USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY14 Final Performance Report
July 15, 2015

Cover Page

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Fiscal Year:	FY14
USDA-ARS Agreement ID:	59-0206-4-002
USDA-ARS Agreement Title:	Accelerating the Development of FHB-Resistant Soft Red Winter Wheat Varieties.
FY14 USDA-ARS Award Amount:	$ 68,823

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.	$ 64,397
VDHR-NWW	Male Sterile Facilitated Recurrent Selection for FHB Resistance (MPI-5).	$ 681
VDHR-NWW	Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials.	$ 3,745
	FY14 Total ARS Award Amount	**$ 68,823**

7/06/15

Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
EC-HQ – Executive Committee-Headquarters
BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
WES-CP – Western 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 accomplishments and their impact (i.e. how are they 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): Pembroke 2014 was released during the period covered by this report. This *FHB1* containing variety combines short stature, early maturing, excellent test weight and high yield potential with strong resistance to FHB.

   Impact: This variety gives Kentucky growers a new option in the form of a genetically resistant wheat variety. Potential impact in a year with heavy scab pressure is great. Additionally, it means that the percentage of susceptible varieties available to growers has been reduced.

   Accomplishment (2): Approximately 28 advanced breeding lines and varieties, a subset of the state variety trial, were grown at two locations, Lexington and Princeton in inoculated non-irrigated 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 allows us to increase focus on lines carrying resistance so that no susceptible genotypes make it through to the final testing stage.

Accomplishment (5): Approximately 100 RIL from crosses with Tribute, were grown under mist irrigation for phenotyping.

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

Accomplishment (6): Approximately 700 crosses were made in the fall and spring greenhouse crossing cycles. 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): 1200 pots (approximately 200 breeding lines) were screened for Type II resistance in the greenhouse in March.

Impact: This will combine identify those lines with resistance to spread of the fungus in the head and will eliminate those lines that lack this trait from further testing.

Project 2: *Male Sterile Facilitated Recurrent Selection for FHB Resistance (MPI-5).*

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

   The NWW CP developed male sterile recurrent selection populations that will ultimately yield scab resistant breeding lines which contain FHB resistant genes from different sources. Intermating selected individuals each generation facilitates recombination among genes from different sources. These populations segregate 1:1 for the dominant male-sterile gene and selfing is not required to generate fertile individuals. Four populations adapted to different regions of the eastern US were developed in Wooster, Ohio by using pollinators from different breeding programs. Resistant male sterile plants were selected each generation.

2. **List the most important accomplishments and their impact (i.e. how are they 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 grew a DMS population in 2014, at Lexington, KY. Sterile heads tagged and susceptible ones were discarded. After harvest Fusarium damaged kernels were removed and the remaining seed was planted back into the scab nursery in the fall of 2014. Numerous FHB resistant lines were planted around the population in nearby rows.

   Impact: These populations can be pollinated by our best scab-resistant breeding lines to generate new recurrent selection populations and ultimately new breeding lines with increased resistance from different sources.

Project 3: *Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials.*

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 wheat cultivars in our region. We are resolving this by screening multiple breeding lines at multiple locations.

2. **List the most important accomplishments and their impact (i.e. how are they 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. In each case detailed observations on incidence, severity, FDK, ISK and DON were recorded.

   Impact: Regional uniform testing is an essential component of variety development. By collecting the data in multiple locations, the variety release process is accelerated. Every year and every location is different in terms of environmental conditions. Growing this material at multiple locations maximizes the likelihood that useful scab resistance information will be generated at a subset of locations, even if some locations do not produce data for environmental reasons beyond their control (e.g. low temperature, drought etc.).

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY14 award period. The term "support" below includes any level of benefit to the student, ranging from full stipend plus tuition to the situation where the student's stipend was paid from other funds, but who learned how to rate scab in a misted nursery paid for by the USWBSI, and anything in between.

1. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their MS degree during the FY14 award period?** No

   If yes, how many?

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY14 award period?** No

   If yes, how many?

3. **Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?** No

   If yes, how many?

4. **Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?** No

   If yes, how many?

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY14 award period. List the release notice or publication. Briefly describe the level of FHB resistance. *If not applicable because your grant did NOT include any VDHR-related projects, enter N/A below.*

Pembroke 2014 soft red winter wheat, was released to and grown by farmers during the period covered by the grant. This cultivar has moderate background FHB resistance and carries *Fhb1* to provide a reasonably high level of overall resistance.

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 FY14 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:

Clark, Anthony J., Jose M. Costa, Carl A. Griffey, Gina L. Brown-Guedira, Yanhong Dong, Edward J. Souza, J. Paul Murphy and David A. Van Sanford. 2014. Registration of Scab-Resistant KY06C-11-3-10 Soft Red Winter Wheat Germplasm. Journal of Plant Registrations 8: 211-216.

Bec, S., Ward, T., O'Donnell, K., Farman, M., Hershman, D., Van Sanford, D., and Vaillancourt, L.J. 2014. Novel fingerprinting markers used to characterize Fusarium strains recovered from wheat with symptoms of head blight in Kentucky. Plant Disease. http://dx.doi.org/10.1094/PDIS-06-14-0610-RE.

Non-Peer Reviewed:

Dill-Macky, Ruth, Yanhong Dong, D. Van Sanford, Carrie Knott and Erick De Wolf. 2014. "Examination of Commercial Grain Samples to Ascertain how Deoxynivalenol Contamination Exceeded Anticipated Levels in some 2014 Wheat Crops from Western Kentucky." In: S. Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), *Proceedings of the 2014 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 13.

Cabrera, A., E. Olson, B. Brisco, F. Kolb, E.A. Brucker, A. Krill, M.P. Arruda, M. Sorrells, D. Van Sanford, A. Clark, A. McKendry and C. Sneller. 2014. "Phenotypic Analysis of FHB Resistance in a Soft Wheat Population for Genomewide Analyses." In: S. Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), *Proceedings of the 2014 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 75.

Cabrera, A., M. Huang, E. Olson, B. Brisco, F. Kolb, E.A. Brucker, A. Krill, M.P. Arruda, M. Sorrells, D. Van Sanford, A. Clark, A. McKendry and C. Sneller. 2014. "Preliminary Analysis of Genomic Selection for FHB Resistance." In: S. Canty, A. Clark, N. Turcott

and D. Van Sanford (Eds.), *Proceedings of the 2014 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 76.

Clark, Anthony, Stine Petersen, Peter V. Maloney, J. Paul Murphy and David A. Van Sanford. 2014. "Comparing Optical Sorting, Air Separation and Digital Image Analysis Estimations of Wheat *Fusarium* Damaged Kernels." In: S. Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), *Proceedings of the 2014 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 78.

Malla, S., C. Griffey, J.P. Murphy, E. Milus, A. Clark, D. Van Sanford, J. Costa, N. McMaster, D. Schmale III, S. Chao and G. Brown-Guedira. 2014. "Identification of FHB Resistance QTL in Native SRW Wheat Cultivar Tribute." In: S. Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), *Proceedings of the 2014 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 84.

Wright, E., C. Griffey, S. Malla, D. Van Sanford, S. Harrison, J.P. Murphy, J. Costa, E. Milus, J. Johnson, A. McKendry, D. Schmale III, A. Clark, N. McMaster, S. Chao and G. Brown-Guedira. 2014. "Identification of New QTL for Native Resistance to FHB in SRW Wheat." *National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 101.