

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY09 Final Performance Report
July 15, 2010**

Cover Page

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Fiscal Year:	2009
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.
FY09- USDA-ARS Award Amount:	\$ 78,317

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
	Total Award Amount	\$ 78,317

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: *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?

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. 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): In the spring of 2010, 166 crosses were conducted to combine FHB resistance with high yield. The FHB resistance parents included MSU lines as well as cooperators lines 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 2010 we collected 898 plant samples (271 F₁s of 3-way crosses, and 619 F₂s) to be used for marker assisted selection for FHB in cooperation with the USDA/ARS Regional Small Grains Genotyping Lab (RSGGL) at Raleigh, NC. Of the 898 plants sampled, 560 were evaluated for both the 3BS and 2DL FHB QTLs for resistance, 207 were evaluated for 3BS alone, and 123 were evaluated for 2DL alone.

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 2009 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. Some of the F3 lines evaluated had been selected through Marker Assisted Selection (MAS) in the spring of 2009. 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). Selected lines were sent for toxin evaluation to the University of Minnesota DON testing lab.

Impact (3): 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.

Accomplishment 6:In 2009 we began to incorporate Fusarium damaged kernel (FDK) evaluations more comprehensively in our FHB screening. We set up white and red control standards for comparison against samples harvested from the FHB screening nursery, and evaluated the majority of our harvested lines (both early and advanced generations).

Impact 6: By adding this additional type of FHB assessment, we will have a better understanding of the effects of FHB on the grain, and further improve our ability to identify lines with better FHB resistance.

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.

MSU Line 'E5011B' was released in 2010. The cross was made in 2000, and the pedigree of E5011B is 'Caledonia' / NY88024-117.

Summary of E5011B Performance:

E5011B is a soft white winter wheat with exceptional yield, good powdery mildew resistance, short stature and it is awnletted (not awned). Fusarium head blight symptoms are summarized in the table below against several other high yielding white wheat cultivars grown in Michigan. 'Caledonia' has been a prominent white wheat cultivar in Michigan for many years, though it's popularity is now in decline. 'Ambassador', 'D8006' and 'Coral' are MSU releases, with Coral being released in 2008. 'Aubrey' is a cultivar from a private company with good FHB resistance. Regarding visual symptoms of FHB (incidence, severity, index), E5011B is susceptible, though its reaction is not statistically different ($LSD_{0.05}$) from the other cultivars shown except for Aubrey (difference is greater than the $LSD_{0.05}$). For DON levels, E5011B is significantly lower than Caledonia and Ambassador, not significantly different from D8006, and significantly higher than Aubrey and Coral.

Fusarium head blight two year data 2008-2009				
	% Incidence	% Severity	% Index	DON
E5011B	93.1	46.9	43.9	9.8
Ambassador	87.3	56.7	49.7	12.6 +LSD
Aubrey	71.2 -LSD	30.9 -LSD	22.3 -LSD	5.08 -LSD
Caledonia	86.1	53.4	48.1	12.4 +LSD
Coral	79.6	42.6	32.9	6.50 -LSD
D8006	86.5	43.0	38.2	8.0
Trial Mean	81.9	37.5	31.5	7.7
LSD (0.05)	15.5	12.0	12.9	2.6
CV (%)	9.4	15.9	20.3	32.7

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.

Patents

Lewis, Janet M., Siler, Lee, Ng, Perry K.W., Souza, Edward, Jiang, Guo L., Ward, Richard W. 2009. "PVP for Wheat Variety MSU Line E2017 Coral." May. PVP 201000001, issued 1/4/10.

Abstract and Poster Presentation:

Mishra, S., S. Hammar, K. Schlee, R. Laurenz, S. Siler, J.M. Lewis. 2009. Evaluation of different greenhouse models for prediction of FHB infection rates in field. 2009 National Fusarium Head Blight Forum, Orlando, Florida, Dec 7-9.

Schlee, K., S. Hammar, F. Trail, and J.M. Lewis. 2009. Pectic gels as a form of Fusarium head blight resistance in Wheat. 11th Annual University Undergraduate Research and Arts Forum, Michigan State University. April 16, 2009.

Reports:

Lewis, J.M., L. Siler, S. Hammar, R. Laurenz, Y. Dong, E. Souza. (2009) Michigan State Wheat Variety Trial Report (http://www.css.msu.edu/varietytrials/wheat/Variety_Results.html).