USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY16 Final Performance Report
Due date: July 28, 2017

Cover Page

Principle Investigator (PI):	Esten Mason
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Fiscal Year:	2016
USDA-ARS Agreement ID:	59-0200-3-007
USDA-ARS Agreement Title:	Developing Double Haploids to Expedite Mapping and Enhance FHB Resistance in SRWW.
FY16 USDA-ARS Award Amount:	$ 72,277
Recipient Organization:	University of Arkansas 305 Administration Bldg. Fayettevllle, AR 72701
DUNS Number:	191429745
EIN:	71-6003252
Recipient Identifying Number or Account Number:	0403-05646-24-0001
Project/Grant Reporting Period:	7/1/16 - 6/30/17
Reporting Period End Date:	06/30/17

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-SWW	Development of FHB-Resistant Wheat Cultivars for the Midsouth.	$ 62,827
VDHR-SWW	Developing Double Haploids to Expedite Variety Development in SRWW.	$ 9,450
	FY16 Total ARS Award Amount	**$ 72,277**

7/28/17

Principal Investigator 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? *Address items 1-4) below for each goal or objective.*

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) Use molecular tools to increase efficiency and expedite the development of improved varieties. In FY16, 339 crosses were made where at least one parent was resistant or moderately resistant to FHB based on inoculated and misted nursery data. This included 66 crosses containing FHB1. Molecular marker data was used to select parents for crossing, with an emphasis on the major gene FHB1 and new QTL derived from Jamestown, Neuse and Bess. A training population of 360 breeding lines was evaluated for a third season (incidence, severity, FDK and DON) and screened with molecular markers for known FHB resistance QTL. Data is currently being used by a graduate student for genome wide association analysis (GWAS) and will be used by a new graduate student for developing prediction models for FHB resistance that will be used for increasing breeding efficiency through genomic selection. A recombinant inbred line (RIL) population of the cross AGS2060/AGS2035 was evaluated in collaboration with LSU to map native resistance in AGS2060. 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 5th, 7th, 10th and 12th most resistant entries for DON accumulation in the 2016 USSN.
- 339 crosses were made with one parent resistant or moderately resistant to FHBm including 66 with at least one parent carrying resistance gene FHB1
- 6,571 unique lines were evaluated in misted and inoculated nurseries
- ARLA06146E-1-4 finished 2nd for grain yield in the SunWheat Nursery across six locations (2016) and 11th in the Arkansas Official Variety Test (2017). It is moderately resistant to FHB (avg. 19% severity). Foundation seed will be produced in 2017-2018.
- AR07133C-19-4 finished 3rd in the Arkansas Official Variety Test (2017) and is moderately resistant to FHB (avg. 16% severity). Breeder's seed will be produced in 2017-2018.

d. Key outcomes or other achievements: Breeding lines with increased levels of FHB resistance and high grain yield continue to be identified at a faster rate since an increased emphasis was put on variety development starting in 2013. The use of molecular markers is increasing in the program, with in-house screening for FHB1 and native QTL. While we have not release an FHB resistant cultivar to date, the developed lines are far superior in terms of grain yield and overall performance (multiple in top 10 in the Arkansas Official Variety Test) compared to germplasm in the program pre-2010. The USWBSI has been vital to this effort.

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

During the granting period, five graduate students (2 Ph.D. and 3 M.S.) were trained in the rating and breeding for FHB resistance, the use of molecular markers and genomic selection.

In July 2017, Amanda Holder, an M.S. student studying FHB and partially funded through the USWBSI attended a summer course titled Diagnosis of Plant Diseases through Aarhus University in Flakkebjerg, Denmark. The course focused on diagnosing diseases of wheat and barley in the field and confirming field diagnosis using molecular methods.

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

Two presentation updates were given to the Arkansas Wheat Promotion board that discussed the development of FHB resistance germplasm and cultivars (listed on pages 8-9).

My graduate student gave two presentations on FHB (listed on pages 8-9)

Project 2: *Developing Double 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? *Address items 1-4) below for each goal or objective.*

1) Major activities: Ten F_1 topcross plants were sent to Heartland with a target of producing 200+ DH lines. Based on molecular marker screening, all 10 were positive for FHB1 and contained on average 5-6 QTL for FHB resistance. In total, 2,456 double haploids were evaluated in misted and inoculated nurseries in Newport AR. This included 1,374 DH lines 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

- 357 double haploid lines were selected for advancement to yield testing in 2017-2018
- 70 double haploid lines will be in the advanced yield testing stage in 2017-2018
- 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, five graduate students (2 Ph.D. and 3 M.S.) were trained in the rating and breeding for FHB resistance, the use of molecular markers, GWAS and genomic selection.

In July 2017, Amanda Holder, an M.S. student studying FHB resistance and partially funded through the USWBSI attended a summer course titled Diagnosis of Plant Diseases through

Aarhus University at the Global Rust Research Center in Flakkebjerg, Denmark. The course focused on diagnosing diseases of wheat and barley in the field and confirming field diagnosis in the laboratory using molecular methods.

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

Two presentation updates were given to the Arkansas Wheat Promotion board that discussed the development of FHB resistance germplasm and cultivars (listed on pages 8-9).

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Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY16 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 FY16 award period?** Yes

   If yes, how many? One

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY16 award period?**

   If yes, how many? No

3. **Have any post docs who worked for you during the FY16 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 FY16 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 FY16 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

Publications, Conference Papers, and Presentations

Instructions: Refer to the FY16-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY16 grant. Only include citations for publications submitted or presentations given during your award period (7/1/16 - 6/30/17). 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. 2016. 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.

Nothing to report

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

Mason R.E., Miller R.G., Moon, D.E., Kelley J.P. 2016. Arkansas Wheat Cultivar Performance Tests 2015-2016. Arkansas Agriculture Experiment Station Research Series 636.
Status: Published in print and online
Acknowledgement of Federal Support: Yes

Kelley, J.P., Mason, R.E., Miller, R.G., Moon, D.M., Spurlock, T. Wheat Update 2016. September 2016. www.uaex.edu.
Status: Published online
Acknowledgement of Federal Support: No

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 Fusarium Head Blight Forum, December 5, 2016, St. Louis, MO (poster).
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (poster), NO (abstract)

Holder, A.L., Mason, R.E., Moon, D.E. Genome Wide Association Study for Resistance to Fusarium Head Blight in Southern Soft Red Winter Wheat. 2017 Eastern Wheat Workers and Southern Small Grain Workers Conference, May 2, 2017 West Lafayette, IN (poster) First Place Plant Breeding Division.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (poster), NO (abstract)

Mason, R.E. Update on Arkansas wheat breeding program Arkansas Wheat Promotion Board Meeting, Aug 2, 2016, Brinkley, AR.
Status: Presented
Acknowledgement of Federal Support: YES

Mason, R.E. Update on Arkansas wheat breeding program Arkansas Wheat Promotion Board Meeting, May 16, 2016, Conference Call.
Status: Presented
Acknowledgement of Federal Support: YES