

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

**Cover Page**

<b>Principle Investigator (PI):</b>	Esten Mason
<b>Institution:</b>	University of Arkansas
<b>E-mail:</b>	esten@uark.edu
<b>Phone:</b>	479-575-5725
<b>Fiscal Year:</b>	2016
<b>USDA-ARS Agreement ID:</b>	59-0200-3-007
<b>USDA-ARS Agreement Title:</b>	Developing Double Haploids to Expedite Mapping and Enhance FHB Resistance in SRWW.
<b>FY16 USDA-ARS Award Amount:</b>	\$ 72,277
<b>Recipient Organization:</b>	University of Arkansas 305 Administration Bldg. Fayetteville, AR 72701
<b>DUNS Number:</b>	191429745
<b>EIN:</b>	71-6003252
<b>Recipient Identifying Number or Account Number:</b>	0403-05646-24-0001
<b>Project/Grant Reporting Period:</b>	7/1/16 - 6/30/17
<b>Reporting Period End Date:</b>	06/30/17

**USWBSI Individual Project(s)**

<b>USWBSI Research Category*</b>	<b>Project Title</b>	<b>ARS Award Amount</b>
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
	<b>FY16 Total ARS Award Amount</b>	<b>\$ 72,277</b>



Principal Investigator

7/28/17

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 11<sup>th</sup> 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 3<sup>rd</sup> 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<sub>1</sub> 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

FY16 Final Performance Report

PI: Mason, Esten

USDA-ARS Agreement #: 59-0200-3-007

Reporting Period: 7/1/16 - 6/30/17

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).

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

FY16 Final Performance Report  
PI: Mason, Esten  
USDA-ARS Agreement #: 59-0200-3-007  
Reporting Period: 7/1/16 - 6/30/17

## **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?**

FY16 Final Performance Report  
 PI: Mason, Esten  
 USDA-ARS Agreement #: 59-0200-3-007  
 Reporting Period: 7/1/16 - 6/30/17

### 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

FY16 Final Performance Report  
PI: Mason, Esten  
USDA-ARS Agreement #: 59-0200-3-007  
Reporting Period: 7/1/16 - 6/30/17

## **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)



FY16 Final Performance Report

PI: Mason, Esten

USDA-ARS Agreement #: 59-0200-3-007

Reporting Period: 7/1/16 - 6/30/17

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