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

FY22 Performance Progress Report

Due date: July 26, 2023

Cover Page

USDA-ARS Agreement ID:	59-0206-2-108
USDA-ARS Agreement Title:	Wheat Crop Improvement for Fusarium Head Blight (FHB) Resistance by Cytogenetics
Principle Investigator (PI):	Dalhoe Koo
Institution:	Kansas State University
Institution UEI:	CFMMM5JM7HJ9
Fiscal Year:	2022
FY22 USDA-ARS Award Amount:	$38,760
PI Mailing Address:	1712 Claflin Road Department of Plant Pthology Manhattan, KS 66506
PI E-mail:	dkoo@ksu.edu
PI Phone:	785-532-2768
Period of Performance:	May 1, 2022 – April 30, 2024
Reporting Period End Date:	April 30, 2023

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	New Sources of Resistance to FHB and DON in Wheat	$38,760
	FY22 Total ARS Award Amount	$38,760

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.

Principal Investigator Signature

07/21/2023
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: New Sources of Resistance to FHB and DON in Wheat

---

1. **What are the major goals and objectives of the research project?**
   The major goal of the project is to identify new source of FHB resistance. The objectives of the project are 1) Detection of alien introgressions in HSD2-32 and 2) Identification of genetic markers linked to FHB resistant loci in HSD2-32.

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?

   Objective 1: Genomic DNA of wild wheat relatives such as *Secale cereale* (RR), *Thinopyrum ponticum* (JJJJJJJ^{s}J^{s}J^{s}J^s), *Dassypyrum villosum* (VV), and *Pseudoroegneria spicata* (S^{t}S^t) were used as probes to detect alien introgression in HSD2-32 by pachytene GISH.

   Objective 2: Genotyping-by-sequencing (GBS) method was used to genotype the F_2 population along with their parents (HSD2-32 and Chinese Spring wheat). Phenotyping of F_2 and contrasting F_3 population was done using point inoculation method following standard procedure. The contrasting F_3 population was genotyped with the KASP markers that are linked with the putative FHB resistance QTLs.

   b) What were the significant results?

   1. Detection of alien introgressions in HSD2-32

   HSD2-32 (2n=42) is FHB resistant and it is derived from the cross involving Ganmei8 (*Trielytrigia* 2n=56, AABBDDEE) and *Thinopyrum intermedium* (2n=42, JJJ^{s}J^{s}SS). However, the exact pedigree information of HSD2-32 is unavailable. GISH using total genomic DNA of *Thinopyrum elongatum* and/or *Th. intermedium* as probes and skim-seq analysis did not detected any *Thinopyrum* introgressions in HSD2-32. However, HSD2-32 had sizable regions in chromosome arms 2DL, 5BL, and 6AS which are not able to map to the wheat reference genome. This gives us a clue that HSD2-32 may have introgressions from other wheat relatives conferring FHB resistance which further needs cytological characterization of HSD2-32.

   2. Identification of genetic markers linked to FHB resistant loci in HSD2-32

   Identification of genetic markers associated with FHB resistant loci in HSD2-32 was done using F_2 population derived from the cross between Chinese Spring wheat and HSD2-32. The putative candidate loci conferring FHB resistance was given in Table 1. Around 54 markers were designed covering all the putative positions, out of which 8 chromosome specific markers were selected in 2D and 4A chromosomes spanning the QTL region for validation of the QTLs. Out of 8 markers 4 markers showed parental polymorphism between Chinese Spring wheat and HSD2-32. Out of four markers Only one SNP marker in Chr2D (Chr2D_627128588) segregates in 3:1 ratio and hence validated (Fig 1).

Table1. Putative candidate loci conferring FHB resistance identified using the F2 population derived Chinese Spring and HSD2-32

Wheat Ch. No.	Position (cM)	LOD	PVE (%)	Add	Dom
2D	629.7	3.7969	9.0667	0.1961	3.9408
4A	45.99	3.3544	4.3105	0.9865	-1.295
4A	692.99	4.8402	12.0483	0.0389	5.3667
4B	172.14	3.6907	6.032	1.2405	-1.4174
4D	496.24	3.3928	4.4294	-0.4062	-1.9039
7A	52.23	4.2488	6.6896	1.7118	-1.2696
7A	180.23	3.2742	9.5815	1.7719	-2.048
7A	719.23	4.0034	6.8826	-1.4095	-1.639

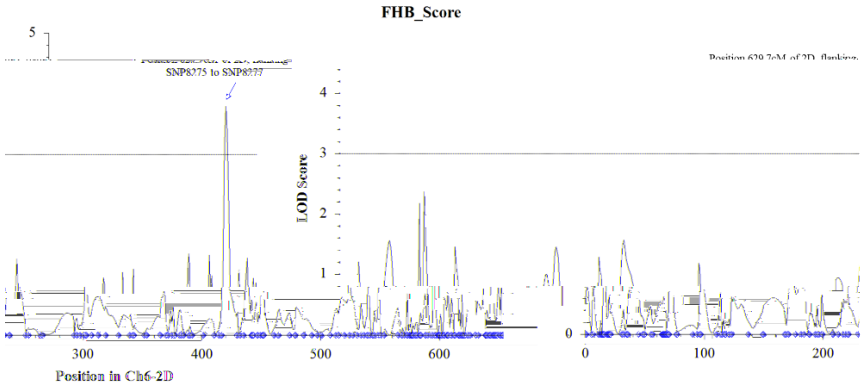

Fig 1. Position of validated QTL in the Chromosome 2D of wheat

c) List key outcomes or other achievements.

1) Identification and characterization of novel sources of FHB resistance in HSD2-32.
2) One SNP marker at 627128588 bp in Chr2D was linked with a QTL region (628574465 – 633228046 bp) segregates in 3:1 ratio and hence validated.
3) The identified genetic marker enables the transfer of FHB resistance from HSD2-32 line to elite winter wheat cultivars.

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

The PI of this project trained Metin Tuna, Faculty at Namik Kemal University, Turkey and Izamar Olivas Orduna, PhD student at KAUST (King Abdullah University of Science and Technology), Thuwal, Makkah, Saudi Arabia in cytology and provide hands on experience to them in various cytogenetic techniques.

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

The results of this project were presented in the USWBSI HWW-CP Spring Update Meeting 2023.

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.

X 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).

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).

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.