USDA-ARS | U.S. Wheat and Barley Scab Initiative

FY21 Performance Progress Report

Due date: July 26, 2023

Cover Page

USDA-ARS Agreement ID:	59-0206-0-176
USDA-ARS Agreement Title:	Accelerating the Development of FHB-Resistant Soft Red Winter Wheat Varieties
Principle Investigator (PI):	Dave Van Sanford
Institution:	University of Kentucky
Institution UEI:	H1HYA8Z1NTM5
Fiscal Year:	2021
FY21 USDA-ARS Award Amount:	$89,413
PI Mailing Address:	University of Kentucky, Department of Plant Science 327 Plant Science Bldg., Lexington, KY 40546-0312
PI E-mail:	dvs@uky.edu
PI Phone:	859-338-2409
Period of Performance:	6/1/21 - 5/31/23
Reporting Period End Date:	5/31/2024

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	$84,014
VDHR-NWW	Coordinated Phenotypes of Soft Wheat Germplasm for the Midwest	$5,399
	FY21 Total ARS Award Amount	$89,413

I am submitting this report as an: ☒ Annual Report

I certify to the best of my knowledge and belief that this report is correct and complete for performance of activities for the purposes set forth in the award documents.

Principal Investigator Signature

07/24/23

Date Report Submitted

[‡] BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
EC-HQ – Executive Committee-Headquarters
FST-R – Food Safety & Toxicology (Research)
FST-S – Food Safety & Toxicology (Service)
GDER – Gene Discovery & Engineering Resistance
HWW-CP – Hard Winter Wheat Coordinated Project
MGMT – FHB Management
MGMT-IM – FHB Management – Integrated Management Coordinated Project
PBG – Pathogen Biology & Genetics
TSCI – Transformational Science
VDHR – Variety Development & Uniform Nurseries
NWW –Northern Soft Winter Wheat Region
SPR – Spring Wheat Region
SWW – Southern Soft Red Winter Wheat Region

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 these three items below.)*

   a) What were the major activities?

   1) Screening: More than 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. We had better scab pressure than in the preceding season but hot dry weather at the wrong time limited infection in some material.
   2) Breeding: Approximately 400 crosses were made during this period, all of which involved at least one scab resistant parent. Breeding populations from F_2 through F_5 were selected for advancement. Preliminary lines were selected for testing based on genomic predictions. Advanced lines were tested in KY and multi state nurseries and tests.
   3) Collaboration – grew uniform scab nurseries, other collaborative nurseries and shared genomic selection ideas and information with breeders in the region.
   4) Outreach – communicated findings to stakeholders through newsletters, web and at meetings and field days

   b) What were the significant results?

   - We observed significant differences among breeding lines in the resistance to FHB as indicated by FHB rating. We will soon be grinding samples to submit for mycotoxin testing.
   - We obtained genomic FHB resistance predictions for all of our preliminary lines: DON, rating, FDK which we will consider in selection of lines to continue testing in agronomic trials and in the scab nursery.

   c) List key outcomes or other achievements.

   - Identified new moderately new resistant lines based largely on genomic predictions
   - Predicted FHB resistance was validated in some breeding lines, particularly those in the uniform scab nurseries grown in other states
   - Several breeding lines had the lowest level of scab symptoms in the uniform scab nurseries

3. **What opportunities for training and professional development has the project provided?**
   We have been able to provide good opportunities for professional development of graduate and undergraduate students. During this period 1 graduate student in our breeding program has learned about scab resistance breeding from the ground up: designing crosses, scoring material in the field, harvesting and processing. Professional development opportunities have been limited but one of the students, Joyce Robinson attended the national FHB forum in FL and interacted with peers and PI's from other universities.

4. **How have the results been disseminated to communities of interest?**
   Our scab data is posted on our website (https://ukwheatbreeding.ca.uky.edu/research-projects) , the variety testing website (http://www.uky.edu/Ag/wheatvarietytest/).

Project 2: Coordinated Phenotypes of Soft Wheat Germplasm for the Midwest

---

1. **What are the major goals and objectives of the research project?**
   Our specific objectives are 1) Phenotype advanced breeding lines that are candidates for release or potential parents: 2) place FHB and other agronomic, disease resistance, and quality data in a database: 3) report on purification and seed increase of the best lines.

   The coordinated testing of advanced lines in the various uniform trials and OVTs plus the data summaries for lines that are candidates for release is an efficient method to determine the FHB resistance of nearly all germplasm that is currently released, or likely to be released in the near future. Each breeder in this coordinated project has breeding lines with improved levels of FHB resistance and other traits that warrant their release. The purification and seed increase of these lines is funded by non- USWBSI sources. We propose to summarize the information that supports the release of the advanced lines and to make that information available to all breeders and extension personnel when appropriate.

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

   a) **What were the major activities?**
   Scab screening data was collected on lines entered in the Uniform Northern, Uniform Preliminary Northern and the Uniform Southern scab nurseries, the Mason-Dixon nursery and the KY Official Variety Trial along with all breeding lines in replicated trials.

   b) **What were the significant results?**
   Significant genotypic differences were observed for FHB rating in the period covered by this grant. Last year we had moderate pressure in the disease nursery and there was sufficient variation in DON levels that we could omit some lines from further testing. We plan to estimate FDK and DON in the 2023 nurseries as time allows.

   c) **List key outcomes or other achievements.**
   We were able to compare predicted DON levels with actual levels which served as a validation of the genomic selection models we are using.

3. **What opportunities for training and professional development has the project provided?**
   We have been able to provide good opportunities for professional development of graduate and undergraduate students. During this period 1 graduate student in our breeding program has learned about scab resistance breeding from the ground up: designing crosses, scoring material in the field, harvesting and processing. Professional development opportunities have been limited but one of the students, Joyce Robinson attended the national FHB forum in FL and interacted with peers and PI's from other universities.

4. **How have the results been disseminated to communities of interest?**
   Data were sent to the coordinators, Murphy and Sneller, and results of the uniform scab nurseries are posted at: https://scabusa.org/reports

Publications, Conference Papers, and Presentations

Please include a listing of all your publications/presentations about your FHB work that were a result of funding from your FY21 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period** should be included.

Did you publish/submit or present anything during this award period?

☒ Yes, I've included the citation reference in listing(s) below.

☐ No, I have nothing to report.

Journal publications as a result of FY21 award

List peer-reviewed articles or papers appearing in scientific, technical, or professional journals. Include any peer-reviewed publication in the periodically published proceedings of a scientific society, a conference, or the like.

Identify for each publication: Author(s); title; journal; volume: year; page numbers; status of publication (published [include DOI#]; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).

Rupesh Gaire, Clay Sneller, Gina Brown-Guedira, David A. Van Sanford, Mohsen Mohammadi, Frederic L. Kolb, Eric Olson, Mark Sorrells, and Jessica Rutkoski. 2021.Genetic trends in Fusarium head blight resistance due to 20 years of winter wheat breeding and cooperative testing in the Northern US. Plant Disease. 20 Jul. 2021 https://doi.org/10.1094/PDIS-04-21-0891-SR. Acknowledgement of Federal Support: YES

Virginia L. Verges , Gina L. Brown-Guedira , David A. Van Sanford. 2021. Genome-Wide Association Studies Combined with Genomic Selection as a Tool to Increase Fusarium Head Blight Resistance in Wheat. Crop Breeding, Genetics and Genomics. https://doi.org/10.20900/cbgg20210007. Acknowledgement of Federal Support: YES

W Jesse Carmack, Anthony J Clark, H Jeanette Lyerly, Yanhong Dong, Gina Brown- Guedira, David Anthony Van Sanford. 2021. Optical sorter–augmented genomic selection lowers deoxynivalenol accumulation in wheat. *Crop Science*. https://doi.org/10.1002/csc2.20494 Acknowledgement of Federal Support: YES

Books or other non-periodical, one-time publications as a result of FY21 award

Report any book, monograph, dissertation, abstract, or the like published as or in a separate publication, rather than a periodical or series. Include any significant publication in the proceedings of a one-time conference or in the report of a one-time study, commission, or the like.

Identify for each one-time publication: Author(s); title; editor; title of collection, if applicable; bibliographic information; year; type of publication (book, thesis, or dissertation, other); status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).

Other publications, conference papers and presentations as a result of FY21 award

Identify any other publications, conference papers and/or presentations not reported above. Specify the status of the publication.

Gabdiel Yulfo-Soto, Franklin Machado, Aline Vieira de Barros , David Van Sanford , Emerson Del Ponte , Frances Trail, Lisa Vaillancourt. (2021). USE OF MATING-TYPE GENE DELETION MUTANTS FOR GENETIC ANALYSIS OF FUSARIUM GRAMINEARUM. Proceedings of the 2021 National Fusarium Head Blight Forum; Virtual. December 6-7, 2021. Retrieved from: https://scabusa.org/forum/2021/2021NFHBForumProceedings.pdf
Status: abstract published. Acknowledgment of Federal Support: YES

Elzbieta Szuleta, Tim Phillips, and David Van Sanford. (2021). EVALUATION OF WINTER RYE (SECALE CEREALE L.) RESISTANCE TO FUSARIUM HEAD BLIGHT IN KENTUCKY. Proceedings of the 2021 National Fusarium Head Blight Forum; Virtual. December 6-7, 2021. Retrieved from: https://scabusa.org/forum/2021/2021NFHBForumProceedings.pdf
Status: abstract published. Acknowledgement of Federal Support: YES