USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY10 Final Performance Report
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Cover Page

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Fiscal Year:	FY10
USDA-ARS Agreement ID:	59-0790-7-075
USDA-ARS Agreement Title:	Alien Chromosome Engineering and the Deployment of a Novel Source of Fusarium Head Blight Resistance in Wheat.
FY10 USDA-ARS Award Amount:	$ 29,991

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Chromosome Engineering for FHB Resistance and DON Accumulation in Wheat.	$ 29,991
	Total ARS Award Amount	**$ 29,991**

13 July 2011

Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Soft Winter Wheat Region
SWW – Southern Soft Red Winter Wheat Region

Project 1: *Chromosome Engineering for FHB Resistance and DON Accumulation in Wheat.*

1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

We are working on transferring new sources of resistance to FHB and DON from the perennial *Leymus racemosus* and *Elymus tsukushiensis* using chromosome engineering, molecular marker analysis, and conventional breeding.

1. We have identified a novel source of FHB resistance, *Fhb3*, derived from *L. racemosus* (T7AL·7Lr#1S), which also has been transferred to Jagger and Overley backgrounds and has been evaluated for FHB resistance and DON accumulation in the greenhouse and field.
2. We have identified a second source for FHB resistance derived from *E. tsukushiensis* and have obtained wheat–*E. tsukushiensis* recombinants that will be evaluated for FHB resistance and DON accumulation in the greenhouse and field.

2. List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):

Accomplishment:

1. Ten lines, homozygous for *Fhb3* in Jagger and Overley wheat backgrounds, were evaluated for resistance in a field nursery in Manhattan, KS, by Dr. W.W. Bockus in the 2009–10 growing season. Two lines, 08-191 and 08-193, in a Jagger background, and 08-184, in an Overley background, flowered about the same time as Jagger and Overley and had FHB ratings (% infected spikelets) of 28.7%, 37.2%, and 33.1%, respectively, compared to 36.8% for Jagger and 50.2% for Overley. DON accumulation of the lines ranged from 7.0 ppm to 13.5 ppm, compared to 12.5 ppm for Jagger and 23.8 ppm for Overley.
2. Further directed chromosome engineering was performed to develop wheat *L. racemosus* recombinant chromosome with reduced alien segments to reduce linkage drag. Screening of 1,118 progenies using molecular markers and genomic in situ hybridization analyses identified one proximal (rec124) and two distal (rec679 and rec989) recombinants, which also were evaluated in the field nursery in the 2009–10 season. The FHB ratings for the lines are: rec124, 27.6%; rec679, 38.1%; and rec989, 48.8% with DON accumulations of 10.8 ppm (rec124), 13.8 ppm (rec679), and 14.0 ppm (rec989), suggesting that the *Fhb3* gene is located proximally. We are transferring rec124 into a Fuller wheat background.
3. A second source of FHB resistance is derived from *E. tsukushiensis* and was transferred to wheat in the form of a disomic addition stock (DA1E^{ts}#1), a ditelosomic addition stock (DtA1E^{ts}#1S), and a disomic addition/translocation stock (DA TW·1E^{ts}#1S). Testing of the DA TW·1E^{ts}#1S stock from 2005–07 indicated that this line conferred resistance to FHB under greenhouse conditions; this was further confirmed in 2010 in the greenhouse where the line averaged an FHB reading of 10.0% compared to Chinese Spring wheat at 32.0% and Sumai 3 at 5.3%. Directed chromosome engineering using molecular markers and genomic in situ hybridization analyses were used to screen 488 progenies homozygous for *ph1b* and heterozygous for chromosomes 1D and TW·1E^{ts}#1S and identified one distal and one interstitial wheat–*E. tsukushiensis* recombinant. These

recombinants were crossed with Fuller and Everst wheats and, after a second backcross with Everest and selfing, homozygous recombinant stocks will be obtained

Impact:

Two novel sources of FHB resistance derived from *L. racemosus* and *E. tsukushiensis* have been identified and are being transferred to adapted wheat cultivars. Advanced *Fhb3* lines with wheat– *L. racemosus* Robertsonian translocations and recombinants with improved FHB resistance and DON accumulation have been developed that can be exploited in wheat improvement.

A second, new, and so far unnamed source, of FHB resistance has been identified and was derived from *E. tsukushiensis*. Wheat– *E. tsukushiensis* recombinants have been obtained and are being transferred to adapted cultivars. Once homozygous recombinants in adapted wheat backgrounds are obtained, they will be evaluated for their FHB resistance and DON accumulation under greenhouse and field conditions.

The identification and transfer to wheat of these alien sources of resistance will broaden the genetic base for FHB resistance and DON accumulation.

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance.

Lines, 08-191 and 08-193, in a Jagger background, and 08-184, in an Overley background with *Fhb3* in the form of a wheat– *L. racemosus* Robertsonian translocation T7AL·7Lr#1S, and rec124, with the recombinant chromosome T7AL·7Lr#1S-7AS, with moderate levels of FHB resistance and DON accumulation, are being distributed upon request.

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.

Bockus WW, Friebe B, and Gill BS. 2010. Reaction of winter wheat accessions containing *Fhb3* and selected cultivars for Fusarium head blight. 2009 Plant Dis Management Rep CCFO12:1-2.

Friebe B, Cainong JC, Wi LL, Chen PD, Bockus WW, and Gill BS. 2010. Chromosome engineering and transfer of alien sources for Fusarium head blight resistance in hard red winter wheat. Proc 2010 Nat Fusarium Head Blight Forum

Qi LL, Friebe B, Pumphrey MO, Chen Q, Chen PD, and Gill BS. 2008. Shortening of the *Leymus racemosus* segment in the *Fhb3* transfer usning *ph1b*-induced homoeologous recombination. In: Proc 2008 Nat Fusarium Head Blight Forum, 2-4 December, 2008, Indianapolis, IN. p. 194.

Qi LL, Pumphrey MO, Friebe B, Chen PD, and Gill BS. 2008. Molecular cytogenetic characterization of alien introgressions with gene *Fhb3* for resistance to Fusarium head blight disease of wheat. Theor Appl Genet 117:1155-1166.