

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY13 Final Performance Report
July 15, 2014**

Cover Page

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Fiscal Year:	FY13
USDA-ARS Agreement ID:	59-0206-9-055
USDA-ARS Agreement Title:	Enhance Variety Development of Scab Resistant Hard Winter Wheat Varieties in Nebraska.
FY13 USDA-ARS Award Amount:	\$ 48,692

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Increase Wheat Acreage Planted to FHB Tolerant, Low DON Varieties.	\$ 48,692
	FY13 Total ARS Award Amount	\$ 48,692

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: *Increase Wheat Acreage Planted to FHB Tolerant, Low DON Varieties.*

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

In 2007 and 2008, major scab epidemics occurred in eastern NE (approximately 600,000 acres of wheat production). In 2009, scab was found in every part of the state (1,700,000 acres), fortunately at low levels. In 2010, scab was found mainly in the southeastern, south central and southwestern NE, again fortunately at low levels. In 2013, we had 6-8 inches (15 – 20 cm) of rain in the last week of May which completely bracketed the flowering period for early to late flowering winter wheat and again scab was present in eastern Nebraska. In 2014, consistent rains in western Nebraska led to scab being in our wheat and barley trials in that region (remarkable in that the region is best known for drought). Genetically improved seed coupled with appropriate management practices (cultural practices and fungicide use) are the quickest and most cost effective ways to reduce DON in the grain supply. In this project, we are using conventional breeding methods of crossing elite adapted lines to lines with known scab resistance/tolerance QTLs (mainly *Fhb1*, but also *5As*, and *Fhb3*) coupled with molecular markers to breed elite adapted lines many of which have native resistance with major scab resistance/tolerance QTLs. In the 2013-2014 crossing blocks we made 126 designed crosses involving named *Fhb* resistance/tolerance genes (mainly *Fhb1*; 87 involved Wesley *Fhb1*; 27 involved Overland *Fhb1*; and 12 involved an elite line with *Fhb1* from a genetic study by Bakhsh et al., 2013). The Wesley and Overland *Fhb1* lines were created by Dr. Guihua Bai and they have been a huge help to our program. We also have additional crosses to lines with native resistance/tolerance, as well as to spring wheat lines with *Fhb1* and additional FHB QTLs. This research is beginning to have very tangible outcomes in that in our F₆ preliminary nursery, four lines had both markers for *Fhb1* and 11 additional lines had one of the two markers for *Fhb1* (out of 280 experimental lines); which is the highest frequency of lines with *Fhb1* in this nursery. As scab is episodic in the Great Plains and *Fhb1* does not have detrimental epistatic effects on grain yield or quality, our goal is to have a higher frequency of resistant lines so that grower will be able to grow scab resistant/tolerant lines routinely. In our preliminary efforts to create hybrid wheat, we have identified that the cytoplasmic male sterility (CMS) due to the *T. timopheevi* cytoplasm with its shriveled anthers may reduce scab in low to moderate infection levels in greenhouse conditions. While we believe the lower scab level is due to shriveled anthers (a possible infection pathway), our results could also be due to the lack of seed set in the CMS lines or the effect of the cytoplasm regardless of anther health. We test Northern Hard Winter Wheat FHB Public and Private Nurseries (coordinated by Dr. Bill Bockus) and NUWWSN nurseries along with the Regional Germplasm Observations Nursery (RGON) at misted inoculated locations to provide regional data to better understand our germplasm and its level of tolerance to this devastating disease.

- 2. List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

Accomplishment:

In 2014, we released NE05548 which will be marketed as Husker Genetics Brand ‘Panhandle’. NE05548 is considered as being moderately susceptible to Fusarium head blight (caused by *Fusarium graminearum*, data from greenhouse and field observations in Nebraska) and moderately resistant for DON accumulation. It is an improvement over the more susceptible cultivars that it replaces. The unique aspect of NE05548 is that it is the tallest semi-dwarf cultivar that we have released from the collaborative USDA-University of Nebraska wheat improvement project, so that as greater plant height has been reported to reduce scab, NE05548 in the field may have less scab than other shorter cultivars. NE05548 is targeted for our drought prone regions which normally escape scab due to insufficient moisture during the infection period.

The second most important accomplishment is refining our strategy to increase the level of scab tolerance throughout our breeding program by focusing in on designed crosses with known QTLs.

Impact:

It is too early to know the impact of Panhandle; however, previous releases with better native resistance to FHB or DON accumulation have reduced the exposure of our growers to the devastating effects of FHB.

The development of released cultivars with known and stable FHB resistance/tolerance is becoming closer.

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY13 award period. List the release notice or publication. Briefly describe the level of FHB resistance.

See above (copied here): In 2014, we released NE05548 which will be marketed as Husker Genetics Brand 'Panhandle'. NE05548 is considered as being moderately susceptible to Fusarium head blight (caused by *Fusarium graminearum*, data from greenhouse and field observations in Nebraska) and moderately resistant for DON accumulation. It is an improvement over the more susceptible cultivars that it replaces. The unique aspect of NE05548 is that it is the tallest semi-dwarf cultivar that we have released from the collaborative USDA-University of Nebraska wheat improvement project, so that as greater plant height has been reported to reduce scab, NE05548 in the field may have less scab than other shorter cultivars. NE05548 is targeted for our drought prone regions which normally escape scab due to insufficient moisture during the infection period.

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 FY13 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

El-Basyoni, I., P.S. Baenziger, I. Dweikat I., D. Wang, K. M. Eskridge and M. Saadalla. 2013. Using DArT markers to monitor genetic diversity throughout selection: A case Study in Nebraska's winter wheat breeding nurseries. *Crop Sci.* 53:2363-2373.

Hernandez Nopsa, J. F., S.N. Wegulo, A. Panthi, H.E. Hallen-Adams, S. D. Harris, and P. S. Baenziger. 2014. Characterization of Nebraska isolates of *Fusarium graminearum* causing head blight of wheat. *Crop Sci.* 54:310-317.