USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY13 Final Performance Report
July 15, 2014

Cover Page

PI:	David Van Sanford
Institution:	University of Kentucky
Address:	Department of Plant Science 327 Plant Science Bldg. Lexington, KY 40546-0312
E-mail:	dvs@uky.edu
Phone:	859-338-2409
Fax:	859-257-7125
Fiscal Year:	FY13
USDA-ARS Agreement ID:	59-0206-9-054
USDA-ARS Agreement Title:	Accelerating the Development of FHB-Resistant Soft Red Winter Wheat Varieties.
FY13 USDA-ARS Award Amount:	$ 58,632

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.	$ 54,250
VDHR-NWW	Male Sterile Facilitated Recurrent Selection for FHB Resistance (MPI-5).	$ 633
VDHR-NWW	Coordinated Evaluation of FHB Resistance of Advanced Soft Winter Wheat Lines and Cultivars.	$ 3,749
	FY13 Total ARS Award Amount	**$ 58,632**

7/10/14

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: *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): an additional 10 lines with a high level of FHB resistance were evaluated in the state variety trial for the third year's testing 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 *Fhb*1 and native resistance QTL will be especially useful. Three lines were increased in Yuma, AZ for possible release as cultivars.

   Accomplishment (2): Approximately 30 breeding lines and varieties 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 early on allows us to increase resistance in segregating populations prior to line derivation.

Accomplishment (5): 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 390 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): 320 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 2013, 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 2013. 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 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?**

   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 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.

   Impact:

   Regional uniform testing is an essential component of variety development. By collecting the data in multiple locations, the data collection required for variety release is accelerated as is the entire process. Every year 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. temperature, drought etc.).

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY13 award period. List the release notice or publication. Briefly describe the level of FHB resistance.

Pembroke 2014 soft red winter wheat, tested as KY03C-1237-32 was released 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.

KY06C-11-3-10 Soft Red Winter Wheat Germplasm was released during the period covered by this grant. This germplasm is highly resistant, carrying 3 QTL: *Fhb1* plus QTL on chromomes 2DL and 5A.

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 FY13 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:

Balut, Ana L., Anthony J. Clark, Gina Brown-Guedira, Edward Souza, and David A. Van Sanford. 2013. Validation of Fhb1 and Qfhs.Nau-2DL in Several Soft Red Winter Wheat Populations. Crop Sci. 2013 53: 3: 934-945.

Liu, Shuyu, Carl A. Griffey, Marla D. Hall, Anne L. McKendry, Jianli Chen, Wynse S. Brooks, Gina Brown-Guedira, David Van Sanford, David G. Schmale. 2013. Molecular characterization of field resistance to Fusarium head blight in two US soft red winter wheat cultivars. Theor. Appl. Genetics 126: 2485–2498.

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 (In Press).

Non-Peer Reviewed:

Canty, S., A. Clark, Y. Salat and D. Van Sanford (Eds.). 2013. *Proceedings of the 2013 National Fusarium Head Blight Forum*, Milwaukee, WI; December 3-5. Michigan State University, East Lansing, MI/University of Kentucky, Lexington, KY.

Anthony Clark, Hussein Khaeim, Tom Pearson and David Van Sanford. 2013. "Mass Selection with Optical Sorters for Head Scab Resistance in Soft Red Winter Wheat." In: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), *Proceedings of the 2013 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 13.

De Wolf, E., P. Paul, S. Crawford, D. Hane, S. Canty, D. Van Sanford, P. Knight and D. Miller. 2013. "Impact of Prediction Tools for Fusarium Head Blight in the US, 2009-2013." In: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), *Proceedings of the 2013 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 106.

S. Malla, C. Griffey, E. Milus, J.P. Murphy, A. Clark, D. Van Sanford, J. Costa, N. McMaster and D. Schmale. 2013. "Mapping FHB Resistance in Native SRW Wheat Cultivar Tribute." In: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), *Proceedings of the 2013 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 25.

Daniela Miller, Gina Brown-Guedira, David Van Sanford, Anthony Clark, Shiaoman Chao and Jose Costa. 2013. "Mapping Fusarium Head Blight Resistance QTL in a Mid-Atlantic-Adapted Breeding Population." In: S. Canty, A. Clark, Y. Salat and D. Van Sanford (Eds.), *Proceedings of the 2013 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 32.

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, A. Clark and N. McMaster. 2013. "Characterization of FHB Resistance in SRW Roane and Jamestown Nam Populations." In: S. Canty, A. Clark, A. Anderson-Scully and D. Van Sanford (Eds.), *Proceedings of the 2013 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 45.