USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY08 Final Performance Report (approx. May 08 – April 09)
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Cover Page

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Fiscal Year:	2008
USDA-ARS Agreement ID:	59-0790-4-117
USDA-ARS Agreement Title:	Enhancement of Fusarium Head Blight Resistance in the Southeastern U.S. Germplasm Pool.
FY08 USDA-ARS Award Amount:	$ 82,472

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
VDHR-SWW	Enhancement of Fusarium Head Blight Resistance in the Southeastern US Germplasm Pool.	$58,253
VDHR-SWW	Marker Characterization of Soft Winter Wheat Scab Screening Nurseries.	$ 24,219
	Total Award Amount	**$ 82,472**

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Principal Investigator 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
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Winter Wheat Region
SWW – Southern Sinter Wheat Region

Project 1: *Enhancement of Fusarium Head Blight Resistance in the Southeastern US Germplasm Pool.*

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

Fusarium Head Blight is a major concern to the wheat industry in North Carolina due to the annual occurrence of the disease in commercial production. We are resolving this problem by: 1) developing southeastern adapted cultivars and germplasms with moderate to high levels of FHB resistance combined with superior productivity, disease and insect resistance and end-use quality demanded by the industry; 2) coordinating the Uniform Southern Soft Red Winter Wheat Scab Nursery to provide breeding programs with reliable, independent data on FHB resistance in advanced generation lines, and 3) seeking to provide eastern U.S. wheat breeders with novel sources of resistance to Fusarium Head Blight particularly from the intergeneric (*Triticum aestivum x Lophopyrum elongatum)* hybrids from the Sando collection.

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:

Advanced Lines

Field data collected under natural and inoculated FHB epidemics provided an opportunity to observe program progress in cultivar development. Three advanced lines slated for release in 2009 (NC04-20814), 2010 (NC05-19896), and 2011 (NC05-19684) were confirmed to have moderate levels of FHB resistance. All three genotypes have native resistance of unknown origin. All have excellent agronomic and good end-use quality characteristics. In addition, NC05-19684 is being evaluated by the sustainable/organic group at NC State for its ability to control annual ryegrass by means of a very dense winter canopy. Twelve of 64 entries in the 2009 Preliminary Test had field resistance at least as good as the moderately resistant NC-Neuse. Eight of the 12 contained exotic sources of resistance (CIMMYT, *Fhb1* etc) and the remainder had native resistance. Thirty five of the 50 entries in the 2010 Preliminary Test will contain native FHB resistant parents in their pedigrees. Eighteen of the 36 entries in the 2010 Advanced Test have exhibited FHB resistance at least as good as the moderately resistant NC-Neuse. One entry contains *Fhb1*. Sixty two $Bc_1F_{3:5}$ lines from crosses between the susceptible NC99-13022 and a diverse set of exotic resistant lines will enter the replicated FHB Observation test in fall 2009. These lines have exhibited good FHB resistance in inoculated and misted nurseries in past three years. A third year of data collected in both natural and inoculated FHB nurseries on 60 entries in the NC Official Variety Test was obtained and made available to producers and end-users.

The 2007-08 Uniform Southern Nursery program contained 48 entries submitted by eight US public and private breeding programs. Fifteen cooperators (13 US and one each in Romania and Hungary) returned laboratory, greenhouse and/or field nursery data. The data were

summarized in a nursery report distributed to wheat breeders and pathologists in Dec 2008. The 2008-09

Uniform Southern Nursery containing 53 entries submitted by ten US public and private breeding programs was distributed for planting in fall 2008.

Doubled Haploid Program

In excess of 120 doubled haploids obtained in each of two populations (Bess x NC-Neuse and SS8641 x MD08#560). Three F_1 populations with parentage containing *Fhb1* in a semi-adapted background and highly productive, adapted lines undergoing corn pollination and doubled haploid regeneration.

Early Generation Materials

Approximately 220 crosses involving FHB resistant parents were made during winter 2008-09. Twelve 3-way F_1 populations and one F_3 population were enhanced for *Fhb1* and the Frontana *7A-5A-3A* complex.

Impact:

The 2007-08 Uniform Southern Nursery provided cooperators with comprehensive evaluations of the FHB resistance in their advanced generation lines. These data are vital for release decisions and for choosing and sharing parents for further population development. The NC program produced advanced generation lines that have moderate to good levels of FHB resistance combined with good overall agronomic and end-use quality. Several of these are of sufficient overall merit to enter regional cooperative trials, which suggests they may be of variety quality.

As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?:

Multi–year evaluations of FHB resistance in state OVT entries helps growers make informed decisions on variety selection. Thus should result in a decline in the use of susceptible cultivars that are high performers in the absence of FHB epidemics, but extremely poor performers in the presence of FHB epidemics. Three lines are being increased for release in 2009, 2010 and 2011 that combine overall agronomic and end-use excellence with enhanced FHB resistance. Breeding lines with resistance from the Sando collection of intergeneric hybrids will enter Uniform Scab Nurseries in Fall 2010 and hopefully provide breeders with novel sources of resistance in a soft red winter wheat background adapted to the southeastern US. Uniform Nurseries provided rapid dissemination of resistant lines throughout the breeding community and provide a ready source of information on the true levels of resistance in advanced generation breeding lines.

Project 2: *Marker Characterization of Soft Winter Wheat Scab Screening Nurseries.*

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

   Evaluate the Eastern FHB screening nurseries with markers.
   Evaluation of the 172 entires in the 2008 NUWWSN, PNUWWSN and USFHBN and the 163 entries in the 2009 NUWWSN, PNUWWSN and USFHBN with 44 sequence tagged site and simple sequence repeat (SSR) markers was completed. For each year, an excel file report of marker alleles and a summary were provided to the nursery cooridinators and sent out to collaborators.
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   Use association genetics to identify new QTL for FHB resistance.
   Data for more than 600 DArT markers were obtained for 96 entries from the 2008 NUWWSN and USFHBN. DNA has been isolated for collection of DArT marker data for entries from the 2009 nurseries. The available DArT and SSR marker data has been combined with the phenotypic data collected by nursery collaborators, including incidence, severity, index and DON. A graduate student assigned to this project is in the process of analyzing results.

   Provide haplotype and marker polymorphism data on parents of mapping populations.
   Parents of regional mapping populations have been evaluated with 45 markers associated with FHB resistance. Mapping populations from crosses with resistant lines that do not appear to have previously mapped QTL are being targeted. Resistant parents Truman, Bess, and Colorben (Italian) and the susceptible parent MO94-314 are currently being evaluated with 500 SSR marker distributed through out the genome. This polymorphism screen is being done in collaboration with Anne McKendry at the University of Missouri and will be completed during July, 2009.

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):**

   The entries of the FHB screening nurseries have been evaluated with markers linked to 19 different genes, including markers linked to seven FHB resistance QTL. Data was also obtained on the *Rht-B1* and *Rht-D1* genes that have recently been implicated as affecting FHB resistance. We have developed new SNP-marker based protocols for evaluating the *Rht-B1*, *Rht-D1* and *Fhb1* loci that should improve the efficiency of marker-assisted selection for these traits. These protocols are being provided to the other USDA-ARS Regional Small Grains Genotyping Labs doing marker-assisted selection for FHB resistance.

Impact:

Marker analysis indicates that the frequency of lines having the *Fhb1* gene derived from Asian sources increased from 7.5% in the 2008 Eastern FHB screening nurseries to almost 15% in the 2009 nurseries (24 of 163 entries). Our 2009 evaluation placed increased emphasis on identification of unique markers associated with four FHB resistance QTL regions mapped in the soft red winter wheat cultivar Ernie. The presence of Ernie haplotypes for markers in the 3BSc and 5A regions indicate that these QTL are important components of the native FHB resistance in the Eastern soft wheat germplasm.

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.

Liu, S., C Griffey, J. Chen, A. McKendry, G. Brown-Guedira, C. Sneller, and J. P. Murphy. 2008. Breeding and Genomics of Fusarium Head Blight in Soft Red Winter Wheat: Research Progress and Ongoing Projects. ASA, Madison, WI.

Griffey, C. A., G. Brown-Guedira, S. Liu, J. P. Murphy, and C. Sneller. 2008. Characterization and development of FHB resistant soft winter wheat cultivars in the Eastern U.S. pp162-165. In:Canty, S. M., A. Clark, E. Walton, D. Ellis, J. Mundell, and D. Van Sanford (Eds), Proceedings of the National Fusarium Head Blight Forum; 2008 Dec 2-4: Indianapolis, IN: University of Kentucky.

Murphy, J. P, and R. A. Navarro. 2008. The 2007-08 Southern Uniform Winter Wheat Scab Nursery. Pp189. In:Canty, S. M., A. Clark, E. Walton, D. Ellis, J. Mundell, and D. Van Sanford (Eds), Proceedings of the National Fusarium Head Blight Forum; 2008 Dec 2-4: Indianapolis, IN: University of Kentucky.

Brown-Guedira, G., Carl Griffey, Fred Kolb, Anne McKendry, J. Paul Murphy, David Van Sanford. 2008. Breeding FHB-resistant soft winter wheat: progress and prospects. Cereal Research Communications 36, supplement b (proceedings of the 3rd intl. symposium on Fusarium head blight, Mesterhazy and Toth, eds.): 31-35.

Murphy, J. P., and R. A. Navarro. 2008. The 2007-08 Southern Uniform Winter Wheat Scab Nursery. Dept. Crop Science, N.C. State Univ., Raleigh.
Also available at http://www.scabusa.org/pdfs_dbupload/04_ussrww_fhb_report.pdf

If your FY08 USDA-ARS Grant contained a VDHR-related project, include below a list 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. If this is not applicable (i.e. no VDHR-related project) to your FY08 grant, please insert 'Not Applicable' below.

No cultivars or germplasm were released in FY08.