USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY08 Final Performance Report (approx. May 08 – April 09)
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Cover Page

PI:	Erick DeWolf
Institution:	Kansas State University
Address:	Department of Plant Pathology 4607 Throckmorton PSC Manhattan, KS 66506
E-mail:	dewolf1@ksu.edu
Phone:	785-532-3968
Fax:	785-532-5692
Fiscal Year:	2008
USDA-ARS Agreement ID:	59-0790-7-072
USDA-ARS Agreement Title:	Prediction Models and Improved Pre-Harvest Estimates of Deoxynivalenol.
FY08 USDA-ARS Award Amount:	$ 31,009

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
MGMT	Enhanced Deployment of Prediction Models for Fusarium Head Blight.	$9,889
MGMT	Incorporating Infection Cycle Components into FHB and DON Prediction Models.	$ 21,120
	Total Award Amount	**$ 31,009**

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
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: *Enhanced 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?**
   Fusarium head blight is best managed through the combination of the best available disease resistance; however, when weather conditions are extremely favorable for disease development, fungicides may also be needed to further reduce the risk of yield losses and DON contamination. The decision to apply this fungicide can not be made based on scouting, but rather depends entirely on awareness of weather patterns that will likely favor the development of FHB. The project supports the deployment of disease prediction models that help small grain producers evaluate the risk of severe disease epidemics and the need for fungicide applications.

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: Disease prediction models were deployed in 24 states during the 2007 growing season. The disease prediction models are part of a web-based interface (www.wheatscab.psu.edu) that provides daily estimates of disease risk in areas where FHB has historically caused problems in grain production and processing. The disease prediction system continues to play a role in the integrated management of FHB by helping grain producers evaluate the need for timely application of fungicide or biological control product. The deployment effort is a multidisciplinary effort that capitalizes on the major research initiatives in the atmospheric and earth sciences, and uses them to help the needs of the small grain producers in the U.S.

   Impact:
   Use of the prediction models continues to increase. The disease prediction models received 7,047 visits between April and August of 2007. This level of web activity represents an increase of 1,073 and 2,347 more visits than were received during this same time period in 2006 and 2005, respectively.

Project 2: *Incorporating Infection Cycle Components into FHB and DON Prediction Models.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**
   The prediction models used to estimate the risk of disease epidemics do not adequately describe the variation in the mycotoxin levels observed by small grain producers. This project supports the effort to develop the next generation of prediction models for both disease and also incorporates models specifically designed to predict the mycotoxin DON.

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:
   STELLA, an object-oriented programming language, was utilized to develop mechanistic FHB and DON prediction models based on the results of past studies on FHB and pathogen biology. One of several candidate models was specifically developed to estimate the DON content of harvested grain based on weather variables. Critical components of the FHB disease cycle, such as perithecia development and infection events, were expressed within the model as weather-driven differential equations. The candidate model predicts whether DON level in the harvested grain will be above 2 ppm based on summaries of temperature and RH prior to and during anthesis and early grain fill. This model can adequately classify cases with >2 ppm DON with 68% accuracy (sensitivity), and cases with < 2 ppm DON with 82% accuracy (specificity). The overall accuracy for this model is 75% using 110 cases used to develop and test the model. The relationship of DON with weather patterns was also evaluated with logistic regression analysis. This analysis produced several candidate models with accuracy ranging between 75 and 83%.

   Impact:
   The models produced in this project are in a format that can be readily deployed via the existing infrastructure used to deploy the current disease prediction models. These candidate models will be tested during the 2009 growing season. If these tests are successful, the most promising model will be released for public deployment as early as 2010.

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. Paul, P.A., Lipps, P.E., De Wolf, E.D., Shaner, G., Buechley, G., Adhikari, T., Ali, S., Stein, J., Osborne, L. and Madden, L.V. 2007. A distributed lag analysis of the relationship between Gibberella zeae inoculum density on wheat spikes and weather variables. Phytopathology 97:1608-1624.

2. De Wolf. E.D. and Isard, S.A. 2007. Disease cycle approach to plant disease prediction. Annual Review of Phytopathology 45:9.1-9.18.

3. De Wolf, E. 2008. Disease prediction models: a disease cycle approach. Oklahoma State University, Plant Pathology Department Seminar. April 23, 2008. Stillwater, OK.

4. De Wolf, E. Nita, M., Paul, P., Madden, L., Stein, J. Ali, S. and Wegulo, S. 2008. Advances in the epidemiology of Fusarium head blight and applications. In: Canty, S., Walton, A. Clark, D., Ellis, J., Mundell, J. and Van Sanford, D. (Eds.), Proceedings of the 2008 National Fusarium Head Bight Forum; 2008 Dec 2-4; Indianapolis, IN. Lexington, KY: University of Kentucky. Pp 18.

5. Nita, M., De Wolf, E., Madden, L., Paul, P., Shaner, G., Adhikari, T, Ali, S., Stein, J., Osborne, L. and Wegulo, S. 2008. Use of mechanistic simulation models to predict disease intensity of Fusarium head blight and deoxynivalenol concentration. Phytopathology 98:S113.

6. Nita, M., De Wolf, E.and Isard, S. 2008. Decline in viability of *Gibberella zeae* ascospores after exposure to solar radiation. Phytopathology 98:S113.

7. Willyerd, K., Archibald, D., Brooczky, K., De Wolf, E. and Kuldau, K. 2008. Detection of trichothecene mycotoxins and ergosterol within wheat florets using gas chromatography with electron capture detection. Phytopathology 98:S172.

8. Bockus, B., Davis, M., De Wolf, E. and Wegulo, S. 2008. Host resistance correlated with amount of DON reduction achieved with fungicides. In: Canty, S., Walton, A. Clark, D., Ellis, J., Mundell, J. and Van Sanford, D. (Eds.), Proceedings of the 2008 National Fusarium Head Bight Forum; 2008 Dec 2-4; Indianapolis, IN. Lexington, KY: University of Kentucky. Pp 9.

9. Nita, M., De Wolf, E., Paul, P., Madden, L., Stein, J., Ali, S. and Wegulo, S. 2008. Prediction models for deoxynivalenol accumulation risk using empirical and mechanistic modeling approaches. In: Canty, S., Walton, A. Clark, D., Ellis, J., Mundell, J. and Van

Sanford, D. (Eds.), Proceedings of the 2008 National Fusarium Head Bight Forum; 2008 Dec 2-4; Indianapolis, IN. Lexington, KY: University of Kentucky. Pp 49.

10. Willyerd, K., Archibald, D., Boroczky, K., De Wolf, E., Kuldau, G. 2008. Effects of temperature on deoxynivalenol translocation and F. graminearum infection of wheat heads. In: Canty, S., Walton, A. Clark, D., Ellis, J., Mundell, J. and Van Sanford, D. (Eds.), Proceedings of the 2008 National Fusarium Head Bight Forum; 2008 Dec 2-4; Indianapolis, IN. Lexington, KY: University of Kentucky. Pp 72.

If your FY08 USDA-ARS Grant contained a VDHR-related project, include below a list all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance. If this is not applicable (i.e. no VDHR-related project) to your FY08 grant, please insert 'Not Applicable' below.

Not applicable