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

FY21 FINAL Performance Progress Report

Due date: July 26, 2023

Cover Page

USDA-ARS Agreement ID:	59-0206-0-156
USDA-ARS Agreement Title:	Characterization of Resistance to Fusarium Head Blight in Wheat and its Relatives
Principle Investigator (PI):	Shaobin Zhong
Institution:	North Dakota State University
Institution UEI:	EZ4WPGRE1RD5
Fiscal Year:	2021
FY21 USDA-ARS Award Amount:	$143,406
PI Mailing Address:	North Dakota State University, Department of Plant Pathology NDSU Dept. # 7520, PO Box 6050 Fargo, ND 58108-6050
PI E-mail:	shaobin.zhong@ndsu.edu
PI Phone:	701-231-7427
Period of Performance:	5/15/21 - 5/14/23
Reporting Period End Date:	5/14/2023

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
DUR-CP	Introgression and Characterization of Hexaploid-Derived FHB Resistance Genes in Durum	$72,703
VDHR-SPR	Enhancing Resistance of Spring Wheat to FHB using Alien Species	$70,703
	FY21 Total ARS Award Amount	$143,406

I am submitting this report as a: ☒ 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.

Shaobin Zhong
Principal Investigator Signature

07/24/2023
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: Introgression and Characterization of Hexaploid-Derived FHB Resistance Genes in Durum

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1. **What are the major goals and objectives of the research project?**
   The major goals of this project was to develop durum germplasm with improved FHB resistance. The specific objectives of this project are to: 1) Characterize inheritance of the hexaploid-derived FHB resistance genes in durum background and understand the effect of D-genome chromosomes on FHB resistance; 2) Incorporate hexaploid wheat-derived FHB resistance genes into durum for germplasm development; and 3) Develop and validate the molecular markers tagging FHB resistance QTL in the durum germplasm.

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?**
   - Increased generations for RIL population development.
   - Evaluated RIL population for FHB resistance in the greenhouse.
   - Genotyping of the RIL populations.
   - Evaluated durum introgression lines for FHB resistance in the field nursery.
   - Performed marker-assisted introgression of *Fhb7* into adapted durum varieties.

   b) **What were the significant results?**
   - Early generations of RIL populations.
   - FHB evaluation data and 90K SNP genotyping data of the RIL populations.
   - DNA markers specific for *Fhb7* in durum backgrounds.
   - *Fhb7* introgression lines.

   c) **List key outcomes or other achievements.**
   - RIL populations for mapping and breeding.
   - *Fhb7*-specific markers.
   - Genotyping phenotyping data of the RIL populations.
   - Durum germplasm lines with potential FHB resistance.

3. **What opportunities for training and professional development has the project provided?**
   One postdoc and several undergraduate students participated in this project and received training in FHB inoculation, evaluation, DNA marker development, and MAS.

4. **How have the results been disseminated to communities of interest?**
   Research results from this project have been presented in the National FHB Forum and will be published in scientific journals.

Project 2: Enhancing Resistance of Spring Wheat to FHB using Alien Species

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1. **What are the major goals and objectives of the research project?**
   The major goals were to identify and produce wild relative-derived wheat materials with FHB resistance and to incorporate alien resistance genes into wheat for germplasm development. The specific objectives of this project were to: 1) Identify alien species-derived FHB resistance genes and incorporate them into the wheat genome; 2) Map the alien chromatin containing FHB resistance genes incorporated into the wheat genome and minimize linkage drag associated with resistance genes; and 3) Develop breeding-friendly spring wheat germplasm with FHB resistance and associated molecular markers for MAS.

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

   d) What were the major activities?
   - Made crosses and backcrosses to introgress *Fhb7* into adapted HRSW.
   - Developed *Fhb7*-specific STS and KASP markers.
   - Performed MAS in *Fhb7* introgression toward germplasm development.

   di) What were the significant results?
   - User-friendly PCR-based markers highly diagnostic for *Fhb7*, which are extremely useful in MAS introgression and breeding.
   - HRSW germplasm containing *Fhb7* and recovered adapted HRSW backgrounds.

   dii) List key outcomes or other achievements.
   - DNA markers useful in breeding for FHB resistance
   - FHB-resistant HRSW germplasm

3. **What opportunities for training and professional development has the project provided?**
   One postdoc and several undergraduate students participated in this project and received training in FHB inoculation, evaluation, DNA marker development, and MAS.

4. **How have the results been disseminated to communities of interest?**
   Research results from this project have been presented in the National FHB Forum and will be published in scientific journals.

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).

Zhang, W., Danilova, T., Zhang, M., Ren, S., Zhu, X., Zhang Q., Zhong, S., Dykes, L., Fiedler, J., Xu, S., Frels, K., Wegulo, S., Boehm Jr., J., Cai, X. 2022. Cytogenetic and genomic characterization of a novel tall wheatgrass-derived Fhb7 allele integrated into wheat B genome. Theor. Appl. Genet.135: 4409–4419. https://doi.org/10.1007/s00122-022-04228-3
Status of publication: published. Acknowledgment of federal support: yes.

Zhu, X, Boehm, J.D. Jr, Zhong, S., Cai, X. 2022. Genomic compatibility and inheritance of hexaploid-derived Fusarium head blight resistance genes in durum wheat. The Plant Genome. 2022 Mar 1:e20183. doi: 10.1002/tpg2.20183. Epub ahead of print. PMID: 35229982. Status of publication: published. 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.