USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY13 Final Performance Report
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Cover Page

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Fiscal Year:	FY13
USDA-ARS Agreement ID:	59-0206-2-087
USDA-ARS Agreement Title:	Prediction Models and Improved Pre-Harvest Estimates of Deoxynivalenol.
FY13 USDA-ARS Award Amount:	$ 43,966

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
MGMT	Continued Deployment of Prediction Models for Fusarium Head Blight.	$ 10,991
MGMT	Development of Prediction Models for Fusarium Head Blight.	$ 32,975
	FY13 Total ARS Award Amount	**$ 43,966**

Erick D. DeWolf

7/4/14

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: *Continued Deployment of Prediction Models 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?**

   The outbreaks of Fusarium head blight are influenced significantly by local weather conditions. Many wheat and barley growers need to evaluate the potential risk of FHB on their farm every year and determine if fungicides are needed to suppress disease. Underestimating the disease risk exposes the farmers to the potential loss of yield caused by uncontrolled FHB. In contrast, overestimating the disease often results in unnecessary fungicide applications, which increase production costs and have potentially harmful effects on the environment. The goal of this project is to deploy prediction models of FHB that help growers determine if fungicides are needed to manage FHB in their area.

2. **List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

   Accomplishment:
   Successful deployment of Fusarium head blight prediction models for 30 states with a history of problems with FHB. This system brings the scientific community together to provide research-based disease management recommendations to thousands of farmers and other stakeholders.

   Improved user interface for testing new prediction models developed by the model development team. This new interface should speed up the deployment of new models.

   Impact:
   A multi-state effort to predict epidemics of Fusarium head blight (FHB) continued during the 2009-2013-growing seasons. This prediction effort includes web-based tools, which display daily estimates of disease risk for 30 states. Commentary developed by a disease specialist in each state is displayed along with the risk maps. Commentary is also distributed via an FHB Alert System that sends email and text messages to mobile devices. The prediction tools received over 20,883 visits (122,000 hits) during the 2013-growing season in the U.S. (April – August). Nearly all of the wheat disease specialists in the 30 states covered by the disease prediction system contributed commentary to the disease prediction effort. A total of 126 commentaries were submitted in 2013. The FHB Alert System sent commentary just under 1,000 subscribers in 2013. Users of the FHB prediction models and the FHB Alert System were surveyed annually in 2009-2012. The survey results included input from 1,828 respondents and indicated that 64% of these users were either farmers or farm advisors. More than 70% of the users applied the information directly on their farm, or used it to make recommendations about disease management to others. In 2009-2012, 95% of the users considered the information to be of high or moderate value for their farm operations and businesses. A subset of questions targeting the influence of the information suggests that more than 90% of the users experienced moderate or great improvement in their awareness

of the disease risk in their area. The results also showed that the information influenced disease management decisions directly for 35% of the respondents, and motivated another 28% to seek advice from others. The 2012 survey asked growers to estimate the monetary value of the information provided to their farm or business. This survey indicates that the average monetary value of the information provided by the prediction system was $17,000 per user. Combining this figure with use statistics suggests that annual impact of the FHB prediction model exceeds $170 million.

Project 2: *Development of Prediction Models 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?**

Fusarium head blight (FHB) is currently managed with a combination of genetic resistance and timely use of fungicides when weather conditions favor the disease development. Evaluating the need for fungicides at a given location is difficult, and avoiding unnecessary applications helps farmers maintain their profitability. We are developing prediction models that help farmers determine if fungicide applications are needed given local weather conditions or if these additional input costs could be saved.

2. **List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

Accomplishment:

This project has completed development of logistic regression models that assess the risk of FHB epidemics. After several rounds of extensive model evaluations, 15 candidate models were identified, of which 4 are currently being tested for potential deployment. These models combine weather-based predictors with other risk factors such as variety genetic resistance, grain market class and presence of crop residues likely to support large populations of *Fusarium*. The results indicate that while these new models perform better than currently deployed models given the expanded data set, the overall accuracy of these models is similar to the benchmarks (70-80% accuracy) set in previous iterations of model development. Having established the baseline for the logistic modeling approaches, we are now evaluating whether the Boosted Regression Tree (BRT) and other more sophisticated approaches can further improve model accuracy. Preliminary BRT models are approximately 31% more accurate than the logistic regression models.

Data set was updated to include recent results from integrated management CP. Weather data set has been expanded to include the new observation (year and location). The expanded weather data set also include an extended time series for each observation. Previously the time series considered 14 days pre and post anthesis. The updated data set now includes 60 days prior to anthesis.

Impact:

The prediction models developed as part of this project contribute to the FHB forecasting effort in 30 states. Four new models are being tested prior to public deployment with a specialized user interface designed for this purpose. These models are more accurate than the currently deployed models based on data available during development and should improve the accuracy of information available to farmers and other stakeholders of the USWBSI.

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 FY13 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Publications:

Shah, D. A., Molinero, J. E., Paul, P.A., Willyerd, K. T., Madden, L. V., and De Wolf, E. D. 2013. Predicting Fusarium head blight epidemics with weather-driven pre- and post-anthesis logistic regression model. Phytopathology 103:906-919.

Presentations:

De Wolf, E., Paul, P. Crawford, S., Hane, D., Canty, S., Van Sanford, D., Knight, P., and Miller, D. 2013. Impact of prediction tools for Fusarium Head Blight in the US, 2009-2013. In: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), Proceedings of the 2013 National Fusarium Head Blight Forum (pp. 106). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.