USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY09 Final Performance Report
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Cover Page

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Fiscal Year:	2009
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Introgression of Scab Resistance from Emmer and Persion Wheat to Durum Wheat.
FY09- USDA-ARS Award Amount:	$ 41,210

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
DUR-CP	Introgression of Scab Resistance from Emmer and Persion Wheat to Durum Wheat.	$ 41,210
	Total Award Amount	**$ 41,210**

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 Winter Wheat Region
SWW – Southern Sinter Wheat Region

Project 1: *Introgression of Scab Resistance from Emmer and Persion Wheat to Durum Wheat.*

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

Compared with bread wheat (*Triticum aestivium*), durum wheat (*T. durum*) is more vulnerable to Fusarium head blight (FHB) because high levels of FHB resistance are almost absent in durum wheat germplasm. Therefore, the major problem in durum wheat production is that durum cultivars with high levels of FHB resistance are not currently available for the U. S. farmers. 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 the durum cultivars adapted to the Northern Great Plains.

We initiated the introgression of FHB resistance from five *T. carthlicum* (PI61102, PI94748, PI94749, PI283888, and PI352281) and three *T. dicoccum* (PI41025, CI14085, and CI14086) accessions into four durum cultivars (Lebsock, Ben, Mountrail, and Maier) using doubled haploid and backcross method. Based on the greenhouse and field evaluations in previous seasons, we selected 16 DH lines and 22 BC_1F_7 lines with improved FHB resistance for testing in field nurseries at two locations (Prosper and Fargo, ND) in the summer of 2009. Fifteen of the lines (8 DH and 7 BC_1F_7 lines) were tested in the Uniform Regional Scab Nursery. To further confirm their enhanced FHB resistance, seven DH lines and 11 BC_1F_7 derived lines were evaluated in greenhouse during the winter of 2009. They are also being evaluated in the field nurseries in Fargo and Langdon during the summer of 2010.

We previously selected four DH lines (BP888-7, BP281-13, BP025-3, and MC085-1), six BC_1F_4-derived lines (07F48, 07F217, 08F130, 08F275, 08F286, and 07F468) developed above, 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) as the FHB resistance sources. In 2008, the selected DH and BC_1F_4-derived lines and 19 *T. dicoccum* accessions were crossed and backcrossed to durum cultivars Alkabo, Grenora, Maier, and Divide. A total of 6,300 BC_1F_1 plants derived from 106 crosses were advanced to the BC_1F_2 generation. From the greenhouse and field testing of $BC_1F_{2\text{-}3}$ plants for FHB resistance during the spring and summer of 2009, about 2,000 $BC_1F_{3\text{-}4}$ plants with putative resistance were selected and were further evaluated in the greenhouse from the winter of 2009 to spring of 2010, and from which, 56 BC_1F_3 and 99 BC_1F_4 plants were selected.

In the summer of 2010, the BC_1F_4 and BC_1F_5 progenies derived from the selected BC_1F_3 and BC_1F_4 plants were evaluated in a field nursery in Langdon, ND using a RCBD design with three replications. Also, another set of BC_1F_4 and BC_1F_5 progenies derived from 128 BC_1F_3 and 139 BC_1F_4 plants were evaluated in field nurseries in Fargo and Prosper, ND. In addition, based on plant height, maturity, and general morphology, about 3,500 heads have been selected among 30,000 BC_1F_2 plants grown in two F_2 nurseries in Casselton and Fargo, ND, and 1,396 of the BC_1F_3 head selections are being evaluated in the field nurseries in Fargo and Langdon in the summer of 2010. The lines with a combination of improved FHB resistance and good agronomic performance will be selected for further evaluation in greenhouse and field nurseries in the coming seasons.

For transferring the FHB resistance from *T. dicoccoides* to durum, PCR-based markers suitable for marker-assisted selection (MAS) were previously identified for three QTLs on chromosome arms 3AS, 6BS, and 7AL. Lines possessing all three QTLs were crossed to Divide, and marker-selected BC_1F_1 plants were backcrossed to Divide. In 2009, a total of 52 BC_2F_2 plants homozygous for one or more QTLs were advanced to the BC_2F_4 generation for phenotyping.

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:

Several durum wheat germplasm (DH and BC_1F_7 derived lines) with improved FHB resistance from crosses of *T. dicoccum* and *T. carthlicum* to durum cultivars have been developed. Over 200 new BC_1F_5 lines with improved FHB resistance and good agronomic performance have been selected based on the evaluation in greenhouse and field nurseries.

Impact: One DH line and two BC_1F_7 derived lines have been transferred to a durum wheat breeding program. The new BC_1F_5 lines with improved FHB resistance and good agronomic performance will be directly used in durum wheat breeding in North Dakota.

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.

Two BC_1F_7 derived lines RWG5 and RWG6 (pedigree: Ben/*T. dicoccum* PI41025//Maier) and a DH line RWG7 (pedigree: Lebsock/*T. carthlicum* PI61102) have been released to a durum wheat breeder through a Material Transfer Agreement in 2010. These lines exhibited a moderate level of FHB resistance.

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, S.S., T.L. Friesen, C.G. Chu, S. Halley, S.B. Zhong, X. Cai, and E.M. Elias. 2009. Development of durum wheat germplasm with enhanced resistance to Fusarium head blight derived from emmer wheat. In: Proceedings of 2009 National Fusarium Head Blight Forum, December 7-9, 2009, Orlando, FL. Lexington, KY: University of Kentucky. pp 160.