

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY07 Final Performance Report (approx. May 07 – April 08)
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Cover Page

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Fiscal Year:	2007
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.
FY07 ARS Award Amount:	\$ 54,279

USWBSI Individual Project(s)

USWBSI Research Area *	Project Title	ARS Adjusted Award Amount
HGR	Introgression of FHB Resistance from Hexaploid and Intergeneric Hybrids into Soft Red Winter Wheat.	\$15,434.
VDUN	Development of Fusarium Head Blight Resistant Wheat for the Southeastern United States.	\$ 38,845
	Total Award Amount	\$ 54,279

Principal Investigator

Date

* CBCC – Chemical, Biological & Cultural Control
 EEDF – Etiology, Epidemiology & Disease Forecasting
 FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
 GET – Genetic Engineering & Transformation
 HGR – Host Genetics Resources
 HGG – Host Genetics & Genomics
 IIR – Integrated/Interdisciplinary Research
 PGG – Pathogen Genetics & Genomics
 VDUN – Variety Development & Uniform Nurseries

Project 1: Introgression of FHB Resistance from Hexaploid and Intergeneric Hybrids into Soft Red Winter Wheat.

1. What major problem or issue is being resolved and how are you resolving it?

We are seeking to provide eastern U.S. wheat breeders with novel sources of resistance to Fusarium Head Blight in adapted backgrounds. Donor sources include exotic cultivars, a diploid wheat relative, and intergeneric (*Triticum aestivum* x *Lophopyrum elongatum*) hybrids from the Sando collection. Donor sources are backcrossed to susceptible North Carolina adapted germplasm.

**2. List the most important accomplishment and its impact (how is it being used?).
Complete all three sections (repeat sections for each major accomplishment):**

Accomplishment:

1. Exotic Cultivars:

Greenhouse

An average of 12 BC₂F₁ progeny in each of 12 backcross families were evaluated by single floret inoculations, and an average of 8 progeny per family were selfed to produce BC₂F₂ seed. The donor parents (Argentina 8, Argentina 93, Brazil 5, CIMMYT 21, CIMMYT 26, CIMMYT 34, and PI 242507) were identified as having resistance distinct from Sumai 3 by Liu and Anderson (Crop Sci., 43:760-766) based on allelic content at five SSR loci.

Field

Approximately 300 BC₁F_{2:3} lines involving donor parents (PI 104131, PI 192660, PI 345731, PI 351993, PI 81791, PI 294975 and PI 285933) identified as having resistance distinct from Sumai 3 by Liu and Anderson (Crop Sci., 43:760-766) were evaluated in an inoculated and misted nursery at Kinston NC in 2007-08. The recurrent parent was a susceptible soft red winter wheat adapted to the southeastern US. Resistant heads were tagged and harvested separately. BC₂F₂ materials involving the same donor and recurrent parents were advanced in bulk in the same nursery.

2. *T. monococcum*:

Field

Two hundred sixty BC₂F_{4:5} lines from a backcross involving a *T. monococcum* donor (PI 167591) and the susceptible NC98-26143 were evaluated in a misted and inoculated head row nursery. Nine lines displaying better resistance than the recurrent parent were harvested in bulk. Unfortunately, the level of resistance in the selected lines was little better than the recurrent parent.

3 Sando Intergeneric Hybrids:

Field

Two hundred thirty BC₁F_{2:3}, BC₁F_{3:4}, and BC₂F_{2:3} progeny in each of four backcross families

were evaluated in an inoculated and misted nursery. The donor parents (PI 611928, PI 611937, PI 611939, and PI 611899) were previously identified as having excellent Type II resistance. Heads exhibiting low FHB symptoms were tagged and harvested.

Impact:

Because the best known sources of resistance to Fusarium head blight in the cultivated wheat gene pool are partial rather than complete, it is timely to seek additional resistance sources to complement those genes already identified. We believe we have moved potentially novel sources of resistance from exotic cultivated wheat and, wheatgrass into southeastern U.S. adapted soft red winter wheat. However additional evaluations will be necessary to confirm the presence of the novel resistance genes.

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?:

Within two seasons we should enter some of these these materials in uniform cooperative nurseries so breeders in the public and private sectors can evaluate the germplasm and have unfettered access to a greater genetic diversity of resistance genes to incorporate into their own variety development programs.

Project 2: *Development of Fusarium Head Blight Resistant Wheat for the Southeastern United States.*

1. What major problem or issue is being resolved 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 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. To provide breeding programs with reliable, independent data on FHB resistance in advanced generation lines the Uniform Southern Soft Red Winter Wheat Scab Nursery is coordinated by North Carolina State University.

**2. List the most important accomplishment and its impact (how is it being used?).
Complete all three sections (repeat sections for each major accomplishment):**

Accomplishment:

Advanced Lines

Field data collected under unusually severe natural and inoculated FHB epidemics combined with Type II greenhouse data provided an opportunity to observe program progress under a worst-case scenario. Two advanced lines were identified for release in 2009 (NC04-20814) and 2010 (NC05-21090) with FHB resistance at least as good as the moderately resistant NC-Neuse. Both genotypes have native resistance of unknown origin. Both have excellent overall agronomic and end-use quality characteristics. Eleven of 49 entries in the 2008 Advanced Test had field resistance at least as good as the moderately resistant NC-Neuse. Ten lines had native sources of resistance, and one contained *Fhb1*. The yield of the latter genotype was not significantly different from the highest yielding entry. Twenty of 54 entries in the 2008 Preliminary Test had field resistance at least as good as the moderately resistant NC-Neuse. Nineteen of the 56 entries in the 2009 Preliminary Test will contain exotic (CIMMYT, Chinese, Italian, Japanese) FHB resistant parents in their pedigrees. Only six of the remaining 37 entries have no FHB resistant parents in their pedigrees. Seventeen of the 30 entries in the 2009 Advanced Test will contain FHB resistant parents in their pedigrees. One entry contains *Fhb1*. A second year of data collected in both natural and inoculated FHB nurseries on 50 entries in the NC Official Variety Test was obtained and made available to producers and end-users.

The 2006-07 Uniform Southern Nursery program contained 45 entries submitted by eight US public and private breeding programs, plus one Romanian program. Eleven cooperators (9 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 2007. The 2007-08 Uniform Southern Nursery containing 52 entries submitted by nine US public and private breeding programs was distributed for planting in fall 2007.

Early Generation Materials

Approximately 250 crosses involving FHB resistant parents were made during winter 2007-08. Twenty three 3-way F₁ populations and two F₂ populations were enhanced for *Fhb1* frequency using MAS. A MAS project to introgress the *Qfhs.ndsu-3AS* resistance into the NC-Neuse background was successfully completed with the derivation of BC₂F_{2,3} lines homozygous for the resistance gene. A similar effort to introgress the 3A and 5A regions controlling Type 1 resistance in 'Frontana' into a susceptible southeastern background resulted in the distribution of BC₂F₂ seed to five public programs for further selection. The BC₂F₂ seed was harvested from BC₂F₁ plants heterozygous for the Frontana alleles. Three F₁ populations with parentage containing *Fhb1* in a semi-adapted background and highly productive, adapted lines are being readied for corn pollination and doubled haploid regeneration.

Impact:

The 2006-07 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. Our sharing of Southeastern adapted germplasm with the novel resistance gene *Qfhs.ndsu-3AS* broadens the genetic variation available in a desirable genetic background. 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?:

Two lines are being increased for release in 2009 and 2010 that combine overall agronomic and end-use excellence with enhanced FHB resistance. Providing growers with more varietal choices with FHB resistance will lead to 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. 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.

FY06 (approx. May 06 – April 07)
PI: Murphy, J. Paul
USDA-ARS Agreement #: 59-0790-4-117

FY06 Final Performance Report

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.

Murphy, J. P., and R. A. Navarro. 2007. The 2006-07 Southern Uniform Winter Wheat Scab Nursery. p. 213. *In* S. M. Canty, A. Clark, D. Ellis and D. A. Van Sanford (eds.) Proc. of the 2007 National Fusarium Head Blight Forum, 2-4 Dec.; The Westin Crown Center, Kansas City, Missouri, USA. Univ. of Kentucky, Lexington, KY.

Reports:

Murphy, J. P. and R. A. Navarro.. 2007. 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