

**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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<b>Fiscal Year:</b>	2007
<b>USDA-ARS Agreement ID:</b>	NA
<b>USDA-ARS Agreement Title:</b>	Marker-Assisted Characterization and Deployment of FHB-Resistance Genes in Wheat.
<b>FY07 ARS Award Amount:</b>	\$ 55,520

**USWBSI Individual Project(s)**

<b>USWBSI Research Area *</b>	<b>Project Title</b>	<b>ARS Adjusted Award Amount</b>
HGG	Characterization of Novel QTLs for FHB Resistance in Asian Wheat Cultivars.	\$30,520
HGR	Improve FHB Resistance in Hard Winter Wheat by High-throughput Marker-assisted Selection.	\$ 25,000
	<b>Total Award Amount</b>	<b>\$ 55,520</b>



Principal Investigator

7-8-2008

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:** *Characterization of Novel QTLs for FHB Resistance in Asian Wheat Cultivars.*

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

Effective utilization of FHB resistant resources relies on identification of new sources of resistance and understanding inheritance of their resistance to FHB and to DON accumulation in wheat grain. A major FHB resistance QTL from Sumai 3 has been mapped and widely used in breeding programs. Identification of resistance genes from new sources may enrich FHB resistance gene diversity and provide new sources of resistance genes to enhance FHB resistance levels through gene pyramiding. We identified new resistant sources that might be different from Sumai 3 after screening a collection of Asian wheat cultivars and landraces. We mapped scab resistance QTLs in Chinese landrace Wangshuibai and Chokwang from Korea. We are testing mapping populations with new Chinese landraces Haiyanzhong and Huangfangzhu as resistant parents in which the QTLs have not been mapped previously and markers for 3BS QTL showed different haplotypes from that of Sumai 3. We will elucidate genetic effects of these QTLs by testing the mapping populations for FHB resistance and DON content under greenhouse and field conditions. The results are also expected to provide breeders with quality markers for breeding wheat cultivars with low DON and high levels of FHB resistance to speed up breeding process.

**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. The population of 250 F<sub>6:7</sub> RILs from the cross of Clark/Chokwang were evaluated in the greenhouse and field at Manhattan KS, spring 2008 for QTL validation. Data will be summarized and a manuscript will be prepared for publication.
2. About 140 F<sub>6</sub> RILs from Wangshuibai/Wheaton were evaluated for field resistance in Manhattan, KS and Lincoln NE to investigate interaction between QTL and environments.
3. Two F<sub>5</sub> RIL populations from the crosses between two Chinese landraces, Haiyanzhong and Huangfangzhu, and Wheaton (a highly susceptible parent) were evaluated for FHB resistance in a greenhouse experiment in Manhattan, KS. Marker screening work is initiated.
4. A high density map with about 900 SFPs derived from Affymetrix array and 300 SSRs was constructed using population Ning 7840/Clark. This is the first high density SFP map in wheat. A manuscript is prepared and will be submitted soon.

**Impact:**

Wangshuibai is a highly resistant landrace from China and Chokwang is a Korean cultivar with FHB resistance. The FHB resistance QTL from both QTLs are analyzed and compared with previously reported QTLs from Sumai 3 etc. The knowledge of similarity and difference of QTLs between these cultivars and Sumai 3 will help breeders to select right resistant parents and develop new breeding strategy for pyramiding FHB resistance QTLs from diverse origins. The SFP map developed will be a powerful tool for high resolution

mapping of wheat resistance QTL and developing SNP markers for high-throughput genotyping.

**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 information on QTLs from different sources and linked molecular markers will be published in a peer-reviewed journal and represents an important technology transfer event because wheat geneticists, pathologists and breeders will have access to QTL and markers in their research or breeding programs. Also, the SFP map was the first high density SNP map developed from a FHB mapping population and will be used by FHB researchers worldwide for FHB mapping and marker identification.

**Project 2: *Improve FHB Resistance in Hard Winter Wheat by High-throughput Marker-assisted Selection.***

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

The best source of FHB resistance in wheat is mainly spring type that derived from Sumai 3 from China. Hard winter wheat cultivars grown in the U.S. are usually highly susceptible to FHB. Progress in breeding HWW for improved FHB resistance has been slow. Major FHB-resistance QTL from Sumai 3 has been mapped and closely linked markers were identified. This QTL has been widely used in spring wheat or soft winter wheat breeding programs in the U.S. with great success. However, it has not been deployed in commercial hard winter wheat cultivars yet. To improve FHB resistance in hard winter wheat, we use marker-assisted backcross method to transfer the 3BS major QTL as well other minor QTLs into adapted hard winter wheat backgrounds. The results are expected to provide breeders with hard winter wheat lines that have low DON content and a high level of FHB resistance.

**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 major QTL on 3BS from Sumai 3 and its derivatives has been transferred into hard white winter wheat cultivar Trego from Kansas, and hard red winter wheat Wesley from NE and Harding from South Dakota. The 200 Bc2F4 lines carrying the 3BS QTL were selected and continuously evaluated for FHB resistance and other agronomic traits in the field experiments at Manhattan KS and Lincoln, NE. The result indicated that most selected lines have good winter hardiness and similar agronomic traits as recurrent parents but better FHB resistance than that of recurrent parents under severe FHB epidemics in greenhouse experiment and field experiments of 2007 and 2008. Five to ten best lines will be selected from each back ground and released as breeding parents to HWW breeding programs. Meanwhile, a new backcross was developed between (Ning7840/Jagger)F1 and (Jagger /Chokwang)F1 to pyramiding different QTLs. Its F1 carrying 3-4 known QTL from two

resistant parents were selected using markers and backcrossed or crossed with locally adapted Jagger and Overlay from Kansas and Overland from Nebraska.

**Impact:**

FHB has been severe in many fields of KS and NE this year and current used HWW cultivars grown in the Great Plains and elite breeding lines available are highly susceptible to FHB. Marker analysis didn't detect 3BS QTL in the breeding lines from HWW regional nurseries. This is the first time to use marker-assisted backcross to transfer 3BS resistance QTL into US hard winter wheat. The resulting breeding lines will be used as breeding parents to speed up FHB improvement in hard winter wheat and these materials may also be released as FHB resistant cultivars after further field selection and FHB evaluation.

**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?:**

Current elite breeding lines from HWW regional nurseries don't carry the 3BS major QTL FHB resistance. After the project is accomplished, breeders from Kansas, South Dakota and Nebraska will have adapted wheat breeding materials that carry 3BS major QTL for FHB resistance.

**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.**

1. Yu GH, Ma HX, Bai GH, Tang KX. 2008. SSCP markers associated with a major QTL for Fusarium head blight resistance in wheat. Mol. Biology (accepted)
2. Yu J-B, Bai G-H, Cai S-B, Dong Y-H, and Ban T. 2008. New FHB-resistant Sources from Asian Wheat Germplasm. Crop Sci. (in press).
3. Yu J-B, Bai G-H, Zhou W-C, Dong Y-H and Kolb FL. 2008. Quantitative trait loci for *Fusarium* head blight resistance in recombinant inbred population Wangshuibai/Wheaton. Phytopathology 98:87-94

Meeting Abstract:

1. A.N. Bernardo, S-W. Hu, P.J. Bradbury, R.L. Bowden, E.S. Buckler and G-H. Bai. 2008. Using Affymetrix array to discover single nucleotide polymorphisms in wheat. 2008 Genome XVI, January 12 - 16, 2008 San Diego, CA.
2. A.N. Bernardo, S-W. Hu, P.J. Bradbury, R.L. Bowden, E.S. Buckler and G-H. Bai. 2007. Using Affymetrix array to discover single nucleotide polymorphisms in wheat. 2007 National Fusarium Head Blight Forum, December 2 - 4, 2006. Kansas City, KS.
3. G Bai, P St. Amand, D Zhang, A Ibrahim, SP Baenziger, B Bockus, and A Fritz. 2007. Marker-assisted Transfer of 3BS QTL for FHB Resistance into Hard Winter Wheat. 2007 National Fusarium Head Blight Forum, December 2 - 4, 2006. Kansas City, KS.
4. A.N. Bernardo, S-W. Hu, P.J. Bradbury, R.L. Bowden, E.S. Buckler and G-H. Bai. 2007. Using Affymetrix array to discover single nucleotide polymorphisms in wheat. Wheat Genomics Conference Nov 31-Dec 2. Kansas City, KS.
5. G Bai, P St. Amand, D Zhang, A Ibrahim, SP Baenziger, B Bockus, and A Fritz. [2007. Improvement of FHB Resistance of Hard Winter Wheat through Marker-assisted Backcross.](#) ASA-CSSA-SSSA 2007 International Annual Meeting, Nov 4-8, New Orleans Louisiana