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

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Fiscal Year:	2008
USDA-ARS Agreement ID:	59-0790-6-061
USDA-ARS Agreement Title:	Development of FHB Resistant Soft White Wheat Varieties for Michigan and similar Environments.
FY08 USDA-ARS Award Amount:	$ 81,090

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
VDHR-NWW	Development of FHB Resistant Soft White and Red Wheat Varieties for Michigan and Similar Environments.	$78,317
VDHR-NWW	Mapping QTL for Type I and II FHB Resistance from CIMMYT Germplasm derived from a Synthetic Hexaploid.	$ 2,773
	Total Award Amount	**$ 81,090**

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: *Development of FHB Resistant Soft White and Red Wheat Varieties for Michigan and Similar Environments.*

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

Proposal Intro

The overall goal of this project is to accelerate development of commercially viable varieties and advanced generation lines of soft white and red winter wheat which exhibit resistance to FHB and are adapted to Michigan and/or the eastern U.S. region. Michigan State University's wheat breeding program is one of two public programs in the eastern U.S. that focuses the majority of the program on soft white winter wheat (SWWW). FHB is a particularly serious threat to the SWWW acreage in Michigan because of the products produced from soft white wheat (SWW), with a large proportion being used by Michigan's cereal food industry. The importance of lowering levels of DON in SWW is amplified by the fact that bran mill fractions are regularly used in ready-to-eat cereal products, and bran fractions have been shown to contain higher levels of DON than flour streams.

We have been addressing this problem through targeted crossing, Marker Assisted Selection, and field phenotypic screening followed by post-harvest toxin evaluation. In addition, several presentations have been given to farmers/industry which emphasize the importance of FHB and highlight the FHB resistance work that is being conducted.

Our achievements are highlighted below.

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 (1):

Of 162 total crosses made in the spring of 2009, 127 of these had at least 25% parentage from germplasm with improved levels of FHB resistance. The FHB resistance parent donors included lines developed at MSU as well as many lines from cooperators selected from the Northern Uniform Winter Wheat Scab Nursery and the Preliminary Northern Uniform Winter Wheat Scab Nursery.

Impact (1):

The emphasis on FHB resistance in the crosses made at MSU will hasten the development of FHB resistant varieties for Michigan. In addition, though many of the MSU sources of FHB resistance are derived originally from the well known Asian sources of resistance, many cooperators have additional native sources of resistance that are now also being incorporated into the MSU germplasm.

Accomplishment (2):

Marker Assisted Selection for FHB. In the spring of 2009 we began marker assisted selection for FHB in cooperation with the USDA/ARS Regional Small Grains Genotyping Lab (RSGGL) at Raleigh, NC. Seven-hundred-fifteen F1 (3-way crosses) and F2 plants with parents known to have the 3BS and/or 2DL FHB QTL were sampled in the field and sent to the RSGGL for DNA extraction and marker analysis. In addition, ninety-five parents and/or advanced select lines were sampled for multiple analyses, including three FHB QTL (3BS, 2DL, 5AS).

Impact (2):
Data of markers linked to FHB QTL in the F1 and F2 will enable us to more effectively select plants with higher levels of FHB resistance. Therefore, we will enrich the populations for FHB resistance – both through selecting lines with the desired marker size, and through eliminating lines without the desired marker size. In addition, the marker analyses of parents will allow us to design crosses more effectively to pyramid resistance to FHB.

Accomplishment (3):
In 2008 we screened F3 and F4 generations for FHB resistance in single row plots in the MSU artificially inoculated FHB nursery. A corresponding plot of each F3 and F4 line was present in the breeding nursery. Lines that performed well for FHB resistance were the focus of further selection in the breeding nursery (while the vast majority of those that performed poorly in the FHB nursery were discarded). In addition, these lines were harvested, and post-harvest estimates were made of the % Fusarium damaged kernels. Selected lines were sent for toxin evaluation to the University of Minnesota DON testing lab.
Impact (3):
These F3 and F4 lines had not been selected previously using molecular markers. The identification of FHB resistance and lower DON accumulation in these earlier generations focuses our resources towards developing advanced lines with better FHB resistance.

Accomplishment (4):
MSU's preliminary and advanced yield trials were phenotyped for FHB resistance in replicated trials in MSU's artificially inoculated FHB nursery. Selected entries were harvested and sent for DON analysis at the University of Minnesota DON testing lab.
Impact (4):
The focused selection of high yielding lines with improved levels of FHB resistance will help us develop FHB resistant varieties adapted to Michigan and help us avoid releases highly susceptible lines. The use of the University of Minnesota DON testing lab helps ensure that lines with reasonable phenotypic levels of FHB are not high in DON.

Accomplishment (5):
The Michigan State Performance Trial (the official variety trial of Michigan), as well as multiple regional trials (the Northern Uniform Winter Wheat Scab Nursery, the Preliminary Northern Uniform Winter Wheat Scab Nursery, the Uniform Eastern Soft Red Winter Wheat Nursery, and the Uniform Eastern Soft White Winter Wheat Nursery) were evaluated for FHB resistance in replicated trials in MSU's artificially inoculated FHB nursery. All lines were harvested and sent for DON analysis at the University of Minnesota DON testing lab
Impact (5):
The evaluation of regional trials provides useful data to all contributors not only of the lines that each contributor submitted, but also of the performance of each other's germplasm across regions. For the MSU Wheat Breeding Program, valuable data is collected from collaborating sights about MSU's germplasm. These data help confirm the performance of MSU's lines for FHB over multiple environments. In addition, MSU benefits from evaluating collaborator's entries, helping us to easily identify germplasm that would be effective for using as an FHB resistance donor parent in crossing, or as a potential variety for cultivation in Michigan.

Project 2: *Mapping QTL for Type I and II FHB Resistance from CIMMYT Germplasm derived from a Synthetic Hexaploid.*

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

   Many breeders work with Asian sources of resistance to complement native resistance. The Asian sources appear to have some useful genes for Type I and II resistance. Multiple sources of resistance are needed to accumulate the complimentary genes needed for FHB reeistance. The diploid wheat (D genome) *Triticum tauschii* (= *Aegilops squarrosa*) is potential source of resistance (1) as are Brazilian wheat. CIMMYT has created synthetic hexaploids derived from *Triticum tauschii* and several have been crossed to bread wheat. One such line, referred to here as "CASS94-A" is derived from the cross MAYOOR//TK SN1081/AE.SQUARROSA (222) (CASS94Y00009S-10PR-2M-0M) and was distributed to US breeders through the USWBSI in 2001. Preliminary data indicated that CASS94-A has excellent Type I and II resistance. The goal of this work was to map QTL for resistance from CASS94-A.

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:

   This work was conducted in collaboration with Clay Sneller at Ohio State University. Ohio State University developed the population of 176 F4:6 families. The F4:6, checks, and OH685 were grown in East Lansing and Wooster in 2007-08 in single row plots with 2 reps per genotype in a misted FHB nurseries inoculated with infested grain spawn (corn OH, wheat and barley MI). FHB incidence (INC, Type I resistance) and index (IND, Type I + II) were assessed for each plot approximately 21-28 DAH depending on disease development. These plots were harvested and analyzed for DON content at the University of Minnesota DON testing lab.

   Impact:

   By collaborating in this QTL mapping work, MSU was able to hasten the collection of FHB field phenotypic data that is necessary for mapping the QTL from CASS94-A.

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.

Presentations were made in various venues (scientific/extension/farmer meetings) by the PI during FY08 regarding the MSU breeding program, with emphasis on development of varieties with improved FHB resistance. These include:

Abstract and Poster Presentation:

J. Lewis, L. Siler, G.L. Jiang, R.W. Ward (2008) History of FHB Resistance Evaluation in Michigan State Performance Trial, Red vs. White. In: Canty SM, Clark A, Walton E, Ellis D, Mundell J, Van Sanford D (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2008 Dec 2-4 Indianapolis, IN. Lexington, KY: University of Kentucky, p. 174.

A. Phillips, C. Sneller, J. Lewis, P. Paul, M. Guttieri (2008) The effect of key chromosome segments on FHB resistance in a cross of soft-winter by hard-spring parents. In: Canty SM, Clark A, Walton E, Ellis D, Mundell J, Van Sanford D (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2008 Dec 2-4 Indianapolis, IN. Lexington, KY: University of Kentucky, p. 193.

Extension Meetings:

J. Lewis, L. Siler, S. Hammar (2008) MSU Wheat Breeding Program Update. Michigan State Miller's Association 143rd Summer Meeting. June 15-16. Mackinac Island, MI.

J. Lewis, L. Siler, S. Hammar (2008) MSU Wheat Breeding Program Update. Soft White Wheat Endowment Meeting, June 11. Michigan State University, East Lansing, MI.

J. Lewis, L. Siler, S. Hammar (2009) Great Lakes Wheat Workers Meeting. March 17th. Michigan State University, East Lansing, MI.

J. Lewis, L. Siler, S. Hammar (2008) MSU Wheat Breeding and Genetics Program. Michigan State Miller's Association, 144th Winter Meeting, January 13, 2009. Michigan State University, East Lansing, MI

J. Lewis, L. Siler. (2008) MSU Wheat Breeding Program Yield Trials. Lenawee/Monroe County, MI, Extension Meeting. June 23. Hosted by Ned Birkey, MSU Extension Agent.

J. Lewis, L. Siler, S. Hammer (2008) FHB Screening Nursery Field Presentation. Ingham County, MI Extension Meeting. June 25. Hosted by Dan Hudson, MSU Extension Agent.

J. Lewis, L. Siler, S. Hammar (2008). Visit of Dr. Jonas Mugabe Debute Director Istitut des sciences agronomiqes du Rwanda to the MSU FHB screening nursery. June 20. East Lansing, MI.

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.

No cultivars or germplasm were released in FY08.