USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY19 Performance Report
Due date: July 24, 2020

Cover Page

Principle Investigator (PI):	Paul Murphy
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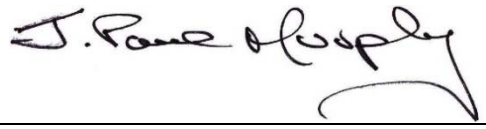
Fiscal Year:	2019
USDA-ARS Agreement ID:	59-0206-8-209
USDA-ARS Agreement Title:	Enhancement of Fusarium Head Blight Resistance in the Southeastern U.S. Germplasm
FY19 USDA-ARS Award Amount:	$ 111,777
Recipient Organization:	North Carolina State University Office of Contracts & Grants Box 7214 Raleigh, NC 27695-7214
DUNS Number:	04-209-2122
EIN:	56-6000756
Recipient Identifying Number or Account Number:	583042-06050
Project/Grant Reporting Period:	6/16/19 - 6/15/20
Reporting Period End Date:	6/15/2020

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-SWW	Enhancement of Fusarium Head Blight Resistance in the Southeastern U.S. Germplasm	$ 111,777
	FY19 Total ARS Award Amount	**$ 111,777**



July, 22, 2020

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

FY19 Performance Report
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Project 1: *Enhancement of Fusarium Head Blight Resistance in the Southeastern U.S. Germplasm*

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

1) To increase the number of varieties with improved FHB resistance and high grain yield and grain quality tested in statewide variety trials;
2) To increase efficiency of the CPs' funded projects to develop and release FHB resistant varieties and germplasm; and
3) Evaluate and implement new breeding technologies and develop germplasm to further enhance short term and long term improvement of FHB resistance.

2. What was accomplished under these goals or objectives? *(For each major goal/objective, address items a-b) below.)*

Objective 1.

a) What were the major activities?

Six hundred twenty-two F_2 and F_3 bulks were advanced during 2019-20. Approximately 23,500 headrows in the F_4, F_5 and F_6 generations were selected using the pedigree method. The misted/inoculated nursery evaluated five cooperative uniform nurseries and in-house advanced lines (Prelim and Advanced Tests). Four hundred seventeen new crosses were made. Approximately 600 doubled haploid lines were produced in-house and approximately 1,500 doubled haploid lines were produced under contract for UGA, Virginia Tech, LSU, and UAR. We evaluated 357 advanced generation in-house lines, at up to six locations for overall agronomic superiority, including FHB resistance. We evaluated six cooperative nurseries for overall agronomic superiority.

b) What were the significant results?

Eight of the highest yielding lines in the NC Official Variety Test 2020 were NC State bred with moderate scab resistance and overall good agronomic performance.

c) List key outcomes or other achievements.

Breeders Seed of three lines with moderate FHB resistance, NC15-21835, NC11546-14, NC11363-25, produced for possible release in 2021.

Objective 2.

a) What were the major activities?

I coordinated the Southern Uniform Scab Nursery containing 42 advanced generation lines from five public and one private company were evaluated in multiple states. I collated and summarized data and published the report on the USWBSI website. Participated in coordinated breeding activities with the six university SUNGRAINS cooperative breeding programs.

b) What were the significant results?

The results of the 2018-19 Southern Uniform Scab Nursery was collected, analyzed and published online at https://scabusa.org/pdfs_dbupload/suwwsn19_report.pdf. The quantification of scab resistance of entries in the SUNGRAINS nurseries impacted the advancement decisions of six breeding programs.

c) List key outcomes or other achievements.

The Southern Uniform Scab Nursery provides public and private sector breeders with timely multi-environment evaluations of FHB resistance in advanced generation breeding lines compared with the resistant check varieties.

Objective 3

a) What were the major activities?

Utilized marker assisted selection, genomic selection and doubled haploid technology to increase breeding efficiency. We coordinated the sequencing pipeline, data curation, updating of training populations, prediction estimation for numerous traits including FDK and DON and investigated various techniques to improve prediction accuracies for approximately 4500 SUNGRAINS early generation lines. Investigated the genetic control of FHB resistance in NC13-20076. Evaluated 200 random DH lines from the cross NC13-20076 x GA06493-13LE6 at three misted and inoculated locations.

b) What were the significant results?

Genomic selection predictions correlated with observed data to investigate the utility of the methodology in wheat breeding in the southeast. PopVar identified optimum crosses to make. We identified major QTL associated with FDK and DON in NC13-20076 with LOD scores up to 10.

c) List key outcomes or other achievements.

The highest correlations between observed and GS predicted performance was for FHB resistance traits (r= 0.77 (DON), 0.67 (FDK) and 0.71 (Severity).

3. Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.

Our doubled haploid production was down 50 percent because we were unable to hire undergraduates to assist in greenhouse and lab activities. George Van Esbroech essentially did everything by himself. Other research aspects completed as planned.

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

Four undergraduate students worked part-time on the laboratory, greenhouse and field aspects of the DH effort. In addition, five undergraduate students worked in scab nurseries and on post-harvest processing of materials harvested from the scab nurseries. Zachary Winn (PhD Student) attended the Scab Forum in in December 2019. He organized and conducted the NC Uniform Scab Nursery, also.

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

Results have been disseminated through poster presentations at scientific meetings, scientific journal publications, and presentations to growers and industry representatives in winter 2019 / spring 2020. In addition the Southern Scab Nursery report can be found at this website: https://scabusa.org/pdfs_dbupload/suwwsn19_report.pdf

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY19 award period (6/16/19 - 6/15/20). 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 FY19 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 FY19 award period?**

   No.

   If yes, how many?

3. **Have any post docs who worked for you during the FY19 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 FY19 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 FY19 award 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**

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 FY19-FPR_Instructions for detailed more instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY19 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period (6/16/19 - 6/15/20**) should be included. If you did not publish/submit or present anything, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each citation, you **must** indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in the publication/ presentation. See example below for a poster presentation with an abstract:

> De Wolf, E., D. Shah, P. Paul, L. Madden, S. Crawford, D. Hane, S. Canty, R. Dill-Macky, D. Van Sanford, K. Imhoff and D. Miller. 2019. "Impact of Prediction Tools for Fusarium Head Blight in the US, 2009-2019." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 12), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
> Status: Abstract Published and Poster Presented
> Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

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

Other publications, conference papers and presentations.

Fitzgerald, J., C. Griffey, W. Brooks, N. Meier, D. Van Sanford, J.P. Murphy, N. McMaster and D. Schmale III. 2019. "Evaluation of Winter Barley Cultivar Nomini for Resistance to Fusarium Head Blight." In: Canty, S., A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 90), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes (poster), Yes (Abstract)

Mergoum, M., J. Johnson, J. Buck, Z. Chen, S. A. Harrison, R. E. Mason, J. P. Murphy, G. L. Brown-Guedira, A. M.H. Ibrahim, R. L. Sutton, B. E. Simoneaux and Md A. Babar. 2019. "GA09129-16E55 (AGS 3015), A New Soft Red Winter Wheat Cultivar Adapted to the US Southeast with Improved FHB Resistance." In: Canty, S., A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 101), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes (poster), Yes (Abstract)

Z.J. Winn, Z. L., R. Acharya, J. Lyerly, G. Brown-Guedira, C. Cowger, C. Griffey, J. Fitzgerald and J.P. Murphy. 2019. "Preliminary Mapping of Fusarium Head Blight Resistance in NC13-20076 Soft Red Winter Wheat." In: Canty, S., A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 125), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes (poster), Yes (Abstract)

Murphy, J. P., J.H. Lyerly, R. Acharya, B. Ward and G. Brown-Guedira. 2019. "The 2019 Uniform Southern Soft Red Winter Wheat Scab Nursery The 2019 Uniform Southern Soft Red Winter Wheat Scab Nursery." In: Canty, S., A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 104), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented

Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes (poster), Yes (Abstract)

Mason, R. E., G. Brown-Guedira, J. Lyerly, D. Van Sanford, J. P. Murphy, B. Ward, J. Johnson, M. Mergoum, S. Harrison, A. Babar, A. Ibrahim and R. Sutton. 2019. "Partnering to predict: centralized genomic selection in southeastern wheat breeding programs." In: Murphy, J. P. (Ed.), *Proceedings of the Eastern Wheat Workers / Southern Small Grain Workers Conference*. Department of Crop and Soil Sciences, North Carolina State University, Raleigh, NC 27695.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes (poster), Yes (Abstract)