

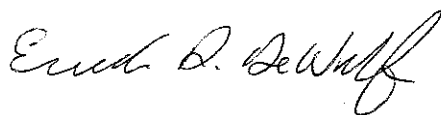
**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY15 Final Performance Report
Due date: July 15, 2016**

Cover Page

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| Principle Investigator (PI): | Erick De Wolf |
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| Phone: | 785-532-3968 |
| Fiscal Year: | 2015 |
| USDA-ARS Agreement ID: | 59-0206-1-110 |
| USDA-ARS Agreement Title: | Development of Scab Resistant Wheat Cultivars for Kansas. |
| FY15 USDA-ARS Award Amount: | \$ 40,960 |
| Recipient Organization: | Kansas State University 10 Anderson Hall Manhattan, KS 66506 |
| DUNS Number: | 929773554 |
| EIN: | 48-0771751 |
| Recipient Identifying Number or Account Number: | AR9934 / GAPP602117 |
| Project/Grant Reporting Period: | 04/21/15-04/20/16 |
| Reporting Period End Date: | 04/20/16 |

USWBSI Individual Project(s)

| USWBSI Research Category* | Project Title | ARS Award Amount |
|----------------------------------|---|-------------------------|
| HW-CP | Development of Scab Resistant Wheat Cultivars for Kansas. | \$ 40,960 |
| | FY15 Total ARS Award Amount | \$ 40,960 |



Principal Investigator

7/1/16

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
 HW-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: *Development of Scab Resistant Wheat Cultivars for Kansas.*

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

The long-term goal of this research is to develop hard red and hard white winter wheat cultivars adapted for Kansas with improved resistance to scab. Short term objectives are to: 1) test existing local cultivars for resistance, 2) test advanced breeding lines for resistance, 3) test exotic germplasm lines for resistance, 4) test the Hard Winter Wheat Scab Nursery (Kansas, Nebraska, South Dakota, North Dakota) for reaction to scab, and 5) incorporate new sources of scab resistance into the Kansas wheat breeding program. Testing will be done in misted field nurseries using soil-applied infested corn grain inoculum and in the greenhouse using single-floret inoculations. Visual disease evaluation methods will be used to rate the percentage spikelets killed by the pathogen and ground grain samples will be analyzed for the toxin DON.

2. What was accomplished under these goals?

1) major activities.

Until involvement in the USDA Scab Initiative, there was virtually no effort to identify sources of scab resistance in Kansas breeding programs. The Initiative has resulted in the development of accurate and efficient greenhouse and field testing nurseries that are providing useful ratings for current cultivars in Kansas and advanced breeding lines, and allow participation in the regional scab nurseries.

2) specific objectives.

The FHB phenotyping nurseries allow dissemination of information to growers on the reaction of current commercial cultivars, selection by breeders for scab resistance in their breeding lines, and identification of additional sources of resistance from other breeding efforts in the region that can be incorporated into Kansas breeding lines. Kansas has also taken the lead in organizing a Hard Winter Wheat Scab Screening Nursery for the hard winter wheat breeding programs of Kansas, Nebraska, South Dakota, and North Dakota. This latter nursery provides valuable data on the reaction of hard winter wheat cultivars to scab in their area of adaptation. The long-term goal of the research is to develop, deploy, and advertise winter wheat cultivars adapted for Kansas with improved levels of resistance to scab.

3) significant results.

Two commercial cultivars in Kansas (Hondo and Heyne) were identified in 2000 (and confirmed in later years) as having good levels of scab resistance (3 and 4 on the 1-9 scale where 1=immune and 9=highly susceptible). These cultivars averaged only 12 and 15% scab, respectively compared with about 50% in susceptible cultivars. Similarly, the cultivar Lakin has shown moderate levels of resistance with 22-34% scab. Six other commercial cultivars have also displayed moderate levels of resistance equal to, or better than, Lakin. Therefore, we have identified a few sources of scab resistance already present in cultivars adapted to Kansas that can be used by producers and may be potential sources of “native” resistance for the development of future cultivars. Both KSU wheat

breeders and the USDA wheat geneticist have been involved in the project by having their breeding lines evaluated for resistance to scab. Several breeding “populations” are tested each year from which the breeders make selections of promising lines showing resistance. Also, there are approximately 40 advanced breeding lines (The Kansas Intrastate Nursery) that are tested each year. In 2009, Kansas State University released the first hard red winter wheat cultivar adapted to Kansas selected for improved levels of resistance to scab.

4) key outcomes or other achievements

Because of the scab testing efforts, a new column for reaction to “Head Scab” was added to the popular KSU extension publication *Wheat Variety Disease and Insect Ratings* for the fall, 2000 issue and has been updated in each subsequent year. For the first time, this has allowed producers in Kansas to use the reaction to scab to help select cultivars for planting. Similarly, data produced from nurseries funded by the Scab Initiative have been incorporated into another popular extension publication (*Kansas Performance Tests with Winter Wheat Varieties*). Both publications are available as “hard copy” or online. The involvement of breeders has resulted in significant progress to improve the level of resistance to scab in future commercial wheat cultivars. This research has resulted germplasm releases in 2004 and 2014 from Kansas State University with resistance to scab. It normally takes 10-12 years to produce a new wheat cultivar from the time initial crosses are made. Right on schedule, the first Kansas scab-resistant cultivar (Everest) produced directly from the activity of the Initiative was released in Fall 2009, 10 years after beginning to receive funding from the Initiative. It has increased in popularity so that it is now is the number one planted cultivar in Kansas. The adoption of this cultivar has significantly lowered the susceptibility of the state’s wheat crop to scab; 22% lower statewide and 40% lower in the eastern part of the state where scab is prevalent.

3. What opportunities for training and professional development has the project provided? None

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

Reports of the phenotyping nurseries are sent to all cooperating breeding programs. These include the public wheat breeding efforts in Kansas, Nebraska, South Dakota, and North Dakota. Similar reports are sent to the breeding efforts in participating private companies (AgriPro, Limagrain, and West Bred). As noted above, the extension publications *Wheat Variety Disease and Insect Ratings* and *Kansas Performance Tests with Winter Wheat Varieties* are updated each year for access online or via paper copies by wheat producers, county agents, and crop consultants.

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? No**

If yes, how many?

- 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 |
|----------------------------|-------------|---|------------------------|------------------|
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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

Refer to the FY15-FPR_Instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY15 grant. If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

Journal publications.

1. Peiris, K. H. S., Bockus, W. W., and Dowell, F. E. 2016. Near-infrared spectroscopic evaluation of single-kernel deoxynivalenol accumulation and Fusarium head blight resistance components in wheat. *Cereal Chemistry* 93:25-31, <http://dx.doi.org/10.1094/CCHEM-03-15-0057-R>.
Status: Journal Publication Published
Acknowledged Fed. Support: Yes
2. Wegulo, S. N., Baenziger, P. S., Hernandez Nopsa, J., Bockus, W. W., and Hallen-Adams, H. 2015. Management of Fusarium head blight of wheat and barley. *Crop Protection* 73:100-107 (KAES # 15-177-J).
Status: Journal Publication Published
Acknowledged Fed. Support: Yes
3. Cainong, J. C., Bockus, W. W., Feng, Y., Chen, P., Qi, L., Sehgal, S. K., Danilova, T. V., Koo, D-H., Friebe, B., and Gill, B. S. 2015. Chromosome engineering, mapping, and transferring of resistance to Fusarium Head Blight disease from *Elymus tsukushiensis* into wheat. *Theor. Appl. Genet.* DOI 10.1007/s00122-015-2485-1 (KAES# 14-395-J).
Status: Journal Publication Published
Acknowledged Fed. Support: Yes
4. Eckard, J. T., Gonzalez-Hernandez, J. L., Caffè, M., Berzonsky, W., Bockus, W. W., Marais, F. G., and Baenziger, P. S. 2015. Native Fusarium head blight resistance from winter wheat cultivars 'Lyman', 'Overland', 'Ernie', and 'Freedom' mapped and pyramided onto 'Wesley'-*Fhb1* backgrounds. *Molecular Breeding* doi:10.1007/s11032-015-0200-1 (KAES # 14-373-J).
Status: Journal Publication Published
Acknowledged Fed. Support: Yes

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

Other publications, conference papers and presentations.

1. Bockus, W. W., De Wolf, E., and Wegulo, S. N. 2015. Effect of fungicide application on Fusarium head blight in eight winter wheat cultivars, 2014. (online) *Plant Disease Management Reports* 9:CF003. DOI:10.1094/PDMR09. The American Phytopathological Society, St. Paul, MN.
Status: Peer Reviewed Technical Report
Acknowledged Fed. Support: Yes

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2. 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.
Status: Peer Reviewed Technical Report
Acknowledged Fed. Support: Yes
3. Appel, J. A., De Wolf, E., Todd, T., and Bockus, W. W. 2015. Preliminary 2015 Kansas Wheat Disease Loss Estimates. Kansas Cooperative Plant Disease Survey Report. (<https://agriculture.ks.gov/docs/default-source/pp-disease-reports-2012/2015-ks-wheat-disease-loss-estimates35b3d4002e6262e1aa5bff0000620720.pdf?sfvrsn=0>)
Status: Technical Report
Acknowledged Fed. Support: Not allowed for this publication type
4. De Wolf, E. D., Bockus, W. W., and Whitworth, J. R. 2015. Wheat Variety Disease and Insect Ratings 2015. Kansas Cooperative Extension Service publication MF-991. 4 pp.
Status: Technical Report
Acknowledged Fed. Support: Not allowed for this type of publication
5. Bockus, W. W., Appel, J. A., De Wolf, E. D., Todd, T. C., Davis, M. A., and Fritz, A. K. 2015. Impact of wheat cultivar Everest on yield loss in Kansas from Fusarium head blight during 2015. Poster presented at the USWBSI conference, St. Louis, MO.
Status: Presentation and Abstract
Acknowledged Fed. Support: Yes
6. Fatima, N., Bai, G., and Bockus, W. 2015. Mapping quantitative trait loci for Fusarium head blight resistance in hard winter wheat Overland. Poster presented at the USWBSI conference, St. Louis, MO.
Status: Presentation and Abstract
Acknowledged Fed. Support: Yes
7. K. H. S. Peiris, Y. Dong, W. W. Bockus, and F. E. Dowell. 2015. Moisture content of grain samples affects the performance of near-infrared spectroscopic calibration for estimation of DON levels in wheat. In: S. Canty, A. Clark, S. Vukasovich and D. Van Sanford (Eds.), *Proceedings of the 2015 National Fusarium Head Blight Forum* (pp. 77-78). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.
Status: Presentation and Abstract
Acknowledged Fed. Support: Yes
8. Peiris, K. H. S., Bockus, W. W., and Dowell, F. E. 2015. Near infrared spectroscopic method for evaluating resistance to deoxynivalenol accumulation in wheat. International Grain Quality and Food Security Conference. Manhattan, KS August 3-6, 2015.
Status: Presentation and Abstract
Acknowledged Fed. Support: Yes