USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY09 Final Performance Report
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Cover Page

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Fiscal Year:	2009
USDA-ARS Agreement ID:	59-0206-9-060
USDA-ARS Agreement Title:	Development and Validation of FHB and DON Predictive Models for Barley.
FY09- USDA-ARS Award Amount:	$ 36,295

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
BAR-CP	Development and Validation of FHB and DON Prediction Models for Barley.	$ 36,295
	Total Award Amount	**$ 36,295**

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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 Winter Wheat Region
SWW – Southern Sinter Wheat Region

Project 1: *Development and Validation of FHB and DON Prediction Models for Barley.*

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 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) develop and validate models for FHB and DON accumulation in barley. Objective 1 was conducted in collaboration with researchers at North Dakota State University and the University of Minnesota. Plots were planted at ~12 locations throughout the region 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, approximately 100 variables, both simple and complex, were generated using environmental parameters that are known to impact the biology of this pathosystem (temperature, relative humidity, etc). Correlation analysis and univariate logistic regressions were then conducted on the combined 2005-8 data sets to determine which, if any, of these factors were potentially predictive of field disease or DON content in the grain. Two models were developed from the best variables. These were evaluated using data from the 2009-growing season.

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:

Four significant accomplishments occurred during the period in question. First, we confirmed our previous observation that there is a strong correlation between disease incidence and economically significant DON accumulation in malting barley. This helps justify the use of an infection model in this pathosystem. Second, we adapted to the FHB pathosystem a mathematical function (2-dimensional Weibull) that predicts disease severity based on the interaction between temperature and wetness duration under controlled conditions. This function was included in our further modeling efforts and could also be used in a mechanistic modeling approach. Third, we continued to evaluate individual variables and models for their ability to predict DON accumulation in barley. Of particular note is that

we developed a weighted humidity duration variable that allowed for the use of the aforementioned FHB infection model in the prediction of DON accumulation in barley under field conditions. This modified function had a prediction accuracy of 86% in our testing dataset and was 80% accurate using 2009 weather data. It should be noted that the environmental conditions in 2009 were very different from the previous four seasons in that it was unusually cool and wet. This new model was evaluated using 10-year climatic data and found to not have any of the artificial limitations that our previous linear, logistic functions had. This means that it should continue to accurately predict DON accumulation in seasons with atypical weather scenarios. Finally, this model was deployed on experimental FHB/DON prediction web sites based at Pennsylvania State University and North Dakota State University. It is being evaluated and optimized using the 2010 field season and will be fully deployed for the 2011 growing season.

Impact:

To date, this effort has had limited impact on barley growers in the region. Full deployment will occur in the spring of 2011 and the availability of this model should help consultants and producers make informed management decisions about FHB and DON in barley.

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.

Posters Abstracts:

Bondalapati, K.D., **J.M. Stein,** L.E. Osborne, S.M. Neate and C.R. Hollingsworth. 2009. Progress on Modeling Deoxynivalenol in Barley. Poster: Proceedings of the 2009 National Fusarium Head Blight Forum, Orlando, FL. Canty, S., Clark, A., Mundell, J., Walton, E., Ellis, D., and Van Sanford, D. (Eds.), University of Kentucky, Erlanger, KY. pp. 26-29.

Bondalapati, K.D., **J.M. Stein,** K.M. Baker, and D.G. Chen. 2009. Using Forecasted Weather Data and Neural Networks for DON Prediction in Barley. Poster: Proceedings of the 2009 National Fusarium Head Blight Forum, Orlando, FL. Canty, S., Clark, A., Mundell, J., Walton, E., Ellis, D., and Van Sanford, D. (Eds.), University of Kentucky, Erlanger, KY. pp. 30-32.

Presentations:

Stein, J. 2010. Searching for DON: Fusarium, Barley, and Weather. Departmental seminar given to the Geographic Department at Western Michigan University.

Stein, J. 2010. Searching for DON: Fusarium, Barley, and Weather. Departmental seminar given to the Plant Pathology Department at Michigan State University.