

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

Cover Page

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Fiscal Year:	2015
USDA-ARS Agreement ID:	59-0206-4-034
USDA-ARS Agreement Title:	Discovering, Understanding, and Utilizing Wheat Genes for FHB Resistance in Ohio.
FY15 USDA-ARS Award Amount:	\$ 81,913
Recipient Organization:	The Ohio State University Research Foundation Accounting Dept. 1960 Kenny Road, 4th Floor Columbus, OH 43210
DUNS Number:	07-165-0709
EIN:	31-6401599
Recipient Identifying Number or Account Number:	GRT00034867 BG001
Project/Grant Reporting Period:	07/06/15-07/05/16
Reporting Period End Date:	07/05/16

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-NWW	Discovering, Understanding, and Utilizing Wheat Genes for FHB Resistance in Ohio.	\$ 59,281
VDHR-NWW	Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials.	\$ 17,493
VDHR-NWW	Implementing Genomic Selection for FHB Resistance in Soft Winter Wheat (SWW) Adapted to the Corn Belt.	\$ 5,139
	FY15 Total ARS Award Amount	\$ 81,913



Principal Investigator

7/16/2016

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: *Discovering, Understanding, and Utilizing Wheat Genes for FHB Resistance in Ohio.*

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

Host resistance to FHB must be combined with high yield for growers to accept FHB resistant cultivars. This can be done by screening the breeding lines that are in development, building parents with good resistance and yield levels, and by designing crosses amongst such parents.

2. What was accomplished under these goals?

1) Major activities: Field screening of OSU wheat breeding lines for resistance to FHB. Use MAS to pyramid genes for FHB resistance.

2) Specific objectives: Develop SRWW germplasm and cultivars with enhanced FHB resistance.

3) Significant results: We assessed the FHB resistance of ~1,000 lines in FY15.

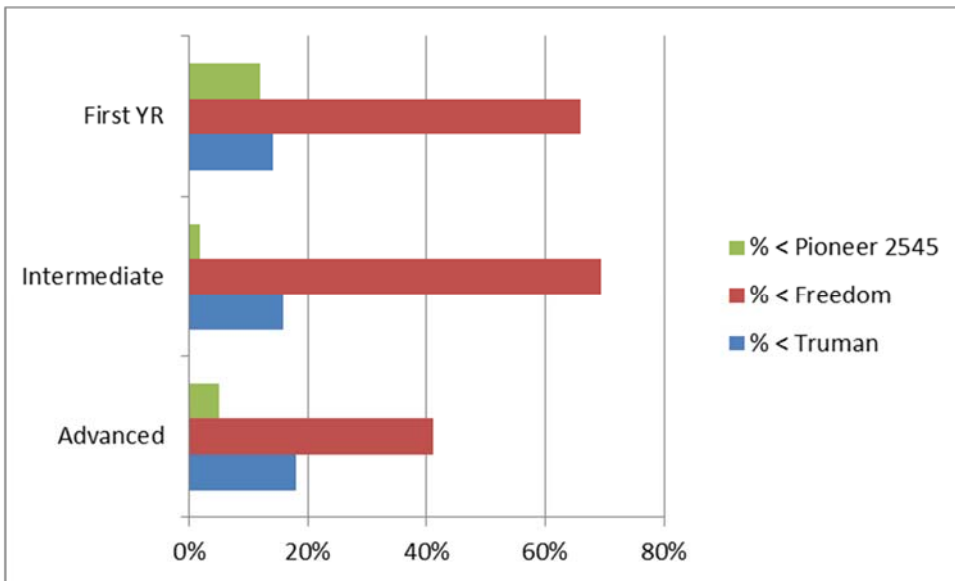


Figure 1. Percentage of OSU breeding lines in different stages of testing that fall into one of three categories of FHB resistance based on FHB Index (e.g. Index < Truman (R check), < Freedom (MR check), or > Pioneer 2545 (S check)).

At all stages of testing over 55% of the OSU lines had better FHB Index than the moderate resistant check Freedom (Freedom). In the most advanced stage of testing, 18% of the lines had better FHB resistance than Truman.

4) key outcomes or other achievements: Several breeding lines with excellent FHB resistance and yield were identified. OH09-207-68 is being increased due to its excellent yield in 2015 and 2016 yield trials, its excellent FHB resistance, and resistance to yellow rust.

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

All students work on the FHB project even if they are not directly funded by the project. This includes scoring disease, harvesting grain samples for DON analysis, as some assistance with data analysis.

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

They have not been disseminated to date.

Project 2: *Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials.*

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

Accurately predicting the FHB resistance of a breeding line or cultivar requires extensive phenotyping in field trials. The OSU program has coordinated a uniform trial of ~120 SRWW lines that are tested in 8-15 locations per year. The lines come from ~13 public and private breeding programs. This provides robust data on FHB resistance so the breeders can make informed decisions on what lines to release and which to use as parents.

In addition to breeding lines, we also screen the OSU Official Variety Trial (OVT) for FHB resistance.

2. What was accomplished under these goals?

1) major activities: Screening entries in a series of uniform tests designed to evaluate promising lines for their yield, quality and resistance to FHB and other diseases and pests.

2) specific objectives: Screen entries in the PNUWWSN, NUWWSN, UE, UEWW, 5STP, 5STA, and MD uniform trials. Evaluate the FHB resistance of all lines in the Official Wheat Performance Trials (OWPT) of commercial cultivars that are being marketed to growers. The PNUWWSN and NUWWSN are designed specifically to assess FHB resistance of SRWW and SWWW adapted to the northern US. These lines are also evaluated for their quality and their marker profiles for key genes associated with FHB resistance and other traits.

3) significant results: Data has been compiled for all tests. The report for the PNUWWSN and NUWWSN has been distributed to all cooperators and posted on the USWBSI website. Results from the other uniform trials have been distributed to cooperators. The results of the OWPT are distributed to growers via extension avenues and scab smart.

4) key outcomes or other achievements: Good levels of FHB resistance were noted in the PNUWWSN and the NUWWSN.

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

Students studying with many of the cooperators are involved in rating the various uniform trials.

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

The report for the PNUWWSN and NUWWSN has been distributed to all cooperators and posted on the USWBSI website. Results from the other uniform trials have been distributed to cooperators. The results of the OWPT are distributed to growers via extension avenues and scab smart.

Project 3: *Implementing Genomic Selection for FHB Resistance in Soft Winter Wheat (SWW) Adapted to the Corn Belt.*

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

Phenotypic selection for FHB resistance is slow in winter wheat with a breeding cycle taking perhaps 5 years. Marker-assisted selection appears to be primarily effective for a few FHB QTL, of which most are not widely present in Eastern soft wheat. The QTL for FHB resistance in SRWW mainly have small effects and are not very amenable to MAS. Genomic selection is a tool that can reduce the breeding cycle to one year and can affect all genes (small and large effects) that impact FHB. Thus we are implementing GS for FHB resistance in SRWW.

2. What was accomplished under these goals?

- 1) major activities: These include isolating DNA, getting GBS data, calling alleles and deriving marker data sets, predicting values, and crossing.
- 2) specific objectives: Evaluate the accuracy and efficacy of genomic selection to improve FHB resistance in SRWW.
- 3) significant results: We have genotyped 1003 cycle 1 F2 and 997 cycle 2 F2. We have compared the GEBVs of the training population lines and the cycle-1 and cycle-2 F2. In all cases the predicted resistance has improved relative to that of the training population (Figure 2.)

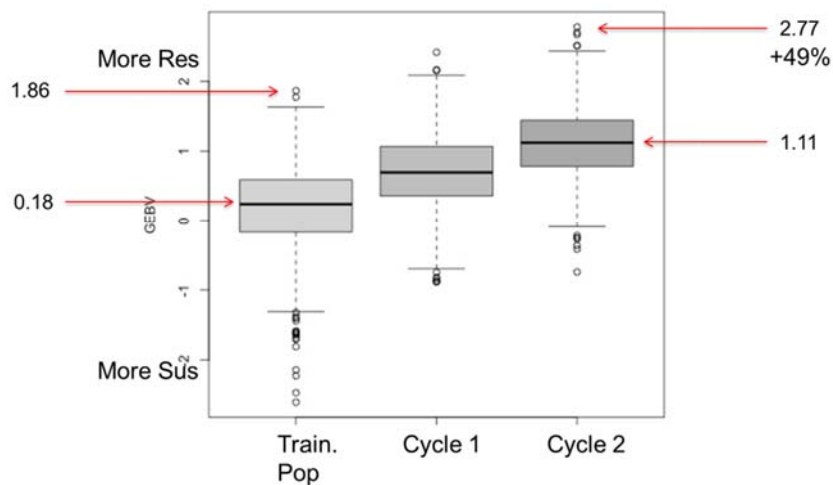


Figure 2. Box plots of the GEBVs for the first principal component scores (+ is more resistant) of the six FHB traits (INC, SEV, IND, FDK, ISK, DON) of the training population, cycle-1 F2s, and cycle-2 F2s.

The mean of the cycle-1 and cycle-2 F2s is greater (e.g. more resistant) than that of the TP (Fig.2). This is due in large part to the absence of very susceptible individuals in these cycles (Fig. 2). In cycle-1 and cycle-2 the F2 there was an individual that was more resistant than the best lines in the TP: the best cycle-2 F2 was 49% more resistant than the best TP line (Fig.2).

The best and worst F2s from cycle-1 were selfed and F3:4 families were derived and planted in the field for FHB evaluation in the summer of 2016. The same will be done for the cycle-2 F2s.

4) key outcomes or other achievements: Seed of the best families derived from GS is being increased and will be made available to breeders once their resistance is confirmed in the field. Two publications are in preparation.

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

The project was lead by a post-doc who was in charge of the greenhouse activities (crossing, tissue collection, harvesting) and data analysis. Other students helped with crossing.

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

The results were presented at the 2015 Scab Forum. Publications are being prepared

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? yes**

If yes, how many? one

- 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? yes**

If yes, how many? one

- 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? yes**

If yes, how many? one

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

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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PI: Sneller, Clay
USDA-ARS Agreement #: 59-0206-4-034

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.

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

Other publications, conference papers and presentations.

Cabrera, A., J. Isedro, E. Olson, B. Brisco, F. Kolb., E.A. Brucker, A. Krill, M.P. Arruda, M. Sorrels, D. Van Sanford, A. Clark, A. McKendry and C. Sneller. 2015. "Utilizing Genomic Selection to Accelerate the Pace of Developing Resistant Varieties." In: S. Canty, A. Clark, S. Vukasovich and D. Van Sanford (Eds.), *Proceedings of the 2015 National Fusarium Head Blight Forum*. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 80.

Status: Talk presented with associated published Abstract

Acknowledgement of Federal Support: No