

FY21 Performance Progress Report

Due date: July 26, 2022

Cover Page

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Fiscal Year:	2021
USDA-ARS Agreement ID:	59-0206-0-176
USDA-ARS Agreement Title:	Accelerating the Development of FHB-Resistant Soft Red Winter Wheat Varieties
FY20 USDA-ARS Award Amount:	\$89,413
Recipient Organization:	University of Kentucky Department of Plant Science 327 Plant Science Bldg., Lexington, KY 40546-0312
DUNS Number:	939017877
EIN:	61-6033693
Recipient Identifying Number or Account Number, if any:	3200003270
Project/Grant Period:	6/1/21 - 5/31/23
Reporting Period End Date:	5/31/2022

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 Final 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

July 25, 2022

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 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 406 crosses were made during FY21 all of which involved at least one scab resistant parent. Breeding populations from F₂ through F₅ 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 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?

- We observed significant differences among breeding lines in the resistance to FHB as indicated by FHB index. We are now grinding samples to submit for mycotoxin testing.
- We obtained FHB resistance predictions for approximately 650 lines which we will consider in concert with the FHB index and mycotoxin data as we decide whether to test these lines in agronomic trials and in the scab nursery.

c) List key outcomes or other achievements.

- Identified new moderately new resistant lines
- Predicted FHB resistance was validated in some lines
- Several breeding lines were among the lowest in terms 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 3 graduate students in our breeding program have 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, Ela Szuleta presented a poster at the virtual FHB forum.

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/>) and is provided to the NFO to be posted on ScabSmart.

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 2021 and 2022 nurseries, the period covered by this grant. Unfortunately we were so short-handed in 2021 that we did not have the personnel to thresh FDK samples and send for DON, so the only data we had in 2021 was FHB rating plus genomic predictions. We plan to estimate FDK and DON in the 2022 nurseries.

c) List key outcomes or other achievements.

One key outcome is that in a year in which we had no actual DON data we did have predicted DON data which provided a real world opportunity to validate the genomic predictions.

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

The same as those listed above: students have learned how to breed for scab resistance.

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

Data were sent to the coordinators, Murphy and Sneller and results of the 2021 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 grant 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*. 6 Feb 2022. <https://doi.org/10.1094/PDIS-04-21-0891-SR>; Acknowledgment 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 Breed Genet Genom*. 2021;3(4):e210007. <https://doi.org/10.20900/cbagg20210007>; Acknowledgment 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*. 22 Feb 2021. <https://doi.org/10.1002/csc2.20494>; Acknowledgment of Federal Support: Yes

Books or other non-periodical, one-time publications as a result of FY21 grant 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).

NA

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

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

Gabriel Yulfo-Soto, Franklin Machado, Aline Vieira de Barros , David Van Sanford, Emerson Del Ponte, Frances Trail, and Lisa Vaillancourt. 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>

Elzbieta Szuleta, Tim Phillips, and David Van Sanford. 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>