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

FY21 Performance Progress Report

Due date: July 26, 2022

Cover Page

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Fiscal Year:	2021
USDA-ARS Agreement ID:	N/A
USDA-ARS Agreement Title:	PHG Analysis of FHB Resistance
FY20 USDA-ARS Award Amount:	$71,184
Recipient Organization:	USDA-ARS Hard Winter Wheat Genetics Research Unit 4008 Throckmorton Hall, 1712 Claflin Rd Manhattan, KS 66506
DUNS Number:	N/A
EIN:	N/A
Project/Grant Period:	5/1/21 - 4/30/22
Reporting Period End Date:	4/30/2022

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
TSCI	Haplotype Informed Prediction of FHB Resistance in US Wheat Breeding Programs	$71,184
	FY21 Total ARS Award Amount	$71,184

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.

07/15/2022

Principal Investigator Signature — Date Report Submitted

ǂ 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: Haplotype Informed Prediction of FHB Resistance in US Wheat Breeding Programs

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

1- Characterize diversity in 250 wheat lines (FHB resistant lines, elite breeding lines, adapted lines)
2- Create a graph-based database for imputation of breeding lines
3- Optimize GS model for FHB resistance using field generated phenotypes
4- Use BLUPs for GWAS to identify functionally relevant variants/QTL for FHB resistance
5- Identify haplotypes in QTL regions that can be used of marker assisted selection in breeding programs

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

1- Characterize diversity in 250 wheat lines (FHB resistant lines, elite breeding lines, adapted lines)

a) What were the major activities?
Great Plains breeders have supplied us with their most FHB resistant and elite breeding lines. DNA was extracted from these 270 lines and subjected to exome capture and Illumina (2x 150) paired-end sequencing.

b) What were the significant results?
Sequencing was completed in June 2022. Raw data (.fastq) has undergone quality control analysis with high quality reads aligned to the wheat genome. Alignments (.bam) are currently being run through the GATK pipeline to generate g.vcf and .vcf files for subsequent analyses.

c) List key outcomes or other achievements.
We generated nearly 3.2 billion paired-end sequencing reads totaling over 960 gigabases of data for 270 wheat accessions, which is equivalent to 22.7 million reads per accession and ~8x coverage of the wheat exome. Data is being complied and nearly ready to populate a custom FHB PHG database.

2- Create a graph-based database for imputation of breeding lines

a) What were the major activities?
Genome variant call files (g.vcf) are being generated for the 270 wheat accessions, which are the input of the graph-based database.

b) What were the significant results?
The results are in progress. The database should be built by the end of August, leading to generation of results.

c) List key outcomes or other achievements
When the database is generated, it will be capable of imputation of breeding lines sequenced at lower coverage levels.

3- Optimize GS model for FHB resistance using field generated phenotypes
4- Use BLUPs for GWAS to identify functionally relevant variants/QTL for FHB resistance

I am combining these objectives as both are dependent on phenotyping data, and currently are in the same state.

a) What were the major activities?

All 270 lines were planted in the Kansas State University FHB field nursery at Rocky Ford. Disease presented in the field this year, allowing for FHB phenotyping of incidence and severity, as well as heading date. Field season just ended and harvesting of samples was completed at the beginning of July. Currently, we are processing samples to submit for DON testing.

b) What were the significant results?

We observed a diverse range of disease severity and incidence, including roughly 25 lines with improved resistance to our moderately resistant control in the field. Data analysis of these 2022 field phenotypes is in the initial phase.

c) List key outcomes or other achievements

Phenotypes were collected and will be able to estimate BLUPs for genome-wide association analyses and to train genomic selection models. However, field phenotyping for another year needs to be incorporated, and will be essential in assessing whether results are repeatable.

5- **Identify haplotypes in QTL regions that can be used of marker assisted selection in breeding programs**

a) What were the major activities?

The final objective is dependent on processing and analysis of sequence data and phenotypic data. Sequence data is currently processing and phenotypic data is being analyzed.

b) What were the significant results?

As objectives 3 and 4 are completed, associations will be identified leading to results within this objective.

c) List key outcomes or other achievements

Results should be available by end of 2022, and presented at FHB Forum.

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

PI Jordan attended and participated in the virtual 2021 FHB Forum. Graduate student funding was included in this project and his PhD training will begin in August 2022 at Kansas State University in the Plant Pathology program.

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

Nothing to Report

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).

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).

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.

Jordan, K. (2021) Applications of the PHG Database in Wheat Breeding. *Proceedings of the 2021 National Fusarium Head Blight Forum;* Virtual. December 6-7, 2021. Retrieved from: https://scabusa.org/forum/2021/2021NFHBForumProceedings.pdf