USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY06 Final Performance Report (approx. May 06 – April 07)
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Cover Page

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Fiscal Year:	2006
USDA-ARS Agreement ID:	59-0790-4-112
USDA-ARS Agreement Title:	Splash Dispersal, Inoculum Level and Fungicide Effects on Fusarium Head Blight.
FY06 ARS Award Amount:	$ 37,770

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Award Amount
EEDF	Effects of Fungicide, Resistance, and Residue on FHB, and Splash Dispersal of Gibberella zeae.	$ 37,770
	Total Award Amount	**$ 37,770**

Principal Investigator Date

* CBCC – Chemical, Biological & Cultural Control
EEDF – Etiology, Epidemiology & Disease Forecasting
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GET – Genetic Engineering & Transformation
HGR – Host Genetics Resources
HGG – Host Genetics & Genomics
PGG – Pathogen Genetics & Genomics
VDUN – Variety Development & Uniform Nurseries

(Form – FPR06)

Project 1: *Effects of Fungicide, Resistance, and Residue on FHB, and Splash Dispersal of Gibberella zeae.*

1. What major problem or issue is being resolved and how are you resolving it?

Fusarium head blight (FHB) continues to cause yield and quality losses in every sector of the wheat and barley industries throughout the world. Years of research suggests that an integrated management approach would be the most effective and economically sound way to reduce losses due to this disease. Several environmental, cultural and crop-related factors influence the development and spread of FHB and the accumulation of deoxynivalenol (DON) in wheat grain. An understanding of how these factors interact to affect FHB and DON is critical for the development of effective integrated management strategies. During the 2005-2006 growing season, the first of two field experiments was conducted to evaluate the integrated effects of cultivar maturity and resistance, fungicide application, and residue management on FHB and DON. Plots were established (in a split-split plot treatment design) to obtain two levels of surface residue (0 and 80% corn stubble), three cultivars varying in maturity (flowering date) and resistance to FHB, and two fungicide treatments (with and without tebuconazole [Folicur 3.6F] application at Feekes growth stage 10.5.1). The incidence and severity ("index") of FHB was assessed within each plot at early dough (Feekes GS 11.2) and a sample of harvested grain was tested for DON.

The second experiment was conducted to evaluate the importance of a local (within-field) source of inoculum for FHB development. Maize kernels infested with *G. zeae* were placed on the soil surface at the corner of each of four wheat plots planted with a susceptible cultivar. Disease intensity was assessed and samples of wheat spikes and rain splash (at 30 and 100 cm above the soil surface) were collected at regular distances in two directions from the source of inoculum. Rain splash and wheat spikes were assayed for spores of *G. zeae* to determine whether inoculum density within the wheat canopy varied with distance from the local source.

2. List the most important accomplishment and its impact (how is it being used?). Complete all three sections (repeat sections for each major accomplishment):

<u>Accomplishment:</u> In Wooster, Ohio, the 2006 wheat crop flowered between May 27 and 30. During the week before flowering, average daily temperature ranged from 8.49 to 18.26^{o}C (mean, 12.36^{o}C), there were on average 7 hours per day with canopy RH > 90%, and it rained on four of the seven days. Despite the frequent rainfall, however, due to the cool temperatures and relatively low RH, FHB intensity was moderate to low, with mean FHB incidence (INC), index (IND), and grain DON content ranged from 0 to 26%, 0 to 8.3%, and 0.5 to 14.50 ppm, respectively. For INC and IND, only the main effect of cultivar was statistically significant (based on *F* statistics form linear mixed models analyses of arcsine-transformed data). Mean IND was highest in non-treated plots of both Hopewell and Patterson (the susceptible cultivars) planted into corn residue. For DON, all main effects and all interactions involving cultivar were statistically significant. Grain harvested from non-treated plots of Hopewell planted into corn residue had the highest mean levels of DON (between 11.5 and 13.5 ppm). These results suggest that even under relatively cool, dry conditions when disease intensity is low, DON may still accumulate to unacceptable levels in grain, if susceptible cultivars are planted in fields with high levels of crop residue (inoculum).

In 2006, propagules of *G. zeae* were recovered from wheat spikes at each distance and direction from the local source of inoculum. Both inoculum density and disease intensity on wheat spikes decreased with increasing distance from the source of inoculum. Similar to what was observed in 2005, when background levels of inoculum were also low and conditions were unfavorable for disease development, the decrease in disease intensity with increasing distance from the source of inoculum was greater than in 2004, when more favorable conditions and 7x higher density of airborne spores of *G. zeae* occurred. This suggests that while a within-field source of inoculum may be important under conditions with both low and high background inoculum levels, the relative importance of the local source is influenced by the level of background inoculum and weather conditions.

Impact: Data collected from these experiments are being used to validate and refine existing risk assessment models for FHB and to initiate the development of DON risk assessment models. The web-based FHB models are currently being used in 23 states as an early warning system to prepare growers, grain buyers, and the milling industry for possible epidemics of FHB and to help growers make fungicide application decisions. Based on the results from these experiments, the models will be modified to improve prediction accuracy and to account for others factors likely to influence disease development. Current modeling efforts focus on the use of cultivar resistance and surface residue (along with weather variables) as risk factors for FHB development. Data from these studies also contributed to the establishment of the ongoing uniform integrated management program for FHB and DON. Through this program, experiments have been designed to evaluate the integrated effects of cultivar resistance and fungicide treatments on FHB and DON under a range of cropping systems and environmental conditions. The goal of this program is to develop and provide growers with a series of ***best management*** strategies for FHB and DON. Coupled with the risk assessment models, these strategies will be used to help minimize yield and quality losses due to FHB.

As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?

The risk assessment models are now an important part of integrated management programs for FHB and DON and as effective fungicides become available and registered, more growers and crop consultants will routinely refer to these models to make management and marketing decisions. No single disease management approach (or set of approaches) has been fully effective at reducing yield and quality losses due to FHB and DON in every cropping system and under every environmental condition. With the risk assessment tool and an improved understanding of how FHB development and DON accumulation are influenced by weather, cultivar maturity and resistance, and cropping practices, growers can make more informed decisions that may lead to more effective and economically sound management of FHB.

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., Hershman, D. E., McMullen, M. P., Draper, M. A., and Madden, L. V. 2007. A quantitative review of tebuconazole effect on Fusarium head blight and deoxynivalenol content in wheat. *Phytopathology* 97: 211-220.
2. Paul, P. A., Lipps, P. E., and Madden, L. V. 2006. Meta-analysis of regression coefficients for the relationship between Fusarium head blight and deoxynivalenol content of wheat. Phytopathology 96:951-961.

1. Paul, P. A., Madden, L. V., Lipps, P. E., De Wolf, E., Shaner, G., Buechley, G., Adhikari, T., Ali, S., Stein, J., and Osborne, L. 2006. Influence of Weather on the Abundance of *Gibberella zeae* Propagules within Wheat Canopies: A lag Regression Analysis. Page 50 in: Proc. 2006 Natl. Fusarium Head Blight Forum, Research Triangle Park, NC.

2. Paul, P. A., Hershman, D., Draper, M., and Madden, L. V. 2006. Effect of Fungicides on FHB and DON in Wheat - 2006 Uniform Fungicide Trials. Pages 15-18 in: Proc. 2006 Natl. Fusarium Head Blight Forum, Research Triangle Park, NC.

3. Nita, M., DeWolf, E., Madden, L., Paul, P., Shaner, G., Adhikari, T., Ali, S., Stein, J. and Osborne, L. Effect of corn residue level, fungicide application, and cultivar resistance level on disease incidence and severity of Fusarium head blight and DON concentration. Page 49 in: Proc. 2006 Natl. Fusarium Head Blight Forum, Research Triangle Park, NC.

4. Schisler, D.A., Boehm, M.J., Dunlap, C., Paul, P. and Palmquist, D.E. 2006. USDA-ARS and The Ohio State University Cooperative Research: Use of Fractional Factorial Field Designs to Assess the Integration of Diverse Treatments against FHB. Pages 21-26 in: Proc. 2006 Natl. Fusarium Head Blight Forum, Research Triangle Park, NC.

5. Nita, M., DeWolf, E., Madden, L., Paul, P., Shaner, G., Adhikari, T., Ali, S., Stein, J. and Osborne, L. Efect of corn residue level on disease intensity of Fusarium head blight (FHB) and on deoxyvalenol (DON) concentration: A multi-state field study. Phytopathology 96:S85.

6. Paul, P. A., Madden, L. V. and Lipps, P. E. 2006. Seasonal variation in the association between within-field inoculum and Fusarium head blight development in winter wheat. Phytopathology 96:S91.

7. Paul, P. A., Madden, L. V., Lipps, P. E., De Wolf, E., Shaner, G., Buechley, G., Adhikari, T., Ali, S., Stein, J., and Osborne, L. 2006 Modeling the abundance of propagules of *Gibberella zeae* within wheat canopies. Phytopathology 96:S91.