USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY08 Final Performance Report (approx. May 08 – April 09)
July 15, 2009

Cover Page

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Fiscal Year:	2008
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.
FY08 USDA-ARS Award Amount:	$ 29,992

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
HWW-CP	Alien Chromosome Engineering and the Deployment of a Novel Source of Fusarium Head Blight Resistance in Wheat.	$29,992
	Total Award Amount	**$ 29,992**

July 15, 2009

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
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Winter Wheat Region
SWW – Southern Sinter Wheat Region

Project 1: *Alien Chromosome Engineering and the Deployment of a Novel Source of Fusarium Head Blight Resistance 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 identifying new sources of FHB resistance from alien species, transferring them to hard winter wheat and evaluating the effectiveness of resistance in controlling FHB and DON in greenhouse and field experiments.

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 three sections (repeat sections for each major accomplishment):

Accomplishments:

1. A wheat-*Leymus* translocation line (T09) involving unknown wheat and *Leymus racemosus* (Lr) chromosomes, developed at Nanjing Agricultural University, conferring FHB resistance was identified as a genetically compensating translocation involving the long arm of wheat chromosome 7A and the short arm of *Leymus* chromosome 7Lr#1 (T7AL·7Lr#1S) by C-banding, genomic in situ hybridization, and RFLP analyses at Kansas State University. T09 was consistently resistant to FHB in greenhouse point-inoculation experiments. The novel FHB resistance gene was designated *Fhb3* and resides in the distal region of the short arm of chromosome 7Lr#1 of *Leymus racemosus*.
2. Three PCR-based markers, BE586744-STS, BE404728-STS, and BE586111-STS, specific for 7Lr#1S were developed to expedite marker-assisted selection in breeding programs.
3. The T09 was backcrossed twice to adapted wheat cultivars Overley and Jagger. A total of 192 progeny homozygous for translocation T7AL.7Lr#1S were selected by molecular markers from 436 BC_1F_2 plants.
4. Ten lines homozygous for translocation T7AL·7Lr#1S, three in Overley and seven in Jagger background were evaluated for FHB resistance and its effect on DON accumulation in a field nursery in Fall 2008 in Manhattan. Two lines 08-193 and 08-189 in Jagger background and 08-184 flowered at about same time as Overley and gave FHB (% infected spikelets) ratings of 12.4%, 14.1% and 16.8%, respectively, compared to 34.1% for Overley. The ratings of other experimental lines varied from 19.5 to 34.6%. Don results will not be available until August ’09.
5. Chromosome engineering was initiated to reduce genetic linkage drag associated with translocation T7AL·7Lr#1S.The T09 line was crossed twice with the *ph1b* mutant stock. 154 BC_1 plants were screened using molecular markers to assay for *ph1b* and T7AL·7Lr#1S. Sixty-one plants were found to be homozygous *ph1b/ph1b* and heterozygous for the translocation chromosome T7AL·7Lr#1S/7A. These plants were either backcrossed with Overley and Danby or selfed. Large recombinant populations of 1,400 BC_2 seeds and more than 8,000 BC_1F_2 seeds were developed. In homozygous *ph1b* genotypes, the alien 7Lr#1S arm with *Fhb3* is

expected to recombine with homoeologous wheat arm 7AS. Upon analysis of 1118 progeny, three wheat-*Leymus* recombinants, one proximal (#124) and two distal (#679 and 989) have been isolated in homozygous condition and work is ongoing to identify recombinants with smaller alien segments that still retain the FHB resistance gene *Fhb3*.

In summary, we met or exceeded the objectives of the grant for the FY08 period.

Impact:

1. The *Fhb3* is a potential new source of resistance for deployment in wheat breeding for control of scab in the US. Since the T09 line is of Chinese origin and although we demonstrated that it does not carry *Fhb1*, the presence of other resistance factors besides *Fhb3* cannot be ruled out.
2. Identification of PCR markers allowed further manipulation of the alien segment and these markers may be of use in marker-assisted breeding.
3. The transfer of *Fhb3* in homozygous lines in winter wheats Jagger and Overly allowed the evaluation of the field effectiveness of this new source of resistance.
4. In greenhouse tests, *Fhb3* resistance was equal to Sumai 3, however, observation of reduced level of resistance in most of the ten lines homozygous for *Fhb3* in Overly and Jagger background in field plots was unexpected and needs additional work.
5. The isolation of recombinants will allow the isolation of *Fhb3* lines with reduce linkage drag while maintaining the same level of resistance.

In conclusion, we have successfully transferred a new source of resistance into Great Plains hard wheat background. However, the first year field testing was very preliminary and additional one year of observations on the effectiveness of this source of resistance under field conditions are needed before this germplasm is made widely available.

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.

Publications (refereed journals):

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.

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

If your FY08 USDA-ARS Grant contained a VDHR-related project, include below a list 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. If this is not applicable (i.e. no VDHR-related project) to your FY08 grant, please insert 'Not Applicable' below.

Some experimental lines have been developed but further evaluation is needed before they can be released.