**USDA-ARS/**
**U.S. Wheat and Barley Scab Initiative**
**FY16 Final Performance Report**
**Due date:** July 28, 2017

## Cover Page

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|---|---|
| **Principle Investigator (PI):** | Stephen Baenziger |
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| **Phone:** | 402-472-1538 |
| **Fiscal Year:** | 2016 |
| **USDA-ARS Agreement ID:** | 59-0206-4-011 |
| **USDA-ARS Agreement Title:** | Enhance Variety Development of Scab Resistant Hard Winter Wheat Varieties in Nebraska. |
| **FY16 USDA-ARS Award Amount:** | $ 53,981 |
| **Recipient Organization:** | University of Nebraska<br>Sponsored Programs<br>2200 Vine St., 151 Whittier Research Center<br>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:** | 5/3/16 - 5/2/17 |
| **Reporting Period End Date:** | 05/02/17 |

## 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. | $ 53,981 |
| | **FY16 Total ARS Award Amount** | **$ 53,981** |

P. Stephen Baenziger 7/18/17
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?**

Our major goal is to develop cultivars with improved scab resistance coupled with improved management to reduce the detrimental effects of scab and DON. Our objectives are: 1. Use our newly renovated scab mist and naturally infected nurseries to identify lines with improved scab tolerance and reduced DON with: a) native resistance (e.g. Overland, Lyman, Everest, Art, SY Wolf, Hitch, and new experimental lines), b) known major Fhb tolerance QTLs (e.g. Overland *Fhb1* isolines), and the recently developed doubled haploid lines with *Fhb1*, and other new lines from Great Plains breeding programs), 2. Use designed crosses and molecular markers to introgress and pyramid known QTLs (Fhb1, Fhb3, 5As, etc.) in native resistance backgrounds, and 3. Advance lines through a full range of agronomic, scab and other disease, winter hardiness, and end-use quality tests.

**2. What was accomplished under these goals?** *Address items 1-4) below for each goal or objective.*

1) Use our newly renovated scab mist and naturally infected nurseries to identify lines with improved scab tolerance and reduced DON with: a) native resistance (e.g. Overland, Lyman, Everest, Art, SY Wolf, Hitch, and new experimental lines), b) known major Fhb tolerance QTLs (e.g. Overland *Fhb1* isolines), and the recently developed doubled haploid lines with *Fhb1*, and other new lines from Great Plains breeding programs), In our research we continued to screen our preliminary, advanced, and elite yield trials for FHB. We screened a total of 997 wheat lines for resistance to FHB in the field. FHB index and DON levels were generally low (≤ 30% index and ≤ 5 ppm DON for most of the lines) due to unfavorable weather conditions for FHB development for which our mist system was unable to compensate. We continue to find low levels of native resistance which are then recycled as parents lines to make future crosses. The *Fhb1* lines developed via previous backcrossing s are being extensively used as parents and in our preliminary nursery we now have 24 lines with the Fhb1 marker and 2 that are heterogenous. This represents a very favorable trajectory and is approximately 10% of the lines in the preliminary trial (n=270).

   While no new cultivar was released, it is important to note that Overland *Fhb1* (Listed as Overland FHB-10 because we tested many backcross lines) was tested in the Northern Regional Performance nursery (see Table 3.) and was in the top half of the trial. It performed similarly to Overland. It should be a good parent line for those needing a source of *Fhb1* in an adapted winter background. NOTE: Lines highlighted in red font were developed collaboratively by this program.

**Table 3. Agronomic Summary of 2016 Northern Regional Performance Nursery**

| | | Grain Yield | | Grain Volume Weight | | Heading Date | | Plant Height | |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Rank | Mean | Rank | Mean | Rank | Mean | Rank |
| Entry | Line | (kg/ha) | | (kg/hl) | | *(DOY)* | | (cm) | |
| 1 | Kharkof | 3145 | 32 | 77.2 | 24 | 157 | 27 | 110 | 1 |
| 2 | Overland | 4520 | 15 | 76.8 | 18 | 154 | 13 | 88 | 11 |
| 3 | Wesley | 4206 | 26 | 74.4 | 5 | 153 | 4 | 77 | 32 |
| 4 | Jagalene | 4577 | 13 | 78.0 | 28 | 153 | 7 | 83 | 23 |
| 5 | Jerry | 3597 | 31 | 75.1 | 7 | 157 | 28 | 94 | 2 |
| 6 | LJ083 or AAC Elevate | 4047 | 29 | 75.6 | 8 | 157 | 31 | 84 | 22 |
| 7 | LCH13NEDH-5-59 | 4581 | 12 | 76.3 | 14 | 154 | 17 | 88 | 10 |
| 8 | PSB13NEDH-14-31 | 4606 | 8 | 76.7 | 17 | 157 | 29 | 81 | 30 |
| **9** | **PSB13NEDH-14-83** | **4770** | **3** | 78.4 | 30 | 154 | 9 | 85 | 18 |
| **10** | **PSB13NEDH-14-71** | **4692** | **5** | 76.9 | 20 | 154 | 11 | 82 | 27 |
| **11** | **LCH13NEDH-14-69** | **4853** | **1** | 77.1 | 22 | 153 | 6 | 78 | 31 |
| 12 | LCH13-056 | 4684 | 6 | 76.3 | 15 | 153 | 2 | 84 | 21 |
| 13 | NI12702W | 4425 | 20 | 79.5 | 32 | 155 | 20 | 85 | 19 |
| 14 | NE12561 | 4382 | 21 | 77.4 | 26 | 154 | 8 | 82 | 29 |
| 15 | NE12589 | 4311 | 23 | 77.2 | 25 | 152 | 1 | 82 | 26 |
| 16 | Overland FHB-10 | 4583 | 11 | 77.1 | 23 | 154 | 12 | 89 | 8 |
| 17 | NE13425 | 4627 | 7 | 78.5 | 31 | 154 | 15 | 86 | 15 |
| 18 | NE13434 | 4601 | 9 | 76.2 | 12 | 154 | 10 | 87 | 14 |
| 19 | NE13604 | 4584 | 10 | 76.6 | 16 | 156 | 23 | 89 | 9 |
| **20** | **NW13669** | **4783** | **2** | 76.2 | 11 | 156 | 22 | 87 | 13 |
| 21 | NE13672 | 3819 | 30 | 72.6 | 1 | 154 | 16 | 82 | 28 |
| 22 | NE13625 | 4048 | 28 | 78.0 | 29 | 153 | 3 | 84 | 20 |
| 23 | MTS1224 (Loma) | 4282 | 24 | 74.2 | 2 | 158 | 32 | 83 | 24 |
| 24 | MT1257 | 4328 | 22 | 74.3 | 3 | 156 | 26 | 92 | 4 |
| 25 | MT1265 | 4505 | 17 | 74.4 | 4 | 157 | 30 | 92 | 5 |
| 26 | SD08200 | 4439 | 19 | 77.0 | 21 | 154 | 19 | 90 | 7 |
| 27 | SD09113 | 4279 | 25 | 74.5 | 6 | 155 | 21 | 85 | 17 |
| 28 | SD09227 | 4507 | 16 | 76.8 | 19 | 156 | 25 | 90 | 6 |
| 29 | SD10257-2 | 4498 | 18 | 77.7 | 27 | 154 | 14 | 93 | 3 |
| **30** | **SD110060-7** | **4722** | **4** | 76.1 | 9 | 154 | 18 | 83 | 25 |
| 31 | SD110085-1 | 4080 | 27 | 76.3 | 13 | 156 | 24 | 88 | 12 |
| 32 | SD10W153 | 4556 | 14 | 76.1 | 10 | 153 | 5 | 86 | 16 |
| | SAS Mean | 4396 | | 76.4 | | 155 | | 87 | |
| | l.s.d. (alpha = 0.05) | 229 | | | | | | | |
| | MSE | 316193 | | | | | | | |
| | n | 47 | | | | | | | |
| | CV | 12.8 | | | | | | | |

2) Use designed crosses and molecular markers to introgress and pyramid known QTLs (Fhb1, Fhb3, 5As, etc.) in native resistance backgrounds, Our emphasis has been on *Fhb1* but as other sources are being pyramiding by Dr. Bai's group we are incorporating those sources in to our breeding effort. Our belief is that it is best to begin with pyramided sources to create our pyramids in locally adapted lines.

and

3) Advance lines through a full range of agronomic, scab and other disease, winter hardiness, and end-use quality tests. In this research, our fungicide treated (three fungicide treatments) vs. untreated trials have proved to be very valuable. Most of our diseases are very visual and many are controlled by fungicides (the exceptions being wheat soilborne mosaic virus and bacterial streak). Wheat soilborne mosaic virus

resistance is very common in our lines, so this confounding disease is rare. Bacterial streak can be common but it is less so in the past three years. Hence using the fungicide treated plots we can compare grain yields and other agronomic traits with fully controlled diseases to those that are visually scored in the untreated plots. The first year of this effort identified scab as causing a 20% yield loss and very high DON (> 4ppm) levels. The second year, scab was less common and important. This year scab was also infrequent. However, this research is giving us very useful information to provide to growers and the Management Group on which genotypes respond to fungicide applications.

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

The main graduate student training activity has been for Mr. Javed Sidiqi, a Fulbright Scholar from Afghanistan, who has been studying the effect of disease and disease management on grain yield in eastern Nebraska. In his first year, Fusarium head blight was a major disease coupled with stripe rust. In the second year, stripe rust was a major disease. The third year is underway now, but Fusarium head blight has been minor, while stripe and leaf rust have been major concerns. All of the graduate students assist (5 additional students) with the Fusarium misting nurseries, hence all are familiar with the disease and the protocols to measure the disease and its affects on plants.

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

We have disseminated the results via field days, radio interviews, newspaper interviews, extension circular, and social media (mainly twitter). In addition, our improved cultivars have been disseminated through our certified seed industry. Our crop management protocols have been refined and improved and disseminated using the above approaches.

# Training of Next Generation Scientists

**Instructions:** Please answer the following questions as it pertains to the FY16 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 FY16 award period?** No graduate student was supported by the USWBSI in 2016-2017. However other students on the project who have tangentially worked on scab did complete their M.S.

   **If yes, how many?** 1. Nicholas Garst.

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY16 award period?** No graduate student was supported by the USWBSI in 2016-2017. However other students on the project who have tangentially worked on scab did complete their Ph.D.

   **If yes, how many?** 1. Wasseem Hussain.

3. **Have any post docs who worked for you during the FY16 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 FY16 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 FY16 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** |
|---|---|---|---|---|
| No New Cultivar released | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

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

**Instructions:** Refer to the FY16-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY16 grant. Only include citations for publications submitted or presentations given during your award period (5/3/16 - 5/2/17). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

**Journal publications.**
None

**Books or other non-periodical, one-time publications.**
None.

**Other publications, conference papers and presentations**.
Council for Agricultural Science and Technology (CAST). 2017. Plant Breeding and Genetics—A paper in the series on The Need for Agricultural Innovation to Sustainably Feed the World by 2050. Issue Paper 57. CAST, Ames, Iowa. Writing Committee: P.S. Baenziger and R. H. Mumm (Cochairs), R. Bernardo, E.C. Brummer, P. Langridge, P. Simon, and S. Smith. CAST Liaison: W. Srnic,
Status: Published.
Acknowledgement of Federal Support: No.

**Proceedings Abstracts:**
Bolanos-Carriel, C., Wegulo, S.N., Hallen-Adams, H., Baenziger, P.S., Eskridge, K.M., and Funnell-Harris, D. "Effects of cultivar resistance, fungicide application timing, and fungicide chemical class on FHB and DON in winter wheat." *Proceedings of the 2016 National Fusarium Head Blight Forum*, December 4-6, 2016. Hyatt Regency St. Louis, MO. Ed. S. Canty, K. Wolfe, D. Van Sanford. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. 2016. 9-10. Digital Print.
Status: Published.
Acknowledgement of Federal Support: Yes.

Bolanos-Carriel, C., Wegulo, S.N., Hallen-Adams, H., Baenziger, P.S., Eskridge, K.M., Funnell-Harris, D., McMaster, N., and Schmalle III, D. G. "Effects of fungicides, time, and grain moisture content on postharvest accumulation of DON in winter wheat." *Proceedings of the 2016 National Fusarium Head Blight Forum*, December 4-6, 2016. Hyatt Regency St. Louis, MO. Ed. S. Canty, K. Wolfe, D. Van Sanford. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. 2016. 11-12. Digital Print.
Status: Published.
Acknowledgement of Federal Support: Yes.