USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY07 Final Performance Report (approx. May 07 – April 08)
July 15, 2008

Cover Page

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Fiscal Year:	2007
USDA-ARS Agreement ID:	59-0790-3-080
USDA-ARS Agreement Title:	Investigating Fungicide and Application Strategies for Increased FHB Control.
FY07 ARS Award Amount:	$ 34,146

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
CBCC	Investigating Ways to Improve Current Management Strategies for FHB on Wheat and Barley.	$34,146
	Total Award Amount	**$ 34,146**

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Principal Investigator Date

* CBCC – Chemical, Biological & Cultural Control
EEDF – Etiology, Epidemiology & Disease Forecasting
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GET – Genetic Engineering & Transformation
HGR – Host Genetics Resources
HGG – Host Genetics & Genomics
IIR – Integrated/Interdisciplinary Research
PGG – Pathogen Genetics & Genomics
VDUN – Variety Development & Uniform Nurseries

Project 1: *Investigating Ways to Improve Current Management Strategies for FHB on Wheat and Barley.*

1. What major problem or issue is being resolved and how are you resolving it?

Preliminary research on spring wheat conducted at several locations in the Red River Valley indicated that a flag leaf application of pyraclostrobin (Headline) significantly increased deoxynivalenol (DON) content of grain over that of the no fungicide control treatment. During five of seven test years, grain of at least one wheat cultivar contained significantly increased levels of DON from the pyraclostrobin treatment compared to the no fungicide control. Chemical company sales personnel and others routinely recommend pyraclostrobin application up to the heading growth stage (wheat) which is allowed by product registration. Recently, much confusion among plant pathologists and others has arisen do to an aggressive "Plant Health" marketing campaign which promotes strobilurin active ingredient application on crops (wheat, barley, corn, soybean, sugar beet, etc.) to obtain "stay-green" physiological effects. This stress management effect is being touted by fungicide application promoters, rather than the more traditional recommendation of disease development. Producers are applying strobilurin products more and more to reduce plant stress and increase yields irrespective of disease pressures. Increased use of this chemistry on wheat and barley is worrisome, not only because overuse will hasten pathogen resistance development, but because strobilurins are associated in the U.S. and Europe with increased DON levels in grain.

This project was conducted to obtain data as described below.

1) The strobilurin chemistry offers excellent control of leaf disease on wheat and barley. It is critical, then, to determine the optimum application timing to support disease management and grain quality. We currently have no grain quality response data (DON content) from fungicide application timings prior to spike emergence. The cereal community must currently rely on fungicide marketing and manufacturing data coming from pesticide companies for best management practices concerning this issue. This research project represents the first important step in addressing this issue and in determining the latest crop growth stage that chemistries can safely be applied.
2) A second objective was to establish if wheat and barley cultivars/entries accumulated DON in grain predictably when compared across resistance levels. Specifically, we wanted to know if strobilurin application on susceptible versus resistant cultivars to Fusarium head blight (FHB) resulted in comparable DON levels. Preliminary studies indicated that wheat cultivars susceptible to FHB had increased DON, whereas cultivars with resistance were affected much less.
3) Finally, weather data (hourly air temperature, humidity, etc.) were collected near the test site to correlate environmental conditions to increased DON accumulation. Our objective was to identify those environmental parameters that increased the risk for elevated DON content.

Recent list serve communications among cereal pathologists and others indicate an increasing level of frustration regarding industry marketing campaigns aimed at producers to apply strobilurin fungicides on crops in the absence of disease. As of today, 16 June, I have been made

aware of a company using data produced by my program in such a manner. We currently do not have the data to response to this issue.

2. List the most important accomplishment and its impact (how is it being used?). Complete all three sections (repeat sections for each major accomplishment):

Accomplishment:

This research project depended on natural infection occurring in the field for disease development. This is always risky, but one of the objectives of the project was to identify environmental conditions that promote increased DON accumulation following fungicide application.

Unfortunately, the environment did not promote disease development during 2007 even though the tests were planted into a commercial field location that had been planted to corn during 2006 and 2005. Grain content of DON was slight, ranging from 0.48 ppm for wheat (Reeder, Quilt applied between Feekes 10 to 10.4) and 0.49 ppm for barley (Tradition, Stratego applied at Feekes 10.5) to 0.04 and 0.07 ppm, respectively. However, three fungicide treatments in wheat and one in barley resulted in significantly greater DON levels compared with nontreated controls. The strobilurin chemistry was present in each instance.

Wheat and barley cultivars with susceptibility to FHB showed increased DON levels following an application of fungicide. Specifically, Reeder had increased DON after an application of Quilt (azoxystrobin and propiconazole) or Headline (pyraclostrobin) at the Feekes 2 or Feekes 10-10.4 growth stages in wheat. In barley, grain of Tradition had elevated DON levels following a Feekes 10-10.3 growth stage application of Quilt, compared with the nontreated control. These results are unexpected since two of the three treatments were applied at approximately the five leaf stage of wheat. This outcome causes us to question the value of using strobilurin chemistries on FHB-susceptible cultivars during early growth stages as well. Additional study is needed to determine if these results are repeatable. This DON effect was also present in barley, which to this PI's knowledge, has not been reported previously.

Impact:

This is the first time that systematic and comparative fungicide research across modes of action has been conducted in the US on wheat and barley in a natural infection system to determine whether increased DON accumulation is occurring from registered fungicide products. It is an important first step in identifying interactions between crop, fungicide, and weather that promote increased DON levels. This information is critical for developing disease management recommendations that support a safe and abundant cereal supply.

As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?:

This project must be repeated at least one more growing season when disease development is moderate to severe to determine its reliability and repeatability. Until this is done, due to the controversial nature of the research, these results should not be shared with producers.

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.

Because of the inherent controversial nature of this research, these results will not be presented to growers until additional information has been collected and the PI is confident in the project's repeatability.

Project 1A: *Investigating Ways to Improve Current Management Strategies for FHB on Wheat and Barley.*

3. What major problem or issue is being resolved and how are you resolving it?
A uniform trial to support the development of an FHB integrated disease management strategy on wheat was discussed and organized in Bloomington, MN during 2006. This PI participated in that discussion. Researchers participating in this trial collected data on residue (type and amount present), variety response by disease resistance level, and fungicide application during 2007, during the first year of the uniform test. In Minnesota, the trial was placed at two Red River Valley locations and neither site was inoculated nor misted.

4. List the most important accomplishment and its impact (how is it being used?). Complete all three sections (repeat sections for each major accomplishment):

Accomplishment:
These data will contribute to understanding which disease management strategies are most important for wheat producers in the Red River Valley of Minnesota as well as in the larger spring wheat production region. We report traditional harvest data and disease development information to growers, as well as incorporate a treatment cost analysis so producers can determine whether one or more applications of fungicide result in a positive or negative revenue outcome for their operation. During 2007, all 13 varieties responded well to the growing environment at both test locations, producing excellent yields of high quality grain. Unexpectedly, fungicide application significantly increased net returns compared with the no fungicide treatment for many varieties even during a year of relatively low disease pressure. The treatment that returned the most revenue across varieties was a triple application of fungicide (seed treatment, Feekes 2, and Feekes 10.51)

Impact:

This is the first time that a number of PIs have worked together uniformly on an integrated FHB management trial to produce data across a number of wheat-producing states. This cooperation will result in data pooling and communication, supporting collection of a greater number of data during a shorter period of time.

As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?:
As our knowledge of additive or multiplicative effects grows concerning integrative disease management, we will be able to make more precise recommendations to growers as to what they can expect to gain, or lose, if certain disease management components are not implemented such as (1) rotation, (2) growing resistant varieties to FHB, or (3) applying fungicide. Additionally, if a correlation between strategy, weather and production returns exists, it is likely that we will begin to understand disease management outcomes as never before.

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

Proceedings and Abstracts

- Hollingsworth, C. R., Motteberg, C. D., Holen, D. L., and Atkinson, L. M. 2007. Understanding practical outcomes from implementing FHB management strategies on spring wheat. Pages 96-97. In: Proceedings National Fusarium head blight Forum. S. Canty, A. Clark, D. Ellis, and D. Van Sanford eds. 2-4 Dec. 2007 Kansas City, MO. Michigan State Univ. East Lansing, MI.

Extension

Publications

- Hollingsworth, C. R. 2007. 2007 Red River Valley on-farm disease management trials. Pages 40-44 In: 2007 Wheat Research Review. MN Wheat Research & Promotion Council. Red Lake Falls, MN.
- Hollingsworth, C., Motteberg, C., Holen, D., Atkinson, L. 2008. 2007 Red River Valley on-farm disease management trials. Pages 28-31 In: On-Farm Cropping Trials Northwest and West Central Minnesota, Jan 2008.
- Hollingsworth, C., Motteberg, C., and Holen, D. 2008. Today's showers bring tomorrow's (sick) flowers. In: Cropping Issues in Northwest Minnesota. Vol. 4 Issue 5.

Producer meetings/workshops/symposia

- 13 Dec. 2007. Prairie Grains Conference. On-farm disease management trial results. Grand Forks, ND: about 200 attendees.

- Jan 2008. Ag Professional Updates. Understanding economic outcomes from implementing disease management strategies on wheat. Crookston, MN. 60 attendees.
- Jan 2009. Small Grains Update Meetings. Fungicide approach to disease management and an outlook for fungicide products in 2008. Morris, Breckenridge, Moorhead, Crookston, Ada, Hallock, Argyle, Roseau, and St. Hilaire. 755 attendees total.

Industry sponsored workshops/training session

- 14-15 Nov. 2007. Cereal/Pulse Crop Fungicide Conference. Response of wheat to disease management ~2007. Fargo, ND: 35 attendees.

Field days

- 16 July 2007. Wheat disease update; identification, management review, and research summary. On-farm wheat disease management and variety trial field days, Perley and Fergus Falls: about 110 attendees total.
- 11 July 2007. Wheat disease update, identification, and research demonstration. Northwest Research and Outreach Center Field Day. Crookston: about 225 total attendees. 3 sessions
- 10 July 2007. Wheat disease update, identification, management review, and research summary. On-farm wheat variety and disease management trial field days, Hallock and Strathcona: about 90 attendees total.
- 9 July 2007. Wheat disease update, identification, management review, and research summary. On-farm wheat variety and disease management trial field day. Oklee: about 45 attendees.

Feature articles in trade journals - mass media

- Hollingsworth, C., Motteberg, C., Holen, D., and Atkinson, L., 2007. On-farm disease management trials of spring wheat in the Red River Valley. Prairie Grains 92:29-31.