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:	59-0790-7-080
USDA-ARS Agreement Title:	Integrated Management and Prediction of Fusarium Head Blight and DON in Winter Wheat.
FY10 USDA-ARS Award Amount:	$ 14,268

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
MGMT	Integrating Strategies to Mitigate Fusarium Head Blight and DON in Winter Wheat.	$ 11,707
MGMT	Within-Field Inoculum from Corn Debris and the Management of FHB/DON.	$ 2,561
	Total ARS Award Amount	**$ 14,268**

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 Soft Winter Wheat Region
SWW – Southern Soft Red Winter Wheat Region

Project 1: *Integrating Strategies to Mitigate Fusarium Head Blight and DON in Winter Wheat.*

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

   The major problem being resolved is to more effectively manage Fusarium head blight (FHB, scab) and deoxynivalenol (DON) in winter wheat through integration of management strategies. We are resolving the problem by comparing the effect of a fungicide (Prosaro = prothioconazole + tebuconazole) application at early flowering to no fungicide application on six cultivars with different levels of tolerance to FHB (2137, Camelot, Harry, Jagalene, McGill (formerly NE01481), and Overland). The six cultivars were planted in the fall of 2009. In the spring of 2010, corn-kernel inoculum of *Fusarium graminearum* was applied to the soil surface of all plots. There also was a low to moderate level of natural inoculum. Prosaro was applied or not applied to plots of all six cultivars. Plots were inoculated with spores of *F. graminearum* (1 x 10^5 spores/ml) using a hand-pumped backpack sprayer 24 hours after fungicide aplication. Data on FHB index, yield, *Fusarium*-damaged kernels (FDK) and DON were obtained from the plots following harvest with a small plot combine.

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:

   It was found that averaged over all cultivars, fungicide application significantly (P = 0.05) reduced index, (4.6% in the check treatment versus 1.1% in the Prosaro treatment), increased yield (53.1 bu/acre in the check treatment versus 60.8 bu/acre in the Prosaro treatment), and reduced DON (0.26 ppm in the check treatment versus 0.12 ppm in the Prosaro treatment). Index was generally low; averaged over fungicide treatments it ranged from 1.7% (McGill) to 5.0% (Harry). Averaged over fungicide treatments, yield did not significantly differ among Overland (62.3 bu/acre), Camelot (61.5 bu/acre), Harry (59.7 bu/acre), 2137 (59.4 bu/acre), and McGill (57.6 bu/acre), but was significantly higher in these five cultivars than in Jagalene (41.2 bu/acre). Averaged over fungicide treatments FDK was highest in Jagalene (10.8%) and Harry (8.9%), moderate in Overland (6.7%) and 2137 (6.0%), and lowest in McGill (4.7% and Camelot (5.5%). Harry (0.55 ppm) and Camelot (0.43 ppm) had significantly higher DON than Jagalene (0.01 ppm), Overland (0.06 ppm), McGill (0.00 ppm), and 2137 (0.00 ppm).

   Impact:

   Data demonstrating differences among cultivars in their reaction to FHB and DON when treated with fungicide or not treated with fungicide will enable producers to choose the combination of cultivar and fungicide application that will be most effective in reducing FHB and DON. Losses from FHB and DON will be reduced and profits for producers will increase.

Project 2: *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?**

   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 eleven variable wheat environments in 2010, 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 commercial-scale wheat fields in Illinois, Missouri, Nebraska, New York, and Virginia, each following a non-susceptible crop. Replicated (six) microplots containing corn debris from a nearby field or no added debris were set out in each field and were separated by a minimum of 100 ft in each dimension. Wheat spikes above each microplot were rated at soft dough stage for FHB incidence, severity, and index. At grain maturity, at least 100 spikes from each microplot were harvested, dried and shipped to Cornell where grain was threshed from a subsample of spikes and sent to the assigned USWBSI Testing Lab for DON analysis. Mature spikes from each microplot were also suface-disinfested and plated on Fusarium selective media to determine the incidence of spikes infected by *G. zeae*.

   Characterization of epidemics over the 11 environments differed through the lenses of visual symptom development, incidence of mature spike infection, and toxin contamination. At every location except Chatham, VA, more than 20% of mature spikes were infected by *G. zeae*, regardless of the degree of symptom development at soft dough stage or the level of DON observed. This suggests that post-anthesis infection was quite common across environments in 2010. Based strictly on FHB index at soft dough, we observed five moderate epidemics (in Illinois, Missouri, and Nebraska) and six mild epidemics (in Nebraska, New York, and Virginia). On the other hand, three of the moderate epidemics, based on symptoms, were associated with toxin levels above 2 ppm. Mean DON levels in the no-debris microplots were 2.9 ppm in Urbana, IL, 4.4 ppm in Columbia, MO, and 12.2 ppm in Novelty, MO, and there was detectable DON at every site except Chatham, VA. Across the 11 environments, there was significantly (P=0.05) higher DON in grain from corn debris microplots (1.8 ppm) than from no-debris microplots (0.2 ppm) only in Bath, NY. It is especially noteworthy that DON levels were not significantly higher in corn debris microplots than no-debris microplots in any of the high DON locations, suggesting the predominance of regional atmospheric inoculum in those locations. FHB incidence, severity, or index was not significantly (P=0.05) higher in corn debris-containing than no-debris microplots in any of the 11 fields at soft dough stage. And only at Wilbur, NE did mature wheat spikes from microplots containing locally overwintered corn debris show a statistically significant increase in infection incidence by *G. zeae* over those from microplots with no corn debris.

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Accomplishment:

The astounding result is that DON levels did not differ significantly between corn debris and no debris microplots in 20 of the 21 winter wheat environments studied over two years. The single exception was in Bath, New York in 2010, an isolated valley environment with less surrounding grain corn acreage than other locations. It is especially noteworthy that DON levels were not significantly higher in corn debris microplots than no-debris microplots in any of the high DON locations, suggesting the predominance of regional atmospheric inoculum over within-field inoculum in severe epidemic circumstances.

Impact:

By inference of our results over two years and 21 winter wheat environments, it appears that elimination of corn debris from single wheat fields in major corn-producing regions may have rather limited benefits in terms of reducing FHB and especially of reducing DON contamination of grain. One caveat regarding this interim conclusion is that the microplot experimental design (small area sources of corn debris) we used may have resulted in an underestimation of the contribution of large area sources of corn debris to wheat infection and DON contamination. Much larger replicated plots will be necessary to definitively assess the quantitative contribution of corn debris to local wheat infection and DON accumulation on an agricultural field scale. This is the approach being taken in the FY11 project by Bergstrom et al and being conducted in wheat fields in seven states.

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., K.D. Waxman, D.G. Schmale III, C.A. Bradley, L.E. Sweets, S.N. Wegulo, and M.D. Keller. 2010. Effects of within-field corn debris in microplots on FHB and DON in eleven U.S. wheat environments in 2010. Pages 69-70 in Proc. 2010 National Fusarium head Blight Forum, Hyatt Regency Milwaukee, Milwaukee, WI, Dec 7-9, 2010. (Abstract for Poster)

Bergstrom, G.C., K.D. Waxman, D.G. Schmale III, C.A. Bradley, L.E. Sweets, S.N. Wegulo, and M.D. Keller. 2009. Effects of within-field corn debris in microplots on FHB and DON in ten U.S. wheat environments in 2009. Page 22 in Proc. 2009 National Fusarium Head Blight Forum, Wyndham Orlando Resort, Orlando, FL, Dec7-9, 2009. (Abstract for Poster)

Wegulo, S. N., Bockus, W. W., Hernandez Nopsa, J., De Wolf, E. D., . Peiris, K. H. S., and Dowell, F. E. 2010. Control of FHB and DON by Prosaro fungicide in moderately resistant and susceptible winter wheat cultivars. Proceedings of the 2010 Fusarium Head Blight Forum. December 7-9, 2010. Hyatt Regency, Milwaukee, WI.

Wegulo, S. N., Bockus, W. W., Hernandez Nopsa, J., De Wolf, E. D., Eskridge, K. M., Peiris, K. H. S., and Dowell, F. E. 2011. Effects of integrating cultivar resistance and fungicide application on Fusarium head blight and deoxynivalenol in winter wheat. Plant Dis. 95:554-560.