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:	59-0206-9-054
USDA-ARS Agreement Title:	Accelerating the Development of FHB-Resistant Soft Red Winter Wheat Varieties.
FY10 USDA-ARS Award Amount:	$ 56,359

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.	$ 35,508
VDHR-NWW	Coordinated Evaluation and Utilization of Marker Assisted Selection.	$ 9,921
VDHR-NWW	Development and Distribution of Male Sterile Facilitated Recurrent Selection Populations.	$ 1,942
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.	$ 3,756
VDHR-NWW	Mapping QTL in Biparental Populations.	$ 2,305
	Total ARS Award Amount	**$ 56,359**

Principal Investigator — 7/15/11 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?**

   This project addresses the need for FHB resistance in soft red winter wheat varieties adapted to Kentucky. Many varieties grown in our region 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.

   This breeding process 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 20 lines homozygous for *Fhb*1 resistance were planted were entered in the state variety trial during the period covered by this grant.

   Impact (1): 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 *Fhb*1 and native resistance QTL will be especially useful. If superior performance is demonstrated, one or more of the lines may be released 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 (2): There is no more critical decision for growers than the choice of a resistant variety. This must be coupled with the decision to use fungicides when conditions warrant. This study gives KY growers the information they need to implement the best tools we have for fighting FHB.

   Accomplishment (3): Approximately 84 breeding lines in the cooperative Mason Dixon nursery (VA, MD, NC, KY) were grown in a mist irrigated, inoculated scab nursery at Lexington for purposes of FHB phenotyping.

Impact (3): The data generated from this type of nursery allows breeders to compile a reliable scab profile for their breeding lines and facilitates more informed selection and release decisions.

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

Impact (4): This procedure allows us to eliminate very susceptible lines from the breeding program early on and 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 (5): This project will provide important information on the effectiveness of genomic selection for FHB resistance.

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

Impact (6): This project will elucidate the nature of the resistance in Roane and hopefully provide markers linked to it, which will speed up the breeding process.

Accomplishment (7): Approximately 587 crosses were made in the winter greenhouse. All of them involved at least 1 scab resistant parent.

Impact (7): These crosses will generate populations and lines with increased and diverse resistance that will benefit other breeding programs as well as our own.

Accomplishment (8): The fourth backcross of *Fhb1* into seven different recurrent parent backgrounds was completed.

Impact (8): 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:

   We have identified the lines in our programs that have been genotyped as homozygous for the resistance alleles at FHB QTL. Seventy such lines were from all programs were planted in a yield trial in Lexington, KY and E. Lansing, MI in October 2010.

   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: *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?**

   This project was designed 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. The issue addressed is diversity of resistance 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:

   The population was planted, male sterile plants were tagged, and intercrossed seed was harvested from them.

Impact:

This project has excellent potential long term to provide a germplasm source from which inbred lines with diverse sources of resistance can be derived.

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 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. At this point we don't know how effective genomic selection will be, but this project should shed some light on that question.

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 to be screened for incidence, severity, FDK and DON.

Impact:

If genomic selection works, it will save time and money in developing resistant varieties.

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 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.

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 issue is the development of DNA markers linked to native resistance QTL that breeders can use to accelerate the FHB resistance breeding process.

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 the Truman RILS and provided the data to Anne McKendry who has been doing the mapping work.

   Impact:

   We anticipate that once completed this project will provide markers linked to native resistance QTL that breeders can use to develop resistant varieties more quickly.

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.

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 (In Press)

Ana Balut, Anthony Clark, Gina Brown-Guedira, Eduard Souza and David Van Sanford. 2010. "Validation of Fhb1 and QFhs.nau-2DL in Several SRW Wheat Breeding Populations." In: Canty, S., A. Clark, J., A. Anderson-Scully and D. Van Sanford (Eds.). *Proceedings from the National Fusarium Head Blight Forum,* Milwaukee, WI; 2010, December 7-9. Lexington, KY: University of Kentucky.

J. Shoots, M. Guttieri, F. Kolb, J. Lewis, A. McKendry, H. Ohm, C. Sneller, M.E. Sorrells, E. Souza, D. Van Sanford, J. Costa, C. Griffey, S. Harrison, J. Johnson and J.P. Murphy. 2010. "Development and Distribution of Male-Sterile Facilitated Recurrent Selection Populations." In: Canty, S., A. Clark, J., A. Anderson-Scully and D. Van Sanford (Eds.). *Proceedings from the National Fusarium Head Blight Forum,* Milwaukee, WI; 2010, December 7-9. Lexington, KY: University of Kentucky.

E.A. Brucker, J.N. Mundell, D.A. Van Sanford and F.L. Kolb. 2010. "Comparison of Two Methods for Estimating *Fusarium* Damaged Kernels in Soft Red Winter Wheat." In: Canty, S., A. Clark, J., A. Anderson-Scully and D. Van Sanford (Eds.). *Proceedings from the National Fusarium Head Blight Forum,* Milwaukee, WI; 2010, December 7-9. Lexington, KY: University of Kentucky.

Sladana Bec, Dave Van Sanford and Lisa J. Vaillancourt. 2010. "A Cross between Two Genetically Similar *Fusarium graminearum* Strains Produces Stable Transgressive Segregants for FHB Pathogenicity Related Traits." In: Canty, S., A. Clark, J., A. Anderson-Scully and D. Van Sanford (Eds.). *Proceedings from the National Fusarium Head Blight Forum,* Milwaukee, WI; 2010, December 7-9. Lexington, KY: University of Kentucky.