USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY17 Final Performance Report – NCE for FY18
Due date: July 12, 2019

Cover Page

Principle Investigator (PI):	Mohamed Mergoum
Institution:	University of Georgia
E-mail:	mmergoum@uga.edu
Phone:	770-228-7289
Fiscal Year:	2017 (NCE for FY18)
USDA-ARS Agreement ID:	59-0206-4-033
USDA-ARS Agreement Title:	Development of Scab Resistant Soft Wheats adapted to the Southeast.
FY17 USDA-ARS Award Amount:	$ 59,602
Recipient Organization:	University of Georgia Research Foundation, Inc. Contracts & Grants 240A Riverbend Road, Box 5333 Athens, GA 30602-5333
DUNS Number:	00-431-5578
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Recipient Identifying Number or Account Number:	25-21-RD316-385
Project/Grant Reporting Period:	6/21/18 - 6/20/19
Reporting Period End Date:	06/20/19

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-SWW	Development of Scab Resistant Soft Wheats Adapted to the Southeast.	$ 49,698
VDHR-SWW	Developing Double Haploids to Expedite Variety Development in SRWW.	$ 9,904
	FY17 Total ARS Award Amount	$ 59,602

M. Mergoum
Principal Investigator

07/10/19
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 Scab Resistant Soft Wheats Adapted to the Southeast.*

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

During four consecutive years (2013-2016) in Georgia and Southeast, scab epidemics have resulted in significant loss revenue due to low grain production and unacceptable toxin levels (DON). The aim is to enhance the development of high yielding soft red winter wheat (SRWW) cultivars with improved FHB resistance and low DON levels. The problems are being solved by developing and releasing improved soft red winter wheat varieties and germplasm with improved FHB resistance combined with disease and insect resistances and evaluating FHB nurseries and regional nurseries for FHB severity and DON levels.

The goal of our research is to enhance the development of high yielding soft red winter wheat (SRWW) varieties with improved FHB resistance and end-use quality; generate populations for marker assisted selection with QTL associated with both native and exotic FHB resistance; and introgress two or more known FHB resistance QTL into adapted SRWW background by using marker assisted selection. By addressing this goal we will achieve our main objectives that are to (1) increase acreage planted to wheat varieties exhibiting improved FHB resistance; (2) increase efficiency of coordinated project breeding programs to develop and release FHB resistant varieties; and (3) develop new breeding technologies and germplasm to further enhance short-term and long-term improvement of FHB resistance and to efficiently introgress effective resistance genes into breeding germplasm. This project is a collaborative effort with cooperators from University of Arkansas, Louisiana State University, North Carolina State University, Virginia Tech, and the USDA-ARS Genotyping Center, Raleigh, NC. Marker Assisted Selection accelerates the development of adapted FHB resistant cultivars by the selections within populations containing Fhb1, 5AS, and 3BLMassey, Jamestown (1B, 6A), Neuse (1A, 4A), and Bess (2B and 3B) in the UGA molecular lab and in cooperation with Gina Brown-Guedira, USDA Genotyping Center

2. What was accomplished under these goals?

Objective 1 is to increase acreage planted to wheat varieties exhibiting improved FHB resistance.

1) major activities: To continue improvement for FHB resistance in adapted soft red winter wheat varieties, about 500 bi-parental, 3-way and 4-way crosses were made between GA elite breeding lines from native sources of FHB resistance derived lines from Truman/Bess, Jamestown, Neuse, IL04-10721, IL00-8530, and IL97-1828, and Hilliard. Elite breeding lines have also been crossed to lines that have *Fhb1* (NC14-23372, MDC07026-F2-19-13-4, IL07-4415, MD09W272-8-4-14-8, K06C-1178). Segregating breeding populations (500) were evaluated and advanced (50,000 headrows) to select desirable pure lines with improved over-all agronomic performance and disease resistance. Advanced and elite lines with FHB resistance have been included in many trails at different levels (PYT, Elite, State and regional).

2) specific objectives: generate SRWW populations/elite germaplsm with high yield and improved diseases resistances including FHB.

3) significant results: Information on the FHB reaction of released wheat cultivars was collected on commercial cultivars in the Georgia Official Variety Testing trial and results were published in the Georgia Wheat Performance Bulletin. Information on the DON levels in grain delivered to flour mills and flour is being obtained from flour mills in the state. Six lines with resistance from *Fhb1* will be entered in the GA state trial in 2019. Two elite lines, GA051207-14E53 (AGS 3040), and JT141-14E45 (AGS 3030) with QTLs for FHB resistance were released. Several elite lines have been identified with good FHB resistance derived from Jamestown, (GA051207-14E53 (AGS 3040), GA09129-16E56 (991109-6E8 *2/ IL00-8530), and GA061471-15LE38 (AGS 2020 /6/ 061636 /5/ Yr15 //99406 /3/ AGS 2000 /4/ 97186). GA09129-16E56 had similar FHB ratings as Jamestown and Bess for incidence, index and ISK. GA09129-16E56 has the QTL 1A and 4A from Neuse, and 1B from Jamestown; GA061471-15LE38 has the QTL 4A from Neuse and 1B from Jamestown.

4) key outcomes or other achievements: Two elite lines, GA051207-14E53 (AGS 3040), and JT141-14E45 (AGS 3030) with QTLs for FHB resistance were released. Several elite lines have been identified with good FHB resistance derived from Jamestown, (GA051207-14E53 (AGS 3040), GA09129-16E56 (991109-6E8 *2/ IL00-8530), and GA061471-15LE38 (AGS 2020 /6/ 061636 /5/ Yr15 //99406 /3/ AGS 2000 /4/ 97186)).

Objective 2 is to increase efficiency of coordinated project breeding programs to develop and release FHB resistant varieties.

1) major activities: The collaborative efforts was accomplished between the University of Georgia and Louisiana State University, North Carolina State University, University of Arkansas, Virginia Tech and the USDA-ARS Genotyping Center, Raleigh, NC with assistance in phenotyping of mapping populations and elite breeding lines; cooperative evaluation of nurseries including the Southern Uniform Scab, the Uniform Southern Wheat, GAWN, and SUNWHEAT nurseries; and the exchange of resistance germplasm, crosses, and double haploid lines and joint evaluation over locations of these germplasm sources. Northern FHB resistant germplasm with an Rht-b1 background has been transferred into Rht-D1 background for better adaptation to the Southeast.

2) specific objectives: Increase efficiency in breeding SRWW for FHB resistance regionally

3) significant results: The collaborative efforts was accomplished between the above universities and the USDA-ARS Genotyping Center, Raleigh, NC and resulted in phenotyping of mapping populations and elite breeding lines. The cooperative evaluation of nurseries including the Southern Uniform Scab, the Uniform Southern Wheat, GAWN, and SUNWHEAT nurseries. Exchange of resistance germplasm, crosses, and double haploid lines and joint evaluation over locations of these germplasm sources were accomplished.

4) key outcomes or other achievements: Using the collaborative and testing network of the coordinated project, many lines were selected with pyramiding QTL of FHB resistance sources from Jamestown, MD03W61-09-7 (*Fhb1*), MD08-26-H2-7 (*Fhb1* 5AS 2DL), MD08-29-E9-26 (Fhb1 5AS 2DL*),* AGS 3030 (GA JT141-14E45), and Hilliard.

Objective 3 is to develop new breeding technologies and germplasm to further enhance short-term and long-term improvement of FHB resistance and to efficiently introgress effective resistance genes into breeding germplasm.

1) major activities: Marker Assisted Backcrossing (MABC) of QTL (*Fhb1*, 2DL, 5AS (Ning 7840), and 3BL (Massey), 1B (Jamestown), 1A, 4A (Neuse), and 2B, and 3B (Bess) into SRWW background was performed using high yielding and moderately resistant FHB lines as recurrent parents. Pyramiding and combining FHB resistant QTLs coupled with good field and consistent screening test will greatly facilitate the development of cultivars that have more improved and effective FHB resistance. Improved derived lines with *Fhb1* and other QTLs were evaluated among elite lines and backcross populations. Widely adapted cultivars, such as Savoy, SS5550, and AGS 2033 were used as recurrent parents to develop homozygous lines with combinations of *Fhb1,* 2DL, and 5AS with improved FHB resistance. These lines will be evaluated for agronomic performance and leaf and stripe resistance in 2019.

2) specific objectives: Use novel techniques to enhance SRWW geramplsm for FHB

3) significant results: Our molecular marker laboratory has cooperated with the USDA Genotyping Centers, (Dr. Gina Brown –Guedira) to evaluate populations with *Fhb1* pyramid with leaf rust and stripe rust genes. Using these facilities, many lines including GA 141077-G5, (AGS 2033 *2 / MD 08-26-H2) and released cultivars JT141-14E45 (AGS 3030) were identified as a high yielding line with the QTL *Fhb1* and other QTLs.

4) key outcomes or other achievements: JT141-14E45 (AGS 3030) was released with FHB QTL from Jamestown.

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

Graduate students were trained in protocol for screening and evaluating germplasm for scab resistance.

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

Presentations have been given at the Annual Forum of the Wheat and Barley Scab Initiative, Small Grain and Soybean Expo, county agent training meeting, and producer's small grain meeting.

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 research is to increase the efficiency of coordinated project breeding programs in developing and releasing FHB-resistant varieties. Doubled haploids (DH) shorten variety development time in fall-sown small grains by approximately four years. Our objective is to expand the use of this technique for the whole Southern Winter Wheat region by the coordinated development of at least five breeding populations through DH production followed by collaborative phenotyping across the region once the DH lines are developed and seed is increased for testing. The doubled haploid facility at Kansas State University (Plant Innovations Facility) and in cooperation with Dr. Paul Murphy, NCST, and Dr. Carl Griffey, VPI, will be used to produce the DH lines from several crosses.

2. What was accomplished under these goals?

1) major activities: About 550 DH lines were evaluated in yield trials for grain yield and test weight and scab and leaf and stripe rust resistance. An additional of 3500 DH lines were evaluated in head rows.

2) specific objectives: To increase the efficiency of coordinated project breeding programs in developing and releasing FHB-resistant varieties using Doubled haploids (DH) techniques.

3) significant results: Among selected DH lines, more than 20 were pyramid for QTL of FHB resistance sources from Jamestown, MD08-26-H2-7 (*Fhb1* 5AS 2DL), MD07026-F2-19-13-3 (*Fhb1*), AGS 3030 (GA JT141-14E45), and Hilliard were selected. DH lines with a wide array of pyramid scab QTL combinations (Fhb1, 2DL, 5AS, 1B, 1A, 4A and 3B) were found to have high grain yield and good disease resistance. These DH lines are been evaluated in 2019 at multiple locations. Data collected in 2019 for these DH is being processed and will be included in the 2019 report.

4) key outcomes or other achievements: 20 DH lines combining good yield and disease resistances including FHB with Fhb1 were selected and advanced to State wide testing. These DH lines have Fhb1 and other FHB resistance QTL.

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

Graduate students were trained in protocol for screening and evaluating germplasm for scab resistance.

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

Presentations have been given at the Annual Forum of the Wheat and Barley Scab Initiative, Small Grain and Soybean Expo, county agent training meeting, and producer's small grain meeting. FHB data has been published in the GA Small Grain Performance Trial bulletin.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY17-NCE 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-NCE 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 FY17-NCE period?**
   No.
   If yes, how many?

3. **Have any post docs who worked for you during the FY17-NCE 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-NCE 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 FY17-NCE period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations.

NOTE: 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**
JT141-14E45 / **AGS 3030**	SRW	MR	3	2018
GA 051207-14E53 / **AGS 3040**	SRW	MS	5	2018

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 FY17-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY17-NCE grant period. Only include citations for publications submitted or presentations given during your award period (6/21/18 - 6/20/19). 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.

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

Other publications, conference papers and presentations.

Mohamed Mergoum, Jerry Johnson, James Buck, and Zhenbang Chen. 2017. FHB Resistance and Agronomic Performance in Georgia Soft Red Winter Wheat Germplasm. In: S, Canty, B. Wiermer and D. Van Sanford (Eds.), Proceeding of the 2017 National Fusarium Head Blight forum (pp. 88). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (poster), Yes (abstract)