

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

Cover Page

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Fiscal Year:	FY12
USDA-ARS Agreement ID:	59-0206-1-114
USDA-ARS Agreement Title:	FHB Resistant Soft Wheat for Michigan and the Eastern Soft Wheat Region.
FY12 USDA-ARS Award Amount:	\$ 57,764

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-NWW	Development of FHB Resistant Soft White and Red Wheat Varieties for Michigan and Similar Environments.	\$ 51,364
VDHR-NWW	Coordinated Evaluation of FHB Resistance of Advanced Soft Winter Wheat Lines and Cultivars.	\$ 1,060
VDHR-NWW	Improved Breeding for FHB Resistance by Advanced Genetic and Phenotypic Characterization of Soft Winter Wheat.	\$ 2,611
VDHR-NWW	Coordinated Evaluation and Utilization of Marker Assisted Selection.	\$ 2,729
	Total ARS Award Amount	\$ 57,764



Principal Investigator

7/16/2013

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: *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?

Fusarium head blight epidemics and DON accumulation in grain pose a serious threat to the Michigan milling and cereal industries that depend on the soft red and soft white wheat grown in the state. The primary end-users of Michigan soft winter wheat, particularly white wheat, is the state milling and cereal industry. With the wheat produced in Michigan being used directly as food, it becomes critical to reduce toxin levels in grain, flour and other milling fractions. The wheat breeding program at Michigan State University is one of few programs with a focus on soft white wheat. The overall goal of the project at Michigan State University is to develop elite soft white and soft red winter wheat varieties with high levels of resistance to scab and DON accumulation.

To develop high-yielding, scab-resistant varieties, the MSU wheat breeding program utilizes a combination of phenotypic and marker assisted selection. The crossing program targets specific resistance sources from exotic and native sources. Research objectives include identification and characterization of new and existing sources of resistance.

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-Crossing Program):

In the spring 2013 crossing block, 321 different cross combinations were made. FHB-resistant parents carried both exotic and native QTL. The DON-resistant MSU soft white line, F6003, was used in 53 crosses. Elite, adapted soft wheat lines were crossed with 5 different CIMMYT spring wheat parents with high levels of FHB resistance.

Impact:

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 exotic sources of resistance, many cooperators have additional native sources of resistance that are now also being incorporated into the MSU germplasm. The use of adapted parents in bi-parental and three-way crosses improve the frequency of agronomically viable progenies when incorporating FHB resistance from different regions.

Accomplishment (2-Field Selections):

In May and June, 2013, field selections were made in F₂ bulk populations and selected F₃ population carrying exotic and native FHB resistance QTL. Selections were made on phenology and visual estimation of agronomic potential. Selections are currently being hand-harvested

Impact:

Selection for agronomic potential in lines carrying resistance QTL enriches breeding populations for high levels of FHB resistance. This ensures that all lines advanced in the breeding program carry resistance to FHB and DON accumulation.

Accomplishment (3-Screening of Breeding Germplasm):

In 2013 F₃ and F₄ generation selections were screened for FHB resistance in single row plots in the artificially inoculated FHB nursery at MSU. A corresponding plot of each F₃ and F₄ line was present in the breeding nursery. Lines that performed well for FHB resistance are the focus of further selection in the breeding nursery (while the vast majority of those that performed poorly in the FHB nursery are discarded). As with selections in previous years, selected lines will be sent for toxin evaluation to the University of Minnesota DON testing lab.

Impact:

Testing of breeding lines under high disease pressure enables selection for high levels of resistance. Lines with superior resistance and agronomic performance are advanced in the breeding program. This provides enrichment for FHB resistance in advanced breeding lines that will eventually be released as varieties.

Project 2: *Coordinated Evaluation of FHB Resistance of Advanced Soft Winter Wheat Lines and Cultivars.*

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

Information on levels of FHB resistance and susceptibility is critical for making variety decisions and selections. Coordinated evaluation of soft wheat germplasm and varieties in the FHB screening nursery at MSU enables progress towards increasing the acreage of resistant varieties. Data provided to cooperator breeding programs facilitates regional selection of germplasm with high levels of scab resistance. On a local scale, data is made available on varieties grown in Michigan and the Great Lakes region giving support to seedsmen and growers to make informed selections of genotypes with FHB resistance.

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:

The MSU wheat breeding operates an artificially inoculated FHB nursery. Regional cooperative nurseries including the Northern Uniform Winter Wheat Scab Nursery, the Preliminary Northern Uniform Winter Wheat Scab Nursery, the Uniform Eastern Soft Red Winter Wheat Nursery, the Uniform Eastern Soft White Winter Wheat Nursery, The NWW

MPI4 population, MSU breeding germplasm and the Michigan State Performance Trial. The nursery was planted in October, 2012 including 2,926 rows with replicates.

Good infection developed in the nursery and high disease pressure was generated. Genotypes were visually evaluated for FHB resistance, incidence, severity and scab index during the first week of July, 2013. For the MPI4, single heads are being harvested, threshed and sent to Ohio State for collection of tissue to be used in genotyping. Also on the MPI4 population, FDK will be evaluated and samples will be sent to the University of Minnesota for DON analysis.

Impact:

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 on MSU breeding lines are provided by collaborators. 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. Both FHB and DON data are used in considering variety release and characterization of varieties when released for the knowledge of growers and the use of breeders.

Project 3: *Improved Breeding for FHB Resistance by Advanced Genetic and Phenotypic Characterization of Soft Winter Wheat.*

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

The major problem being resolved is the identification of QTL contributing FHB resistance within Eastern Soft Wheat germplasm. There are many sources of resistance that have been identified that we expect, according to pedigree, to be independent of the frequently used and well-characterized Chinese sources of resistance. Early generation populations were identified having parents with native sources of resistance. These populations were combined and distributed to multiple participating breeders for phenotyping.

Additionally, a graduate student in the MSU wheat breeding program has conducted an association analysis study of FHB resistance with CIMMY spring wheat germplasm targeting new sources of resistance for introgression.

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:

Spring wheat lines with the highest levels of FHB resistance have been crossed with elite soft wheats transfer resistance QTL into MSU breeding germplasm. Markers identified to be in linkage disequilibrium with FHB resistance will be used to select resistance QTL in segregating progeny from these crosses.

Impact:

New sources of FHB resistance increases the diversity of scab resistance QTL in the breeding program and further enhances short term and long term improvement of FHB resistance present in MSU wheat breeding populations. Markers identified can be used to efficiently introgress effective resistance genes into breeding germplasm.

Project 4: *Coordinated Evaluation and Utilization of Marker Assisted Selection.*

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

Chinese spring wheat sources of resistance have been well characterized for the levels of FHB resistance that they provide, but their use in soft winter wheat breeding can impact critical agronomic traits, primarily yield and grain quality. The objectives of this project are to 1) evaluate the effectiveness of use of FHB-resistance QTL in the NWW breeding programs through marker assisted selection (MAS); 2) quantify the effects of these QTL in reducing FHB and DON, and 3) measure their impact on other important traits such as yield and milling and baking quality.

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:

Molecular marker analysis was previously used to identify sister lines were identified at Michigan State University (and other collaborating programs) with and without QTL from Chinese sources of resistance. Phenotyping for FHB related traits was conducted in 2013.

Impact:

The extensive phenotyping and testing of these lines should expedite the release of those lines with variety release potential. Beyond individual institution releases, it is possible that the regional evaluation of these lines will identify some candidates for joint release as improved FHB-resistant, low DON varieties. Further, this project will provide crucial information on the variability of QTL effects across genetic backgrounds. This will inform breeders in the SWW region on the probability of success of deploying these QTL in high yielding resistant, low DON varieties and thus make the breeding process more efficient.

Include below a list of 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.

This section is limited as Dr. Eric Olson began as the wheat breeder at MSU in May,2013. Dr. Russel Freed worked as the interim breeder from September, 2011 through April, 2013.

No varieties or germplasm were released in 2012.

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.

This section is limited as Dr. Eric Olson began as the wheat breeder at MSU in May,2013. Dr. Russel Freed worked as the interim breeder from September, 2011 through April, 2013.

Presentations:

Freed, Russell. MSU Variety Development Updates to Michigan Crop Improvement Association, March, 2013. (Presentation)

Reports:

Dr. Russel Freed, Lee Siler, Sue Hammar, and Donna Ellis. (2012). Michigan State Wheat Variety Trial.