USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY10 Final Performance Report
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Cover Page

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Fiscal Year:	FY10
USDA-ARS Agreement ID:	59-0206-9-071
USDA-ARS Agreement Title:	A First-Generation Model for DON Prediction and Integrated Management of FHB and DON.
FY10 USDA-ARS Award Amount:	NCE*

USWBSI Individual Project(s)

USWBSI Research Category**	Project Title	ARS Award Amount
MGMT	A First-Generation Model for DON Prediction in Multiple Wheat Classes in the US.	NCE
MGMT	Integrated Control and Harvesting Tactics to Minimize FHB/DON Losses in SRWW.	NCE
	Total ARS Award Amount	**NCE**

Principal Investigator Date

* NCE – Carry-over from FY08 expired agreement was used to fund this grant and projects.
** 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: *A First-Generation Model for DON Prediction in Multiple Wheat Classes in the US.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

   In 2010, Ohio suffered its worst scab epidemics in 15 years, with incidence as high as 60% and vomitoxin levels as high as 18 ppm in some fields. With new and fairly effective fungicides now available for use against scab, the web-based FHB risk assessment tool continues to be important to help guide fungicide application decisions. However, there is room for improvements to the current FHB risk models and the need for models to directly predict DON. Both the refinement of existing FHB models and development of DON model require additional disease, DON and weather data.

   As part of the FHB Integrated Management CP (MGMT IM CP), field trials were conducted in 18 locations across 11 states, representing different environments and grain classes. Data were collected from these trials for use in the FHB/DON modeling effort. The 2010 data, along with those collected in previous years, is currently undergoing quality control to identify and correct questionable disease and weather data, incorporate information pertaining to FHB resistance of winter wheat, and imputation of missing observations.

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:

   More than 1830 unique FHB observations were collected from the MGMT IM CP during the 2009/10 season. Out of these, 795 cases were considered suitable for use in modeling (i.e. the uninoculated, untreated observations). Mean FHB index and DON values, averaged across location, grain class and cultivar, were 6.4% and 1.8 ppm, respectively.

   After quality control and editing, the 2010 data will be added to a larger data set to continue model refinement, validation, and development. The focus is now on incorporating information pertaining to surface crop residue and genetic resistance of winter wheat. In addition, other forms of representing weather variables as FHB risk factors are being explored. This has resulted in several candidate models that may provide improvement in terms of prediction accuracy over current models. These models are now being tested and evaluated internally by the FHB risk model development team (PIs of this project and a hired post-doc and research scientist).

   Impact:

   The FHB forecasting models developed and refined as part of this this project now contribute to FHB risk assessment in 30 US states. The results thus far suggest that model performance will likely improve with the incorporation of new observations and implementation of novel data mining and modeling approaches, resulting in more accurate predictions of FHB.

Project 2: *Integrated Control and Harvesting Tactics to Minimize FHB/DON Losses in SRWW.*

1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

Evaluation and validation of FHB and DON integrated management strategies, and a formal assessment of the cost and benefit on modifying combine harvester configurations to minimize grain quality loss due to FHB/DON. Inoculated field trials were conducted to determine the efficacy, based on percent control, of combining cultivar resistance and fungicide application to manage FHB and DON. Six SRWW cultivars with different levels of resistance to FHB (three moderately resistant, two moderately susceptible, and one susceptible) were planted in pairs of 20 x 5 ft. plots in each of four blocks. One plot of each pair was treated with Prosaro (6.5 fl oz, at 20 gal/acre) at anthesis and the other was left untreated. All plots were spray-inoculated with a spore suspension of *Fusarium graminearum*, approximately 24 hours after treatment application. An adjacent set of plots of each cultivar was left untreated and inoculated. Disease intensity was rated, and yield, test weight, and DON quantified and compared among treatments.

In another trial, plots were planted with a susceptible SRWW cultivar and inoculated with five different spore concentrations of *Fusarium graminearum* to generate different levels of FHB. At maturity (when moisture dropped to about 14%), plots were harvested with a research plot combine, adjusted to one of four different configurations, consisting of a combination of different fan speeds and shutter openings (C1 being the standard, set at a fan speed of 1,375 rpm and a shutter opening of 70 mm, and C2, C3, and C4 regulated to fan speeds and shutter openings of 1,475 rpm and 70 mm, 1,475 rpm and 90 mm, and 1,375 rpm and 90 mm, respectively). FDK, DON, yield, and test weight were determined and compared among disease level x combine configuration combinations. A cost-benefit assessment was then conducted based on grain quality, price discounts, and grain market prices to determine whether the gain in grain quality was sufficient to offset the reduction in harvested grain that resulted from changing the default combine setting.

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:

The overall level of FHB was low in this trial, with a mean index of 9% in the untreated, susceptible check. Cultivar, fungicide treatment, and their interaction had significant effects ($P < 0.05$) on index and FDK. However, only the main effects of cultivar and fungicide were statistically significant for yield ($P < 0.05$). In general, for each cultivar, the untreated check plots had higher levels of FHB than the fungicide treated plots. Combining moderate resistance and a fungicide provided > 90% control of index, whereas using a moderately susceptible or moderately resistant cultivar alone provided >70% of FHB control, relative to the untreated susceptible.

Plots harvested with configurations C3 and C4 consistently had significantly lower mean FDK and DON, and higher mean test weight than C1. However, C3 and C4 also resulted in significantly lower mean amounts of harvested grain than C1. C2, C3, and C4 resulted in between $10 and $40/MT lower grain price discounts than C1, with the lowest discounts for grain harvested with C3 and C4. Estimated gross cash income (GCI: mean estimated yield x grain price adjusted for discounts due to inferior quality) was generally higher for grain harvested with C2 and C4 than with C1 or C3, with C4 being the most consistent across a range of FHB index levels (5 to 35%) and grain prices ($118 to 276/MT). For all modified configurations, the greatest increases in GCI over C1 were observed at low grain prices, and the difference in GCI between modified configurations and C1 increased with increasing index up to the highest level tested (35%)

Impact:

Data from the integrated management trial were combined with data from similar trials conducted as part of the MGMT IM CP and analyzed to determine the efficacy and stability of integrating fungicide treatment and cultivar resistance to manage FHB and DON. Results from the analyses showed that the integrated approach was a more effective and stable management practice for both index and DON than either approach used alone; however, the magnitude of percent control with the integrated strategy varied among trials. Findings from the MGMT IM CP are currently being prepared for publication in a peer-reviewed journal and for preparation of extension articles and presentations. In addition, data from the MGMT IM CP continue to be used for development and refinement of FHB and DON predictions models.

Results from the harvesting strategy study will serve as the basis for formal assessment of the value of changing harvester configuration when harvesting grain from scabby wheat fields. The results suggest that when harvesting grain from FHB-affected fields, the improvement in grain quality and, consequently, reduction in price discounts with increased fan speeds and wider shutter openings could be great enough to compensate for the reduction in harvested grain that results from the adjustment. Findings from this study were recently accepted for publication in *Plant Disease* and are being used in extension presentations and newsletters.

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.

Peer-reviewed Articles:

Salgado, J. D., Wallhead, M. W., Madden, L. V., and Paul, P. A. 2011. Grain harvesting strategies to minimize grain quality losses due to Fusarium head blight in wheat. Plant Dis. Accepted 06/10/2011.

APS Abstract:

Willyerd, K. T., Bradley, C., Grybauskas, A., Hershman, D., Madden, L., McMullen, M., Osborne, L., Sweets, L., and Paul, P. 2010. Multi-state evaluation of integrated management strategies for Fusarium head blight and deoxynivalenol in small grain. Phytopathology 100:S137.

Salgado, J. D., Wallhead, M. W., Madden, L. V., and Paul, P. A. 2010. Relationship between grain yield and Fusarium Head Blight in soft red winter wheat as influenced by cultivar resistance. Phytopathology 100:S66.

Forum Proceedings:

Willyerd, K., Madden, L., McMullen, M., Wegulo, S., Bockus, W., Sweets, L., Bradley, C., Wise, K., Hershman, D., Bergstrom, G., Grybauskas, A., Osborne, L., Esker, P., and Paul, P. 2010. Inoculated field trials for evaluating FHB/DON integrated management strategies. In: S. M. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2010 Dec. 7-9; Milwaukee, WI. FL. Lexington, KY: University of Kentucky. pp. 109-110.

Salgado, J. D., Wallhead, M. W., Madden, L. V. and Paul, P. A. 2010. Grain Harvesting Strategies to Mitigate Losses due to Fusarium Head Blight: A Cost/Benefit Assessment. In: S. M. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2010 Dec. 7-9; Milwaukee, WI. FL. Lexington, KY: University of Kentucky. pp. 95-96.

De Wolf, E., Shah, D., Paul, P., Madden, L., Willyerd, K., Knight, P., and Miller, D. 2010. Advances in the development and application of prediction models for FHB and DON. In: S. M. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2010 Dec. 7-9; Milwaukee, WI. FL. Lexington, KY: University of Kentucky. pp. 79.

Extension Presentations: ***All of the listed presentations included results from the FHB risk assessment effort and the integrated management and combine configuration experiments.***

Event: Wheat Production Workshop (~ 30 participants)
Title: *"Wheat Disease Scouting Thresholds and Fungicide Controls"*
Location: Custar, OH
Date: 03/31/2011

Event: Winter Wheat Management Meeting, 2011 (~ 190 participants)
Title: "*Avoiding Yield and Quality Losses Due to Wheat Diseases*"
Location: Frankenmuth, MI
Date: 03/03/2011

Event: Northern Ohio Crops Day (~170 participants)
Title: "*Wheat, Going for the Best Yield and Quality"*
Location: Gibsonburg, OH
Date: 02/10/2011

Event: Putnam County Agronomy Night (~120 participants)
Title: *"Managing Wheat for Yield and Quality"*
Location: Kalida, OH
Date: 01/27/2011

Event: Corn/Soybean Day (~180 participants)
Title: *"Managing Wheat for Yield and Quality"*
Location: Archbold, OH
Date: 01/27/2011

Event: Paulding County Agronomy Day (~ 70 participants)
Title: "*Managing Wheat for Yield & Quality*" (60 minutes)
Location: Paulding, OH
Date: 01/26/2011

Event: Ohio Seed Improvement Association - 76th Annual Ohio Professional Seed Grower's School (~ 80 participants)
Title: *"Wheat Disease Update"*
Location: Columbus, OH
Date: 01/13/2011

Event: Agronomic Crops In-Service (~25 participants)
Title: *"Sorting out Economic Injury Thresholds and Damage threshold for Ohio's Major Diseases"*
Location: Columbus, OH
Date: 01/05/2011

Event: Ohio Foundation Seeds Annual Meeting (~ 30 participants)
Title: "*What Fungus is Among US: Wheat Diseases*"
Location: Croton, OH
Date: 09/02/2010

Event: Ruff Seed Farm Wheat Crop Meeting (~140 participants)
Title: "*Wheat Diseases, and Grain Yield and Quality*"
Location: Amanda, OH
Date: 06/15/2010