

**USDA-ARS/  
U.S. Wheat and Barley Scab Initiative  
FY14 Final Performance Report  
July 15, 2015**

**Cover Page**

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<b>Fiscal Year:</b>	FY14
<b>USDA-ARS Agreement ID:</b>	59-0206-4-011
<b>USDA-ARS Agreement Title:</b>	Enhance Variety Development of Scab Resistant Hard Winter Wheat Varieties in Nebraska.
<b>FY14 USDA-ARS Award Amount:</b>	\$ 43,780

**USWBSI Individual Project(s)**

<b>USWBSI Research Category*</b>	<b>Project Title</b>	<b>ARS Award Amount</b>
HWW-CP	Enhance Variety Development of Scab Resistant Hard Winter Wheat Varieties in Nebraska.	\$ 43,780
	<b>FY14 Total ARS Award Amount</b>	<b>\$ 43,780</b>

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Principal Investigator

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Date

\* MGMT – FHB Management

FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain

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

WES-CP – Western 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 major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

Nebraska has had major scab epidemics in 2007, 2008, 2013, and currently in 2015. 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 (manly *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 2014-2015 crossing blocks we made 66 designed crosses involving named *Fhb* resistance/tolerance genes (mainly *Fhb1* or well-known native resistance lines). 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 F<sub>6</sub> preliminary nursery, 12 lines were homogeneous or heterogeneous for *Fhb1* (out of 270 experimental lines); which is among the highest frequency of lines with *Fhb1* in this nursery. Six lines in the advanced yield trial were homogeneous or heterogeneous for *Fhb1* (out of 57 experimental lines). As would be expected, to release a truly scab resistant cultivar, we will need many additional traits. New lines developed using doubled haploidy have been requested and they should provide additional diversity for important disease resistances beyond FHB. To further our molecular marker research, we recently were awarded a KASP marker system. 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 growers will be able to grow scab resistant/tolerant lines routinely. To better understand the role of genetics and fungicides, we initiated a study where two replications of our elite nursery (60 entries) were sprayed with fungicides at flag leaf and at flowering (the latter with Caramba®) to control disease. Two additional replications were not sprayed. Scab is rampant in our eastern NE nurseries and these treatments have greatly reduced scab symptoms in the treated plots. 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:** Sixty wheat lines were screened in the greenhouse and a total of 1,105 lines (including the 60 screened in the greenhouse) were screened in the field for resistance to FHB.

**Impact:** Lines found to have moderate resistance to FHB will be advanced in the breeding program. Cultivars released in future from these lines will yield more due to FHB resistance, leading to increased profits and therefore improved economic and social lives for wheat growers in Nebraska and surrounding states.

**Accomplishment:** While no new wheat cultivars were released, good progress continues on our development of scab tolerant lines, especially through the use of molecular markers.

**Impact:** We are closer to lines with truly better scab tolerance/resistance above that of native resistance (e.g. Overland, Lyman, Art, Hitch, Everest, etc.)

**Accomplishment:** Grower awareness of the importance of fungicides to control disease has greatly increased. This year we had the wettest May in history in most of Nebraska. Though it is too early to know the full extent of fungicide application, we are heartened that virtually every grower associated with certified seed production or the state variety trial have used fungicides to control disease, many using Prosaro® or Caramba® at flowering to control stripe rust and scab.

**Impact:** Again it is too early to know, but every field day we have been at, the growers have been discussing how important fungicides were this year to control foliar diseases including scab. Scabsmart is also widely discussed. This level of discussion, knowledge, and use of Scabsmart and fungicides should greatly reduce scab and DON in our Nebraska wheat crop.

### **Training of Next Generation Scientists**

**Instructions:** Please answer the following questions as it pertains to the FY14 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 FY14 award period?** My project and that of Dr. Wegulo’s work as teams. As such, all of our students work in part on our scab research, however, no students received direct funding from the USWBSI.

**If yes, how many?** No M.S. students completed their degrees in FY2014

- 2. Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY14 award period?** Again, my project and that of Dr. Wegulo’s work as teams. As such, all of our students work in part on our scab research, however, no students received direct funding from the USWBSI.

**If yes, how many?** 2. Juthamas Fakhongphan and Tadele Tadessa Kumsa. Tadele was a MBBIS, but had responsibility to help with the scab project.

- 3. Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?** In this case we have insufficient funds to hire postdocs.

**If yes, how many?**

- 4. Have any post docs who worked for you during the FY14 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 as per the response above.

**If yes, how many?**

**Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY14 award period. List the release notice or publication. Briefly describe the level of FHB resistance. If not applicable because your grant did NOT include any VDHR-related projects, enter N/A below.**

None in 2014-2015. We are increasing NE10589 (a winter wheat) for release in 2015-2016 which seems to have some tolerance to scab. Two additional winter barley lines are under discussion for release/licensing also.

**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 FY14 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.**

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.*: accepted.

Eckard, J.T. M. Caffè, 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.

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>

Bockus, W. W., Zhang, G., Fritz, A., Davis, M., Baenziger, P., and Caffè-Treml, M. 2015. Reaction of Kansas, Nebraska, and South Dakota winter wheat accessions to Fusarium head blight (FHB), 2014. (online) *Plant Disease Management Reports* 9:CF004. DOI:10.1094/PDMR09. The American Phytopathological Society, St. Paul, MN.