USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY05 Final Performance Report (approx. May 05 – April 06)
July 14, 2006

Cover Page

PI:	**Laurence Madden**
Institution:	**Ohio State University**
Address:	**Department of Plant Pathology** **1680 Madison Ave.** **Wooster, OH 44691**
E-mail:	**madden.1@osu.edu**
Phone:	**330-263-3843**
Fax:	**330-263-3841**
Fiscal Year:	**2005**
FY05 ARS Agreement ID:	**59-0790-4-112**
Agreement Title:	**Splash Dispersal, Inoculum Level and Fungicide Effects on Fusarium Head Blight.**
FY05 ARS Award Amount:	**$ 51,717**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
EDM	Weather, Fungicide, and Resistance Effects on FHB and Splash Dispersal of G. zeae.	$ 51,717
	Total Award Amount	**$ 51,717**

_____

Principal Investigator Date

* BIO – Biotechnology
CBC – Chemical & Biological Control
EDM – Epidemiology & Disease Management
FSTU – Food Safety, Toxicology, & Utilization
GIE – Germplasm Introduction & Enhancement
VDUN – Variety Development & Uniform Nurseries

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

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

Fusarium head blight (FHB) continues to have devastating effects on every sector of the wheat and barley production systems throughout the world, causing substantial yield and quality losses. While it is clear that several environmental, cultural and crop-related factors influence the development of this disease, the way these factors interact to affect disease intensity, deoxynivalenol accumulation, and the efficacy of integrated (chemical, cultural, and resistance) management strategies is still not fully understood. In an effort to provide some answers to these questions, two experiments were conducted during the 2004-2005 growing season. In the first, the integrated effects of cultivar maturity and resistance, fungicide application, and residue management on FHB development were investigated. 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). In one plot of each residue level, Burkard cyclone spore samplers were used to monitor daily numbers of airborne spores from Feekes growth stage 10 through 11.2. During the same period, wheat spikes were collected and assayed directly for spores using head washing. The incidence and severity of FHB was assessed within each plot at early dough (Feekes GS 11.2).

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):

Accomplishment: The 2005 wheat growing season was cool and dry, resulting in low inoculum and disease levels. During flowering (May 29 - June 4), average daily temperatures were between 13 and 19^{o}C, and a total of 4 mm of rain occurred. The mean number of spores per spike was slightly higher in plots with 80% residue than in plots with 0% residue. The greatest spore density occurred 2 days after the highest rain event, and coincided closely with the flowering date of the earliest-maturing cultivar. Average FHB severity ranged from 0 to 2.5%. Fungicide and all associated interactions with fungicide did not have a significant effect on disease severity. The interaction between residue and cultivar was significant, suggesting that, under the conditions of this study, the effect of residue on FHB development was dependent on cultivar resistance and flowering date. The highest mean level of disease occurred in plots with 80% residue, planted with the most susceptible, early-flowering cultivar.

Propagules of *G. zeae* were recovered from rain splash and wheat spikes at each distance and direction from the local source of inoculum. Both inoculum density and disease intensity on wheat spikes decreased by approximately 90% with increasing distance from the source of

inoculum. Relative to 2004, when more favorable conditions for FHB development occurred (warmer and wetter weather, and 7x higher density of airborne spores of *G. zeae*), the decrease in disease intensity with increasing distance from the source of inoculum was greater in 2005. 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 is being used to validate and refine an existing risk assessment models for FHB. These web-based models are currently being used in 23 states as an early warning system to prepare growers, grain buyers, and the milling industry for a possible epidemic of FHB and to help growers make fungicide application decisions. Based on the results from these experiments, the models are modified to improve prediction accuracy and to account for others factors that are likely to influence disease development. Current modeling efforts are focusing on the use of cultivar resistance and surface residue (along with weather variables) as risk factors for FHB development. Coupled with the risk assessment models, results from these studies will also be used to develop region- and cultivar-specific integrated management programs for FHB based on cultivar resistance, residue management, and fungicide application.

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?:

No single disease management approach has been highly effective at preventing yield and quality losses due to Fusarium head blight. In addition, no single management approach (or set of approaches) has been equally effective and economical in every region and every year. With the risk assessment tool and an improved understanding of how FHB development is 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. P. A. Paul, P. E. Lipps, and L. V. Madden. 2005. Relationship between visual estimates of Fusarium head blight intensity and deoxynivalenol accumulation in harvested wheat grain: A Meta-Analysis. Phytopathology 95:1225-1236.

2. Paul, P. A., El-Allaf, S. M., Lipps, P. E., and Madden, L. V. 2005. Relationship between incidence and severity of Fusarium head blight on winter wheat in Ohio. Phytopathology 95:1049-1060.

3. Paul, P. A., Madden, L. V., and Lipps, P. E. 2005. Relationship between FHB Index and DON: A Quantitative Synthesis of Eight Years of Research. Pages 138-139 in: Proc. 2005 Natl. Fusarium Head Blight Forum, Milwaukee, WI.

4. Paul, P. A., Hershman, D., Draper, M., and Madden, L. V. 2005. Effect of Fungicides on FHB and DON in Wheat - 2005 Uniform Fungicide Trials. Pages 225-229 in: Proc. 2005 Natl. Fusarium Head Blight Forum, Milwaukee, WI.

5. Nita, M., DeWolf, E., Madden, L., Paul, P., Shaner, G., Adhikari, T., Ali, S., Stein, J. and Osborne, L. 2005 Effect of Corn Residue Level on the Incidence of Fusarium Head Blight. Page 124 in: Proc. 2005 Natl. Fusarium Head Blight Forum, Milwaukee, WI.

6. Molineros, J., DeWolf, E., Madden, L., Paul, P., and Lipps, P. 2005. Incorporation of Host Reaction and Crop Residue Level into Prediction Models for Fusarium Head Blight. Pages 119-122 in: Proc. 2005 Natl. Fusarium Head Blight Forum, Milwaukee, WI.

7. Paul, P. A., Lipps, P. E., and Madden, L. V. 2005. Inoculum and Fusarium head blight gradient generated by wind and rain splash from a small area-source within wheat canopies. Phytopathology 95:S81.

8. Paul, P. A., Lipps, P. E., and Madden, L. V. 2005. Relationship between Fusarium head blight intensity and deoxynivalenol toxin content in harvested wheat grain. Phytopathology 95:S81.

9. Molineros, J., De Wolf, E. Francl, L., and Madden, L. 2005. Modeling epidemics of Fusarium head blight: Trials and tribulations. Phytopathology 95:S71.

10. De Wolf, E., Molineros, J., Madden, L., Lipps, P., Knight, P., and Miller, D. Future directions in the development and application of risk assessment models for Fusarium head blight. Page 117 in: Proc. 2005 Natl. Fusarium Head Blight Forum, Milwaukee, WI.

11. Sneller, C. H., Lipps, P., Paul, P., Herald, L., Sugerman, B., and Johnston, A. Report on the 2004-05 Preliminary (PNUWWSN) and Advanced (NUWWSN) Northern Uniform Winter Wheat Scab Nursery. Pages 86-90 in: Proc. 2005 Natl. Fusarium Head Blight Forum, Milwaukee, WI.

12. Schisler, D. A., Boehm, M. J., Lipps. P. E., Slininger, P. J. 2005. USDA-ARS and The Ohio State University Cooperative Research: Greenhouse and Field Tests of Combinations of Choline Metabolizing Strains and Antagonist *Cryptococcus nodaensis* OH 182.9 for Reducing FHB of Wheat. Pages 232-235 in: Proc. 2005 Natl. Fusarium Head Blight Forum, Milwaukee, WI.

13. Pierce Paul and Dennis Mill – As Predicted, Moderate to Low Levels of Wheat Head Scab in Ohio. Crop Observation and Recommendation Network Newsletter 2006-18. http://corn.osu.edu/

14. Pierce Paul and Dennis Mill - The Risk of Wheat Scab Remains Low in Ohio. Crop Observation and Recommendation Network Newsletter 2006-14. http://corn.osu.edu/

15. Pierce Paul and Dennis Mill – Wheat scab update - Crop Observation and Recommendation Network Newsletter 2006-13. http://corn.osu.edu/

16. Pierce Paul and Dennis Mills - Wheat scab risk prediction tool and wheat update. Crop Observation and Recommendation Network Newsletter 2006-10. http://corn.osu.edu/