FY22 Performance Progress Report

Due date: July 26, 2023

Cover Page

USDA-ARS Agreement ID:	59-0206-2-118
USDA-ARS Agreement Title:	Breeding Spring Wheat for Fusarium Head Blight (FHB) Resistance in South Dakota
Principle Investigator (PI):	Karl D. Glover
Institution:	South Dakota State University
Institution UEI:	DNZNC466DGR7
Fiscal Year:	2022
FY22 USDA-ARS Award Amount:	$126,393
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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
VDHR-SPR	Spring Wheat Breeding for Scab Resistance in South Dakota	$126,393
	FY22 Total ARS Award Amount	$126,393

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.

_____ June 25, 2023 _____

Principal Investigator Signature　　　　　　　　　Date Report Submitted

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[‡] 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: Spring Wheat Breeding for Scab Resistance in South Dakota
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1. **What are the major goals and objectives of the research project?**

   The overall goal is to mitigate losses caused by FHB to HRSW growers and end-users. Several interrelated activities associated with FY22 VDHR-SPR Research Priorities 1, 2, and 3 were carried out to achieve the overall goal. VDHR priority 1 aimed to increase acreage planted with varieties with improved FHB resistance to reduce DON in the US grain supply. Priorities 2 and 3 were carried out to increase efficiency of coordinated project breeding programs in developing and releasing FHB resistant varieties, and develop new breeding technologies and germplasm to further enhance short and long term improvement of FHB resistance and to efficiently introgress effective resistance genes into breeding 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?**

   Goal 1 - Participated in multi-location regional screening efforts (i.e., Uniform Regional Scab Nursery, as well as phenotyping of released cultivars, mapping, and other experimental populations created by colleagues, etc).
   Goal 2 – Collected data from USDA-ARS genotyping center in Fargo, ND, our own mist-irrigated and inoculated FHB nurseries, and submitted samples for DON testing.
   Goal 3 - Utilized FHB resistance phenotypes collected from our screening nurseries, and molecular marker data, to identify sources of FHB / DON resistance of potential releases and breeding parents.

   b) **What were the significant results?**

   Goal 1 - Phenotypic data was collected for entries within the Uniform Regional Scab Nursery, as well as among released cultivars available to South Dakota and regional producers.
   Goal 2 – Marker genotype, resistance phenotype, and DON concentration data were accumulated for 48 Advanced and 72 Preliminary yield trial entries.
   Goal 3 - Marker genotype and resistance phenotype data were collected on approximately 350 F_2 and 300 F_4 segregating populations.

   c) **List key outcomes or other achievements.**

   Goal 1 - Phenotypic data was utilized within this breeding program, shared with colleagues, and data pertaining to released cultivars was made available to regional producers through Extension publications / presentations.
   Goal 2 - Data were used to identify experimental lines which possessed the highest levels of FHB resistance, best agronomic potential, and also the highest levels of end-use

quality for further consideration as future cultivar releases and as parents in population development activities.

Goal 3 - A greater number of selections were made from within segregating populations with the highest levels of resistance which, in future years, should increase the frequency and resistance levels of lines available in the breeding program for consideration as cultivar releases as well as use as parents for population development.

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

Undergraduate and graduate students assist with collecting FHB resistance data from screening nurseries. Additionally, the same students assist with collecting Fusarium damaged kernel scores and help prepare samples for DON analysis.

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

FHB resistance data collected on released cultivars was made available to growers as a part of the annual South Dakota Crop Performance Testing Hard Red Spring Wheat report and selection guide. This document is made available online as well as in print. Additionally, abridged copies from the previous crop year are available at producer field days each year and FHB resistance levels are routinely points of discussion at the same field days. Data collected for breeding program colleagues, such as Uniform Regional Scab Nursery observations, are provided in the annual report to the nursery coordinator who then makes data available to all participants. Likewise, data collected for other colleagues are emailed once completed.

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?

X   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).

Glover K. D., J. L. Kleinjan, C. Graham, S. Ali, Y. Jin, J. A. Ingemansen, E. B. Turnipseed, and L. Dykes. 2023. Registration of 'Ascend-SD' Hard Red Spring Wheat. Journal of Plant Registrations. (Accepted, awaiting publication – acknowledgement of federal support = YES).

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.

Dalitso N. Yabwalo, Shaukat Ali, Karl Glover, Connie Tande and Madalyn Shires. (2022). Management of Fusarium Head Blight with Demethylation Inhibitors and Succinate Dehydrogenase Inhibitors Combinations under High Disease Pressure in Spring Wheat. P*roceedings of the 2022 National Fusarium Head Blight Forum*; Tampa, FL. December 4-6, 2022. Retrieved from: https://scabusa.org/forum/2022/2022NFHBForumProceedings.pdf

Ahmed Abdalla, Babak Azad, Karl Glover, Sunish Kumar Sehgal, Shaukat Ali, Kwanghee Won, and Ali Mirzakhani Nafchi. (2022). FHB Stage Detection, Deep Scanning Robot. *Proceedings of the 2022 National Fusarium Head Blight Forum*; Tampa, FL. December 4-6, 2022. Retrieved from: https://scabusa.org/forum/2022/2022NFHBForumProceedings.pdf

Babak Azad, Ahmed Abdalla, Karl Glover, Sunish Kumar Sehgal, Shaukat Ali, Kwanghee Won, and Ali Mirzakhani Nafchi. (2022). Large-scale Wheat-FHB Disease Analysis with Deep Neural Networks. *Proceedings of the 2022 National Fusarium Head Blight Forum*; Tampa, FL. December 4-6, 2022. Retrieved from: https://scabusa.org/ forum/2022/2022NFHBForumProceedings.pdf

Ali Mirzakhani Nafchi, Ahmed Abdalla, Babak Azad, Karl Glover, Sunish Kumar Sehgal, Shaukat Ali, and Kwanghee Won. (2022). Improving Wheat Breeding Process Efficiency, Utilizing AI and Deep Scanning Model. *Proceedings of the 2022 National Fusarium Head Blight Forum*; December 4-6, 2022. Retrieved from: https://scabusa.org/forum/2022/2022NFHBForumProceedings.pdf

Anshul Rana, Jyotirmoy Halder, Jinfeng Zhang, Subash Thapa, Dinesh K. Saini, Harsimardeep Gill, Julie Thomas, Jonas Klein, Shaukat Ali, Maitiniyazi Maimaitijiang, Karl Glover, and Sunish K. Sehgal. (2022). Artificial Intelligence-based Detection and Sorting of Fusarium Damaged Kernels in Wheat and Implications for FHB Resistance Breeding. *Proceedings of the 2022 National Fusarium Head Blight Forum*; December 4-6, 2022. Retrieved from: https://scabusa.org/forum/2022/2022NFHBForumProceedings.pdf

Dinesh Kumar Saini, Anshul Rana, Maitiniyazi Maimaitijiang, Jyotirmoy Halder, Jinfeng Zhang, Subash Thapa, Shaukat Ali, Karl Glover, and Sunish K. Sehgal. (2022). Prediction of DON Content in Wheat Flour Using Close-Range Hyperspectral Imaging Coupled with Machine and Deep Learning Approaches. P*roceedings of the 2022 National Fusarium Head Blight Forum*; December 4-6, 2022. Retrieved from: https://scabusa.org/forum/2022/2022NFHBForumProceedings.pdf