USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY09 Final Performance Report
July 15, 2010

Cover Page

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Fiscal Year:	2009
USDA-ARS Agreement ID:	59-0206-9-064
USDA-ARS Agreement Title:	Studies on Management Strategies and Environmental Factors Affecting FHB and DON in Multiple Grain Classes, ND.
FY09- USDA-ARS Award Amount:	$ 75,874

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
MGMT	Greenhouse Studies of DON in Wheat as Influenced by Environment and F.g. Isolate.	$ 28,293
MGMT	Uniform Evaluation of Fungicides for FHB Control in Multiple ND Grain Classes.	$ 9,045
MGMT	Integrated Management Studies for the Reduction of FHB and DON in Multiple Grain Classes, ND.	$ 38,536
	Total Award Amount	**$ 75,874**

July 13, 2010
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 Winter Wheat Region
SWW – Southern Sinter Wheat Region

Project 1: *Greenhouse Studies of DON in Wheat as Influenced by Environment and F.g. Isolate.*

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

Durum and spring wheat have differing durations of vulnerability to Fusarium head blight infection, because of head type and duration of flowering. In addition, an understanding of how late infections impact DON accumulation provide information needed on determining fungicide timing and how the FHB and DON forecasting models will function. Controlled studies in the greenhouse allow exposure of durum and spring wheat varieties to differing durations of moisture and differing timings of inoculation to determine the range of disease and DON possible under different environmental conditions. Two spring wheat and two durum varieties of differing levels of FHB susceptibility are exposed to multiple durations of moisture, multiple growth stage inoculations, and two isolates with differing trichothecene genotype, under greenhouse conditions. Information on FHB severity and DON accumulation with these multiple parameters provides additional information on the environmental parameters which affect disease management and disease forecasting.

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: Determined that long mist periods of 10 days resulted in the highest DON levels and overwhelmed even the best resistance available (from Sumai3). Inoculations at early dough stage of development resulted in very little disease or DON. Inoculations with 3ADON isolate did not result in higher DON recovery than inoculations with the 15 ADON isolate, in the resistant spring wheat line Glenn, but did so in the susceptible cultivar Trooper.

Impact: Results indicate that late infections, once dough development starts, are minor contributions to DON accumulation in wheat. Very long durations of moisture can overwhelm resistance sources and if occurs in nature, disease and DON forecasting systems must take this into account. Results with the two isolates indicate that resistance derived from Sumai3 does not result in greater development of DON when inoculated with a 3ADON isolate and this resistance source is appropriate for reducing disease, no matter the isolate type.

Project 2: *Uniform Evaluation of Fungicides for FHB Control in Multiple ND Grain Classes.*

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

   Fungicides are one of the key management strategies for reducing FHB and DON. Recent registrations have helped provide more efficacy products for producers, but the top products are all triazoles. There is always a potential that resistance could develop to this chemistry with wide spread use, plus some combinations of products may work more effectively than a single component. In addition, some new chemistries have recently been developed by major crop protection companies, chemistries that need to be tested against FHB. ND has the largest acreages in the nation of three major spring grain crops, hard red spring wheat, barley, and durum wheat, and has a history of scab infection. It is necessary to test new products or combinations on these crops and multiple locations representing different environments, in order to gain efficacy data to provide to producers and to assist in fungicide registrations. Multiple locations (Fargo, Carrington and Prosper) have been established which represent unique environments across the state. At each location, two grain classes are planted for testing and participation in the Uniform testing protocol. At each site, field history, variety, and inoculum source may vary, as will environmental parameters, such as rainfall and temperature. Having a standard protocol to compare across multiple sites and varieties gives assurance that good disease data will be collected and successful evaluations will be achieved.

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: In 2009, the uniform trials across ND and across the US provided information on the effects of strobilurin fungicides applied prior to flowering on FHB and DON accumulation. This information further validated pathologist's recommendations that strobilurins should not be used for FHB control and should not be applied at heading, because of increased DON risk. The results also validated that Caramba and Prosaro were efficacious products, but too early of applications (Feekes 10.3 in barley, and Feekes 10.5 in wheat) were not as efficacious as when applied at full head emergence in barley or flowering in wheat.

   Impact: Results reinforced our recommendations that strobilurin containing products should not be used to control FHB nor applied as late as the heading stage, because of increased DON risk. The results also indicated that applying fungicides to wheat or barley too early is not as effective as applying at the designated growth stages of flowering in wheat or full head emergence in barley. These results will be relayed to producers through newsletters and grower meetings. A better "too early" than "too late" application policy needs to be more accurately defined for the producer.

Project 3: *Integrated Management Studies for the Reduction of FHB and DON in Multiple Grain Classes, ND.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**
   It is difficult to manage Fusarium head blight and reduce DON with only one management strategy. In the presence of very favorable environment for Fusarium infection, usually use of one strategy fails. Resistance available is generally moderate resistance, and certainly is not immunity. The best fungicides can reduce FHB by an average of 60-70% and DON by 50-60%, but remaining disease and DON levels may still be high. Multiple strategies, such as use of resistance and fungicides, or resistance, plus fungicides plus good rotation strategy, have been shown to increase the grain yield, quality, and reduce the disease parameters, over that of a single strategy. The key is to demonstrate this advantage to producers, with economics of these strategies also in mind.

   We are participating in an integrated management coordinated project across multiple states, using ND grain classes and varieties and our rotation crops. We established multiple strategy sites at several locations for spring wheat, durum wheat, and barley. At each location, multiple varieties of varying levels of FHB resistance were established and then either treated or not treated with fungicide (Prosaro at flowering for wheat, early head emergence for barley), plus two locations also had a rotational effect (soybean vs. wheat at Fargo; canola vs. wheat at Langdon). Information from these studies has been presented at winter meetings, posted on the Internet, and presented at professional meetings.

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: The disease reduction and yield response to growth of more resistant varieties was demonstrated, along with variety response to fungicide treatment. This information and its delivery to producers illustrates the value of growing a more resistant variety along with fungicide use, and demonstrates the economics of these practices across multiple environments. The rotational studies demonstrate the value of putting a broadleaf crop in the rotation to reduce this disease. This information aids grower decisions during the growing season.

   Impact: Growers are responding to integrated management information by choosing more FHB tolerant varieties in ND (ND Ag. Statistics Service yearly report indicates that top 5 of 6 varieties of spring wheat grown in ND in 2009 had moderate to moderately resistant reaction to FHB), increasing use of the disease forecasting system to make a fungicide decision, and using efficacious fungicides when needed. The rotation benefits are understood, but growers will make rotation decisions based on many factors, such as previous herbicide use, fertility credits, and economics.

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.

Ali, S., McMullen, M., and Zhong, S. 2009. Aggressiveness and DON production of *Fusarium graminearum* 3ADON and 15ADON populations as affected by wheat cultivar resistance and fungicide treatment under ND field conditions, 2009. Pages 19-21 in: S. Canty, A. Clark, J. Mondell, E. Walton, D. Ellis and D. Van Sanford (Eds), Proc. 2009 National Fusarium Head Blight Forum, Dec. 7-9, 2009. Orlando, FL. University of Kentucky, Lexington, KY.

Bradley, C.A., Adee, E.A., Ebelhar, S.A., Grybauskas, A.P., Hollingsworth, C.R., Kirk, W.W., McMullen, M.P., Milus, E.A., Osborne, L.E., Ruden, K.R., and Young, B.G. 2009. Application timings of Caramba and Prosaro foliar fungicides for management of FHB and DON. Page 34 in: S. Canty, A. Clark, J. Mondell, E. Walton, D. Ellis and D. Van Sanford (Eds), Proc. 2009 National Fusarium Head Blight Forum, Dec. 7-9, 2009. Orlando, FL. University of Kentucky, Lexington, KY.

Bradley, C.A., Adee, E.A., Ebelhar, S.A., Grybauskas, A.P., Hollingsworth, C.R., Kirk, W.W., McMullen, M.P., Milus, E.A., Osborne, L.E., Ruden, K.R., and Young, B.G. 2009. Effect of pyraclostrobin applications to wheat at different growth stages on DON concentrations in grain. Page 35 in: S. Canty, A. Clark, J. Mondell, E. Walton, D. Ellis and D. Van Sanford (Eds). Proc. 2009 National Fusarium Head Blight Forum, Dec. 7-9, 2009. Orlando, FL. University of Kentucky, Lexington, KY.

Halley, S. and Misek, K. 2009. Using cultivar selection and fungicide as management tools to control disease on hard red winter wheat, Langdon, ND. Online report: http://www.ag.ndsu.edu/langdon/09data/hrww%20summary%2007-09.pdf

McMullen, M., Meyer, S., and Jordahl, J. 2010. Inoculation Timing, Mist Duration and Isolate Effects on Fusarium Head Blight and Deoxynivalenol in Two Hard Red Spring Wheat Cultivars Abstract presented at NC APS Division Meeting, June 7-8, 2010, Rapid City, SD.

McMullen, M., Jordahl, J., and Meyer, S. 2009. Uniform fungicide trial results on HRS wheat and spring barley, Fargo, ND 2009. Page 69 in: S. Canty, A. Clark, J. Mondell, E. Walton, D. Ellis and D. Van Sanford (Eds), Proc. 2009 National Fusarium Head Blight Forum, Dec. 7-9, 2009. Orlando, FL. University of Kentucky, Lexington, KY.

McMullen, M. and Mathew, Febina. 2009. Development of the ScabSmart Web site – A quick guide to U.S. Scab Management information. Page 68 in: S. Canty, A. Clark, J. Mondell, E. Walton, D. Ellis and D. Van Sanford (Eds), Proc. 2009 National Fusarium Head Blight Forum, Dec. 7-9, 2009. Orlando, FL. University of Kentucky, Lexington, KY.

McMullen, M. 2009. Use of Integrated Strategies to Improve Head Scab Control in Small Grains. On-line report: http://www.ag.ndsu.edu/ext-emp/evaluation/reports/impactreports/10state-m.mcmullen.pdf

Paul, P.A., McMullen, M. P., Hershman, D.E., and Madden, L. V. 2010. Meta-analysis of the effects of triazole-based fungicides on wheat yield and test weight as influenced by Fusarium head blight intensity. Phytopathology 100:160-171.

Ransom, J. 2009. Results of Integrated Study with Spring Wheat using Varieties and Fungicide. Two location results posted in On-line report:
http://www.ag.ndsu.edu/varietytrials/spring-wheat/barley/spring-wheat/fargo-main-station

Willyerd, K., Madden, L., Bergstrom, G., Bradley, C., Grybauskas, A., Hershman, D., McMullen, M., Ruden, K., Sweets, L., Wegulo, S., Wise, K., and Paul, P. 2009. Integrated management of FHB and DON in small grains: 2009 Coordinated trials. Pages 3-94 in: S. Canty, A. Clark, J. Mondell, E. Walton, D. Ellis and D. Van Sanford (Eds), Proc. 2009 National Fusarium Head Blight Forum, Dec. 7-9, 2009. Orlando, FL. University of Kentucky, Lexington, KY.