

**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:	59-0790-4-115
USDA-ARS Agreement Title:	Management of FHB in Arkansas.
FY07 ARS Award Amount:	\$ 71,881

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
VDUN	Developing FHB-Resistant Wheat Cultivars for the Midsouth.	\$71,881
	Total Award Amount	\$ 71,881

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: *Developing FHB-Resistant Wheat Cultivars for the Midsouth.*

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

The major problems are that wheat cultivars currently grown in the region have little or no resistance to FHB, levels of DON in harvested grain sometimes exceed the allowable level, and a nivalenol chemotype of the FHB pathogen has been found recently at high frequency in the region.

The Arkansas program is resolving this by developing several wheat cultivars and lines with more competitive yield potential and moderate to high levels of resistance to FHB and other diseases that are important in the region.

The Arkansas program also assisted other breeding programs by evaluating the Southern Winter Wheat Scab Nursery and lines from the LSU wheat breeding program for resistance to FHB and other diseases.

A Ph. D. graduate student is conducting research to 1) determine if wheat lines with resistance to the DON chemotype also will be resistant to the nivalenol chemotype, 2) to quantify resistance to DON injected into florets and determine the utility of this variable for evaluating resistance to FHB, 3) to identify wheat lines with resistance to initial infection (type I resistance) and to DON and nivalenol accumulation in harvested grain, and 4) to improve the methodology for evaluating resistance to initial infection and mycotoxin accumulation in grain.

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:

The most important accomplishment has been the development of three lines with good FHB resistance. The resistance was verified in the 2007 Southern Uniform Winter Wheat Scab Nursery. Three of the Arkansas entries, AR97002-10-2, AR97124-4-2, and AR850-1 were ranked in the top ten for FHB index across all locations at 15, 16, and 16, respectively. This was not significantly different than either of the resistant checks, Ernie and Bess at 12 and 7 respectively. They were also low in DON (9.1, 9.0, and 13.3 ppm) compared to the checks (9.1 and 5.3 ppm).

Lines from the 2008 Southern Winter Wheat Scab Nursery, Arkansas and LSU wheat breeding programs, and Arkansas germplasm enhancement program were evaluated in inoculated, misted nurseries at two field locations to identify resistant lines. Lines from the 2008 Southern Winter Wheat Scab Nursery also were evaluated for type I resistance in the greenhouse.

Fifteen winter wheat lines with diverse sources of FHB resistance ranked similarly for resistance to DON and NIV chemotypes of the pathogen in evaluations for type I and type II resistance, indicating that the resistance genes currently used in US soft red winter wheat programs are effective against both chemotypes. Experiments with injection of purified DON into wheat florets confirmed that resistance gene *FHB1* confers resistance to DON and determined that this is likely the only FHB resistance gene that confers both resistance to DON and resistance to spread within a spike. The level of type I resistance in 15 winter wheat lines was quantified. Efforts to quantify resistance to DON accumulation in grain and to improve methodology for evaluating resistance to initial infection and mycotoxin accumulation in grain are still in progress.

(Form FPR07)

Impact:

Two of the three lines are either commercially available or are being closely looked at for release. AR850-1 was released and licensed to a commercial seed company in Arkansas. AR97124-4-2 was entered in the 2008 Uniform Eastern Soft Wheat Nursery as well as the Arkansas State Variety Trials. The ultimate goal of the project is to get FHB-resistant cultivars into growers' fields. AR97124-4-2 will also give other breeders the chance to use an FHB-resistant line with good stripe rust and winterhardiness (even for the Midwest) as a parent in their program.

Evaluation of breeding lines for resistance to FHB and other diseases facilitates the development of FHB-resistant cultivars.

Cultivars with resistance to DON chemotypes also will be resistant to NIV chemotypes, therefore a special breeding program for resistance to NIV chemotypes is not necessary. Resistance gene *FHB1* was shown to be the only gene that confers both resistance to DON and resistance to spread within a spike, indicating that this gene is more valuable than previously believed because it has a unique mode of action. Lines with high levels of type I resistance were identified, indicating that suitable sources of resistance to initial infection are available in adapted lines. Improving the methodology for evaluating resistances to initial infection and mycotoxin accumulation in grain will facilitate development of resistant cultivars.

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?:

Growers will have the opportunity to plant AR850-1, and the last set of evaluations for AR97124-4-2 will determine if it becomes commercialized. The breeding community will also have adapted germplasm to utilize with AR97002-10-2 being a southern line that derives resistance from a more northerly background.

Evaluation of breeding lines for resistance to FHB and other diseases provides data that breeders use to make decisions relative to advancement of lines and release of cultivars.

Breeders will be confident that cultivars developed for resistance to DON chemotypes also will be resistant to NIV chemotypes. Breeders have access to adapted lines with high levels of type I resistance. The scientific community has new knowledge that gene *FHB1* has a unique mode of action.

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.

Horevaj, P., Milus, E. A., Gale, L. R., and Kistler, H. C. 2007. Resistance in soft red winter wheat lines to deoxynivalenol and nivalenol chemotypes of *Fusarium graminearum*. *Phytopathology* 97S:48.

Horevaj, P., and Milus, E. A. 2007. Resistance of winter wheat to *Fusarium* head blight and mycotoxin accumulation. Pages 14-15 in: Arkansas Crop Protection Association Research Abstracts Vol. 11. (Peter earned second place in the Ph. D. oral presentation competition.)

Horevaj, P., and Milus, E. A. 2008. Resistance of winter wheat to *Fusarium* head blight and mycotoxin accumulation. Gamma Sigma Delta Arkansas Chapter Student Research Competition, February 25, 2008. (Peter earned second place in the Ph. D. oral presentation competition.)

Horevaj, P., Milus, E. A., Gale, L. R., and Kistler, H. C. 2007. Resistance of winter wheat lines to deoxynivalenol and nivalenol chemotypes of *Fusarium graminearum*. Pages 183-187 in: Proceedings of the 2007 National *Fusarium* Head Blight Forum.

Milus, E. A., and Hedge, J. 2007. Evaluations for FHB severity, Type II resistance, and stripe rust resistance. Pages 8, 21, and 26, respectively, in: 2007 Southern Winter Wheat Scab Nursery Report. J.P. Murphy and R.A. Navarro, editors.