

**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:	59-0790-4-111
USDA-ARS Agreement Title:	Development of Scab Resistant Soft Red Winter Wheat Varieties.
FY07 ARS Award Amount:	\$ 100,549

USWBSI Individual Project(s)

USWBSI Research Area *	Project Title	ARS Adjusted Award Amount
HGG	Mapping QTL Associated with Kernal Retention Scab Resistance in Wheat.	\$26,341
VDUN	Development of Scab Resistant Soft Red Winter Wheat Varieties.	\$ 74,208
	Total Award Amount	\$ 100,549

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: *Mapping QTL Associated with Kernel Retention Scab Resistance in Wheat.*

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

Production of sound, plump kernels rather than shriveled or “tombstone” kernels when wheat is infected with scab is an important component of host plant scab resistance. Some lines produce sound, unshriveled kernels in spite of severe scab symptoms in the spike. In these lines the percentage of shriveled kernels produced is lower than would be expected on the basis of the level of symptoms observed in the heads. We refer to this as “kernel retention”. Identification of QTL conferring kernel retention resistance (from a source other than Sumai 3 derived lines) would facilitate combining scab resistance genes from different sources to produce transgressive segregants with both Type II resistance and kernel retention. The plump kernels produced must also be evaluated for DON content.

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 second year of greenhouse and field data were collected for FHB symptoms (AUDPC) and percentage of Fusarium damaged kernels (FDK) on the 269 F_{6,8} RILs we developed from the cross IL94-1653 / Patton. Thus, phenotypic data on kernel retention were collected twice in the greenhouse, and twice in the misted, inoculated FHB evaluation nursery. The phenotypic data were combined with molecular marker data. Four severity quantitative trait loci (QTL) were identified on chromosomes 2B, 3B, 4B, and 6B, each explaining about 4% to 6% of the phenotypic variation. Three kernel damage QTL were identified on chromosomes 2B, 4B, and 6B, with 4B QTL explaining 7% and 12.3% of the phenotypic variation for kernel damage in the greenhouse and field trials, respectively. This is the second report of a kernel damage QTL in this region of chromosome 4B, indicating that this QTL may contribute to reducing FDK percentage.

Impact: Although the information generated by this research will not be of direct use to wheat producers or consumers, information from this project combined with knowledge gained from other research should enhance the selection efficiency for scab resistance which will benefit producers and consumers in the long-term through the development of improved scab resistant varieties.

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 primary users of the information generated by this project will be other scientists working on scab resistance. This information on the kernel retention type of resistance was made available to the scientific community through a poster at the 2007 ASA/CSSA meeting and the 2007 Scab Forum, and a manuscript describing this research is in preparation. This information may contribute to the overall goal of understanding FHB resistance.

Accomplishment: In 2005-06 and 2006-07 field seasons, to better understand the kernel retention type of resistance, we examined kernel retention in two groups of breeding lines; one group of lines that differ in kernel retention but have the same FHB index and a second group that have the same kernel retention percentages but differ in FHB index. These groups of lines include lines with diverse pedigrees and were evaluated in the mist-irrigated,

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inoculated field scab evaluation nursery. DON levels were determined on samples from both 2006 and 2007.

Impact: This experiment examines the relationship among percentage of FDK, DON level and FHB field symptoms and will provide information that will aid in the development of wheat varieties with low DON levels.

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?:

Breeders will have information that will aid in the development of wheat varieties with low DON levels and low percent FDK. A manuscript describing this research is in preparation.

Project 2: *Development of Scab Resistant Soft Red Winter Wheat Varieties.*

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

The major issue is that producers need varieties with high levels of scab resistance. We are working on the development of high-yielding, well-adapted, scab resistant lines. As more lines with good scab resistance are identified we are using these parents in crosses, so that in many crosses both parents, or two parents out of three in a three-way cross, are scab resistant. We also believe that it is important to combine several types of resistance rather than rely solely on Type II resistance. We are addressing this by using the ISK index to select breeding lines with high levels of scab resistance. Development of varieties with low DON levels is also crucial; therefore, all breeding lines are evaluated each year for DON level.

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: Forty-eight varieties from the Illinois State Variety Trial were evaluated for FHB resistance in a FHB evaluation nursery, and data were made available to producers.

Impact: In order to use FHB resistance as a criterion in variety selection producers must have as much information as possible on FHB resistance. The FHB resistance data provide very useful information to Illinois seedsmen and producers and allows them to use FHB resistance as a criterion in variety selection.

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?:

Producers and seedsmen have a three year summary of data of FHB resistance and DON level that can be used in decisions about what varieties to produce. The information on FHB resistance was made available at <<http://vt.cropsoci.uiuc.edu/wheat.html>>.

Accomplishment: About 288 breeding lines in cooperative nurseries including the Uniform Northern Winter Wheat Scab Nursery, the Uniform Preliminary Northern Winter Wheat Scab Nursery, the Uniform Southern Scab Nursery, the Uniform Eastern Soft Winter Wheat Nursery, and the Adv. and Prelim. Five-State Nurseries were evaluated for FHB resistance in a misted, inoculated FHB field nursery. Lines from the Univ. of Illinois program were submitted for all of the cooperative nurseries except the Uniform Southern Scab Nursery, thus, breeding lines with FHB resistance were made available to other breeding programs for use as germplasm. Five University of Illinois lines were among the most FHB resistant lines in the 2007 PNUWWN.

Impact: The data provided were useful to many different breeding programs in making decisions about which breeding lines merit further evaluation as varieties and which breeding lines will be useful as germplasm. Exchange of FHB resistant breeding lines among programs is essential and will contribute to the development of FHB resistant varieties.

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?:

Obtaining FHB resistance data for entries in the cooperative nurseries from many environments allow wheat breeders to make better selection decisions about what lines to advance for further evaluation. Breeding lines from the University of Illinois breeding program were made available to other breeding programs for use as parents if the breeders wish to use them.

Accomplishment: In 2007, about 415 breeding lines from the University of Illinois wheat breeding program were evaluated in the misted, inoculated scab evaluation field nursery. Scab resistant lines were evaluated for many additional traits including grain yield, milling and baking quality, standability, and resistance to other diseases.

Impact: Sustained annual selection for FHB resistance in the inoculated, misted field nursery has significant long-term impact by assuring that new varieties will be FHB resistant.

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?:

Constant selection for FHB resistance in the breeding program is essential in order to identify breeding lines with FHB resistance and also to discard FHB susceptible lines early so that resources are not wasted evaluating FHB susceptible lines. The constant selection pressure applied using evaluation in misted, inoculated nurseries is essential in reducing DON.

Accomplishment: In 2007, 1793 wheat samples were sent to the lab at the University of Minnesota for DON analysis.

Impact: DON evaluation is an essential component of FHB resistance evaluation because new varieties must have not just lower FHB field symptoms but also reduced DON content.

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 is information that is primarily useful to the wheat breeder, but information on low DON producing varieties can also be used by the producer in variety selection.

Accomplishment: In 2007-08, 236 single crosses and 202 three-way and four-way crosses were made involving FHB resistance sources. For a few of these populations MAS will be used for F₂ enrichment for the 3BS FHB resistance locus. MAS for the 3BS locus is also being used for some additional populations including a backcrossing project to introgress the 3BS locus into IL00-8061.

Impact: The crosses of scab resistant parents by adapted high yielding parents will provide populations that can be used for development of scab resistant varieties.

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?:

These crosses are the source of variability that will be used for future development of scab resistant soft red winter wheat varieties.

Accomplishment: Four soft red winter wheat breeding lines combining FHB resistance equal to or better than Ernie with high yield potential were released in 2007 for brand labeling and potential commercial production.

Impact: The lines that enter commercial production will provide seedsmen and producers with additional FHB resistant varieties.

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 availability of improved varieties with FHB resistance provides additional choices for seedsmen and producers and contributes to an overall reduction in DON and decreased susceptibility to FHB.

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.

Non-refereed bulletins, reports and publications:

Kolb, F.L. 2007. Fusarium head scab evaluation of variety trial entries at Urbana, Illinois. Tables of data prepared for field days, variety trial report, and posted on Variety Trial website (<http://vt.cropsci.uiuc.edu/wheat.html>).

Kolb, F.L. 2007. Development of Fusarium head blight resistant wheat varieties. Proceedings of the Illinois Crop Protection Technology Conference. Jan. 3-4, 2007. p. 53-56.

Abstracts:

Bonin, C.M., and F.L. Kolb. 2007. Resistance to kernel damage caused by Fusarium head blight in an RIL population. ASA-CSSA-SSSA Annual meeting, Nov. 2-4, 2007, New Orleans, LA. Abstract included on meeting CD.

Bonin, C.M., F.L. Kolb, and E.A. Brucker. 2007. QTL associated with reduced kernel damage and resistance to Fusarium head blight in wheat. Proceedings of the 2007 National Fusarium Head Blight Forum. Kansas City, MO, December 2-4, 2007, page 168.

Bonin, C.M., and F.L. Kolb. 2007. Resistance to kernel damage caused by Fusarium head blight in an RIL population. Proceedings of the 2007 National Fusarium Head Blight Forum. Kansas City, MO, December 2-4, 2007, page 169.

Perugini, L., C. Sneller, F. Kolb, D. VanSanford, C. Griffey, H. Ohm, and G. Brown-Guedira. 2007. Haplotype structure and genetic diversity at Fusarium head blight QTLs in soft winter wheat germplasm. Proceedings of the 2007 National Fusarium Head Blight Forum. Kansas City, MO, December 2-4, 2007, page 214.

M.S. Thesis:

Bonin, Carolyn. 2008. M.S. Thesis. Resistance to Fusarium head blight in wheat: Resistance QTL mapping and evaluation of resistance to kernel damage. 118 pages.