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

Cover Page

PI:	Steven Xu
Institution:	USDA-ARS
Address:	Northern Crop Science Lab 1307 18th Street North Fargo, ND 58105-5677
E-mail:	Steven.Xu@ARS.USDA.GOV
Phone:	701-239-1327
Fax:	701-239-1369
Fiscal Year:	FY12
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Introgression of Scab Resistance from Emmer and Timopheev Wheat into Durum Wheat.
FY12 USDA-ARS Award Amount:	$ 38,000

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
DUR-CP	Introgression of Scab Resistance from Emmer and Timopheev Wheat into Durum Wheat.	$ 38,000
	Total ARS Award Amount	**$ 38,000**

July 6, 2013
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: *Introgression of Scab Resistance from Emmer and Timopheev Wheat into Durum Wheat.*

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

A major problem relevant to Fusarium head blight (FHB) is that high breeding value durum wheat (*Triticum turgidum* ssp. *durum*) germplasm and cultivars with high levels of FHB resistance are not available for U.S. durum breeders and growers. To resolve this problem, we have been conducting research to identify, map, and transfer FHB resistance from other tetraploid species such as emmer (*T. dicoccum*), Persian (*T. carthlicum*), and timopheevii (*T. timopheevii*) wheat into durum cultivars adapted to the Northern Great Plains.

For introgression of the FHB resistance from *T. carthlicum* and *T. dicoccum* into durum cultivars, in this fiscal year 30 BC_1-derived advanced lines (BC_1F_{7-10}) and doubled haploid (DH) lines with improved FHB resistance from *T. dicoccum*, *T. carthlicum*, and the hexaploid wheat line PI 277012 were evaluated in the greenhouse and three FHB nurseries (Fargo, Langdon, and Prosper) in the summer of 2012. They were further evaluated in two FHB nurseries (Fargo and Prosper) in the summer of 2013. The BC_1F_2 progeny from 170 BC_1F_1 plants, which were derived from backcrosses of seven BC_1-derived advanced (BC_1F_{7-10}) lines (10FAR2627, 10FAR2891, 08F285, 08G33, 08G105, 07F459, and 10FAR2778) and a DH line (LP102-14) with three new ND cultivars 'Tioga', 'Carpio', and 'Joppa', were evaluated in the greenhouse and the three FHB nurseries (Fargo, Langdon, and Prosper) in the summer of 2012. Over 3,000 heads were selected from three locations and about 30 BC_1F_2 plants with improved FHB resistance were selected based on the greenhouse evaluation. Approximately 600 BC_1F_3 progenies are growing in two FHB nurseries (Fargo and Prosper) and the greenhouse for evaluation and generation advance in the summer of 2013. To transfer the 5A QTL derived from *T. timopheevii* PI 343447 into durum cultivars, spring wheat line TC67 carrying the 5A QTL from PI 343447 has been crossed and backcrossed with Divide, Tioga, Carpio, and Joppa. Approximately 70 BC_1F_1 plants from each of the backcrosses are being evaluated in the greenhouse in the summer of 2013. In addition, two wheat-*Elymus tsukushiensis* translocation lines TA5660 and TA5661 with novel FHB resistance developed by Dr. Bernd Friebe have been crossed to Tioga, Carpio, and Joppa.

For mapping FHB-resistant QTLs derived from *T. dicoccum*, a population of 200 $F_{2:7}$ lines derived from cross Ben/*T. dicoccum* PI 41025 that was previously evaluated for Type II resistance was genotyped using the wheat 9000-SNP array, SSR, and EST-STS markers. A high density linkage map consisting of the 2,593 markers (2,461 SNPs, 128 SSRs, and 4 EST-STS markers) was developed and used for mapping three major FHB-resistant QTLs on chromosomes 2A, 3A, and 5A, respectively. We previously mapped two major FHB resistance QTLs on chromosome arms 5AS and 5AL in PI 277012 using an SSR-based linkage map in a population of 130 DH lines from the cross between PI 277012 and spring wheat cultivar 'Grandin'. In 2013, we genotyped the DH population using the wheat 9000-SNP array and identified 4,317 polymorphic SNP markers. A saturated map is currently

being developed with the SNP markers and being used for saturation mapping of the 5AS and 5AL QTLs.

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:

A SNP-based linkage map consisting of the 2,593 markers (2461 SNPs, 128 SSRs, and four EST-STS markers) has been developed based on the Ben/*T. dicoccum* PI 41025 population. Three major QTLs were identified on chromosomes 2A, 3A, and 5A, respectively. Ten durum lines with improved FHB resistance have been selected from the Ben/PI 41025 population. Other durum lines with improved FHB resistance derived from hexaploid wheat lines PI 277012 and *T. dicoccum* accessions PI 41025 and PI 272527, respectively, were further verified through greenhouse and field evaluations and they were backcrossed with new ND durum cultivars for developing high breeding value durum germplasm.

Impact:

The durum lines with improved FHB resistance derived from hexaploid wheat lines PI 277012 and *T. dicoccum* accessions PI 41025 and PI 272527, respectively, have been backcrossed with new ND durum cultivars for developing high breeding value durum germplasm. They are also being used for developing durum cultivars with improved FHB resistance in ND durum wheat breeding program.

The Ben/PI 41025 population and its SNP-based linkage map provide resources for investigating the mechanism of FHB resistance in tetraploid wheat. The marker and map data have been distributed to other durum researchers.

A durum line 10FAR2778 (10Ae564), which may carry 5AS and 5AL QTLs for FHB resistance derived from hexaploid wheat line PI 277012, was transferred to a U.S. public institution for evaluating and studying FHB resistance in durum wheat.

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.

None