

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

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Fiscal Year:	FY11
USDA-ARS Agreement ID:	59-0206-9-060
USDA-ARS Agreement Title:	Development and Validation of FHB and DON Predictive Models for Barley.
FY11 USDA-ARS Award Amount:	\$ 48,150

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	Validation and Refinement of DON Models in Barley for the Northern Great Plains.	\$ 26,687
HWW-CP	Using Association Mapping to Identify and Validate New FHB Resistance QTL and Integrate the QTL into HWW.	\$ 3,902
MGMT	Determining the Contribution of Secondary Tillers to Total DON Concentration.	\$ 17,561
	Total ARS Award Amount	\$ 48,150

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: *Validation and Refinement of DON Models in Barley for the Northern Great Plains.*

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

Fusarium head blight (FHB) of barley continues to be a serious problem for producers in the Northern Great Plains. Barley production in the Dakotas and Minnesota has declined steadily since the early 1990's and this can be attributed to, at least in part, the re-emergence of *Fusarium* head blight. Of particular importance to barley production is the accumulation of deoxynivalenol (DON) in the grain. Models exist for predicting disease development in wheat, however they are not effective for DON in barley. We are addressing this issue by developing and validating models for forecasting systems that can predict disease and/or DON accumulation in malting barley. The information provided by this model will offer extension specialists, consultants, and producers the information required to make effective management decisions or recommendations.

The objectives of the proposed research were to 1) contribute to the development of an experimental database containing information on cultural practices, weather, and resulting field disease and mycotoxin levels for barley and 2) validate and refine the models for FHB and DON accumulation in barley. Objective 1 was conducted at South Dakota State University. Plots were planted at 8 locations throughout the state of South Dakota and the environment monitored at each location during the growing season. Field ratings of disease were taken and DON concentration in the grain was quantified. For objective 2, predicted risk was calculated at all locations using the 2-dimensional Weibull model developed from the six growing seasons prior to 2011. This was then compared with the observed risk to estimate the model efficiency.

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: Two significant accomplishments occurred during the period in question. First, the 2-dimensional Weibull model was validated with the 8 locations from the region and found that the model had a prediction accuracy of 70% using 2011 weather data. Second, this model was deployed on small grain disease forecasting model web site during the growing season at North Dakota State University.

Impact: The model was deployed on NDSU disease forecasting website and this website helps the consultants and producers to make informed decisions about FHB and DON in Barley.

Project 2: *Using Association Mapping to Identify and Validate New FHB Resistance QTL and Integrate the QTL into HWW.*

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

Since 2005, regular scab epidemics have occurred in the hard winter wheat crop of the central and northern Great Plains. Genetically improved seed coupled with appropriate management practices (cultural practices and fungicide uses) are the quickest and most cost effective ways to reduce DON in the grain supply. There are multiple sources of moderate resistance already present in hard winter wheat germplasm adapted to the region. To best use this germplasm in varietal improvement efforts; the quantitative trait loci (QTL) associated with this resistant should be mapped so that breeders can employ marker-assisted selection to accelerate efforts to develop FHB-resistant lines. This project is part of a larger effort to use association mapping to identify these QTL. The South Dakota State University role in this project is minor, mainly providing some phenotypic data. The major project report is given by Drs. Guihua Bai and Stephen Baenziger.

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: Phenotypic data for FHB have been obtained from the greenhouse experiments and the data have been submitted to Dr. Stephen Baenziger (UNL).

Impact: The phenotypic data of the population collected from SDSU and collaborators will be important for breeders to better select parents for crosses because the population mainly consisted of elite breeding materials and new varieties that breeders use most often as parents in their crosses.

Project 3: *Determining the Contribution of Secondary Tillers to Total DON Concentration.*

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

Studies in the past have reported that late infection of wheat and barley results in low disease development but high DON concentration. Formation of higher number of tillers is desirable as it has positive impact on final grain yield. Lateral tillers of wheat and barley, however, have delayed physiological development, which might correlate with the late infection findings. Studies addressing the contribution of secondary tillers in final DON concentration are limited. This project aims to improve our understanding of the relationship between FHB symptoms and DON concentration by examining the contribution of main stem and secondary tillers as it relates to the final DON concentration.

An understanding of the contribution of secondary tillers in final DON levels in Fusarium-infected wheat and barley heads can be used in disease management, as farmers can use cultivar selection based on tiller numbers depending upon the contribution they provide to DON levels. Adjustments in planting density may also help to manipulate tillering in wheat and barley as required. Further, knowledge obtained from the study might be useful to breeders so that they can consider tillering characteristics in FHB resistant cultivar breeding.

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: Field experiment was conducted to evaluate contribution of main spike vs secondary tillers. Our result suggests that FHB severity tends to be higher in primary spikes than tiller in wheat when infection occurs under environment conditions conducive for infection. Similarly, primary spikes have larger contribution towards total DON levels at harvest than tillers.

Impact: The study has increased our knowledge on FHB dynamics especially in terms of contributions of spikes type. The result has been shared with other colleague working in FHB disease and in the process of publication. Breeders can utilize the information that development of cultivars with higher tillers is advisable to get low level of DON in the final harvest grain. Further, based on the result obtained from the study, growers can opt to less denser planting density to get higher numbers of tillers and consequently low DON levels in the final harvest.

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.

1. Bondalapati, K. D., Stein, J. M., Neate, S. M., Halley, S. H., Osborne, L. E., and Hollingsworth, C. R. 2012. Development of weather-based predictive models for Fusarium head blight and deoxynivalenol accumulation for spring malting barley. *Plant Dis.* 96:673-680.
2. Gautam, P., K. D. Bondalapati and J. M. Stein. 2011. Barley Scab: Forecasting to management. In: Canty, S.M., A. Clark, A. Anderson-Scully, D. Ellis, and D.A. Van Sanford (Eds.), *Proceedings of the National Fusarium Head Blight Forum*; 2008 Dec 2-4; Indianapolis, IN. Lexington, KY. University of Kentucky pp:136
3. Gautam, P., S. Halley and J. Stein. 2012. Deoxynivalenol concentration in primary spikes and tillers of barley and wheat. In: *Proceedings of APS Meeting, August 4-8, Providence, RI.*
4. Gautam, P., S. Halley and J. Stein. 2012. Contribution of primary spikes vs tillers to total deoxynivalenol in harvested grain of wheat and barley. *American Journal of Agricultural and Biological Sciences* (in press).
5. Gautam, P. 2011. Contribution of secondary tillers to total deoxynivalenol concentration in harvest grain. In: Canty, S.M., A. Clark, A. Anderson-Scully, D. Ellis, and D.A. Van Sanford (Eds.), *Proceedings of the National Fusarium Head Blight Forum*; 2008 Dec 2-4; Indianapolis, IN. Lexington, KY. University of Kentucky pp:137