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Pesticide Risk Reduction Program

Final Report

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Project Title: On-farm field demonstration of the impact of irrigation management, timing of fungicide sprays and cropping system on Fusarium head blight control in irrigated wheat production in Southern AB

Project Code: PRR-130

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Executive Summary

Fusarium head blight (FHB) is a serious problem for grain production in Canada. Specifically, *Fusarium graminearum* produces high levels of deoxynivalenol (DON), a mycotoxin that interferes with acceptability of grain for livestock and human consumption and has quality and functional impacts for the brewing, milling and pasta industries. A three year, field scale study conducted in southern Alberta attempted to verify and demonstrate best management practices associated with irrigation scheduling and fungicide applications. Agriculture and Agri-Food Canada's Pest Management Centre funded the project and Farming Smarter led it in partnership with AAFC, Alberta Agriculture and nine grain producers in southern Alberta.

Fusarium damaged kernels (FDK), a visual grading, were shown to be reduced up to 3.9% with irrigation management and 5.5% with a fungicide application in the co-operators fields (Tables 1-3). Fungicide treatments reduced FDK in 12 of 15 fields (%80) by up to 5.5% in 2010, 2.4% in 2011 and 1.7% in 2012. More intensive pathogen analysis showed that fungicide applications reduced *Fusarium graminearum* (Fg) levels by up to 12% in 2010 & 2012, and 7% in 2011 and irrigation management decreased Fg up to 2%. Deoxynivalenol levels were present at detectible limits (0.1 ppm to 11.0 ppm) in all samples. Fungicide applications reduced DON by up to 3.3 ppm (7.0 – 3.7 ppm) in 2010, up to 1.3 ppm (1.8 – 0.5 ppm) and up to 2.5 ppm (5.7 – 3.2 ppm) in 2012. Irrigation management alone showed a reduction in DON of 0.2 ppm (0.3 – 0.1 ppm) in 1 of 7 fields from 2010-2012.

Net economic benefits of fungicides was positive in 4 of 5 durum fields ranging from approximately \$1-\$3/bu while hard red spring fields showed a positive net benefit in 6 of 9 fields ranging from \$0.1 -\$1.75/bu.

In addition to the field-scale trials, 25 commercial wheat fields were surveyed each year to study production practices that might influence the prevalence of FHB. Information was collected from both irrigated and rain-fed fields including tillage practices, cultivar susceptibility, irrigation management, crop rotation (Tables 4-6).

Surveys indicate a significant increase in producer awareness of Fusarium head blight management as only 2 fields in 2010 noted a history of FHB, 4 fields in 2011 and 16 in 2012. The number of fields sprayed with a fungicide for FHB increased from 4 fields in 2010 to 18 in 2012.

Grain sample analysis showed that 25% of the total fields surveyed contained *Fusarium graminearum,* and 60% contained other *Fusarium spp.* The majority of the fields surveyed (64%) were growing a variety with poor to very poor resistance to FHB, and 59% continued to grow a susceptible variety in fields with a history of FHB. While fields planted to the Canadian Western Red Spring class (CWRS) showed the highest frequency of seed with *Fusarium graminearum* and other *Fusarium spp,* fields of *Canadian Western Amber Durum* (CWAD) showed the highest level (severity) of infected seeds. Fields with varieties rated very poor or poor contained 68% of the *Fusarium graminearum* found in the grain samples. Seventy one percent of the fields that contained Fg had grown a host crop within the previous 2 years.

Irrigation appears to be a key influence as 83% of Fg infected grain samples were from irrigated fields, whereas only 17% were dryland production fields. Consequently, 56% of irrigated fields were treated with a reduced irrigation management strategy. *Fusarium graminearum* and other *Fusarium spp.* seed infection was 3% higher under irrigation compared to dryland. Over the three year study period, 33% of fields that had *Fg* in the grain samples used conventional tillage, were under irrigation and had grown a host crop within two years.

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Background

Fusarium head blight (FHB) is a major cereal disease infecting wheat, barley and field corn in the irrigated areas of southern Alberta. The disease can be caused by a variety of *Fusarium spp.*, but the main species of concern is *F. graminearum* due to its high mycotoxin production and aggressive pathogenic nature. FHB causes Fusarium-damaged kernels (FDK) in grain that may contain a mycotoxin, deoxynivalenol (DON), that is toxic to humans and animals at levels as low as a few parts per million. FDK tolerances in grain are strict and minimal amounts affects grade, resulting in significant reduction in payments to producers. Currently, legislation in Alberta forbids the planting of cereal seed infected with *F. graminearum* as a strategy to help slow down the introduction and spread of this pathogen in Alberta, especially in central and northern Alberta.

Irrigated wheat producers in southern Alberta have been forced to cope with *Fusarium graminearum* for the past number of years with severe implications to profitability. While irrigated acres are at most risk, the problem continues to spread into rain fed areas as far north as the Peace River region of Alberta. Wheat remains a very important crop in rotations with many high value crops grown under irrigation. A reduction in wheat acres, due to FHB, would negatively impact entire cropping systems which include canola seed production, dry beans, potatoes and sugar beets.

Producers are eager to maintain sustainable cropping systems to ensure long term profitability as well as to manage higher than average costs associated with irrigated crop production. It is noteworthy that much effort in this study has been driven by producers from initiating the study to administering the field scale trials and collecting data. Farming Smarter coordinated with producers and researchers in an attempt to demonstrate proven practices as well as learn more about Fusarium management using a practical, applied approach.

Materials and Methods

The main purpose of this study was to demonstrate and fine tune known Fusarium head blight management strategies in a practical field scale approach. In order to accomplish this, Farming Smarter worked with nine producers across southern Alberta (Field-Scale Trial) to study various fungicide and irrigation treatments in 2010 to 2012. An economic analysis of results was completed by ARD economists. We also completed an annual survey of 25 additional fields (Annual Field Survey) to better understand infection levels and linkages to common management practices. Small plot demonstration trials were also established to serve as communication and extension tools during crops tours and field schools.

Field-Scale Trial

Nine producer co-operators in southern Alberta participated in the project from 2010-2012 (Table 1, Table 2, Table 3). Once study field locations were determined, cereal stubble samples from adjacent fields (preferably upwind or east of the study field) were taken and tested for *Fusarium graminearum* (Fg) inoculum levels (Table 1, Table 2, Table 3). Residue samples were collected from standing stubble along a diamond-shaped or W-shaped path starting at least 50 m in from the edge of each field with at least 50 m between sampling sites (Figure 42). At each site 10 clumps of stubble, consisting of the first nodes, crowns and the root systems were collected non-selectively at each of 10 sites along the survey path. Sampled residues were placed in separate, labelled paper bag(s) for each field. If necessary, the samples were air dried at room temperature for several days to ensure that pathogens present in the collected residues remained viable and that sampled plant material was not colonized and decomposed by environmental saprophytes. Ten stem pieces including the first node above ground level were selected from each of the 10 sampling sites within each field. Subsamples of these pieces were cut approximately 1-2 cm long, including stem tissue above and below the lowest node on the stem. Samples were packaged, labeled and sent to BioVision Seed Labs, Edmonton, AB (2010) or AAFC Lacombe, Lacombe, AB (2011, 2012) to determine Fusarium spp. levels.

In the laboratory, node samples were surface-disinfected by soaking in 5% bleach (NaOCl) for 1–2 minutes. After treatment, the bleach solution was drained off using a strainer and sub-samples were air dried under a fume hood. Dried sub-samples were placed on suitable growth media (e.g. potato dextrose agar) for isolation and identification of *Fusarium* spp. Petri dishes were incubated at room temperature for 5–10 days and exposed to 12 h of light per day, consisting of one long wave UV light and three fluorescent cool white lights placed about 50 cm above the plates. Cultures were examined under a dissecting microscope for preliminary recognition of *Fusarium* colonies. A compound microscope was used for species identification via microscopic examination of fungal spores and associated structures. *Fusarium* species were identified using morphological features (Aoki and O'Donnell, 1999; Burgess et al., 1994; Nelson et al., 1983).

Field Treatments and Procedures

One field in 2010 and three fields in 2011 and 2012 received a split irrigation treatment, in which a portion of the field was irrigated during flowering and for the remainder, irrigation was avoided for approximately 4-6 days during the critical flowering period.

Six fields each year received comparative fungicide treatments during the trial. Fungicide selection was left to the co-operating producers. Fungicides were applied by ground sprayer when the crop was between 75% head emergence and 50% flowering (anthesis) of heads on the main stem and according to recommended practices and rates (Anonymous 2011). The only exception to this was co-operator 5 in 2010, whose fungicide was aerially applied due to wet field conditions (Table 1). Fungicides were applied at recommended rates, i.e. Caramba at 405 mL/ac, Folicur at 118 mL/ac, and Prosaro at 320 mL/ac (Anonymous 2011). One exception was in 2010 when co-operator 6 added a ¾ rate of Folicur to compare to the full rate treatment. In 2011, co-operators 6 and 8 tested two wheat cultivars in addition to the irrigation or fungicide treatments in their fields (Table 2).

Disease ratings were collected at the late milk to early dough stage. In each treatment, fifty heads were examined at six stops for a total of 300 heads. Percent incidence was recorded as the number of heads exhibiting visual symptoms of FHB. Percent severity was determined by examining each affected head and recording the percent spikelets infected on the head. FHB index was calculated by multiplying the % incidence by % severity and then dividing by 100.

Yield and Grain Analysis

Yield data was collected when possible for each treatment, using either yield monitor technology or determined by hand-harvesting. Hand-harvesting included 10 random locations of 1 m^2 quadrats per treatment. The material was then threshed using a Hege plot combine and weighed using calibrated analytical balances.

Grain samples from each treatment were collected to assess quality including thousand kernel weight (TKW), test weight (TWT) and protein content. Thousand kernel weight was determined by taking subsamples from each grain sample, counting out and weighing 100 kernels, and multiplying by 10. Test weight was determined with a Dickey-John GAC 2000. Protein was determined with a calibrated Foss Food Technology Grain Spec.

Each grain sample was also assessed for grade and percentage of Fusarium damaged kernels (FDK). These assessments were completed by Cargill AgHorizons Ltd. in Lethbridge according to Canadian Grain Commission standards (Canadian Grain Commission, 2010). Subsamples were sent to Dr. Kelly Turkington's lab (AAFC Lacombe) for pathogen isolation (*Fusarium* spp*., Pyrenophora tritici-repentis*, *Stagonospora nodorum*, etc.) and to AAFC Winnipeg for grinding of samples and AAFC in Ottawa for deoxynivalenol (DON) analysis using an ELISA-based technique. Pathogen isolation and identification procedures were similar to those reported for residue samples from 2010- 2012. For DON assessments, it was ensured that each grain sample was well mixed so that the lighter (FDK) kernels were incorporated with the heavier healthy kernels. The grain was sent to Dr. Jeannie Gilbert's lab (AAFC Winnipeg) for grinding prior to assessment of DON. For grinding, the well mixed sample was passed through the grinder. Next, exactly one gram of the ground sample was placed into a 10 ml screw cap centrifuge tube with an identification label firmly attached. After grinding each sample, the grinder was thoroughly cleaned using an air hose and vacuum. The ground samples were then sent to Dr. B. Blackwell lab (AAFC Ottawa) and analysed for DON content. The 1.0 gram sample was taken and extracted with 5 ml methanol:water (1:9 vol/vol) in a 10 ml plastic tube, which was subjected to end-over-end mixing for 1 hour and then centrifuged at 2,000 rpm. DON analysis was performed on the filtrate by the competitive direct enzyme-linked immunosorbent assay procedure (ELISA) described by Sinha et al. (1995). Results are reported in ppm and the limit of quantitation is 0.1 ppm.

Economic Evaluation

The following outlines the key elements for evaluating BMP's related to the project. The economic evaluation of BMP's is layered over the production-based findings, extending the interpretation from simple yield and revenue results to actionable "net profitability" estimates. As such, producers were exposed to information on, and procedures to evaluate, in their own businesses, the benefits and costs associated with Fusarium mitigation strategies.

Key Production Research Parameters

Project design lays out field trials and demos, differentiating treatments by:

- crop,
- timing of irrigation, and
- fungicide application.

Project results collected, by treatment, include:

- yield,

- grade,
- incidence of infestation, and
- severity of infestation.

Crops were valued using local pricing, accounting for grade and yield, by treatment. Direct costs, by treatment, were estimated using fungicide and application costs as appropriate. Differentials in other direct and indirect costs will be accounted for, starting from base line ***AgriProfit$***[1] benchmarks.

Evaluation Procedures

The primary focus of the economic evaluation related to short term (annual) net benefit estimation. Both risk and return components are highlighted – ranking BMP's by likelihood and net benefit[2]. This creates actionable information for producers entertaining direct or systems-related BMP's, and enhances adoption, as appropriate, based on farm-specific circumstances.

It is of significant note that, depending on the mitigation strategy selected, longer term benefits, costs, and risks can also accumulate. These are not involved in the direct scope of this project and will be addressed qualitatively. They can, however, have far reaching effects on the production, agronomic, and systems choices available to producers in the near term, spilling over to long term shifts in profitability.

Standardized partial budgeting procedures were used to quantify net change in profitability by treatment and associated BMP's. Treatments were compared regarding their added (input and operating) costs and reduced returns (driven by yield and grade), relative to a control or a base case.

As noted previously, these net benefits, or changes in profitability were then mapped relative to their associated risk (see the "BMP Risk-Return Concepts" graphic for a sample depiction). This enables producers to evaluate BMP's relative to the likelihood and severity of a Fusarium event. Mitigation strategies can be short listed according to those practices to avoid and those practices that offer the best profitability outcome.

Annual Field Survey

A head survey of approximately 25 randomly selected fields was conducted in 2010, 2011 and 2012 at the late milk to early dough stage (Table 4, Table 5, and Table 6). The survey included both irrigated and dryland fields across southern Alberta. In each field, 100 heads were examined in

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[1] ***AgriProfit$*** Business Analysis & Research Program, Economics & Competitiveness Division, Alberta Agriculture and Rural Development

[2] Using the ***RiskChoice$*** approach (http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/bmi12504), charting BMP's according to their likelihood (risk) and impact (net benefit) adds a much needed dimension to the presentation of trial and demo results.

three locations for a total of 300 heads per field. Heads were collected, hand threshed, and grain sent to Dr. Kelly Turkington's (AAFC Lacombe) lab for pathogen identification.

Agronomic information was collected from producers including variety, crop rotation, irrigation regime and FHB history of the field surveyed as well as adjacent fields. Cultivar susceptibility was determined once variety information was collected.

Maps were created to evaluate the distribution of Fusarium damaged kernels (FDK) throughout the study for 2010- 2012 using Arc Map (Figure 8). The legal land description from each field were converted to latitude and longitude coordinates using prairie land locator (www.prairielandlocator.com) that pinpoints the location to the center of a section; therefore the positions are within a ½ mile accuracy of the true field. The projection is North American Datum 1983 Universal Trans Mercator Zone 12 North, a common projection for Alberta maps.

Demonstration Trials

Demonstration plots were established in 2010 at the Farming Smarter research & demonstration site just east of Lethbridge, Alberta (Figure 39). Plots were set up with 6 susceptible varieties under standard irrigation and reduced irrigation and an application of one of three fungicides and a check.

The Fusarium demo in 2011 contained varieties from CPS, CWSWS, Triticale, Durum, CWRS, CWHWS, general purpose wheat, 2-row malt, 6-row feed & malt or 2-row feed in combination with one of four treatments; Prosaro, Caramba, untreated check or inoculated check (Figure 40).

2012 looked at one of three fungicide application timings; with herbicide, at flag leaf and FHB timing (Figure 41).

Results and Discussion

Field-Scale Trials

Some good results were gathered in 2010 despite a very challenging season with regards to weather (Table 1). Seeding was delayed due to a very wet spring which led to many producers to change their cropping plans, usually from durum to spring wheat. Some fields also had multiple seeding dates due to areas drowning out after being seeded. Co-operator 2's field received no irrigation or fungicide treatments due to excess moisture. The wet weather continued until June, leading most producers to delay irrigation until well after flowering, if at all (Figure 44, Figure 45). However, co-operators were able to administer fungicide applications, except co-operator 5, who was unable to leave a check strip due to the requirement of an aerial application. A severe hail storm caused significant damage to co-operator 7's field, which decreased the amount of data that could be collected.

In 2011, extreme spring precipitation also created complications. However, three producers were able to administer irrigation treatments and eight applied fungicide for FHB suppression (Figure 46, Figure 47). Two co-operators, 5 and 7, were unable to leave check strips when applying fungicide

(Table 2). Co-operator 1 administered irrigation treatments, but had significant flooding and excess moisture issues, leading to late seeding and harvest.

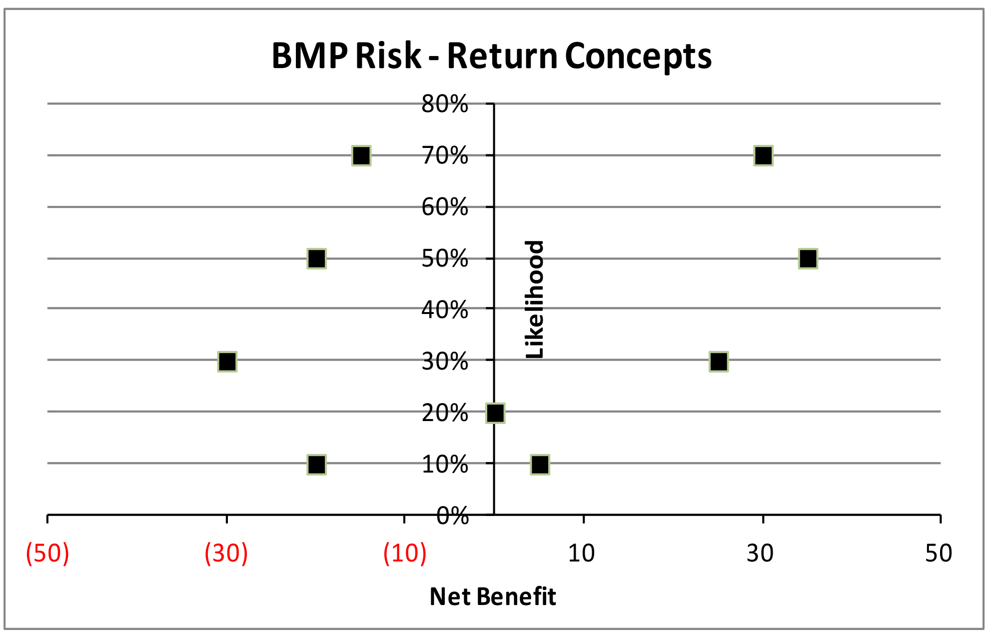
2012 brought a cool, wet spring that promoted lush crop growth. Starting around July, temperatures were above normal and very little precipitation occurred during the flowering period and throughout harvest (Figure 48, Figure 49). A number of late season days over 30 degrees resulted in yields that were lower than expected. These environmental conditions favored leaf disease, but not Fusarium due to the hot and dry conditions during flowering. Heavy winds after swathing reduced yields for co-operator 1, while late season hail reduced yield on field 3; which prevented data collection of FDK, DON, grade and accurate yields.

Economic Evaluation of Field Trials

Project results from the three years of trials do show differentiation between treatments. There is an indication that some of the BMP's may show a positive short term net benefit (Figure 1-6).

However, rainfall events during one of the project's crop years removed the opportunity to gain agronomic results associated with timing of irrigation. Moisture conditions were such that irrigation was not required, effectively removing one of the conditions that allows Fusarium to thrive.

Figure 1: Likelihood of Net Benefit with Fungicides and Irrigation Management

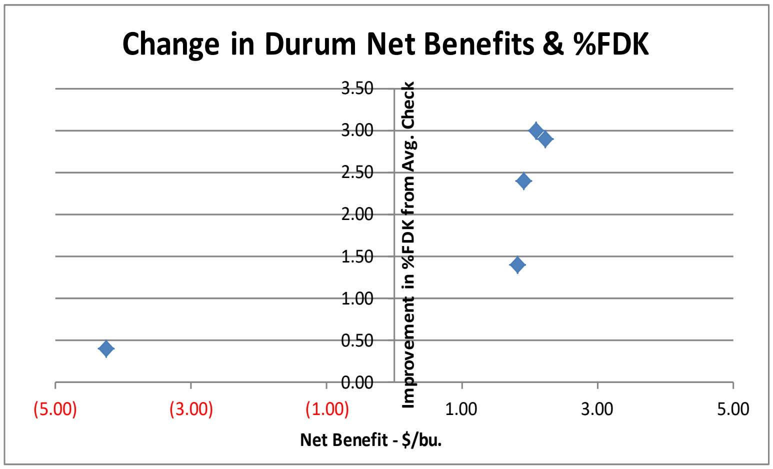


Results – Fungicide Applications[3]

[3] Please see Table 15, Table 16, Table 17 for a listing of grain prices, fungicide costs, and fungicide application cost.

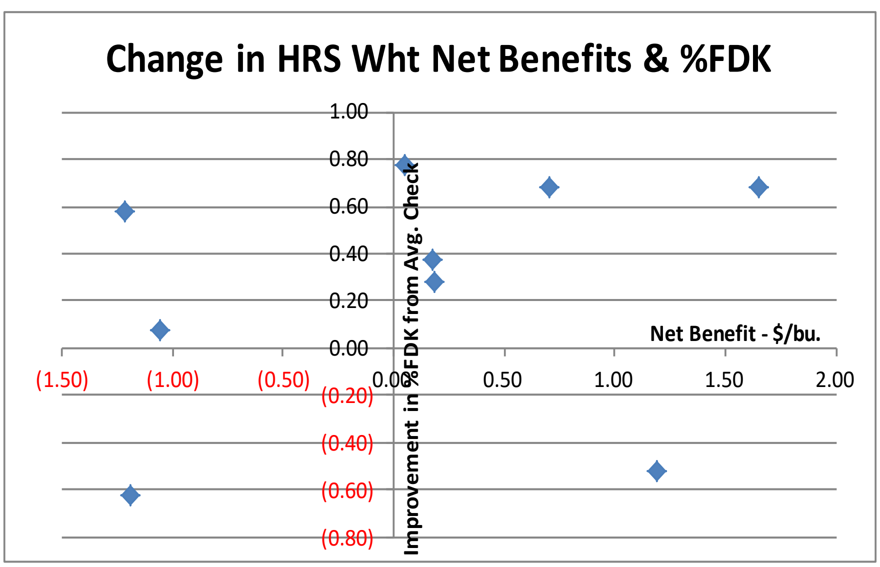
Trial results do reveal some of the patterns expected regarding fungicide applications and Fusarium control. Durum, which is more susceptible to Fusarium, shows a predominant pattern of improved profitability for four of the five fields in 2010 and 2011 while all five fields showed a reduction in %FDK (improvement, y-axis) (Figure 3). Please note that durum results for 2012 are not included due to incomplete trial data.

Figure 2: Change in Durum Net Benefits 2010-2011



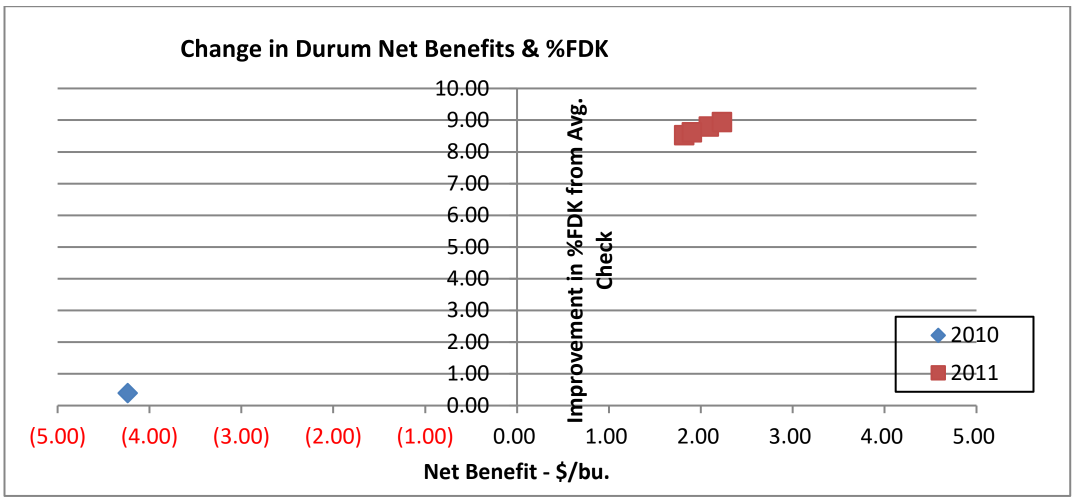
The results for the hard red spring trials are more mixed, but still visibly hold a pattern similar to durum (Figure 4). Five of nine trials showed an improvement in net benefit and % FDK relative to the average of the check fields. One trial showed a net decrease in both, while one trial result showed an increased net benefit even though the % FDK also increased compared to the average. These results could be attributed to a wide array of agronomic reasons and conditions conducive to Fusarium infestation.

Figure 3: Change in HRS Wheat Net Benefits and %FDK with fungicide applications 2010-2012



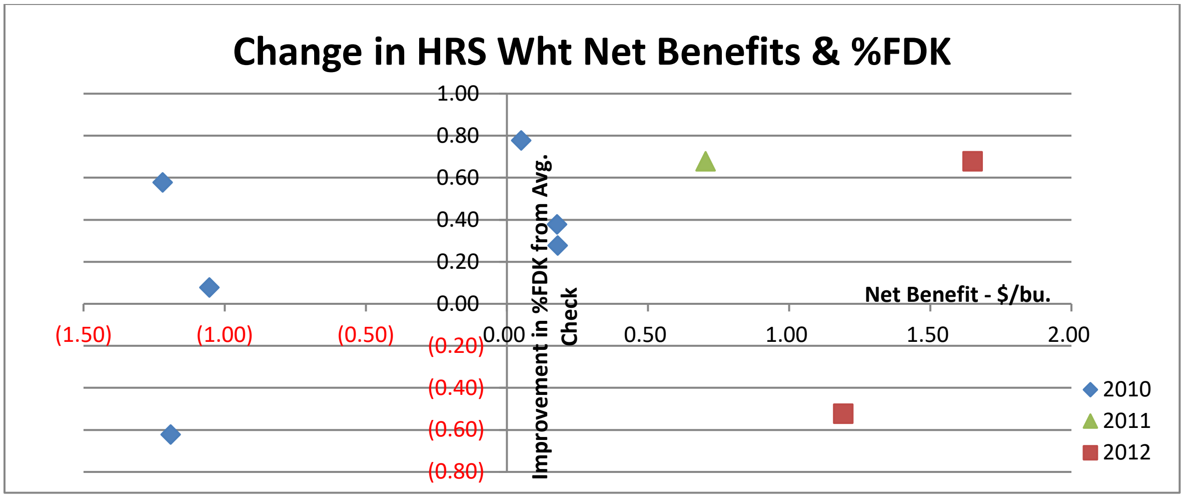
The net benefit of individual fungicide applications within each trial year was reviewed for potential patterns (Figure 5). Results show that durum displays a distinct net benefit pattern in 2011. When this result was cross referenced with type of fungicide applied, this net benefit was associated with Prosaro. However, caution should be used with this result as agronomic practices and/or the 2011 growing year may have had an effect. As such, both of these areas should be considered in future research trials. Negative net benefit in the 2010 field was due to highly reduced returns associated with severe yield loss and grade reduction due to frost damage. Again, durum trial data for 2012 could not be included due to incomplete data.

Figure 4: Change in Durum Net Benefits associated with fungicide applications and %FDK



However in trials of hard red spring wheat no clear pattern was found when the net benefit of fungicide application was compared among years (Figure 6). We can see that in 2011 there was a definite net benefit from fungicide application. But years 2010 and 2012 showed mixed results. Again the impact of agronomic practices and/or growing year conditions may have had an effect. Therefore, additional future research should be of consideration.

Figure 5: Change in HRS Wheat Net Benefits and %FDK with fungicide applications 2010-2012 Cross-referencing with timing of irrigation should add a significant dimension to the results. Extension of these findings adds information for producers to evaluate management options.

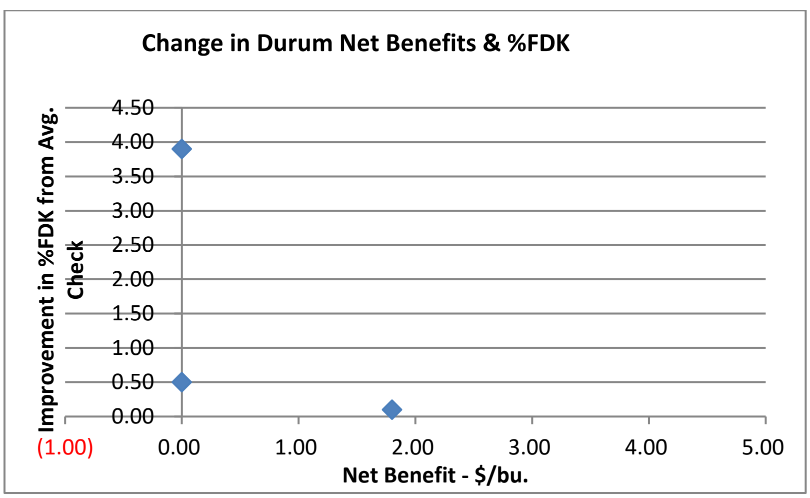


Results – Irrigation Timing

Prevailing moisture conditions in the first two trial years limited the ability to observe Fusarium response to delayed vs. regular irrigation timing. A few observations were available for comparison, though. In all three instances, delay of irrigation was at least indifferent or improved % FDK, without a net reduction in economic benefit (figure 7). Again, please observe that durum results for 2012 could not be included due to incomplete data.

If the pattern of delaying irrigation during flowering holds, then it may provide producers with a viable option to manage moisture conditions, thereby reducing the likelihood and severity of Fusarium within a cropping season.

Figure 6: Change in Durum Net Benefits and %FDK with irrigation scheduling 2010-2011



Short & Long Term Implications

The evaluation approach documented above lays out the nature of short term economic results expected from the project. However, there are longer term considerations that should also be kept in mind, predicated on the notion that "Fusarium is here". If practical mitigation strategies are not put in place, the disease will likely increase in frequency and severity. As such:

- near term BMP's that keep FHB in check and manageable are likely more cost effective than the future, more radical treatment approaches
- crop rotations and other common cultural practices, in combination with fungicide use, may effectively minimize the impact of Fusarium in susceptible crops on a year-to-year basis. However, it would likely be best to combine fungicide use, with rotation and use of a resistant variety to provide the most effective reduction in the impact of FHB
- maintaining flexibility in crop and varietal choices for annual cropping plans is critical. Fusarium has the potential to chase current profitable and risk-beneficial crops out of rotations.
- reliance on new disease resistant varieties comes at a cost, typically a yield or quality trade-off

Each of these elements can effectively diminish the long term profit prospects of crop producers in the region. This project stands to reveal some practical, realistic, and profit-motivated BMP's that could be readily adopted by producers.

Finally, the evaluation processes and logic presented are not restricted to Fusarium-related BMP's. These same principles apply to similar diseases afflicting crop production. The knowledge set associated with this project is transferrable to other cereal disease issues.

Weather Monitoring

Weather data was collected by accessing information from the closest weather station from Alberta Agriculture and Rural Developments AgroClimatic Information Service (ACIS, http://agriculture.alberta.ca/acis/).

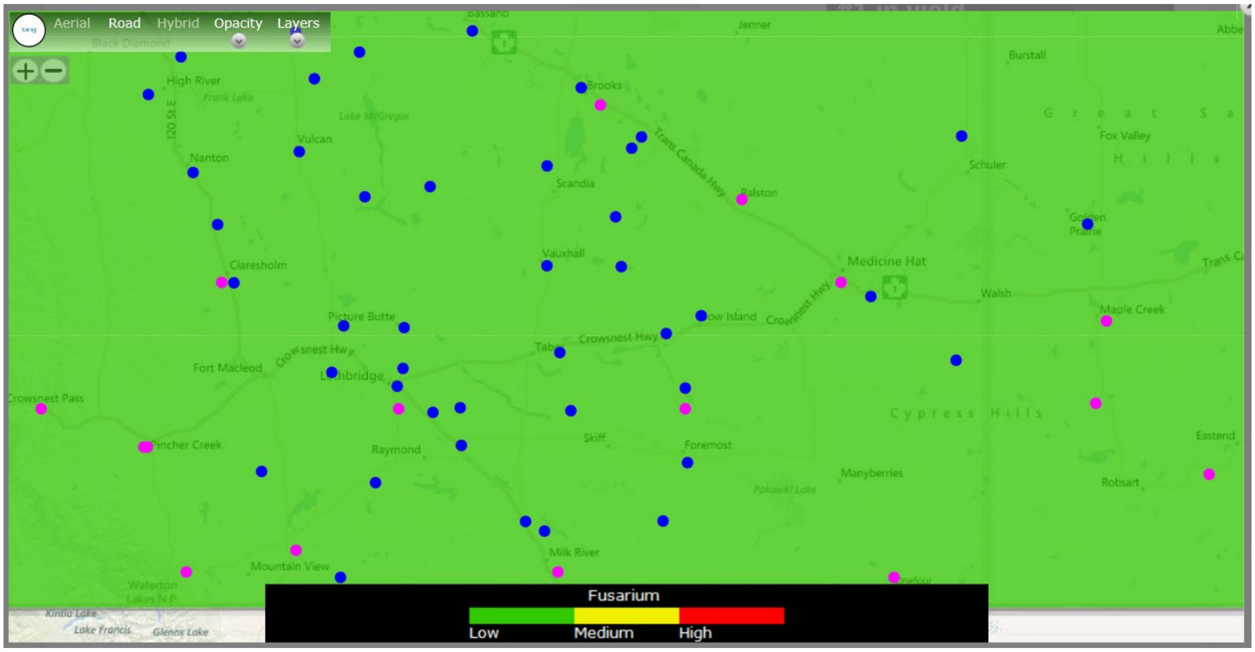
Additionally, FHB risk forecasts were accessed for 2011 from the CWB for areas in southern Alberta where field trials and surveys were located (www.cwb.ca). In 2010, above average precipitation occurred in many areas of southern Alberta and likely contributed to the development of FHB in some fields.

In 2011, dry conditions in July likely precluded the development of significant levels of FHB in southern Alberta. The lower levels of FHB, seed infection and DON contamination observed in 2011 in southern Alberta generally reflected the low risk of FHB that was predicted by the WeatherFarm FHB risk map forecasts generated by the Canadian Wheat Board. For example, Figure 7 has the risk forecast map for July 1, 2011 and for a wheat variety rated as poor for FHB resistance. For southern Alberta on this date, the risk of FHB was rated as low.

Given changes to the Canadian Wheat Board, forecasts were not available for 2012.

Precipitation and temperature from nearest weather stations is attached in Appendix D.

Figure 7: Fusarium head blight risk forecast for wheat varieties rated as poor for FHB, July 1, 2011. Weather Farm website, courtesy of G. Ash, Canadian Wheat Board, Winnipeg, MB. (http://commandcenter.weatherbug.com/Pages/RiskMaps.aspx?tab=9&acct=5).



Results Tables

Results from the field-scale trials are displayed below. Table 1 summarizes the data collected in 2010, Table 2 the data from 2011, the data from 2012. Information includes spring stubble samples, cultivar susceptibility to FHB, treatment details, visual disease ratings, grain quality characteristics, % FDK, DON levels, and yield. Explanation of significant results follows the tables.

Table 1. Crop information and grain analysis results from each treatment in nine Fusarium head blight (FHB) irrigation management/fungicide demo trials in commercial wheat fields in southern Alberta in 2010

Co-operator	Stubble Results[c]		Cult. Susc.[d]	Fungicide Treatment(s)[e]	Irr. Trt.[f]	FHB % Incid-ence	FHB % Severity	FHB Index[g]	TKW (g)	Test Weight (kg/hL)	Protein Content (%)	%FDK	Grain Sample Fg (%)	DON (ppm)	Grade	Yield (bu/ac)
	% Fg	% Other Fus. spp.														
1	0	73	VP	None	F	N/A	N/A	N/A	29	54.7	13.2	8.5	1	0.2	Special[h]	30.6
			VP	None	R	0.33	7.00	0.02	29	55.5	12.9	4.6	0	0.2	Special[h]	31.5
			VP	Folicur	F	0.00	0.00	0	23	50.5	12.8	3	0	0.7	Special[h]	30.7
2	16	86	F	Untreated	N	3.00	24.3	0.73	40.75	72.7	13.6	0.6	3	1.5	Feed[h]	81
3[a]	8	N/A	VP	Folicur July 26	N	3.83	16.0	0.61	41.25	71.1	11.6	2.3	43	3.7	Feed[h]	75
			VP	Folicur Aug 4	N	1.67	17.7	0.29	35.5	68.1	11.8	3.9	35	11.0	Special[h]	83
			VP	Untreated	N	N/A	N/A	N/A	32	69.2	11.4	6.4	31	7.0	Special	65
4	8	92	VP	Untreated	N	1.33	8.2	0.11	34.75	78.8	10	0.8	0	0.1	1	94
5	4	83	P	Caramba	N	0.33	2.3	0.01	45	76.6	15.6	0.2	0	0.1	Feed[h]	65
6[a]	34	57	F	Folicur	N	0.67	4.7	0.03	41.5	74.1	14.8	0.7	1	0.2	Feed	110
			F	Folicur 3/4 rate	N	0.33	21.5	0.07	42.75	72.7	14.5	0.4	2	0.1	3[h]	93
			F	Caramba	N	0.17	1.2	0.01	43.25	75.8	14.1	0.5	1	0.1	3[h]	100
7[a, b]	10	N/A	P	Untreated N	N	1.00	4.7	0.05	42.5	N/A	N/A	N/A	2	N/A	N/A	34
			P	Untreated S	N	1.00	7.0	0.07	26.5	N/A	N/A	N/A	10	N/A	N/A	1.8
			P	Caramba	N	1.57	11.7	0.18	20.5	N/A	N/A	N/A	9	N/A	N/A	0.35
8	12	78	G	Untreated	N	0.58	5.67	0.04	36.5	72	13.7	1	3	0.2	Feed[h]	N/A
			G	Folicur	N	0.17	2.3	0.01	34.5	72.5	13.4	1.4	3	0.1	Feed[h]	66
9	14.5	75	U	Untreated	N	2.00	10.5	0.21	37	73.8	14.5	0.1	0	0.3	3[h]	61
			U	Folicur	N	1.17	17.7	0.21	38	75.8	14.5	0	0	0.1	3[h]	61

[a] Samples and yields for these co-operators were obtained using hand-threshing

[b] Co-operator 7's sustained severe hail damage, resulting in incomplete data

[c] Results from spring stubble samples of adjacent; % Fg = % lower stem infection by F. graminearum; %Other *Fus*. Species = % lower stem infection by other *Fusarium spp.*

[d] Cult. Susc. = Cultivar susceptibility to FHB; VP = Very Poor, P = Poor, F = Fair, G = Good

[e] Typically made according to recommended rates and timings (Anonymous 2011). See Materials and methods for further details.

[f] Irr trt = Irrigation Treatment; F = Full irrigation (irrigation continued during flowering), R = Reduced Irrigation (irrigation avoiding at flowering), N = no difference in irrigation between treatments

[g] FHB index = (% incidence x % severity)/100	[h] Grade received due to effects of frost

Table 2. Crop information and grain analysis results from each treatment in nine Fusarium head blight (FHB) irrigation management/fungicide demo trials in commercial wheat fields in southern Alberta in 2011

Co-operator	Cult. Susc.[b]	Stubble Results[c]		Fungicide Treatment[d]	Irr. Trt[e]	FHB Incid-ence (%)[f]	TKW (g)	Test Weight (kg/hL)	Protein Content (%)	%FDK	Grain Sample Fg (%)	DON (ppm)	Grade	Yield (bu/ac)
		% Fg	% Other Fus. Spp.											
1	P	0	53.0	None	F	0	35	74.2	14.3	0.1	0	0.1	Feed[g]	39.5
	P			None	R	0	36	76.5	14.3	0.1	0	0.1	Feed[g]	39.5
2[a]	VP	2.7	27.3	Untreated	N	2.67	46.8	75.9	14.5	4.4	7	0.6	5	73.7
	VP			Prosaro	N	0.67	50.4	78.7	12.7	2	1	1.3	3	75.3
3	F	19.1	24.6	Untreated	N	2.33	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	F			Folicur	N	1.00	36	>75.0[h]	16	0.1	1	0.2	1	65
4	P	0.0	15.1	Untreated	N	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	56.7
	P			Tilt	N	0	33	>75.0[h]	11.2	Nil	0	0.1	1	68.3
5	P	0.0	56.4	Caramba	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6[a]	P	8.2	40.0	Untreated	N	N/A	44.4	76.5	15.6	0.8	1	0.4	3	67.1
	P			Prosaro	N	N/A	41.4	74.6	17.1	0.4	0	0.2	2	53.5
	VP			Untreated	N	5.00	47	77.7	15.9	1.4	1	0.2	3	68.4
	VP			Prosaro	N	1.33	42.4	78.9	14.4	0.5	4	0.4	2	78.4
7[a]	F	47.3	40.9	Caramba	N	3.67	39	81.8	14.7	0.85	12	1.1	3	68
	F			Caramba (w/ Tilt)	N	0.67	38.4	81.3	15.3	0.5	8	1.2	2	62.3
8	P	3.0	36.6	Prosaro- Snowstar	R	0	34	82.7	14.4	Nil	0	0.1	1	96
	P			Prosaro- Snowstar	F	0	35	80.5	13.8	0.15	0	0.3	1	100
	G			Prosaro- Waskada	F	0	43	81.8	14	0.1	0	0.2	1	N/A
9	P	5.5	43.6	Untreated	F	N/A	48	77.6	11.7	1.9	0	0.3	4[g]	99
	P			Prosaro	F	N/A	49	78.3	11.4	1	0	0.3	3[g]	102.5
	P			Untreated	R	5.00	48	79.4	11.8	1.8	0	0.3	3[g]	97
	P			Prosaro	R	2.67	53	77.8	11.7	0.5	0	0.3	3[g]	102

[a] Samples and yields for these co-operators were obtained using hand-threshing [b] Cult. Susc. = Cultivar susceptibility to FHB; VP = Very Poor, P = Poor, F = Fair, G = Good
[c] Results from spring stubble samples; % Fg = % lower stem infection by F. graminearum; %Other *Fus*. Species = % lower stem infection by other *Fusarium spp.*
[d] Typically made according to recommended rates and timings (Anonymous 2011). See Materials and methods for further details.
[e] Irr trt = Irrigation Treatment; F = Full irrigation (irrigation continued during flowering), R = Reduced Irrigation (irrigation avoiding at flowering), N = no differentiation
[f] FHB severity was not taken this year therefore cannot calculate FHB Index [g] Grade received due to effects of frost, green seed, and/or mildew
[h] Test weight was estimated as there was not enough sample to get an accurate reading from the DICKEY-john

Table 3. Crop information and grain analysis results from each treatment in nine Fusarium head blight (FHB) irrigation management/ fungicide demo trials in commercial wheat fields in southern Alberta in 2012

Co-operator	Cult. Susc.[b]	Stubble Results[c]		Fungicide Treatment[d]	Irr. Trt[e]	FHB Incid-ence (%)[f]	FHB % Severity	FHB Index[l]	TKW (g)	Test Weight (kg/hL)	Protein Content (%)	% FDK	Grain Sample Fg (%)	DON (ppm)	Grade	Yield (bu/ac)
		% Fg	% Other Fus. Spp.													
1	G	0	10	None	F	0.00	0.00	0.00	26.7	59.8	14.6	0.05	0	0.1	3[g]	~28[h]
				None	R	0.00	0.00	0.00	29.0	61.6	15.5	0.2	0	0.1	2[g]	~28[h]
2	P	0	88	Untreated	R	5.33	10.69	0.57	N/A	N/A	N/A	N/A	6	N/A	N/A	N/A
				Caramba	R	0.33	7.00	0.02	43.7	63.8	12.2	0.4	1	0.5	5[g]	~90[i]
3	F	5	47	Prosaro	F	0.00	0.00	0.00	N/A	N/A	N/A	N/A	0	N/A	N/A	~20[j]
				Prosaro	R	1.00	7.00	0.07	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A
4	P	0	28	Untreated	R	0.00	0.00	0.00	29.7	62.6	12.6	0.05	14	0.1	1	64.31
				Caramba	R	0.00	0.00	0.00	28.7	62.4	12.9	0.1	0	0.1	1	78.52
5	P	1	39	Caramba	R	0.33	7.00	0.02	42.7	61.9	15.8	0	57	0.1	3[g]	N/A
				Caramba	R	N/A	N/A	N/A	37.3	62.1	14.8	0.3	52	0.7	2[g]	71
6	G	0	34	Untreated	R	0.00	0.00	0.00	N/A	N/A	N/A	N/A	23	N/A	N/A	N/A
				Prosaro	R	0.00	0.00	0.00	39.3	62.9	15.8	0.05	9	0.1	3[g]	87
7[a]	P	7	35	Untreated #1	F	3.67	8.27	0.30	33.3	55.6	15.5	3	0	3.2	SAMPLE	37.9
				Caramba #1	F	3.00	7.00	0.21	34.7	58.4	15.3	1.3	1	5.7	3	63.5
				Untreated #2	F	0.67	7.00	0.05	34.7	59.2	14	0.8	0	1.6	2	49.7
				Caramba #2	F	0.33	7.00	0.02	38.0	59.3	14.4	0.1	0	0.7	1	58.5
8	P	0	7	Untreated #1	F	0.00	0.00	0.00	34.3	62.9	15.9	0.2	0	0.1	1	N/A[k]
				Prosaro #1	F	0.33	7.00	0.02	37.3	62.5	16.2	0.05	2	0.2	2[g]	N/A[k]
				Untreated #1	R	0.00	0.00	0.00	34.7	61.7	15.9	0	0	0.7	1	N/A[k]
				Prosaro #1	R	0.00	0.00	0.00	33.3	62	15.4	0.05	0	0.1	1	N/A[k]
				Untreated #2	F	0.00	0.00	0.00	36.3	63.3	15.8	0.08	0	0.1	1	N/A[k]
				Prosaro #2	F	N/A	N/A	N/A	37.0	63.4	15.4	0.08	0	0.1	1	N/A[k]
				Untreated #2	R	N/A	N/A	N/A	34.7	63	16	0	0	0.2	1	N/A[k]
9	G	1	51	Untreated	R	0.67	7.00	0.05	35.3	62.2	15.3	0.2	0	0.3	1	76.4
				Folicur	R	0.00	0.00	0.00	36.7	61.3	15	0.15	0	0.1	1	76.2
				Folicur	R	N/A	N/A	N/A	35.3	61.2	15.3	0	6	0.1	1	77.1
				Prosaro	R	0.00	0.00	0.00	36.3	62.1	15.2	0.1	1	0.1	1	77.4

[a] Samples and yields for these co-operators were obtained using hand-threshing [b] Cult. Susc. = Cultivar susceptibility to FHB; VP = Very Poor, P = Poor, F = Fair, G = Good
[c] Results from spring stubble samples; % Fg = % lower stem infection by F. graminearum; %Other *Fus*. = % lower stem infection by other *Fusarium spp.*
[d] Typically made according to recommended rates and timings (Anonymous 2011). See Materials and methods for further details.
[e] Irr trt = Irrigation Treatment; F = Full irrigation (irrigation continued during flowering), R = Reduced Irrigation (irrigation avoiding at flowering)
[f] FHB index = (% incidence x % severity)/100
[g] Grade received due to ergot, midge, and/or smudge damage
[h] Yield low due to heavy wind damage of swaths
[i] Yield was not mapped and therefore less accurate
[j] Yield low due to hail damage one week before maturity
[k] Yield estimated by hand harvesting which is less accurate
[l] Cooperator had two combines running on the field and one was not recording properly, information was lost

Spring Stubble Samples

Spring stubble sample results in 2010 showed high levels of *Fusarium graminearum* colonization with 8 of 9 testing positive with a range from 0 to 34% (Table 1). Other *Fusarium* spp. including avenaceum, accuminatum, poae, sporotrichiodes, equiseti, sativas, tritici-repentis and nodorum made up the majority of isolates obtained and it appears likely that some would also be contributing FDK and DON content.

Spring stubble samples results for 2011 also showed high levels of Fg inoculum with 6 of 9 fields testing positive with a range from 0 to 47.3% (Table 2). In spring stubble samples in 2012 there were relatively low levels of *Fusarium graminearum* colonization with 4 out of 9 testing positive with a range from 1 to 7% (Table 3). Co-operators 3 and 7 had the highest Fg levels at 5% and 7% respectively and the remaining fields had 0 to 1%. All fields contained other *Fusarium spp.* that ranged from 7 to 88%, some of which contained *F. culmorum* that also produces DON. Depending on the year, other *Fusarium* spp. including *F. avenaceum*, *F. accuminatum*, *F. poae*, *F. sporotrichiodes*, and *F. equiseti*, as well as *Cochliobolus sativus* (common root rot, kernel smudge), *Pyrenophora tritici-repentis* (tan spot, red smudge) and *Stagonospora nodorum* (leaf and glume blotch) made up the majority of isolates obtained. Several of the *Fusarium* spp. and *S. nodorum* likely contributed to the presence of FDK in harvested grain, while *F. graminearum* and *F. culmorum* would have also contributed to DON contamination.

Visual Disease Ratings

Visual FHB incidence in 2010 ranged from 0-3.83%, and severity ranged from 0-24.3% (Table 1). Co-operator 2 and 3 received the highest overall FHB index at 0.73 and 0.61. FDK and DON were also high for these cooperators.

In 2011, Fusarium head blight incidence was highest in Fields 2, 3, 6, 7, and 9 for some or all treatments, while FHB levels in the remaining fields were zero (Table 2). In Fields 2, 3, 6 and for the reduced irrigation treatment in Field 9, fungicide application seemed to be associated with reductions in FHB incidence. FHB incidence in co-operators fields that used a fungicide was reduced up to 3.7% in 2011.

Maximum FHB incidence was higher in 2012 (5.33%) than 2010 (3.83%) but the severity was lower with 10.7% in 2012 compared to 24.3% in 2010 (Table 3). Field 2 showed the greatest reduction in incidence (5%) and severity (3.69%) with the application of a fungicide. Reduced irrigation with fungicide on co-operator 8 showed no FHB while the full irrigation with fungicide had 0.33% incidence and 7% severity. On average, over the three year study, FHB incidence in fields where a fungicide was used was reduced on by 1.3%.

Yield

Discernible yield effects associated with treatments were minimal in 2010 (Table 1). Cooperator 3 showed a response to Folicur treatments (July 26 and Aug 4) compared to the check which may have been due to leaf disease control as Fg levels were relatively low. In co-operator 6's field, the

Folicur ¾ rate treatment had a lower % FDK compared to the full rate Folicur and Caramba treatments. The yield results for co-operator 7 were very low due to severe hail damage.

In all cases in 2011 there was no difference in yield between the reduced irrigation and full irrigation treatments (Table 2). This should be seen as a positive result as producers were concerned about the potential yield loss associated with not irrigating during flowering. Fungicide treatment increased yield for co-operators 2, 4 and 9 due to lower FHB, as well as improved leaf disease management. Co-operators 6's Strongfield wheat yielded 10 bu/ac higher with a fungicide treatment whereas the yield in CDC Verona decreased by 13.6 bu/ac with a fungicide treatment. This discrepancy could be attributed to field variability and error. The decrease in yield on CDC Verona on field 6 was not the same on co-operator 9's field.

Accurate yield information was not possible in three fields during 2012 (Table 3). Co-operator 1 had low yields due to heavy wind damage to swaths, co-operator 3 had low yields from hail damage one week before maturity, and co-operator 8 had a malfunction with the yield monitor in one of the two combines running on this field. However, co-operator 4 showed a 14bu/ac increase in yield with the use of a fungicide and co-operator 7 showed a 9-25 bu/ac increase. No yield comparisons for irrigation treatments were available in 2012 given issues with wind damage in some fields and/or where producers did not have both reduced and full irrigation treatments.

Over the 3 year period of this study, 8 fields applied a fungicide treatment to combat Fusarium head blight with a check, 7 times out of 8 showed a yield improvement of 1 - 25.6 bu/ac. Given the virulent nature of this disease and issues with mycotoxins, it was often difficult to convince cooperators to leave untreated checks without any fungicides applied.

Grade

In 2010, FDK rarely had an effect on grade. In most cases frost damage determined the grade of the wheat (Table 1). This is not common, but due to the late seeding in the spring of 2010 most crops did suffer frost damage in the fall before harvest. One treatment of note where this was not true was co-operators 3's no fungicide treatment. The frost damage would have reduced it only to feed, but FDK reduced it further to a grade of special. It should be noted that in this field the areas treated with fungicide had a lower percentage of FDK, which suggest a positive result from the fungicide application.

Fusarium was the cause of some downgrading in 2011. Untreated grain from co-operator 2 was reduced from a #3 to a #5, and from a #2 to a #3 for both co-operators 6 and 7, respectively (Table 2). It is also interesting to note that co-operator 7 had #3 CWRS in the area treated with Caramba, versus #2 CWRS in the area treated with both Caramba and Tilt (a foliar fungicide not recommended for suppression of FHB).

Downgrading in 2012 due to FDK only occurred in co-operator 7's field, where the untreated check resulted in a grade of sample, compared to the fungicide treatment at #3 CWRS (Table 3). These treatments were under full irrigation and based on the results we have seen would likely have seen a reduction in Fusarium and better grain grades under a reduced irrigation regime, with little or no reduction in yield. The downgrading that occurred during 2012 in the remaining fields was due to ergot, midge, and/or smudge damage.

TKW, Test Weight, and Protein

No discernible trends were observed among treatments for thousand kernel weight (TKW), test weight, or protein content from 2010-2012 (Table 1, Table 2, Table 3).

Fusarium Damaged Kernels (FDK)

Overall % Fusarium damaged kernels (FDK) levels were lower in 2011 & 2012 than in 2010 likely due to warmer and drier conditions during flowering. Highest levels of FDK were observed in 2010 at 8.5% on co-operator 1's untreated field under full irrigation (Table 1), co-operator 2's untreated check at 4.4% (Table 2) in 2011, and 3% on co-operator 7's untreated field under full irrigation in 2012 (Table 3). FDK decreased with the application of a fungicide 80% of the time (12/15 fields) by a range of 0.1-5.5%.

Fusarium-damaged kernels were present in 15 of 16 treatments in 2010 indicating the high level of Fusarium. Co-operator 1 observed the highest amount of FDK at 8.5% in the untreated check and the greatest reduction in FDK with a fungicide application up to 5.5%. Co-operator 3 also noted a large difference (4.1%) in FDK between treated and untreated on CPSR AC Crystal (very poor rating) on a dryland site in 2010 (Table 1).

The largest difference in % FDK occurred in 2011 on co-operator 2's field where the fungicide treatment reduced FDK from 4.4 to 2.0%, resulting in a two-grade improvement in his CWAD wheat (Table 2). Co-operator 6 also had an improvement in % FDK and grade in CWAD wheat with fungicide treatments; which was more marked in Strongfield than CDC Verona. Co-operator 8 had a small reduction in % FDK in the reduced versus full irrigation treatment, but levels in both were very low. There was very little difference in FDKs between Snowstar, a hard white spring wheat, and Waskada, a hard red spring wheat, under full irrigation for co-operator 8, even though Snowstar is rated as poor for FHB reaction, while Waskada is rated as good (less susceptible). A larger reduction in % FDK occurred in co-operator 9's fungicide treatments than in his irrigation treatments in a CWAD field. The reduced irrigation and fungicide treatment had the lowest % FDK, suggesting the combined strategies provide an additional benefit over either strategy alone. Mildew also lowered the grade of the sample.

In 2012 the largest difference in % FDK occurred in co-operator 7's field where the fungicide treatment #1 reduced FDK from 3.0 to 1.3%, resulting in a 3 grade improvement in his CWRS wheat (Table 3). Cooperator 7 had a very high level of infection with *F. graminearum* and likely the fungicide treatment helped to reduce FDK levels. Treatment #2 was reduced from 0.8% in untreated to 0.1% in the fungicide application and a one grade difference.

Deoxynivalenol (DON) Levels

DON levels are the biggest concern regarding Fusarium head blight. All samples that were tested over three years were found to have detectable levels of DON (0.1ppm or greater). The range of DON results for 2010 was from 0.1 to 11.0ppm. Fungicide applications in 2010 seem to have resulted in reductions in DON levels (Table 1). The best results showed reductions in DON due to fungicide applications from 0.7-0.2 ppm with Co-operator 1, from 7.0-3.7 ppm from Co-operator 3, from 0.2-0.1 ppm for Co-operator 8 and from 0.3-0.1 ppm for Co-operator 9.

Levels of DON were generally lower in 2011 ranging from 0.1 to 1.3 ppm (Table 2). Best examples of DON reduction due to fungicide applications were 1.3 to 0.6 ppm with Co-operator 2, 0.4 to 0.2ppm with Co-operator 6 and 1.8 to 0.5ppm with Co-operator 9.

DON levels in 2012 ranged from 0.1 to 5.7ppm (Table 3). Best results where fungicide applications appeared to reduce DON were from 5.7 to 3.2 with Co-operator 7 and from 0.3 to 0.1ppm with Co-operator 9.

Only 1 out of 7 fields with reduced irrigation treatments appeared to result in lower DON levels. This occurred in 2011 where Co-operator 8's DON levels went from 0.3 to 0.1ppm for the full versus the reduced irrigation treatment. However, it could be argued that the highest levels of Fg and DON and FDK in Cooperator 7's field in 2012 resulted from the full irrigation schedule that was followed for all treatments and that the field had the highest level of stubble infection with Fg. In general fields with no or low levels of detection of Fg or *F. culmorum* tended to have the lowest DON levels.

Pathogen Isolations

In 2010, significant levels of seed infection with Fg occurred in co-operator 3's field with levels that ranged from 31-43% (Table 1). No Fg was detected in fields belonging to co-operators 4, 5, and 9, despite the fact that this pathogen was detected in stubble samples from adjacent fields. Fg from the grain sample was absent in two of three treatments for co-operator 1 and the remaining fields ranged from 3-10%. For co-operator 7, fungicide application seemed to reduce Fg and total *Fusarium spp.* levels compared with one of the untreated areas (untreated N), but not for the other untreated area. For the remaining fields, levels of infection were either too low to assess treatment effects or Fg levels were similar among the treatments.

In 2011, levels of seed infection with Fg were highest for co-operators 2, 6, and 7 for some or all of the treatments; however, in the remaining fields Fg was either not detected or was very low (Table 2). Fungicide application in field 2 seemed to result in a reduction in the level of seed infection with Fg for both dates of application.

Levels of Fg infection in seed were highest in co-operators 5 and 7 in 2012 and ranged from 9-57% and 14 out of 23 samples came back with zero (Table 3). Fungicide application in field 7 resulted in a reduction in the level of seed infection for Fg by 5-12%.

Annual Field Survey Results

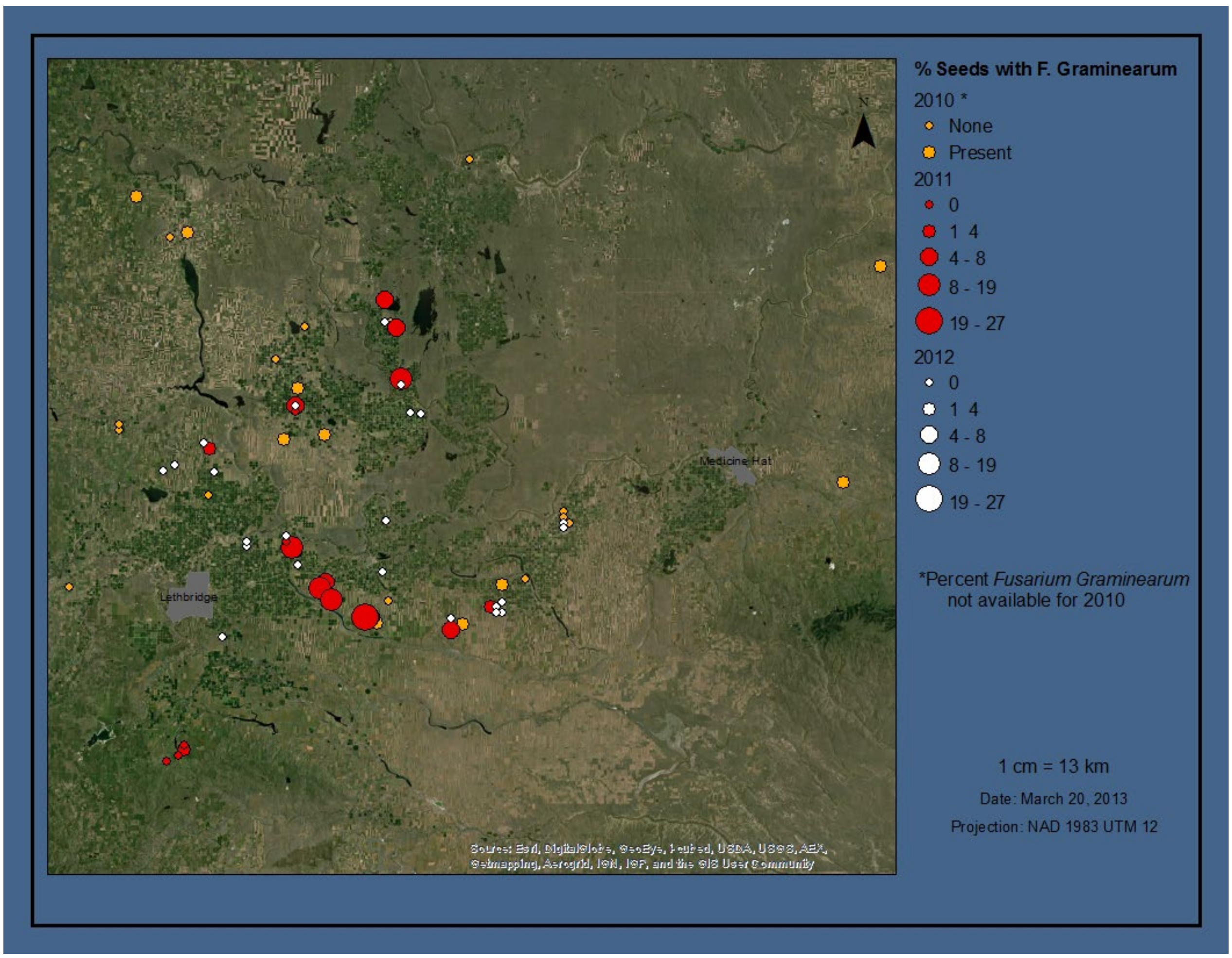
The awareness of the disease appears to have increased over the 3 years of the study. Only 2 of 25 producers said they had a history of FHB in 2010 (Table 4), 4 in 2011 (Table 5) but this value jumped to 16 in 2012 (Table 6). This may be partly due to producers either not being aware of the issue or if it has never been the primary cause of downgrading in their fields before. It is possible that the *F.*

graminearum spread in from adjacent fields. Many producers did not know the FHB history of the adjacent fields if they did not own the land.

Of the surveyed fields, a quarter of them showed positive identification for *Fusarium graminearum* in grain samples, 83% of them were under irrigation (Figure 8). The number of fields with a fungicide application that has activity on FHB has also increased each year from 4 fields in 2010 to 18 fields in 2012. A summary of the cultural practices is found in Figure 10. The combination of irrigation management and a fungicide application to combat FHB seems to be increasingly adopted by producers. Out of the 43 fields under irrigation 24 (56%) used irrigation management and 64% of fields had a fungicide applied (Figure 10).

Figure 8: Survey results from 2010-2012 showing the distribution of fields with grain samples positive for *Fusarium graminearum.*

The percent of seed infected by Fg is represented by the different sized dots.

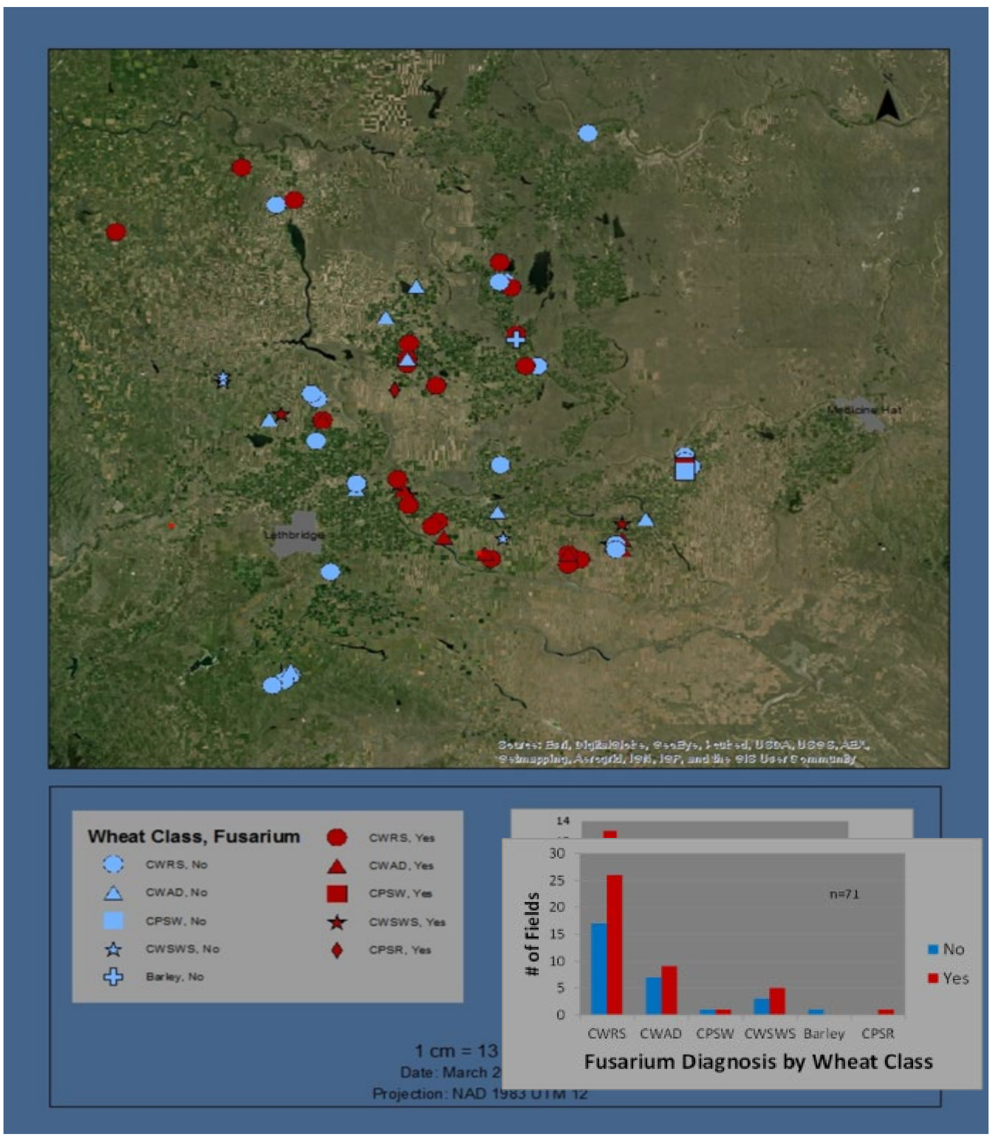


The CWRS (Canadian Western Red Spring) wheat class had the highest number of fields with infected grain samples (Figure 9), while the CWAD (Canadian Western Amber Durum) had the most infected fields and highest percentage of infection for a single variety.

In 2010, 40% or 10 of the 25 fields surveyed detected *Fusarium graminearum* (Table 4). Of those, 9 were irrigated fields and the other a rain fed site that had grown durum for the previous 3 years. The large majority of the Fg positive fields (70%), were planted to a very poor or poor FHB rated variety and only 4 fields were treated with a fungicide that had registered activity on Fusarium head blight. Of the fields that detected FHB, 4 were seeded to CWAD, 4 were CWRS and one for each CPSW and CWSWS.

Figure 9: Survey results from 2010 to 2012 showing the number of fields affected by FDK in each wheat class.

Samples were more numerous among some wheat classes than others. The corresponding histogram shows the number of fields affected by FDK per wheat class.



Close to 33% (8/24) of fields surveyed in 2011 contained *Fusarium graminearum* in the grain samples with the highest levels in field 1 at 11% and field 10 at 7% (Table 5). The other 6 fields contained Fg levels between 1 – 5%. The majority of the fields (6/8) with Fg had a fungicide applied to control FHB and 75% were found under irrigation. Cultivars with poor to very poor resistance ratings represented 63% of the grain samples containing Fg (Figure 12). There was a fairly even distribution of *Fusarium graminearum* throughout the wheat classes; 3-CWRS, 2-CWSWS, 3-CWAD.

None of the grain samples in 2012 tested positive for Fg and had very low (1-4%) levels of total *Fusarium spp*. (Table 6). Environmental conditions at flowering in 2012 clearly played a significant role in limiting disease development. In 2012, 64% (16/25) of fields were planted to cultivars with poor to very poor FHB resistance.

Figure 10: Field Survey Descriptive Summary 2010-2012 (73 fields across S. Alberta)

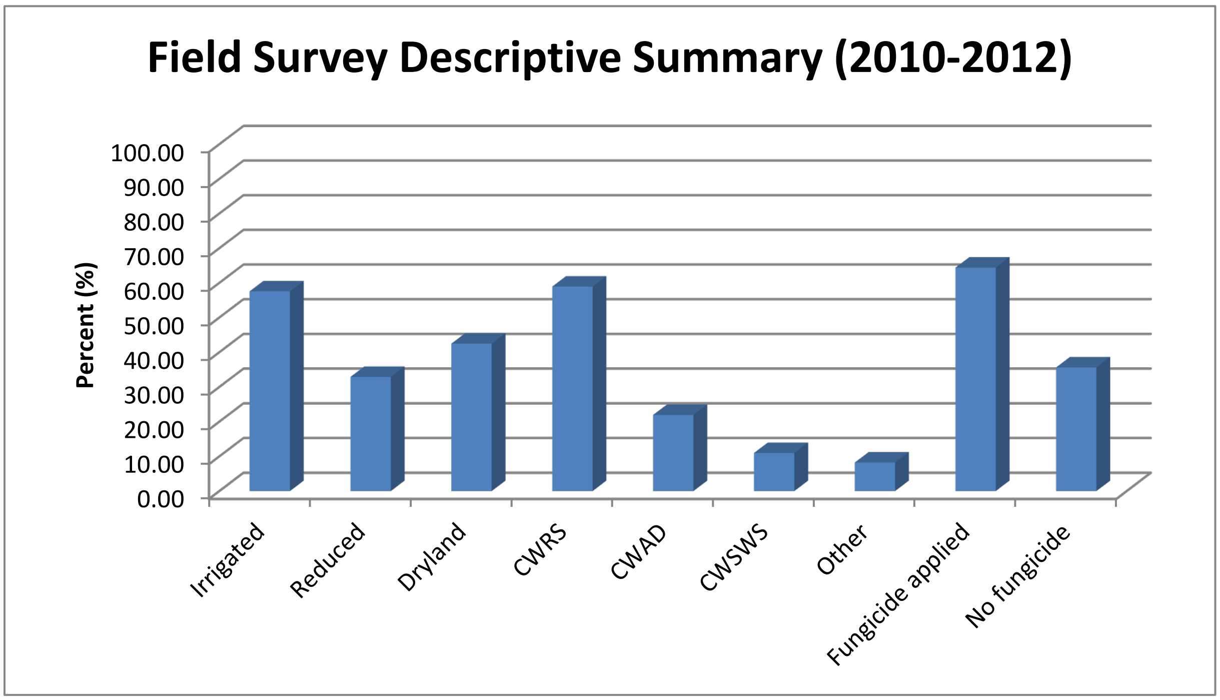


Figure 11: Summary of the survey results in each category identified with Fg from 2010-2012.

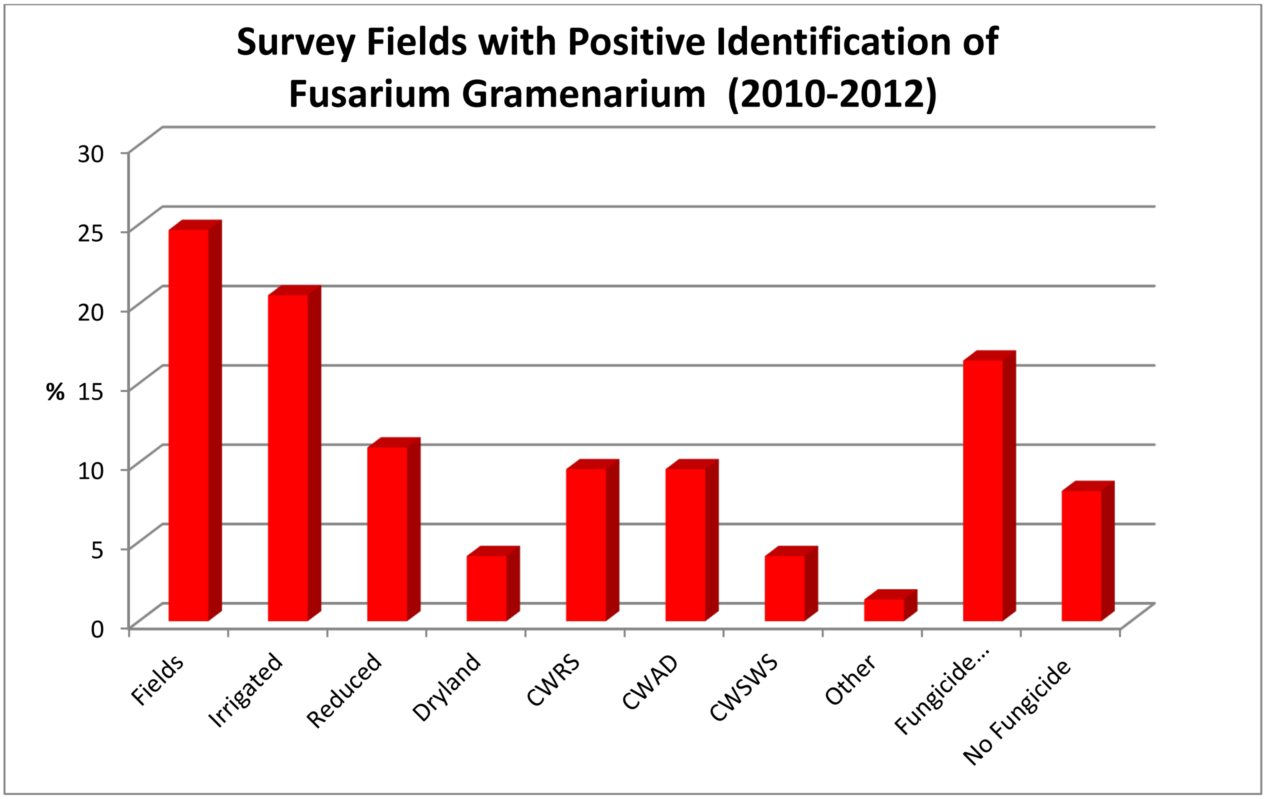


Figure 12: Summary of the survey results in each susceptibility rating and % fields with Fg from 2010-2012.

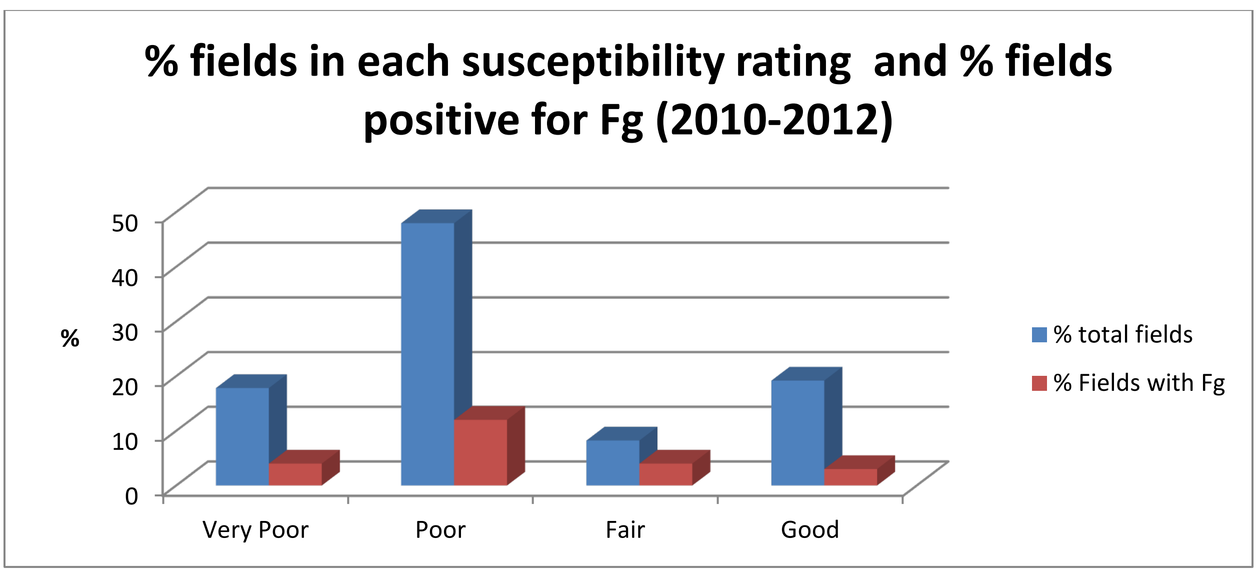


Table 4. Field characteristics and Fusarium head blight (FHB) information for twenty-five fields surveyed for FHB in southern Alberta, 2010											
Field #	Wheat Class[a]	Wheat Variety	Cult. Susc.[b]	Tillage ('06-'10)	FHB History	AF FHB History[c]	Crop History ('06-'09)	Irrigated	Irrigation Regime[d]	Fungicide Used[e]	FHB Detected
1	CWRS	CDC Abound	Poor	Conventional ('09-'10)	None	None	?, dry beans, durum, canola	Yes	Reduced	None	Yes
2	CWRS	CDC Go	Fair	No till ('06-'08) Conventional ('09-'10)	None	Some	Cereal, cereal, cereal, dry beans	Yes	Reduced	None	Yes
3	CPSW	Snowstar	Very Poor	No till	None	None	Timothy, timothy, timothy, flax	Yes	Full	None	Yes
4	CPSW	Snowstar	Very Poor	No till	None	None	Grass, grass, grass, peas	Yes	Full	None	No
5	CWAD	CDC Verona	Poor	No till	None	None	Wheat, peas, wheat, canola	Yes	Reduced	Folicur + Proline	Yes
6	CWAD	CDC Verona	Poor	No till	None	None	Alfalfa, alfalfa, alfalfa, alfalfa	Yes	reduced	Folicur + Proline	Yes
7	CWRS	Glenn	Good	Minimum	Yes	Yes	Wheat, beans, wheat, potatoes	Yes	Reduced	Tilt	No
8	CWRS	Superb	Poor	Conventional	None	None	Wheat, hybrid canola, wheat, corn	Yes	Reduced	None	No
9	CWRS	Superb	Poor	Conventional	Corn -2008	None	Potatoes, wheat, silage corn, dry beans	Yes	Reduced	Tilt	Yes
10	CWRS	CDC Abound /Glenn	Poor/Good	Minimum	None	None	Wheat, sugar beets, wheat, dry beans	Yes	None this year	Caramba	Yes
11	CWAD	Unavail.	Unavail.	Conventional	None	None	Wheat, sugar beets, durum, dry beans	Yes	Reduced	Caramba/ Folicur	Yes
12	CWRS	CDC Abound	Poor	No till	None	None	Spring rye, barley, canola, durum	Yes	full	None	No
13	CWRS	Lillian	Very Poor	No till	None	None	Wheat, canola, wheat, canola	No	N/A	None	No
14	CWAD	Strongfield	Very Poor	Minimum	None	None	Peas, durum, durum, peas	No	N/A	None	No
15	CWAD	Strongfield	Very Poor	No till	None	None	?, ?, durum or canola, peas	No	N/A	None	No
16	CWRS	Unavail.	Unavail.	No till	None	None	Wheat, triticale, wheat, triticale	No	N/A	None	No
17	CWAD	AC Avonlea	Poor	No till	None	None	Barley, durum, canola/durum, peas/durum	No	N/A	None	Yes
18	CWRS	Unavail.	Unavail.	Unavail.	none	None	Wheat, fallow, wheat, fallow	No	N/A	None	No

19	CWRS	AC Eatonia	Unknown	Conventional	None	None	Wheat/fallow x 4	No	N/A	None	No
20	CWRS	AC Intrepid	Poor	No till	None	None	Canola, wheat, barley, canola	No	N/A	None	No

Table 4 continued. Field characteristics and Fusarium head blight (FHB) information for twenty-five fields surveyed for FHB in southern Alberta, 2010

Field #	Wheat Class[a]	Wheat Variety	Cult. Susc.[b]	Tillage ('06-'10)	FHB History	AF FHB History[c]	Crop History ('06-'09)	Irrigated	Irrigation Regime[d]	Fungicide Used[e]	FHB Detected
21	Barley	Xena	Good	No till	None	None	?, ?, ?, Wheat/Barley	No	N/A	None	No
22	CWAD	Strongfield	Very Poor	Conventional	None	Yes	Durum/fallow x4	No	N/A	None	No
23	CWAD	Strongfield	Very Poor	No till	None	None	Durum, fallow, durum, fallow	No	N/A	None	No
24	CWSWS	Sadash	Unknown	Conventional	None	Yes	Wheat, beans, wheat, sugar beets	Yes	Full	None	Yes
25	CWRS	AC Elsa	Poor	No till	None	None	Cereal, peas, cereal, canola	No	N/A	None	No

[a] CWRS = Canadian Western Red Spring, CPSW = Canadian Prairie Spring – White, CWAD = Canadian Western Amber Durum, CWHWS = Canadian Western Hard White Spring
[b] Cult. Susc. = Cultivar Susceptibility to FHB
[c] AF FHB History = Adjacent Fields FHB History
[d] Full = irrigation not avoided during flowering, Reduced = irrigation avoided at flowering
[e] Fungicides were applied at the recommended rates and crop stages

Table 5. Field characteristics and Fusarium head blight (FHB) information for twenty-four fields surveyed for FHB in southern Alberta, 2011

Field #	Wheat Class[a]	Wheat Variety	Cult. Susc.[b]	Tillage ('07-'11)	FHB History	AF FHB History[c]	Crop History ('07-'10)	Irr.	Irrigation Regime[d]	Fungicide Used[e]	% seed with Fus. spp.[f]	% seed with Fg[g]
1	CWAD	CDC Verona	Poor	No till	None	None	Durum, canola, durum, peas	Yes	Pending	Tilt/ Caramba	27	11
2	CWSWS	AC Sadash	Poor	No till	None	None	Wheat, canola, dry beans, soybeans	Yes	Pending	Tilt/ Caramba	12	2
3	CWRS	Carberry	Good	No till	None	None	Durum, winter wheat, peas, lentils	No	N/A	Tilt	3	0
4	CWRS	CDC Thrive	Poor	No till	None	None	Wheat, winter wheat, chick peas, lentils	No	N/A	Tilt	1	0
5	CWAD	CDC Verona	Poor	No till	None	None	Unknown, barley, barley, peas	No	N/A	N/A	7	5
6	Pend.	Pend.	Pend.	Pend.	Pend.	Pend.	Pend.	No	N/A	N/A	1	0
7	CWRS	Glenn	Fair	Conventional	Some	None	Wheat, wheat, hybrid canola, wheat	Yes	Full	Tilt/ Folicur	19	1
8	CWRS	Glenn	Fair	No till (07-8) Min. (09-11)	Some	None	Fallow/Wheat (x 4 years)	No	N/A	Tilt	16	1
9	CWRS	Carberry	Good	Conservation	Yes	In corn	Grass, grass, grass, flax	Yes	Reduced	Caramba	6	0
10	CWRS	Carberry	Good	Minimum ('11)	None	None	Wheat, canola, faba beans, wheat	Yes	Reduced	Caramba	14	7
11	CWRS	Carberry	Good	Minimum ('11)	None	None	Barley, faba beans, wheat, canola	Yes	Reduced	Caramba	8	0
12	CWRS	CDC Go	Poor	Minimum	None	None	Canola, durum, durum, canola	No	N/A	None	0	0
13	CWRS	CDC Go	Poor	Minimum	None	None	Winter wheat, canola, wheat, wheat	No	N/A	None	0	0
14	CWRS	CDC Go	Poor	Minimum	None	None	Barley, canola, wheat, winter wheat	No	N/A	None	0	0
15	CWAD	Strongfield/ AC Avonlea	V. Poor/ Poor	Conventional ('11)	None	None	Durum, durum/barley, durum, canola	No	N/A	Folicur/ Tilt	0	0

16	CWRS	CDC Abound	Poor	Conventional	None	None	Peas, sweet corn, potatoes, sunflowers	Yes	Reduced	Caramba	6	0

Table 5 continued. Field characteristics and Fusarium head blight (FHB) information for twenty-four fields surveyed for FHB in southern Alberta, 2011

Field #	Wheat Class[a]	Wheat Variety	Cult. Susc.[b]	Tillage ('07-'11)	FHB History	AF FHB History[c]	Crop History ('07-'10)	Irr.	Irrigation Regime[d]	Fungicide Used[e]	% seed with Fus. spp.[f]	% seed with Fg[g]
17	CWRS	CDC Go	Poor	No till	None	None	Wheat, barley, durum, mustard	No	N/A	Tilt	1	0
18	CWAD	CDC Verona	Poor	No till ('10&'11)	None	None	Canola, durum, wheat, canola	No	N/A	Tilt	8	0
19	CWRS	Waskada	Good	Conventional ('10&'11)	None	None	Wheat, wheat, barley, sugar beets	Yes	Full	Tilt/ Prosaro	8[a]	0[a]
20	CWRS	Waskada	Good	No till	Yes	Yes	winter wheat, peas, barley, canola	No	N/A	Folicur	0	0
21	CWSWS	AC Andrew	Very Poor	Conventional	None	None	Wheat, potatoes, durum, beans	Yes	Reduced	Prosaro	1[a]	0[a]
22	CWAD	AC Navigator	Very Poor	No till ('07-09) Conventional ('10-'11)	None	None	Alfalfa, alfalfa, alfalfa, potatoes	Yes	Full	Caramba	2[a]	1[a]
23	CWSWS	AC Andrew	Very Poor	Conventional	None	None	Wheat, potatoes, wheat, beans	Yes	Reduced	Prosaro	4	4
24	Pend.	Pend.	Pend.	Pend.	None	None	Pend.	Yes	No irrigation this year	None	0	0

[a] CWAD = Canadian Western Amber Durum, CWSWS = Canadian Western Soft White Spring, CWRS = Canadian Western Red Spring
[b] Cult. Susc. = Cultivar Susceptibility to FHB
[c] AF FHB History = Adjacent Fields FHB History
[d] Full = irrigation not avoided during flowering, Reduced = irrigation avoided at flowering
[e] Fungicides were applied at the recommended rates and crop stages
[f] % seed with *Fus*. spp. = % seed infection with *Fusarium* spp.
[g] % seed with Fg = % seed infection with *Fusarium graminearum*

Table 6. Field characteristics and Fusarium head blight (FHB) information for twenty-four fields surveyed for FHB in southern Alberta, 2012

Field #	Stubble Results		Wheat Class[a]	Wheat Variety	Cult. Susc.[b]	Tillage ('08-'12)	FHB History	AF FHB History[c]	Crop History ('08-'11)	Irr.	Irrigation Regime[d]	Fungicide Used[e]	% seed with Fus. spp.[f]	% seed with Fg[g]
	% Other Fus Spp	% Fg												
1	44	1	CWSWS	AC Andrew	Very Poor	Conventional	Yes	Unknown	CWRW, Potatoes, CWSWS, Dry Beans	Yes	Reduced	Caramba	0	0
2	20	0	CWSWS	AC Andrew	Very Poor	Conventional	Yes	Unknown	Potatoes, Peas, CWRW, Sugar Beets	Yes	Reduced	Caramba	1	0
3	35	4	CWRS	CDC Go	Poor	Conventional	Yes	Unknown	Wheat, Dry Beans, CWRS, Sugar Beets	Yes	Reduced	Caramba	0	0
4	N/A	N/A	CWAD	CDC Verona	Poor	Conventional	Yes	Unknown	Wheat, Dry Beans, CWAD, Sugar Beets	No	N/A	Caramba	0	0
5	30	8	CWAD	Brigade	Poor	Conventional	Suspected	Suspected	Durum, Dry Beans, Durum, Seed Canola	Yes	Reduced	Prosaro	0	0
6	19	4	CWAD	Brigade	Poor	Conventional	Unknown	Unknown	Durum, Sum fallow, Durum, Sum fallow	No	N/A	Prosaro	0	0
7	55	39	CWRS	Glenn	Fair	Conventional	No	Unknown	Canola, Wheat, Corn, Corn	Yes	Reduced	Folicur	0	0
8	21	5	CWRS	CDC Go	Poor	Conventional	Yes	Unknown	CWRS, Dry Beans, CWRS, Canola	Yes	Full	Prosaro	0	0
9	38	33	CWRS	CDC Go	Poor	Conventional	Yes	Unknown	CWRS, Dry Beans, CWRS, Sugar Beets	Yes	Reduced	Prosaro	0	0
10	N/A	N/A	CWRS	CDC Go	Poor	Conventional	Yes	Unknown	CWRS, Dry Beans, CWRS, Sugar Beets	No	N/A	Prosaro	0	0
11	63	59	CWRS	Carberry	Good	No Till	No	No	CWRW, Peas, Lentils, CWRS	No	N/A	1/2 Tilt with herbicide	0	0
12	78	22	CWSWS	Sadash	Poor	No Till	Yes	Yes	CWSWS, Canola, CWSWS, Flax	Yes	Full	Tilt w herbicide, twinline @flagleaf, Caramba @ flowering)	0	0

Table 6 continued. Field characteristics and Fusarium head blight (FHB) information for twenty-four fields surveyed for FHB in southern Alberta, 2012

Field #	Stubble Results		Wheat Class[a]	Wheat Variety	Cult. Susc.[b]	Tillage ('08-'12)	FHB History	AF FHB History[c]	Crop History ('08-'11)	Irr.	Irrigation Regime[d]	Fungicide Used[e]	% seed with Fus. spp.[f]	% seed with Fg[g]
	% Other Fus Spp	% Fg												
13	97	0	CWSWS	Sadash	Poor	No Till	Yes	Yes	Beans, Canola, CWSWS, Flax	Yes	Full	Tilt w herbicide, twinline @flagleaf, Caramba @ flowering)	0	0
14	57	22	CWRS	Superb	Poor	Conventional	Yes	Suspected	Dry Beans, Wheat, Sugar Beets, Wheat	Yes	Full	Caramba	3	0
15	24	15	CWRS	Superb	Poor	Conventional	Yes	Suspected	Wheat, Dry Beans, Wheat, Sugar Beets	Yes	Full	Caramba	1	0
16	27	9	CWRS	Carberry	Good	Conventional	No	Unknown	Bly, Wheat, Bly, Sugar Beets/Wheat	Yes	Reduced	Caramba	0	0
17	14	7	CWRS	Stettler	Poor	No Till	No	No	CWRS, CWRS, Canola, CWRS	No	N/A	Prosaro	4	0
18	59	5	CWRS	Carberry	Good	Conventional	Yes	Yes	sugar beets, strongfield, potatoes, HRS, peas	Yes	Reduced	Quilt	1	0
19	35	2	CWRS	Carberry	Good	Conventional	Yes	Yes	HRS, beans, HRS, onions, potatoes	Yes	Full	Quilt	4	0
20	59	15	CPSR	SY985	Fair	No Till	Yes	Yes	Native grass, native grass, Canola, Wheat	Yes	Reduced	Caramba	2	0
21	59	35	CWRS	Carberry	Good	No Till	No	No	Wheat, flax, canola, wheat	Yes	Reduced	Caramba	4	0
22	19	0	CWRS	Stettler	Poor	No Till	Yes	Yes	Winter Wheat, Peas, Barley, Canola	No	N/A	Tilt	1	0
23	28	1	CWRS	AC Barrie	Fair	No Till	Yes	Yes	2010- Barley (land rented)	No	N/A	Quilt	1	0

24	27	4	CWRS	CDC Go	Poor	No Till	No	No	Wheat, barley, barley, wheat	Yes	Full	None	1	0

[a] CWAD = Canadian Western Amber Durum, CWSWS = Canadian Western Soft White Spring, CWRS = Canadian Western Red Spring
[b] Cult. Susc. = Cultivar Susceptibility to FHB
[c] AF FHB History = Adjacent Fields FHB History
[d] Full = irrigation not avoided during flowering, Reduced = irrigation avoided at flowering
[e] Fungicides were applied at the recommended rates and crop stages
[f] % seed with *Fus*. spp. = % seed infection with *Fusarium* spp.
[g] % seed with Fg = % seed infection with *Fusarium graminearum*

Technology Transfer Results

Since 2000, attempts have been made to better inform Alberta producers and industry about the FHB issue through presentations by pathologists and Alberta Agriculture, Food and Rural Development, Cereal and Oilseed Crop Specialists. The development of a provincial Fusarium response plan in 2002 also helped to increase awareness and focus attention on this issue. In addition, information on FHB has been available through extension factsheets, news media broadcasts, and websites (Appendix F). Extensive coverage of the FHB problem has also occurred via a number of agricultural publications. However, even with these efforts the awareness of this issue within Alberta's agricultural industry has been limited since the mid to late 2000's and has partly waned due to the emergence of other cropping issues such as clubroot in canola. Moreover, a not in my back yard mentality has also likely been a factor. Wheat and barley are the mainstays of crop production in Alberta. With further spread and build-up of *F. graminearum*, farmers will face additional costs associated with changing to more resistant varieties, limited cropping options, and additional input costs (e.g. fungicides) similar to what has occurred in Manitoba.

The current project has built on the foundation established in the early-mid 2000's regarding awareness and management of FHB. Although not directly related to the project, extension and technology transfer activities undertaken as part of the current project have emphasized that farmers within Alberta need to take actions to reduce the risk of further spread and establishment of *F. graminearum*, otherwise very high economic losses could be expected. Monitoring of seed intended for planting, harvested grain, and even crop residues should be encouraged to identify potential risks and emerging issues. Testing of stubble and seed as part of this project has helped to increase awareness of FHB and the presence of *F. graminearum* especially in southern Alberta under irrigation and in susceptible cereal varieties. With this knowledge producers can then put in place practices that help to lower the risk that *F. graminearum* becomes more of a problem.

Due to the magnitude of possible crop losses, AAFRD and other agricultural organizations need to extensively promote measures which will reduce the risks associated with FHB caused by *F. graminearum*. The current project has played a pivotal role in fostering more extensive awareness within Alberta's agricultural industry regarding the potential risks associated with the continued appearance and development of FHB in Alberta. These risks are not only important for grain producers, but for livestock sectors where mycotoxin contamination is a significant issue. The loss of the feed market for pigs, as well as a reduced ability to grow high quality cereals that can be marketed internationally are significant concerns.

As a result of the current PMC project there is enhanced awareness regarding the need for integrated management of FHB ideally using a combination of variety resistance, rotation, fungicide, and irrigation management. Farming Smarter technology transfer activities have been crucial in southern Alberta as the pathogen appears to be well-established in some fields in this region with resulting yield and quality losses when irrigation is not carefully managed to reduce disease risk while meeting crop water needs.

Overall, numerous crop walks, Farming Smarter Field Schools, and various presentations by Farming Smarter staff were the primary means of extension (Table 7). Social media tools, including

Facebook, Twitter, and YouTube, along with the project page on the Farming Smarter website (www.farmingsmarter.com) were used to distribute information from these and other events electronically. The project has been featured in articles in the popular press, articles can be found in Table 8**.**

The collaborating researchers, Dr. Kelly Turkington and Dr. Ron Howard, and associated staff, also extended the reach of the project through their extension work. The producer co-operators involved in this project are another source of extension. They have a broad range of contacts through agronomists, industry representatives, grower groups, and neighbours which extends the reach of the information even further.

With the intent of demonstrating best management principals associated with FHB management small plot diagnostic/instruction sites were used in all three years of the study. The diagnostic plots proved to be extremely useful as they could be featured readily to illustrate disease symptoms, treatment effects and to create awareness and understanding of FHB amongst Farming Smarter field day attendees during both summers.

The demonstration plots had excellent disease development in 2010 and proved useful for teaching disease identification (Figure 40). Many heads were infected and symptoms were very well developed. The small plot demo was continued in 2011 and 2012 (Figure 41, Figure 42), but disease development was minimal in the plots due to hot and dry environmental conditions during anthesis, despite frequent irrigation. Therefore, the plots were used for training sessions and the disease crop walk in August.

Several handouts on FHB developed by plant pathologists such as T.K. Turkington (AAFC), K. Xi (AARD), I. Evans (AAFRD), J. Calpas (AARD), L. Harrison (AARD), and R. Clear (CGC) were distributed at the crops walks and survey training sessions (Figure 51, Figure 52, Figure 53). Project poster (Figure 54) was created to serve as an extension tool for interested producers and agronomists.

In 2011 due to the travel cap in place within Agriculture and Agri-Food Canada, Dr. T.K. Turkington and research staff from AAFC Lacombe were unable to assist with field research activities or technology transfer activities.

Table 7 List of extension events:

Date	Location	Attendance
January 11-12, 2010	Lethbridge Lodge, Lethbridge, AB	413
July 6-8, 2010	Farming Smarter R&D site, Lethbridge, AB	203
July 23, 2010	Lacombe, AB	
July 29, 2010	Brooks, AB	
August 11, 2010	Farming Smarter R&D site, Lethbridge, AB	82
September 15, 2010	Farming Smarter R&D site, Lethbridge, AB	26
December 1, 2010	Medicine Hat Exhibition, Med Hat, AB	250
January 19, 2011	Lethbridge Lodge, Lethbridge, AB	450
July 18, 2011	Farming Smarter R&D site, Lethbridge, AB	20

July 21, 2011	Farming Smarter/Cypress County R&D site, Med Hat, AB	46
August 18, 2011	Farming Smarter R&D site, Lethbridge, AB	63
November 7-9, 2011	Executive Royal Inn, Leduc, AB	50
December 6-7, 2011	Lethbridge Lodge, Lethbridge, AB	269
July 10-12, 2012	Farming Smarter R&D site, Lethbridge, AB	191
August 9, 2012	Farming Smarter R&D site, Lethbridge, AB	26
November 16, 2012	Fairview, AB	18
November 19, 2012	Strathmore, AB	17
November 21, 2012	Lethbridge, AB	40
November 22, 2012	Vermillion, AB	46
November 30, 2012	Red Deer, AB	32
December 4-5, 2012	Medicine Hat Exhibition, Med Hat, AB	222
February 7 ,2013	Foremost, AB	27
February 20 ,2013	Lethbridge, AB	10
February 28, 2013	Bully's grandstand, Lethbridge, AB	62
	Total	**2563**

Table 8 List of articles (complete articles are in List of Articles):

Publications	Title
Spring 2010 Edition, Farming Smarter Magazine	Stack strategies to manage fusarium - it can kill your grain profits
Fall 2010 Edition, Farming Smarter Magazine	Managing fusarium head blight focus of new project
Western Producer - December 9, 2010	Fusarium marches west to Alberta
Western Producer - December 9, 2010	Rules amended as infection area expands
Spring 2011 Edition, Farming Smarter Magazine	Survey updates fusarium head blight situation
Barley Country - April 2011	Local producer-run associations offer research you can use on your crop
The Forty-Mile County Commentator - July 26, 2011	Cypress County hosts agriculture field tour
Spring 2012 Edition, Farming Smarter Magazine	No clear winner in FHB treatments
Fall 2012 Edition, Farming Smarter Magazine	Farming Smarter tackles fusarium management

Conclusions and Recommendations

Fusarium Head blight management is critical to the long term sustainability of irrigated crop production in southern Alberta. Irrigation is costly but enables producers to grow extremely valuable crops that contribute a large percentage of gross revenue to Alberta's agricultural industry. Cereal crops remain very important for both profitability and as rotational components to high value crops such as canola (seed and production), potatoes, sugar beets and dry beans. FHB can significantly reduce profitability of cereals which may result in the reduction of cereals grown in irrigated rotations. This in turn can result in higher proportions of alternative crops, creating new risks of disease outbreaks.

Community based systems approaches are clearly required for FHB management. Positive results from this study help demonstrate the effectiveness of best management practices and the real, economic impact associated with their adoption. Due to the localization of inoculum and its ability spread in the wind through spores, it is not only important for individual producers to adopt BMPs but for all neighbours to make similar efforts.

Information generated through this trial has demonstrated that fungicides can be effective while irrigation scheduling at a minimum can be accomplished without compromising yield. It also showed that awareness of FHB is continuing to grow as the problem continues to spread. While field scale research has proven valuable it is not without drawbacks. Clear and concrete statistical information was very difficult to obtain as many variables were impossible to control. Weather issues affected results as well as technical issues with yields monitors. Producers had varying equipment capabilities and management styles which lead to unique situations on every field. Nevertheless, they worked diligently in providing some real world experiences with FHB management. Future small plot and field scale work is warranted but there is a need for improved techniques.

Key messages

Moisture arrives in the crop canopy from various sources including rain, dew, fog, and irrigation and is stored in various components of the crop volume, where it can potentially influence disease development. The current PMC project illustrated the beneficial influence of fungicide application in terms of reducing disease and DON contamination, while potentially increasing crop yields and TKW. Irrigation treatment is an influential factor in the development of Fusarium head blight in dry areas such as southern Alberta, although excesses or droughty conditions can override the potential impact of irrigation management. The Alberta field assessments from the current irrigation study, as well as results from the commercial field surveys, and field characteristics have showed that the presence and increased level of FHB and percentage seed infection with *F. graminearum* were more commonly associated with irrigated wheat compared with dryland production, where a susceptible variety was grown and no fungicide applied and potentially where tighter rotations with susceptible crops occur. Similar irrigation results were found by Strausbaugh and Maloy (1986) in Washington State, where scab, caused by various *Fusarium* spp. including *F. graminearum*, was found in irrigated fields, but not in dryland wheat fields.

Overall, the current study indicated that reducing irrigation at flowering and/or fungicide application and using a less susceptible variety may have a beneficial impact on disease levels, while maintaining yields when the risk of FHB is high. Although difficult to demonstrate given the nature of the current study the use these strategies in combination may help to provide more effective FHB management. The most difficult aspect of irrigation management for FHB control in the irrigated dry regions of southern Alberta will be trying to balance the water requirements of the crop versus the need to reduce the risk of FHB. Efetha (2003) has produced a set of recommendations to help producers meet the water needs of their cereal crops, but at the same time reduce the risk of FHB and potential DON contamination of harvested grain. Other pathologists with extensive FHB experience have indicated that irrigation should not be applied for 5-10 days after flowering to help limit humid conditions that favour infection (M. McMullen and B. Stack, North Dakota State University, personal communication). This is consistent with the results and interpretation from the current studies. Moreover, the current study suggests that reducing irrigation will likely not result in a negative impact on crop productivity, but can have a beneficial impact in relation to reducing the severity and impact of FHB.

Implementation of Results

- fungicides can work well, but do not always limit FHB. It will be crucial to also look at a combination of more resistant varieties, longer rotations and irrigation management and by using these three strategies farmers may be able to limit FHB without resorting to fungicides unless the disease risk clearly warrants it
- avoid highly susceptible wheat classes and varieties
- encourage irrigation scheduling especially since no yield losses were shown with this practice
- continue to increase awareness of FHB and management practices through extension activities including video production of results and recommendations
- extend information to other wheat growing areas as FHB continues to spread and is well established in southern AB, especially under irrigation
- inform growers that dryland can be at risk as well when moisture is available
- develop continued surveys perhaps work with seed testing labs
- monitor environmental conditions during flowering critical for disease development and may limit the impact and usefulness of some or all management strategies
- work with grain graders to ensure FDK levels are correct and determine relationship with DON
- Develop ways to better communication area specific Fg inoculum levels. I.e. are you in an Fg hot spot? Fast and complete forecasts for weather during flowering

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Appendix A Tables

Table 9. Co-operator locations and crop details for fields used for Fusarium head blight irrigation management/fungicide trials in southern Alberta in 2010.

Cooperator	Location	Wheat Class[a]	Variety	Cultivar Susceptibility to FHB
1	Carmangay	CWAD	Navigator	Very Poor
2	Burdett	CWRS	CDC Go	Fair
3	Rainier	CPSR	AC Crystal	Very Poor
4	Lomond	CWRW	Radiant	Very Poor
5	Lomond	CWRS	CDC Abound	Poor
6	Burdett	CWRS	CDC Go	Fair
7	Duchess	CWRS	Superb	Poor
8	Picture Butte	CWRS	Waskada	Good
9	Bow Island	CWRS	Stettler	Poor

[a]CWAD = Canadian Western Amber Durum, CWRS = Canadian Western Red Spring, CPSR = Canadian Prairie Spring – Red, CWRW = Canadian Western Red Winter

[a]CWRS = Canadian Western Red Spring, CWAD = Canadian Western Amber Durum, CWHWS = Canadian Western Hard White Spring

Table 10. Co-operator locations and crop details for fields used for Fusarium head blight irrigation management/fungicide trials in southern Alberta in 2011

Cooperator	Location	Wheat Class[a]	Variety	Cultivar Susceptibility to FHB
1	Carmangay	CWRS	CDC Abound	Poor
2	Burdett	CWAD	Strongfield	Very Poor
3	Rainier	CWRS	Glenn	Fair
4	Lomond	CWHWS	Snowstar	Poor
5	Lomond	CWRS	CDC Abound	Poor
6	Burdett	CWAD	CDC Verona/ Strongfield	Poor/Very Poor
7	Duchess	CWRS	Glenn	Fair
8	Picture Butte	CWHWS	Snowstar/ Waskada	Poor/Good
9	Bow Island	CWAD	CDC Verona	Poor

Table 11. Cooperator locations and crop details for fields used for Fusarium head blight irrigation management/fungicide trials in southern Alberta in 2012

Cooperator	Location	Wheat Class[a]	Variety	Cultivar Susceptibility to FHB
1	Carmangay	CWRS	CDC Abound	Good
2	Burdett	CWAD	CDC Verona	Poor
3	Rainier	CWRS	Glenn	Fair
4	Lomond	CWWS	Snowstar	Poor
5	Lomond	CWRS	CDC Abound	Poor
6	Burdett	CWRS	Carberry	Good
7	Duchess	CWRS	Superb	Poor
8	Picture Butte	CWRS	Stettler	Poor
9	Bow Island	CWRS	Carberry	Good

Table 12. Seed-borne pathogen assessments (% seed infection) for harvested grain from each field in nine Fusarium head blight (FHB) irrigation management/fungicide demo trials in commercial wheat fields in southern Alberta in 2010.

Co-operator	Treatment	Total *Fusarium* spp.	*F. graminearum*	*F. avenaceum*	*F. accumin-atum*	*F. poae*	*F. sporotrich-ioides*	*F. equiseti*	*F. culmorum*	*Cochliobolus sativus*	*Pyrenophora tritici-repentis*	*Stagonospora nodorum*
1	Full Irr.	10	1	6	2	0	1	0	0	1	0	0
1	Red. Irr.	6	0	4	2	1	0	0	0	4	0	0
1	Folicur - Full Irr.	24	0	2	1	21	0	0	0	5	0	0
2	Untreated	9	3	3	0	0	1	0	2	0	0	0
3	Untreated	45	43	2	0	0	0	0	0	0	0	0
3	Folicur July 26	36	35	1	0	0	0	0	0	0	0	0
3	Folicur Aug 4	32	31	1	0	0	0	0	1	0	0	0
4	Untreated	1	0	0	0	0	0	0	0	0	0	0
5	Caramba	16	0	2	0	13	0	0	0	6	0	0
6	Folicur 3/4	3	1	0	1	1	0	0	1	5	0	0
6	Folicur Full	8	2	4	1	0	0	0	0	1	0	0
6	Caramba	5	1	2	0	1	0	0	1	0	0	0
7	Untreated(N)	6	2	2	1	0	0	0	2	0	0	0
7	Untreated(S)	12	10	1	1	0	0	0	0	0	0	0
7	Caramba	13	9	4	0	0	0	0	1	0	0	0
8	Untreated	5	3	2	0	0	0	0	0	0	0	0
8	Folicur	4	3	1	1	0	0	0	0	0	0	0
9	Untreated	8	0	5	1	1	0	0	1	0	0	0
9	Folicur	7	0	5	1	0	0	1	0	1	0	0

Table 13. Seed-borne pathogen assessments (% seed infection) for harvested grain from each field in nine Fusarium head blight (FHB) irrigation management/fungicide demo trials in commercial wheat fields in southern Alberta in 2011.

Co-operator	Treatment	Total *Fusarium* spp.	*F. gramin-earum*	*F. avenaceum*	*F. accumin-atum*	*F. poae*	*F. sporotrich-ioides*	*F. equiseti*	*F. culmorum*	*Cochliobolus sativus*	*Pyrenophora tritici-repentis*	*Stagonospora nodorum*
1	Full Irr.	13	0	0	0	13	0	0	0	0	0	0
1	Reduced Irr.	9	0	0	1	8	0	0	0	0	0	0
2	Untreated	19	7	9	1	0	0	1	0	1	0	0
2	Prosaro	26	1	14	4	0	0	2	5	0	0	0
3	Untreated	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	Treated	3	1	2	0	0	0	0	0	0	0	0
4	Untreated	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	Treated	0	0	0	0	0	0	0	0	0	0	0
5	Caramba	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	Untreated - Verona	6	1	1	2	0	0	0	2	0	0	0
6	Treated - Verona	2	0	0	0	2	0	0	0	0	0	0
6	Untreated - Strongfield	9	1	7	0	0	0	0	1	0	0	0
6	Treated - Strongfield	6	4	1	2	0	0	0	0	0	0	0
7	Caramba	12	12	0	0	0	0	0	0	0	0	0
7	Caramba + Tilt	8	8	0	0	0	0	0	0	0	0	0
8	Full Irr. - Snowstar	0	0	0	0	0	0	0	0	0	0	0
8	Full Irr. - Waskada	4	0	0	0	4	0	0	0	0	0	0
8	Red. Irr. - Snowstar	0	0	0	0	0	0	0	0	0	1	0
9	Prosaro - Reduced Irrigation	3	0	1	0	0	0	1	1	0	0	0
9	Untreated - Reduced Irrigation	2	0	0	0	0	0	0	2	0	0	0
9	Prosaro - Full Irr.	2	0	2	0	0	0	0	0	0	8	0
9	Untreated - Full Irr.	3	0	2	0	0	0	0	1	0	3	0

Table 14. Seed-borne pathogen assessments (% seed infection) for harvested grain from each field in nine Fusarium head blight (FHB) irrigation management/fungicide demo trials in commercial wheat fields in southern Alberta in 2012.

Co-operator	Treatment	Total Fusarium	*F. gramin-earum*	*F. avenaceum*	*F. accum-inatum*	*F. poae*	*F. sporotri-chioides*	*F. equiseti*	*F. culmorum*	*F. Cochli-obolus sativus*	*Pyrenophora tritici-repentis*	*Septoria nodorum*
1	Full Irrigation	4	0	0	0	3	1	0	0	0	0	0
1	Reduced Irrigation	1	0	0	0	1	0	0	0	0	0	0
2	Caramba	13	6	5	0	0	0	0	0	1	0	0
4	Untreated	1	1	0	0	0	0	0	0	0	0	0
4	Caramba	0	0	0	0	0	0	0	0	0	0	0
5	Caramba (North)	6	0	0	0	6	0	0	0	0	0	0
5	Caramba (South)	15	14	0	0	0	0	0	1	0	0	0
6	Prosaro	1	0	0	0	1	0	0	0	0	0	0
7	Untreated # 1	57	57	0	0	0	0	0	0	0	0	0
7	Caramba # 1	52	52	0	0	0	0	0	0	0	0	0
7	Untreated # 2	23	23	0	0	0	0	0	0	0	0	0
7	Caramba # 2	9	9	0	0	0	0	0	0	0	0	0
8	South Dry Untreated	3	0	0	0	1	2	0	0	0	0	0
8	South Irrigated Treated	1	1	0	0	0	0	0	0	0	0	0
8	South Irrigated Untreated	1	0	0	0	0	1	0	0	0	0	0
8	North Irrigated Treated	0	0	0	0	0	0	0	0	0	0	0
8	North Dryland Treated	0	0	0	0	0	0	0	0	0	0	0
8	North Irrigated Untreated	3	2	0	1	0	0	0	0	0	0	0
8	North Dryland Untreated	0	0	0	0	0	0	0	0	0	0	0
9	Untreated	2	0	0	0	0	1	1	0	0	0	0
9	Folicur (near untreated)	1	0	0	0	0	0	1	0	0	0	0
9	Folicur (near Prosaro)	2	0	0	0	2	0	0	0	0	0	0
9	Prosaro	2	0	0	0	2	0	0	0	0	0	0

Appendix B Field Maps

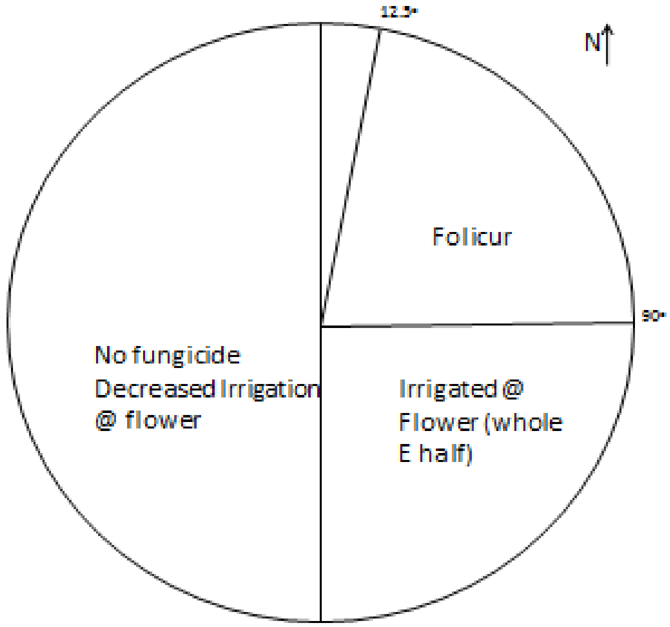


Figure 13: Co-operator 1 2010 field map

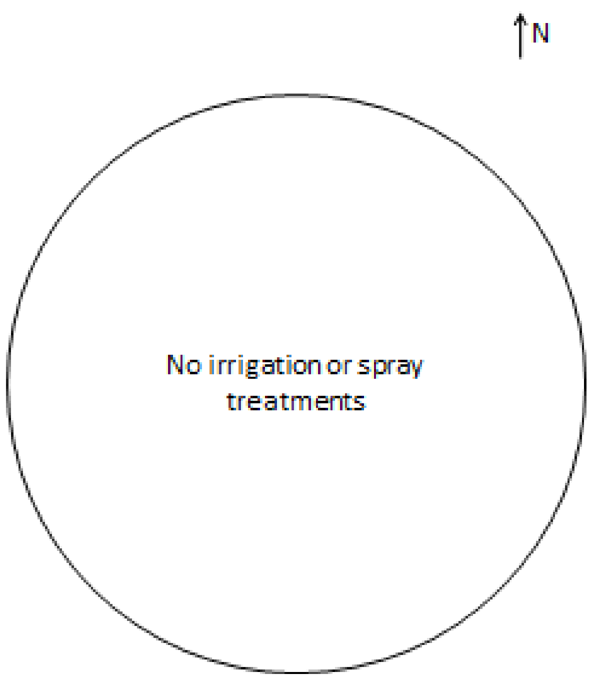


Figure 14: Co-operator 2 2010 field map

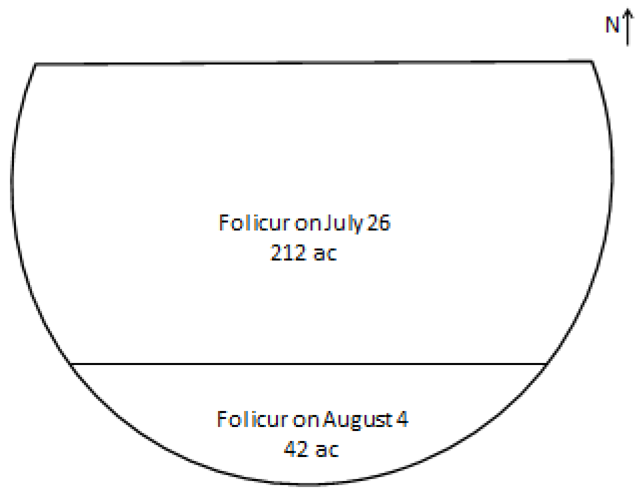


Figure 15: Co-operator 3 2010 field map

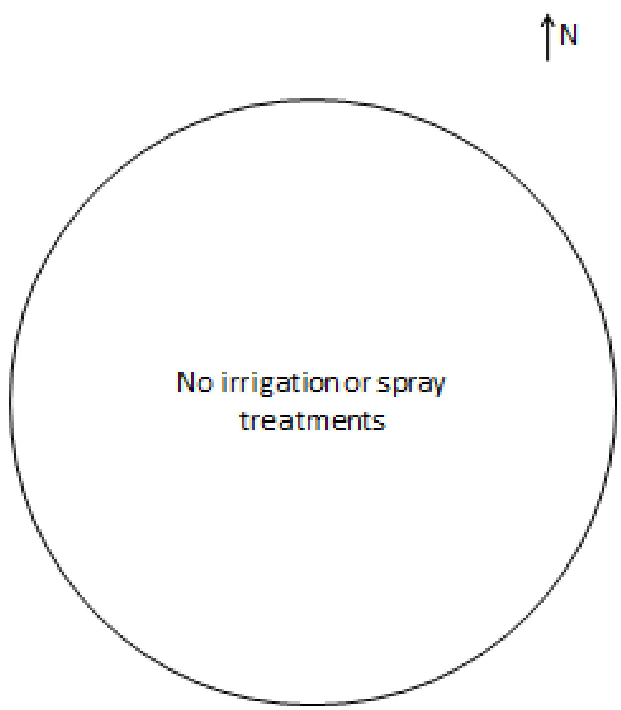


Figure 16: Co-operator 4 2010 field map

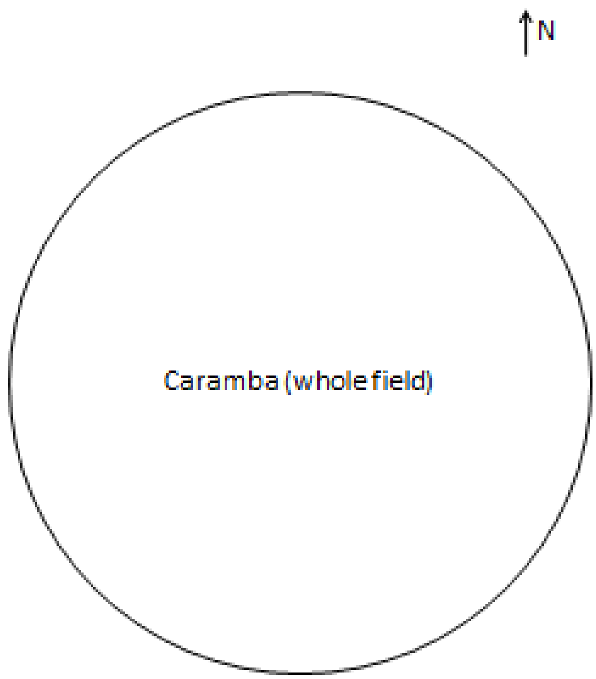


Figure 17: Co-operator 5 2010 field map

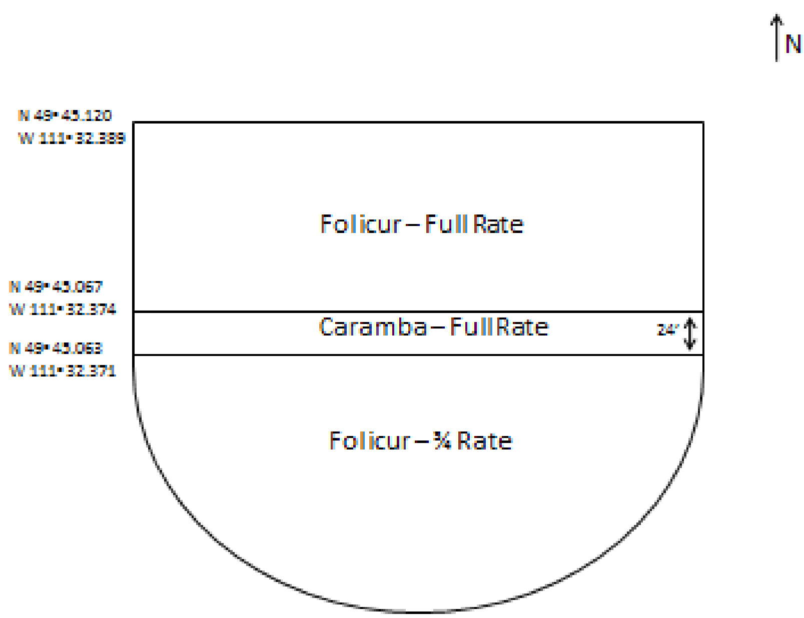


Figure 18: Co-operator 6 2010 field map

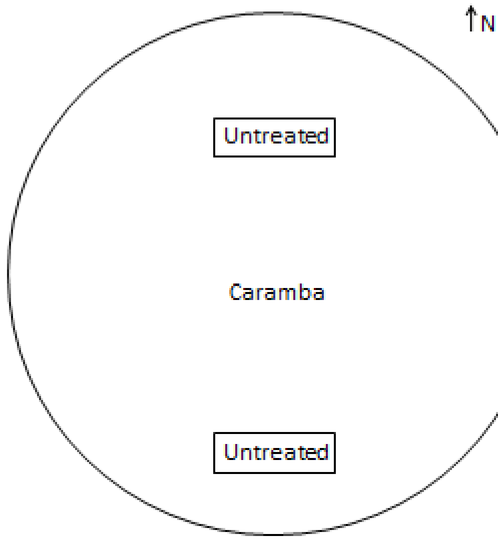


Figure 19: Co-operator 7 2010 field map

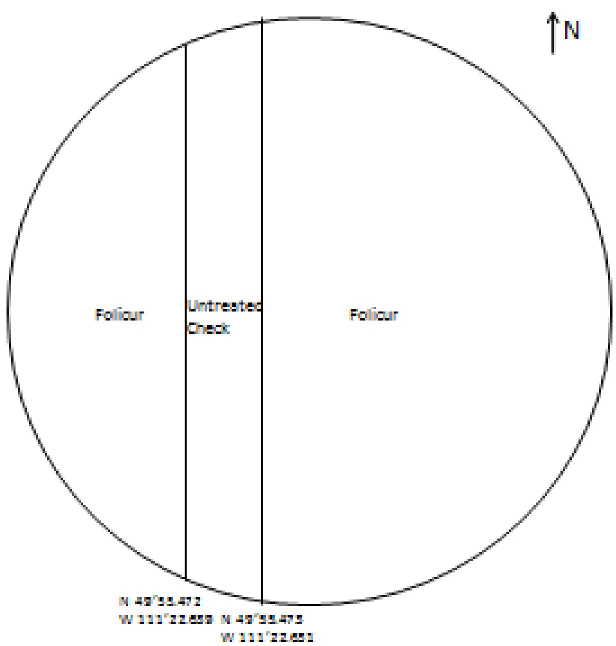


Figure 20: Co-operator 8 2010 field map

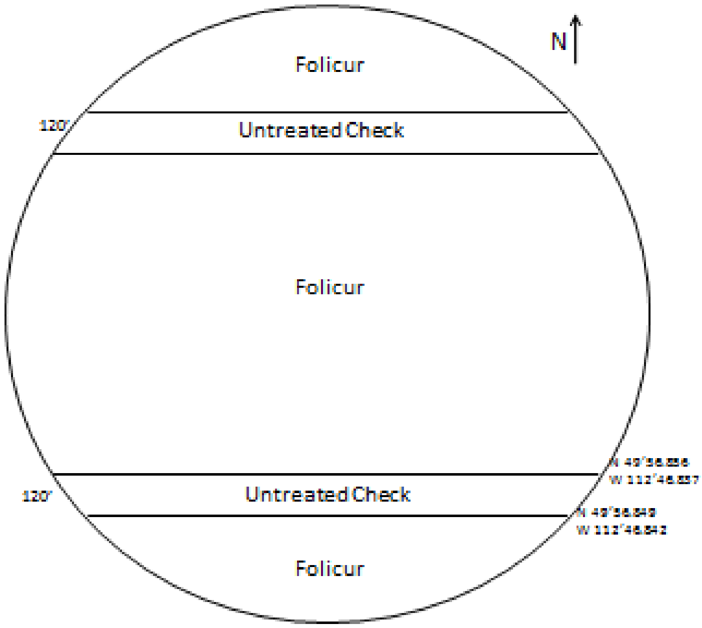


Figure 21: Co-operator 9 2010 field map

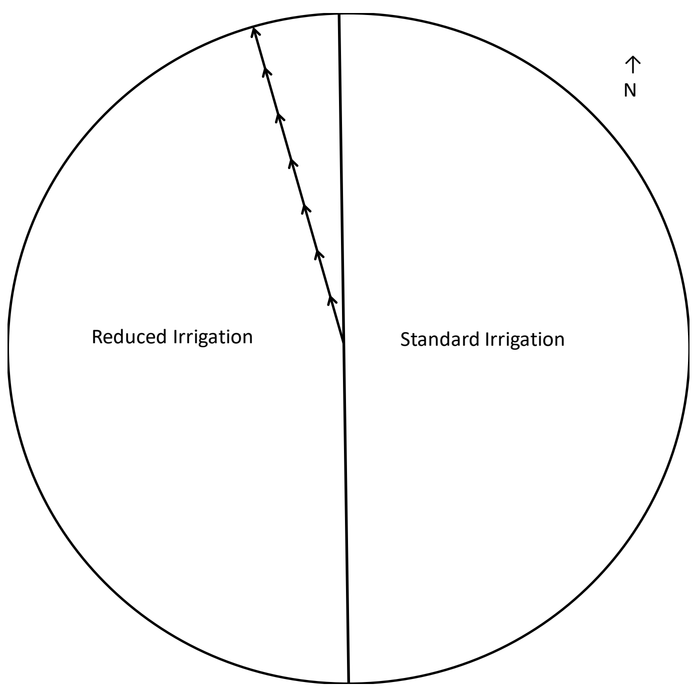


Figure 22: Co-operator 1 2011 field map

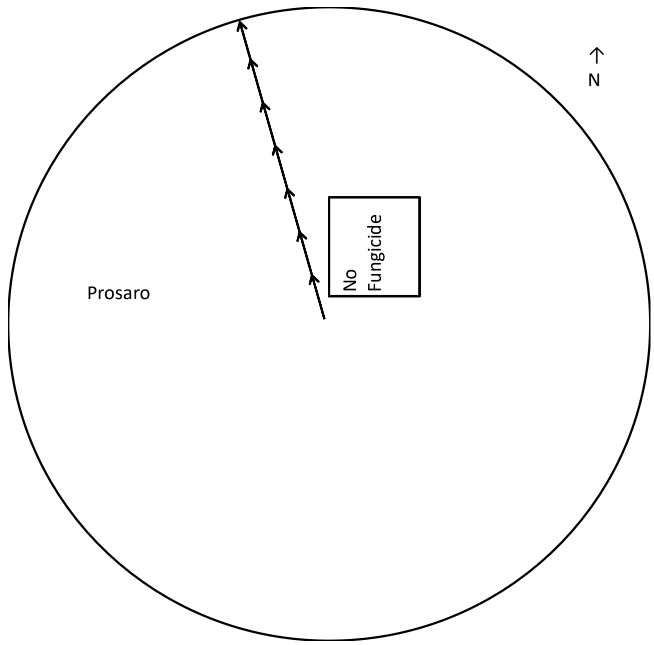


Figure 23: Co-operator 2 2011 field map

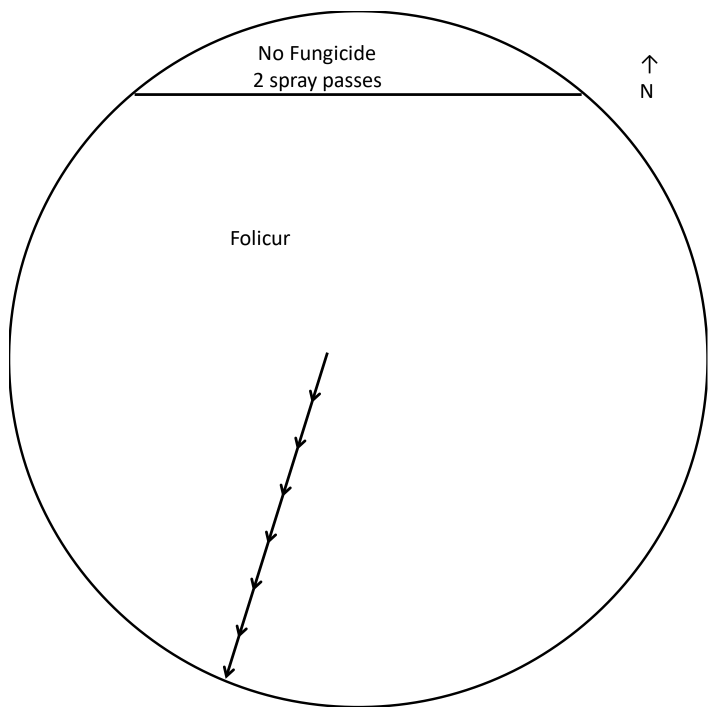


Figure 24: Co-operator 3 2011 field map

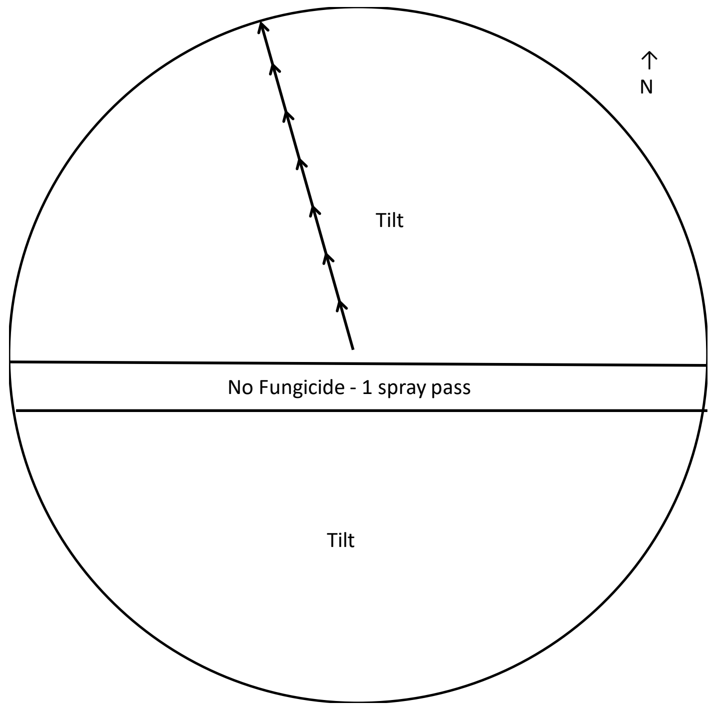


Figure 25: Co-operator 4 2011 field map

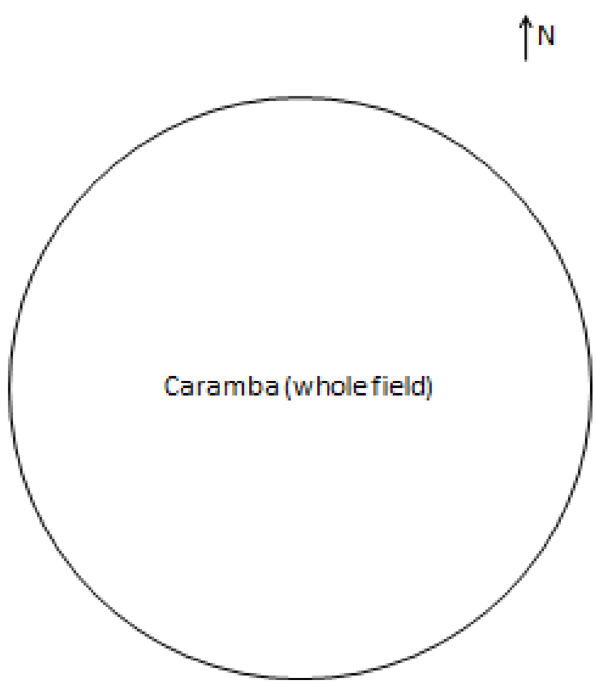


Figure 26: Co-operator 4 2011 field map

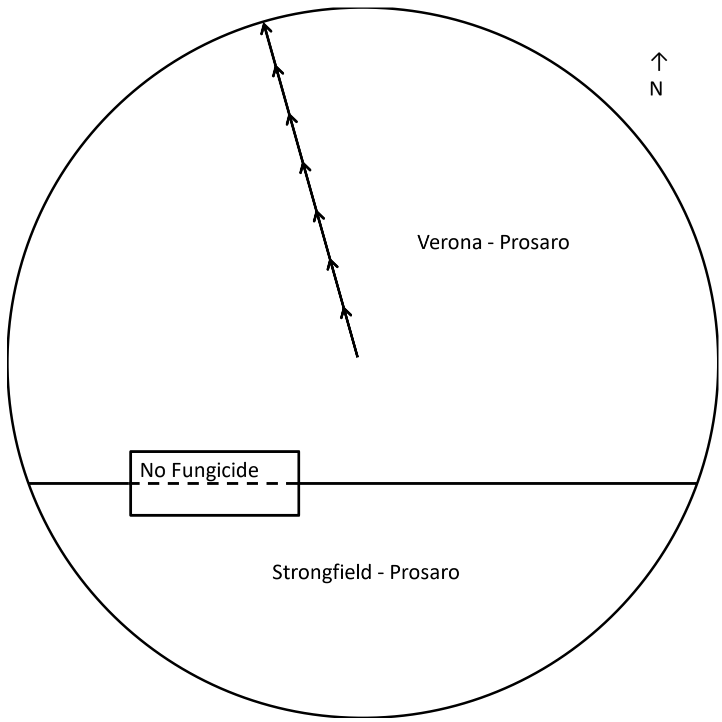
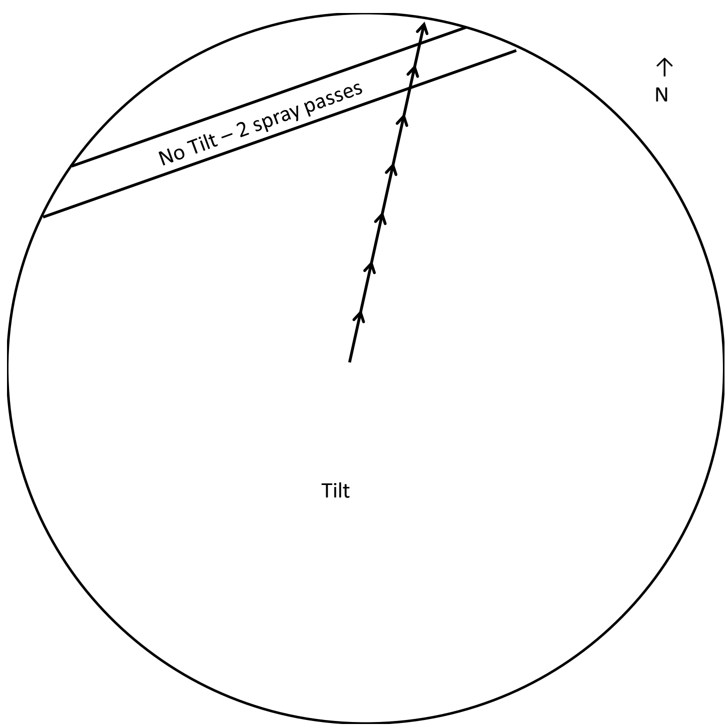


Figure 27: Co-operator 6 2011 field map



*Note: Caramba was sprayed on the entire field, no check strip left

Figure 28: Co-operator 7 2011 field map

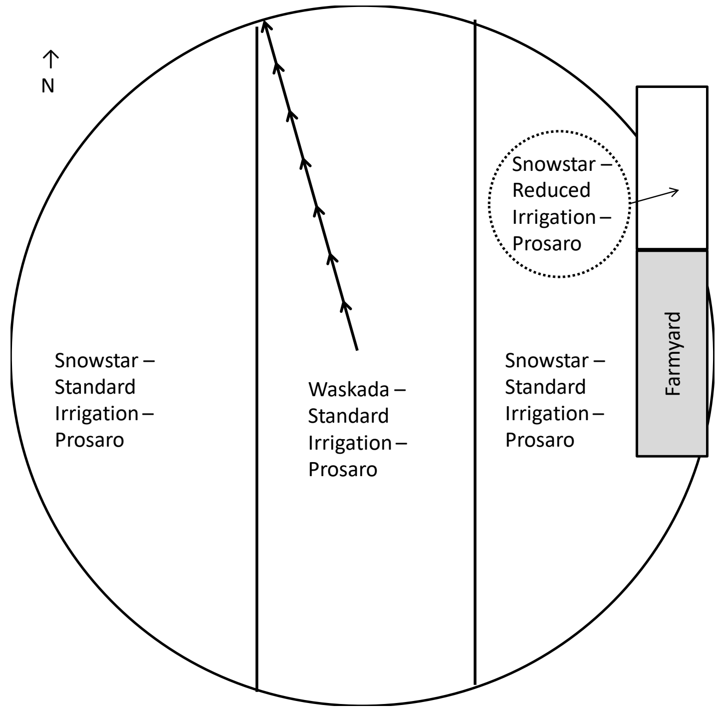


Figure 29: Co-operator 8 2011 field map

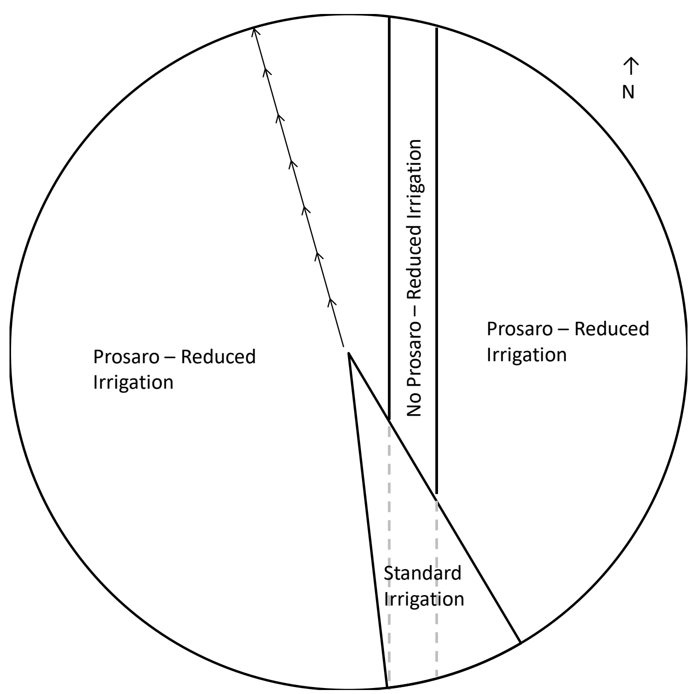


Figure 30: Co-operator 9 2011 field map

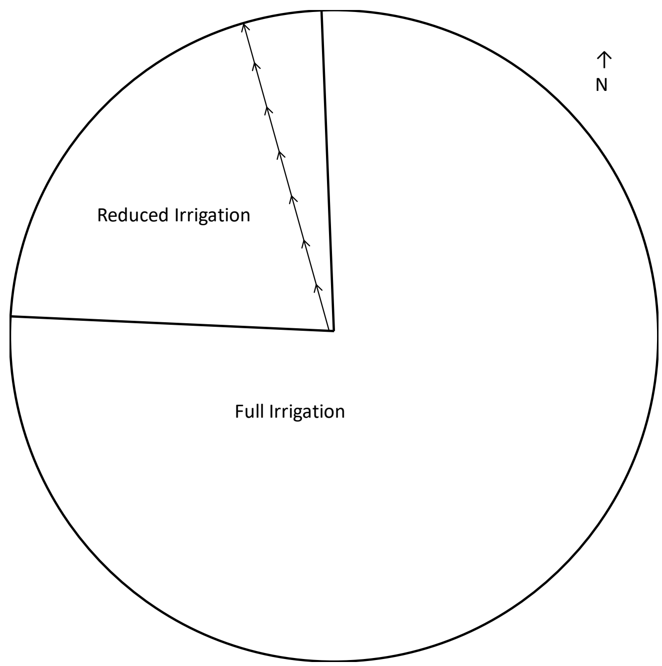


Figure 31: Co-operator 1 2012 field map

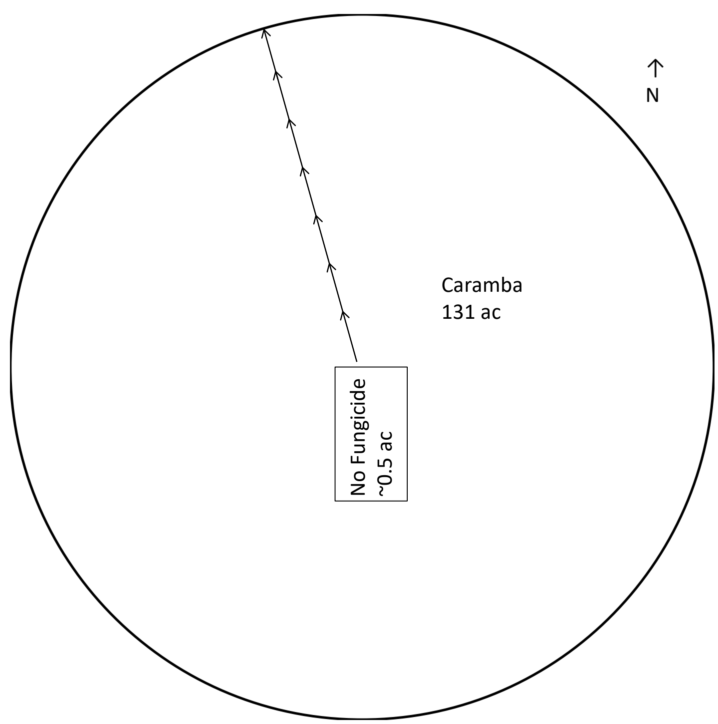


Figure 32: Co-operator 2 2012 field map

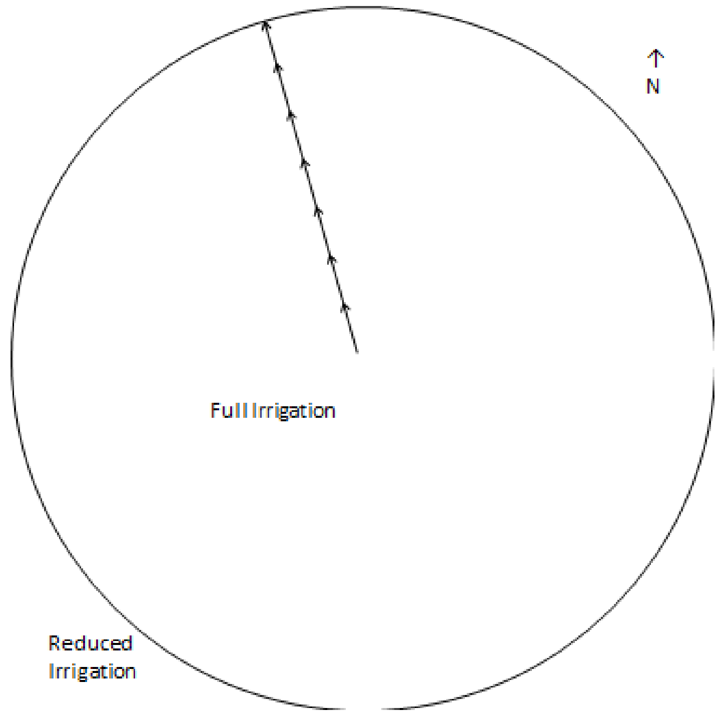


Figure 33: Co-operator 3 2012 field map

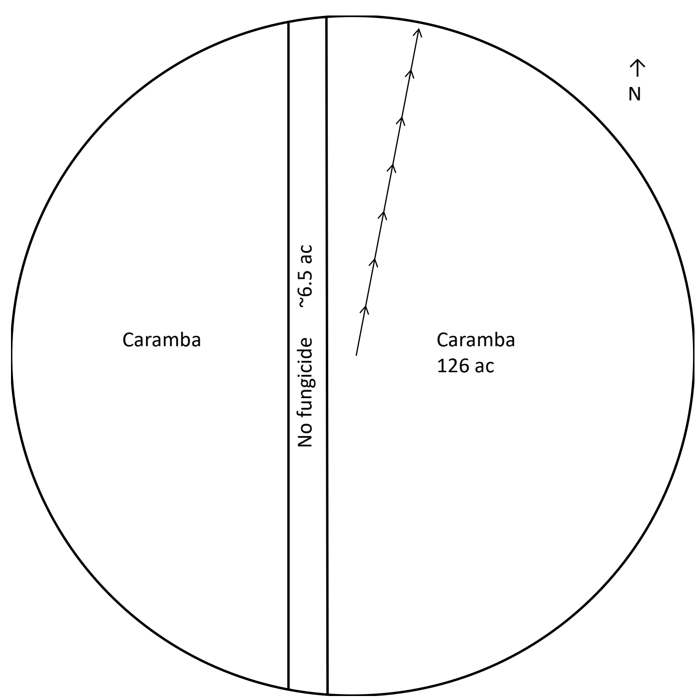


Figure 34: Co-operator 4 2012 field map

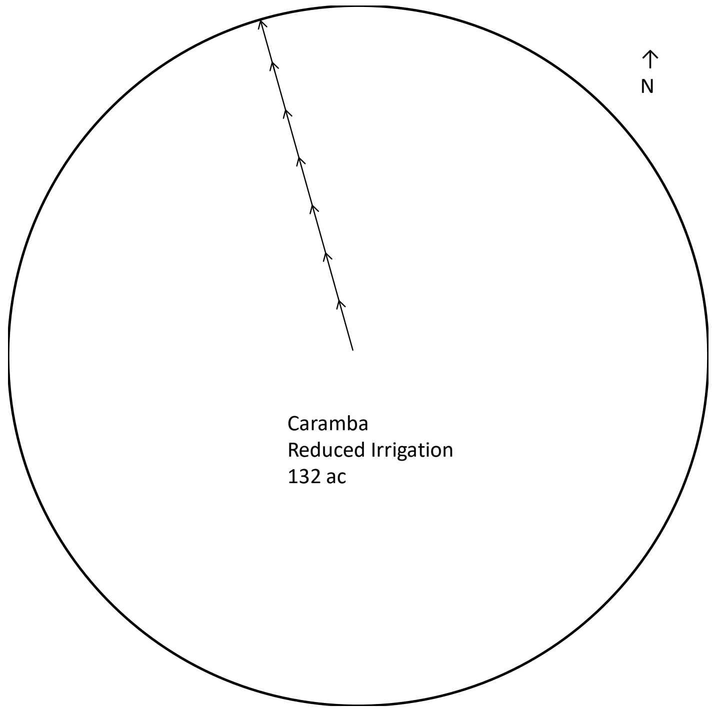


Figure 35: Co-operator 5 2012 field map

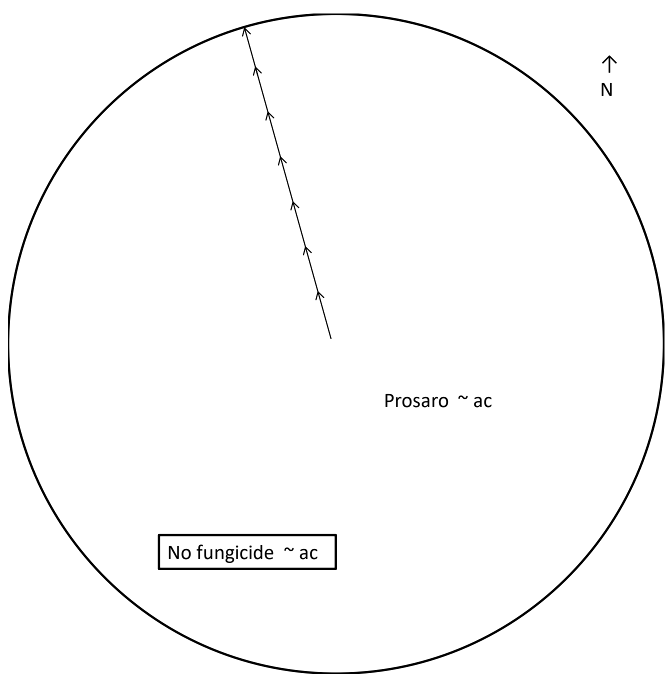


Figure 36: Co-operator 6 2012 field map

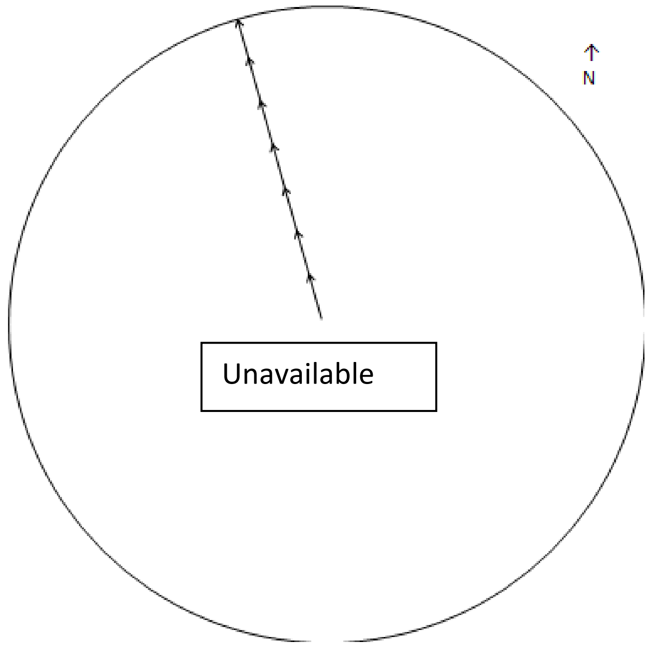


Figure 37: Co-operator 7 2012 field map

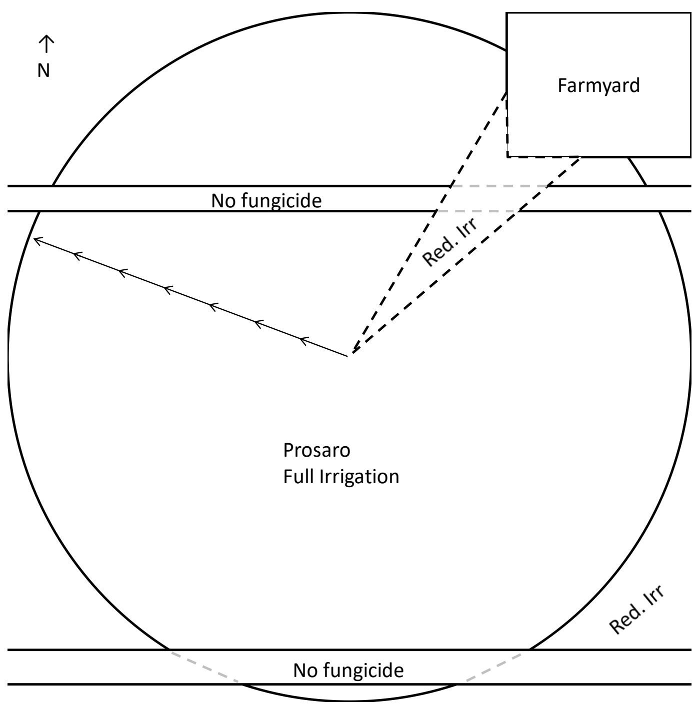


Figure 38: Co-operator 8 2012 field map

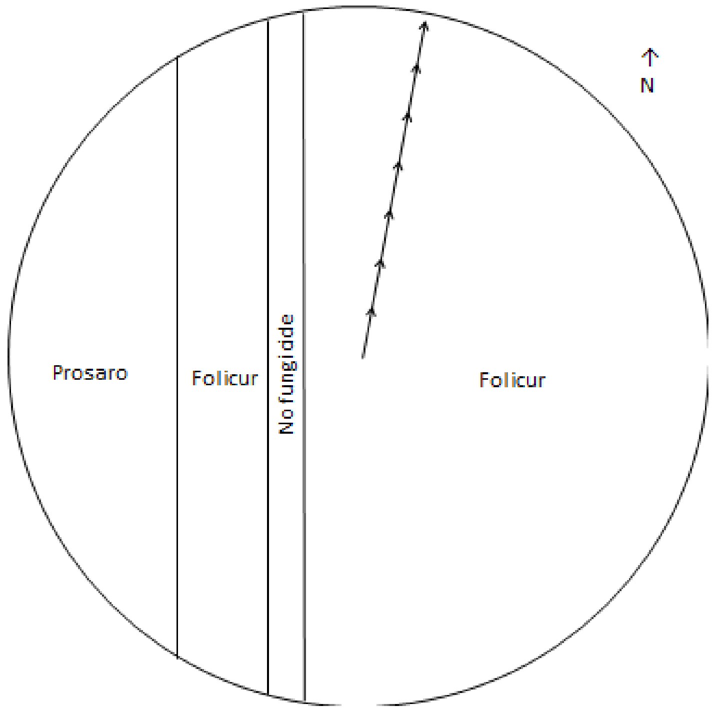


Figure 39: Co-operator 9 2012 field map

Appendix C Reference Documents

Figure 40: 2010 Demonstration plot layout

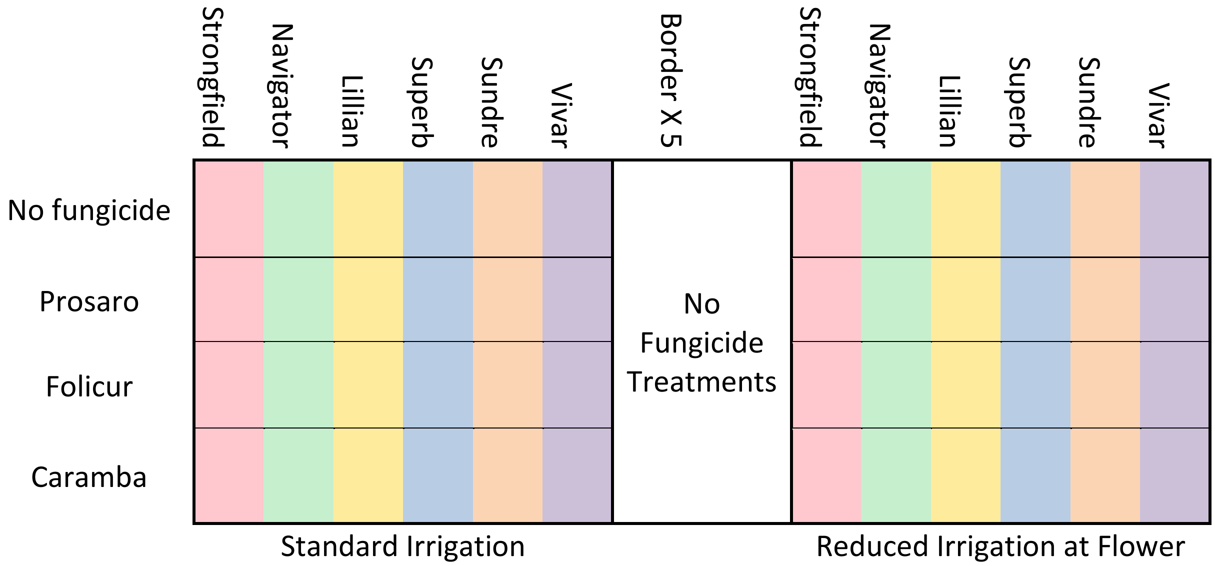


Figure 41: 2011 Fusarium demo plot plan

↑ N

	Border
Hulless	CDC Carter
2-Row Malt	CDC Reserve
	CDC Kindersley
	CDC Meredith
	CDC Copeland
	AC Metcalfe
6-Row Feed & Malt	CDC Anderson
	Vivar
	Chigwell
	Trochu
2-Row Feed	FB205
	CDC Cowboy
	Seebe
	Gadsby
	Ponoka
	CDC Austenson
	CDC Mindon
	Border

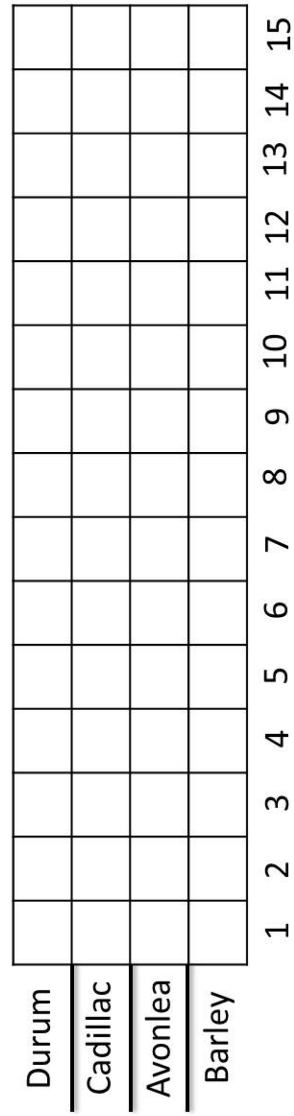
Treatment strips (west to east): Inoculated Check, Prosaro, Caramba, Untreated

Border CWRS	
Foremost	CPS
AC Crystal	
AC Minnedosa (GP)	General Purpose
Pasteur (GP)	
AC Sadash	CWSWS
AC Andrew	
Bumper	Triticale
Tyndal	
AC Strongfield	Durum
CDC Thrive (PT575)	CWRS
AC Domain	
AC Shaw VB	
AC Vesper VB	
AC Fieldstar VB	
AC Unity VB	
AC Waskada	
AC Barrie	
AC Alvena	
AC Lillian	
AC Stettler	
Superb	
AC Carberry	
AC Kane	
HW024	CWHWS
AC Snowstar	
Border CWRS	

Treatment strips (west to east): Inoculated Check, Prosaro, Caramba, Untreated

Figure 42: 2012 Farming Smarter Field School - Cereal Killers plot plan

Treatment Name	Trt #	Herbicide timing	Flag leaf emerged timing	FHB timing
Check	1	none	none	none
Herbicide timing only - Tilt (HTO Tilt)	2	Tilt	none	none
Herbicide timing only - Prosaro (HTO Pro)	3	Prosaro	none	none
Flag leaf application only - Tilt (Flg Tilt)	4	none	Tilt	none
Flag leaf application only - Prosaro (Flg Pro)	5	none	Prosaro	none
FHB application only - Tilt (FHB Tilt)	6	none	none	Tilt
FHB application only - Prosaro (FHB Pro)	7	none	none	Prosaro
HTO Tilt + Flg Tilt	8	Tilt	Tilt	none
HTO Pro + Flg Pro	9	Prosaro	Prosaro	none
HTO Tilt + FHB Tilt	10	Tilt	none	Tilt
HTO Pro + FHB Pro	11	Prosaro	none	Prosaro
Flg Tilt + FHB Tilt	12	none	Tilt	Tilt
Flg Pro + FHB Pro	13	none	Prosaro	Prosaro
HTO Tilt + Flg Tilt + FHB Tilt	14	Tilt	Tilt	Tilt
HTO Pro + Flg Pro + FHB Pro	15	Prosaro	Prosaro	Prosaro



Cereal Killers Module

Early application of fungicide:
Recently, there has been increasing interest in tank mixing fungicides with herbicides and applying the mixture at an early crop growth stage. Although this represents an opportunity for a convenient one pass operation for weed and disease management in cereals, it does not provide direct protection of the upper cereal canopy leaves which are crucial for grain filling and yield. Moreover, if the application is delayed to the 5-6 leaf stage it may compromise the level of weed management, given that previous research has illustrated the importance of early weed removal.

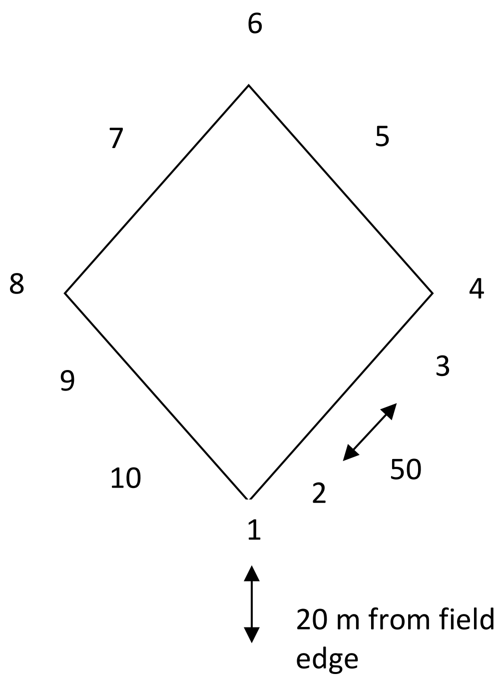
Take home message:
Although a number of fungicides used for cereal leaf disease management are systemic, movement within the plant is typically limited to within an individual leaf and not between leaves. Thus, the fungicide needs to be applied directly to those leaves that are important for grain filling. Furthermore, the level of activity on well-established infections is typically limited and thus fungicides need to be applied prior to extensive disease development. Ultimately, when using an in-crop fungicide for cereals, protection of the upper canopy leaves should be the primary goal as this permits a longer period of grain filling, leading to higher grain yield, kernel weight, plumpness, and test weight.

Figure 43: Stubble sampling protocol

FHB Stubble Sampling Information

When collecting samples ensure you take ONLY the lowest node from the stubble. The protocol for sampling is as follows:

5 stalk samples from 10 points in each field should be selected. A diamond pattern should be used, 20 m in from the edge of the field. There should be 50 m between each sample site. Each sample collected in the field must include the first stem node, with at least 1 cm of stem on either side of the node. Before being sent to the lab samples should be cut down to include only the first node and 1 cm of stem on either side of the node. All samples from one field should be put in the same bag.



THINGS YOU NEED TO BRING

- Camera
- Clippers
- Bags for samples
- Sharpies
- Elastic bands

Figure 44: Visual disease rating protocol.

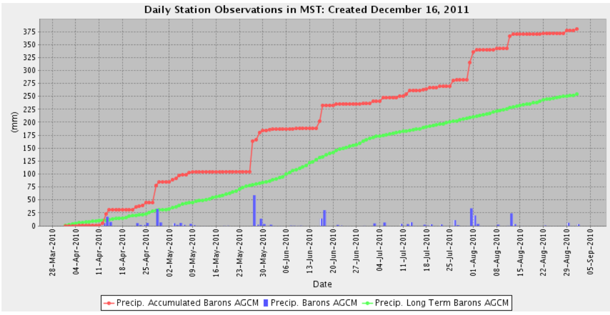
FHB Disease Rating Protocol

Please assess and collect samples along a "diamond-shaped" path starting at least 50 m in from the edge of each field. At each of three sites along the diamond-shaped path, randomly select and examine 100 heads (300/field total) when plants are at the late milk to early dough stage (Feekes B G.S. 11.1-11.2, Zadoks et al. B 77-84). **It is critical to assess and collect samples at the correct growth stage in order to recognize typical FHB symptoms. Such symptoms may be difficult to see on mature heads. Make sure that heads are selected at random to ensure that a representative assessment of the average level of infection is made.** Insure that sampling sites are at least 50 - 100 m apart. At each site, count and record the number of heads with any typical symptoms of FHB (e.g. 0 out of 100, 10 out of 100, 5 out of 100, etc.). At each site, collect any infected heads present and put them in separate a labeled paper bag(s) for each site and field. Please keep the head samples separate for each site and avoid crushing the bags.

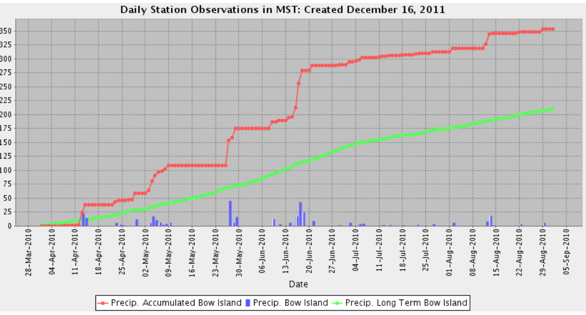
Appendix D Weather Data

Figure 45: 2010 precipitation data for all co-operators

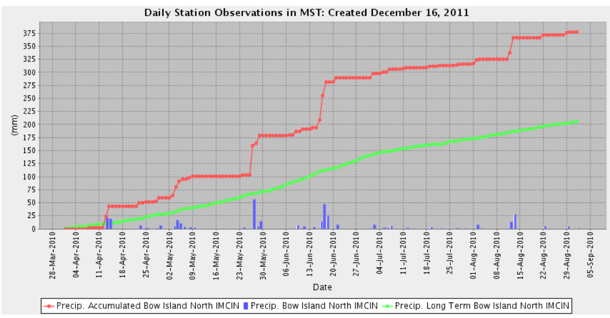
Barons – Co-operator 1



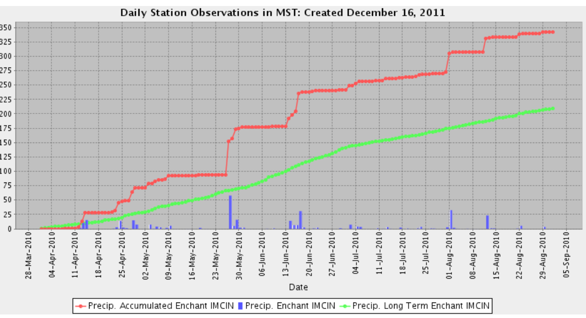
Bow Island – Co-operators 2 & 6



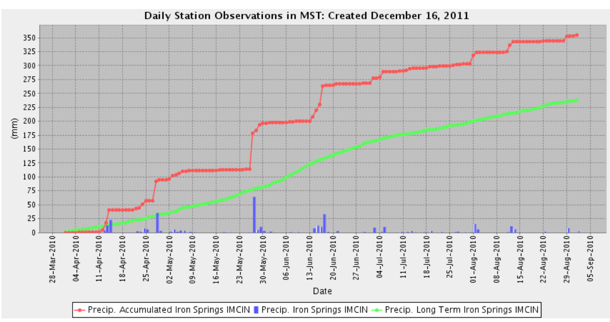
Bow Island North – Co-operator 9



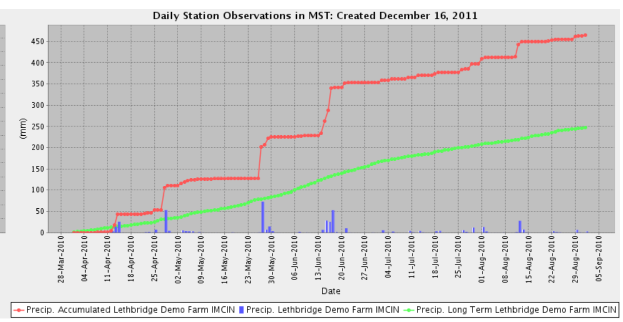
Enchant – Co-operator 3



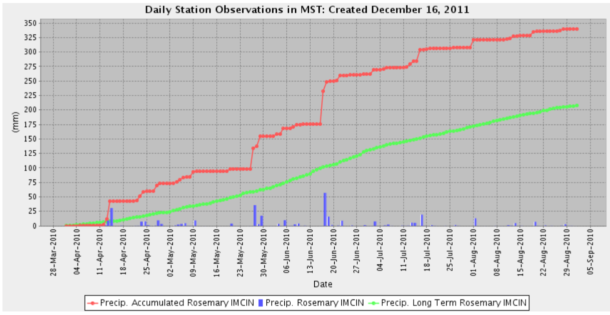
Iron Springs – Co-operator 8



Lethbridge Demo Farm – SARA R & D



Rosemary – Co-operator 7



Travers – Co-operators 4 & 5

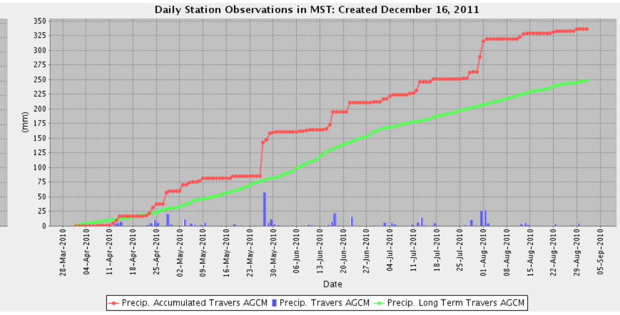
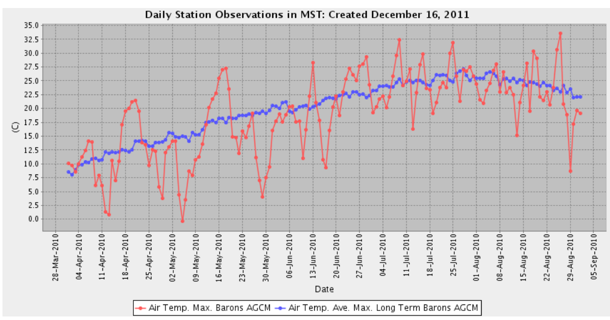
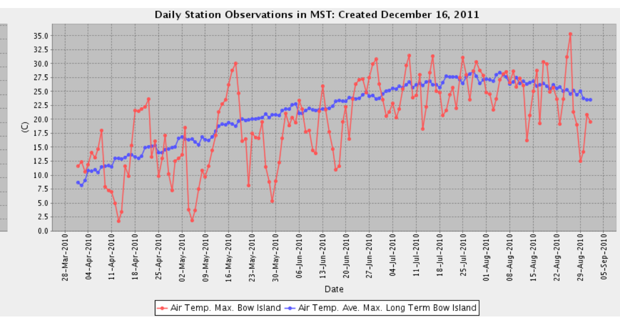


Figure 46: 2010 temperature data for all co-operators

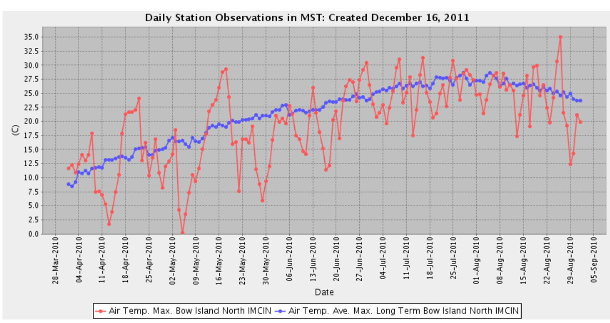
Barons – Co-operator 1



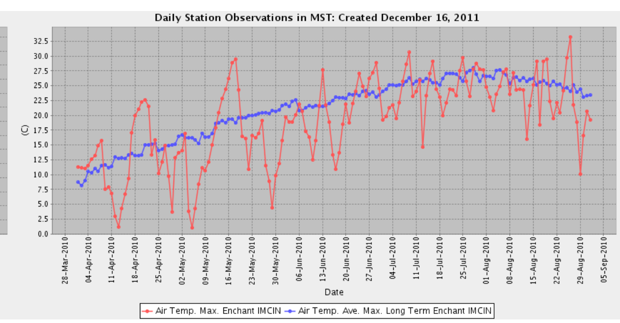
Bow Island – Co-operators 2 & 6



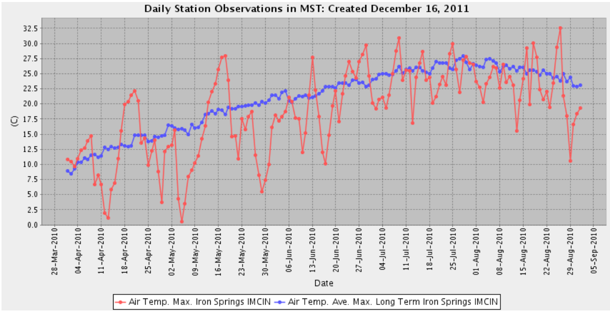
Bow Island North – Co-operator 9



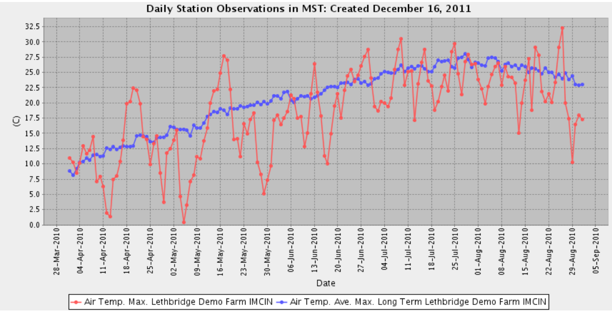
Enchant – Cop-operators 3



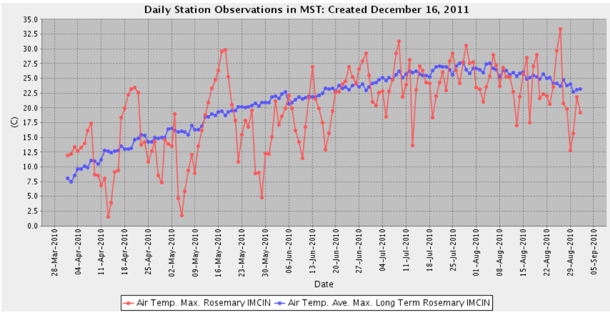
Iron Springs – Co-operator 8



Lethbridge Demo Farm – SARA R & D



Rosemary – Co-operator 7



Travers – Co-operators 4 & 5

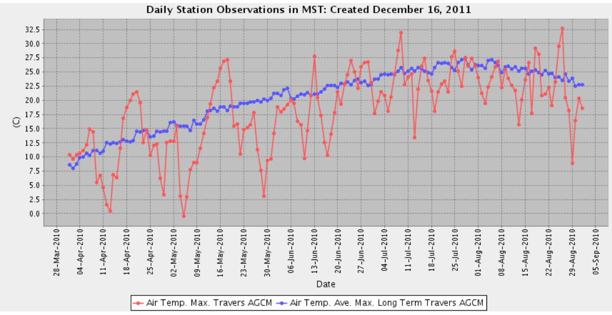
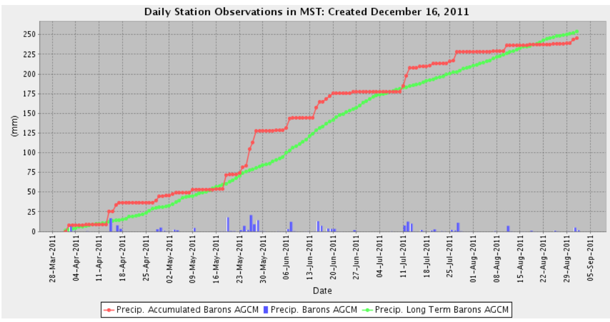
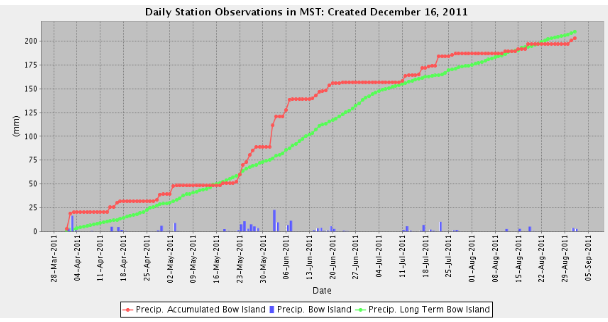


Figure 47: 2011 precipitation data for all co-operators

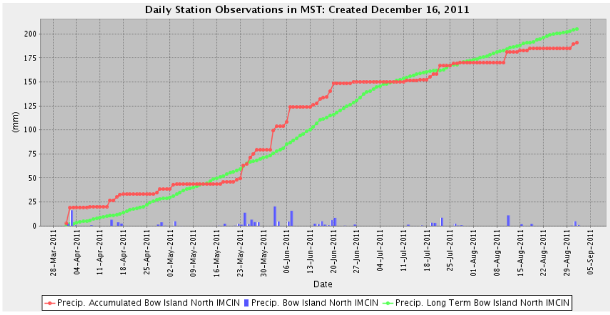
Barons – Co-operator 1



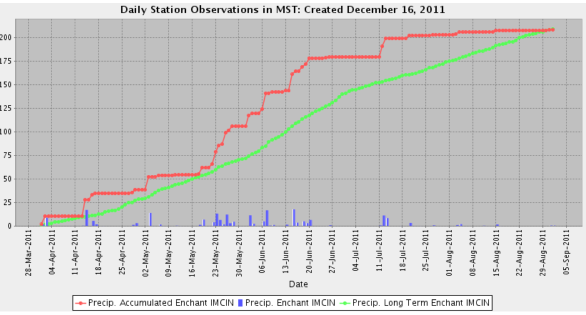
Bow Island – Co-operators 2 & 6



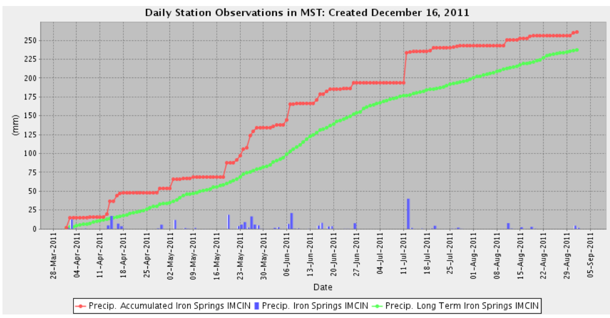
Bow Island North – Co-operator 9



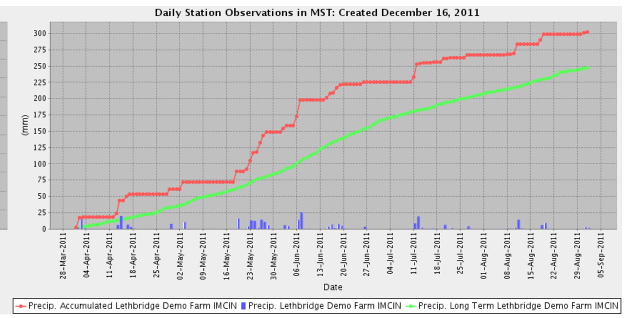
Enchant – Co-operators 3



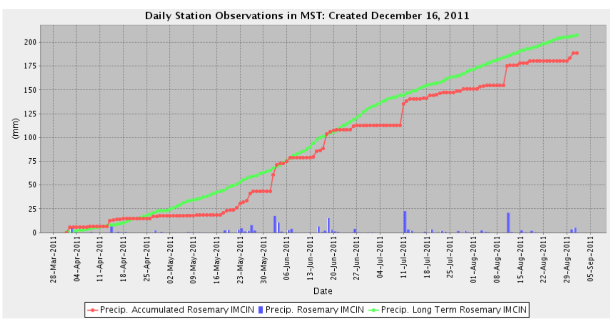
Iron Springs – Co-operator 8



Lethbridge Demo Farm – SARA R & D



Rosemary – Co-operator 7



Travers – Co-operators 4 & 5

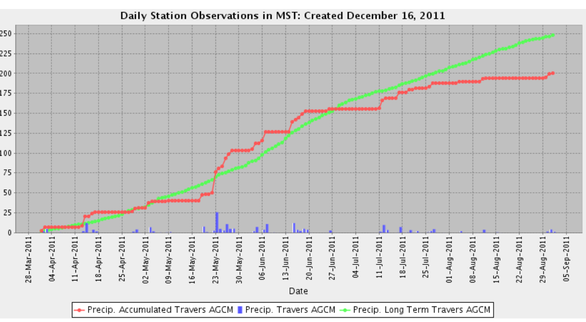
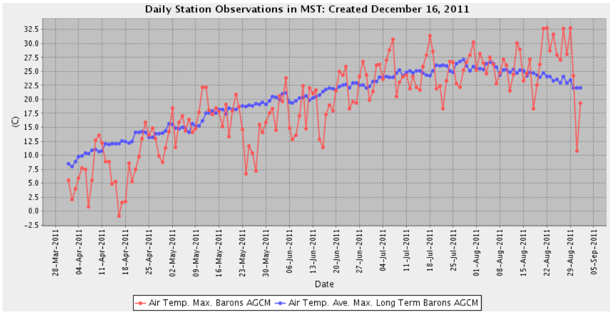
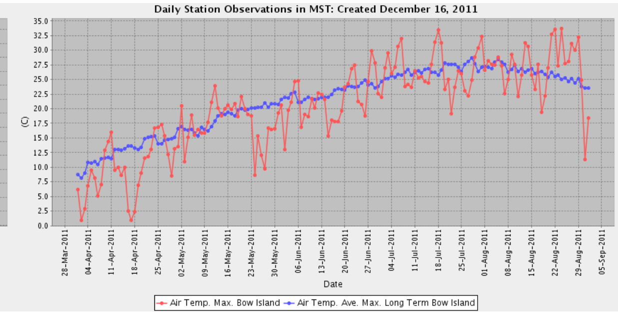


Figure 48: 2011 temperature data for all co-operators

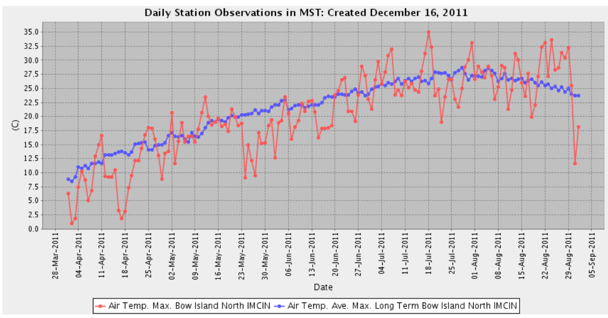
Barons – Co-operator 1



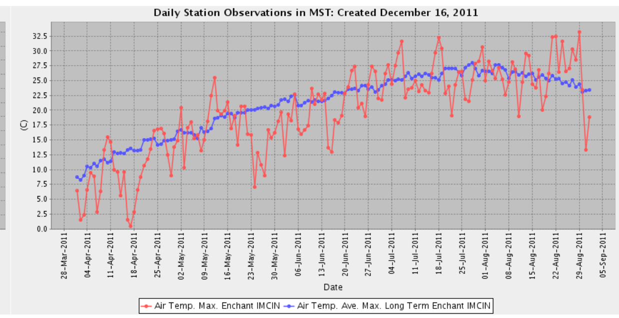
Bow Island – Co-operators 2 & 6



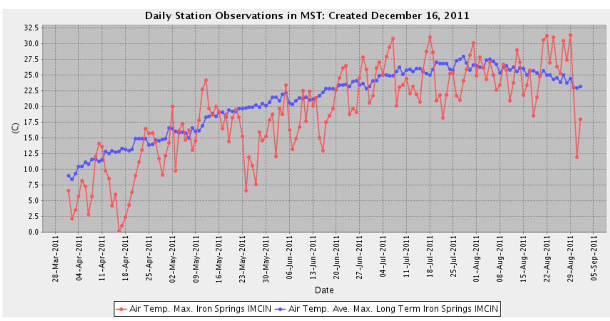
Bow Island North – Co-operator 9



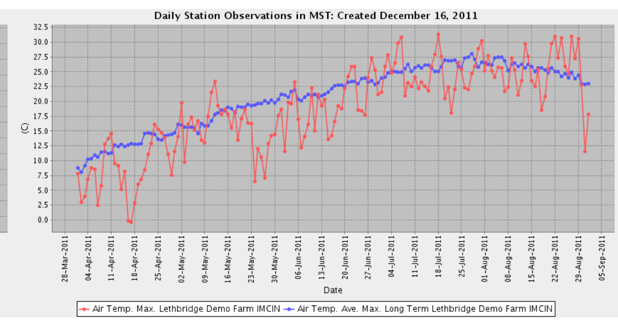
Enchant – Co-operators 3



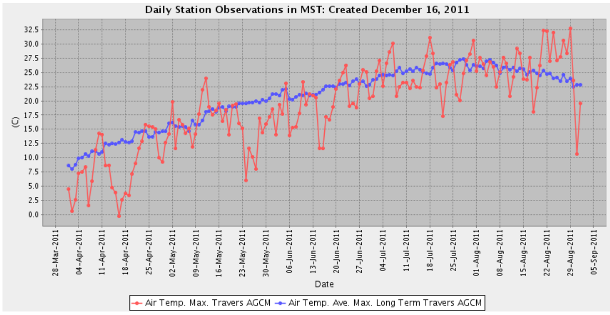
Iron Springs – Co-operator 8



Lethbridge Demo Farm – SARA R & D



Rosemary – Co-operator 7



Travers – Co-operators 4 & 5

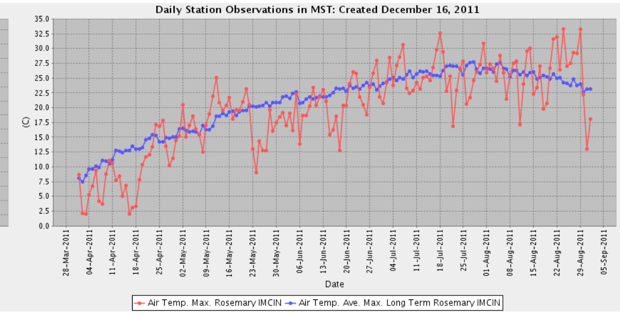
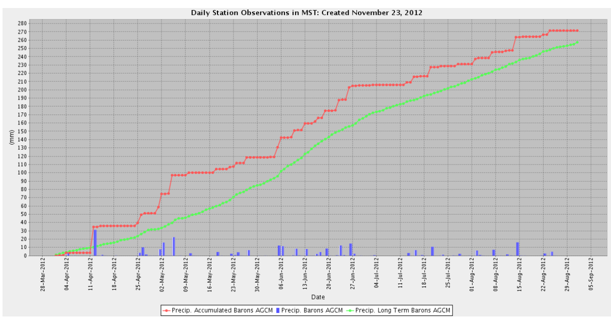
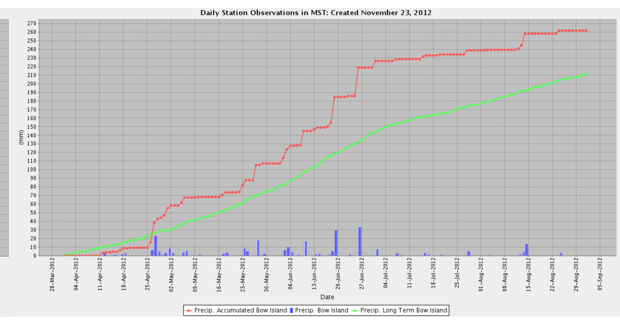


Figure 49: 2012 precipitation data for all co-operators

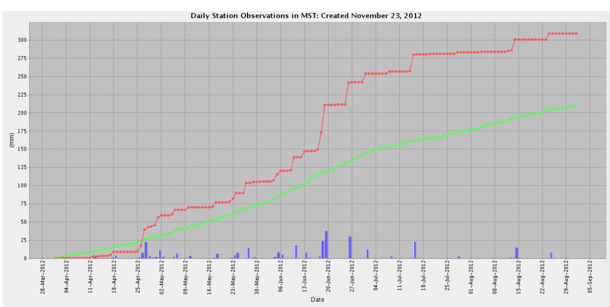
Barons – Co-operator 1



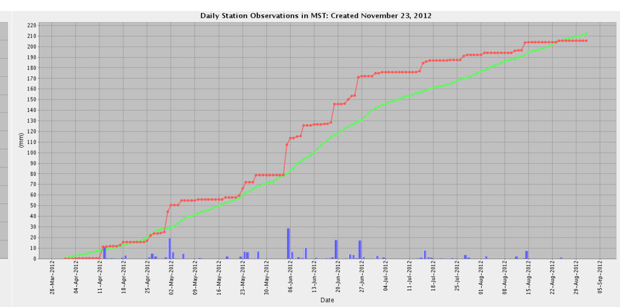
Bow Island – Co-operators 2 & 6



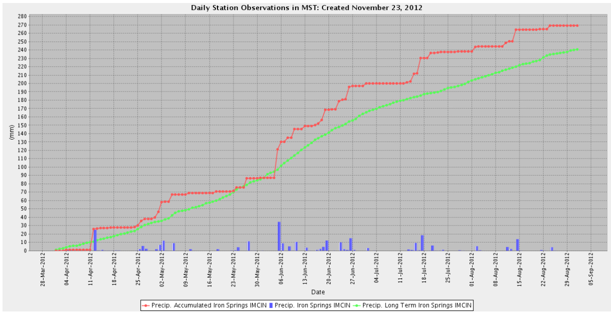
Bow Island North – Co-operator 9



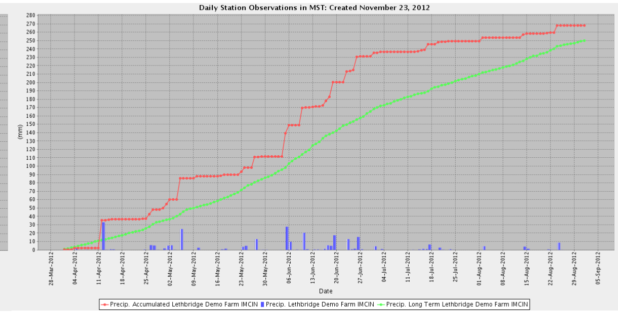
Enchant – Co-operators 3



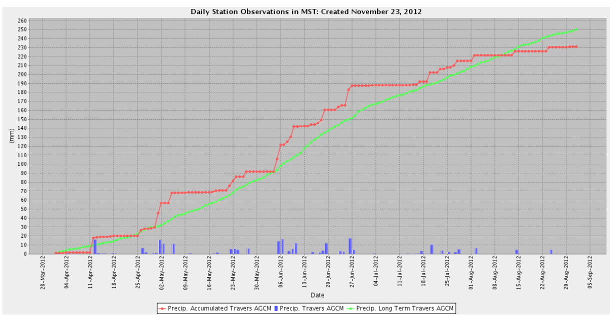
Iron Springs – Co-operator 8



Lethbridge Demo Farm – SARA R & D



Rosemary – Co-operator 7



Travers – Co-operators 4 & 5

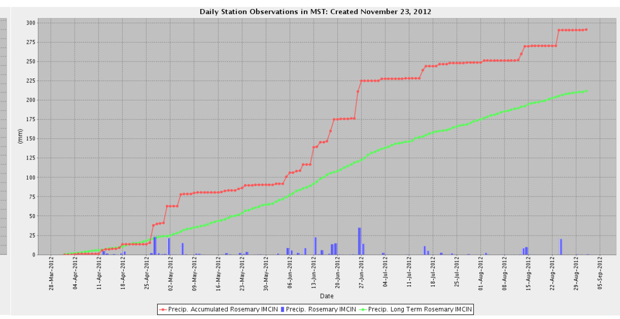
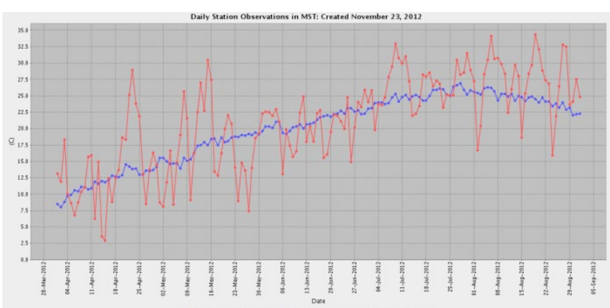
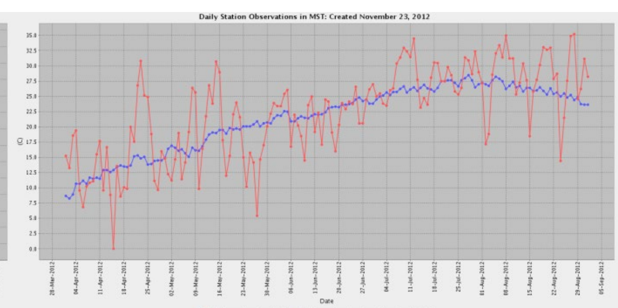


Figure 50: 2012 temperature data for all co-operators

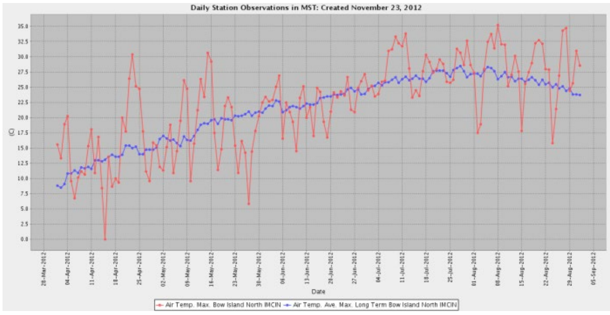
Barons – Co-operator 1



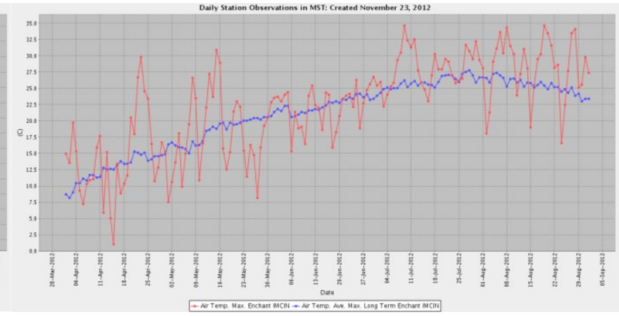
Bow Island – Co-operators 2 & 6



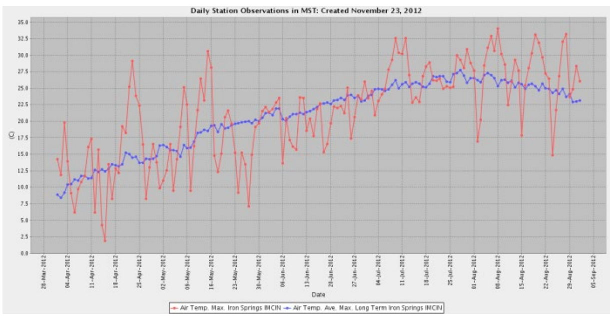
Bow Island North – Co-operator 9



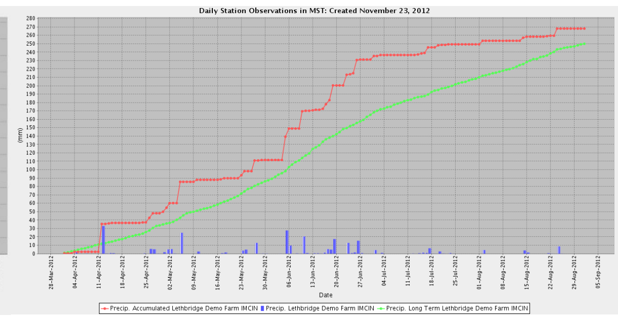
Enchant – Co-operators 3



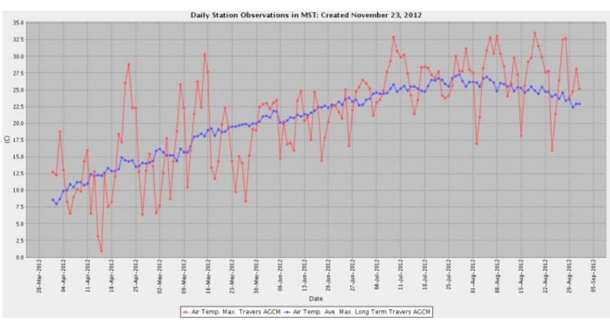
Iron Springs – Co-operator 8



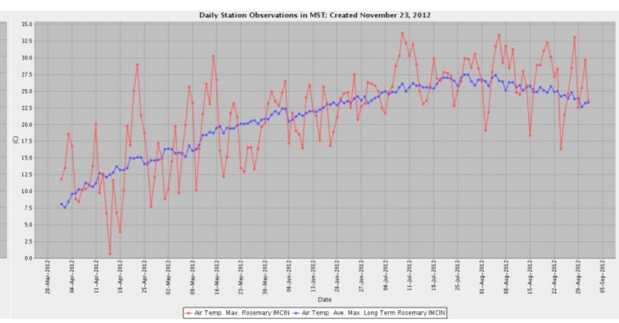
Lethbridge Demo Farm – SARA R & D



Rosemary – Co-operator 7



Travers – Co-operators 4 & 5



Appendix E - Economic Evaluation Prices

Table 15. Grain Prices – for 2010 and 2011 Trial Data

Grain Prices	CWB PRO $/bushel
#1 CWRS*	$8.30
#2 CWRS*	$8.14
#3 CWRS*	$7.67
CW Feed*	$6.40
#2 CWAD*	$9.25
#3 CWAD*	$8.85
#4 CWAD*	$7.05
#5 CWAD*	$5.61
Spec CWAD*	$3.21

*CWB PRO Pricing

Table 16. Grain Prices – for 2012 Trial Data

Grain Prices	CWB PRO $/bushel
#1 CWRS*	$9.31
#2 CWRS*	$9.20
#3 CWRS*	$8.82
CW Feed**	$6.18
#2 CWAD*	$8.82
#5 CWAD**	$6.18

*CWB Harvest PRO 2012-13 Pricing
**CWB PRO 2011-12 Pricing

Table 17. Fungicide Prices/ Application Cost for all Trial Years

Fungicide Prices	$/acre
Folicur	$14.00
Prosaro	$15.50
Caramba	$15.50
Application Rate	$8.50

Appendix F - Extension

Figure 51: Fusarium head blight diseases symptoms poster

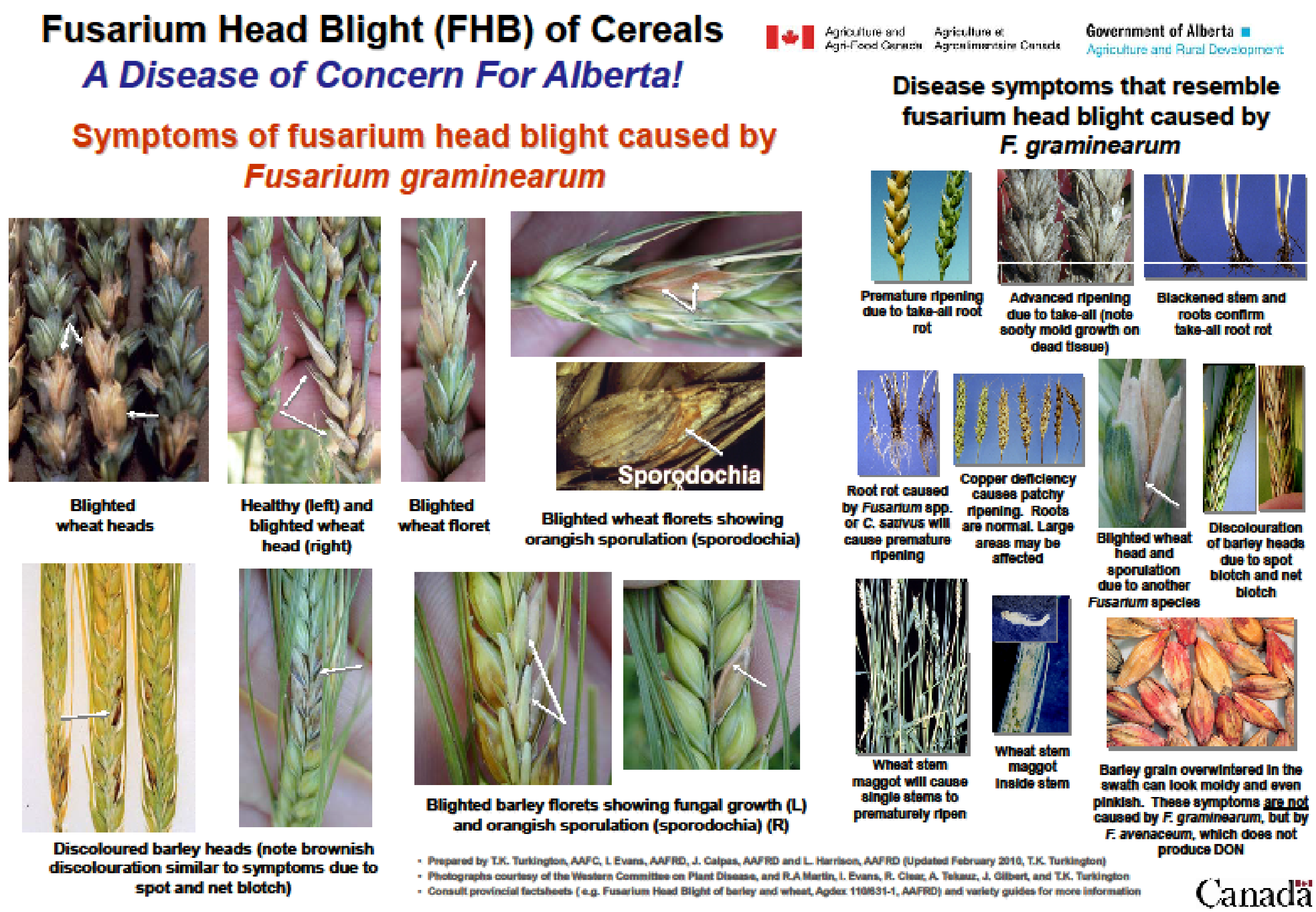


Figure 52: Fusarium head blight seed poster

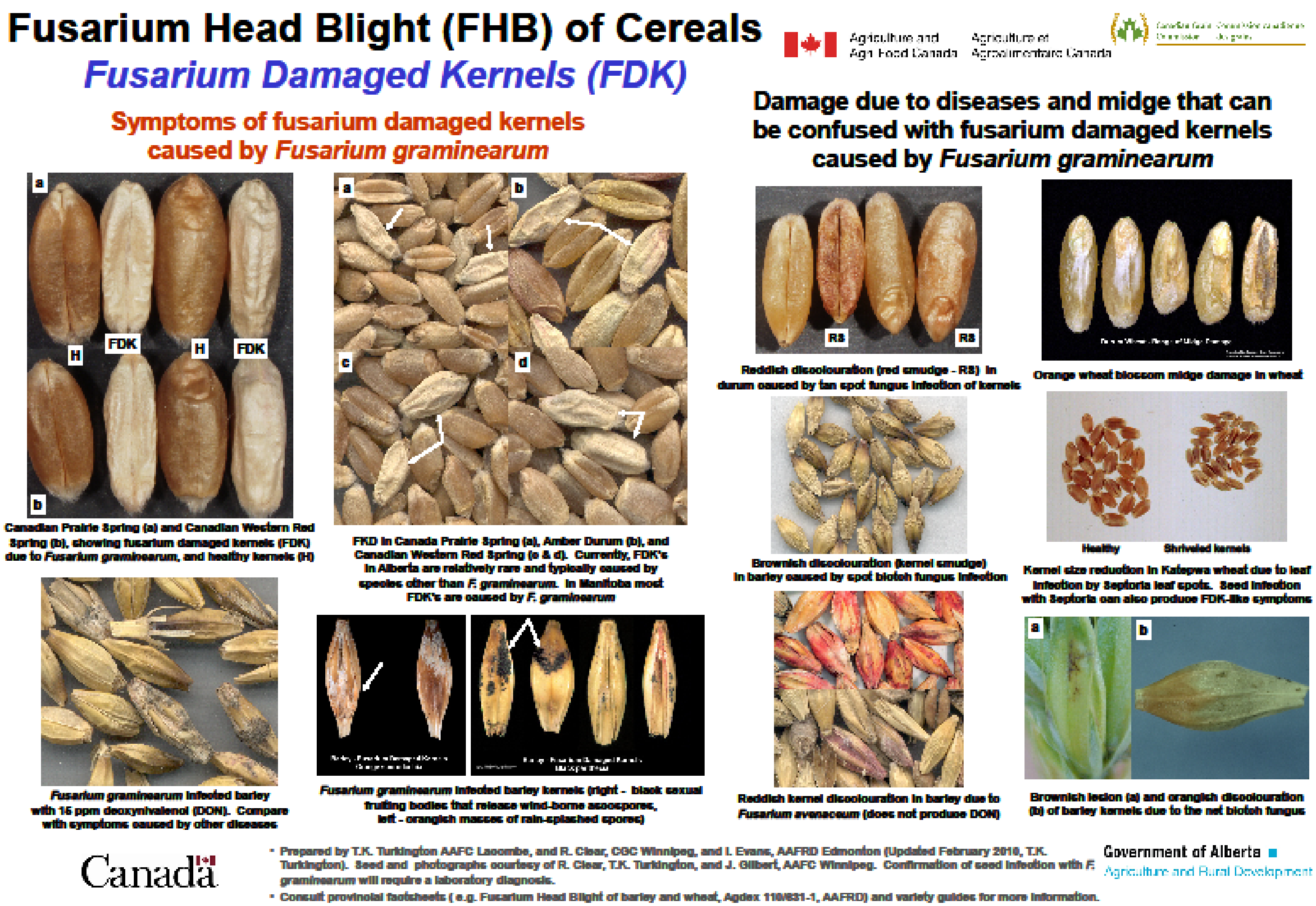


Figure 53: Fusarium head blight of cereals poster

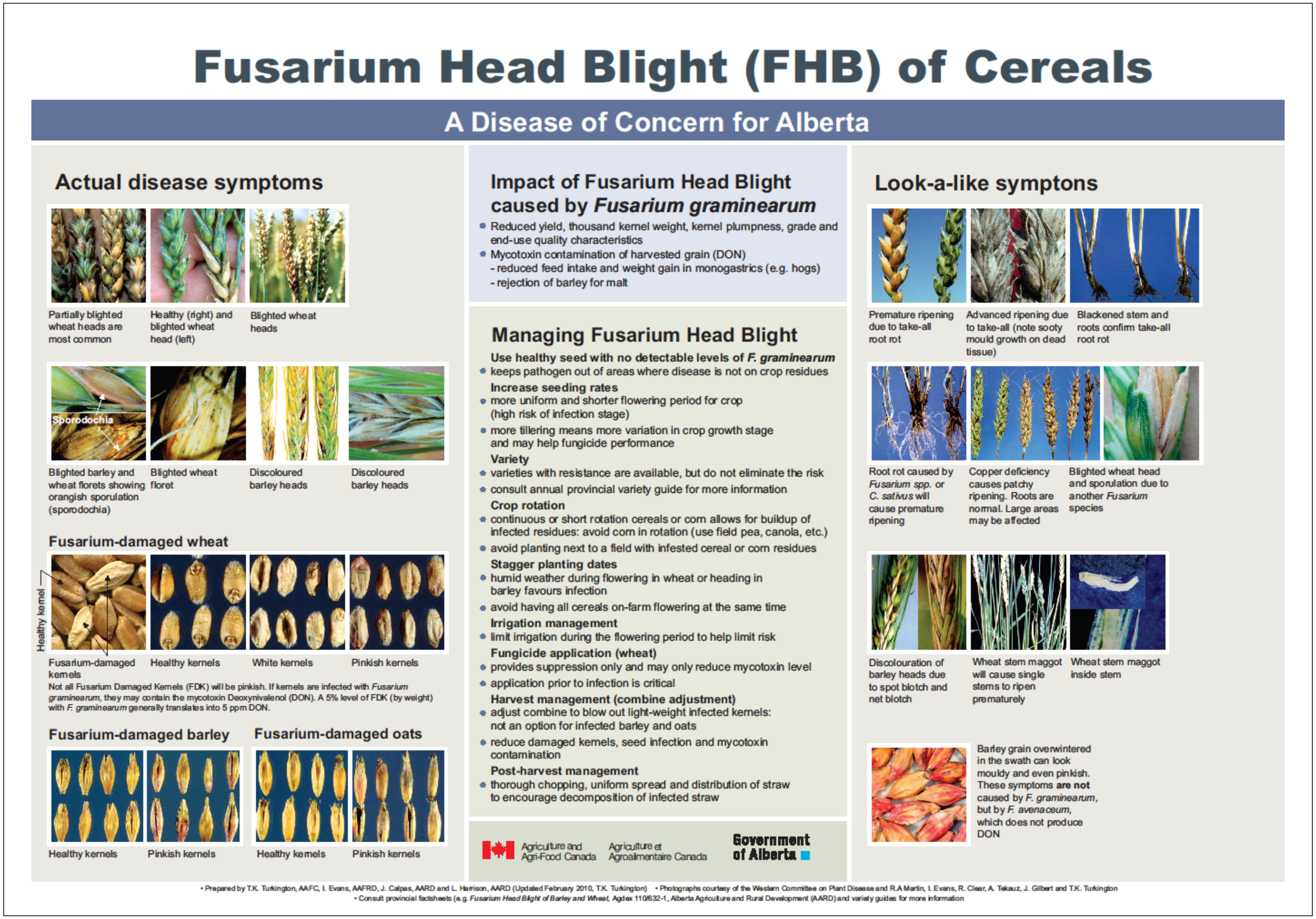


Figure 54: Fusarium head blight project poster

Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada

On-Farm Field Demonstration of the Impact of Irrigation Management, Timing of Fungicide Sprays and Cropping System on Fusarium Head Blight Control in Irrigated Wheat Production in Southern Alberta

Ken Coles[1], Ty Faechner[2], Kelly Turkington[3], Ron Howard[4], Mike Harding[4]

[1]Farming Smarter [2]Agricultural Research and Extension Council of Alberta [3]Agriculture and Agri-Food Canada [4]Alberta Agriculture and Rural Development

Introduction

- Fusarium head blight (FHB) is a cereal disease caused by several strains of *Fusarium spp.* pathogens. Infection causes fusarium damaged kernels (FDK) affecting grade, yield and profitability.
- *Fusarium graminearum* produces high levels of deoxynivalenol (DON), a mycotoxin that interferes with livestock and human consumption, as well as brewing, milling and pasta processing.
- Project examined irrigation management, fungicide application and cultural practices affecting FHB management.

Materials and Methods

- Nine co-operator field trials were conducted and 25 random fields were surveyed annually in southern Alberta.
- Field trials examined reduced vs. full irrigation regimes and fungicide applications.
- Field data collected included pathogen identification and quantification of stubble and grain samples, visual FHB ratings, yield, grade, and DON analysis.
- Survey data included crop rotation, wheat class and variety, FHB history, irrigation vs. dryland, tillage practice, fungicide applications and pathogen isolation of grain samples.

Results

- Fusarium damaged kernels (FDK) were reduced up to 3.9% with irrigation management.
- Fungicide treatements reduced FDK in 80% of fields by up to 5.5%.
- Pathogen analysis of grain samples showed fungicide applications reduced *Fusarium graminearum* (Fg) levels by up to 12% in 2010 & 2012 and 7% in 2011.
- Irrigation management decreased the Fg levels in grain samples by up to 2%.
- Net economic benefits of fungicides was positive in 4 of 5 fields raging from $1-3/bu.
- When reduced irrigation and fungicide application were combined, %FDK reductions were greater than when either practice was used on its own.
- Annual producer surveys indicate a significant increase in producer awareness of Fusarium head blight management as only 2 fields in 2010 noted a history of FHB, 4 fields in 2011 and 16 in 2012.
- The number of fields sprayed with a fungicide for FHB increased from 4 fields in 2010 to 18 in 2012.
- Majority of fields (64%) were growing a susceptible variety and 59% continued to grow a susceptible variety in fields with a history of FHB.
- In the fields that contained Fg in the grain samples, 71% had grown a host crop within the previous 2 years.
- Irrigation appears to be a key influence as 83% of Fg infected grain samples were on irrigated fields.

Figure 1. Wheat head with FHB

Figure 2. Co-operator spraying fungicide

Acknowledgements

Thank you to the producer co-operators who donated their land, equipment, time, and knowledge to this project, and also to Drs. Kelly Turkington (AAFC Lacombe), Ron Howard (AARD Brooks), and Mike Harding (AARD Brooks) for pathology support. This work is supported by the Pest Management Center of Agriculture and Agri-Food Canada, Pesticide Risk Reduction Program (www.agr.gc.ca/prrmup).

ARECA FARMING SMARTER Canada

Figure 55: Fusarium Head Blight Reaction Chart from 2010 in Alberta

Fusarium Head Blight Reaction of Cereal Varieties For Alberta

Based on Varieties of Cereal and Oilseed Crops For Alberta - 2010, AAFRD Agdex 100/32

T.K. Turkington[1], *and K. Xi*[2]

[1] *Agriculture and Agri-Food Canada Lacombe, AB;*

[2] *Alberta Agriculture, Food and Rural Development (AAFRD), Lacombe, AB*

*Fusarium Head Blight Reaction**

Good (G) | Fair (F) | Poor (P) | Very Poor (VP)

Wheat, Triticale, and Oat

CWRS

5602HR	G
Waskada	G
AC Barrie	F
AC Cadillac	F
Alikat	F
CDC Bounty	F
CDC Go	F
Kane	F
Katepwa	F
McKenzie	F
AC Elsa	P
AC Intrepid	P
AC Splendor	P
Alvena	P
CDC Abound	P
CDC Alsask	P
Journey	P
Somerset	P
Superb	P
Unity VB	P
AC Abbey	VP
CDC Imagine	VP
CDC Osler	VP
CDC Teal	VP
Goodeve VB	VP
Harvest	VP
Infinity	VP
Lillian	VP
Lovitt	VP
Park	VP
Peace	VP
Prodigy	VP
Roblin	VP
5603HR	XXxx
AC Eatonia	XX
BW859	XX
Fieldstar VB	XX
Stettler	XX

CPS Red

5702PR	P
AC Taber	VP
5700PR	VP
5701PR	VP
AC Crystal	VP
AC Foremost	VP

CPS White

Snowhite475	VP
Snowhite476	VP

CWWS

Kanata	F
Snowbird	P
Snowstar	P

CWAD

AC Avonlea	P
Kyle	P
AC Morse	VP
AC Navigator	VP
Commander	VP
Strongfield	VP
Brigade	XX
Eurostar	XX

SWS

AC Meena	P
Bishaj	P
AC Andrew	VP
AC Reed	XX
Sadash	XX

Winter wheat (WW)

CDC Buteo	F
Norstar	F
AC Bellatrix	P
CDC Clair	P
AC Readymade	VP
AC Tempest	VP
CDC Falcon	VP
CDC Harrier	VP
CDC Kestrel	VP
CDC Osprey	VP
CDC Ptarmigan	VP
CDC Raptor	VP
McClintock	VP
Radiant	VP
Accipiter	XX
Peregrine	XX

Triticale

Pronghorn	G
AC Ultima	F
Bunker	P
Tindale	P
Companion	XX

Oat

All varieties	XX

CWES

CDC Rama	F
Amazon	P
Bluesky	P
Laser	VP

Barley (row type)

General purpose

Conlon (2)	G
CDC Cowboy (2)	G
CDC Dolly (2)	G
CDC Mindon (2)	G
Seebe (2)	G
Xena (2)	G
Busby (2)	F
CDC Austenson (2)	F
CDC Coalition (2)	F
CDC Trey (2)	F
Champion (2)	F
McLeod (2)	F
Ponoka (2)	F
Trochu (6)	F
CDC Helgason (2)	P
Manny (6)	P
Niobe (2)	P
Alston (6)	VP
AC Lacombe (6)	VP
Chigwell (6)	VP
Sundre (6)	VP

Semi-dwarf

CDC Bold (2)	VP
Kasota (6)	VP
Vivar (6)	VP

Hulless

Millhouse (2)	F
Tyto (6)	P
Falcon (6)	VP

Malting

Harrington (2)	G
TR05671 (2)	G
AC Metcalfe (2)	F
CDC Copeland (2)	F
CDC Kendall (2)	F
CDC Meredith (2)	F
Newdale (2)	F
Bentley (2)	P
CDC Mayfair (6)	P
CDC Reserve (2)	P
CDC Select (2)	P
Legacy (6)	P
CDC Battleford (6)	VP
CDC Clyde (6)	VP
CDC Kamsack (6)	VP
CDC Yorkton (6)	VP
Lacey (6)	VP
Tradition (6)	VP
Formosa	XX

Relative reactions of small grain cereals

Most susceptible ←→ Least susceptible

Durum--SWS--CPS--WW--ES--CWRS--Triticale--6-row barley--2-row barley--Oat

*Under conditions favourable for disease all small grain cereals will sustain damage. Ratings are largely based on data from screening nurseries in Manitoba. Winter wheat may avoid significant FHB because it matures earlier than spring types.

**XX = insufficient data to describe.

Figure 56: FHB reaction of cereal varieties for 2011 in Alberta

Fusarium Head Blight Reaction of Cereal Varieties For Alberta

Based on Varieties of Cereal and Oilseed Crops For Alberta - 2011, AARD Agdex 100/32

T.K. Turkington [1], and K. Xi [2]

[1] Agriculture and Agri-Food Canada Lacombe, AB; [2] Alberta Agriculture and Rural Development (AARD), Lacombe, AB

*Fusarium Head Blight Reaction**

Good (G) — Fair (F) — Poor (P) — Very Poor (VP)

Wheat, Triticale, and Oat

CWRS

5602HR	G
BW878	G
Carberry	G
Waskada	G
5603HR	F
5604HR CL	F
AC Barrie	F
AC Cadillac	F
Alikat	F
CDC Bounty	F
CDC Kernen	F
Fieldstar VB	F
Glenn	F
Kane	F
Katepwa	F
McKenzie	F
AC Elsa	P
AC Intrepid	P
AC Splendor	P
Alvena	P
CDC Abound	P
CDC Alsask	P
CDC Go	P
CDC Stanley	P
CDC Thrive	P
CDC Utmost VB	P
Journey	P
Muchmore	P
Shaw VB	P
Somerset	P
Stettler	P
Superb	P
Unity VB	P
CDC Imagine	VP
CDC Osler	VP
CDC Teal	VP
Goodeve	VP
Harvest	VP
Infinity	VP
Lillian	VP
Lovitt	VP
Park	VP
Peace	VP
Prodigy	VP
Roblin	VP
AC Eatonia	XX

CPS Red

5702PR	P
AC Taber	VP
5700PR	VP
5701PR	VP
AC Crystal	VP
AC Foremost	VP

CPS White

Snowhite475	VP
Snowhite476	VP

CWWS

Kanata	F
Snowbird	P
Snowstar	P

CWAD

AC Avonlea	P
Brigade	P
CDC Verona	P
Enterprise	P
Eurostar	P
Kyle	P
AC Morse	VP
AC Navigator	VP
Commander	VP
Strongfield	VP

SWS

AC Meena	P
Sadash	P
Bishaj	VP
AC Andrew	VP

Winter wheat (WW)

CDC Buteo	G
Norstar	G
AC Bellatrix	F
AC Tempest	F
CDC Harrier	P
CDC Osprey	P
Peregrine	P
Broadview	VP
CDC Falcon	VP
McClintock	VP
Radiant	VP
Accipiter	VP
AC Readymade	XX
CDC Clair	XX
CDC Kestrel	XX
CDC Ptarmigan	XX
CDC Raptor	XX
Sunrise	XX

Triticale

Pronghorn	G
AC Ultima	F
Bunker	F
Bumper	P
Tyndal	P
Companion	XX

Oat

All varieties	XX

CWES

CDC Rama	F
Amazon	P
Bluesky	P
Laser	VP

Barley (row type)

General purpose

Conlon (2)	G
CDC Cowboy (2)	G
CDC Dolly (2)	G
CDC Mindon (2)	G
Seebe (2)	G
Xena (2)	G
Busby (2)	F
CDC Austenson (2)	F
CDC Coalition (2)	F
CDC Trey (2)	F
Champion (2)	F
McLeod (2)	F
Ponoka (2)	F
Trochu (6)	F
AC Harper (6)	P
CDC Helgason (2)	P
Manny (6)	P
Niobe (2)	P
AC Lacombe (6)	VP
AC Ranger (6)	VP
AC Rosser (6)	VP
Chigwell (6)	VP
Stander (6)	VP
Sundre (6)	VP

Semi-dwarf

CDC Bold (2)	VP
Mahigan (6)	VP
Vivar (6)	VP

Hulless

CDC McGwire (2)	G
CDC Carter (2)	F
Millhouse (2)	F
Tyto (6)	P
Falcon (6)	VP

Malting

Harrington (2)	G
Merit 57 (2)	G
TR05671 (2)	G
AC Metcalfe (2)	F
CDC Copeland (2)	F
CDC Kendall (2)	F
CDC Meredith (2)	F
Cerveza (2)	F
Major (2)	F
Newdale (2)	F
Stellar ND (6)	F
Bentley (2)	P
CDC Mayfair (6)	P
CDC Reserve (2)	P
CDC Select (2)	P
Legacy (6)	P
CDC Battleford (6)	VP
CDC Clyde (6)	VP
CDC Kamsack (6)	VP
CDC Yorkton (6)	VP
Excel (6)	VP
Tradition (6)	VP
Formosa	XX

Relative reactions of small grain cereals

Most susceptible ⟷ Least susceptible

Durum—SWS—CPS—WW—ES—CWRS—Triticale—6-row barley—2-row barley—Oat

*Under conditions favourable for disease all small grain cereals will sustain damage.
Ratings are largely based on data from screening nurseries in Manitoba.
Winter wheat may avoid significant FHB because it matures earlier than spring types.
**XX = insufficient data to describe.

1.Spring 2010 Edition Farming Smarter

Stack strategies to manage fusarium – it can kill your grain profits

The synergistic effects of stacking fusarium control measures on yield and disease levels.

By Helen McMenamin

Fusarium is now a fact of farming in southern Alberta, but it can be managed to avoid completely devaluing your cereal crops. Stacking two or three strategies controls the disease much more reliably than depending on just one measure or trusting to luck, according to experts.

Last year's late summer rains led to high levels of fusarium head blight even on dryland, infecting many new fields with the disease. The fungus is also very common in corn, causing seed, root, stem and ear rot, so corn residue is a huge reservoir of fusarium inoculum. Given the right weather conditions, such as we had last summer, the disease can infect wheat and barley crops including those in neighboring fields.

Fusarium head blight (FHB) cuts into yield and infected wheat goes very quickly from a number 1 to a 2 or a 3, says Agriculture Canada crop disease specialist, Kelly Turkington. But the worst feature of FHB is the toxins produced in infected grain, deoxynivalenol (DON) and zearalenone, toxins that even at low levels have dramatic health effects on most animals eating the grain. It also interferes with the beer making and baking qualities of the grain.

Buyers, especially those in Europe and Asia, are specifying maximum DON levels for their purchases. This is a particular problem because a new strain of fusarium that is becoming the prevalent type produces a more toxic form of DON. Lab tests for DON levels rather than visual assessments of fusarium damaged kernels may be needed and the acceptable level in grain may be lowered. On the other hand, surveys of FHB have shown that under irrigation a significant amount of the FHB is caused by *Fusarium culmorum*, which is much less of a problem than *Fusarium graminearum*.

Rather than depending entirely on any single method of controlling FHB, Turkington recommends using at least two, preferably more.

As with most diseases, rotation is the first line of defense. Although alternating cereals with broadleaf crops cuts down the level of inoculum, a rotation that gives you at least a two-year break from cereals has a much greater impact. If you grow corn and cereals on the same or adjacent fields, a break of more than a year would likely be especially valuable.

Growing a resistant variety or a less susceptible class of wheat also reduces infection. You can expect to see a resistant durum in the next few years. Applying a fungicide also cuts down the level of FHB.

Irrigators are in the unique position of being able to control moisture conditions within the crop canopy by managing irrigation. You can lower the risk and level of FHB by avoiding water application just before and during flowering.

Increasing seeding rates reduces tillers so all flowering is concentrated into the shortest time possible reduces the chances of humid conditions in the canopy carrying fungus spores up to the heads.

"Each of these strategies cuts down fusarium levels in your grain and increases yield to some extent," says Turkington. "But, stacking several together can really make a difference and minimize the impact of the disease."

For central Alberta, Turkington advises first testing seed with the more sensitive DNA test that tells you whether fusarium is present, and following up a positive result with the traditional plate test that shows the level of infection. For southern Alberta, local seed is quite likely to have some level of fusarium, but he says testing is still worthwhile. Knowing the level of infection, you have a better idea of the risks you face.

Stacking at least some of these strategies should have a synergistic effect – that is the control from using several measures together is much greater than the sum of the parts, says Turkington.

North Dakota researchers found yield increased from 49 bushels to 70 bushels per acre when they grew a resistant variety following a broadleaf crop and applied a fungicide rather than a susceptible variety, following wheat with no fungicide treatment. The level of DON was also much lower.

<Sidebar>

Fusarium touchy issue for seed growers

Seed growers have borne the brunt of financial losses from fusarium head blight and some want to see other growers take the problem more seriously.

Under the Pest Control Act all seed, including common seed, must be tested for fusarium before being used as seed.

"That's not happening," says Richard Stamp, chair of the Fusarium Action Committee and a seed grower. "A lot of crops are grown from untested seed. They could be making problems for themselves and for their neighbors, because the spores can spread to adjacent fields."

The provincial government decided 10 years ago to focus its enforcement efforts on seed grain imported from other provinces but as fusarium has become more common, particularly in the south, policies need to change.

The seed growers want seed cleaning plants to accept only tested seed to avoid infected seed lots from contaminating other seed.

The Fusarium Action Committee recommends that since southern Alberta fields are assumed to be contaminated with the fungus, seed with levels of fusarium up to 0.5% be acceptable in certified seed in this region.

2.Fall 2010 Edition Farming Smarter

Managing fusarium head blight focus of new project

SARA works with area farmers to plan strategies

By: Helen McMenamin

As fusarium graminearum infects more fields every year, farmers can no longer pretend it isn't here. Everybody is forced to manage fusarium head bight — either to keep fields free of fusarium or to prevent fusarium in your fields from downgrading your grain and cutting into returns.

Southern Applied Research Association (SARA) is working with nine farmers across southern Alberta to see how well fusarium head blight control strategies work in real life. SARA staff are taking grain and stubble samples from their fields to check the level of infection and the species of the fungus and linking that information to each farmer's management strategies — rotations, cereal varieties, irrigation management and fungicide use.

The project started with stubble samples last fall that showed seven of the nine farmers' fields were infested with Fusarium graminearum. The never-ending rain and high humidity this year made it impossible to use irrigation management against fusarium — only one farmer in the project started up his pivot and only once, but perhaps the impact of fungicides and other strategies will show up in the grain samples.

Fusarium overwinters in cereal crop residues or corn waste. In summer, spores are carried to flowers where they multiply and prevent proper development of the grain and produce the toxin DON. SARA has a demonstration of fusarium at its Lethbridge site so you can see exactly what fusarium looks like in a real crop at various stages of development. Plant pathologists Kelly Turkington of Agriculture Canada and Ron Howard of Alberta Agriculture showed farmers and agronomists the signs of crop damage at a field day in August.

"The late milk or early dough stages are the best time to see fusarium damage," says Howard. "The fungus kills the glumes [the thin covers that protect the grain kernel] so they are white and stand out against the healthy heads that are still green. Later, the dead spikelets disappear in the mature heads.

"After harvest, fusarium may discolor the first node above the ground, but you need lab analysis to confirm that the symptoms are from fusarium."

If you know you have fusarium damage in your crop, you can set the combine to blow out the lighter, fusarium-infected grains, so they don't go into the tank. Keeping fusarium levels as low as possible in the grain you deliver is particularly important as the maximum FDK (fusarium damaged kernels) has been lowered — from 3 per cent to 2.5 per cent in No. 1 HRS for example, and by similar proportions for other grades. US standards have also been lowered.

In part, the change is to allow grain companies to continue to blend grain to raise the value of as much grain as possible and still meet buyer specs in the face of increasing fusarium levels. Buyer specs are written with maximum levels of DON and a new strain of F. graminearum is spreading across the country from east to west.

This new strain, the 3-A DON chemotype, produces much more DON than the older 15-A strain, about twice as much DON per damaged kernel. Last year, Canadian Grain Commission scientists found the 3-A chemotype in 7 per cent of Alberta samples and in about 60 per cent of Manitoba samples.

Plant pathologists expect fusarium levels will be quite high in all cereals this year. Fusarium head blight was found in around 10 per cent of grain samples from the two most south-eastern crop districts last year. That suggests inoculum levels were quite high and the wet weather has provided ideal conditions for the spread

of the disease.

SARA is playing a major part in a survey led by Howard that aims to assess levels of fusarium inoculum across Alberta, with the most intensive sampling in southern Alberta. The fusarium survey began with SARA staff, ag fieldmen, other applied research groups, crop advisors and anybody else Howard could press into service walking W patterns through fields picking wheat heads and searching for signs of fusarium infection. They collected samples of infected heads for lab confirmation of the disease. Once crops are combined, the surveyors will take stubble samples. Howard hoped to have results by year-end, but it may be later as sample collection has been delayed so much.

The survey will give farmers, specialists and others an idea of the fusarium levels in fields in various regions. Farmers and their crop advisors will use the information to gauge the level of management they need to apply to wheat and other cereals.

Solid information on the spread of fusarium head blight will be used in reviewing the fusarium regulations of Alberta's Pest Act. Some people are suggesting the zero tolerance for fusarium in seed needs to be relaxed for southern Alberta. The Alberta Seed Growers have asked the province and municipalities to enforce the Pest Act or, if fusarium is too widespread, that those municipalities should be exempted from the fusarium regulations of the Pest Act.

According to Seed Growers general manager, Lorena Pahl, the goal is "know your seed." Whether you use your own seed or buy from a seed grower, you should have germination and vigor test information as well

as test results for all diseases that are relevant in your area, including fusarium. ☐

<Sidebar>

SARA is working to find the most effective ways to deal with fusarium, to see how well each strategy works on a farm scale. So far, these are the tools you can use to fight fusarium.

Rotation: Fusarium can't live free in the soil, it needs a susceptible crop or its residue. Generally, it takes two years for residue to disappear, so you need a two-year break from cereals to eliminate inoculum from an infected crop. Back to back cereals alternating with two broadleaf crops should keep fusarium levels low.

Crop type, variety: Corn almost always carries fusarium, wheat is very susceptible, barley slightly less and oats least susceptible. Among wheat's, durum is the most susceptible, and some varieties have some resistance.

Seed: If you don't have any fusarium in your field, have seed tested for fusarium before cleaning or before using it. This strategy is no help if there is fusarium in the field already.

Fungicides: Spraying fungicide early in the flowering period, at 10 per cent open flowers, can protect the crop for about a week

Irrigation management: Fusarium can spread on wind but it needs moisture. Top up the soil moisture before flowering and don't irrigate cereals again until flowering is finished.

Harvest management: Set combine to blow fusarium damaged kernels over the sieves. Don't forget this strategy spreads inoculum that you need to manage next year

3.December 9, 2010 Western Producer

Fusarium marches west to Alberta

By: Michael Raine

MEDICINE HAT, Alta. – Fusarium's spread in Alberta has elevated the disease to a prairie-wide concern from one that had been limited to the central and eastern Prairies.

"We have this disease in southern Alberta and we can ill-afford to ignore it," said Alberta plant disease specialist Ron Howard.

Fusarium head blight has been on a steady march west from the wetter eastern Prairies since the early 1990s.

In 1993, fusarium graminearum destroyed Manitoba's most popular spring wheat variety, Roblin, and caused many growers there to avoid wheat and barley altogether.

"Since that time it is estimated that it has cost Manitoba farmers more than $1 billion … it's now well established in southeast Alberta, in crop districts one and two," he said.

Shauna Fankhauser works for the Southern Applied Research Association in Lethbridge and farms near Claresholm, Alta.

"This was a wet year. If there is one thing that this disease needs it is water," she said.

"It has to rain during flowering. The disease needs those moisture events. This summer, well, we know that happened," said Fankhauser, about the disease that can affect wheat, barley, oats, rye, corn and triticale.

Fusarium, specifically the graminearum type, is a serious pest that can result in grade and yield losses, livestock poisoning and delivery rejections of crops such as malting barley.

Fusarium has been listed as reportable disease in Alberta since 1999.

The fungal pest produces deoxynivalenol, also known as DON, or vomitoxin. The mycotoxin causes serious production issues in livestock.

Fusarium damaged grain that is malted causes foaming problems and also creates production problems for ethanol distillers, bakers and pasta makers.

Tolerance for malting barley is zero. In feed for pigs, dairy cattle and horses one part per million is acceptable. For beef cattle, poultry and sheep, five parts per million are allowed.

Howard said the tolerances for infected grain have fallen in the past year.

“In August the Canadian Grain Commission reduced the acceptable amounts you can deliver,” he said.

This was a result of a more prevalent, more aggressive and toxic strain of the fungus that is showing up in Canada, called 3-ADON. Until 1999, all fungus types were a strain called 15-ADON.

The 3-ADON invader has mostly displaced its predecessor and its ability to produce more DON created a need for lower tolerances of observed damage in delivered grain.

In Manitoba, almost 70 percent of fusarium infections are now of the 3-ADON type.

While the disease mainly affects cereal production, fusarium graminearum has also become a serious pest of potato growers in North Dakota, where it causes dry rot.

“And it puts less grain in your bins,” Fankhauser told producers attending the Southern Alberta Conservation Association conference in Medicine Hat last week.

“If you haven’t seen this pest, you are going to and you will need to take some action as a result,” she said.

Best management practices for Fusarium in cereals

• Start with Fusarium free seed, compulsory in Alberta.

• Higher seeding rates reduce tillering and shorten flowering period when the plants are susceptible to infection.

• Use less susceptible varieties. Wascada and Glenn are the two CWRS varieties that have good resistance to infection.

• Crop rotation should recognize that the disease lives in the stubble and can’t live in soil. It takes two years to break down in small cereals and three or more years in corn.

• Reduce economic risk by staggering planting dates across the farm to avoid having all cereals flowering at the same time.

• Plant winter wheat varieties such as CDC Buteo and Norstar with fair resistance. Winter wheat often flowers before the Fusarium spores develop and start flying.

• Irrigation management can reduce risk of infection because the Fusarium needs moisture and humidity to spread. Fill the soil profile prior to flowering. Leave the pipes off during flowering for as long as possible.

• Fungicides can be used, but they are preventive and used at 10 percent flowering. Use flat fan nozzles, facing forward at 30 to 45 degrees to cover heads well with pesticide.

• At harvest, turn up the fan speed on combine to separate the lighter, Fusarium damaged seed out for a cleaner commercial sample that might fall under the CGC maximum infection levels.

• Run the combine chopper to shred and spread the straw to break down residue.

4.December 9, 2010 Western Producer

Rules amended as infection area expands

By: Michael Raine

Fusarium infection is still new to many Alberta producers due in part to action taken eight years ago when it was still more a concept than a reality. That has changed.

Ron Howard of Alberta Agriculture said the same committee that suggested legislation that helped limit the spread of infection in Alberta is now dealing with the realities that it is established.

Rules that limited the import and use of potentially infected seed, hay and straw and programs offering subsidized seed testing and other measures won't have the same effect on the disease's progress now that it is prevalent in central and southern Alberta.

"The plan was getting old and we began amending it in 2009," he said. As part of the evolution of rules, the Fusarium Action Committee had made some suggestions this year that would have designated counties or regions as free of the pest but some producers and seed growers objected.

"Growers that were clean of the disease and made efforts to keep if off their farms might be in counties that have a lot of it. They felt they might be improperly discriminated against. So the committee rescinded their 2010 decision and will revisit the issue this January," said Howard.

Shauna Fankhauser works for the Southern Applied Research Association in Lethbridge and farms near Claresholm. She said the rules should change to reflect the change in infection rates.

"SARA is studying irrigation and fungicide practices in southern Alberta. We have nine field-scale experiments looking at best management practices."

Howard said that type of research within the region is critical to ensuring that regulations are created based on facts appropriate for Alberta.

Alberta grain and cereal forage producers should be taking an interest in fusarium due to the nature of the spread of the disease, said Fankhauser.

“Not only do you need to work to reduce the infection, (but) if your neighbour has a feedlot and has that corn-barley-corn rotation, those spores can blow onto your land and there is no best practice to avoid that,” she said. “This is an agricultural community issue that affects all of us.”

5.Spring 2011 Edition Farming Smarter

Survey updates fusarium head blight situation

By: Helen McMenamin

A review of the fusarium head blight (FHB) situation across Alberta in 2010 shows the disease still spreading, but not quite as fast as seemed likely because of the rainy weather last year, or even as it might seem from the extent of downgraded grain at elevators according to testing carried out by the Canadian Grain Commission. Nevertheless,

FHB is becoming more prevalent in the irrigated areas of southern Alberta on both cereals and corn.

Ron Howard, Agriculture and Rural Development (ARD) plant pathologist, coordinated a province-wide survey for FHB with staff from ARD, agriculture service boards, applied research associations, Agriculture and Agri-Food Canada (AAFC) and Innovotech Inc. They collected wheat and barley heads with FHB symptoms in commercial fields in the summer and cereal stubble and corn stalks after harvest to determine if they were infected with Fusarium graminearum, the most important cause of FHB. The made the effort to survey about 1% of the wheat acreage in the main cereal-growing counties and municipalities and fields of barley, oats and corn where available.

Subsamples of all of the grain, stubble and stalk samples were sent to BioVision Seed Labs in Edmonton to determine if F. graminearum was present. The lab put the samples on agar plates and under the right conditions, the Fusarium fungus developed into colonies that microbiologists were able to identify. To confirm that samples visually identified as Fusarium graminearum were actually the vomitoxin-producing fungus, the lab sent subcultures to the Canadian Grain Commission's (CGC) testing laboratory in Winnipeg for confirmation by molecular (DNA) analysis, as well as to determine whether the strain of Fusarium was the old 15ADON type or the new, more aggressive ADON type that is displacing the old strain in Manitoba and Saskatchewan.

Over 900 cereal and corn fields were included in the survey. FHB and F. graminearum were found mostly in irrigated cereal fields in CGC Crop Districts (CD) 1 and 2, the same regions where the disease has been routinely found for the past decade. The survey found higher levels in amber durum, the most susceptible type of grain. The disease was also found in several other types of wheat in these areas and is slowly spreading westward into CD 3. Outside the southern area of the province, the survey found low levels of F. graminearum in a small number of fields in five municipalities in central and northeastern Alberta. No FHB was detected in the Peace Region, where dry conditions prevailed for most of the growing season.

"We actually found that levels of fusarium in 2010 were slightly lower in some areas of southern Alberta than in 2009," says Howard. "It's possible that the warmer summer temperatures in 2009 suited the fungus better. In 2010, cereal crops were quite staggered in their growth staging. Seeding started in some areas in April, as normal, then we had rain events from mid-April onwards that shut seeding down for two or three weeks. Germination was uneven in some fields because of soil crusting and flooding and there was heavy tillering. Tillers flower later than the main stem heads thus extending the susceptible flowering stage for Fusarium infection to as much as four weeks. This situation certainly made it very difficult for growers to time fungicide sprays for the ideal growth stage; which is early anthesis when the anthers show on the side of the wheat head."

Many samples of wheat heads appeared to be infected with Fusarium, with chalky, shriveled kernels called Fusarium-damaged kernels or FDKs. FDKs can be caused by fungi other than F. graminearum. For example, F.culmorum, F. avenaceum and Stagonospora nodorum may be commonly isolated from FDKs during lab testing, says Howard. Stagonospora was quite common in central Alberta in 2010 according to CGC tests on elevator grain samples. This fungus causes glume blotch, a disease that is more prevalent under humid conditions. Howard's team also found Fusarium pseudograminearum in some stubble samples. This fungus is indistinguishable from F. graminearum in conventional plate testing and has to be identified with a DNA test. It's usually a root rot organism that doesn't infect grain heads as commonly as F. graminearum does. Many growers had their grain downgraded because of FDKs, but that was based on a visual examination, which didn't distinguish between FDKs caused by F. graminearum and other fungi. Any of these pathogens could render the grain less marketable.

The survey included testing to determine the chemotypes of F. graminearum collected during the survey, that is the older 15ADON or the newer 3ADON type, a strain of the pathogen that produces more of the vomitoxin or DON (deoxynivalenol) that makes fusarium-infected grain an issue in cereal processing (e.g. milling, beer-making and ethanol production) and for use as livestock feed, especially for monogastric animals such as hogs. The more aggressive 3ADON chemotype has been spreading across Canada from east to west and now dominates in provinces east of Ontario and in Manitoba. In 2009, 6 to 7% of F. graminearum isolates were the 3ADON chemotype, whereas in 2010 the new strain comprised 10 to 12% of the isolates. All of the F. pseudograminearum isolates were the 3ADON chemotype. Howard was not surprised to find fusarium in corn samples from Newell, Taber and Lethbridge Counties because it was there in earlier surveys. F.

graminearum causes stalk and ear rot in corn, but isn't usually a serious problem in Alberta. It's very common in corn residues and growing wheat or barley in a field with Fusarium-infected corn stubble is the worst case scenario for promoting FHB, according to Howard. Because corn is an excellent host for F. graminearum, the fungus can reproduce sexually, possibly creating new strains of pathogen to infect following or adjacent cereal crops.

Updating the Alberta Fusarium graminearum Management Plan

As F. graminearum spread westward from Manitoba and Saskatchewan and threatened Alberta some years ago, ARD, AAFC, municipalities and various agriculture groups got together and formed the

Fusarium Action Committee (FAC). Fusarium graminearum became a pest under the Agricultural Pests Act in 1999, giving the Fusarium graminearum management plan the force of law. The key objective

of the plan was to prevent the establishment of F. graminearum and prevent its increase and spread.

Infected seed, straw or other types of infested crop residues can introduce F. graminearum to new areas. Under moist conditions during the summer, the fungus releases spores that float on air currents to cereal heads, where they most often enter via the flowers. The pathogen infects and destroys the developing grain kernels, replacing them with shriveled, chalky kernels containing a mycotoxin, DON that downgrades the grain.

In addition, crop residues and soil can become contaminated with Fusarium. Once introduced, the fungus can persist in fields for many years.

To prevent FHB infection, the management plan requires that all grain used for seed must be tested and have no detectable F. graminearum and should be treated with a fungicide to help control the pathogen. Seed grain must also have a certificate showing it was tested. There are also regulations for the proper disposal of infected cereal or corn waste.

Some seed growers would like to see the management plan strictly enforced in their areas. Careless disposal of corn by truckers delivering to feedlots and acceptance of untested seed at cleaning plants may contribute to the spread of F. graminearum. If this pathogen spreads to seed growing fields it can destroy their business. But, the reality is that as municipal and provincial staff have many responsibilities and enforcement of the Pest Act is often reactive at best.

The main objective of the seed regulation, according to Alberta Agriculture’s Jim Broatch, was to prevent movement of infected seed grain from irrigated areas of southern Alberta, where F. graminearum to other areas of the province. In areas where F. graminearum and other Fusarium species causing FHB are well established and many cereal and corn fields are contaminated, seed may not be a significant source of infection, compared to crop residues and soil. Prohibiting the sale of seed with low levels of F. graminearum no longer makes sense in this situation say some seed and commercial cereal growers. They want to see the regulations changed to require testing and a statement of the level of infection for cereal seed.

For the south, as in moister production areas to the east of Alberta, it’s time to manage FHB through the use of best management practices rather than by exclusion and eradication. A preventative approach may no longer be feasible in irrigated areas where the disease is well established. However, grain growers on dryland may still have the luxury of working to keep the F. graminearum out of their fields by following the preventative measures recommended in the Fusarium Management Plan.

6.Barley Country Article

Local producer-run associations offer research you can use on your crop

CAROLYN KING

Comparing variety performance, evaluating fertilizer practices, assessing the value of fungicide applications—those are just a few examples of the work by Alberta's applied research associations (ARAs). These producer-driven, not-for-profit agricultural research organizations conduct projects specific to the needs of their respective regions and take part in broader initiatives under their provincial association, the Agricultural Research and Extension Council of Alberta (ARECA). *Barley Country* asked seven ARA managers and agronomists for down-to-earth production tips for barley growers in each of the Alberta Barley Commission's six regions.

Choose the best barley variety for your needs

Perhaps the most important way ARAs promote barley production is by annual regional variety trials and regional silage variety trials. These trials for barley and other crops are carried out across Alberta, with data and funding from many agencies, such as the ARAs, ARECA, government, the Commission and seed companies. The results are available from your ARA or at www.seed.ab.ca. "These trials are a good place to compare the varieties that growers know with new ones that may be a little better, and take the risk out of trying a new variety," explains Keith Kornelsen, manager for the Lakeland Agricultural Research Association (LARA), based in Bonnyville, which is in Region 4.

"Most barley varieties are bred in Lacombe or Saskatchewan or Manitoba, but our growers need to know which ones do well in our area," notes Andrea Fox-Robinson, the general manager and crop research agronomist for the Gateway Research Organization (GRO), based in Westlock (Region 5). Fox-Robinson keeps an eye out for promising varieties; for instance, two new 2-row barley varieties—CDC Austenson and Gadsby—have done quite well at the GRO sites in the past two years.

Test barley seed for germination and vigour this year

If you don't normally test your barley seed for germination, this is definitely the year to do it, says Kornelsen. "At our local seed plant, the germination percentages they are getting for barley are really low this year. Depending on how much frost damage there was, some of the samples are as low as 50 per cent or under. And at a seminar recently, a representative from 20/20 Seed Labs was talking about even lower percentages—lots of them were under 25 per cent."

Proper seeding leads to good starts

Fox-Robinson's seeding tips are based on work by GRO and others. "One of the main ones is to use proper seeding rates, like using 1,000-kernel weights and bushel weights to figure out your seeding rates, because different varieties are sized differently. If you ignore that, you can wind up with a poor stand. Seed treatment is important too because often guys here are seeding into really cool soils. It's like a bit of insurance; for a few dollars an acre you can hopefully decrease the amount of seed-borne disease."

Variety selection key to managing disease

"We have some farmers who grow barley year after year after year, and of course they are seeing more disease than producers who rotate their barley crop," says crop agronomist Audrey Bamber of the Chinook Applied Research Association (CARA) in Oyen (Region 2).

"To prevent and control disease in barley, I recommend crop rotation, variety rotation, choosing varieties with a good disease resistance package, and treating the seed." She notes that most of CARA's work on barley is through regional variety trials. That work contributes to the annual guide on Alberta varieties, which includes the disease package for each variety.

Photo courtesy Keith Kornelsen

"(Annual regional variety) trials are a good place to compare the varieties that growers know with new ones that may be a little better, and take the risk out of trying a new variety," says Keith Kornelsen (above), manager for the Lakeland Agricultural Research Association, based in Bonnyville.

Try to seed barley before mid-May

"People know barley will yield less when it's seeded too late in this area. They aren't going to seed it as early as their peas, but especially if they are trying to get malt, they need to seed before the middle of May to have a better chance of getting it in without being rained on too much," says Alvin Eyolfson, manager and agrologist for the Battle River Research Group (BRRG) in Forestburg (Region 3).

A 2001 BRRG project funded by Alberta Agriculture compared several seeding dates in May at two locations. Eyolfson notes: "At Stettler, with a Thin Black soil, there wasn't much difference in barley yields. But at Castor, with a Dark Brown soil, the yields went from 1.2

tonne/hectare (26 bushel/acre) seeded on May 2, which isn't great, to .57 tonne/hectare (12 bushel/acre) seeded on May 23—the barley came up and then burnt up in the heat."

Balance fungicide yields increases with costs

"Of the people who grow malt, maybe a third or more use a fungicide to help get plumpness. We did a project on that in 2006 at Camrose and Stettler [in Region 3], using CDC Copeland," explains Eyolfson. The project was funded by the Agriculture Opportunity Fund and the local counties.

"That year, we didn't have a whole lot of disease, but there was some. By using Headline, we got about a 190- kilogram/hectare [four-bushel/acre] increase at both sites. The 1,000-kernel weights also increased at both sites. At the prices at that time, you would have made money with the fungicide application if it enabled the crop to make malt. But the barley prices were under $140/tonne [$3/bushel], and if the crop didn't make malt, you would have lost a little bit of money."

He adds: "This year we're expecting better barley prices, so people might be more likely to consider a fungicide because the payoff could be there."

Irrigation and fungicide help control fusarium

"In southern Alberta in the irrigated zone, fusarium head blight is becoming more of a problem," explains Ken Coles, general manager/agronomist with the Southern Applied Research Association (SARA), based in Lethbridge (Region 1). With funding from the Pest Management Centre of Agriculture and Agri-Food Canada (AAFC), SARA is working with AAFC and Alberta Agriculture and Rural Development to assess irrigation scheduling and fungicide strategies to control fusarium; although this project involves wheat, the findings also apply to barley.

Coles recommends: "Try to avoid irrigating while the crop is flowering, which is when the crop is susceptible to fusarium. Schedule irrigation to top up the profile right as the crop is coming into flower, and then avoid irrigating for as long as you can without compromising yield too much. That lets the canopy dry out so you don't encourage disease onset."

For fungicide treatments, he advises: "Good coverage of the heads is essential for controlling fusarium, so things like double nozzles and high water volumes are very important."

Follow proper agronomic practices

The Mackenzie Applied Research Association (MARA), based at AAFC's Experimental Farm in Fort Vermilion, works in Mackenzie County (Region 6). It has assessed barley production practices through regional variety trials.

MARA's research coordinator Nasar Iqbal outlines the key practices: "The first thing is to get the soil tested, select the variety best suited to local conditions, and apply fertilizer as per the soil test analysis. The second is to use a pre-seeding burnoff with glyphosate. Third, during seeding, consider the ultimate plant density; we recommend about 210 plants/metre2. To achieve this density, growers need to consider factors like seed germination percentage and soil moisture conditions. Seed rating should be adjusted accordingly."

Next, he adds, growers need to know which weeds they have and carefully select and apply the herbicide. The final factor is proper harvesting. In Mackenzie County, some varieties are prone to lodging under optimal growing conditions. If the variety you're growing does this, Iqbal recommends reducing yield losses by swathing first, then combining when the crop has dried.

Extra potassium helps make malting grade

"For malting barley, applying some extra potassium will keep your protein level low, which is one of the requirements for malting barley. There's information on that in the literature, we recommended it to a couple of people here and they were pretty successful in keeping their protein level low," says Kabal Gill, research coordinator with the Smoky Applied Research and Demonstration Association (SARDA) in Falher (Region 6).

Seed treatment can improve barley seed yields

In 2009 and 2010, SARDA conducted a seed treatment trial in Region 6 that compared Rancona Apex, Vitaflo-280, Dividend XL RTA and a check. Gill says, "All the seed treatments significantly reduced the number of heads with smut in both years, and increased the barley seed yield in 2009, with relatively better performance in the Rancona Apex and Vitaflo-280 treatments. In 2010, the yield was much lower and was not significantly influenced by the seed treatments, probably due to severe drought." This trial was funded by Chemtura, Alberta Agriculture and local municipalities.

Yield mapping can be great anywhere

Six ARAs are working on a province-wide ARECA project about precision agriculture tools, like yield mapping. Project funding is from the Alberta Crop Industry Development Fund, Alberta Canola Producers Commission, Alberta Pulse Growers Commission and Novozymes. SARA's Coles says: "We are huge proponents of growers developing their own on-farm research using precision agriculture tools—doing their own strip trials with things like seeding rates, varieties and fertility rates, and using yield monitors and such. We are trying to promote and develop the methodology for this, keeping it simple while having as much science to it as we can."

Carolyn King is an Ontario-based agricultural writer.

7.The Forty-Mile County Commentator Article

Written by production

Wednesday, 27 July 2011 16:06

A group of southeast Alberta crop producers gathered in a field east of Medicine Hat on July 21 to take in a tour of demonstration crops that are being conducted as part of a partnership between Cypress County's Ag Service Board and Farming Smarter (formerly SARA and SACA).

Garry Lentz, county councillor and ASB chairman

The tour included discussions on pea, lentil, and chickpea regional variety trials, as well as SeCan variety demos, Canola demos, Winter Wheat regional variety trials and Cruiser Winter Hardiness.

Ken Coles, research manager for Farming Smarter led the tour which drew producers from throughout Cypress County and County of Forty Mile.

“We have regional variety trials and we seeded the same all across the province to provide local data,” said Coles.

Some of the trials have been done on winter wheat varieties, a crop some producers say they have stopped planting.

“Some producers have stopped winter wheat because it cannot beat the deals with spring wheat,” said Coles.

“Time constraints with harvesting of winter wheat is one of the biggest complaints we hear from producers and we are looking at breaking that convention. Summer fallow might be a good option. The crops coming out now have better winter hardiness than they once did,” he added.

They are also conducting a two-year study to look at the yields and downy brome and constraints facing winter wheat acres.

Dr. Ron Howard, disease specialist with the Alberta Research Council branch of Alberta Agriculture and Rural Development talked with the group about diseases and pests infecting the south region of the province, with fusarium head blight being an increasing problematic disease for farmers.

“The Southeast Alberta district is the central point for fusarium head blight. A survey was done last year throughout Alberta and it remains prevalent in districts 1, 2, and 3. It has been found in all seven districts, but in the south, we seem to have the right conditions," said Howard.

Fusarium head blight also infects corn, making the crop less valuable for ethanol production.

"In Cypress County, fusarium head blight has been around for years, 30-plus years. It has just been getting more publicity now," he said.

Howard also said it is vital to disease test the seeds coming onto the farm.

"Seed is the main way to get diseases onto the farm. Farmers buy the disease onto the farm, so they need to disease test the seeds," said Howard.

"You aren't supposed to plant any seed infected with fusarium anywhere in Alberta. You would need to prove that you did not bring that seed onto the farm," he added.

Farmers should also pay attention to prevailing winds if they are concerned about stripe rust infecting their fields.

"Stripe rust tends to progress from western Alberta to east and into Saskatchewan. It is brought up from the US on the Pacific winds. Spore showers out of the Pacific Northwest is what gets the epidemic going," said Howard.

Stripe rust can result in defoliation and shrived kernels. Once the spores land on the plant, they need moisture to germinate and infect the host. Symptoms, including an elongated yellow strip along the leaf, will appear on the plant about a week after infection.

"If the leaves are infected already, no fungicide is going to get rid of it. You need to get it on prior to disease or in its early stages," said Howard, adding that some varieties are more resistant than others.

"Radiant is starting to lose its resistance to rust because it is adapting. Rusts have tremendous potential to reproduce, but of the crop varieties, Radiant is still the most resistant," he added.

Howard also said producers need to rotate their varieties to aid in warding off diseases.

8.Spring 2012 Farming Smarter

No clear winner in FHB treatments

Combo of fungicide and timing of irrigation may offer some benefit

By Lee Hart

While the differences haven't been earth shattering, so far a three-year southern Alberta study looking at the effect of different treatments on wheat shows the combination of using a fungicide and timing of irrigation might have a slight benefit in reducing fusarium head blight (FHB).

Results of the third year of the project in 2012 still have to be tabulated, says Kristina Halma, a research assistant who coordinated the project for Farming Smarter in Lethbridge. But, the first two years showed some benefit of the treatments, even though there were no dramatic yield or quality differences.

"We looked at two different treatments over nine farms in southern Alberta," she says. One part of the study was to evaluate the effectiveness of fungicides in controlling FHB, and the other part was to evaluate timing of irrigation water application, and the effect that might have on disease development. Aside from the treatment component, a third aspect of the study involves a random survey of fields.

"Depending on the year and the farm, there was some response, but nothing consistent or significant," says Halma. "In some cases, we did see where the combination of using a fungicide, as well as limiting the amount of water applied to the crop just as it was flowering, did have some benefit in reducing the disease. Once the data is processed from this year's growing season, we'll be able to write the final report."

Valid questions

The study looked at two good questions. Do three of the more common fungicides marketed to protect wheat crops against FHB work? And, can the risk or degree of FHB developing in the crop be reduced by eliminating irrigation during the critical two- or three-week flowering period?

Farmer's participating in the study were asked to use any of three common fungicides—Caramba from BASF and Folicur and Prosaro from Bayer Crop Science—to see if a product, applied at the recommended 75 per cent heading to 50 per cent flowering stage, had an affect on development of FHB. Halma says it wasn't a trial comparing the effectiveness of the individual products. The study compared the effectiveness of treated versus untreated crop on a field scale basis.

The nine participating producers are spread across a large area of southern Alberta from Bow Island in the east, west to the Carmangay area and north to Duchess.

“There is a lot of variability in that area,” says Halma. “Growing conditions vary and the level of FHB varies as well. Overall, I would say there was some benefit to using a fungicide. In one case in 2010 there was a 4.1 per cent reduction in the amount of kernels affected by fusarium.”

On untreated crop, the level of infection was 6.4 per cent, and on treated crop, it was reduced to 2.3 per cent. Halma says looking at the fusarium tolerance levels for various grades in amber durum, the fungicide treatment would have made the difference of the crop grading a #3 to #4 or coming in a grade lower, a #5.

In the 2011 study year, the most notable improvement between treated versus untreated was a 2.4 per cent reduction of fusarium in spring wheat.

Irrigation timing

On the other side of the study, looking at the effect of irrigation timing, the objective was to adjust the timing of the water application to avoid the peak flowering period, which is when the crop is most susceptible to disease infection.

“We didn’t want to reduce the amount of water the crop received, but rather just adjust the timing to avoid that critical two- or three-week period, which is likely in late June and early July,” says Halma. “So producers were asked to pick a portion of a field, and perhaps top up irrigation just before flowering, avoid watering during flowering, and then resume after flowering.”

Again, the first two years of the study showed no significant difference on most farms between full water and limited watering sites. However, in one case there was a 3.9 per cent reduction in disease on a field where irrigation was stopped during the flowering period.

“We also had a producer who saw a slight benefit from both treatments,” says Halma. The farmer reported a 1.3 to 1.8 per cent reduction of fusarium in crops that received the adjusted water application, as well as a 0.5 per cent reduction in disease on wheat treated with fungicide versus no fungicide.”

“So far we are not seeing any significant benefit of the treatments, so a lot may depend on the degree of disease pressure on a particular farm,” she says. “The benefits aren’t significant but there may be a slight yield advantage and perhaps also opportunity to increase the quality of the crop by a grade or two.”

Good to know

Bow Island-area producer Will Van Roessel, who has participated in the study for the past three years, says he really hasn’t seen any advantage of either treatment in his crops.

“In one sense, the results have been a bit disappointing, but on the other hand at least you know whether something makes a difference or not,” says Van Roessel.

“Farmers in southern Alberta are realizing that fusarium head blight is becoming more of a problem and we need to look at whatever tools are available. These treatments haven’t made a difference on my farm, but they may work for someone else depending on where they farm and their specific conditions.”

Van Roessel says there was “minimal” yield or quality difference in crop he treated with fungicide versus untreated. “And we also did some comparisons of fungicide on our own, outside of this particular study,” he says. “The benefits were pretty marginal, and not enough to pay for the cost of the fungicide. To me, if I’m using a crop protection product, I need to see a 2:1 payback.” He estimates the cost of the fungicide application at about $20 per acre.

He also saw no great difference in disease levels or quality improvement in a field of durum wheat where the timing of water was adjusted during crop flowering. “Not irrigating during flowering is probably a good practice, but I didn’t see a great difference,” says Van Roessel.

He also says it is a bit more difficult to measure differences too because water is being adjusted on a quarter of a circle, so when combining he has to know where that pie-shaped area is in the field. And even though the pivot starts and stops spraying over that quarter circle, it isn’t necessarily an exact line in the crop either “so it may not be a perfect trial”, he says.

Field surveys too

A third component of the Farming Smarter fusarium project involves a random survey of fields across southern Alberta, evaluating the level of disease on both irrigated and dryland crops and comparing that with farming practices on those fields.

In this part of the project, Halma selected 25 fields in an area that includes Lethbridge, Forty-Mile, and Newell counties and the Municipal District of Taber.

In each of the three years of the survey, she selected 25 fields at random, collecting 300 wheat head samples from each field. She did a visual inspection and also sent a sample away for testing. And along with that, she interviewed the producer to get background on cropping history, variety used, fungicides used, and other production practices.

“We hope from this part of the project we may see some trends or common farming practices that may affect the level of the disease in cereal crops,” says Halma.

9.Fall 2012 Edition Farming Smarter

Farming Smarter tackles fusarium management

Decreases in damaged kernels observed where irrigation was avoided at flowering

By Kristina Halma

Farming Smarter is adding to the arsenal against Fusarium Head Blight (FHB) with a field-scale project looking at on-farm methods for managing this emerging disease in irrigated wheat.

Nine producers from the counties of Forty Mile, Lethbridge, Newell and Vulcan have participated in the trial with one field each. Despite a wet start to 2011, three fields received irrigation treatments to compare FHB levels during flowering in irrigated versus non-irrigated areas.

Six fields received a fungicide treatment, and were then compared with an untreated check strip, with fungicides for *Fusarium* suppression chosen by each producer to fit their situation. Two producers also chose to include a variety comparison in addition to the other treatments.

FHB is characterized by premature bleaching of part or all of the head and shrivelled white kernels. The disease not only reduces yield, but also can be the cause of downgrading, since the most aggressive *Fusarium* species, *Fusarium graminearum*, produces mycotoxins that render the grain unsuitable for consumption by humans or animals, even at low levels. This fungal disease can be spread in the soil, through infected seed or residues, and in the air.

The study evaluated an integrated approach to irrigation timing, chemical fungicides and cropping systems to minimize the impact of this disease, which is caused by several *Fusarium* species.

In 2010, a 3.9 per cent decrease in Fusarium damaged kernels (FDK) was seen in one field where irrigation was avoided at flowering. This helps reduce the impact of the disease since the disease develops best in humid conditions. As well, researchers observed a decrease of up to 4.1 per cent FDK when comparing fungicide treatments with untreated areas.

Initial results from 2011 appear to follow the same trend, but analysis to determine *Fusarium* species present in the grain samples and DON (a mycotoxin) levels are in progress to determine the exact impact of the disease on grain quality. Key results from the project will be posted on the Farming Smarter website: www.farmingsmarter.com.

Besides the field trials, a 25-field survey of dryland and irrigated fields was conducted in which head and stubble samples and information on cropping practices were collected to examine how those practices impact development of FHB. Furthermore, demonstration plots were established in 2009 on the Farming Smarter research site as a talking point for several events, including annual disease crop walks and the Diagnostic Field Schools.

A proposal to continue this project for a third year (funded by the Pest Management Centre of Agriculture and Agri-Food Canada) has been submitted. For more information about the project, visit www.farmingsmarter.com or contact Ken Coles or Kristina Halma at (403) 381-5855.

Appendix G Provincial Scale Maps

Figure 57: Distribution of *Fusarium spp.* in survey fields from 2010-2012.

Red indicates presence of Fusarium spp. and shape shows the year.

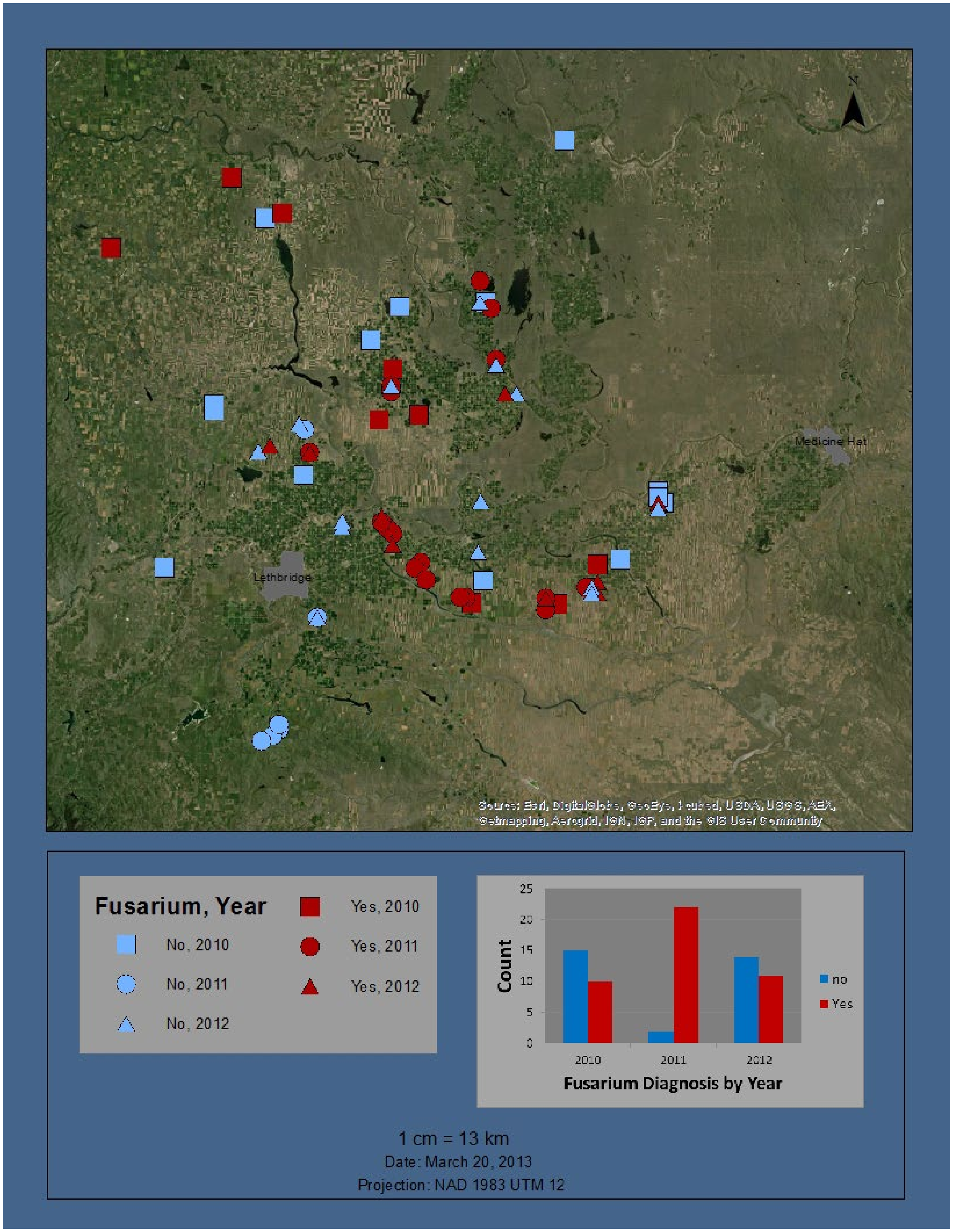


Figure 58: Distribution of *Fusarium spp.* and irrigation regime in survey fields from 2010-2012.

Red indicates presence of Fusarium spp., circles indicate irrigation and squares are dryland.

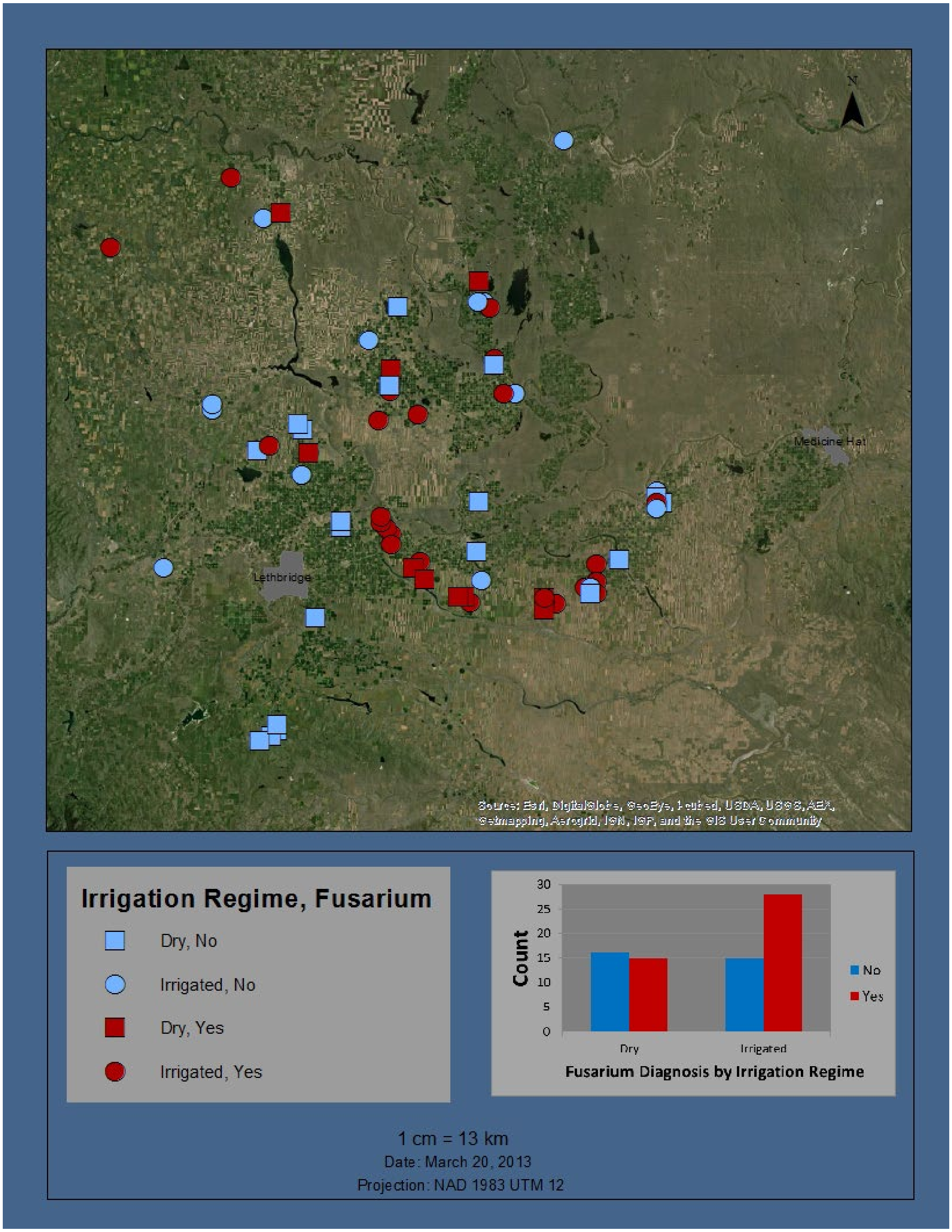


Figure 59: Distribution of *Fusarium spp.* and fungicide applications in survey fields from 2010-2012.

Red indicates presence of Fusarium spp., circles indicate no fungicide and squares had fungicide applied.

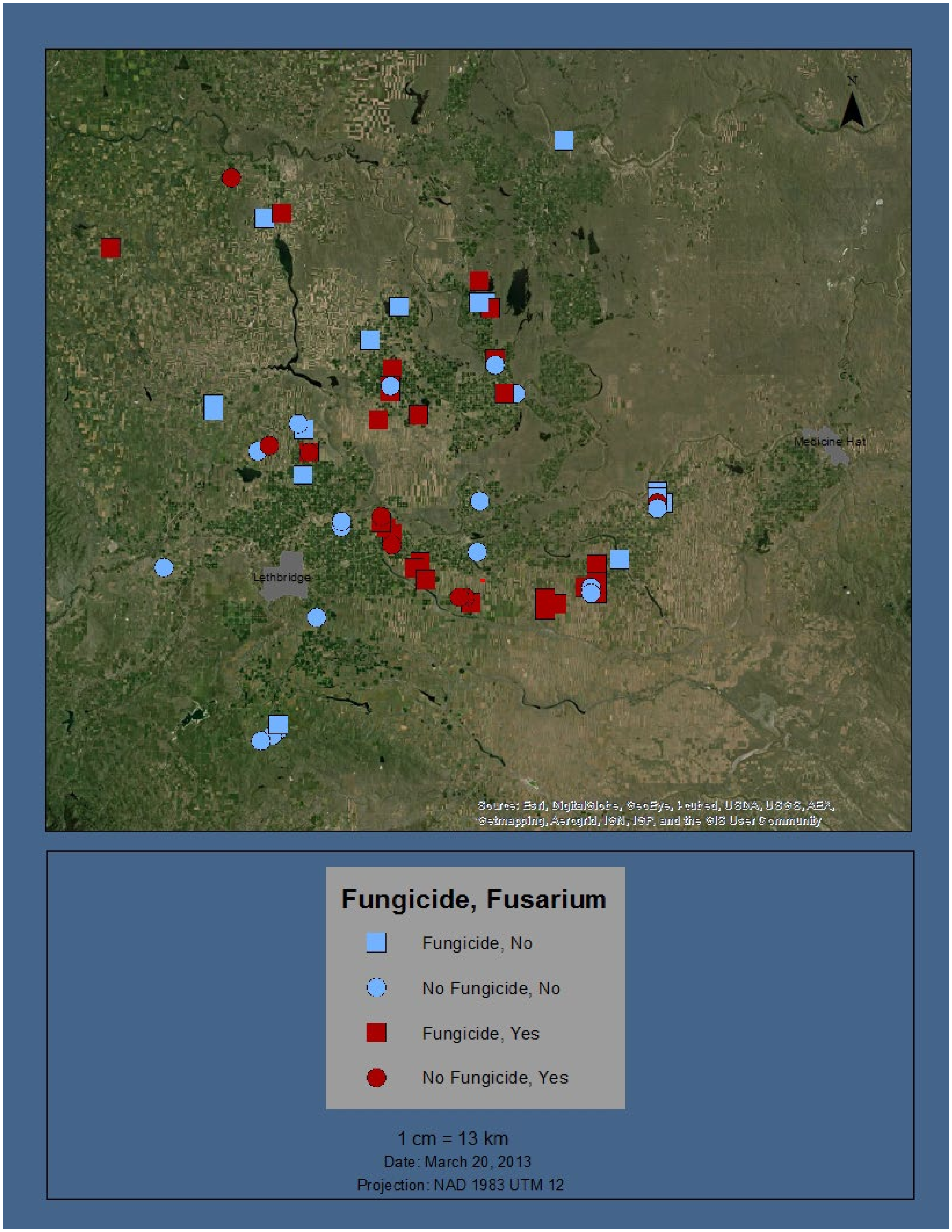


Figure 60: Distribution of *Fusarium spp.* within each wheat class in survey fields from 2010-2012.

Red indicates presence of Fusarium spp. and shapes indicate wheat class.

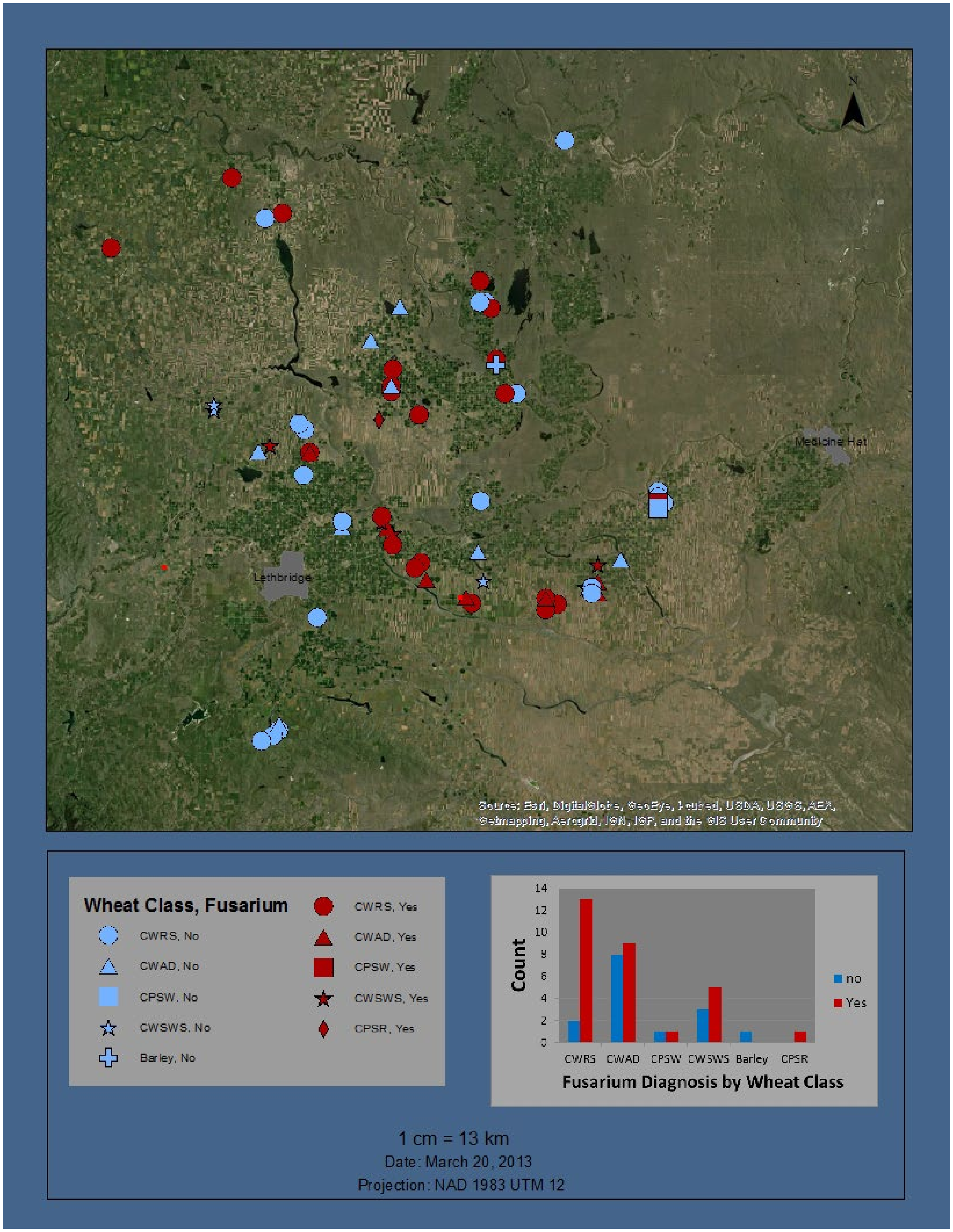


Figure 61: Distribution of *Fusarium spp.* and cultivar susceptibilty in survey fields from 2010-2012.

Red indicates presence of Fusarium spp. and shapes indicate susceptibility rating.