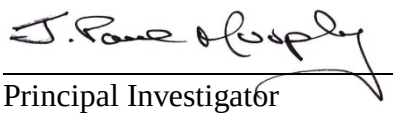
USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY12 Final Performance Report
July 16, 2013

Cover Page

PI:	J. Paul Murphy
Institution:	North Carolina State University
Address:	Department of Crop Science Box 7629 Raleigh, NC 27695
E-mail:	Paul_Murphy@ncsu.edu
Phone:	919-513-0000
Fax:	919-515-5657
Fiscal Year:	FY12
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.
FY12 USDA-ARS Award Amount:	$ 63,644*

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.	$ 57,796
VDHR-SWW	Developing Double Haploids to Expedite Mapping and Enhance FHB Resistance in SRWW.	$ 5,848
	Total ARS Award Amount	**$ 63,644**



July 15, 2013
Principal Investigator Date

* Award Amount does not include additional funding awarded in September of 2012 earmarked for other PIs at same institution

** 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?

Fusarium Head Blight (FHB) became an annual feature of wheat production in North Carolina during the past decade. Serious FHB loses were observed in the northeast region of the state in 2008, the Piedmont and northeast in 2009, and throughout the state in 2013. FHB outbreaks were sporadic in 2010, 2011 and 2012. Thus, the major problem being resolved is to increase acreage planted with varieties with improved FHB resistance to reduce DON in the US grain supply.

I am resolving this problem by:

1) Conducting variety development research to combine high levels of FHB resistance with overall agronomic and end-use quality in NC State variety releases. We make 500 new crosses annually with the majority containing parents exhibiting moderate levels of FHB resistance. We evaluate 30,000 head rows and several thousand yield plots annually. NC State is a member of the SUNGRAINS breeding cooperative with extensive cooperative testing of advanced lines and sharing of germplasm between the six participant universities. In addition to in-house breeding lines, we evaluate the Uniform Southern Soft Red Winter Wheat Scab Nursery, the Gulf Atlantic Nursery and NC Official Variety Test entries in replicated trials in our misted / inoculated scab nursery.

2) Increasing efficiency of Southern breeding programs to develop and release FHB resistant varieties by coordinating the Uniform Southern Soft Red Winter Wheat Scab Nursery involving 13 cooperators in US and Europe. I solicit entries, mail seed to cooperators, compile results, analyze the data and produce hard copy and web based reports annually.

3) Developing new breeding technologies to further enhance short term and long term improvement of FHB resistance and to efficiently introgress effective resistance genes into breeding germplasm. One graduate student (Maloney) initiated the mapping of FHB resistance in NC-Neuse, and this work was continued by a second graduate student (Petersen). Petersen is also validating markers for resistance in NC-Neuse and Bess in a DH population. We cooperated with VA-Tech and Univ. of Maryland in graduate student studies to map native resistances in two other parents. Our doubled haploid program, designed to speed the variety development process, produced 1,000 doubled haploid lines entering advanced yield trials in 2013-14. Ten to twenty three-parent and F_2 populations are sent to the Genotyping Center annually to undergo marker assisted selection.

2. List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):

Accomplishment (1):
Collected data on 182 RILs from the NC-Neuse / AGS 2000 population at two locations. Third year of data collection. Constructed map of population containing over 1,600 SSR, DArT, and SNP markers. Collected data on 113 DH lines from the cross of NC-Neuse / Bess at two locations. Second year of data collection. Collected data in one NC location for graduate student research projects based in VA.

Impact:
These are ongoing studies to map resistance in NC-Neuse, Bess and Tribute, and validate resistance QTLs in NC-Neuse and Bess. In addition, we identified DH lines in the NC-Neuse / Bess population that were entered into our Wheat Observation Yield Test in 2012-13, and our Crossing Block in fall 2012.

Accomplishment (2):
Seven NC entries were submitted to the 2012-13 Uniform Southern Soft Red Winter Wheat Scab Nursery. Four of these entries contained *Fhb1* -- three DH lines, and one entry developed by conventional approaches. One contained unknown FHB resistance of CIMMYT origin and two contained native resistance. Three GA entries and one MD entry in the Nursery were DH lines developed at Raleigh, gratis, for these programs.

Impact:
Immediate impact is the availability of these lines as parents to the entire breeding community starting in fall 2013. The doubled haploid materials are coming on-line four years earlier than if they were developed using conventional methods.

Accomplishment (3):
Coordinated and developed report for the 2013 Uniform Southern FHB Nursery, and I am in the process of coordinating the 2014 Southern FHB Nursery.

Impact:
This nursery is a key component of the overall variety development and germplasm exchange efforts in the southern soft wheat breeding community

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?

Fusarium Head Blight (FHB) has become an annual feature of wheat production in the eastern soft red winter wheat region. Doubled haploid technology decreases the time taken for the development of inbred lines of winter wheat by four to six years. This is important, not just in the variety development context, but also for the rapid development of research populations. Genetic variances and heritabilities of important traits are greater in fully inbred populations compared to partially inbred populations.

I am resolving this problem by developing doubled haploid lines from crosses involving one or two parents with moderate resistance to FHB aimed at variety development, or involving one resistant and one susceptible parent aimed at developing research populations.

2. List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):

Accomplishment:
During the past twelve months we have developed approximately 300 DH lines from the following crosses for the purposes of variety development.

Crosses	Traits
NC92-22206 / NC09-20986 (Fhb1)	Yield, Test Weight, excellent Scab
VA08W-294 / NC08-23089 (Fhb1)	Yield, Test Weight, Disease resistance
NC09-20896 (Fhb1) / Shirley	Yield, Disease Resistance, excellent Scab

Currently we are developing DH progenies from the cross SS86-41 x MD01W233-06-01 with the purpose of fine mapping the FHB resistance in the MD line

Impact:
We have reduced the time to development of inbred materials involving four important FHB crosses by approximately four to six years.

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

No cultivars or germplasms released in 2012-13.

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

Chen, J., C. A. Griffey, S. Liu, M. A. Saghai Maroof, J. P. Murphy, R. A. Navarro, C. H. Sneller, G. L. Brown-Guedira, and E. J. Souza. 2012. Registration of Fusarium Head Blight–Resistant Soft Red Winter Wheat Germplasm VA04W-433 and VA04W-474. J. Plant Reg. 6:1-6.

Wright, E, C. Griffey, S. Malla, S. Harrison, J. Johnson, G. Milus, J. P. Murphy, J. Costa, D. Van Sanford, A. McKendry, and D. Schmale. 2012. Mapping Fusarium head blight resistance QTL in the soft wheat cultivar Jamestown. AnMtgsAbsts2012. 239-1. ASA, Madison WI.

Conway, B., J. P. Murphy, G. Brown-Guedira, Y. Dong, S. Chao, C. Griffey, and J. Costa. 2012. Mapping resistance to Fusarium head blight in a doubled haploid wheat population from the cross MD01W233-06-1/SS86412012. In: S. Canty, A. Clark, A. Anderson-Scully, and D. Van Sanford (Eds.) Proceedings of the 2012 National Fusarium Head Blight Forum (p 56). East Lansing MI/Lexington KY: U.S. Wheat and Barley Scab Initiative.

Maloney, P. V., S. Petersen, R. A, Navarro, D. Marshall, A. L. McKendry, J. Costa and J. P. Murphy. 2012. Comparison of visual and digital image analysis methods for estimation of Fusarium damaged kernels in wheat. In: S. Canty, A. Clark, A. Anderson-Scully, and D. Van Sanford (Eds.) Proceedings of the 2012 National Fusarium Head Blight Forum (p 66). East Lansing MI/Lexington KY: U.S. Wheat and Barley Scab Initiative.

Murphy, J. P., and R. A. Navarro. 2012. The 2011-12 Uniform Southern Soft Red Winter Wheat Nursery. In: S. Canty, A. Clark, A. Anderson-Scully, and D. Van Sanford (Eds.) Proceedings of the 2012 National Fusarium Head Blight Forum (p 82). East Lansing MI/Lexington KY: U.S. Wheat and Barley Scab Initiative.

Petersen, S., P. V. Maloney, R. A. Navarro, J. H. Lyerly, C. Cowger, G. Brown-Guedira, D. Marshall, J. M. Costa, C. A. Griffey, and J. P. Murphy. 2012. QTL associated with Fusarium head blight resistance in the NC-Neuse x AGS 2000 recombinant inbred population. In: S. Canty, A. Clark, A. Anderson-Scully, and D. Van Sanford (Eds.) Proceedings of the 2012 National Fusarium Head Blight Forum (p 93). East Lansing MI/Lexington KY: U.S. Wheat and Barley Scab Initiative

Xiong, M., G. Brown-Guedira, J. P. Murphy, A. McKendry, and S. Islam. 2012. Marker enrichment of an FHB resistance QTL on chromosome 3B in SRWW. PAG XX PO320

Murphy, J. P, and R. A. Navarro. 2011. The 2010-2011 Southern Uniform Winter Wheat Scab Nursery. Also available at http://scabusa.org/pdfs_dbupload/suwwsn10_report.pdf