

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY13 Final Performance Report
July 15, 2014**

Cover Page

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Fiscal Year:	FY13
USDA-ARS Agreement ID:	59-0206-9-083
USDA-ARS Agreement Title:	Breeding for FHB Resistance in the Southeaster U.S. - Uniform Nursery and Marker Characterization.
FY13 USDA-ARS Award Amount:	\$ 63,582

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.	\$ 57,740
VDHR-SWW	Developing Double Haploids to Expedite Mapping and Enhance FHB Resistance in SRWW.	\$ 5,842
	FY13 Total ARS Award Amount	\$ 63,582



Principal Investigator

July 14, 2014

Date

* MGMT – FHB Management
 FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
 GDER – Gene Discovery & Engineering Resistance
 PBG – Pathogen Biology & Genetics
 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: *Enhancement of Fusarium Head Blight Resistance in the Southeastern U.S. Germplasm.*

1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

The major problem being addressed is the annual occurrence of Fusarium Head Blight in the Southeastern U.S. wheat crop. Our contribution to the national team working to increase the acreage planted to varieties with improved FHB resistance and low DON were as follows:

1) Coordinated the annual Uniform Southern Scab Nursery which provided nine public and four private sector breeding programs in the US plus two in Europe with multi-environment evaluations of FHB resistance in advanced generation breeding lines compared with the resistant checks Ernie, Bess and Jamestown. Molecular and end-use quality data were provided by two USDA-ARS laboratories. Data obtained from cooperators in 2012-13 were analyzed and a report was compiled and published on the USWBSI website. NCSU contributed seven lines to the 2013-14 nursery, including four conventional and three doubled haploid lines. Three lines contained *Fhb1* included pyramid combinations with the 2D and 5A QTLs. Five NC lines ranked ahead of the resistant check Ernie in multi-state data for FHB Index. In addition, two lines entered by non-NCSU sources were doubled haploid lines developed at NCSU and shared with other breeding programs. In addition, we evaluated important released varieties (60 plus) entered in the NC Official Variety Testing (OVT) program. Results were posted on the NC Small Grains Production website utilized by producers.

2) Continued two major studies to identify FHB resistant QTL's in the varieties NC-Neuse and Bess. Final year of misted nursery phenotypic evaluations at two NC locations completed. Harvested seed is undergoing evaluation for FDK and DON. Over 15,000 SNP, SSR and DArT markers mapped to two populations. Obtained phenotypic data at one location for VA Tech researcher identifying FHB resistance QTL in the variety Tribute.

3) Approximately 550 F₂ and F₃ bulks (combined) were advanced during 2013-14 utilizing mass selection. Most of these crosses contained one or more parents exhibiting partial FHB resistance. Approximately 30,000 headrows in the F₄, F₅ and F₆ generations (combined) were advanced using the pedigree method. The misted/inoculated nursery evaluated 3200 headrows, including Preliminary and Advanced tests. Six three-way populations segregating for FHB resistance QTL underwent marker assisted selection. As a member of SUNGRAINS (Southeastern University Grains), I partnered closely in a collaborative cultivar development program by public small grain programs in NC, GA, FL, LA, AR and TX.

- 2. List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

Accomplishment:

Breeder Seed of two lines with good FHB resistance obtained (NC09-20869 and NC8170-4-3). Three other lines with high levels of FHB resistance and good overall agronomic quality identified in Advanced Test (NC9305-7, NC11-22289 and NC11-23084). All these lines exhibit FHB resistance at least as good as Ernie and Bess.

Impact:

NC09-20869 and NC8170-4-3 with *Fhb1* and *H13* will be released in the 2014-15 season resulting in two new varieties with good levels of FHB resistance and good overall agronomic quality. Three additional lines are one season behind and Breeders Seed of those lines will be produced in 2014-15.

Project 2: *Developing Double Haploids to Expedite Mapping and Enhance FHB Resistance in SRWW.*

- 1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

It is imperative that all breeding approaches that can speed the development of FHB resistant varieties be utilized to increase efficiency. The doubled haploid (DH) technology is particularly advantageous when breeding winter wheat varieties, because by their nature, one cannot use off-season nurseries when breeding fall-sown crops as a way to speed variety development. The doubled haploid approach reduces the time for variety development in winter wheat by four years.

During 2013-14, 800 DH lines were selected and increased in headrows from the crosses Carolina White sib / Yorktown, Shirley / NC09-20986, Jamestown / NC09-22206, NC09-22206 / Jamestown, NC09-22206 / Yorktown and Bess / NC06-19896. Each of these pedigrees has at least one parent with moderate FHB resistance. Selected lines will enter first year yield testing in fall 2014.

During the 2013-14 greenhouse cycle we harvested seed from doubled haploid plants from the crosses: GA04570-10E46 / NC8170-4-3, GA04570-10E46 / Jamestown, GA04570-10E46 / NC08-20986, Shirley / NC8170-4-3, Jamestown / NC08-20768, NC8170-4-3 / NC08-140, NC8170-4-3 / NC-Cape Fear, NC8170-4-3 / NC08-21273, and NC8170-4-3 / NC09-20768. Each of these pedigrees has at least one parent with moderate FHB resistance. These DH lines will be planted in the field in headrows in fall 2014.

In spring 2014 we initiated the DH protocol in-house for the following nine crosses which will be segregating for FHB resistance: NC10-23663 / NC09-20986, NC10-23663 / VA11W-278, NC10-23663 / NC11-22289, GA041293-11LE37 / Bess, GA041293-11LE37 / VA11W-278, GA041293-11LE37 / NC11-22289, NC09-20986 / VA11W-108, NC09-20986 / NC09-22402 and Shirley / NC11-22289.

- 2. List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

Accomplishment:

One hundred forty eight DH lines segregating for FHB resistance were selected to enter first year yield testing during the upcoming season. This represents approximately thirty percent of lines at this stage of the variety development conveyor belt. These lines reached this stage of the breeding process four years ahead of conventional breeding approaches.

Impact:

More breeding material developed to combat the threat of FHB is moving faster through the breeding process, and increasing the likelihood that more resistant varieties will be commercially available in a timely manner.

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY13 award period. List the release notice or publication. Briefly describe the level of FHB resistance.

‘Carolina White’ (NC08-23324), a soft white winter wheat was released to Carolina Ground Mill in 2014. It has FHB resistance similar to Jamestown as determined in the 2012 Uniform Southern Scab Nursery (below).

Line	FHB Index	FHB ISK
Ernie	4	15
Coker 9835	35	49
Jamestown	7	22
Carolina White	9	27

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Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in the FY13 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

*Petersen, S., P. V. Maloney, J.H. Lyster, R.A. Navarro, C. Cowger, G. Brown-Guedira, J.M. Costa, and J.P. Murphy. 2013. QTL Associated with Fusarium Head Blight Resistance in the NC-Neuse X AGS 2000 Recombinant Inbred Population. In: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), Proceedings of the 2013 National Fusarium Head Blight Forum (pp. 38). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

*Wright, E., C. Griffey, S. Malla, D. Van Sanford, S. Harrison, J.P. Murphy, J. Costa, G. Milus, J. Johnson, A. McKendry, D. Schmale III, A. Clark and N. McMaster. 2013. Characterization of FHB Resistance in SRW Roane and Jamestown NAM Populations. In: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), Proceedings of the 2013 National Fusarium Head Blight Forum (pp. 45). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

*Conway, B., J. P. Murphy, G. Brown-Guedira, Y. Dong, S. Chao, C. Griffey and J. Costa. 2013. Mapping Wheat Fusarium Head Blight Resistance QTL in the MD01W233-06-1/SS8641 Doubled Haploid Mapping Population. In: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), Proceedings of the 2013 National Fusarium Head Blight Forum (pp. 14). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

*Malla, S., C. Griffey, G. Milus, J. P. Murphy, A. Clark, D. Van Sanford, J. Costa, N. McMaster, and D. Schmale. 2013. Mapping FHB Resistance in Native SRW Variety Tribute. In: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), Proceedings of the 2013 National Fusarium Head Blight Forum (pp. 25). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

*Murphy, J. P., R.A. Navarro and S. Petersen. 2013. The 2012-13 Southern Uniform Soft Red Winter Wheat Scab Nursery. In: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), Proceedings of the 2013 National Fusarium Head Blight Forum (pp. 33). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

*Wright, E., C. Griffey, S. Malla, D. Van Sanford, S. Harrison, J. P. Murphy, J. Costa, G. Milus, J. Johnson, A. McKendry, D. Schmale III, A. Clark, and N. McMaster. 2013. Mapping FHB Resistance QTL in Jamestown x LA97113UC-124 RIL Population. Small Grain Workers Conference. March 21st-22nd, Shisler Center, Wooster, OH.

Reports (1):

* Murphy, J. P., and R. A. Navarro. 2013. The 2012-2013 Southern Uniform Winter Wheat Scab Nursery. Also available at http://scabusa.org/pdfs_dbupload/suwwsn10_report.pdf