USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY12 Final Performance Report
July 16, 2013

Cover Page

PI:	Shaobin Zhong
Institution:	North Dakota State University
Address:	Department of Plant Pathology NDSU Dept. # 7520 PO Box 6050 Fargo, ND 58108-6050
E-mail:	Shaobin.Zhong@ndsu.edu
Phone:	701-231-7427
Fax:	
Fiscal Year:	FY12
USDA-ARS Agreement ID:	59-0790-8-067
USDA-ARS Agreement Title:	Identification and QTL Mapping of Fusarium Head Blight Resistance in Wheat and Durum Wheat.
FY12 USDA-ARS Award Amount:	$ 52,692*

USWBSI Individual Project(s)

USWBSI Research Category**	Project Title	ARS Award Amount
DUR-CP	Identify FHB Resistance in Timopheevii Wheats and Introgress it into Durum Wheat.	$ 15,603
VDHR-SPR	Enhancing FHB Resistance Screening Capacity and Efficiency for Spring Wheat Breeding Programs.	$ 10,789
VDHR-SPR	Fine Mapping of QTL for FHB Resistance in PI 277012 and Introgression of the Resistance into Adapted Spring Wheat Varieties.	$ 26,300
	Total ARS Award Amount	**$ 52,692**

Principal Investigator Date

* Partial funding for this research is under ARS agreement # 59-0206-9-062

** 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: *Identify FHB Resistance in Timopheevii Wheats and Introgress it into Durum Wheat.*

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

Triticum timopheevii possesses resistance to many diseases in wheat, but its resistance to FHB has not been extensively explored. The USDA National Small Grains Collection (NSGC) at Aberdeen, Idaho, has a large collection of *Triticum timopheevii* accessions. To search for accessions with good resistance to FHB for potential use in durum wheat improvement, we evaluated all available *T. timopheevii* accessions in field nurseries and greenhouse. The goal is to identify new sources of FHB resistance from these *T. timopheevii* accessions and use them for durum wheat breeding program.

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:

Of the 240 accessions of *Triticum timopheevii* subsp. *armeniacum*, which are of winter growth habit and require vernalization for flowering, 120 accessions were evaluated in the past years. In this year, we evaluated the remaining 120 accessions of *Triticum timopheevii* subsp. *armeniacum* for FHB resistance using the single floret point inoculation method in the greenhouse. The disease severity ranged from 38% to 100% and most of the winter type accessions were susceptible to FHB although the levels of susceptibility varied among them.

Three spring type *Triticum timopheevii* accessions with good FHB resistance (FHB severity<30%) were selected to cross with durum wheat cultivars and hybrids were obtained. Introgression of the FHB resistance from *Triticum timopheevii* into durum wheat will be continued by evaluation of the progenies from the crosses.

Impact:

a. Information about the FHB susceptibility of *Triticum timopheevii* subsp. *armeniacum* is useful for selecting lines for further making crosses with durum and spring wheat.
b. Those accessions with some level of resistance to FHB may be used as alternative sources of resistance for durum wheat improvement.

Project 2: *Enhancing FHB Resistance Screening Capacity and Efficiency for Spring Wheat Breeding Programs.*

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

   FHB resistance is a quantitative trait, which needs evaluation and validation in multiple locations and multiple years. Local nurseries in the US are sometimes not producing quality data for FHB reactions due to the occurrence of poor weather conditions (too hot, too dry, flooding and so on). We are addressing the issues by screening selected advanced spring wheat breeding lines from the three wheat breeding programs (ND, MN, and SD) in a scab nursery located in Hangzhou, China, where environmental conditions are consistently conducive for FHB development and disease epidemics each year.

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:

   In this year, we evaluated a total of 373 advanced breeding lines (120 from SD, 150 from ND, and 103 from MN) in the Hangzhou nursery from November 2011 to May 2012. The disease severity ranged from 7.0% to 92.5% among the entries evaluated. Thirty five of the materials showed a disease severity below 15%, indicating they have a very good level of FHB resistance under natural infection conditions.

   Impact:

   The oversea FHB nursery is very effective in enhancing FHB resistance evaluation for the three spring wheat breeding programs. It provides high quality field data to measure the FHB resistance level of advanced breeding lines and other germplasm and thus can speed up the release of FHB resistant varieties to minimize the threat of FHB and/or reduce mycotoxins.

Project 3: *Fine Mapping of QTL for FHB Resistance in PI 277012 and Introgression of the Resistance into Adapted Spring Wheat Varieties.*

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

PI 277012 consistently showed a high level of FHB resistance across all environments in both greenhouse and field experiments. Previous study identified two major QTL on 5A using a mapping population consisting of 130 doubled haploid (DH) lines from the cross between PI 277012 and the hard red spring wheat cultivar 'Grandin' (susceptible to FHB). However, the regions surrounding the two QTL loci were not saturated with enough DNA markers and thus DNA markers closely linked to the QTL loci were lacking. The objectives of this project were (1) to fine map the two QTL regions with additional markers for easy identification of the FHB resistance QTL loci in wheat breeding programs and (2) to introgress the QTLs into adapted spring wheat cultivars.

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:

The 130 DH lines were genotyped using the wheat 9K-SNP array and 4,317 polymorphic SNP markers were generated. These SNP markers have been integrated into the genetic maps and SNP markers linked to the 5AS and 5AL QTLs have been identified.

A larger mapping population was also developed, which consists of 1052 recombinant inbred lines (F2:7) from the cross between PI 277012 and Grandin. These recombinant inbred lines will be used for developing user-friendly markers for selection of the FHB resistance QTLs transferred into adapted wheat germplasm.

Advanced spring wheat lines were developed from crosses and backcrosses using PI 277012 as the FHB resistance donor and adapted spring wheat cultivar as recurrent parents. Some of these wheat lines showed a high level of FHB resistance based on the greenhouse inoculation experiments.

Impact:

The SNP markers associated with the FHB resistance QTL will be very useful in developing new FHB resistant wheat varieties by marker assisted selection and gene pyramiding.

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.

Mergoum, M., Frohberg, R. C., Stack, R. W., Simsek, S., Adhikari, T. B., Rasmussen, J. W., **Zhong, S.**, Acevedo, M., Alamri, M. S., Singh, P. K., Friesen, T., L., and Anderson, J. A. 2013. 'Prosper': A high-yielding hard red spring wheat cultivar adapted to the North Central Plains of the USA. J. Plant Reg. 7: 75-80.

Puri, K. D., Saucedo, E. S., **Zhong, S**. 2012**.** Molecular characterization of Fusarium head blight pathogens sampled from a naturally infected disease nursery used for wheat breeding programs in China. Plant Dis. 96:1280-1285.

Huhn, M. R., Elias, M. E., Ghavami, F., Kianian, S. F., Chao, S., **Zhong, S.**, Alamri, M. S., Yahyaoui, A., and Mergoum, M. 2012. Tetraploid tunisian wheat germplasm as a new source of Fusarium head blight resistance. Crop Sci. 52:136-145.

Puri, K. D., and **Zhong, S**. 2012. Functional characterization of the gene *GzOch1* for mannosyltransferase in *Fusarium graminearum*. Phytopathology 102:S39. (Poster)

Puri, K. D., Yan, C., **Zhong, S**. 2012. RNA-seq revealed gene expression differences between 3ADON and 15ADON populations of *Fusarium graminearum* in vitro and in planta. Proceedings of the 2012 National Fusarium Head Blight Forum, Dec 4-6, 2012, Orlando, FL. P121-122. (Poster).

Mergoum, M., Frohberg, R. C., Stack, R. W., Simsek, S., Adhikari, T. B., Rasmussen, J. W., **Zhong, S.**, Acevedo, M., Alamri, M. S., Singh, P. K., Friesen, T., L., and Anderson, J. A. 2012. 'Prosper': A new hard red spring wheat cultivar combining high yield and good resistance to Fusarium head blight, leaf resistance, and quality attributes. Proceedings of the 2012 National Fusarium Head Blight Forum, Dec 4-6, 2012, Orlando, FL. P74-77. (Poster).

Zhu, X., **Zhong, S**., Xu, S. S., and Cai, X. 2012. Fusarium head blight reactions of Langdon durum D-genome disomic substitution lines. Proceedings of the 2012 National Fusarium Head Blight Forum, Dec 4-6, 2012, Orlando, FL. P110. (Poster).