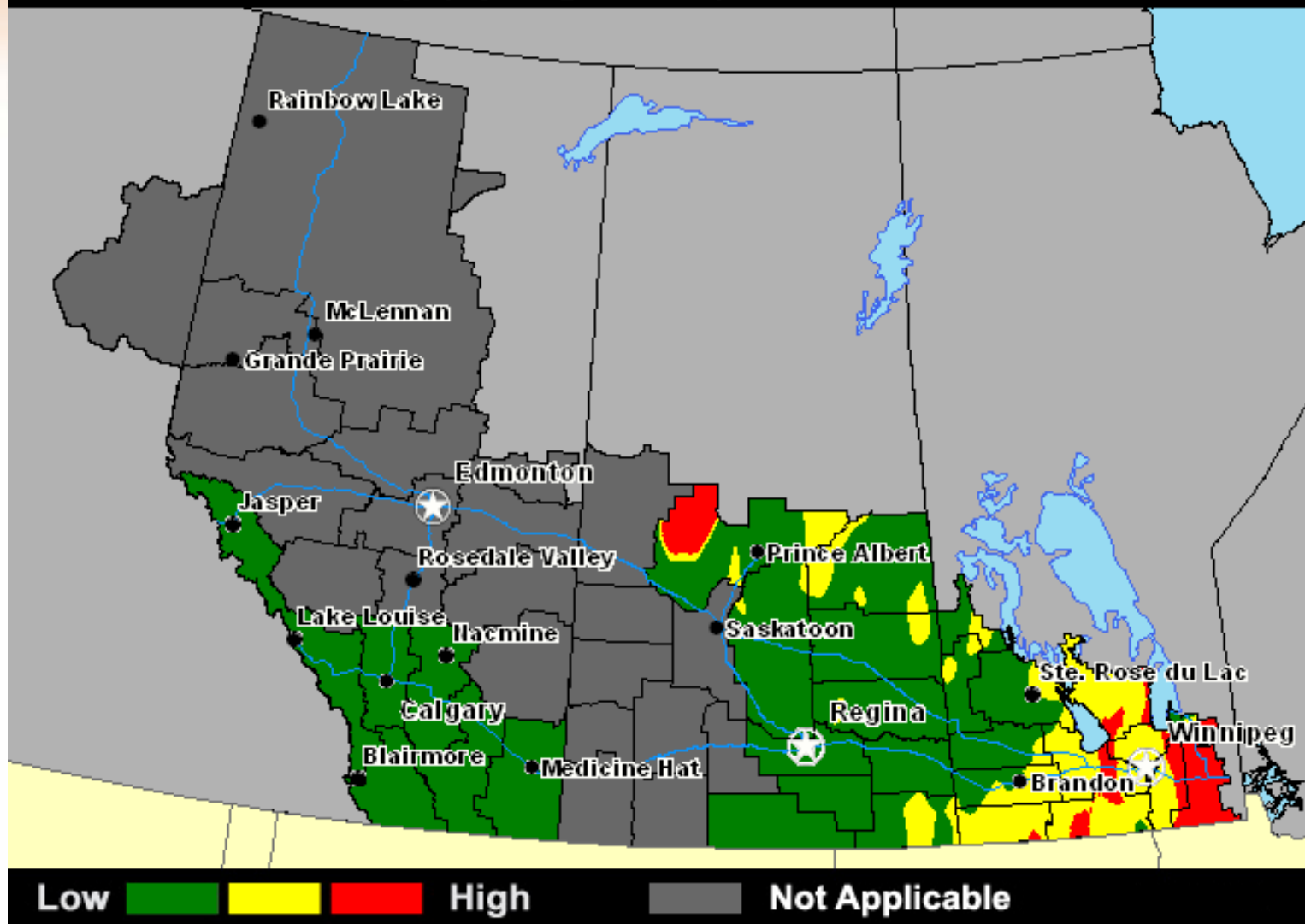
WeatherBug® fusarium head blight risk maps 2009 (Guy Ash, CWB)



WeatherBug® fusarium head blight risk maps 2009 (Guy Ash, CWB)

Fusarium Risk Map (Spring Wheat)

07/03/09





Farmer recommendations for managing FHB

- **Farmers encouraged to use a combination of the following strategies**
 - **Grow more resistant cultivars or classes**
 - **Extend the interval between host crops**
 - At least a 2 year break
 - **Take into account FHB risk from adjacent fields**
 - **Manage irrigation to minimize risk**
 - Avoid excessive irrigation just prior to and during flowering
 - **Consider fungicide application**
 - Where risk warrants it
 - **Monitor appearance and level of *F. graminearum***
 - Harvested grain, seed, and crop residues
 - Respond accordingly





Canada