

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY10 Final Performance Report
July 15, 2011
Cover Page**

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Fiscal Year:	FY10
USDA-ARS Agreement ID:	59-0206-9-059
USDA-ARS Agreement Title:	Genetics and Breeding of FHB Resistant Soft White Winter Wheat for the Northeastern U.S.
FY10 USDA-ARS Award Amount:	\$ 39,386

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-NWW	Breeding of FHB Resistant Soft White Winter Wheat for the Northeastern U.S.	\$ 17,910
VDHR-NWW	Coordinated Evaluation and Utilization of Marker Assisted Selection.	\$ 10,188
VDHR-NWW	Development and Distribution of Male Sterile Facilitated Recurrent Selection Populations.	\$ 1,951
VDHR-NWW	Improved Breeding for FHB Resistance by Advanced Genetic and Phenotypic Characterization of Soft Winter Wheat.	\$ 2,927
VDHR-NWW	Coordinated Evaluation of FHB Resistance of Advanced Soft Winter Lines and Cultivars.	\$ 3,205
VDHR-NWW	Mapping QTL in Biparental Populations.	\$ 3,205
	Total ARS Award Amount	\$ 39,386



June 18, 2011

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: *Breeding of FHB Resistant Soft White Winter Wheat for the Northeastern U.S.*

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

The primary purpose of this project is to develop FHB resistant varieties for the northeastern U.S. We have resolved essentially all of the problems encountered in earlier FHB screening and evaluation nurseries and our testing program is now efficient and routine. By doubling our irrigation capacity last year we now have sufficient space to service our breeding program as well as our mapping activities.

We have released 5 soft winter wheat varieties (4 white and 1 red) that have moderate resistance to FHB. Although there has been a reduction in white wheat acreage in NY in recent years, it has stabilized at an estimated 30% of the wheat acreage. We are co-releasing with Ohio State, a new soft red winter wheat named Otsego that is very promising and will be in certified seed production this fall. The problem with branded varieties whose FHB resistance is unknown has not been resolved. By the time we get FHB data on them, they are gone and replaced with something new.

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 release of 5 new soft winter wheat varieties with FHB and preharvest sprouting resistance is a major accomplishment. Two of the varieties have fhb1 from marker assisted backcrossing and three have native resistance.

Impact:

Impact has been increasing as the new varieties gain acceptance and certified seed becomes available. Previously, there were no white winter wheat varieties available so this is an important accomplishment for the northeastern U.S. Un-tested, branded varieties come into NY and are reducing impact of our new varieties. Many are not entered in our state trials and we cannot legally evaluate them for FHB resistance. This limits our ability to keep susceptible red varieties out of the state.

Project 2: *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?

The primary purpose of this project is to evaluate the effectiveness of use of FHB-resistance QTL in the northern winter wheat breeding programs through marker assisted selection,

quantify the effects of these QTL in reducing FHB and DON, and 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:

We have identified the lines in our programs that have been genotyped as homozygous for the resistance alleles at FHB QTL. Those were planted in fall 2009, phenotyped in our FHB screening nursery, and increased outside the nurseries for distribution to cooperators in fall 2010.

Impact:

This project is providing useful information on the effect of genetic background on QTL expression, which lines to use as parents in the breeding programs, and lines worthy of joint germplasm and/or cultivar release.

Project 3: *Development and Distribution of Male Sterile Facilitated Recurrent Selection Populations.*

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

The primary purpose of this project is to develop male-sterile facilitated recurrent selection populations to combine genes for FHB resistance from multiple sources in soft wheat backgrounds adapted to the eastern U.S. This is accomplished by creating pools of adapted breeding lines with genes for FHB resistance derived from multiples sources. Recurrent selection is a proven method for accumulating favorable alleles and raising their frequency in a population. We experienced few issues with the MSFRS populations. They flowered slightly later than most of the entries in our FHB nurseries but we simply added an additional spray inoculation to catch the later flowering types.

- 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:

We planted the MSFRS populations in the fall of 2010 and tagged them in mid June 2011. We have tagged the resistant male sterile plants and will harvest those plus a random sample

of this base population for future evaluations. These samples will allow us to estimate heritability and gain from selection.

Impact:

This project has much potential for impact in the long-term by providing a mechanism to accumulate genes for FHB resistance from diverse sources in locally adapted backgrounds. These populations are simultaneously beneficial to regional and local breeding programs by providing the opportunity for individual breeding programs to select genotypes with favorable local adaptation and the region-wide opportunity to recombine and recombine local selections into an improved regional pool. This project will provide breeding programs in the eastern region with germplasm from which to extract breeding lines that will have the potential to have unique combinations of FHB resistance genes.

Project 4: *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 purpose of this project is to implement and evaluate the efficacy of genomic selection (GS) for FHB resistance. There is strong to moderate resistance to FHB in Eastern US Soft Winter Wheat. The FHB resistance includes Type I & II as well as resistance to kernel infection (RKI) and toxin accumulation (RTA). It is likely that a combination of all types of resistance is needed to reliably produce grain with low deoxynivalenol (DON). While there are a few QTL with sizeable effects, recent studies suggest that there are also likely to be many QTL with small effects. This project will address determine if GS for FHB is effective.

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:

At the USWBSI Forum, we presented an analysis of the potential for GS using 3 years of cooperative FHB nursery severity and incidence data (see citation at end) and the results were promising. Cross validation of genomic estimated breeding values compared to phenotypic values resulted in correlations ranging from 0.3 to 0.7.

For this project, we provided 10 elite lines with excellent FHB resistance and 100 lines with varying FHB resistance from multiple crosses involving the elite parents and parents with less FHB resistance. These along with 70 common lines were evaluated in our FHB screening nursery for incidence and severity. After harvest we will evaluate percent diseased kernels and send samples for DON testing.

Impact:

Traditional mapping and MAS approaches may not be effective given the potentially large number of unique resistance sources and that most variation is controlled by genes with small effect. This project, combined with the information in our earlier study on GS have set the stage for greatly enhancing the rate of genetic gain from selection for FHB resistance.

Project 5: *Coordinated Evaluation of FHB Resistance of Advanced Soft Winter Lines and Cultivars.*

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

The primary purpose of this project is to evaluate breeding lines and varieties that are likely to be released in the eastern U.S. We did not experience any issues with the evaluation this past funding cycle.

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:

We completed FHB evaluation of the NUWWSN and our advanced and regional nurseries. We will submit all trial data to the database that Clay Sneller is developing.

Impact:

Regional uniform testing has stood the test of time as one of the best ways to evaluate and distribute new germplasm that is essential for breeding progress. The NUWWSN and PNUWWSN tests were created to specifically test FHB resistance and are coordinated by Ohio State University. The NUWWSN and PNUWWSN are also evaluated for milling and baking quality by the USDA Soft Wheat Quality Lab and are assessed for other diseases as they occur. Through these coordinated evaluation efforts, we can determine the FHB resistance of most of the varieties that are grown in NY. Un-tested, branded varieties have come into NY and are creating some serious issues. Many are not entered in our state trials and we cannot legally evaluate them for FHB resistance. This limits our ability to keep susceptible red varieties out of the state. We anticipate that all data from the trials of breeding lines will be placed in the database that is being developed to benefit breeders, growers, millers, and bakers.

Project 6: *Mapping QTL in Biparental Populations.*

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

The primary goal of this project is to identify novel sources of native FHB resistance. The cost of DArT genotyping nearly doubled this past year and we were not able to cover the cost in our budget. Consequently, we have delayed the genotyping until the cost comes down or we switch to a cheaper genotyping platform and will complete this project as soon as feasible.

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:

We have completed the FHB evaluation of these populations that are segregating for native resistance and analyzed the data. We have extracted the DNA and will submit them for genotyping as soon as we can find the funds to cover the cost.

Impact:

We anticipate that once completed this project will provide a new source of FHB resistance that can be combined with other sources to reduce the losses from this disease.

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.

Jensen Soft White Winter Wheat - Crop Science Registration manuscript in preparation. A release notice has been distributed through the Cornell Cooperative Extension Network. FHB resistance is moderate and native in origin.

Saranac Soft White Winter Wheat - Crop Science Registration manuscript in preparation. A release notice has been distributed through the Cornell Cooperative Extension Network. FHB resistance is moderate and Chinese in origin.

Hopkins Soft White Winter Wheat - Crop Science Registration manuscript in preparation. A release notice has been distributed through the Cornell Cooperative Extension Network. FHB resistance is moderate and Chinese in origin.

Medina Soft White Winter Wheat - Crop Science Registration manuscript in preparation. A release notice has been distributed through the Cornell Cooperative Extension Network. FHB resistance is moderate and native in origin.

Otsego Soft Red Winter Wheat - Crop Science Registration manuscript in preparation. A release notice has been distributed through the Cornell Cooperative Extension Network. FHB resistance is moderate and native in origin.

All of these varieties have been made available for licensing and Foundation seed quantities are adequate. Jensen has been licensed for sale by 4 seed companies, Hopkins has been licensed by 2, and Medina by 1.

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.

Sorrells, M.E. Bishop-Tran, A., Rutkoski, J., Benson, J., Guedira-Brown, G., and Heffner, E. 2010. Genomic Selection for Fusarium Head Blight Resistance in Wheat. Abstract – USWBSI, December 2010.

Registration articles are in preparation.