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:	59-0206-9-051
USDA-ARS Agreement Title:	Winter Wheat Breeding for Scab Resistance in South Dakota.
FY10 USDA-ARS Award Amount:	$ 52,053

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Developing FHB Resistant Red and White Winter Wheat Varieties for SD.	$ 52,053
	Total ARS Award Amount	**$ 52,053**

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: *Developing FHB Resistant Red and White Winter Wheat Varieties for SD.*

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

   Approximately 50% of all wheat production in South Dakota is winter wheat, and in any production year, a Fusarium head blight (FHB) epidemic can result in significant monetary losses. In a single South Dakota production year, losses due to FHB have been estimated at $20 million. For fall 2011, the USDA estimated that South Dakota producers planted nearly 300,000 acres more winter wheat than the previous year. Furthermore, a recently established initiative by Bayer CropScience and Ducks Unlimited targets expanding the production acres of winter wheat in the northeast and north-central areas of South Dakota. These are areas that typically are at highest risk for FHB. Consequently, South Dakota winter wheat varieties with adequate resistance are needed to address expansion of production into areas at highest risk for FHB. We are continuing to develop resistant germplasm and varieties to meet the demand for the northeast and north-central regions of South Dakota as well as other FHB prone areas in the hard winter wheat region.

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(s):

   We continued to evaluate and develop winter wheat breeding lines and varieties with excellent resistance to FHB. In 2010, seven of the ten genotypes expressing the lowest FHB index were breeding lines developed by the SDSU Winter Wheat Breeding Program (see www.plantmanagementnetwork.org/pub/trial/pdmr/volume5/abstracts/cf008.asp). Of nearly 50 breeding lines and varieties evaluated for resistance to FHB by Kansas State University, four of the top five expressing the lowest FHB index were SDSU breeding lines and the line with the lowest FHB index was SD08198. The mean FHB index of SD08198 was lower than that for Overland and Hondo, resistant check varieties from Nebraska and Kansas, respectively. In addition, Wesley BC lines with *Fhb1* were tested across several SD locations, and higher yielding lines with excellent resistance to FHB were identified relative to the Overland check variety. Wesley BC lines are being used to determine any possible "yield drag" associated with *Fhb1*.

   As part of a graduate student study funded by this grant, we made progress in determining the impact of bran on the DON content of red and white wheat grain. Near-isogenic red and white winter wheat genotypes were inoculated and samples were pearl-milled into bran and non-bran fractions. These samples are presently being evaluated for DON content. Analyses of non-bran fractions using SKNIR indicated that pearling was uniform and DON content decreased with the removal of more bran. Preliminary results of this study will be presented at the 2011 AACC Meetings in

Impact:

For perhaps the first year in many, planted winter wheat acres in South Dakota will likely exceed spring wheat acres. Therefore, we expect the impact of developing adapted winter wheat germplasm and varieties with resistance to FHB to be more significant than ever in FY10. As the most resistant winter wheat variety in the region, Lyman will have a significant positive impact on the production economics for growers in South Dakota and surrounding states as well as the end-use economics of millers and bakers sourcing wheat from the region. This variety and future resistant varieties from SDSU complement excellent resistant varieties released from the University of Nebraska and Kansas State University, such as Overland and Everest. Working together, breeders within the region continue to develop an excellent core set of varieties to offer growers the necessary diversity of choice for their areas of adaptation.

The development of Wesley BC lines with *Fhb1* will provide valuable information on the impact of this major resistance gene on yield, and the potential release of one or more of these lines as FHB resistant germplasm will positively impact all winter wheat breeding programs in the region. Furthermore, the development of these lines is the first important step to combining *Fhb1* with other new and indigenous sources within the region to perhaps increase the level and durability of resistance to FHB. Whereas developing and releasing resistant varieties rapidly and directly impacts the economics of winter wheat production and end-use, developing and releasing resistant germplasm impacts breeding efforts long-term. This impact should not be underestimated considering the importance and necessity of continually improving the level and durability of resistance to FHB.

The production of whole grain wheat products continues to expand within the food industry, and concern over food safety is ever-present. Thus, it is important to determine the levels of DON present in red and white wheat bran as a consequence of genetic differences. Results of this study will impact how breeders consider developing varieties for whole grain markets as well as how end-users consider processing and sourcing winter wheat. A determination of the reasons why near-isogenic red and white breeding lines differ in DON content will impact breeding strategies for selecting for genotypes that exhibit the lowest levels of DON accumulation.

Include below a list of 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.

No releases during this funding period, but Lyman HRWW was released from the SDAES in 2008, and it remains the most resistant winter wheat variety in the region. Wesley BC lines with *Fhb1* are being evaluated for future potential release as FHB resistant germplasm.

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.

Bockus, W. W., Baenziger, P. S., and Berzonsky, W. 2011. Reaction of Kansas, Nebraska, and South Dakota winter wheat accessions to Fusarium head blight (FHB), 2010. Plant Dis. Mgmt. Rpt .(online). Report 5:CF008. DOI:10.1094.

Malla, S., A.M.H. Ibrahim, K.D. Glover, W.A. Berzonsky. 2010. Combining ability for Fusarium head blight resistance in wheat (*Triticum aestivum* L.) Commun. Biom. Crop Sci. 5:116-126.

Malla, S., A.M.H. Ibrahim, Y. Yen, W. Berzonsky, K.D. Glover, J. Stein. 2010. QTL Analysis of a putative novel source of resistance to *Fusarium* head blight in hard winter wheat. Int. J. Plant Breed.

Malla, S., A.M.H. Ibrahim, Y. Yen, K.D. Glover, and W.A. Berzonsky. 2012. Association of *Fhb1* and Qfhs.ifa-5A in spring versus winter growth habits in bread wheat (*Triticum aestivum* L.). J. Agri. Sci. 4 (1).

Peiris, K.H.S., Y. Dong, S. Wegulo, W. Berzonsky, W.W. Bockus, P.S. Baenziger and F.E. Dowell. 2010. Development of single kernel NIR technology for evaluation of FHB resistance and for identification of reduced DON in harvested wheat grain. pg. 161. *In* Canty et al. (eds) Proc. Nat. FHB Forum. Dec. 7-9, Milwaukee, WI.

Peiris K.H.S., M.O. Pumphrey, Y. Dong, E.B. Maghirang, W. Berzonsky, and F. E. Dowell. 2010 Near-infrared spectroscopic method for identification of *Fusarium* head blight damage and prediction of deoxynivalenol in single wheat kernels. Cereal Chem. 87:511-51.