USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY11 Final Performance Report
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Cover Page

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Fiscal Year:	FY11
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.
FY11 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**

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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?**
2. We are working on identifying and transferring new sources of resistance to FHB and DON from the perennial species *Leymus racemosus* and *Elymus tsukushiensis* using chromosome engineering, molecular marker analysis, genomic in situ hybridization analysis, and conventional breeding.
   1. We have identified a novel source of FHB resistance, *Fhb3*, derived from *L. racemosus* (T7AL·7Lr#1S), which has been transferred to Jagger background and has been evaluated for FHB resistance and DON accumulation in the greenhouse and in the field.
   2. We have identified a second source of FHB resistance derived from *Leymus tsukushiensis* and have obtained one distal (TWL·WS-1E^{ts}#1S and one interstitial (TiWL·WS-1E^{ts}#1S-WS) recombinant, which are presently being evaluated for their FHB resistance and DON accumulation in the greenhouse and in the field.

3. **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):**

<u>Accomplishment:</u>

1. Ten lines homozygous for *Fhb3*, present on the wheat-*Leymus racemosum* Robertsonian translocation chromosome T7AL·7Lr#1S, were evaluated for FHB resistance in a field nursery in Manhattan, KS, by Dr. W. W. Bockus in the 2009/10 growing season. Two lines in Jagger background, 08-191 and 08-193 flowered about the same time as Jagger and had FHB ratings (% infected spikelets) of 28.7%, and 37.2% compared to 36.8% for Jagger. DON accumulation of these lines ranged from 7.0 ppm to 13.5 ppm compared to 12.5 ppm for Jagger.
2. We have used directed chromosome engineering to produce two distal (T7AL·7AS-7Lr#1S, rec679 and rec989) and one proximal recombinant (T7AL·7Lr#1S-7AS, rec124). The FHB ratings for these lines were 27.6% (rec124), 38.1% (rec679), and 48.8% (rec989), with DON accumulations of 10.8 ppm (rec124), 13.8 ppm (rec679), and 14.0 ppm (rec989), indicting that the *Fhb3* gene is located proximally.
3. The Robertsonian translocation present in lines 08-191 and 08-193 as well as the proximal recombinant T7AL·7Lr#1S-7AS (rec124) are being transferred into Fuller background. All lines have now three backcrosses to Fuller and homozygous translocation and recombinant lines will be selected next and then evaluated for their FHB resistance and DON accumulation in greenhouse and field tests.
4. A second source of FHB resistance is derived from *Elymus tsukushiensis* and was transferred to wheat in the form of a disomic addition (DA1E^{ts}#1), a ditelosomic addition for the short arm (DtA1E^{ts}#1S) and a disomic addition/translocation stock (TWL·1E^{ts}#1S). Greenhouse testing in 2010 revealed that DA1E^{ts}#1 had an FHB rating

of 10.0% compared to 32.0% of Chinese Spring and 5.3% of Sumai 3. Directed chromosome engineering using molecular marker and genomic in situ hybridization analyses of 488 progenies homozygous for *ph1b* and heterozygous for 1D and TWL·1E^{ts}#1S identified one distal (TWL·WS-1E^{ts}#1S) and one interstitial (TiWL·WS-1E^{ts}#1S-WS) recombinant, and homozygous recombinant stocks were obtained after self pollination. We evaluated the FHB resistance of the *E. tsukushiensis* recombinants in the greenhouse during the 2011/12 growing season after point inoculation of about 40 spikes per entry. Whereas Everest and Karl92 had FHB ratings of 27.7% and 32.7%, the susceptible check Overly and Chinese Spring had FHB ratings of 54.4% and 35.1%, respectively. The interstitial recombinant TiWL·WS-1E^{ts}#1S-WS had an average FHB rating of 13.5%, the distal recombinant TWL·WS-1E^{ts}#1S had a average rating of 8.8% compared to 12.5% of DA1E^{ts}#1 and 6.2% of TWL·1E^{ts}#1S. Both recombinant chromosomes are presently being transferred into Fuller and Everest background.

Impact:

Two novel sources of FHB resistance derived from *Leymus racemosus* and *Elymus tsukushiensis* have been identified and transferred to adapted winter wheat backgrounds. 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 derived from *E. tsukushiensis* has been identified and homozygous distal and interstitial recombinants have been obtained and are being evaluated in greenhouse and field tests for their FHB resistance and DON accumulation and also being transferred into adapted winter wheat cultivars.

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 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, Qi 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

Friebe B, Cainong JC, Chen PD, Bockus WW, and Gill BS. 2011. Utilizing alien sources of resistance to Fusarium Head Blight for wheat improvement. Proc 2011 Nat Fusarium Head Blight Forum, 4-6 December 2011, St Louis, MO.

Qi LL, Friebe B, Pumphrey MO, Chen Q, Chen PD, and Gill BS. 2008. Shortening of the Leymus racemosous segment in the *Fhb3* transfer using 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.