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

FY22 Performance Progress Report

Due date: July 26, 2023

Cover Page

USDA-ARS Agreement ID:	59-0206-2-139
USDA-ARS Agreement Title:	Genetic Dissection and Improvement of Fusarium Head
Principle Investigator (PI):	Xuehui Li
Institution:	North Dakota State University
Institution UEI:	EZ4WPGRE1RD5
Fiscal Year:	2022
FY22 USDA-ARS Award Amount:	$39,462
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Period of Performance:	May 1, 2022 – April 30, 2026
Reporting Period End Date:	April 30, 2023

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
DUR-CP	Recurrent Selection to Improve FHB Resistance in Durum Wheat	$39,462
	FY22 Total ARS Award Amount	$39,462

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.

Xuehui Li
Principal Investigator Signature

7/2/2023
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: Recurrent Selection to Improve FHB Resistance in Durum Wheat

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1. **What are the major goals and objectives of the research project?**
   Objective 1. Develop durum wheat germplasm with improved FHB resistance through recur rent phenotypic selection.
   Objective 2. Explore genomicsa assisted recurrent selection to accelerate genetic improvement.
   Objective 3. Develop new durum wheat lines with improved FHB resistance through introgr ession 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 Objective 1
   A total of 136 $S_{0:1}$ lines of the Cycle3 population were evaluated for FHB severity at locati ons, Fargo and Prosper in 2022. Top 15 lines will be selected. A total of 150 remnant seeds (10 seeds from each of the top 15 selected lines) were planted and intercrossed in greenhouse in 2022 winter. The resulted hybrids were selfa pollinated to get the Cycle4 population in 2023 spring. The Cycle4 population containing 194 $S_{0:1}$ lines is being evaluated at two locations, Fargo and Prosper in 2023 summer.

   Towards Objective 2
   A total of 192 S_0 parents of the Cycle4 population were genotyped using 40K SNP array.

   Towards Objective3
   Top two halfa sib families from our hard red spring wheat (HRS) recurrent selection Cycle3 population with great FHB resistance was selected and crossed to durum wheat cultivar ND Riveland in 2022 winter. The resulted interspecific F1 plants were backcrossed to Riveland in 2023 spring. A total 525 BC_1F_1 progenies from the hexaploid/ tetraploid crosses (HRSa RSC3/Riveland) are being evaluated for FHB resistance in greenhouse in 2023 summer. A total of 50 $BC_1F_{3:4}$ progenies derived from the interspecific crosses between top lines selected from HRS recurrent selection Cycle1 population and ND Riveland (HRSa RSC1/Riveland) are being evaluated in field nurseries in 2023 summer.

   b) **What were the significant results?**
   Objective1
   Five $S_{0:1}$ lines from the Cycle3 population were identified with significant lower FHB seve rity than the check cultivar ND Riveland.

Objective2

Prediction models for FHB severity, plant height, and daysa toa flowering were developed and validated using the Cycle2 and Cycle3 populations. The models will be updated by adding the Cycle4 population in 2023.

Objective3

A total of six $BC_1F_{3:4}$ lines from the interspecific crosses (HRSa RSC1/Riveland) were identified with significant lower FHB severity than the check cultivar ND Riveland.

c) List key outcomes or other achievements.

Objective1

Four of the five $S_{0:1}$ lines from the Cycle3 population with lower FHB severity than ND Riveland did not taller than ND Riveland nor flower later than ND Riveland. Their S_1 progenies are being evaluated for FHB severity in greenhouse using the remnant seeds. After greenhouse screening, promising progeny lines will be evaluated in field nursery in 2024 to identify desirable inbred lines.

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

All 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. Graduate students were also trained for marker genotyping and genomic prediction modeling.

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. A manuscript was submitted to the journal Crop Science.

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 FY22 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 May 1, 2022 – April 30, 2023?

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

☐ No, I have nothing to report.

Journal publications as a result of FY22 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 FY22 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 FY22 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. (2022). Recurrent Selection for Fusarium Head Blight Resistance in Durum Wheat Population. *Proceedings of the 2022 National Fusarium Head Blight Forum*: Tampa, FL. December 4-6, 2022. Retrieved from: https://scabusa.org/forum/2021/2021NFHBForumProceedings.pdf