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:	NA
USDA-ARS Agreement Title:	Molecular Mapping and Introgression of Scab Resistance derived from Emmer Wheat.
FY10 USDA-ARS Award Amount:	$ 38,000

USWBSI Individual Project(s)

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

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: *Molecular Mapping and Introgression of Scab Resistance derived from Emmer Wheat.*

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

Since the mid-1990s, durum wheat (*Triticum turgidum* L. subsp. *durum*) production in the U.S. has been seriously threatened by Fusarium head blight (FHB). Development of durum wheat cultivars with improved FHB resistance has been seriously hindered due to a deficiency of high levels of FHB resistance in durum wheat germplasm. Therefore, the major problem in durum wheat production is that durum cultivars with high levels of FHB resistance are not available for U. S. famers. To resolve this problem, we have been conducting research to transfer FHB resistance from emmer (*T. dicoccoides* and *T. dicoccum*) and Persian (*T. carthlicum*) wheat to durum cultivars adapted to the Northern Great Plains. We are also mapping the resistance genes or QTLs in tetraploid accessions with a high level of FHB resistance.

We previously produced over 6,000 BC_1F_1 plants by crossing and backcrossing four doubled haploid (DH) lines (BP888-7, BP281-13, BP025-3, and MC085-1), six BC_1F_4-derived lines (07F48, 07F217, 08F130, 08F275, 08F286, and 07F468), and 19 *T. dicoccum* accessions (PI191390, PI254188, PI254193, PI272527, PI275998, PI276005, PI276007, PI276014, PI276018, PI276021, PI289603, PI330544, PI352337, PI352338, PI352342, PI352361, PI355460, PI355461, and PI355489) with the durum cultivars Alkabo, Grenora, Maier, and Divide. About 150 BC_1F_{4-5} lines with improved FHB resistance have been evaluated in field nurseries in Fargo and Langdon during the summer of 2010. Based on the field evaluation, 44 BC_1F_{5-6} lines were selected and evaluated in the greenhouse in the winter of 2010 and their derived BC_1F_{6-7} lines are currently being evaluated in greenhouse and field nurseries in Fargo and Prosper during the summer of 2011. To further improve the agronomic traits, six BC_1-derived advanced lines (10FAR2627 and 10FAR2891 from Divide/PI 272527//Divide, 08F285, 08G33, and 08G105 from Ben/PI 41025//Maier, and 07F459 from Lebstock/PI 94748//Lebstock) and one double haploid (LP102-14 from Lebsock/PI 61102) have been crossed and backcrossed with the new ND durum cultivar 'Tioga' and two elite durum lines (D03028 and D04581).

For mapping the resistance QTL in *T. dicoccum* PI 41025, a population BP025 (Ben/PI 41025) of 200 $F_{2:7}$ recombinant inbred lines has been evaluated for Type II resistance in the greenhouse for two seasons. In addition, we identified a "*T. dicoccum*" accession (PI 277012) consistently showing a high level of FHB resistance across all environments. PI 277012 is currently classified as *T. dicoccum* in the National Small Grains Collection, but we verified that PI 277012 is actually a hexaploid wheat line. Using a doubled haploid ('Grandin'/ PI 277012) population, we mapped two major FHB resistance QTLs on chromosome arms 5AS (*Qfhb.rwg-5A.1*) and 5AL *(Qfhb.rwg-5A.2*), respectively, with each explaining up to 20% and 32% of the variation in FHB severity, respectively. The two QTLs also showed major effects on reducing the percentage of Fusarium damaged kernels and DON accumulation in seeds. To transfer FHB resistance QTLs from PI 277012 to durum

wheat, we backcrossed PI 277012 to six durum cultivars (Ben, Maier, Divide, Lebsock, Mountrail, and Alkabo). A durum line (10FAR2778) carrying both QTLs, and six durum lines carrying only the 5AS QTL, have been selected in the BC_1F_5 from the backcrosses of PI 277012 with Lebsock, Ben, Divide, and Mountrail. To further improve agronomics, the durum line carrying the two QTLs has been crossed and backcrossed with Lebsock, Tioga, D03028, and D04581.

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: Two major FHB resistance QTLs derived from PI 277012 have been mapped on chromosome arms 5AS (*Qfhb.rwg-5A.1*) and 5AL *(Qfhb.rwg-5A.2*), respectively. FHB resistance has not previously been reported to be associated with this particular genomic region of chromosome arm 5AL, thus indicating the novelty of FHB resistance in PI 277012. Two new durum lines (10FAR2627 and 10FAR2891) with improved FHB resistance derived from *T. dicoccum* PI 272527 and one durum line (10FAR2778) carrying the two FHB resistance QTLs from wheat PI 277012 have been developed.

Impact: One DH line and three BC_1F_9 lines with improved FHB resistance derived from *T. dicoccum* and *T. carthlicum*) have been transferred to a durum wheat breeding program in Germany. The three new durum lines (10FAR2627, 10FAR2891, and 10FAR2778) with improved FHB resistance are being used in durum wheat breeding in North Dakota. They have been backcrossed with the new ND durum cultivar Tioga and two elite durum lines (D03028 and D04581).

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.

Xu SS, Chu CG, Friesen TL, Chao S, Zhong S, Halley S, Cai X, Elias EM (2010) Introgression of two major FHB-resistance QTLs into durum and hard red spring wheat. In: Canty S, Clark A, Anderson-Scully A, Ellis D, Van Sanford D (eds) Proceedings of the National Fusarium Head Blight Forum, Milwaukee, WI, 7-9 December, 2010, University of Kentucky, Lexington, KY. pp 172.

Chu CG, Zhong S, Chao S, Friesen TL, Halley S, Elias EM, Faris JD, Xu SS (2010) Fighting against FHB – an excellent novel resistance source for future wheat breeding. In: Canty S, Clark A, Anderson-Scully A, Ellis D, Van Sanford D (eds) Proceedings of the National Fusarium Head Blight Forum, Milwaukee, WI, 7-9 December, 2010, University of Kentucky, Lexington, KY. pp 14.

Chu CC, Niu Z, Zhong S, Chao S, Friesen TL, Halley S, Elias EM, Dong YH, Faris JD, Xu SS (2011) Identification and molecular mapping of two QTLs with major effects for resistance to Fusarium head blight in wheat. Theor. Appl. Genet. (in press).