

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY07 Final Performance Report (approx. May 07 – April 08)
July 15, 2008**

Cover Page

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Fiscal Year:	2007
USDA-ARS Agreement ID:	59-0790-4-092
USDA-ARS Agreement Title:	Developing Winter Wheat with Improved Fusarium Head Blight Tolerance by Conventional and Transgenic Approaches.
FY07 ARS Award Amount:	\$ 46,378

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
VDUN	To Enhance Variety Development of Scab Resistant Hard Winter Wheat Varieties.	\$46,378
	Total Award Amount	\$ 46,378

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: *To Enhance Variety Development of Scab Resistant Hard Winter Wheat Varieties.*

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

The major problem that we are addressing is the susceptibility of wheat cultivars grown in Nebraska and adjacent regions. We are resolving this problem through: 1. developing elite hard winter wheat cultivars that are resistant to Fusarium head blight (FHB, scab) and 2. screening experimental lines in regional FHB nurseries and hard winter wheat regional nurseries to identify the level of FHB resistance within the existing elite winter germplasm of the Great Plains. In our 2007-2008 crossing blocks we made 221 crosses specifically for FHB tolerance. The crossing effort was greatly aided by our receiving 255 backcrossed derived lines using MAS for the FHB1 allele developed in Wesley (an excellent variety and parent, released by the USDA-University of Nebraska cooperative breeding program and currently grown on 7.7% of Nebraska’s acreage, 2007-2008 field season statistics, NASS), Trego, and Harding from Dr. Guihua Bai. It should be noted that Wesley is predominantly grown in eastern NE and under irrigation, so its acreage in the primary region for FHB is larger than the reported 7.7%. A brief summary of the breeding progress so far is:

	Native or Marker Parent	Marker Based	Comment
Crosses made	221		Using native resistance or known FHB QTLs
F2 Populations	153		Using native resistance or known FHB QTLs
F3 Populations	103		Using native resistance or known FHB QTLs
F4 Headrows	3500		Using native resistance or known FHB QTLs
F5 Lines Selected	>100	57*	Generation where line are tested with markers for FHB QTLs
F6 Lines Selected	27	14	Many of the 14 lines are agronomically unacceptable
F7 Lines Selected	NA**	1	
F8 - F12 Lines Selected	14	0	Three years of FHB mist testing, mostly using native resistance
Lines released (2008)	2		Native resistance

*Have parents with FHB1

** Second year of testing in Mist Nursery, hence waiting additional testing before being considered tolerant.

We increased our crosses because we have better germplasm as parents, but also to help assist the SDSU winter wheat breeding program which is currently looking for a new winter wheat breeder (hence may not be making as many crosses as normal). We are not satisfied with the frequency of known QTLs in our breeding program so we are working with Dr. Bai to develop a F₁ half seed system for 3-way crosses and F₂s after they have been sorted by Dr. Dowell (see below) to remove soft kernel types. Allele enrichment will be a critical strategy for the future.

In addition, we have grown a replicated experiment in two locations to determine if our seed sorting efforts with Dr. Floyd Dowell is selecting for heritable traits. It appears that kernel hardness (critical as we use VA and MO soft winter wheat lines as parents) and color selection is heritable (it is doubtful that white wheats will be grown in the major FHB areas of the Great Plains). Sorting on protein content is still being studied but may be less heritable as might be expected for a trait with considerable environmental variation. Efficacy for sorting on low DON concentration is being evaluated in the field this year. The FHB nurseries were successfully screened and submitted for DON testing.

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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: Two of the difficulties in the Hard Winter Wheat Region (HWWR) are that many lines are susceptible to FHB and that lines are poorly characterized, thus not allowing growers to select more tolerant lines for their farms (make educated decisions). In 2008, we released two new hard red winter wheat lines (e.g. Camelot (formerly NE01604) and Settler CL (formerly NH03614 CL) which have a higher level of tolerance to scab. Both lines are under seed increase and will be sold to certified seed producers in the fall, 2008. Camelot is a very high quality line for milling and baking and has an excellent disease resistance package. Settler CL is a new, broadly adapted herbicide tolerant wheat and will be co-released with South Dakota and Wyoming. Both of these wheats will complement Overland (formerly NE01643), our first release (in 2007) with better levels of FHB tolerance which will be widely available to growers in 2008 (expect a minimum of 120,000 units of seed to be available). Though these lines only give a partial improvement in reducing FHB, they are moving us away from truly susceptible lines. The three wheats can be grown with early flowering winter wheat as a way for growers to use flowering date to buffer against episodic events of FHB infection.

Impact: We expect these three cultivars (Camelot, Settler CL, and Overland) will be widely grown and provide growers with three better choices for producing grain with lower DON on their farms. Overland is a superior agronomic line with acceptable end-use quality and stem rust resistance. Camelot has good agronomic performance, but better end-use quality and stem rust resistance than Overland. Settler CL has good end-use quality and stem rust resistance with the highest grain yield potential of the current herbicide tolerant wheats in NE and SD.

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?:

The growers of NE and SD will have agronomically superior cultivars that fit their cropping systems and that will lessen their risk to FHB. The millers and bakers of the hard winter wheat region will have grain that will have lower levels of DON, thus increasing food safety. We expect the tolerance to FHB in these cultivars will lessen the need for fungicides and will also increase the efficacy of fungicides when applied to reduce DON.

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.

Baenziger, P.S., B. Beecher, R.A. Graybosch, A. M. H. Ibrahim, D.D. Baltensperger, L.A. Nelson, Y. Jin, S. N. Wegulo, J.E. Watkins, J. H. Hatchett, Ming-Shun Chen, and Guihua Bai. 2008. Registration of 'NE01643' wheat. *J. Plant Registrations* 2: 36–42.

Bockus, W. W., Baenziger, P. S., and Ibrahim, A. M. H. 2008. Reaction of Kansas, Nebraska, and South Dakota winter wheat accessions to *Fusarium* head blight (FHB), 2007. *Plant Disease Management Reports* (online). Report 1:CF009. DOI: 10.1094/PDMR02. The American Phytopathological Society, St. Paul, MN.