

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY05 Final Performance Report (approx. May 05 – April 06)
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Cover Page

PI:	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:	2005
FY05 ARS Agreement ID:	59-0790-4-117
Agreement Title:	Enhancement of Fusarium Head Blight Resistance in the Southeastern U.S. Germplasm Pool.
FY05 ARS Award Amount:	\$ 54,310

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
GIE	Introgression of FHB Resistance from Hexaploid, Diploid, and Intergeneric Hybrids into Soft Red Winter Wheat.	\$ 17,964
VDUN	Development of Fusarium Head Blight Resistant Wheat for the Southeastern United States.	\$ 36,346
	Total Award Amount	\$ 54,310

Principal Investigator

Date

* BIO – Biotechnology
CBC – Chemical & Biological Control
EDM – Epidemiology & Disease Management
FSTU – Food Safety, Toxicology, & Utilization
GIE – Germplasm Introduction & Enhancement
VDUN – Variety Development & Uniform Nurseries

(Form – FPR05)

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 novel sources of resistance to Fusarium Head Blight in exotic cultivars, *Triticum monococcum* diploid relatives, intergeneric (*Triticum aestivum* x *Lophopyrum elongatum*) hybrids from the Sando collection and advanced generation North Carolina triticales (*Triticale hexaploide*). Potential donor sources are evaluated for Type II resistance in greenhouse evaluations and crossed and backcrossed to susceptible North Carolina adapted germplasm (primarily NC99-13022). Approximately 600 donor accessions, F₁ and BC_xF₁ progenies are evaluated annually using the single floret inoculation method. Resistant BC₂F₁ and BC₃F₁ progenies are selfed and advanced to field inoculated and misted nurseries for further selection.

**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: An average of 25 BC₁F₁ progeny in each of 11 backcross families were evaluated by single floret inoculations, and an average of 3.5 progeny per family were backcrossed to produce BC₂F₁ seed. The donor parents (PI 104131, PI 192660, PI 345731, PI 350768, 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 based on allelic content at five SSR loci.

2. *T. monococcum*: Seventy BC₂F_{2.3} lines from a backcross involving a *T.monococcum* donor (PI 167591) and the susceptible NC98-26143 were evaluated for Type II resistance in the greenhouse and for field resistance in a misted and inoculated nursery. Six lines were identified as having resistance superior to the recurrent parent, but this resistance was very moderate with severities ranging from 35 to 65% in resistant lines versus 80% in the susceptible recurrent parent. This level of resistance is much inferior to that observed using other approaches in this project. We have discontinued this line of introgression in order to concentrate on other aspects that appear to be yielding better prospects.

3 Sando Intergeneric Hybrids: An average of 52 BC₁F₁ or BC₂F₁ progeny in each of four backcross families were evaluated by single floret inoculations, and an average of eight progeny per family were backcrossed to produce BC₂F₁ or BC₃F₁ seed using the susceptible NC99-13022 as the recurrent parent. The donor parents (PI 611928, PI 611937, PI 611939, and PI 611899) were previously identified as having excellent Type II resistance.

BC₁F₁ hybrids were obtained with 18 additional Sando accessions having excellent Type II resistance (PI 611883, PI 611887, PI 611890, PI 611892, PI 611894, PI 611896, PI 611906, PI 611907, PI 611908, PI 611911, PI 611912, PI 611917, PI 611924, PI 611927, PI 611930, PI 611935, PI 611940, and PI 611942).

4. Triticales: Ninety two BC₂F_{2:3} lines from two backcross populations involving NC-adapted triticale lines (NC99-424 and NC99-1017) with high levels of Type II resistance were evaluated in the greenhouse and a misted and inoculated field nursery. Individual plants were selected from 18 lines in the field.

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. Materials from all three streams have undergone sufficient backcrossing generations to permit selfing and selection with a reasonable chance of finding adapted materials with elevated levels of FHB resistance.

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?:

This research identified additional sources of Type II resistance to Fusarium head blight that are likely different to those currently in widespread use in U.S. breeding programs. 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?

The Fusarium Head Blight (FHB) epidemic of 2002-03 left one-half of the North Carolina wheat crop unsuitable for human consumption due to elevated DON levels. In the interim, low to moderate levels of FHB have been observed annually in commercial production and the disease has remained a concern to wheat producers and processors in the state. 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 that the wheat community expects. To provide breeding programs with solid, independent data on 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:

Twelve of 39 entries in the 2005-06 Wheat Advanced Test had field FHB ratings equal to or better than the NC-Neuse check. Two of these lines had Chinese parentage and were developed with the aid of marker assisted selection, but the remainder had southeastern adapted parentage only. This represented the first time FHB resistant lines underwent multi-location replicated yield testing in the advanced stages of our program. One line was of sufficient overall merit to be entered in the official state and regional trials in 2006-07. Seventeen of 69 entries in the 2005-06 Wheat Preliminary Test had field FHB ratings equal to or better than the NC-Neuse check. Two of these lines had Chinese parentage and were developed with the aid of marker assisted selection, but the remainder had southeastern adapted parentage only. Eleven of these lines were of sufficient overall merit to be entered in the advanced and regional breeder cooperative nurseries in 2006-07.

The Uniform Southern Nursery program increased to 46 entries in 2004-05 submitted by ten US public and private breeding programs and one Romanian cooperator. Eleven cooperators (8 US and one each in Romania, Switzerland and Hungary) returned greenhouse and/or field nursery data. The data were summarized in a nursery report distributed to wheat breeders and pathologists in Dec 2005. The 2005-06 Uniform Southern Nursery containing 36 entries submitted by seven US cooperators was distributed in fall 2005.

Impact:

We are seeing signs of some maturity in the NC program with a modest stream of 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. These provide more parental options when crossing programs are being planned by breeders. There may be variety quality material here which is the goal of VDUN, but several more years of testing are required before this can be determined. 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.

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.

Abstract:

Murphy, J. P., R. A. Navarro and J. H. Lyerly. 2005. The 2004-05 Uniform southern Fusarium head blight screening nursery. p. 75. *In* S. M. Canty, T. Boring, J. Wardwell, L. Siler and R. W. Ward (eds.) Proc. of the National Fusarium Head Blight Forum, 11-13 Dec.; Milwaukee, WI, USA. Michigan State Univ., East Lansing. MI.

Report:

*Murphy, J.P., and R.A. Navarro. 2005. Uniform Winter Wheat Scab Nursery. Dept. of Crop Science, N.C. State Univ. 32 pp. also available at http://www.scabusa.org/pdfs_dbupload/04_ussrww_fhb_report.pdf