

**USDA-ARS/  
U.S. Wheat and Barley Scab Initiative  
FY06 Final Performance Report (approx. May 06 – April 07)  
July 16, 2007**

**Cover Page**

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<b>Fiscal Year:</b>	2006
<b>USDA-ARS Agreement ID:</b>	59-0790-4-117
<b>USDA-ARS Agreement Title:</b>	Enhancement of Fusarium Head Blight Resistance in the Southeastern U.W. Germplasm Pool.
<b>FY06 ARS Award Amount:</b>	\$ 54,504

**USWBSI Individual Project(s)**

<b>USWBSI Research Area*</b>	<b>Project Title</b>	<b>ARS Award Amount</b>
HGR	Introgression of FHB Resistance from Hexaploid, Diploid, and Intergeneric Hybrids into Soft Red Winter Wheat.	\$ 17,881
VDUN	Development of Fusarium Head Blight Resistant Wheat for the Southeastern United States.	\$ 36,623
	<b>Total Award Amount</b>	<b>\$ 54,504</b>

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Principal Investigator

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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  
 PGG – Pathogen Genetics & Genomics  
 VDUN – Variety Development & Uniform Nurseries

**Project 1: Introgression of FHB Resistance from Hexaploid, Diploid, 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, intergeneric (*Triticum aestivum* x *Lophopyrum elongatum*) hybrids from the Sando collection and advanced generation North Carolina triticales (*Triticale hexaploide*). 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 25 BC<sub>1</sub>F<sub>1</sub> progeny in each of 8 backcross families were evaluated by single floret inoculations, and an average of 2 progeny per family were backcrossed to produce BC<sub>2</sub>F<sub>1</sub> seed. The donor parents (Argentina 8, Argentina 93, Brazil 5, CIMMYT 21, CIMMYT 26, CIMMYT 34, PI 242507 and PI 8588430) were identified by Liu and Anderson (Crop Sci., 43:760-766) as having resistance distinct from Sumai 3 based on allelic content at five SSR loci.

An average of 12 BC<sub>2</sub>F<sub>1</sub> progeny in each of 19 backcross families were evaluated by single floret inoculations, and an average of 2 progeny per family were selfed to produce BC<sub>2</sub>F<sub>2</sub> seed. The donor parents (PI 104131, PI 192660, PI 345731, PI 351993, PI 382167, PI 519798, PI 81791, PI 294975, PI 285933, and PI 256958) were identified by Liu and Anderson (Crop Sci., 43:760-766) as having resistance distinct from Sumai 3.

**Field**

Ten BC<sub>1</sub>F<sub>2</sub> populations were evaluated in a misted and inoculated head row nursery at Kinston NC in 2006-07. The donor parents (PI 104131, PI 192660, PI 345731, PI 351993, PI 382167, PI 519798, PI 81791, PI 294975, PI 285933, and PI 256958) were identified by Liu and Anderson (Crop Sci., 43:760-766) as having resistance distinct from Sumai 3. Heads exhibiting low FHB symptoms were tagged and harvested.

**2. *T. monococcum*:**

**Field**

Two hundred thirty BC<sub>2</sub>F<sub>3,4</sub> 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 at Kinston NC in 2006-07. Ten heads were harvested from each of 19 rows identified as having resistance superior to the recurrent parent.

### **3 Sando Intergeneric Hybrids:**

#### **Greenhouse**

Two hundred fifty five BC<sub>2</sub>F<sub>1</sub> progeny in each of four backcross families were evaluated by single floret inoculation. Twenty two were selected and selfed. The donor parents (PI 611928, PI 611937, PI 611939, and PI 611899) were previously identified as having excellent Type II resistance.

#### **Field**

Eleven BC<sub>1</sub>F<sub>2</sub> and BC<sub>2</sub>F<sub>2</sub> populations were evaluated in a misted and inoculated head row nursery at Kinston NC in 2006-07. The donor parents (PI 611939, PI 611928, and PI 611937) were previously identified as having excellent Type II resistance. Heads exhibiting both low and high FHB symptoms were tagged and harvested. The reason for harvesting both susceptible and resistant types is to facilitate the possible identification of translocations containing the resistance factors using cytogenetic techniques.

### **4 Triticales:**

#### **Field**

Eight BC<sub>2</sub>F<sub>3</sub> bulks from two backcross populations involving NC-adapted triticale lines (NC99-424 and NC99-1017) with high levels of Type II resistance and the FHB susceptible winter wheat recurrent parent NC99-13022 were evaluated in a misted and inoculated field nursery at Kinston NC in 2007-08. 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 have rapidly moved potentially novel sources of resistance from exotic cultivated wheat, wheatgrass and triticale into southeastern U.S. adapted soft red winter wheat.

#### **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 three seasons we will enter 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 with 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):**

**Accomplishments:**

**Advanced Lines**

Two lines (NC03-7957 and NC03-8026) with moderate FHB resistance were entered in the Uniform Southern Yield nursery in 2006-07. Fourteen of 39 entries in the 2006-07 NC Wheat Advanced Test and 22 of 86 entries in the NC Wheat Preliminary test had Fusarium damaged kernel ratings equal to or better than the NC-Neuse check. Four entries from the Advanced test will enter the Uniform Southern Yield Nursery in 2007-08. The resistance in these materials traces to both native and Chinese sources. Three lines with a Chinese source of resistance exhibited excellent agronomic performance in the Preliminary test. This represented the first time FHB resistant lines based on Chinese sources had comparable agronomic performance to lines with native sources only.

**Early Generation Materials**

Approximately 200 crosses involving FHB resistant parents were made during winter 2006-07. Fourteen F<sub>2</sub> and F<sub>3</sub> populations were enhanced for *Fhb1* and *Qfhs.ifa-5A*. BC<sub>3</sub>F<sub>1</sub> materials were obtained in programs involving MAS for the LDN(3A) and Frontana Type 1 resistance.

The 2005-06 Uniform Southern Nursery program contained 34 entries submitted by seven US public and private breeding programs. Fourteen cooperators (12 US and one each in Romania and Hungary) returned laboratory, greenhouse and/or field nursery data. Milling and Baking quality data were included for the first time. The data were summarized in a nursery report distributed to wheat breeders and pathologists in Dec 2006. The 2006-07 Uniform Southern Nursery containing 42 entries submitted by nine US public and private breeding programs and one Romanian cooperator was distributed for planting in fall 2006.

**Impact:**

For the second year, the NC program is 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 be entered in regional cooperative trials which suggests they may be of variety quality. Advanced generation wheat lines adapted to the southeastern U.S. with moderate to high levels of FHB resistance were made available to 11 cooperators by way of the Uniform Nursery programs

**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?**

Advanced generation NC lines with moderate to good levels of FHB resistance add to the pool of adapted lines available to breeders, and potential varieties for commercial production. 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.

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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 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., R. A. Navarro and J. H. Lyerly. 2006. The 2005-06 Uniform Southern Fusarium head blight screening nursery. p. 114-115. *In* S. M. Canty, A. Clark and D. A. Van Sanford (eds.) Proc. of the 2006 National Fusarium Head Blight Forum, 10-12 Dec.; Research Triangle Park, N.C., USA. Univ. of Kentucky, Lexington, KY

Reports:

Murphy, J. P., R. A. Navarro and J. H. Lyerly. 2006. 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](http://www.scabusa.org/pdfs_dbupload/04_ussrww_fhb_report.pdf)