

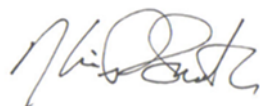
USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY17 Final Performance Report
Due date: July 31, 2018

Cover Page

Principle Investigator (PI):	Kevin Smith
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Fiscal Year:	2017
USDA-ARS Agreement ID:	59-0206-4-020
USDA-ARS Agreement Title:	Breeding and Genetics of Fusarium Head Blight Resistance in Barley.
FY17 USDA-ARS Award Amount:	\$ 155,901
Recipient Organization:	Regents of the University of Minnesota Suite 450 Sponsored FIN RPT-P100100001 Minneapolis, MN 55455-2003
DUNS Number:	555917996
EIN:	41 -6007513
Recipient Identifying Number or Account Number:	CON000000048320
Project/Grant Reporting Period:	5/13/17 - 5/12/18
Reporting Period End Date:	05/12/18

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	Developing Malting Barley Varieties with Enhanced FHB Resistance and Lower DON.	\$ 88,959
BAR-CP	Investigating Genomic Selection for Fusarium Head Blight Resistance in Barley.	\$ 66,942
	FY17 Total ARS Award Amount	\$ 155,901



Principal Investigator

7/31/18

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: *Developing Malting Barley Varieties with Enhanced FHB Resistance and Lower DON.*

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

The overall goal of this project is to develop malting barley varieties with enhanced resistance to FHB and lower concentration of the mycotoxin deoxynivalenol (DON). To accomplish this goal, we are conducting a comprehensive FHB breeding effort utilizing greenhouse for crossing and single-seed advance, extensive field trials for FHB evaluation, various uses of markers to improve selection, regional yield and quality testing, and collaborative regional nurseries to evaluate elite breeding lines. We have recently added two-rowed and winter barley programs to our long-time spring six-row breeding program with the aim of increasing the tools available to manage disease risk in barley production.

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

1) major activities

We conducted FHB evaluation in misted and inoculated field nurseries at Crookston and St. Paul, MN for totaling over 7,700 plots. We evaluated FHB severity and harvested selected plots for DON. These nurseries included trials for a genetic study of population variance for FHB severity, a mapping population for a region on chromosome 6H associated with FHB resistance, first year yield trial entries for our spring two-row and spring six-row, and winter six-row breeding programs, and advanced breeding lines and varieties. We initiated new crosses in our spring six-row, spring two-row, and winter two-row breeding programs.

2) specific objectives

- Develop breeding populations segregating for FHB resistance.
- Evaluate breeding lines in replicated field disease nurseries. Field FHB trials were conducted at two locations in Minnesota that utilize overhead mist irrigation and inoculum applied as either grain spawn or as a suspension of conidia with backpack sprayers.

3) significant results

One variety candidate from our six-row spring program, S6M166 was rated satisfactory in its third year of industry malt evaluations. This line is similar in DON compared to Quest with better lodging resistance and yields equal to Lacey. It has lower protein, higher malt extract, and lower beta-glucan compared to Lacey, thus a good malting quality profile.

In our spring two-row program, we advanced three lines to their first year of industry malt evaluations with the 2018 crop. These three lines have favorable agronomics and lower DON than Pinnacle.

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4) key outcomes or other achievements

SM166 is a promising spring six-row line with improved FHB resistance that was rated satisfactory in two years of industry testing in the AMBA pilot program. It has been deemed eligible for plant scale brewing evaluation. We are currently preparing a report for industry members to review to determine their interest in testing this line. Based on that interest we will begin increasing seed for testing and a possible variety release. We designated the first three spring two-row lines from our breeding program to be entered into AMBA pilot evaluations.

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

Two undergraduate students, four graduate students, and one post-doc participated in FHB research and learned about the breeding challenges and approaches that we use thus contributing to their training and development as scientists.

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

All of our raw data is uploaded to the public database, T3 Barley, and is freely available to researchers. Results of the North American Barley Evaluation Nursery (NABSEN) are posted online. We report the FHB rating for all varieties grown in Minnesota in the Variety Trials Bulletin and in the publication Prairie Grains. I also discuss FHB breeding research at field days in Minnesota.

Project 2: *Investigating Genomic Selection for Fusarium Head Blight Resistance in Barley.*

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

The overall goal of the project is to empirically evaluate the effectiveness of genomic selection to improve the breeding of FHB resistant varieties and to develop and evaluate methods to improve prediction accuracy.

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

1) major activities

We have advanced crosses designed to test whether our models are accurate in predicting the variance of breeding populations for FHB severity and other traits. Forty populations were planted in two FHB nurseries in spring of 2016. We are now evaluating lines to determine the FHB severity and will use that data to calculate population variance to compare with our model predictions.

We are also continuing our simulation work to predict the effect of various training population design strategies on prediction accuracy and long term gain from selection.

2) specific objectives

- a) Characterize the effects of GS parameters on prediction accuracy and the identification of superior crosses, where a superior cross is one with high progeny mean and variance.
- b) Contribute to the optimization of GS of FHB resistance through better training population design.

3) significant results

In our published study, we showed that several methods of optimizing the composition of a GS training population were better than using a random set of lines. It also appears that updating the training population with the best perform was the best method or equal to the other best methods for maintaining prediction accuracy. Keeping the most recent lines from the breeding program and dropping older lines from the training population was also more accurate than leaving lines in the training population over time.

4) key outcomes or other achievements

The most interesting result was that using the best lines to update your training population was optimal. This means that breeders can use data that they already routinely generate to update the training population and do not need to conduct additional experiments solely for the purpose of training GS prediction models.

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

One graduate student is primarily involved in this research. However, we discuss this work in lab meetings so that other students and post-docs can be involved in learning from this project.

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

All of our raw data is uploaded to the public database, T3 Barley, and is freely available to researchers. We will be preparing a draft of a manuscript describing the population variance work once all of the data from this summer have been collected.

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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? Yes**

If yes, how many? 1

- 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**

If yes, how many?

- 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?

- 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?

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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 FY17 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

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

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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 (5/13/17 - 5/12/18). 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. See example below for a poster presented at the FHB Forum:

Conley, E.J., and J.A. Anderson. 2017. Accuracy of Genome-Wide Prediction for Fusarium Head Blight Associated Traits in a Spring Wheat Breeding Program. In: Proceedings of the XXIV International Plant & Animal Genome Conference, San Diego, CA.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (poster), NO (abstract)

Journal publications.

Tiede, T. and K.P. Smith. 2018. Evaluation and retrospective optimization of genomic selection for yield and disease resistance in spring barley. Mol Breeding 38:55
<https://doi.org/10.1007/s11032-018-0820-3>
Status: Published
Acknowledgement of Federal Support: Acknowledgement sections was excluded from publication by the publishers.

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

Other publications, conference papers and presentations.

Neyhart, J. and K.P. Smith. 2018. Predicting Genetic Variance and Correlation in Barley using Genomewide Markers. 2017 National Fusarium Head Blight Forum, December 3-5, 2017 Hyatt Regency Milwaukee, Milwaukee, WI.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: No (poster), Yes (abstract)