USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY11 Final Performance Report
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Cover Page

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Fiscal Year:	FY11
USDA-ARS Agreement ID:	59-0206-9-078
USDA-ARS Agreement Title:	Managing FHB Through Integrated Practices, Biological Control Agents, and Within-field Inoculum Sources.
FY11 USDA-ARS Award Amount:	$ 18,146

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
MGMT	Evaluation of Integrated Management Strategies for Fusarium Head Blight	$ 11,707
MGMT	Uniform Trial to Evaluate Efficacy of Biologicals against FHB.	$ 4,390
MGMT	Effects of Local Corn Debris Management on FHB and DON Levels.	$ 2,049
	Total ARS Award Amount	**$ 18,146**

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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
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: *Evaluation of Integrated Management Strategies for Fusarium Head Blight*

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

   This research project addresses the need of identifying the best management methods for FHB/DON or good farming practices for FHB/DON management through integrated management studies. Needs addressed also include evaluation of potential disease reductions through combinations of host resistance and fungicides, documentation of the impact of crop sequence on disease risk and potential role as part of the integrated management of FHB/DON and development of outreach materials and opportunities for exchange of information with clientele.

   The proposed research project very clearly mirrors Goal #1 of the FHB Management Action Plan, i.e. "Validate integrated management strategies for FHB and DON". It also contributes to the goals of developing the next generation of management tools for FHB/DON control and enhancing communication and end used education/outreach by providing valuable research results on best management practices to clientele.

   2010-2011 was the fifth year for the Integrated Management of Fusarium Head Blight and Deoxynivalenol study in Missouri. The recommended treatments were applied to five soft red winter wheat varieties. Ratings were made at the appropriate times and data for the five years of the study has been analyzed and summarized.

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:
   Weather conditions were conducive for the development of FHB in all five varieties in both crop sequence trials during the 2011 season. In the corn residue trial all main and interaction effects were statistically significant for both yield and DON. Yields in the corn residue were lower than in the soybean residue and DON levels were higher in the corn residue than in the soybean residue. These results confirm the importance of crop rotation and variety selection as management tools for both FHB and DON.

   Impact:
   This research has shown the importance of crop sequence or residue type on the level of FHB and DON in the subsequent wheat crop. Crop rotation as a management tool for both FHB and DON management needs to be stressed. In general, the greatest reductions in FHB intensity and DON accumulation were observed when moderately resistant varieties were used with crop rotation and fungicide application. Resistant varieties had lower levels of both FHB and DON in both residue types and with or without fungicide application. Under high disease pressure, a three tier management approach of crop rotation with a non-host, moderately resistant to resistant varieties and fungicide application was required to achieve < 2ppm DON.

This research project has provided data that can be used by producers to manage both FHB and DON levels in wheat. The importance of crop rotation, variety selection and the use of fungicide applications as the wheat flowers if weather conditions are conducive to the development of FHB are viable options for producers trying to manage FHB and reduce DON levels.

Project 2: *Uniform Trial to Evaluate Efficacy of Biologicals against FHB.*

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

   This research project addresses the research needs of optimizing biological control application timing and methodology, developing control methods that include consistent and effective biological control agents, assessing new control methods for FHB/DON, developing a repository of negative data with potential explanations for why control was not attained and enhancing communication and end user education/outreach opportunities.

   The project very clearly mirrors Goal #2 of the FHB Management Action Plan, i.e. "Develop the next generation of management tools for FHB/DON control". It also contributes to the goals of developing components for use in integrated management of FHB and enhancing communication and end used education/outreach by providing valuable research results on best management practices to clientele.

   The work proposed in the original research grant submission has been completed for the 2007-2008, 2008-2009, 2009-2010 and 2010-2011 seasons. The uniform biological trial was conducted on two soft red winter wheat varieties, Elkhart and Roane. All four seasons were very favorable for the development of FHB and DON. Elkhart is a susceptible variety and FHB had a negative impact on yield and lead to high levels of DON in the untreated plots. Roane is moderately tolerant to FHB but still had significant levels of both FHB and DON. The biological control agents used were efficacious on Elkhart, especially in 2009 and 2010.

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:
   For 2011 moderate to high FHB levels were recorded in the Missouri trial. On Roane five of seven treatments had FHB incidence less than the untreated. On Elkhart, significant differences in test weight were reported with five of seven treatments different from the untreated and significant differences in DON levels were reported with six of seven treatments less than the untreated.

   Impact:
   The results from 2010-2011 lend further evidence to the value of combining a biological with a fungicide to maximize control of FHB and DON.

Project 3: *Effects of Local Corn Debris Management on FHB and DON Levels.*

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

   Reduction or elimination of within-field sources of inoculum of *Fusarium graminearum* is the basis for cultural control measures such as crop rotation sequences in which cereals follow non-cereal crops. The goal of this USWBSI research project is to provide realistic estimates of 'DON reduction' that can be expected from cultural controls that reduce within-field inoculum sources. We utilized moldboard plowing of corn debris as a proxy for planting after a non-cereal crop to compare directly with wheat planted no-till into corn debris in commercial-scale wheat fields planted following grain corn harvest in Illinois, Kentucky, Michigan, Missouri, Nebraska, New York, and Vermont. Following corn harvest in 2010, replicated wide (60 ft) strips were moldboard plowed or left non-plowed prior to sowing wheat over the entire field with a no-till drill. Wheat in each strip was monitored for FHB and sampled for laboratory quantification of head infection by *F. graminearum* and contamination of grain by DON in 2011. FHB symptoms at soft dough stage were low to moderate at every location except Missouri. Yet, at crop maturity, a high percentage of wheat heads was found to be infected by *F. graminearum* in all locations except Nebraska and Vermont. Measurable DON was found in grain from every environment and the levels were lowest in Vermont and highest in Kentucky and Nebraska. It is interesting that the Nebraska site showed the lowest disease index and lowest incidence of head infection, but the highest average toxin level. Moldboard plowing resulted in a significant decrease in FHB index in four environments (IL, MO, NY, MI), though the magnitude of the difference was large only in Missouri. In Nebraska, FHB index was significantly higher in the moldboard-plowed treatment in which the wheat crop matured earlier than in the no-till corn debris treatment. Moldboard plowing was associated with a small but significant decrease in recovery of *F. graminearum* from mature heads in three environments (IL, MI, NY). There was no significant effect of plowing on DON level in five environments (IL, KY, MO, NY, VT) and there were small, but significant decreases in toxin in moldboard-plowed compared to no-till strips in two environments (MI and NE). An additional treatment of minimum tillage (chisel plow) was added in the Michigan experiment; DON levels in the minimum-till plots were intermediate between moldboard and no-till but not significantly different from no-till. There is a strong trend in year one data suggesting that inoculum from area atmospheric sources exerts a far greater effect than inoculum from in-field corn residue on the level of DON contamination.

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>
   There is a strong trend in year one data suggesting that inoculum from area atmospheric sources exerts a far greater effect than inoculum from in-field corn residue on the level of DON contamination in agricultural-scale strip plots, yet there were small, but significant

decreases in toxin in moldboard-plowed compared to no-till strips in two environments (MI and NE).

Impact:

Based on year one data, it appears that localized corn debris management prior to wheat planting results, on average, in fairly small reductions in FHB and in DON contamination in wheat. Regional atmospheric inoculum appears to play a far greater role in corn-dominated landscapes, thus prioritizing the need for resistant wheat varieties and effective fungicides as the main pillars of integrated management in corn production regions. A second year of experimentation in seven additional wheat environments in 2012 is being conducted to provide increased evidence of the magnitude of the effect of localized corn residue management on DON reduction. It should be noted, however, that while DON analysis has not yet been conducted on the 2012 samples, FHB occurred at very low levels across the Midwest and Northeast in 2012 due to extraordinarily warm and dry conditions through flowering and grain filling. A third year of research including more normal environments may be needed to derive a realistic quantitative answer to the question being addressed.

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.

Electronic Publication:

Willyerd, K.T., C. Li, L.V. Madden, C.A. Bradley, G.C. Bergstrom, L.E. Sweets, M. McMullen, J.K. Ransom, A. Grybauskas, L. Osbourne, S.N. Wegulo, D.E. Hershman, K. Wise, W.W. Bockus, D. Groth, R. Dill-Mackey, E. Milus, P.D. Esker, K.D. Waxman, E.A. Adee, S.E. Ebelhar, B.G. Young and P.A. Paul. 2011. Efficacy and stability of integrating fungicide and cultivar resistance to manage Fusarium head blight and deoxynivalenol in wheat. Posted online at (http://apsjournals.apsnet.org/doi/abs/10.1094/PDIS-09-11-0763) on November 28, 2011. P. 40. Online publication. (5% contribution) (published).

Proceedings:

Bergstrom, G.C., K.D. Waxman, C.A. Bradley, A.L. Hazelrigg, D.E. Hershman, M.Nagelkirk, L.E. Sweets and S.N. Wegulo. 2011. Effects of local corn debris management on FHB and DON levels in seven U.S. wheat environments in 2011. Proceedings of the 2011 National Fusarium Head Blight Forum, St. Louis, MO, December 4-6, 2011. P. 119-121. Abstract in proceedings and poster at forum. (10% contribution) (published).

Halley, S., G. Yuen, C.C. Jochum, B.H. Bleakley, N.K.S. Murthy, K.R. Ruden, K.D. Waxman, G.C. Bergstrom and L.E. Sweets. 2011. Uniform biological fungicide evaluations for control of Fusarium head blight and deoxynivalenol in wheat. Proceedings of the 2011 National Fusarium Head Blight Forum, St. Louis, MO, December 4-6, 2011. P.140-141. Abstract in proceedings and poster at forum. (10% contribution) (published).

Willyerd, K., G. Bergstrom, C. Bradley, R. Dill-Mackey, P. Gross, A. Grybauskas, S. Halley, D. Hershman, L. Madden, M. McMullen, G. Milus, L. Osborne, K. Ruden, J.D. Salgado, L. Sweets, S. Wegulo K. Waxman, K. Wise and P. Paul. 2011. Proceedings of the 2011 National Fusarium Head Blight Forum, St. Louis, MO, December 4-6, 2011. P.161-166. Abstract in proceedings and poster at forum. (10% contribution) (published).

Yuen, G.Y., C.C. Jochum, S.A. Halley, L.E. Sweets, W.W. Kirk and D.A. Schisler. 2011. Biological control of Fusarium head blight in wheat caused by *Gibberella zeae*- a two year, multilocation study. Proceedings of the 2011 American Phytopathological Society Annual Meeting, Honolulu, HA, August 6-10, 2011. P. 70. Abstract on proceedings CD and poster at meeting (10% contribution) (published).