

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY10 Final Performance Report
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Cover Page

PI:	Marcia McMullen
Institution:	North Dakota State University
Address:	Department of Plant Pathology NDSU Dept. # 7520 PO Box 6050 Fargo, ND 58108-6050
E-mail:	marcia.mcmullen@ndsu.edu
Phone:	701-231-7627
Fax:	701-231-7851
Fiscal Year:	FY10
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.
FY10 USDA-ARS Award Amount:	\$ 66,970

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
MGMT	Greenhouse Studies of DON in Wheat as Influenced by Environment and F.g. Isolate.	\$ 23,329
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.	\$ 34,596
	Total ARS Award Amount	\$ 66,970

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: *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 each grain class, as well as in varieties among a grain class. Information is needed on what stage of heading and flowering in each grain class has the greatest vulnerability to the disease, information which will allow better fungicide timing. Also, 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. This greenhouse research project allows exposure of durum and spring wheat varieties to differing durations of moisture and differing timings of inoculation under controlled conditions, 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. 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: Project is identifying the primary stage of flower development that favors FHB severity, and how durations of moisture at these periods affects FHB severity, which in turn provides information relevant to fungicide application timing and disease forecast predictions. Results with two genotypes of the pathogen also indicated that inoculations with a 3ADON isolate did not result in higher DON recovery than inoculations with the 15 ADON isolate in the more resistant durum Divide, but did so in the susceptible cultivar Monroe.

Impact: Results indicate that very early infections, prior to flowering, result in little disease or DON, as do very late infections, once dough development starts. Very long durations of moisture may 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 more resistant cultivars are able to express their resistance even in the presence of the more aggressive 3ADON inoculant.

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. The most efficacious products registered for reducing FHB severity and DON levels are in the triazole chemistry family. However, promotion of other products, such as strobilurin fungicides, are being done in the real world. The purpose of the uniform fungicide trials in 2010 was to evaluate the best timings of application of the top triazole products, and to further delineate the effects of applying strobilurins on wheat before or near flowering to determine if they cause a bump in DON. In addition, some new fungicide chemistries were 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. The uniform fungicide trial, consisting of a core of 10 treatments, was conducted at three locations (Fargo, Carrington and Langdon) on spring wheat, durum wheat and two row and six row barley. Having a standard protocol to compare across multiple sites and varieties gave assurance that good disease data would be collected and successful evaluations would 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 2010, the uniform trials across ND and across the US provided information on the best products and timing of application for DON reduction. Some trials did show that the use of a strobilurin product, even when applied at boot stage, did increase the DON levels above the untreated check. 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 the most efficacious products, but too early of applications, approximately five days before flowering in wheat or full head emergence of barley, were not as efficacious as when applied at full head emergence in barley or flowering in wheat.

Impact: Results are used by pathologists to provide wheat and barley producers updated and best recommendations for fungicide use and timing for FHB control and DON reduction in three grain classes. 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 were relayed to producers through newsletters and grower meetings. The results also provide information to crop protection companies on the efficacy of experimental products that may or may not be better than registered products, information needed for further developing the product for sale.

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?

Fusarium head blight severity and mycotoxin levels generally cannot be adequately reduced with only one management strategy. In the presence of very favorable environment for Fusarium infection, use of one strategy generally fails. Moderate resistance available is in some varieties but not high resistance or immunity. The best variety resistance available will still result in some FHB and DON in very favorable environments. 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 in favorable environments for disease. 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.

We continue to participate 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. 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. New varieties with better resistance are added when available.

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.

Accomplishment: The value of using a combination of disease resistance and the best fungicides available were demonstrated again in 2010, at multiple locations across ND. Two sites also had a broad leaf crop vs. small grain crop rotation in the study, to demonstrate the additive effect of good rotations, as well. This information was delivered to growers via demonstrations at field days, and summary reports posted on-line, as well as at winter meetings. This information aided grower decisions on rotations, variety choice, and use of fungicides during the growing season.

Impact: ND growers have responded 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 2010 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 by growers, 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., Puri, K.D., McMullen, M., and Zhong, S. 2010. Aggressiveness of *Fusarium graminearum* 3ADON and 15ADON populations as affected by Hard Red Spring cultivar resistance and fungicide treatment, under field conditions in North Dakota. Pages 65-68 in: S. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds), Proc. 2010 National Fusarium Head Blight Forum, Dec. 7-9, 2010. Milwaukee, WI. University of Kentucky, Lexington, KY.
- Bradley, C.A., Adee, E.A., Ebelhar, S.A., Dill-Macky, R., Wiersma, J.J., Grybauskas, A.P., Kirk, W.W., McMullen, M.P., Milus, E.A., Halley, S., 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. Page 74 in: S. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds), Proc. 2010 National Fusarium Head Blight Forum, Dec. 7-9, 2010. Milwaukee, WI. University of Kentucky, Lexington, KY.
- Jordahl, J., Meyer, S., and McMullen, M. 2010. Results of 2010 uniform fungicide trial on barley, Fargo, ND. Pages 81- 83 in: S. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds), Proc. 2010 National Fusarium Head Blight Forum, Dec. 7-9, 2010. Milwaukee, WI. University of Kentucky, Lexington, KY.
- McKee, G., Ransom, J., and McMullen, M. 2010. Determinants of adoption of scab management techniques. Pages 86-89 in: S. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds), Proc. 2010 National Fusarium Head Blight Forum, Dec. 7-9, 2010. Milwaukee, WI. University of Kentucky, Lexington, KY.
- McMullen, M., Jordahl, J., and Meyer, S. 2010. Inoculation timing, mist duration and isolate effects on FHB and DON in two durum cultivars. Page 90 in: S. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds), Proc. 2010 National Fusarium Head Blight Forum, Dec. 7-9, 2010. Milwaukee, WI. University of Kentucky, Lexington, KY.
- 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. <http://www.apsnet.org/members/divisions/nc/meetings/Pages/2010MeetingAbstracts.aspx>
- McMullen, M., and Markell, S. 2010. 2011 ND Field Crop Fungicide Guide. NDSU Ext. Circular PP-622 (revised) 66 p.
- McMullen, M. 2011. Integrated management of Fusarium head blight – research and outreach. Presented at the 6th Canadian Workshop of Fusarium Head Blight. Published in: Can. J. Plant Pathology 33:248.

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.

Willyerd, K., Bradley, C., Grybauskas, A., Hershman, D., Madden, L., McMullen, M., Osborne, L., Sweets, L., and Paul, P. 2010. Multi-state evaluation of integrated management strategies for Fusarium head blight and deoxynivalenol in small grain. Abstract presented at national APS Meeting, Aug. 7-11, 2010, Charlotte, NC.

Willyerd, K., Madden, L., McMullen, M., Wegulo, S., Bockus, B., Sweets, L., Bradley, C., Wise, K., Hershman, D., Bergstrom, G., Grybauskas, A., Osborne, L., Esker, P., and Paul, P. 2010. Inoculated field trials for evaluating FHB/DON integrated management strategies. Pages 109-110 in: S. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds), Proc. 2010 National Fusarium Head Blight Forum, Dec. 7-9, 2010. Milwaukee, WI. University of Kentucky, Lexington, KY.

North Dakota State University Crop and Pest Report, on-line:

<http://www.ag.ndsu.nodak.edu/aginfo/entomology/ndsucpr/index.htm>).

North Dakota State University Small Grains web page with updates posted by Joel Ransom:

<http://www.ag.ndsu.edu/smgrains/>

NDSU Plant Pathology Extension web site, with postings on fungicide results:

<http://www.ag.ndsu.edu/extplantpath/>