USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY10 Final Performance Report
One-Year No Cost Extension through FY11
July 13, 2012

Cover Page

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Fiscal Year:	FY10
USDA-ARS Agreement ID:	59-0790-8-070
USDA-ARS Agreement Title:	Developing Practical FHB Disease Management Strategies for Wheat and Barley Crops.
FY10 USDA-ARS Award Amount:	$ 44,345

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
MGMT	Differential DON Accumulation from Pre-head Foliar-applied Fungicide Application.	$ 24,390
MGMT	2009 Uniform Fungicide Trial on Spring Wheat in Minnesota.	$ 5,321
MGMT	Developing Practical and Economic Disease Management Strategies for FHB in MN.	$ 14,634
	Total ARS Award Amount	**$ 44,345**

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
DUR-CP – Durum Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Soft Winter Wheat Region
SWW – Southern Soft Red Winter Wheat Region

Project 1: *Differential DON Accumulation from Pre-head Foliar-applied Fungicide Application.*

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

   The primary objective of this research was to determine whether commonly accepted leaf disease management strategies in wheat, which incorporate a fungicide application at the 4 to 5 leaf stage (Feekes growth stage 2) or later, may promote increased levels of DON in FHB-diseased grain compared with the non-treated control. Specific goals were to determine DON response to cultivar resistance, fungicide, application timing, and environment. This project addresses research priorities in the FHB Management research area including enhancing communication and end user education/outreach, and developing a fuller understanding of specific environmental and biological factors influencing infection and toxin accumulation.

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):**

   <u>Accomplishment:</u>

   An inoculated, mist-irrigated experiment was conducted in 2010 at the Northwest Research & Outreach Center (NWROC), Crookston, MN as a randomized complete block design with four replications. The cultivar 'Samson', susceptible to Fusarium Head Blight, was solid seeded on June 7 in plots that measured approximately 1.5 m by 6 m. Plots were inoculated by spreading *F. graminearum*-colonized corn grain on July 15. A mist-irrigation system was installed just prior to inoculation and ran until disease assessment on August 13, except when rain events caused soil saturation. The fungicide metconazole (Caramba), pyraclostrobin (Headline), and the premix of the both (Twinline) were each applied at Feekes 5, 7, 9, and 10.51 on July 6, 9, 13, and 26, respectively. An untreated plot was included in each replication as a control. Fungicide applications were made at 30 psi and 10 gpa with 8002 XR flat fan nozzles for the first three timings and with 8001 TwinJet flan fan nozzles at 30 psi and 10 gpa at the final timing using a CO_2-powered hand-held sprayer.

   Flag leaf tissue and heads were collected from individual experimental units just prior to anthesis and one week following anthesis and submitted to the Olson Agricultural Analytical Services Laboratory at SDSU, Brookings, SD for residue analysis of the three active ingredients. FHB severity and incidence was rated by visually evaluating 50 heads for FHB symptoms (five heads at each of 10 arbitrarily selected locations were rated in each plot). Other data that was collected included grain yield, test weight, percentage of visually scabby kernels, and DON content.

   FHB incidence ranged from 30% for the Feekes 10.51 timing to 95% in the untreated checks. Severity ranged from 10% for the Caramba application at Feekes 10.51 to over 22% in the

untreated control. The moderate to severe FHB infections resulted in VSK scores up to 40% and DON concentrations up to 21 ppm in the untreated control. The data suggests that earlier applications of the strobilurin compound pyraclostrobin did not aggravate the incidence and severity of FHB or the accumulation of DON. Residue analysis of the tissue showed that no active ingredient of any of the three compounds was present in heads collected immediately prior to anthesis, whilst some active ingredient was detected in flag leaf material from the application at Feekes 9. Likewise, residue of the three compounds was present in the heads collected one week after anthesis for the treatments made at anthesis but not for any of the prior fungicide applications.

Impact:

In contrast to previous reports and Project 2 (reported below), DON content was not increased by the application of any fungicide, including strobilurins, in this particular trial, despite the moderate to severe incidence and severity of the FHB.

Project 2: *2009 Uniform Fungicide Trial on Spring Wheat in Minnesota.*

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

   This research was part of a multi-state cooperative effort designed to determine the Fusarium head blight (FHB) control efficacies of fungicides, including experimental and unregistered products, on multiple wheat classes and barley across diverse environments. Uniform fungicide trials are needed to identify the compounds that can best manage disease development and preserve crop yield and quality.

   In this project our contribution to the cooperative uniform fungicide trials was to conduct a trial using hard red spring wheat at the Northwest Research and Outreach Center in Crookston, located in northwest Minnesota. The test was inoculated and misted to promote FHB development. Symptoms of foliar diseases and FHB were recorded, along with grain yield and quality data.

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:

   An inoculated, mist-irrigated experiment as part of the collaborative uniform fungicide trials examining 10 fungicide treatments was conducted at the Northwest Research & Outreach Center (NWROC), Crookston, MN as a randomized complete block design with four replications. The cultivar ‘Samson’, rated susceptible to Fusarium Head Blight, was solid seeded on June 7 in plots that measured ca. 1.5 m by 6 m. Plots were inoculated by

spreading *F. graminearum*-colonized corn grain on July 15. A mist-irrigation system was installed just prior to inoculation and ran until disease assessment on August 13, except on days with significant rainfall. Fungicides were applied on July 13, 20, and 26 for the applications at Feekes 9, 10.5, and 10.51, respectively and on August 3 for the application timing at 5 days after the beginning of anthesis. All but the first fungicide applications were made at 30 psi and 10 gpa with 8001 TwinJet flat fan nozzles using a CO_2-powered hand-held sprayer. For the Feekes 9 timing, vertically directed 8002 XR flat fan nozzles were used. The trial protocol established for the cooperative effort was followed as closely as possible.

Disease development as well as grain yield and quality data was collected for all plots. Percent symptomatic flag leaf tissue was recorded per plot as an indication of leaf diseases. At Feekes 11.2 (soft dough growth stage), 50 heads were rated for FHB symptoms (five heads at each of 10 arbitrarily selected locations were rated in each plot). Yield, test weight, moisture, 1000-kernel weight, and DON data were recorded for each plot.

FHB incidence was reduced by more than 25% with the application of Prosaro and Caramba at Feekes 10.51. Likewise, severity was reduced by more than 20% for the application of Prosaro and Caramba at Feekes 10.51 compared the untreated checks. Delaying the application to 5 days after anthesis did not significantly reduce or improve control whilst applying earlier than Feekes 10.51 tended to increase FHB incidence but not FHB severity. The data indicated that earlier applications of the strobilurin compound pyraclostrobin increased both FHB incidence and severity by 8% and increased the accumulation of DON by 8%.

Impact:

Testing wheat responses following fungicide treatments in an inoculated and mist-irrigated experiments such as this provide data that can be delivered to producers as best management practices for FHB and DON. As part of large collaborative effort this project has helped to build a knowledge base for integrated management throughout the hard red spring wheat growing region, including Minnesota.

Project 3: *Developing Practical and Economic Disease Management Strategies for FHB in MN.*

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

   This project represents Minnesota's participation in the uniform integrated management effort for FHB. This multi-state research cooperative was organized during 2005 to identify best management practices for protecting small grain crops against FHB-related yield and quality losses. The research has focused on correlating FHB disease severities with in-field crop residue, FHB resistance level of cultivars, and fungicide applications. Economic outcomes of the research are to be determined using local cash-basis market schedules for grain premiums and discounts. The study thus completes the informational thread all the way from cultivar selection to economic outcomes for each disease management strategy, allowing extension services to better advice producers on the value of production inputs.

   The specific objective of the experiments conducted within this project was to identify best disease management approaches for producing wheat in the Minnesota, and determine if strategies are economically sustainable for producers.

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):**

   <u>Accomplishment:</u>

   Four experimental sites across the western third of Minnesota, representing different agricultural ecosystems, were implemented in 2010. Different disease pressures for the three economically most important fungal diseases (tan spot, leaf rust, and FHB) are observed across these locations. The experiment locations in 2010 were in Lamberton, Morris, Crookston, and Roseau, MN. A total of 45 spring wheat cultivars that are available to producers in the state, with various levels of disease resistance, were tested. The experiments were split-plot designs with three replicates where fungicide treatment is the main factor and cultivar is the sub-factor. The fungicide treatments consisted of a non-treated control and the combination treatment of Stratego at half labeled rate at Feekes 5, Tilt at labeled rate at Feekes 9, and Prosaro at labeled rate at Feekes 10.51.

   Fungicide applications were made at 30 psi and 10 gpa with 8002 XR flat fan nozzles for the first two timings (Stratego at Feekes 5 and Tilt at Feekes 9) and with 8001 TwinJet flan fan nozzles at 30 psi and 10 gpa at the final timing (Prosaro at Feekes 10.51) using either a CO_2-powered hand-held sprayer or a tractor mounted sprayer.

   Data collected included FHB disease symptom ratings from 10 spikes/plot, foliar disease symptoms, yield, protein, test weight, and thousand kernel weight. Little to no FHB was observed at any of the four locations. Leaf rust was moderate to severe in the two southern

locations while little leaf rust was observed at the two northern locations. Across the two northern locations (Crookston and Roseau), the yield advantage across cultivars for the combination treatment of Stratego, Tilt, and Prosaro was 7 bu/A with little to no FHB or leaf rust being detected. Across the two southern locations (Morris and Lamberton), an increase of 4 bu/A was detected across cultivars for the combination treatment of Stratego, Tilt, and Prosaro.

Impact:

In collaboration with other scientists in the USWBSI these experiments are helping to identify best disease management approaches for producing wheat and to determine if the currently proposed strategies are agronomically sound and economically sustainable.

Ultimately this research will enhance communication and end user education/outreach, and develop a fuller understanding of specific environmental and biological factors that influence the infection of wheat by *Fusarium* species and associated toxin accumulation.

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.

Bradley, C.A., Adee, A.E., Ebelhar, S.A., Dill-Macky, R., Wiersma, J.J., Grybauskas, A.P., Kirk, W.W., McMullen, M.P., Halley, S., Milus, A.E., Osborne, L.E., Ruden, K.R. and Young, B.G. (2010). Multi-state uniform fungicide evaluations for control of Fusarium head blight and associated mycotoxins. In: *Proceedings of the 2010 National Fusarium Head Blight Forum*, Milwaukee, Wisconsin, USA, December 7-9, 2010, p. 74.