USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY17 Final Performance Report
Due date: July 31, 2018

Cover Page

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Fiscal Year:	2017
USDA-ARS Agreement ID:	59-0206-4-011
USDA-ARS Agreement Title:	Enhance Variety Development of Scab Resistant Hard Winter Wheat Varieties in Nebraska.
FY17 USDA-ARS Award Amount:	$ 53,876
Recipient Organization:	University of Nebraska Sponsored Programs 2200 Vine St., 151 Whittier Research Center Lincoln, NE 68588-0430
DUNS Number:	55-545-6995
EIN:	47-0049123
Recipient Identifying Number or Account Number:	25-6222-0611-001
Project/Grant Reporting Period:	5/3/17 - 5/2/18
Reporting Period End Date:	05/02/18

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Breed Scab Resistant Hard Winter Wheat Varieties for the Northern Great Plains.	$ 53,876
	FY17 Total ARS Award Amount	$ 53,876

P. Stephen Baenziger — July 25, 2018

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: *Breed Scab Resistant Hard Winter Wheat Varieties for the Northern Great Plains.*

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

The main goals of this project were to: 1. develop new cultivars with superior Fusarium head blight (FHB) tolerance and reduced DON, and 2. Determine how fungicide management might supplement/augment genetic-based FHB tolerance.

2. What was accomplished under these goals?

Under goal 1, we made 76 new crosses specifically for FHB tolerance. Over 400 crosses involved lines with better than average FHB tolerance. In addition, we made a number of crosses for anther extrusion for our hybrid wheat efforts. If anthers/filaments are involved with FHB infection, these anther extruding lines may reduce the level of FHB in the lines. We had a minimum of 78 F_2 and 79 F_3 populations and 3920 headrows specifically made for FHB tolerance. By markers, 10 out of our 280 lines in our preliminary yield nursery have *Fhb1*. This level is high enough that we hope to include the *Fhb1* locus as a routine call in our genome wide scan used in genotyping (currently 11 traits are identified in our genome scans) and genomic selection. We continue to screen for native and major gene resistance in our preliminary, advanced, and elite nurseries, as well as screen the Nebraska State Variety Trial, the USDA-Regional Germplasm Observation Nursery, and the northern public and private hard winter wheat screening nurseries. We also began exploring the detached leaf assay which is very difficult, so to increase our selection precision and power, we have begun cooperating with Dr. Ann McKendry to screen our preliminary observation nursery for FHB tolerance (doubling the number of tests on this nursery). Our in house screening has greatly improved due to previous support from the Initiative to modernize our misting nursery. However, weather variation remains a constraint to effective screening in Nebraska. In 2018, we experienced drought and 102 F temperatures at flowering. To increase the frequency of *Fhb1* in our program we have begun a dedicated backcrossing program to put the *Fhb1* and additional genes into our elite backgrounds. There is one significant result and achievement. Four elite lines, NE13604, NW13493, NE13515, and NE14696, all of which are under consideration for release, have superior FHB tolerance. At a minimum, they are excellent parents and will increase our level of FHB tolerance in the program.

Under goal 2, we continue to spray our elite nursery with a full complement of fungicides at flag leaf and at flowering with the hope of controlling foliar fungal diseases including FHB. In 2017, the harvest of this trial occurred during this funding period and the fungicides increased grain yield by 18% (4,783 kg/ha^{-1} for fungicide treated compared to 4,047 kg/ha^{-1} for untreated). Natural FHB infection and disease was not measurable in this experiment. Hence the yield improvement was due to other fungal diseases (mainly leaf rust). There were no significant outcomes or achievements related to breeding for FHB tolerance under this goal.

3. What opportunities for training and professional development has the project provided?

We recruited Ms. Fang Wang as a graduate student on this project. She is supported by the Initiative and by the Chinese Scholarship Council. She has spent much of her time determining if the detached leaf assay is a potential way to screen for FHB tolerance. Her molecular biology skills are considerable and she will assist with genomic selection and molecular marker work in the future.

4. How have the results been disseminated to communities of interest?

To communicate these results we use a variety of different media approaches from Twitter to field days to news releases to radio and television interviews. Our Twitter followers are 1576 (verified on July 20, 2018) and reach many of the influential growers and seed producers in our state. We did field days in the main scab prone regions of the state (two in eastern Nebraska, three in southwestern Nebraska, and one at an irrigated nursery in western Nebraska). Approximately 480 growers and crop consultants attended the six field days. Furthermore we did three major seed days (when seed is being purchased) that reached approximately 350 growers. We also disseminated results and information on FHB and other wheat diseases and their management through oral presentations at Crop Production Clinics (CPCs) which are held in January of every year. In 2017, CPC attendees (mainly growers and crop consultants) totaled 1,558 at nine locations throughout the state. Other channels through which we disseminated results and information were the Nebraska Farmer magazine (a regional magazine) and the University of Nebraska CropWatch newsletter which has a national audience. In 2017 CropWatch articles had 213,813 page views and the newsletter has 5,961 Twitter followers and 3,324 email subscribers.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY17 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 FY17 award period?** No.

   If yes, how many? 0

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY17 award period?** No, however, a Fulbright scholar who studied the effect of foliar fungicides on fungal diseases in eastern Nebraska, did successfully complete his Ph.D. FHB was a major disease during the first year of his study (2015).

   If yes, how many? One—see above.

3. **Have any post docs who worked for you during the FY17 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?** No

   If yes, how many? 0

4. **Have any post docs who worked for you during the FY17 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? 0

Release of Germplasm/Cultivars

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
LCS Link*	HRW	S/MS	4	2017

*LCS Link was jointly developed by Limagrain Cereal Seeds and the University of Nebraska via a shared doubled haploid breeding program. It is an excellent line targeted for irrigated production or high management cropping systems. As Limagrain was the lead on releasing the line, the best source of information on the line is: https://limagraincerealseeds.com/hard-red-winter-wheat-seed/lcs-link/ In the Limgrain trials, they list the line as being intermediate for FHB. However, I tend to be harsher and consider the line as susceptible to moderately susceptible to FHB. LCS Link's targeted region in Nebraska is where fungicides are commonly used or where it is commonly too dry at flowering to be promote FHB. I alert growers to its FHB level of tolerance in the scab prone region of Nebraska.

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

Instructions: Refer to the FY17-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY17 grant. Only include citations for publications submitted or presentations given during your award period (5/3/17 - 5/2/18). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each reference/citation, you must indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in publication/ presentation.

Journal publications.

Bhatta, M., T. Regassa, **S. N. Wegulo**, and **P. S. Baenziger**. 2018. Foliar fungicide effects on disease severity, yield, and agronomic characteristics of modern winter wheat genotypes. Agronomy Journal. 110. 1-9. 10.2134/agronj2017.07.0383.
Status: Published
Acknowledgement of Federal Support: No

Books or other non-periodical, one-time publications.

Wegulo, S.N. 2017. Integrated wheat disease management. Pages 417-441 in: Achieving Sustainable Cultivation of Wheat Vol. 1: Breeding, quality traits, pests and diseases. P. Langridge (Ed.). Burleigh Dodds Science Publishing, Cambridge, UK.
Status: Published
Acknowledgement of Federal Support: No

Other publications, conference papers and presentations.

Bolanos-Carriel, C., Hallen-Adams, H., **Wegulo, S. N**., **Baenziger, P. S.**, Eskridge, K. M., Funnell-Harris, D., McMaster, M., and Schmale III, D. G. 2017. Toxin gene expression analysis and deoxynivalenol concentration during postharvest storage of wheat grain from a Fusarium head blight epidemic in Nebraska. Page 31 in: Proceedings of the 2017 National Fusarium Head Blight Forum. Hyatt Regency Milwaukee, Milwaukee, Wisconsin, USA. December 3-5, 2017.
Status: Published
Acknowledgement of Federal Support: No