

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY11 Final Performance Report
July 13, 2012**

Cover Page

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Fiscal Year:	FY11
USDA-ARS Agreement ID:	59-0206-9-054
USDA-ARS Agreement Title:	Accelerating the Development of FHB-Resistant Soft Red Winter Wheat Varieties.
FY11 USDA-ARS Award Amount:	\$ 57,804

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-NWW	Accelerating the Development of FHB-Resistant Soft Red Winter Wheat Varieties.	\$ 33,248
VDHR-NWW	Coordinated Evaluation and Utilization of Marker Assisted Selection.	\$ 9,921
VDHR-NWW	Improved Breeding for FHB Resistance by Advanced Genetic and Phenotypic Characterization of Soft Winter Wheat.	\$ 10,879
VDHR-NWW	Coordinated Evaluation of FHB Resistance of Advanced Soft Winter Lines and Cultivars.	\$ 3,756
	Total ARS Award Amount	\$ 57,804



Principal Investigator

7-13-12

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: *Accelerating the Development of FHB-Resistant Soft Red Winter Wheat Varieties.*

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

Many wheat varieties in KY are susceptible to FHB; thus, Kentucky wheat producers and end users are at risk for severe economic losses as a result of head scab epidemics. We are resolving this problem by breeding FHB resistant cultivars.

Our breeding program involves: 1) evaluating germplasm and breeding lines as parents for FHB resistance; 2) incorporating known resistance into crosses with elite, high yielding lines and cultivars, and 3) evaluating resistance in the progeny of the crosses. We evaluate early generation populations in inoculated nurseries so that only resistant segregates are brought forward and developed into lines that can be evaluated for the usual array of traits at multiple locations.

Field evaluation is carried out at two locations: Lexington, under mist irrigation with inoculum provided by the scabby corn method, and at Princeton in a non-irrigated nursery with a combination of conidial spray and scabby corn as inoculum sources.

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): Approximately 10 lines homozygous for *Fhb1* resistance or containing native resistance were evaluated in the state variety trial during the period covered by this grant.

Impact: These lines will provide breeders with additional germplasm and parental lines to use in crosses for the development of scab resistant germplasm and varieties. The combination of *Fhb1* and native resistance QTL will be especially useful. Three lines have been increased for possible release as cultivars.

Accomplishment (2): Approximately 30 breeding lines and varieties were grown at two locations, Lexington and Princeton in inoculated scab nurseries in the presence and absence of Prosaro® fungicide.

Impact: This study gives KY growers the information they need to implement the best tools we have for fighting FHB: resistant varieties in combination with well-timed fungicides.

Accomplishment (3): Breeding lines in the cooperative Mason Dixon nursery (VA, MD, NC, KY) were grown in a mist irrigated, inoculated scab nursery at Lexington for FHB phenotyping.

Impact: The data will help breeders develop a reliable scab profile for their breeding lines and increases the likelihood of FHB resistant variety release in the region.

Accomplishment (4): Approximately 3500 rows including UK breeding lines, varieties, populations, accessions and recombinant inbred lines were phenotyped in a mist irrigated, inoculated scab nursery at Lexington.

Impact: Elimination of very susceptible lines from the breeding program early on allows us to increase resistance in segregating populations prior to line derivation.

Accomplishment (5): Approximately 90 RIL from MPI 4, the genomic selection project of the NWW CP, were grown under mist irrigation.

Impact: This project provides crucial phenotypic data required for effective genomic selection for FHB resistance.

Accomplishment (6): Approximately 100 RIL from crosses with Roane, were grown under mist irrigation for phenotyping.

Impact: This project will elucidate the nature of the resistance in Roane and hopefully identify new resistance QTL that breeders can use to develop resistant varieties.

Accomplishment (6): Approximately 587 crosses were made in the winter greenhouse. All of them involved at least 1 scab resistant parent.

Impact: These crosses will generate populations and lines with increased and diverse resistance that will benefit other breeding programs as well as our own.

Accomplishment (7): BC4 *Fhb1* derived lines in seven different recurrent parent backgrounds were increased for yield testing.

Impact: This effort will combine outstanding yield potential with known, QTL derived resistance. Two of the recurrent parents would have been released but for scab susceptibility. It is possible that scab resistant versions of these lines may be released as varieties.

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:

Seventy breeding lines that were plus/minus QTL were yield tested at two locations (KY,MI) and grown in scab nurseries at four locations (IN,IL,MO,OH). Fhb1 reduced scab in many but not all instances; native resistance was also effective. Milling quality was not seriously affected.

Impact:

This project will provide 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: *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 issue being resolved is the efficiency and effectiveness of selection for FHB resistance. The problem is being resolved through genomic selection of small effect QTL for all types 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:

The KY breeding project identified 8 lines with a high level of resistance and a larger set of lines derived from crosses involving parents with native resistance. These lines and 70

common lines were planted in our FHB screening nursery and screened for incidence, severity, FDK and DON. Native sources of FHB resistance were identified.

Impact:

If genomic selections optimized, it will expedite the release of resistant varieties.

Project 4: *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 major issue is the level of FHB resistance among SRW wheats in our region. We are resolving this by screening multiple breeding lines at multiple locations.

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, PNUWWSN, and SUS and our advanced and regional nurseries.

Impact:

Regional uniform testing is an essential component of variety development. By collecting the data in multiple locations, the data collection required for variety released is accelerated as is the entire process.

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.

None

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.

Peer Reviewed Journal Articles:

- Andres M. Agostinelli, Anthony J. Clark, Gina Brown-Guedira, David A. Van Sanford. 2011. Optimizing phenotypic and genotypic selection for Fusarium head blight resistance in wheat. *Euphytica* 186: 115-126.
- Marcia McMullen, Gary Bergstrom, Erick De Wolf, Ruth Dill-Macky, Don Hershman, Greg Shaner , Dave Van Sanford. 2012. A Unified Effort to Fight an Enemy of Wheat and Barley: Fusarium Head Blight. *Plant Disease* (First Look Online <http://dx.doi.org/10.1094/PDIS-03-12-0291-FE>)

Non-Peer Reviewed:

- Ana Balut, Anthony Clark, Gina Brown-Guedira, Yanhong Dong, Edward Souza and David Van Sanford. 2011. "Effects of *Fhb1* and *QFhs.nau-2DL* on Fusarium Head Blight and Agronomic Traits in SRW Wheat." In: S. Canty, A. Clark, A. Anderson-Scully and D. Van Sanford (Eds.), *Proceedings of the 2011 National Fusarium Head Blight Forum*. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 7.
- Anthony Clark, Cindy Finneseth and David Van Sanford. 2011. "Mutation Breeding for Fusarium Head Blight Resistance." In: S. Canty, A. Clark, A. Anderson-Scully and D. Van Sanford (Eds.), *Proceedings of the 2011 National Fusarium Head Blight Forum*. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 14.
- Md. Sariful Islam, Gina Brown-Guedira, Herb Ohm, David Van Sanford and Anne L. McKendry. 2011. "QTL Associated with Fusarium Head Blight Incidence and Severity in Truman Soft Red Winter Wheat." In: S. Canty, A. Clark, A. Anderson-Scully and D. Van Sanford (Eds.), *Proceedings of the 2011 National Fusarium Head Blight Forum*. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 27.
- Md. Sariful Islam, Gina Brown-Guedira, Herb Ohm, David Van Sanford, Yanhong Dong and Anne L. McKendry. 2011. "QTL Associated with Kernel Quality Retention and DON in Truman Soft Red Winter Wheat." In: S. Canty, A. Clark, A. Anderson-Scully and D. Van Sanford (Eds.), *Proceedings of the 2011 National Fusarium Head Blight Forum*. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 28.
- Shuyu Liu, Carl A. Griffey, Marla D. Hall, Anne L. McKendry, Jianli Chen, Gina Brown-Guedira, David Van Sanford and David G. Schmale. 2011. "Mapping Fusarium Head Blight Resistance in Wheat Cultivars Ernie and Massey." In: S. Canty, A. Clark, A. Anderson-Scully and D. Van Sanford (Eds.), *Proceedings of the 2011 National Fusarium Head Blight Forum*. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 34.

Daniela Sarti, Anthony Clark, Gina Brown-Guedira, Yanhong Dong and David Van Sanford. 2011.

“Evaluation of FHB Resistance and Agronomic Performance in Backcross and Forward-Cross Populations.” In: S. Canty, A. Clark, A. Anderson-Scully and D. Van Sanford (Eds.), *Proceedings of the 2011 National Fusarium Head Blight Forum*. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 48.

E. Wright, C. Griffey, S. Malla, D. Van Sanford, S. Harrison, J.P. Murphy, J. Costa, G. Milus, J. Johnson, A. McKendry, D. Schmale III and N. McMaster. 2011. “Family Based Mapping of Fusarium Head Blight Resistance in Soft Wheat Cultivars Roane and Jamestown.” In: S. Canty, A. Clark, A. Anderson-Scully and D. Van Sanford (Eds.), *Proceedings of the 2011 National Fusarium Head Blight Forum*. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 60.

Presentations:

D. A. Van Sanford. 2012. Deoxynivalenol: A Problem For The Wheat Industry. Presented at the Mid South Assn of Wheat Scientists Meeting, Madison, AL, April 3-4.