USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY16 Final Performance Report
Due date: July 28, 2017

Cover Page

Principle Investigator (PI):	David Van Sanford
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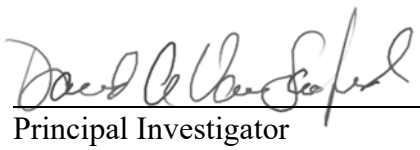
Fiscal Year:	2016
USDA-ARS Agreement ID:	59-0206-4-002
USDA-ARS Agreement Title:	Accelerating the Development of FHB-Resistant Soft Red Winter Wheat Varieties.
FY16 USDA-ARS Award Amount:	$ 67,005
Recipient Organization:	University of Kentucky Research Foundation University Station Lexington, KY 40506-0057
DUNS Number:	939017877
EIN:	61-6033693
Recipient Identifying Number or Account Number:	3048111385
Project/Grant Reporting Period:	4/6/16 - 4/5/17
Reporting Period End Date:	04/05/17

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.	$ 62,583
VDHR-NWW	Male Sterile Facilitated Recurrent Selection for FHB Resistance.	$ 680
VDHR-NWW	Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials.	$ 3,742
	FY16 Total ARS Award Amount	**$ 67,005**



Principal Investigator — July 28, 2017 Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
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
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

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Project 1: *Accelerating the Development of FHB-Resistant Soft Red Winter Wheat Varieties.*

1. What are the major goals and objectives of the project?

Major, overarching goal: Release high yielding, scab resistant SRW wheat varieties adapted to KY and the southern corn-belt. Sub objectives include: (1) accurately phenotyping and developing a scab profile for existing cultivars, advanced breeding lines and populations. We accomplished this by evaluating material under a range of disease pressures at two locations; (2) breeding: choosing parents, crossing them and selecting resistant progeny based on phenotype, marker genotype and genomic estimated breeding value; (3) collaboration: growing and screening collaborative nurseries to facilitate germplasm exchange, broaden the diversity of sources used in the breeding program, and provide excellent pre-release multi-location data for candidate varieties; and (4) outreach: through collaboration with our grains extension specialist and extension plant pathologist, we will screen a set of varieties and elite breeding lines in scab nurseries at two KY locations with and without fungicides.

2. What was accomplished under these goals? *Address items 1-4) below for each goal or objective.*

1) Major activities: More than 4000 individual headrows were screened in the scab nursery at Lexington, KY. Material phenotyped included breeding lines, released cultivars, segregating populations and genetic studies.

   Approximately 400 crosses were made during FY16, all of which involved at least one scab resistant parent. Breeding populations from F_2 through F_5 were selected for advancement; some F_2's were grown in the scab nursery and in other cases we could selected for resistance due to natural scab infection.

2) Specific objectives
   (1) screening
   (2) breeding
   (3) collaboration
   (4) outreach

3) Significant results
   - We were successful in creating sufficient disease pressure in the scab nursery to be able to distinguish resistant breeding lines for advancement. This also facilitated completion of genetic studies.
   - Natural scab infection in F_5 headrows allowed us to select for resistance in a generation not included in the scab nursery because there are too many lines.
   - We had low FDK but high DON, indicative of a late infection due to cool temperatures. This allowed us to provide valuable information for other breeding programs with respect to collaborative nurseries like the Northern, Preliminary Northern and Southern uniform scab nurseries along with the Mason Dixon nursery.

- We discussed FHB alerts and the importance of resistant varieties and well timed fungicides at our annual wheat field day and winter wheat grower meeting.

4) Key outcomes or other achievements: In FY16 we identified a number of high yielding breeding lines with good scab resistance, stemming from both native resistance and from the gene *Fhb1*.

3. What opportunities for training and professional development has the project provided?

PhD student Lisa Tessman played a more prominent role in organizing, implementing and running our irrigated scab nursery. She was also responsible for designing and carrying out a study of the impact of warming on scab resistance. Lisa attended the National Fusarium Head Blight Forum, heard talks, presented a poster and networked.

4. How have the results been disseminated to communities of interest?

We posted scab nursery results on our website and a subset of that data in an annual written report. That information was also discussed at our annual Wheat Science field day and at our winter wheat growers meeting.

Project 2: *Male Sterile Facilitated Recurrent Selection for FHB Resistance.*

1. What are the major goals and objectives of the project?

The goal is for this project to further develop several pools of adapted breeding lines with genes for FHB resistance derived from multiples sources.

2. What was accomplished under these goals? *Address items 1-4) below for each goal or objective.*

1) Major activities: Intermating among male sterile and male fertile plants occurred.
2) Specific objectives: Allow intermating of diverse sources of resistance.
3) Significant results: Another cycle of recurrent selection was carried out.
4) Key outcomes or other achievements: Resistant plants were identified.

3. What opportunities for training and professional development has the project provided?

PhD student Lisa Tessman learned about recurrent selection and the use of male sterility in a breeding program.

4. How have the results been disseminated to communities of interest?

To date there have not been outcomes or results suitable for dissemination because this is a long term project in which much time has been spent on intermating and creating new gene combinations. It is possible that this year some or all PI's will begin to extract lines from the population; these lines will comprise outputs and results that can be disseminated outside the project group.

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

1. What are the major goals and objectives of the project?

The goals of this project are to: phenotype in multiple environments advanced breeding lines that are candidates for release; generate FHB and agronomic data along with milling and baking quality data that can be stored in T3, an online database.

2. What was accomplished under these goals? *Address items 1-4) below for each goal or objective.*

1) Major activities – FHB screening
Accomplishment: We phenotyped three regional uniform scab nurseries that we grow (Northern, Preliminary Northern and Southern uniform soft wheat scab nurseries) along with our advanced and regional collaborative nurseries and our state variety trial. In some cases detailed observations on incidence, severity, FDK, ISK and DON were recorded; for other nurseries we measured FHB rating (0-9) and FDK and DON. In all nurseries and trials we measured heading date and height.

2) Specific objectives: create a functional screening environment.

3) Significant results: An epidemic level of scab pressure was created, allowing for identification of resistant lines.

4) Key outcomes or other achievements: Uniform and regional nursery data that provided breeders with assessments of their lines in multiple screening environments.

3. What opportunities for training and professional development has the project provided?

PhD student Lisa Tessman collected screening data for the uniform scab nurseries and the Mason Dixon Nursery as well as the state Wheat Variety Trial.

4. How have the results been disseminated to communities of interest?

Results communicated via written and web based reports; data was posted to T3, the online database.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY16 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 FY16 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 FY16 award period?** NO

   If yes, how many?

3. **Have any post docs who worked for you during the FY16 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 FY16 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?

Release of Germplasm/Cultivars

Instructions: In the table below, list all germplasm and/or cultivars released with full or partial support through the USWBSI during the FY16 award period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations. *Leave blank if you have nothing to report or if your grant did NOT include any VDHR-related projects.*

Name of Germplasm/Cultivar	**Grain Class**	**FHB Resistance** (S, MS, MR, R, where R represents your most resistant check)	**FHB Rating** (0-9)	**Year Released**
NA				

Add rows if needed.

NOTE: List the associated release notice or publication under the appropriate sub-section in the 'Publications' section of the FPR.

Abbreviations for Grain Classes

Barley - BAR
Durum - DUR
Hard Red Winter - HRW
Hard White Winter - HWW
Hard Red Spring - HRS
Soft Red Winter - SRW
Soft White Winter - SWW

Publications, Conference Papers, and Presentations

Instructions: Refer to the FY16-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY16 grant. Only include citations for publications submitted or presentations given during your award period (4/6/16 - 4/5/17). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

Journal publications.

Knott, Carrie A., David A. Van Sanford, Edwin L. Ritchey, and Ethan Swiggart. 2016. Wheat Yield Response and Plant Structure Following Increased Nitrogen Rates and Plant Growth Regulator Applications. Crop, Forage, & Turfgrass Management 2: doi:10.2134/cftm2015.0202.
Status: Published
Acknowledgement of Federal Support: No

Clark, Anthony J., Daniela Sarti-Dvorjak, Gina Brown-Guedira, Yanhong Dong, Byung-Kee Baik and David A. Van Sanford. 2016. Identifying rare FHBresistant transgressive segregants in intransigent backcross and F2 winter wheat populations. Front. Microbiol. 7:277. doi:10.3389/fmicb.2016.00277.
Status: Published
Acknowledgement of Federal Support: No

Huang, Mao, Antonio Cabrera, Amber Hoffstetter, Carl Griffey, David Van Sanford, José Costa, Anne McKendry, Shiaoman Chao, Clay Sneller. 2016. Genomic selection for wheat traits and trait stability. Theor. Appl. Genet. (doi:10.1007/s00122-016-2733-z).
Status: Published
Acknowledgement of Federal Support: No

Hitz, Katlyn, Anthony Clark, and David Van Sanford. 2016. Identifying Nitrogen-Use Efficient Soft Red Winter Wheat Lines in High and Low Nitrogen Environments. Field Crops Research 200 (2016) 1–9. DOI:10.1016/j.fcr.2016.10.001.
Status: Published
Acknowledgement of Federal Support: No

Books or other non-periodical, one-time publications.

Nothing to report.

Other publications, conference papers and presentations.

Lisa Tessmann, Anthony Clark and David Van Sanford. "Morphological and FHB Trait Variation in the Elite Eastern Mapping Panel." *Proceedings of the 2016 National Fusarium Head Blight Forum*, December 4-6, 2016. Hyatt Regency St. Louis, MO. Ed. S. Canty, K. Wolfe, D. Van Sanford. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. 2016. P. 98. Digital Print.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Ullrich, J., S. Malla, C. Griffey, N. Carpenter, W. Brooks, D. Van Sanford, A. Clark, J.P. Murphy, R. Brueggeman, C. Cowger, N. McMaster, D. Schmale III, S. Chao and G. Brown-Guedira. "Evaluation of Winter Barley Cultivar Eve for Quantitative Resistance to Fusarium Head Blight." *Proceedings of the 2016 National Fusarium Head Blight Forum*, December 4-6, 2016. Hyatt Regency St. Louis, MO. Ed. S. Canty, K. Wolfe, D. Van Sanford. East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. 2016. P. 101. Digital Print.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Not applicable for this agreement.