USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY14 Final Performance Report
July 15, 2015

Cover Page

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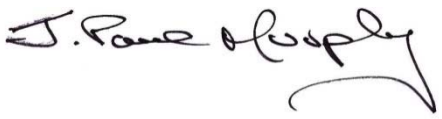
Fiscal Year:	FY14
USDA-ARS Agreement ID:	59-0206-4-031
USDA-ARS Agreement Title:	Enhancement of Fusarium Head Blight Resistance in the Southeastern U.S. Germplasm.
FY14 USDA-ARS Award Amount:	$ 64,202

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.	$ 64,202
	FY14 Total ARS Award Amount	**$ 64,202**



July 15, 2015

Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
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
WES-CP – Western 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 problem being resolved is the deficiency in number of varieties exhibiting moderate to high levels of FHB resistance available to southeastern wheat growers. Several new varieties with improved levels of resistance have been developed, but there is a paucity of such varieties to meet the diverse needs of growers in this region stretching from Maryland to Arkansas that incorporate high levels of FHB resistance with all necessary agronomic and end-use requirements demanded by the wheat community.

The approaches used to resolve the problem are a combination of conventional variety development, combined with newer doubled haploids and marker assisted selection technologies that appear to have promise. 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 five public and four private sector breeding programs in the US 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 2013-14 were analyzed and a report was compiled and published on the USWBSI website. NCSU contributed six lines to the 2014-15 nursery and three additional doubled haploid lines we developed were entered by other programs with whom we previously shared DH lines. NC09-22289, containing native resistance, performed equal to the resistant check Ernie. In addition, we evaluated important released varieties (60 plus) entered in the NC Official Variety Testing (OVT) program in our misted and inoculated nursery at Kinston NC. Results were posted on the NC Small Grains Production website utilized by producers. We also evaluated Preliminary and Advanced entries from the North Carolina program and two barley mapping populations for VA Tech.

2) Concluded two major studies to identify and validate FHB resistant QTL's in the varieties NC-Neuse and Bess. Over 15,000 SNP, SSR and DArT markers mapped to two populations.

3) Approximately 600 F_2 and F_3 bulks (combined) were advanced during 2014-15 utilizing mass selection. Most of these crosses contained one or more parents exhibiting partial FHB resistance. Approximately 30,000 headrows in the F_4, F_5 and F_6 generations (combined) were advanced using the pedigree method. The misted/inoculated nursery evaluated 3200 headrows. 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. During the 2014-15 crossing season, 595 new two- and three-way crosses were made and over 95 percent of the crosses had one or more parents with FHB resistance. Seventeen new crosses entered the doubled haploid program, all with FHB

resistant parents. A total of 2,500 doubled haploid lines were produced internally during 2014-15 and will enter field evaluation in fall 2015.

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:

Stine Peterson concluded a major four year study where 1) she identified the QTLs responsible for FHB resistance in NC-Neuse, 2) conducted a second study where she validated the resistance genes in both NC-Neuse and a Missouri variety Bess, and 3) combined the resistance genes from both NC-Neuse and Bess into double haploid lines. Quantitative trait loci on chromosomes 1A, 4A, and 6A with resistance contributed by NC-Neuse were validated. Additionally, QTL on chromosomes 2B and 3B with resistance contributed by Bess and Truman were validated. Marker assays were developed for QTL in the overlapping regions. Preliminary tests using these assays on recent Uniform Southern Winter Wheat Scab Nursery entries indicated that the assays developed for the QTL *Qfhb.nc-1A*, *Qfhb.nc-2B.1*, and *Qfhb.nc-6A* may be good candidates for use in MAS.

Impact:

Bess and NC-Neuse are frequently utilized as FHB resistant parents by breeders in the Southeastern US, thus having important QTL identified, validated and relevant KASP assays developed is having an impact on marker assisted selection in breeding populations. Stine Petersen brought samples of several NC-Neuse x Bess doubled haploid lines to the Scab Forum in December 2014. These DH lines contained all the verified QTL's and showed good levels of partial resistance in multiple years of field testing. These DH lines were distributed freely to public and private breeders to use as parents. Several programs utilized these lines in crossing blocks in spring 2015. The KASP assays developed in Petersen's work will be utilized for marker assisted selection in these populations during inbreeding generations.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY14 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 FY14 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 FY14 award period?**
   Yes
   If yes, how many?
   One, Stine Petersen

3. **Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**
   None
   If yes, how many?

4. **Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**
   None
   If yes, how many?

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY14 award period. List the release notice or publication. Briefly describe the level of FHB resistance. *If not applicable because your grant did NOT include any VDHR-related projects, enter N/A below.*

NC09-20986 in process of release.

Contains Fhb1,

Entry	FHB Incidence %	FHB Severity %	FHB Index[1]	Scabby Kernels %	ISK[2] Index	DON[3] ppm
NC09-20986	45	13	9	17	26	5
BESS	35	14	7	15	22	5
JAMESTOWN	49	19	13	19	30	5
ERNIE	36	18	8	15	24	6
COKER 9835	81	52	44	49	59	16
Mean	52	29	22	28	38	10
LSD (0.05)	14	9	9	9	9	9
CV%	12.3	14.2	19.5	15.7	11	43.2
Location / years	13	19	12	14	8	10

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 FY14 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Peer Reviewed:

Maloney, P. V., S. Petersen, R. A. Navarro, D. Marshall, A. L. McKendry, J. M. Costa, and J. P. Murphy, 2014. Digital image analysis method for estimation of Fusarium-damaged kernels in wheat. Crop Sci. 54:2077–2083.

Abstracts:

Clark, A. J., S. Petersen, P. V. Maloney, J. P. Murphy and D. A. Van Sanford. 2014. Comparing optical sorting, air-separation, and digital image analysis estimations of wheat Fusarium damaged kernels. In: S. Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), Proceedings of the 2014 National Fusarium Head Blight Forum (p. 77). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

Malla, S., C. Griffey, J.P. Murphy, E. Milus, A. Clark, D. Van Sanford, J. Costa, N. McMaster, D. Schmale III, S. Chao and G. Brown-Guedira. 2014. Identification of FHB resistance QTL in native SRW wheat cultivar Tribute. In: S. Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), Proceedings of the 2014 National Fusarium Head Blight Forum (p. 84). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

Murphy, J. P., R.A. Navarro and S. Petersen. 2014. The 2013-14 Southern Uniform Soft Red Winter Wheat Scab Nursery. In: S. Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), Proceedings of the 2014 National Fusarium Head Blight Forum (pp. 86-88). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

Petersen, S., J.H. Lyerly, P.V. Maloney, R.A. Navarro, C. Cowger, G. Brown-Guedira, J.M. Costa,, C.A. Griffey and J.P. Murphy. 2014. Fusarium Head Blight resistance QTL in the NC-Neuse / AGS2000 recombinant inbred population. In: S. Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), Proceedings of the 2014 National Fusarium Head Blight Forum (pp. 91). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

Petersen, S., J.H. Lyerly, A.L. McKendry, R. Navarro, C. Cowger, G. Brown-Guedira, S. Islam and J.P. Murphy. 2014. Validation of Fusarium head blight resistance QTL using the NC-Neuse / Bess doubled haploid population. In: S. Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), Proceedings of the 2014 National Fusarium Head Blight Forum (pp. 93). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

E. Wright, E., C. Griffey, S. Malla, D. Van Sanford, S. Harrison, J.P. Murphy, J. Costa, E. Milus, J. Johnson, A. McKendry, D. Schmale III, A. Clark, N. McMaster, S. Chao and G. Brown-Guedira. 2014. Identification of new QTL for native resistance to FHB in SRW wheat. In: S.

Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), Proceedings of the 2014 National Fusarium Head Blight Forum (pp. 101). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.

Reports:

Murphy, J. P, and S. Petersen. 2014. The 2013-2014 Southern Uniform Winter Wheat Scab Nursery. Also available at http://scabusa.org/pdfs_dbupload/suwwsn14_report.pdf