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:	59-0206-0-161
USDA-ARS Agreement Title:	Genetic Characterization and Selection for Fusarium Head Blight Resistance in Durum Wheat
FY20 USDA-ARS Award Amount:	$39,468
Recipient Organization:	North Dakota State University Department of Plant Sciences NDSU Dept # 7670, PO Box 6050 Fargo, ND 58108-6050
DUNS Number:	80-388-2299
EIN:	45-6002439
Recipient Identifying Number or Account Number, if any:	FAR0031935
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
DUR-CP	Genomics-Assisted Recurrent Selection to Enhance FHB Resistance in Durum Wheat	$39,468
	FY21 Total ARS Award Amount	$39,468

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.

Xuehui Li
Principal Investigator Signature

6/30/2022
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: Genomics-Assisted Recurrent Selection to Enhance FHB Resistance in Durum Wheat

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1. **What are the major goals and objectives of the research project?**
   (1) Develop durum wheat germplasm with improved FHB resistance through recurrent selection.
   (2) Explore genomics-assisted recurrent selection to accelerate genetic improvement.
   (3) Develop new durum wheat lines with improved FHB resistance through introgression of resistance genes from hard red spring wheat.

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?

   Towards Objective1

   A total of 150 S_1 families of the Cycle2 population were evaluated for FHB severity at two locations, Fargo and Prosper in 2021. Top 15 families will be selected. The 150 S_1 families were also evaluated in greenhouse. Top two plants from each of the top 15 selected families were selected and their $S_{1:2}$ progenies were intercrossed in greenhouse in 2021 winter. Furthermore, the resulted hybrids were self-pollinated to get the Cycle3 population in 2022 spring. The Cycle3 population containing 134 S_1 families is being evaluated at two locations, Fargo and Prosper in 2022 summer.

   Towards Objective 2

   The 134 parents of the Cycle3 population were genotyped using 90K SNP array. Genomic selection models will be developed and validated using the genotyping data along with phenotypic data collected from the Cycle1, Cycle2, and Cycle3 populations.

   Towards Objective 3

   Top five half-sib families from our hard red spring wheat recurrent selection Cycle2 population with great FHB resistance was selected and crossed to durum wheat cultivar Riveland in 2021 winter. The resulted interspecific F_1 plants were backcrossed to Riveland in 2022 spring. A total 360 BC_1F_1 progenies from the hexaploid/tetraploid (6x/4x) crosses were evaluated for FHB resistance in greenhouse in 2022 summer. The selected BC_1F_1 progenies were self-pollinated. The BC_1F_2 progenies will be evaluated for FHB severity in greenhouse in 2022 fall. The selected BC_1F_2 plants will be self-pollinated and their BC_1F_3 progenies will be evaluated in field nurseries in 2023 summer.

   b) What were the significant results?

   Using historical FHB severity data collected from the NDSU durum wheat breeding program, an initial GS model was developed with a prediction accuracy of 0.53 for FHB severity. Using the phenotypic data and marker data collected from the durum wheat recurrent selection Cycle2 population, an initial GS model was developed with a prediction accuracy of 0.38 for FHB severity.

c) List key outcomes or other achievements.

Some durum wheat S_1 families from the recurrent selection population showed better FHB resistance than check cultivar Riveland.

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

All members of my group including graduate students and hourly students have been involved in inoculation and disease scoring in greenhouse and field nurseries. This provided them a training opportunity for phenotypic evaluation of FHB resistance.

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

The results of FHB resistance of our recurrent selection population and other germplasm were shared with wheat breeders and research scientists through personal communication and the annual FHB forum.

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).

None.

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).

None.

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.

Wang, R., J. Axtman, E. Salsman, J. Hegstad, J. Fiedler, S. Xu, S. Zhong, E. Elias, and X. Li. 2021. "Recurrent Selection to Develop Fusarium Head Blight Resistance Germplasm for Durum Wheat." In: the USWBSI Networking & Facilitation Office (Eds.), *Proceedings of the 2021 National Fusarium Head Blight Forum* (p. 85), Virtual; December 6-7. Online: https://scabusa.org/forum/2021/2021NFHBForumProceedings.pdf