

**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:	59-0200-3-007
USDA-ARS Agreement Title:	Developing Double Haploids to Expedite Mapping and Enhance FHB Resistance in SRWW.
FY15 USDA-ARS Award Amount:	\$ 70,378
Recipient Organization:	University of Arkansas 305 Administration Bldg. Fayetteville, AR 72701
DUNS Number:	191429745
EIN:	71-6003252
Recipient Identifying Number or Account Number:	0403-05646-24-0001
Project/Grant Reporting Period:	07/01/15-06/30/16
Reporting Period End Date:	06/30/16

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-SWW	Development of FHB-Resistant Wheat Cultivars for the Midsouth.	\$ 60,253
VDHR-SWW	Developing Doubled Haploids to Expedite Variety Development in SRWW.	\$ 10,125
	FY15 Total ARS Award Amount	\$ 70,378



Principal Investigator

7/12/16

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
 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: *Development of FHB-Resistant Wheat Cultivars for the Midsouth.*

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

The overarching goal is the development of high-yielding and FHB resistant wheat cultivars adapted to Arkansas and the mid-south soft red winter wheat growing region of the U.S. The specific objectives include:

1. Develop and release high yielding, FHB resistant cultivars adapted to Arkansas and the mid-south.
2. Increase breeding efficiency through collaborative phenotyping, marker development and introgression of new genes using marker assisted selection (MAS).
3. Screen and report the reactions of breeding lines and currently grown commercial cultivars to FHB using misted inoculated nurseries.

2. What was accomplished under these goals?

- a. Major activities: The major activities of the program on a yearly cycle include 1) Developing and advancing wheat breeding populations and lines with a high level of FHB resistance, 2) Screening of breeding material, cooperative nurseries and currently grown cultivars in inoculated and misted nurseries and 3) To use molecular tools to increase efficiency and expedite the development of improved varieties. In 2015-2016, 413 crosses were made where at least one parent was resistant or moderately resistant to FHB based on inoculated and misted nursery data. Molecular marker data was also used to select parents for crossing, with an emphasis on the major gene FHB1 and to a lesser extent 2DL, 3BS and 5AS_{Ning}, 3BSc, 5A_{Ernie} and new QTL derived from Jamestown, Neuse and Bess. A training population consisting of 360 breeding lines segregating for FHB resistance was evaluated (incidence, severity, FDK and DON) for the second season and screened with molecular markers for known FHB resistance QTL. Data will be used for developing prediction models for FHB resistance that can be utilized for increasing breeding efficiency through genomic selection. Misted and inoculated nurseries were established in both Fayetteville and Newport, AR. Arkansas breeding material, cooperative nurseries, and entries in the official state variety test were screened for FHB severity in two locations.
- b. Specific objectives
 1. Develop and release high yielding, FHB resistant cultivars adapted to Arkansas and the mid-south
 2. Increase breeding efficiency through collaborative phenotyping, marker development and introgression of new genes using marker assisted selection (MAS)
 3. Screen and report the reactions of breeding lines and currently grown commercial cultivars to FHB using misted inoculated nurseries.

c. Significant results for the granting period included:

- Overall, the Arkansas program had the 1st, 2nd, 3rd and 4th most resistant entries for FHB index in the 2015 Uniform Southern Scab Nursery. Data is not currently available for the 2016 USSN.
- 413 crosses were made with one parent resistant or moderately resistant to FHB
- 156 crosses were made with at least one parent carrying resistance gene FHB1
- 1,955 lines were evaluated in misted and inoculated nurseries and in two locations
- AR06024-7-2 (AR800-1-3-1/VA01W-476) contains FHB1 and performed well for yield in the 2015 SunWheat nursery tested across the southeastern region (15th of 83 entries) and was highly resistant to FHB in the Uniform Southern Scab Nursery (USSN), ranking 4th for FHB index. It is currently being tested in the 2016 Uniform Southern Nursery (Data not currently available).
- ARLA06146E-1-4 finished 2nd in the SunWheat Nursery across six regional locations and is resistant to FHB (19% severity in 2014-2015). Breeders seed will be produced in 2016-2017.
- ARLA07084C-10-1 finished 5th in the SunWheat Nursery across six locations and is resistant to FHB (16% severity in 2014-2015). Breeders seed will be produced in 2016-2017.
- Breeders seed was increased for AR01040-4-1 and AR00343-5-1, both of which are moderately resistant to FHB and have received interested from seed dealers as potential licensed varieties for 2016-2017.

d. Key outcomes or other achievements: Breeding lines with increased levels of FHB resistance and high grain yield potential were identified and continue to be identified at a faster rate since an increased emphasis was put on variety development starting in 2013. Improvements still need to be made in the use of molecular tools (Objective 2), particular more routine genotyping of breeding lines at an earlier stage for major FHB resistance QTL such as FHB1 and for pyramiding of genes in 3-way crosses. We will work to better coordinate with the genotyping center in order to improve in this area. While we have not release an FHB resistant cultivar to date, the lines currently being identified are far superior than the germplasm in the program pre-2010 and the USWBSI has played a key role in this improvement.

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

During the granting period, a total of six graduate students (2 Ph.D. and 4 M.S.) were trained in rating of FHB resistance (incidence and severity) and participated in selection of FHB resistant plants within segregating material (F3 bulks). In addition, I taught a Cereal Grain Production course to 26 undergraduate students at the University of Arkansas and provided hands on experience in the field identifying wheat diseases, including FHB. In addition, I gave a guest lecture in Plant Disease Control, an undergraduate course in the UA Department

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of Plant Pathology to 20 undergraduate students which covered various aspects of breeding for FHB resistance and a discussion of the USWBSI.

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

A wheat field day was hosted on May 12, 2016 in Newport, AR which included a demonstration and information about the misted inoculated nursery. The importance of the USWBSI to the wheat breeding community was emphasized.

A presentation titled “Evaluation of Southern Soft Red Winter Wheat Lines for Resistance to Fusarium Head Blight” was given at the Southern ASA Southern Regional Branch Annual Conference, February 7-9, 2016, San Antonio, TX

Project 2: *Developing Doubled Haploids to Expedite Variety Development in SRWW.*

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

The goal of this proposal is use double haploid technology to combine favorable loci for more rapid improvement of FHB resistance.

2. What was accomplished under these goals?

1) Major activities: Two crosses were made and sent for DH production (MDC07026-F2-19-13-3/AGS2055 and (MDC07026-F2-19-13-3/VA11W-106) both combining FHB1 resistance in a high performing background with moderately susceptible/resistant high yielding lines well adapted to Arkansas with a focus on obtaining more advanced lines which contain FHB1. A total of 530 double haploids developed from previous USWBSI funding were evaluated in misted and inoculated nursery in Newport AR, including 263 received from NC State, LSU and VA Tech as exchanges.

2) Specific objectives

1. Crossing parents which contain favorable loci for FHB resistance
2. Development of double haploid lines from these crosses
3. Evaluation for FHB resistance, including genotyping for known resistance loci, grain yield and other important traits
4. Cooperative distribution of these lines to other regional programs

3) Significant results

- 150 double haploid were selected for advancement to yield testing in 2016-2017
- 50 additional double haploids will be in second year of yield testing
- Selected double haploids were sent to other breeders for cooperative testing.

4) key outcomes or other achievements

Double haploid lines with a high level of resistance were identified and advanced.

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

During the granting period, a total of six graduate students (2 Ph.D. and 4 M.S.) were trained in rating of FHB resistance (incidence and severity) and participated in selection of FHB resistant plants within segregating material (F3 bulks). In addition, I taught a Cereal Grain Production course to 26 undergraduate students at the University of Arkansas and provided hands on experience in the field identifying wheat diseases, including FHB. In addition, I gave a guest lecture in Plant Disease Control, an undergraduate course in the UA Department of Plant Pathology to 20 undergraduate students which covered various aspects of breeding for FHB resistance and a discussion of the USWBSI.

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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?**

Yes

If yes, how many? 2

- 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
Nothing to report				

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

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 - Nothing to Report

Books or other non-periodical, one-time publications - Nothing to Report

Other publications, conference papers and presentations.

Holder, A.L., Mason, R.E., Moon, D.E. Evaluation of Southern Soft Red Winter Wheat Lines for Resistance to Fusarium Head Blight. 2016 ASA Southern Regional Branch Annual Conference, February 7-9, 2016, San Antonio, TX (Oral Presentation)

Status: Abstract Published and poster presented

Acknowledgement of Federal Support: YES

Holder, A.L., Mason, R.E., Moon, D.E. Evaluation of Southern Soft Red Winter Wheat Lines for Resistance to Fusarium Head Blight. 2016 Annual Gamma Sigma Delta Student Oral and Poster Competition, March 20, 2016, Fayetteville, AR (Oral Presentation)

Status: Abstract Published and poster presented

Acknowledgement of Federal Support: YES

Mason R.E., Miller R.G., Moon, D.E., Kelly J.P. 2015. Arkansas Wheat Cultivar Performance Tests 2014-2015. Arkansas Agriculture Experiment Station Research Series 627.

Status: Published

Acknowledgement of Federal Support: Not applicable for this publication