USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY09 Final Performance Report
July 15, 2010

Cover Page

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Fiscal Year:	2009
USDA-ARS Agreement ID:	59-0206-9-076
USDA-ARS Agreement Title:	Applied Managment of Fusarium Head Blight in Illinois.
FY09- USDA-ARS Award Amount:	$ 40,698

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
MGMT	Uniform Fungicide Tests for Control of Fusarium Head Blight in Illinois.	$ 15,610
MGMT	Integrated Management Strategies for Scab in Illinois.	$ 17,561
MGMT	Within-Field Inoculum from Corn Debris and the Management of FHB/DON.	$ 2,683
VDHR-NWW	Fungicide x Variety Interaction Experiment.	$ 4,844
	Total Award Amount	**$ 40,698**

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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 Winter Wheat Region
SWW – Southern Sinter Wheat Region

Project 1: *Uniform Fungicide Tests for Control of Fusarium Head Blight in Illinois.*

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

   Growers now have multiple fungicide products to choose from for management of Fusarium head blight (FHB), and information on which products are the best in reducing FHB severity and DON is needed. Fungicide application timing is considered a critical component of achieving the best efficacy; however, due to adverse weather conditions or difficulties in scheduling a custom applicator, timely application is not always possible for a grower. Information is needed on how wide the window of application is for the most efficacious fungicides. Although strobilurin fungicides are good tools for controlling foliar diseases, they have been shown to increase DON levels in grain when applied at later growth stages. Information is needed on how late in the growing season these products can be applied without increasing DON levels. Uniform fungicide trials on winter wheat were conducted at five locations in Illinois during the 2008-2009 growing season. To ensure high levels of disease pressure, four of these sites were mist-irrigated to provide conditions conducive for FHB.

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: Uniform fungicide trials were conducted at five locations in Illinois (Monmouth, Urbana, Brownstown, Carbondale, and Dixon Springs). At all of these locations except Monmouth, mist-irrigation was used to help ensure high levels of disease pressure. The average FHB index and DON in the untreated controls ranged from 6 to 46, and 3.2 ppm to 16.7 ppm, respectively.

   At all locations, Caramba (metconazole, BASF) fungicide significantly reduced FHB index and DON when applied at Feekes growth stage (FGS) 10.5.1 or 5 days after. Caramba applied at 5 days prior to FGS 10.5.1 significantly reduced FHB index at three of the locations and reduced DON at two of the locations. Prosaro (prothioconazole + tebuconazole, Bayer CropScience) fungicide significantly reduced FHB index at four locations and DON at two locations when applied at FGS 10.5.1, and significantly reduced FHB index at all locations and DON at one location when applied 5 days after. When applied 5 days prior to FGS 10.5.1, Prosaro reduced FHB index at two locations and did not reduce DON at any locations. These results indicate that the window of application for Caramba and Prosaro may be slightly wider than FGS 10.5.1, and that applications within a few days after FGS 10.5.1 may be as effective at reducing FHB index and DON.

   Headline (pyraclostrobin, BASF) fungicide applied at the boot stage significantly increased DON compared to the untreated control at one location. Headline applied at the heading stage significantly increased DON compared to the untreated control at two locations.

Impact: Results from Illinois FHB uniform fungicide trials indicate that the window of application for Caramba and Prosaro may be slightly wider than FGS 10.5.1, and that applications within a few days after FGS 10.5.1 may be as effective at reducing FHB index and DON. Although the importance of applying fungicides at FGS 10.5.1 will continue to be stressed, the results of this study will provide growers with information that applications slightly after FGS 10.5.1 may still provide similar levels of FHB and DON control.

Pyraclostrobin was shown to increase DON levels compared to an untreated control when applied as early as the boot stage. This information is alarming, and warrants further investigation. The strobilurin fungicides are excellent tools that can be used for foliar disease management, but growers may be at risk of increasing DON levels when applying at boot stage or even before (results from 2008 indicated that an application at the flag leaf emergence stage could increase DON). Further research is needed, so that growers can have accurate information on when they can apply strobilurin fungicides to their wheat crop without increasing DON levels.

Data from Illinois uniform fungicide trials were compiled with uniform fungicide trial data received from other states. These multi-state results were used to prepare two abstracts and posters for the 2009 National Fusarium Head Blight Forum. Information gleaned from this research project has been used to help prepare a multi-state fungicide efficacy table (compiled by members of NCERA 184 Small Grain Diseases Committee) that Extension personnel, crop consultants, industry personnel, and growers can use to help make FHB management decisions. Additionally, information from this research project has been used to prepare multiple Extension newsletter articles and presentations.

Project 2: *Integrated Management Strategies for Scab in Illinois.*

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

Under severe FHB pressure, using only one control tactic is not effective enough to prevent losses. The use of integrated management tactics is needed to provide the highest levels of FHB and DON control. Research studies were initiated to evaluate the combination effects of crop rotation, moderately-resistant cultivars, and foliar fungicides on FHB severity and DON contamination.

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: Research trials were conducted at Urbana, IL, Monmouth, IL, Carbondale, IL, and Dixon Springs, IL that evaluated the effects of previous crop (soybean or corn stubble), cultivars ranging in FHB susceptibility level, and fungicide (Prosaro fungicide or nontreated.

Highest FHB and DON levels occurred at the two locations in southern Illinois (Dixon Springs and Carbondale). The highest levels of FHB control and DON control (Carbondale location only – DON data are not available from Dixon Springs) were achieved when the most resistant cultivars were planted into soybean stubble and sprayed with Prosaro fungicide.

Additionally, strips of corn and soybean were established in 2009, so that the effect of crop rotation could be evaluated again with cultivar and fungicide effects for studies to be conducted in the 2009-10 winter wheat season. These strips were established at four locations in the state (Monmouth, Urbana, Carbondale, and Dixon Springs).

Impact: Results indicated that using the best FHB management practices in combination with each other provided the lowest FHB severity values and the highest yields. Information from these results have been used to prepare Extension newsletter articles and presentations and a proceedings paper for the 2009 National Fusarium Head Blight Forum.

Project 3: *Within-Field Inoculum from Corn Debris and the Management of FHB/DON.*

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

Knowledge of the relative contribution of within-field inoculum sources of *Gibberella zeae* to infection of local wheat and barley is important for developing and/or excluding strategies for managing FHB. Our experimental objective was to quantify the relative contribution of within-field corn debris as an inoculum source of *Gibberella zeae* for Fusarium head blight and DON contamination in ten variable wheat environments in 2009, all in regions where corn is the predominant crop in the agricultural landscape and corn debris is left on the land surface over large areas. Our research is based on the hypothesis that spores of *Gibberella zeae* that are deposited on wheat spikes and that result in Fusarium head blight come primarily from well-mixed, atmospheric populations in an area. The research was conducted in two commercial-scale wheat fields in Illinois, Missouri, Nebraska, New York, and Virginia, each following a non-susceptible crop. Over these environments we encountered six severe epidemics (in Illinois, Missouri, and Virginia), two moderate epidemics (in New York), and two mild epidemics (in Nebraska). Locally overwintered, natural corn stalks were collected in spring from two different sources in each locale by placing a 33 inch diameter plastic 'Hoola Hoop' onto four arbitrarily selected areas in a corn stubble field, and then removing all of the stubble within the hoop and placing it in a paper bag. Replicated (four) microplots containing corn debris and without debris were set out in each field and were separated by a minimum of 100 ft in each dimension. Debris was secured within the source circles by using cages fashioned of 2 ft high hardware cloth and shaped with the same 33 inch diameter plastic 'Hoola Hoop', fastened with plastic zip-ties, and secured to the soil with metal ground staples. Wheat heads above each microplot were rated at soft dough stage for FHB incidence, severity, and index. At grain maturity, at least 100 heads from each microplot were harvested, dried and shipped to Cornell where grain was threshed from a subsample of heads and sent to Virginia Tech for DON analysis.

Despite a 'low' predicted risk of FHB (Penn State model) in each location, significant FHB symptoms (>5% with no debris) developed in four fields, and DON was detected in every field. FHB symptoms at soft dough were a poor predictor of DON ppm, e.g., in Columbia, MO and Riner, VA. *Gibberella zeae* was recovered from a large percentage of mature spikes at every location except Lincoln and Mead, NE, suggesting late infections in some fields with no or few symptoms at soft dough. Local corn debris resulted in significant (P=0.05) increases over no debris in FHB only in one field in Riner, VA, and did not result in a significant increase in DON in any location. Released clonal inoculum resulted in a significant (P=0.05) increase (over no debris) in FHB only in Urbana, IL, and resulted in significant increases in DON only at Dixon Springs and Urbana, IL.

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 astounding result is that DON level did not differ significantly between corn debris and no debris microplots in any of the ten wheat environments.

   Impact: By inference of our results, it appears that elimination of corn debris from single wheat fields in a major corn- producing region may have rather limited benefits in terms of reducing FHB and especially of reducing DON contamination of grain. The experiments will be repeated in ten additional environments in 2010.

Project 4: *Fungicide x Variety Interaction Experiment.*

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

   Suppression of FHB under heavy disease pressure frequently requires more than a single method of control. In this experiment we studied the control of FHB under heavy disease pressure using resistant and susceptible varieties in combination with and without fungicide application. Our hypothesis was that the best suppression of FHB will occur by growing a FHB resistant variety in combination with application of a fungicide at flowering.

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 second year of this experiment was conducted in the 2008-2009 growing season. Six Fusarium head blight (FHB) susceptible and six FHB resistant breeding lines and varieties were grown and three treatments (no fungicide, Folicur® and Prosaro®) were applied to each variety. A split-plot design with three replications and fungicide treatment as the main plots was used. The plots were grown in a mist-irrigated, inoculated nursery to enhance disease pressure. Data were collected on FHB incidence, severity, % Fusarium damaged kernels, deoxynivalenol content (ppm), grain yield and test weight. The experiment was conducted in the 2008 season and was repeated in the 2009 season. Useful data were obtained from both years, and the following results are based on the combined data from both years.

   •Averaged over all cultivars, both Prosaro® and Folicur® significantly reduced incidence, severity, FHB index, and ISK index while also increasing grain yield and test weight.

   •In 2008 the fungicide treatment did not significantly change the DON concentration. In 2009, both Folicur® and Prosaro® significantly reduced DON concentration.

   • Prosaro® increased yield by an average of 12.4 bu/A, while decreasing FHB incidence by 32% and severity by 10%. Folicur® increased yield by an average of 8.98 bu/A, while decreasing FHB incidence by 20% and severity by 8.6%.

   •The six resistant cultivars outperformed the susceptible cultivars for all measured variables. When no treatment was applied, the resistant varieties yielded 12.7 bu/A more than the susceptible varieties. The resistant varieties also had significantly (P<.0001) lower FHB incidence and severity than susceptible varieties. Resistant cultivars had a mean FHB incidence 26% lower than susceptible varieties and a mean severity 17% lower than susceptible varieties.

   Impact: Based on the 2008 and 2009 data we clearly demonstrated that best management practices for suppression of FHB under heavy disease pressure include combining a resistant variety with fungicide application. The results from the trial were presented in a poster at the 2009 Scab Forum, and the results of this experiment have been used extensively locally

in Illinois in a number of presentations at field-days and grower meetings to provide producers with important information on best management practices to use for suppression of FHB.

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.

Not applicable.

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.

Presentations

Bradley, C. A. 2010. Fungicide research on corn, soybean, and wheat. Southern Illinois Crop Management Conference, February 2, 2010, Whittington, IL.

Bradley, C. A. 2010. Fungicide research on corn, soybean, and wheat. Central Illinois Crop Management Conference, February 3, 2010, Springfield, IL.

Bradley, C. A. 2010. Fungicide research on corn, soybean, and wheat. East-Central Illinois Crop Management Conference, February 16, 2010, Champaign, IL.

Bradley, C. A. 2010. Fungicide research on corn, soybean, and wheat. Northern Illinois Crop Management Conference, February 17, 2010, Malta, IL.

Bradley, C. A. 2010. Management of wheat diseases. Illinois Wheat Association Winter Forum, February 15, 2010, Mt. Vernon, IL.

Bradley, C. A. and Esker, P. 2010. Winter wheat disease identification and management. Joint University of Illinois – University of Wisconsin Winter Wheat Workshop, March 18, 2010, Rockford, IL.

Bradley, C. A. 2010. Management of wheat diseases. University of Illinois / Illinois Wheat Association Small Grains Field Day, June 24, 2010, DeKalb, IL.

Non-peer reviewed articles
Abstracts and Proceedings:

Bergstrom, G. C., Waxman, K. D., Schmale III, D. G., Bradley, C. A., Sweets, L. E., Wegulo, S. N., and Keller, M. D. 2009. Effects of within-field corn debris in microplots on FHB and DON

in ten U.S. wheat environments in 2009. Proc. 2009 National Fusarium Head Blight Forum, Orlando, FL, p. 22.

Bradley, C. A., Adee, E. A., Ebelhar, S. A., Grybauskas, A. P., Hollingsworth, C. R., Kirk, W. W., McMullen, M. P., Milus, E. A., Osborne, L. E., Ruden, K. R., and Young, B. G. 2009. Application timings of Caramba and Prosaro foliar fungicides for management of FHB and DON. Proc. 2009 National Fusarium Head Blight Forum, Orlando, FL, p. 34.

Bradley, C. A., Adee, E. A., Ebelhar, S. A., Grybauskas, A. P., Hollingsworth, C. R., Kirk, W. W., McMullen, M. P., Milus, E. A., Osborne, L. E., Ruden, K. R., and Young, B. G. 2009. Effect of pyraclostrobin applications to wheat at different growth stages on DON concentrations in grain. Proc. 2009 National Fusarium Head Blight Forum, Orlando, FL, p. 35.

Karplus, N. H., Brucker, E. A., Bradley, C. A., and Kolb, F. L. 2009 Evaluation of host plant resistance and fungicide treatment for suppression of Fusarium Head Blight. Proc. 2009 Fusarium Head Blight Forum, Orlando, FL, p. 129.

Willyerd, K., Madden, L., Bergstrom, G., Bradley, C., Grybauskas, A., Hershman, D., McMullen, M., Ruden, K., Sweets, L., Wegulo, S., Wise, K., and Paul, P. 2009. Integrated management of FHB and DON in small grains: 2009 coordinated trials. Proc. 2009 Fusarium Head Blight Forum, Orlando, FL, p. 95-99.

Extension Publications, Articles, and Videos:

Illinois Pest Management and Crop Development Bulletin Newsletter Articles (available at http://ipm.illinois.edu/bulletin/index.php*):*

Bradley, C. A. 2009. Applying foliar fungicides to early-stage wheat. April 10 issue.

Bradley, C. A. 2009. Management of Fusarium head blight (scab) of wheat. April 24 issue.

Bradley, C. A. 2009. Wheat scab alert and results of 2008 Illinois wheat fungicide trials. May 8 issue.

Bradley, C. A. 2009. Wheat disease update. May 22 issue.

Bradley, C. A. 2009. Update on a wheat disease survey in Illinois. June 5 issue.

Bradley, C. A. 2009. Field Diagnosis: Wheat Scab, YouTube Video Clip Posted on June 16, 2009 by Farm Journal. (http://www.youtube.com/watch?v=bvEBZ922CtI).

NCERA 184 Management of Small Grain Diseases Committee. 2010. Fungicide Efficacy Table for Control of Wheat Diseases (available online at multiple websites including: http://www.ppdl.purdue.edu/ppdl/wise/NCERA_184_Wheat_fungicide_chart_2010_v2.pdf)