USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY19 Performance Report
Due date: September 30, 2020

Cover Page

Cooperating Principle Investigator (CPI):	David Van Sanford
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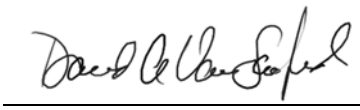
Fiscal Year:	2019
USDA-ARS Agreement ID:	58-6070-8-020
USDA-ARS Agreement Title:	Collaborative Research to Accelerate the Development of FHB-Resistant Soft Red Winter Wheat Varieties
FY19 USDA-ARS Award Amount:	$ 74,424
Recipient Organization:	University of Kentucky Research Foundation University Station Lexington, KY 40506-0057
DUNS Number:	939017877
EIN:	61-6033693
Recipient Identifying Number or Account Number:	3200002116
Agency PI:	Gina Brown-Guedira
Project/Grant Reporting Period:	8/1/19 - 7/31/20
Reporting Period End Date:	7/31/2023

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	$ 69,915
VDHR-NWW	Male Sterile Facilitated Recurrent Selection for FHB Resistance	$ 953
VDHR-NWW	Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials	$ 3,556
	FY19 Total ARS Award Amount	**$ 74,424**



Sept. 22, 2020

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

FY19 Performance Report
CPI: Van Sanford, David
NACA Agreement #: 58-6070-8-020
Reporting Period: 8/1/19 - 7/31/20

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

1. What are the major goals and objectives of the research 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 all stakeholders in the wheat industry: growers, crop consultants, extension agents, millers, bakers and consumers.

2. What was accomplished under these goals or objectives? *(For each major goal/objective, address items a-b) below.)*

a) What were the major activities?

1) Screening: More than approximately 3500 individual headrows were planted to be 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. Unfortunately freezes on April 15 and May 9 killed all of the material planted.
2) Breeding: 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.
3) Collaboration – grew uniform scab nurseries, other collaborative nurseries and participated in male sterile project, grew barley lines for collaborators at Virginia Tech.
4) Outreach – communicated findings to stakeholders through newsletters, web and at virtual meetings and virtual field days

b) What were the significant results?

- Because our scab nursery was destroyed by freezes, this was a year in which FHB screening data from the northern, preliminary northern and southern scab nurseries was hugely important. We also received scab ratings from the 5 state nursery and the Mason Dixon nursery from certain locations.
- This was also a year in which the genomic predictions for scab resistance were extremely important. Ongoing research has shown us that these predictions have been reasonably accurate in terms of agreement with actual screening data, so we relied on these genomic predictions in selecting lines to go forward for continued agronomic and FHB testing.

c) List key outcomes or other achievements.

Nothing to report

3. Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.

Yes. We had an extremely small crew this year – 3 undergraduates vs 7-8 that we normally have. Getting the scab irrigation set up and taken down was a formidable task.

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

Graduate students Virginia Verges and Jesse Carmack, Ela Szuleta and Paula Castellari all were exposed to the concepts of scab screening and breeding for scab resistance – though they did not get the hands on experience this year due to the freezes. However, they organized the scab nursery according to heading date and planned disease scoring accordingly – but the screening never happened due to the freezes.

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

We did not have 2020 screening data to disseminate this year because of the freezes. However, data from the 2017-19 State Variety Trial that was grown in the irrigated, inoculated scab nursery is online in ScabSmart currently. 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 research project?**
   The goal is for this project to concentrate resistance genes from adapted agronomically fit breeding lines into a breeding population that can then be tapped for derivation of inbred lines.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address items a-b) below.)*

   a) What were the major activities?
   This goal could not be pursued this year due to the aforementioned spring freezes.

   b) What were the significant results?
   None due to the freezes.

   c) List key outcomes or other achievements.
   None due to the freezes.

3. **Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.**

   Yes. We had an extremely small crew this year – 3 undergraduates vs 7-8 that we normally have. Getting the scab irrigation set up and taken down was a formidable task.

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

   Graduate students Virginia Verges and Jesse Carmack, Ela Szuleta and Paula Castellari all were exposed to the concepts of scab screening and breeding for scab resistance with a special focus on recurrent selection and the use of male sterility in a breeding program. They did not get the hands on experience this year due to the freezes.

5. **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 research 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 or objectives?** *(For each major goal/objective, address items a-b) below.)*

   a) What were the major activities?

      FHB screening – The northern scab nurseries were planted in anticipation of screening but were not screened due to the freezes that killed all of the material in the scab nursery.

   b) What were the significant results?

      No significant results because we could not screen the nurseries.

   c) List key outcomes or other achievements.

      No key outcomes for reasons noted above.

3. **Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.**

   Yes. We had an extremely small crew this year – 3 undergraduates vs 7-8 that we normally have. Getting the scab irrigation set up and taken down was a formidable task.

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

   Graduate students Virginia Verges and Jesse Carmack, Ela Szuleta and Paula Castellari all were exposed to the concepts of scab screening and breeding for scab resistance but they did not get the hands on experience this year due to the freezes.

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

   No results to communicate due to the freezes.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY19 award period (8/1/19 - 7/31/20). 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 FY19 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 FY19 award period?**
   NO

   If yes, how many?

3. **Have any post docs who worked for you during the FY19 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 FY19 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 FY19 award 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 FY19-FPR_Instructions for detailed more instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY19 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period (8/1/19 - 7/31/20**) should be included. If you did not publish/submit or present anything, state 'Nothing to Report' directly above the Journal publications section.

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

De Wolf, E., D. Shah, P. Paul, L. Madden, S. Crawford, D. Hane, S. Canty, R. Dill-Macky, D. Van Sanford, K. Imhoff and D. Miller. 2019. "Impact of Prediction Tools for Fusarium Head Blight in the US, 2009-2019." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 12), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

Tessmann. Elisane W., and David A. Van Sanford.2019. Associations between morphological and FHB traits in a soft red winter wheat population. Euphytica (2019) 215:189https://doi.org/10.1007/s10681-019-2509-z
Status: Article Published
Acknowledgement of Federal Support: YES

W. Jesse Carmack, Anthony J. Clark, Yanhong Dong and David A. Van Sanford. 2019. Mass selection for reduced deoxynivalenol concentration using an optical sorter in SRW wheat. *Agronomy* 2019, *9*(12), 816; https://doi.org/10.3390/agronomy9120816 - 28 Nov 2019
Status: Article Published
Acknowledgement of Federal Support: YES

Verges, V.L., and D. A. Van Sanford. 2020. Genomic Selection at Preliminary Yield Trial Stage: Training Population Design to Predict Untested Lines. Agronomy-Basel Agronomy 2020, 10, 60; doi:10.3390/agronomy10010060
Status: Article Published
Acknowledgement of Federal Support: YES

Verges Virginia L., Jeanette Lyerly, Yanhong Dong and David A. Van Sanford. 2020. Training Population Design with the Use of Regional Fusarium Head Blight Nurseries to Predict Independent Breeding Lines for FHB Traits. Frontiers in Plant Science doi: 10.3389/fpls.2020.01083

Status: Article Published
Acknowledgement of Federal Support: YES

Katherine Rod, Carl A. Bradley, David A. Van Sanford, Carrie Knott. 2020. Integrating management practices to decrease deoxynivalenol contamination in soft red winter wheat. Frontiers in Plant Science. doi: 10.3389/fpls.2020.01158
Status: Article Published
Acknowledgement of Federal Support: YES

Carpenter, Neal R., Emily Wright, Subas Malla, David Van Sanford, Anthony Clark, Stephen Harrison, J. Paul Murphy, Jose Costa, Shiaoman Chao, Gina L. Brown-Guedira, David Schmale III1, Niki McMaster1, Carl A. Griffey and Nidhi Rawat. 2020. Identification and Validation of Native FHB Resistance QTL in the US Soft Red Winter Wheat Cultivar Jamestown. Crop Science (In Press).
Status: Article in press
Acknowledgement of Federal Support: YES

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

Other publications, conference papers and presentations.

De Wolf, E., D. Shah, P. Paul, L. Madden, S. Crawford, D. Hane, S. Canty, R. Dill-Macky, D. Van Sanford, K. Imhoff and D. Miller. 2019. "Impact of Prediction Tools for Fusarium Head Blight in the US, 2009-2019." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 12), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Talk Presented
Acknowledgement of Federal Support: YES (Abstract)

Rod, Katherine, Carrie Knott, Carl Bradley and David Van Sanford. 2019. "Can Agronomic Practices Reduce DON?" In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 30), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Talk Presented
Acknowledgement of Federal Support: YES (Abstract)

Rod, Katherine S., Carrie A. Knott, David Van Sanford, and Carl A. Bradley. 2019. Deoxynivalenol Contamination and *Fusarium graminearum* Infected Wheat Kernels from Various Production Practices. In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 31), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Talk Presented
Acknowledgement of Federal Support: YES (Abstract)

Sladana Bec, Franklin J. Machado, Mark Farman, Aline Vieira de Barros, Scott Schwartz, Richard Metz, Charles Johnson, David Van Sanford, Emerson Del Ponte and Lisa Vaillancourt. 2019. "Highly Aggressive and Toxigenic Transgressive Progeny from a Cross of Model *Fusarium graminearum* Strains PH-1 and GZ3639 are Associated with a Recombination Hotspot on Chromosome 2." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 61), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Talk Presented
Acknowledgement of Federal Support: YES (Abstract)

Gabdiel E. Yulfo Soto, Aline Vieira de Barros, Sladana Bec, Franklin J. Machado, Frances Trail, David Van Sanford and Lisa Vaillancourt. 2019. "Exploring the Role of Mating-type Genes in *Fusarium graminearum.*" In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 79), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Talk Presented
Acknowledgement of Federal Support: YES (Abstract)

Carmack, W. Jesse, Anthony J. Clark, Yanhong Dong and David A. Van Sanford. 2019. "Mass Selection for Reduced Deoxynivalenol Concentration using an Optical Sorter in SRW Wheat." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 89), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Talk Presented
Acknowledgement of Federal Support: YES (Abstract)

Fitzgerald, J., C. Griffey, W. Brooks, N. Meier, D. Van Sanford, J.P. Murphy, N. McMaster and D. Schmale III. 2019. "Evaluation of Winter Barley Cultivar Nomini for Resistance to Fusarium Head Blight." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 90), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Talk Presented
Acknowledgement of Federal Support: YES (Abstract)

Virginia L. Verges, Jeanette Lyerly and David A. Van Sanford. 2019. "Application of Genomic Selection at Preliminary Yield Trial Stage: Training Population Design to Predict Untested Lines." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 121), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Talk Presented
Acknowledgement of Federal Support: YES (Abstract)