USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY08 Final Performance Report (approx. May 08 – April 09)
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Cover Page

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Fiscal Year:	2008
USDA-ARS Agreement ID:	59-0790-8-070
USDA-ARS Agreement Title:	Developing Practical FHB Disease Management Strategies for Wheat and Barley Crops.
FY08 USDA-ARS Award Amount:	$ 21,210

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
MGMT	Evaluating Efficacy of Integrated FHB Management Strategies in Wheat & Barley.	$18,074
BAR-CP	Development and Validation of FHB and DON Prediction Models for Barley.	$ 3,136
	Total Award Amount	**$ 21,210**

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Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
BAR-CP – Barley Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Winter Wheat Region
SWW – Southern Sinter Wheat Region

Project 1: *Evaluating Efficacy of Integrated FHB Management Strategies in Wheat & Barley.*

1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

In 2006, a multi-state uniform trial to support the development of an FHB integrated disease management strategy on wheat was discussed by research participants during a Bloomington, MN meeting of the Management Research Area Committee. This PI participated in the discussion and is committed to developing best disease management strategies for Minnesota cereal producers based on sound science, as well as biological and economic realities. Since then, participating researchers have collected crop response data from environments with different residues (type and approx. amount present), cultivars (disease resistance level differences), and fungicide applications (treated vs. not treated). In 2008, the Minnesota trial was placed at two commercial field locations in the Red River Valley. Test sites were not inoculated with *Fusarium graminearum* or misted.

2. List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):

Accomplishment:

Wheat. These data promote understanding of disease management strategies that support sustainable wheat production not only in Minnesota, but across the spring wheat growing area of the Dakotas, as well. In addition to reporting data to the cooperative research group and the scientific community, information is also delivered to growers through extension activities so they will know if integrated disease management strategies result in economic outcomes. During 2008, harvest information from all 30 wheat varieties and experimental lines in the experiment indicated a supportive growth environment at both test locations. Excellent yields of high quality grain were produced. Disease development and its associated yield and kernel quality losses were minimal.

Barley. This was the second year of a two year experiment to determine grain yield and kernel quality benefits after treating four commercially-available 6-rowed malting barley cultivars and four advanced 6-rowed malting germplasm lines with different fungicide-based disease management strategies to manage FHB. Breeding for FHB resistance in barley is an ongoing effort. Experimental lines in the test represented germplasm bred with increased resistance to FHB from North Dakota State University, Busch Ag Resources, and the University of Minnesota. Grain harvest and deoxynivalenol (DON) results from these lines were compared with current, commercially available varieties that have less disease resistance to FHB. Experiments were located in commercial field environments. Our objective was to determine whether increased resistance levels for FHB would contribute to increasingly effective disease management when crop rotation and a fungicide application were also used. In the past, commercially available 6-row malting barley cultivars have been too susceptible to successfully contribute toward FHB management when an integrated management approach was deployed.

Impact:

The integrated FHB management trial on wheat is a cooperative effort which is producing data across a number of wheat-producing states. This cooperation will result in data pooling and communication between researchers, supporting a database in support of best management practices over the spring wheat producing region. The barley research effort is a single state research effort which is applicable to Red River Valley producers. A cooperative group of researchers has not been formed to organize methods and materials or to share and publish data. Having this information produced within Minnesota is crucial to understanding whether malting barley production acres can be successfully increased in the state after FHB-resistance levels are increased in cultivars.

Wheat.

Combined year data analysis from Minnesota's 2007-08 research indicates that prophylactic applications of one or more fungicides do not significantly increase yield, quality, or net return in environments with low disease pressures. Thus, disease management strategies that include fungicide inputs when diseases do not develop are not economically sound. While this statement seems intuitive to many, chemical sales representatives and others promote fungicide applications on crops in a number of production situations independent of disease development. This information is helpful in answering questions associated with applying fungicide in the absence of damaging levels of disease. Obtaining data that support when to apply fungicide and when to not apply fungicide is important and valuable in Minnesota.

Barley. Data from this two-year test indicate that varietal resistance, rather than fungicide treatment, is most critical for managing FHB losses in malting barley in the Red River Valley. While fungicides appear to benefit barley production in general, their effects were often not statistically significant in low disease years. While crop rotation and timely fungicide application is important in years when elevated disease pressures occur, it is important to have cultivars with an increased level of resistance. Specifically, if sufficient management of FHB is to be achieved, it must start with increased resistance in malting barley cultivars while crop residue and fungicide application are important secondary integrated management considerations.

Project 2: *Development and Validation of FHB and DON Prediction Models for Barley.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**
   Barley producers do not have commercially-available 6-row malting barley cultivars with an effective level of FHB-resistance. They also do not have a decision aid that supports timely fungicide application decisions in the crop. Disease management decision aid development in barley lags behind that of wheat. This project supports development of an FHB epidemic risk model that will assist producers in making an informed and timely fungicide application decision.

2. **List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):**

   Accomplishment:
   Barley producers in the region will benefit from an FHB epidemic risk advisory system when determining whether a fungicide application at early heading is needed to protect the yiled and quality of their crop. A cooperative uniform trial has been conducted for several years between South Dakota, Minnesota, and North Dakota to investigate the influence of environmental conditions on FHB severity and mycotoxin contamination in malting barley. Our objective is to develop and deploy an FHB epidemic risk model for barley that will function much like the Minnesota wheat epidemic risk model. This project is being conducted in cooperation with researchers who are part of the wheat modeling effort. The development of this risk advisory system for barley will be used by producers in support of an integrated management of FHB and DON accumulation in grain.

   Impact:
   We have found that the average hourly temperature and relative humidity in the 10 days prior to full head emergence were both significantly correlated with final disease severity. Interestingly, these same factors appeared to have no impact on mycotoxin concentration in the grain. In contrast, measurements of humidity after heading (e.g. vapor point depression) were the only factors associated with final DON concentration.

   The continued analysis of a growing dataset will allow for the exclusion of non-significant variables and expedite the identification and further investigations of significant ones. Eventually, the variables that are most strongly correlated with disease and/or DON will be subjected to a thorough analysis. If enough locations develop disease and DON during the growing season, we should be able to generate candidate models that will be validated. The first generation barley FHB and DON models are expected to be made publicly available in the near future and will assist growers in making informed disease management decisions for their barley crop.

Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in the grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Research and Extension Articles

Hollingsworth, C. R., C. D. Motteberg, L. M. Atkinson, and J. V. Wiersma. 2008. Agronomic and economic responses of spring wheat to management of Fusarium head blight. Plant Dis. 92:1339-1348.

Bondalapati, K. D., J. M. Stein, L. E. Osborne, S. M. Neate, and C. R. Hollingsworth. 2008. Modeling Fusarium head blight and DON in barley. Page 10 in: Proceedings of 2008 National Fusarium Head Blight Forum. 2-4 Dec. 2008. Indianapolis, IN.

Hollingsworth, C. R. and C. D. Motteberg. 2008. Determining potentials for DON accumulation from pre-head timing of fungicide application on spring wheat and 6-rowed malting barley in Minnesota. Page 26 in: Proceedings of 2008 National Fusarium Head Blight Forum. 2-4 Dec. 2008. Indianapolis, IN.

Hollingsworth, C. R., C. D. Motteberg, and L G. Skoglund. 2008. Understanding practical outcomes from implementing integrated FHB management strategies on malting barley in Minnesota. Page 28 in: Proceedings of 2008 National Fusarium Head Blight Forum. 2-4 Dec. 2008. Indianapolis, IN.

Hollingsworth, C. R., C. D. Motteberg, and S. Ross. 2008. Understanding practical outcomes from implementing integrated FHB management strategies on spring wheat in Minnesota. Page 30 in: Proceedings of 2008 National Fusarium Head Blight Forum. 2-4 Dec. 2008. Indianapolis, IN.

Chen, J., D. See, C. R. Hollingsworth, and J. Windes. 2008. Molecular marker-assisted evaluation and characterization of Fusarium head blight resistance in wheat genotypes grown in the Pacific Northwest. Page 155 in: Proceedings of 2008 National Fusarium Head Blight Forum. 2-4 Dec. 2008. Indianapolis, IN.

Stein, J., K. Bondalapati, L. Osborne, S. Neate, and C. Hollingsworth. 2008. Progress towards predictive models for Fusarium head blight and DON in barley. Page 34 in: Proceedings of the 2008 N. American Barley Researchers Workshop. 26-29 Oct. 2008. Madison, WI.

Hollingsworth, C., S. Ross, and C. Motteberg. 2009. 2008 Red River Valley on-farm disease management trials. Pages 24-29 in: On-Farm Cropping Trials of Northwest and West Central Minnesota. Online.

Hollingsworth, C., C. Motteberg, and L. Skoglund. 2009. Understanding practical outcomes from implementing integrated Fusarium head blight (FHB, scab) management strategies on malting barley in Minnesota. Page 22 in: Prairie Grains. April Issue.

Hollingsworth, C., C. Motteberg, and S. Ross. 2009. 2008 Red River Valley on-farm disease management trials. Pages 24-25, 27 in: Prairie Grains. April Issue.

Hollingsworth, C., C. Motteberg, and L. Skoglund. 2009. Understanding practical outcomes from implementing integrated Fusarium head blight management strategies on malting barley in Minnesota. Page 7 in: Fusarium Focus. Online. http://www.scabusa.org/pdfs/fus-focus_4-09_newsletter.pdf

Hollingsworth, C., C. Motteberg, and L. Skoglund. 2009. Practical outcomes from implementing integrated Fusarium head blight (scab) management strategies on malting barley in Minnesota. May 9 post. Online at AgBuzz http://minnesotafarmguide.com/blog/

Presentations

18-19 Feb. 2009. International Crop Expo 2009. Wheat diseases: To spray or not to spray. Grand Forks, ND: about 60 attendees. 30 minutes.

4-6 Nov 2008. Yield and economic results from UM wheat disease management research. Argyle, Greenbush, Thief River Falls, Crookston, Mahnomen, Moorhead, Fergus Falls, Morris: 111 attendees total. 30 minutes each location.

20-26 Feb 2009. Fungicide use decision in wheat. 2009 Private pesticide applicator recertification training workshops. Argyle, St. Hilaire, McIntosh, Roseau, and Hallock. About 185 attendees total. 40 minutes each location.

If your FY08 USDA-ARS Grant contained a VDHR-related project, include below a list all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance. If this is not applicable (i.e. no VDHR-related project) to your FY08 grant, please insert 'Not Applicable' below.

Not applicable