USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY09 Final Performance Report
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Cover Page

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USDA-ARS Agreement Title:	Management of Fusarium Head Blight of Wheat in Maryland.
FY09- USDA-ARS Award Amount:	$ 21,326

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
MGMT	Management of Fusarium Head Blight of Wheat in Maryland - Uniform Fungicide Trial Component.	$ 8,741
MGMT	Management of Fusarium Head Blight of Wheat in Maryland - Uniform Integrated Management Trial Component.	$ 12,585
	Total Award Amount	**$ 21,326**

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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: *Management of Fusarium Head Blight of Wheat in Maryland - Uniform Fungicide Trial Component.*

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

Management of Fusarium head blight with the best available fungicides has been demonstrated by the coordinated uniform fungicide trial of the USWBSI to reduce DON by an average 40-45%. This is a great improvement over the 12-23% reductions achieved with first generation products registered in some states under section 18 for scab suppression. However, in seasons when untreated fields are averaging as low as 2-3 ppm DON, a 45% reduction will not produce a crop that would pass the 1 ppm FDA advisory limit and could still be rejected. New products and combinations need to be tested to improve upon the DON reduction. Research conducted to date has demonstrated that the optimum timing for first generation materials was at initial flowering for wheat based on visual symptom reduction. The optimum timing of newer materials and combinations needs to be confirmed and DON reduction should be the primary criteria. Furthermore, at the end-user level it is operationally impossible for all fields that need a fungicide application to be treated exactly at initial flowering. The effective window of application needs to be determined so that the best management practices are clearly defined and delimited. Finally, there is increasing evidence that the strobilurin class of fungicides when used for management of other diseases of wheat may increase DON in the event of a subsequent scab outbreak. Therefore the impact of fungicides used for management of other wheat diseases on scab and DON development in particular needs to be examined, and recommendations on their use as they affect DON be incorporated in best management practices for scab. We initiated trials in the 2009-2010 winter wheat production season to address these additional concerns by expanding upon the basic uniform fungicide trial by including a combination of the best two fungicides, a range of application dates including 5 days after early flowering, and several products applied pre-flowering to determine their effect on 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):

<u>Accomplishment:</u>

The environmental conditions were extremely favorable for a severe natural epidemic of Fusarium head blight in Maryland in the 2009-2010 growing season. The cultivar used in the fungicide trial had some resistance to scab so that DON levels in untreated plots averaged 4.4 ppm. All fungicides applied at the boot stage of crop development, 9 days before initial flowering, had no significant effect on DON. Headline at 6 fl oz/A, a strobilurin fungicide, applied at heading, 3 days before initial flowering, had significantly higher DON at 8.2 ppm. All fungicides having a known suppressive effect on DON produced numerically lower levels of DON when applied at heading, but only Caramba at 13.5 fl oz/A and a tank mix of Proline at 3 fl oz/A with Caramba at 7 fl oz/A significantly reduced DON at this timing. Prosaro at 6.5 fl oz/A, Caramba at 13.5 fl oz/A and the tank mix of Proline at 3 fl oz/A plus Caramba at 7 fl oz/A all suppressed scab and DON when applied at early flower and similarly when applied 5 days later. Folicur at 4 fl oz/A, which was widely registered under section 18, did not significantly reduce DON at any timing.

Impact:

The results from the expanded uniform fungicide trial illustrated that some strobilurin fungicides did indeed exacerbate DON levels. Thus use of strobilurins for management of diseases such as rust, mildew or glume blotch, in particular close to flowering, must be limited if the threat of scab is indicated. The greatest reduction in DON was 63% and it was achieved with Prosaro applied 5 days after flowering. However, this was not significantly different than the 43% reductions obtained at heading. The effective window of fungicide applications for DON reduction is from 3 days before flowering to 5 days after. It is unclear if the optimum is at initial flowering or somewhat later, since the early flower applications received rainfall 2 hr after application. The rain-fast period is usually not very well defined for new products and there is some indication from this trial that there was a loss of effectiveness in controlling foliar disease when compared to other application timings. Perhaps scab incidence, severity and DON could have been lower from the fungicide application at initial flowering if a longer rain-free period would have occurred.

These results were used in Extension presentations in three states, Maryland, Delaware and Pennsylvania, to demonstrate the effectiveness of currently recommended products, as well as the extent of the application window, and the potential negative effect of strobilurins on DON development.

Project 2: *Management of Fusarium Head Blight of Wheat in Maryland - Uniform Integrated Management Trial Component.*

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

The search for management tactics that can protect producers from the losses in yield and mycotoxin contamination associated with Fusarium head blight has taken great strides forward with the development of cultivars with moderate resistance and the registration of two new triazole fungicides, Prosaro and Caramba. However, neither tactic alone has proved to be adequate in seasons highly favorable for disease development. Furthermore, some of the more highly resistant cultivars have had lower yield potentials than other highly adapted but susceptible cultivars and thus lose favor among producers after seasons with low disease development. The effectiveness of the best available fungicides has been primarily tested with highly susceptible varieties and disease-conducive environments. Thus their overall contribution to a management package is not adequately understood. An integrated approach primarily testing the combination of cultivars that have a modicum of resistance with the best available fungicide is being tested and demonstrated in this project under various debris management and rotation schemes. We are also using the web-based forecasting system to help producers determine the "real-time" risk of disease development to help determine if the fungicide application is warranted that season.

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 environmental conditions were extremely favorable for a severe natural epidemic of Fusarium head blight in Maryland in the 2009-2010 growing season. The disease-conducive conditions provided an excellent means to compare and demonstrate the effectiveness of individual components and their combination in the integrated management of Fusarium head blight. In the Maryland trial rotation to reduce corn debris from within the study site provided 10 to 87% reduction in DON. The site where only 10% reduction occurred was surrounded by corn debris so that no part of the study site was greater than 100 ft away from an inoculum source in any cardinal direction. The study site where an 87% reduction occurred was much more isolated and an outside source of inoculum was available from only one direction and was approx. 200 to 500 ft away. A highly susceptible cultivar had 11.8 to 16.5 ppm DON at all sites except at the one with the lowest disease pressure. The cultivar Chesapeake was in the 52nd percentile of DON levels among cultivars tested for resistance in Maryland trials. This intermediate level of resistance in the management trials produced 47 to 77% reductions in DON when compared to the highly susceptible cultivar. Cultivars with the highest resistance to DON ranged from 82 to 96% reductions in DON when compared to the highly susceptible cultivar. Fungicide treatment when compared to no treatment averaged 40% reduction in DON. However, when the contribution of the fungicide treatment is calculated after taking into account the reduction from genetic resistance, fungicide treatment reduced DON levels by an additional 10% (range 6 to 15%). Clearly the largest

reductions in DON come from rotation and resistance. In no case in a highly disease favorable year did any one component produce DON levels below 1 ppm. Even a good DON tolerant cultivar with a fungicide treatment under high disease pressure may not go below 1 ppm. It is imperative that rotation or tillage be part of the management of scheme that relies on resistance, and currently registered fungicides when used as needed will only provide a small additional reduction in DON. But the combination of all three components appears to be very close to getting DON to the desired 1 ppm tolerance level.

Impact:

These results provide the scientific basis for an Extension program to encourage producers to combine tactics that can reduce mycotoxin accumulation and yield loss due to Fusarium head blight. It also helps to establish a strategy that a high yield potential cultivar with a only a moderate level of resistance may be effectively managed with fungicides in seasons favorable for disease development without the yield drag cost associated with a cultivar having a higher level of resistance if rotation or tillage is included in the management scheme. This is a critical step in gaining grower acceptance particularly within the region and encourages the selection of cultivars with resistance. It further demonstrates that currently available fungicides play only a small role in disease management. Extension presentations were made in three states, Maryland, Delaware and Pennsylvania.

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.

Willyerd, K. L., C. Bradley, A. Grybauskas, D. Hershman, L. Madden, M. McMullen, L. Osborne, P. Paul and L. Sweets. Multi-state evaluation of integrated management strategies for Fusarium head blight and deoxynivalenol in small grain. APS Annual meeting, Aug 2010, Charlotte, NC.

Grybauskas, A.P. 2010. The facts about fungicides in small grains at spring greenup. UME Agronomy Newsletter 1(1):1-2.

Grybauskas, A.P. and E. Reed. 2010. MD Field Crop Disease Management Research Update. NJ-DelMarVa-Pa Plant Pathologist Assoc., March 31, 2010, Newark, DE.

Grybauskas, A.P. and E. Reed. 2010. DON mycotoxin increases with some fungicide applications in wheat update. APS Potomac division annual meeting, March 24-25, 2010, Ocean City, MD.

Bradley, C.A., E.A. Adee, S.A. Ebelhar, A.P. Grybauskas, C.R. Hollingsworth, W.W. Kirk, M. P. McMullen, E.A. Milus, L.E. Osborne, K.R. Ruden, and B.G. Young. 2009. Application timings of Caramba and Prosaro foliar fungicides for management of DON and FHB. Proceedings of the 2009 National Fusarium Head Blight Forum, Dec 7-9, 2009, Orlando, Fl.

Bradley, C.A., E.A. Adee, S.A. Ebelhar, A.P. Grybauskas, C.R. Hollingsworth, W.W. Kirk, M. P. McMullen, E.A. Milus, L.E. Osborne, K.R. Ruden, and B.G. Young. 2009. Effect of pyraclostrobin applications to wheat at different growth stages on DON concentrations in grain. Proceedings of the 2009 National Fusarium Head Blight Forum, Dec 7-9, 2009, Orlando, Fl.

Willyerd, K. L. Madden, G. Bergstrom, C. Bradley, A. Grybauskas, D. Hershman, M. McMullen, K. Ruden, L. Sweets, S. Wegulo, K. Wise, and P. Paul. 2009. Integrated management of FHB and DON in small grains: 2009 Coordinated Trials. Proceedings of the 2009 National Fusarium Head Blight Forum, Dec 7-9, 2009, Orlando, Fl.

Grybauskas, A.P. 2010. Managing Fusarium head blight in wheat. Pennsylvania Agronomic Education Conference, January 19-20, State College, PA.

Grybauskas, A.P. 2010. Small grain fungicides effect on head blight. Delaware Agronomy Day Program, January 21, Harrington, DE.

Wheat scab management and effect of fungicides on vomitoxin, Cecil County Agronomy meeting, Rising Sun, MD, March 22, 2010.

Wheat scab management and effect of fungicides on vomitoxin, Queen Ann County Agronomy meeting, Centreville, MD, March 5, 2010.

Wheat scab management and effect of fungicides on vomitoxin, Dorchester County Agronomy meeting, Cambridge, MD, February 23, 2010.

Wheat scab management and effect of fungicides on vomitoxin, Lower Eastern Shore Agronomy meeting, Princess Anne, MD, February 22, 2010.

Wheat scab management and effect of fungicides on vomitoxin, Caroline County Agronomy meeting, Denton, MD, February 17, 2010.

Wheat scab management and effect of fungicides on vomitoxin, Carroll County Crops Roundtable, Westminster, MD, February 2, 2010.

Fungicides for wheat disease control and potential effect on toxins if scab develops. Kent County Ag Day, Chestertown, MD, January 27, 2010.

Scab outbreak of 2009 – what did we learn. Maryland Crop Improvement Association Annual Meeting, Ruthsburg, MD, January 21, 2010.

Field crop disease update winter 09 – wheat. Southern Maryland Crops Dinner, Waldorf, MD, 2 December, 2009

Small grain diseases and new fungicide update. Lower Eastern Shore Small Grain Breakfast meeting, Hebron, MD 8 September, 2009.

Diseases in the forefront of Maryland Grain Production, 11th Annual Maryland Commodity Classic, Queenstown, MD, 23 July 2009.