USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY17 Final Performance Report – NCE for FY18
Due date: July 12, 2019

Cover Page

Principle Investigator (PI):	David Van Sanford
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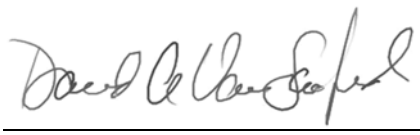
Fiscal Year:	2017 (NCE for FY18)
USDA-ARS Agreement ID:	59-0206-4-002
USDA-ARS Agreement Title:	Accelerating the Development of FHB-Resistant Soft Red Winter Wheat Varieties.
FY17 USDA-ARS Award Amount:	$ 66,875
Recipient Organization:	University of Kentucky Research Foundation University Station Lexington, KY 40506-0057
DUNS Number:	939017877
EIN:	61-6033693
Recipient Identifying Number or Account Number:	3048111385
Project/Grant Reporting Period:	4/6/18 - 4/5/19
Reporting Period End Date:	04/05/19

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.	$ 62,462
VDHR-NWW	Male Sterile Facilitated Recurrent Selection for FHB Resistance.	$ 678
VDHR-NWW	Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials.	$ 3,735
	FY17 Total ARS Award Amount	$ 66,875



7/12/19

Principal Investigator 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?

1) Develop and release improved scab resistant varieties; 2) Develop and release improved scab resistant germplasm; 3) generate new knowledge on the inheritance of FHB resistance to expedite the breeding process and 4) communicate the importance of BMP to growers, crop consultants, extension agents and other stakeholders in the soft wheat industry.

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

1) major activities. More than approximately 3500 individual headrows were screened in the scab nursery at Lexington, KY. Material screened included breeding lines, uniform scab nurseries, other cooperative nurseries, released cultivars, segregating populations and genetic studies.

Approximately 470 crosses were made during FY17, all of which involved at least one scab resistant parent. Breeding populations from F_2 through F_5 were selected for advancement.

2) specific objectives
(1) screening – as described above
(2) breeding – crossing and population advancement as noted above
(3) collaboration – grew uniform scab nurseries, other collaborative nurseries and participated in male sterile project
(4) outreach – communicated findings to stakeholders through newsletters, web and at meetings and field days

3) Significant results

- The scab nursery was successful in providing an excellent environment for identifying resistant vs susceptible phenotypes. This was helpful to the breeding effort in that it allowed us to collect high quality data so that our selection of resistant lines was done with confidence. This was also useful for genetic studies such that we were able to assess the effectiveness of minor QTL in managing scab.
- Some natural scab infection in F_4, F_5 and doubled haploid headrows allowed us to select for resistance in a generation which we cannot include in the scab nursery because there are too many lines.
- Our FDK and DON levels were high, but CVs were reasonably low. This allowed us to provide good data to other breeding programs with respect to collaborative nurseries like the Northern, Preliminary Northern and Southern uniform scab nurseries along with the Mason Dixon nursery.

- FHB alerts and the importance of resistant varieties and well timed fungicides continue to be a familiar refrain at our annual wheat field day and winter wheat grower meeting.

4) Key outcomes or other achievements: During this reporting period, we identified several high yielding breeding lines with good scab resistance that includes both native resistance and *Fhb1* based resistance. In a number of cases, the native resistance has been resolved into specific QTL that the Eastern Regional Genotyping lab has been using in its haplotype analysis the last 2 years.

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

Graduate students Lisa Tessman, Virginia Verges and Jesse Carmack all were exposed to excellent training in scab screening and breeding for scab resistance - specifically all gained experience in rating FHB on the plant and in kernels. They organized the scab nursery according to heading date and planned disease scoring accordingly. All presented their work at either the Scab Forum, the ASA meetings, and/or the regional Eastern Wheat Workers meeting in Raleigh in April 2019.

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

As noted above, results have been shared through newsletters, field days, grower meetings and web delivery of information and data. Data from the 2018 State Variety Trial that was grown in the scab nursery is online in ScabSmart currently, where growers can find DON levels for varieties of interest. This came about through our collaboration with Bill Bruening who runs the small grains variety trials.

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 students Lisa Tessman, Virginia Verges and Jesse Carmack 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. Most or all PI's have begun 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 favorable screening environment.

   3) Significant results: A high level of scab pressure was created which allowed identification of resistant lines.

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

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

   PhD students Lisa Tessman, Jesse Carmack and Virginia Verges collected screening data for the uniform scab nurseries and the Mason Dixon Nursery as well as the KY 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 FY17-NCE 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 FY17-NCE 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 FY17-NCE period?**
   YES

   If yes, how many? One student, Lisa Tessman graduated.

3. **Have any post docs who worked for you during the FY17-NCE 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 FY17-NCE period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**
   NA
   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 FY17-NCE period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations.

NOTE: 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**

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 FY17-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY17-NCE grant period. Only include citations for publications submitted or presentations given during your award period (4/6/18 - 4/5/19). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each reference/citation, you must indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in publication/ presentation. See example below for a poster presented at the FHB Forum:

> Conley, E.J., and J.A. Anderson. 2017. Accuracy of Genome-Wide Prediction for Fusarium Head Blight Associated Traits in a Spring Wheat Breeding Program. In: Proceedings of the XXIV International Plant & Animal Genome Conference, San Diego, CA.
> Status: Abstract Published and Poster Presented
> Acknowledgement of Federal Support: YES (poster), NO (abstract)

Journal publications.

Huang, M., Mheni, N., Brown-Guedira, G., McKendry, A., Griffey, C., Van Sanford, David, Costa, J., Sneller, C. 2018. Genetic analysis of heading date in winter and spring wheat, (8 ed., vol. 214) EUPHYTICA.
Status: Published
Acknowledgement of Federal Support: YES

Tessmann, E. W., Van Sanford, D. A. 2018. GWAS for Fusarium Head Blight Related Traits in Winter Wheat (*Triticum Aestivum* L.) in an Artificially Warmed Treatment Agronomy 2018, 8, 68; doi:10.3390/agronomy8050068
Status: Paper Published and Poster Presented
Acknowledgement of Federal Support: YES (poster), YES (paper)

Huang, M., Ward, B., Griffey, C., Van Sanford, D. A., McKendry, A., Brown-Guedira, G., Tyagi, P., Sneller, C. 2018. The accuracy of genomic prediction between environments and populations for soft wheat traits. Crop Science 58: 6: 2274-228doi:10.2135/cropsci2017.10.0638
Status: Paper Published
Acknowledgement of Federal Support: YES

Van Sanford, D. A., Clark, A., Bradley, C., Brown-Guedira, G., Cowger, C., Dong, Y., Baik, B.-K. 2018. Registration of 'Pembroke 2016' Soft Red Winter Wheat, (vol. 12) Journal of Plant Registrations 2018 12: 3: 373-378 doi:10.3198/jpr2017.12.0089crc
Status: Paper Published
Acknowledgement of Federal Support: YES

Ward, B.P., Brown-Guedira, G.L., Kolb, F.L., Van Sanford, D.A., Tyagi, P., Sneller, C.H. and Griffey, C.A. 2019. Genome-wide association studies for yield-related traits in soft red winter wheat grown in Virginia. Published 22 Feb 2019 PLOS ONE https://doi.org/10.1371/journal.pone.0208217
Status: Paper Published
Acknowledgement of Federal Support: YES

Ward, B.P., Brown-Guedira, G.L., Tyagi, P., Kolb, F.L., Van Sanford, D.A., Sneller, C.H. and Griffey, C.A. 2019. Multienvironment and multitrait genomic selection models in unbalanced early-generation wheat yield trials. Crop Science. 59: 2: 491-507doi:10.2135/cropsci2018.03.0189.
Status: Paper Published
Acknowledgement of Federal Support: YES

Tessman, Elisane, Yanhong Dong, David Van Sanford. 2019. GWAS for Fusarium Head Blight Traits in a Soft Red Winter Wheat Mapping Panel. Crop Science doi: 10.2135/cropsci2018.08.0492.
Status: Published
Acknowledgement of Federal Support: YES

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

Nothing to report.

Other publications, conference papers and presentations.

Jesse Carmack and David A. Van Sanford. 2018. "Recurrent Phenotypic Selection Augmented by Genomic Selection for Head Scab Resistance." In: Canty, S., A. Hoffstetter, B. Wiermer and R. Dill-Macky (Eds.), *Proceedings of the 2018 National Fusarium Head Blight Forum,* (p. 109). East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES

Elisane Tessmann and David Van Sanford. 2018. "WAS for Fusarium Head Blight Traits in the Elite Eastern Wheat Mapping Panel." In: Canty, S., A. Hoffstetter, B. Wiermer and R. Dill-Macky (Eds.), *Proceedings of the 2018 National Fusarium Head Blight Forum,* (p. 139). East Lansing, East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES