USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY12 Final Performance Report
July 16, 2013

Cover Page

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Fiscal Year:	FY12
USDA-ARS Agreement ID:	59-0206-9-076
USDA-ARS Agreement Title:	Applied Managment of Fusarium Head Blight in Illinois
FY12 USDA-ARS Award Amount:	$ 43,124[*]

USWBSI Individual Project(s)

USWBSI Research Category[**]	Project Title	ARS Award Amount
MGMT	Integrated Management Strategies for Scab in Illinois.	$ 21,053
MGMT	Uniform Fungicide Tests for Control of Fusarium Head Blight in Illinois.	$ 16,095
MGMT	Influence of FHB Management Practices on Mycotoxins in Wheat Straw.	$ 3,930
MGMT	Effects of Local Corn Debris Management on FHB and DON Levels (Year Two).	$ 2,046
	Total ARS Award Amount	**$ 43,124**

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Principal Investigator Date

[*] Partial funding for this research is under ARS agreement # 59-0206-9-080

[**] 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: *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?

Regardless of the availability of foliar fungicides with efficacy against *Fusarium graminearum*, there is more to managing Fusarium head blight (FHB) and deoxynivalenol (DON) than just applying fungicides. On highly susceptible cultivars, the reduction in DON with a foliar fungicide may not be enough to allow the grower to sell the grain (DON may still be above 2 ppm even though a fungicide was applied). This research project investigated management of FHB and DON using the combination of a foliar fungicide and moderately-resistant cultivars. Results from this research have been used to show the importance of integrating more than one management practice to achieve the largest reduction in FHB and 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: Field research trials were conducted at Urbana, Monmouth, and Dixon Springs, IL to investigate the impact of combining a foliar fungicide application and moderately-resistant wheat cultivars on FHB and DON reduction. Results of this research indicated that utilizing the combination of moderately-resistant cultivars with a properly-timed fungicide application (Prosaro fungicide applied at Feekes 10.5.1) provided the largest reduction in FHB and DON.

Impact: The results of this research have been used in Scab Forum and grower presentations and newsletter articles to show the importance of utilizing more than one strategy for FHB and DON management. Wheat growers, crop consultants, and industry representatives in Illinois have utilized this information to be better prepared to manage FHB and DON.

Project 2: *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?

Wheat growers in Illinois now have multiple fungicide products registered on wheat that have Fusarium head blight (FHB) on the label, but non-biased data on product efficacy is not always available. This project provided non-biased data on product efficacy that wheat growers and the wheat industry utilize. Because fungicide applications cannot always be perfectly timed (due to adverse weather, scheduling an application, etc.), this project also evaluated the efficacy of fungicides applied at different timings. Some fungicides (those in the strobilurin class of fungicides) may actually increase deoxynivalenol (DON) contamination in the harvested grain. This project evaluated how the potential increase in DON associated with strobilurin fungicides could be reduced using a properly-timed triazole fungicide application.

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:

Fungicide trials were conducted at Urbana, Monmouth, Brownstown, and Dixon Springs, IL. Results from these trials indicated that Prosaro and Caramba fungicides are the most efficacious fungicides currently registered on wheat in reducing FHB and DON. Results also indicated that Prosaro and Caramba applied 5 days after Feekes 10.5.1 provided some reduction of FHB and DON, but generally this application timing generally did not provide the same level of reduction as a Feekes 10.5.1 application. Strobilurin fungicides often increased DON contamination in grain, but a triazole application at Feekes 10.5.1 generally reduced the effect of the strobilurin fungicide on DON contamination.

Impact:

The results of this research have been utilized in Scab Forum and grower presentations and newsletter articles. Due to rainy weather in the spring of 2013, many growers were unable to properly time their fungicide applications on wheat. The results of the research were utilized by growers, in that they could still see potential value in a fungicide application even if it was a day or two after the "perfect timing". Results of this research also have used to develop a "Wheat fungicide efficacy table" that growers have utilized to choose the most effective fungicides for FHB and DON management.

Project 3: *Influence of FHB Management Practices on Mycotoxins in Wheat Straw.*

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

   Wheat straw is used for livestock bedding, but livestock still eat some of the bedding (i.e. swine sows eat 2-4 kg of straw bedding per day). If the straw contains high levels of mycotoxins, such as deoxynivalenol (DON), zearalenone (ZEA), or nivalenol (NIV), then the livestock can become very sick and non-productive. Little is known about the presence of mycotoxins in straw, nor if typical Fusarium head blight management practices also reduce mycotoxins in the straw.

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:

   Straw samples (wheat stem) were collected from FHB management trials located in Urbana, Monmouth, Brownstown, and Dixon Springs, IL and assayed for mycotoxins. Mycotoxins detected in the wheat straw were DON, 3-ADON, 15-ADON, NIV, and ZEA. In several cases, the DON levels found in straw exceeded the DON levels found in grain from the same plot. Preliminary results indicate that management practices such as planting moderately-resistant cultivars and applying a triazole fungicide at Feekes growth stage 10.5.1 provided inconsistent reduction of mycotoxins in the straw.

   Impact:

   Results from this research have been presented at the Scab Forum. More research is needed to better understand the impact of finding these mycotoxins in wheat straw and the etiology of how these mycotoxins accumulate; however, this research is the first to evaluate the effects of management practices on the mycotoxins in the straw.

Project 4: *Effects of Local Corn Debris Management on FHB and DON Levels (Year Two).*

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

Reduction or elimination of within-field sources of inoculum of *Fusarium graminearum* is the basis for cultural control measures such as crop rotation sequences in which cereals follow non-cereal crops. In USWBSI-supported microplot experiments conducted in twenty-one winter wheat fields over five states in 2009 and 2010, DON level differed significantly between corn debris and no debris microplots in only one location, strongly suggesting that regional atmospheric inoculum is the strongest contributor to infection even when corn debris is present in a wheat field. Small area sources of debris, however, may result in an underestimation of the contribution of spores from a larger field of corn debris to FHB and DON. The goal of the current USWBSI research project is to provide realistic estimates of 'DON reduction' that can be expected from cultural controls that reduce within-field inoculum sources. We utilized moldboard plowing of corn debris as a proxy for planting after a non-cereal crop to compare directly with wheat planted no-till into corn debris in commercial-scale wheat fields planted following grain corn harvest in Illinois, Kentucky, Michigan, Missouri, Nebraska, New York, and Vermont. Following corn harvest, replicated wide (60 ft) strips were moldboard plowed or left non-plowed prior to sowing wheat over the entire field with a no-till drill. Wheat in each strip was monitored for FHB and sampled for laboratory quantification of head infection by *F. graminearum* and contamination of grain by DON. Results were collected over two years, 2011 and 2012, from winter wheat in six states (IL, KY, MI, MO, NE, and NY) and spring wheat in one state (VT).

In 2011, FHB symptoms at soft dough stage were low to moderate at every location except Missouri. Yet, at crop maturity, a high percentage of wheat heads was found to be infected by *F. graminearum* in all locations except Nebraska and Vermont. Measurable DON was found in grain from every environment and the levels were lowest in Vermont and highest in Kentucky and Nebraska. It is interesting that the Nebraska site showed the lowest disease index and lowest incidence of head infection, but the highest average toxin level. Moldboard plowing resulted in a significant decrease in FHB index in four environments (IL, MO, NY, MI), though the magnitude of the difference was large only in Missouri. In Nebraska, FHB index was significantly higher in the moldboard-plowed treatment in which the wheat crop matured earlier than in the no-till corn debris treatment. Moldboard plowing was associated with a small but significant decrease in recovery of *F. graminearum* from mature heads in three environments (IL, MI, NY). There was no significant effect of plowing on DON level in five environments (IL, KY, MO, NY, VT) and there were small but significant decreases in toxin in moldboard-plowed compared to no-till strips in two environments (MI and NE). An additional treatment of minimum tillage (chisel plow) was added in the Michigan experiment; DON levels in the minimum-till plots were intermediate between moldboard and no-till but not significantly different from no-till.

In 2012, a generally warm and dry cropping season across the experimental region, FHB symptoms at soft dough stage were not observed in four locations (KY, MI, NY, VT) and were observed at low levels at three locations (IL, MO, NE); plowing had no significant effect on FHB index in any location. At crop maturity, a moderate percentage of wheat heads (i.e., greater than 10%) was found to be infected by *F. graminearum* only in Missouri and Vermont; in both environments there was a significantly greater incidence of heads infected in no-till than in moldboard-plowed strips. DON was not detected in Nebraska, and was detected at low levels in all other states. Moldboard plowing resulted in a significant decrease in already low DON levels in New York and Vermont. A similar level of reduction in DON level was observed in wheat from moldboard-plowed strips in Michigan, but DON was assayed in small samples that were pooled from the replicate strips, so no statistical comparison could be made.

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:

There is a strong trend in two years of data suggesting that inoculum from area atmospheric sources exerts a far greater effect than inoculum from in-field corn residue on the level of DON contamination. A third year of experimentation in three additional wheat environments in 2013, in Illinois, Nebraska and New York, will provide increased evidence of the magnitude of the effect of corn residue management on DON reduction.

Impact:

Based on two years of data in 14 wheat growing environments, but especially on data from 2011, it appears that localized corn debris management prior to wheat planting results, on average, in relatively small reductions in FHB and in DON contamination in wheat. Regional atmospheric inoculum appears to play a far greater role in corn-dominated landscapes, thus prioritizing the need for resistant wheat varieties and effective fungicides as the main pillars of integrated management in corn production regions. Collection of useful data to address the research question was challenging in the warm and dry cropping season of 2012 as FHB and DON levels were low in most locations. A third year of experimentation in seven additional wheat environments in 2012 is being conducted to provide increased evidence of the magnitude of the effect of localized corn residue management on DON reduction. It appears that this third year of data collection will pay off since significant FHB development occurred in each of the three locations in 2013 and presumably there will be measureable levels of DON in each of the corresponding grain samples.

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.

Bergstrom, G. C., Cummings, J. A., Waxman, K. D., Bradley, C. A., Hazelrigg, A. L., Hershman, D. E., Nagelkirk, M., Sweets, L. E., and Wegulo, S. N. 2012. Effects of local corn debris management on FHB and DON levels in fourteen U.S. wheat environments in 2011 and 2012. Pgs. 5-6, Proc. National Fusarium Head Blight Forum, Orlando, FL.

Bradley, C. A. 2012. Management of wheat diseases. Presentation at Wheat Disease Workshop, UI Brownstown Research Farm, May 15, 2012, Brownstown, IL.

Bradley, C. A. 2012. Management of wheat diseases. Presentation at the Northern Illinois Small Grains Field Day, June 21, 2012, Shabbona, IL.

Bradley, C. A. 2012. Management of wheat diseases. Presentation at the Illinois Wheat Association Summer Forum, Aug. 21, 2012, Highland, IL.

Bradley, C. A. 2013. Management of wheat diseases. Presentation at Wheat field day, May 21, 2013, Brownstown, IL.

Bradley, C. A. 2013. Wheat – foliar disease update and outlook. University of Illinois Pest Management and Crop Development Bulletin, on-line at: http://bulletin.ipm.illinois.edu/?p=456. (May 3, 2013).

Bradley, C. A. 2013. Conditions favorable for Fusarium head blight (scab) in southern Illinois. University of Illinois Pest Management and Crop Development Bulletin, on-line at: http://bulletin.ipm.illinois.edu/?p=548. (May 9, 2013).

Bradley, C. A., Ames, K. A., Dong, Y., Brucker, E. A., and Kolb, F. L. 2012. Influence of management practices on *Fusarium* mycotoxins in wheat straw. Pgs. 8-9, Proc. National Fusarium Head Blight Forum, Orlando, FL.

McMullen, M., Friskop, A., Jordahl, J., Meyer, S., Bergstrom, G., Bradley, C. A., Dill-Macky, R., Smith, M., Wiersma, J., Halley, S., Arens, A., Milus, G., Ruden, K., and Schatz, B. 2012. Uniform fungicide trial results for management of FHB and DON, 2012. Pgs. 19-20, Proc. National Fusarium Head Blight Forum, Orlando, FL.

Willyerd, K., Ames, K., Bergstrom, G., Bradley, C., Cummings, J., Gross, P., Madden, L., Ransom, J., Ruden, K., Salgado, J. D., Sweets, L., Wise, K., and Paul, P. 2012. Uniform FHB integrated management trials: a summary from 2012. Pgs. 29-33, Proc. National Fusarium Head Blight Forum, Orlando, FL.