USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY15 Final Performance Report
Due date: July 15, 2016

Cover Page

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Fiscal Year:	2015
USDA-ARS Agreement ID:	59-0206-4-011
USDA-ARS Agreement Title:	Enhance Variety Development of Scab Resistant Hard Winter Wheat Varieties in Nebraska.
FY15 USDA-ARS Award Amount:	$ 61,181
Recipient Organization:	University of Nebraska Sponsored Programs 2200 Vine St., 151 Whittier Research Center Lincoln, NE 68588-0430
DUNS Number:	55-545-6995
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Project/Grant Reporting Period:	05/03/15-05/02/16
Reporting Period End Date:	05/02/16

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Enhance Variety Development of Scab Resistant Hard Winter Wheat Varieties in Nebraska.	$ 61,181
	FY15 Total ARS Award Amount	**$ 61,181**

Principal Investigator Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
EC-HQ – Executive Committee-Headquarters
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: *Enhance Variety Development of Scab Resistant Hard Winter Wheat Varieties in Nebraska.*

1. What are the major goals and objectives of the project?

The main goal of this research was to develop Fusarium head blight (Fhb) tolerant lines with lower levels of DON, thus reducing the effects of the disease and increasing the food safety and marketability of our hard winter wheat.

2. What was accomplished under these goals?
Our objectives and specific approaches were to:

1. Use our scab mist nurseries to identify lines with improved scab tolerance and reduced DON with: a) native resistance--We evaluated the Elite (NIN), Advanced (TRP), Preliminary (DUP) yield trials, the Regional Germplasm Observation Nursery, the Hard Winter Wheat Public FHB and Hard Winter Wheat Private FHB Screening Nurseries in 2015 and replanted the same nurseries for evaluation in 2016.Of a total of 183 entries in four of these nurseries (NIN, TRP, Public, and Private) for which DON data were obtained, 31 or 17% had DON values comparable to that for Overland which is moderately resistant. The key outcome was that lines with promising FHB and DON tolerance levels were identified and can utilized in future breeding efforts. We also installed our greatly improved misting system (supported by funds from the ARS/USWBSI, thank you!). b) known major Fhb tolerance QTLs. In 2015, 10 lines out of 270 were identified as being homozygous or heterogeneous for Fhb1 in the preliminary yield trial. This is the highest level of lines with Fhb1 in this nursery since we began looking for this QTL in that nursery. In addition, these lines also carry Lr68, Lr37/Sr38/Yr17, or Lr24/Sr24. Hence they have an excellent disease resistance package. Phenotypic data on these will be collected in 2016. **The key outcome** was increasing the number of lines with proven FHB QTLs for FHB tolerance and resistance genes to other important diseases.

2. Use designed crosses and molecular markers to introgress and pyramid known QTLs (*Fhb1*, Fhb3, 5As, etc.) in native resistance backgrounds. Eighty eight crosses were made to develop improved lines with FHB tolerance. Over 500 plants were subjected to KASP assays to determine the presence of *Fhb1* in three way crosses. One Overland Fhb1 line co-developed with Dr. Guihua Bai was entered into the Northern Regional Performance nursery and the data should be available in 2016. This line is the most widely adapted winter wheat Fhb1 line for the northern Great Plains and should be a very useful parent line if it is not released. We increased seed of the newly backcross derived lines of McGill with Fhb1 and NE06607 *Fhb1*—they will be harvested in 2016. **The key outcome** was an elite line available with Fhb1 for crossing and potential release.

3. Determine how genetics and management (specifically fungicides) can be used to reduce Fhb and DON, so as to provide growers with better information on reducing the disease and DON in their fields. The Elite trial was grown under fungicide treatments to control disease or without fungicides. The conditions were ideal for Fusarium head blight (FHB, incited by *Fusarium graminearum*.) in 2015. The other major disease present was stripe rust (incited by

Puccinia striiformis f. sp. *tritici*). Other diseases that are favored by cool moist conditions were present, but not to the extent of FHB and stripe rust. Average FHB index in the untreated plots was 56% (range 4% to 96%) compared to 10% in the treated plots (an 82% reduction in index; range 0% to 68%). Yield in the treated plots averaged 3460 kg/ha (range 4860 kg/ha to 1360 kg/ha) compared to 1940 kg/ha (a 44% reduction in yield; range 3500 kg/ha to 340 kg/ha). On average, the diseases caused a 44% reduction in yield (excluding the two historic check cultivars which actually yielded higher in the untreated plots; yield loss due to disease ranged from 15% to 86%). There was a significant negative correlation between FHB index and yield in the untreated plots ($R = -0.38$; $P = 0.0034$) indicating that some lines had good FHB resistance whereas others were susceptible. In contrast, there was no correlation between FHB index and yield in the treated plots ($R = 0.04$; $P = 0.7454$), indicating the effectiveness of Caramba® applied at flowering in suppressing FHB. The stripe rust reactions varied among lines from highly resistant to highly susceptible. In looking at those lines which had infection scores of 1-3 (on a 1= resistant to 9= susceptible scale) for stripe rust, the grain yield loss averaged 30% presumably due to FHB. In looking at those lines with infection scores of 7-9 for stripe rust, the grain yield loss averaged 50%. In both the resistant and susceptible to stripe rust groups, lines varied in their response to FHB with the best lines having only a 15% or 27% yield loss, respectively. Though still being measured, the effects on grain volume weight and seed germination were obvious in preparing and planting seed this fall. This experiment will be repeated in 2015-2016 to provide multi-year disease loss information and to ensure having high quality seed for planting. **The key outcome** was documenting the devastation of FHB in eastern Nebraska and providing the information on how to greatly reduce disease loss through genetics and management (fungicides).

3. **What opportunities for training and professional development has the project provided?** The students involved in this project include Mr. Javed Sidiqi (Fulbright Scholar who did the research on fungicide vs no fungicide experiment documenting the need for and value of fungicides; Ms. Amanda Easterly (helped with setting up the KASP marker lab): Dr. Ahmed Sallam (visiting scientist) who learned and did the KASP assays for Fhb1); Dr. Vikas Belamkar (who is using association mapping to identify lines with *Fhb1* from our GBS data) and Ms. Caixia Liu, Ms. Rungravee Boontung, Mr. Waseem Hussain, and Mr. Nick Garst who have helped in our FHB phenotyping and data collection.

4. **How have the results been disseminated to communities of interest?**
Growers in eastern Nebraska were warned of the 2015 scab epidemic via Twitter, press releases, and radio interviews. Many growers decided to use fungicides despite the low price of wheat. Clearly in 2015, fungicides were economically beneficial, especially when coupled with cultivars that also had some tolerance or resistance to FHB and stripe rust. The fungicide data were shared with growers at field days, crop clinics, and seed days; and with BASF so that they can disseminate the information through their channels.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY15 award period. The term "support" below includes any level of benefit to the student, ranging from full stipend plus tuition to the situation where the student's stipend was paid from other funds, but who learned how to rate scab in a misted nursery paid for by the USWBSI, and anything in between.

1. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their MS degree during the FY15 award period?** No

   If yes, how many?

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY15 award period?** Yes

   If yes, how many? 2

3. **Have any post docs who worked for you during the FY15 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?** No

   If yes, how many?

4. **Have any post docs who worked for you during the FY15 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?** No

   If yes, how many?

Release of Germplasm/Cultivars

Instructions: In the table below, list all germplasm and/or cultivars released with full or partial support through the USWBSI during the FY15 award period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations. *Leave blank if you have nothing to report or if your grant did NOT include any VDHR-related projects.*

Name of Germplasm/Cultivar	**Grain Class**	**FHB Resistance** (S, MS, MR, R, where R represents your most resistant check)	**FHB Rating** (0-9)	**Year Released**
NE10589 (Husker Genetics Brand Ruth)	HRW	MS	6	2015

Add rows if needed.

NOTE: List the associated release notice or publication under the appropriate sub-section in the 'Publications' section of the FPR.

Abbreviations for Grain Classes

Barley - BAR
Durum - DUR
Hard Red Winter - HRW
Hard White Winter - HWW
Hard Red Spring - HRS
Soft Red Winter - SRW
Soft White Winter - SWW

Publications, Conference Papers, and Presentations

Journal publications.

Wang, M-Y, P. S. Baenziger, I. S. El-Basyoni, and S. N. Wegulo. 2015. Comparison of Fusarium head blight Resistance in Cytoplasmic Male Sterile, Maintainer and Restorer Lines in Winter Wheat. Cer. Res. Comm. 43:374-383.
Status: Published
Acknowledgement of Federal Support: YES

Eckard, J.T. M. Caffe, W. Berzonsky, W. W. Bockus, G. F. Marais, P. S. Baenziger, and J. L. Gonzalez-Hernandez. 2015. Native Fusarium head blight resistance from winter wheat cultivars 'Lyman', 'Overland', 'Ernie', and 'Freedom' mapped and pyramided onto 'Wesley'-Fhb1 backgrounds. Molec. Breeding 35:6-16.
Status: Published
Acknowledgement of Federal Support: YES

Wegulo, S. N., P.S. Baenziger, J. Hernandez Nopsa, W. W. Bockus, and H. Hallen-Adams. 2015. Management of Fusarium head blight of wheat and barley. Crop Protection. 73:100-107. http://dx.doi.org/10.1016/j.cropro.2015.02.025
Status: Published
Acknowledgement of Federal Support: YES

Baenziger, P.S., R. A. Graybosch, T. Regassa, R. N. Klein, G. R. Kruger, D. K. Santra, L. Xu, D. J. Rose, S. N. Wegulo, Y. Jin, J. Kolmer, G. L. Hein, M.-S. Chen, G. Bai, R. L. Bowden and J. Poland. 2016. Registration of 'NE05548' (Husker Genetics Brand Panhandle) Hard Red Winter Wheat. Journal of Plant Registrations: In press. Available on the web. doi:10.3198/jpr2016.01.0006crc
Status: Web Published, but not in print yet.
Acknowledgement of Federal Support: YES

Books or other non-periodical, one-time publications. None
Other publications, conference papers and presentations.

Release notice for NE10589, Husker Genetics Brand Ruth can be found at: http://agronomy.unl.edu/Baenziger/NE10589SignedRelease.pdf .
Status: Web Published
Acknowledgement of Federal Support: YES

Sidiqi, J., P.S. Baenziger, and S. N. Wegulo. 2015. The effect of Fusarium head blight and stripe rust on grain yield of hard winter wheat in Lincoln, NE. In: S. Canty, Clark, S. Vukasovich and D. Van Sanford (Eds.), *Proceedings of the 2015 National Fusarium Head Blight Forum*. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 31.
Status: Abstract Published and poster presented
Acknowledgement of Federal Support: YES