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

# FY22 Performance Progress Report

**Due date:** July 26, 2023

## Cover Page

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| **USDA-ARS Agreement ID:** | 59-0206-2-129 |
| **USDA-ARS Agreement Title:** | Regional Screening Nurseries - Kansas |
| **Principle Investigator (PI):** | Jessica Rupp |
| **Institution:** | Kansas State University |
| **Institution UEI:** | CFMMM5JM7HJ9 |
| **Fiscal Year:** | 2022 |
| **FY22 USDA-ARS Award Amount:** | $68,047 |
| **PI Mailing Address:** | Kansas State University, Department of Plant Pathology<br>4024 Throckmorton,<br>Manhattan, KS 66506-5500 |
| **PI E-mail:** | jrupp@ksu.edu |
| **PI Phone:** | 785-532-1378 |
| **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 |
|---|---|---|
| HWW-CP | Development of Scab Resistant Cultivars for Kansas | $68,047 |
| | **FY22 Total ARS Award Amount** | $68,047 |

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.*

DN: cn=Jessica L. Shoup Rupp, o=Kansas State University, ou=Department of Plant Pathology, email=jrupp@ksu.edu, c=US
Date: 2023.07.25 08:31:23 -05'00'

Principal Investigator Signature

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:** Development of Scab Resistant Cultivars for Kansas

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1. **What are the major goals and objectives of the research project?**
   The purpose of this research is to aid in the development of hard red and white winter wheat cultivars adapted for Kansas and the Great Plains region with improved resistance to scab. The short-term objectives of this research are to 1) test existing local cultivars for their reaction to scab, 2) test advanced breeding lines for reaction to scab, 3) test exotic germplasm lines for reaction to scab, 4) test the public Hard Winter Wheat (Kansas, Nebraska, South Dakota, North Dakota, Montana, Oklahoma, Texas) Nursery and the private (BASF, Bayer, LimaGrain, and Syngenta) for reaction to scab, and 5) incorporate newly identified sources of scab resistance into the KS wheat breeding program. This particular project is wheat pathology-based and works in heavy coordination with breeders across the region to do a blind field evaluation of cultivars

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?**
   The following activities regarding evaluation were completed: 1) Hard Winter Wheat FHB Nursery: 15 entries each (120 total) from FHB breeding programs in Kansas, Nebraska, Oklahoma, Colorado, Texas, South Dakota, Montana, and North Dakota were evaluated. Check cultivars were added to the above entries; Everest (moderately resistant), Karl 92 (intermediate), and Overley (susceptible). The Northern Nursery uses checks Emerson (R-MR) and Flourish (susceptible.) 2) Private Breeder Winter Wheat FHB Nursery: 15 entries (60 total) from four major private wheat breeding programs in the region. Three check cultivars will be added to the above entries; Everest (moderately resistant), Karl 92 (intermediate and grain quality), and Overley (susceptible). 3) Kansas Commercial Cultivar FHB Nursery: 15-25 common Kansas commercial cultivars. 4) Kansas Intrastate FHB Nursery: 30 advanced breeding lines from wheat breeders at Kansas State University. 5) Wheat Breeding FHB Nurseries: Additional breeding material, mostly involving populations for recurrent selection, from Dr. Allan Fritz' wheat breeding programs. 6) Response to Fungicide: Advanced Yield Nursery x Fungicide was added due to a request from the EC. These lines were evaluated for their response to control of FHB by foliar fungicides. This experiment will utilize 5' by 15' plots for yield determinations. 7) These nurseries were planted each fall. They were inoculated using corn spawn inoculum, heading date was recorded and all entries were evaluated throughout season. Plots were harvested for FDK and DON analysis.

   b) **What were the significant results?**
   Until involvement in the USDA Scab Initiative, there was little effort to identify sources of scab resistance in Kansas breeding programs. The Initiative has resulted in the development of accurate and efficient field testing nurseries that are providing useful ratings for current cultivars in Kansas and advanced breeding lines. This screening effort now includes entries from winter wheat breeding programs throughout the Great Plains region. The long-term goal of the research is to develop, deploy, and advertise winter wheat cultivars adapted for Kansas with improved levels of resistance to scab.

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

In 2009, Kansas State University released the first hard red winter wheat cultivar adapted to Kansas selected for improved levels of resistance to scab. This variety "Everest" is still a top variety in KS representing more than 60% of the acres planted in regions of the state most prone to FHB. KSU released a new variety, Zenda, with moderate levels of resistance to FHB in 2016, several private breeding programs have also released varieties with improved resistance to FHB including Bob Dole, WB4269, WB4699 and SY Benefit. The screening nurseries supported by the USWBSI were essential in the development of these varieties. In 2021 KS Ahern, with a moderate response to FHB was released. Additionally, three key lines with exceptionally high levels of resistance have been identified carrying quantitative resistance and will continue in the breeding program. These lines, collectively, KS16FHB0211 carry resistance, currently suspected to be 2-3 genes that result in phenotypes with 20% greater resistance than the MR check. These varieties have all been evaluated in our nursery. A key additional component is that these have been evaluated for their response to fungicide as well. Three varieties that have been screened in the nursery have been released including KS Territory, KS Big Bow, and KS Providence.

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

The FHB screening nursery provided training opportunities for 4 graduate students and 8 undergraduates within the Applied Wheat Pathology Lab to gain hands-on experience in the operation and rating of these multi-disciplinary projects. Students are involved in every aspect of the project from planting, harvesting and processing the diseased grain. Additionally, the FHB nursery was a tour stop for the annual wheat tour hosted by Dr. Allan Fritz and attended by many researchers. The scab nursery also was used during K- State's REU (research experience for undergraduates.) Eight students from across the US toured the nursery and learned about FHB and phenotyping. This nursery was also toured by numerous guests, including those from the Gates Foundation and NSF, as well as during Rocky Ford's public field day.

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

Reports of the phenotyping nurseries are sent to all cooperating breeding programs as both preliminary results and full results. Information about current wheat varieties is released via KSU extension publications "Wheat Variety Disease and Insect Ratings, 2022" and "Kansas Performance Tests with Winter Wheat Varieties". Both publications are available as "hard copy" or online. plant disease management reports were also published. These results are available through the Plant Management Network.

# 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).

Journal publications submitted, but not yet published:

1. Bian, R., Liu, N., Xu, Y., Su, Z., Chai, L., Bernardo, A., St. Amand, P., Fritz, A., Zhang, G., Rupp, J.L., Akhunov, E., Jordan, K., and Bai, G., Quantitative trait loci for rolled leaf trait in a wheat EMS mutant from Jagger, TAAG-D-22-00551, Theoretical and Applied Genetics. Submitted August 17, 2022.
2. Yuzhou Xu[a], Yaoguang Li[a,b], Ruolin Bian[a], Allan K. Fritz[a], Guorong Zhang[a], Yanhong Dong[c], Lanfei Zhao[a], Yunfeng Xu[a,d], Nida Ghori[a,e], Amy Bernardo[f], Paul St. Amand[f], Jessica L. Shoup Rupp[g], Myron Bruce[g], Wei Wang[g], Eduard Akhunov[g], Brett Carver[h] and Guihua Bai[f,a*] Genetic architecture of quantitative trait loci (QTL) for FHB resistance and agronomic traits in a hard winter wheat population.

## 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.

**Technical Reports Published with Acknowledgement of Support**

1. Zhang, G., Martin, T.J.; Fritz, A.K., Li, Y., Seabourn, B.W., Chen, R.Y., Bai, G., Bowden, R., Chen, M., **Rupp, J.L.S**., Jin, Y., Chen, X., Kolmer, J., Marshall, D., (2022) Registration of 'KS Hamilton' Hard Red Winter Wheat, Journal of Plant Registrations, manuscript ID is JPR-2021-04-0040-CRC.R1.
2. Mangel, D.,** Davis, M., Bruce, M., Fritz, A., and **Rupp, J.L.,** (2022b) Reaction of Kansas Interstate Nursery winter wheat accessions to Fusarium head blight, 2020. Plant Disease Management Report (PDMR), 16:CF076
3. Mangel, D.,** Davis, M.A., Bruce, M.A., **Rupp, J.L.,** Carver, B., Ibrahim, A., and Rudd, J., (2022c) Reaction of Oklahoma and Texas winter wheat accessions to Fusarium head blight, 2020. Plant Disease Management Report (PDMR), 16:CF075

**Conference Presentations given with Acknowledgement of Support**

1. **Dahal, A., **** Bruce, M., Turner, K., and Rupp, J. (2022). Fungal Species Associated with Kernza. Proceedings of the 2022 National Fusarium Head Blight Forum; Tampa, FL. December 4-6, 2022. Retrieved from: https://scabusa.org/forum/2022/2022NFHBForumProceedings.pdf
2. **Tibadki, L.,**** Bai, G., Rupp, J., and Jordan, K., Haplotype-Informed Prediction of Fusarium head blight resistance in USA wheat breeding programs. Proceedings of the 2022 National Fusarium Head Blight Forum; Tampa, FL. December 4-6, 2022. Retrieved from: https://scabusa.org/forum/2022/2022NFHBForumProceedings.pdf
3. **Dahal, A.,**** Bruce, M., Turner, K., Rupp J., (2022). Molecular and Morphological Characterization of Fusarium species in Kernza. Plant Health 2022, The American Phytopathological Society,August 6-10, 2022, Pittsburgh, PA.
4. **Davis, D.,**,** Dahal, A., Bruce, M., Davis, M.A., and Rupp, J.L., (2022) Analysis of isolates of Fusarium head blight collected from Kansas, Summer Undergraduate Research Showcase, July 28, 2022, Manhattan, KS.
5. **Dahal, A.,**** Bruce, M., Turner, K., Rupp J., (2022). Molecular and Morphological Characterization of Fusarium spp. found in Kernza. Kernza Conference Lightning Talk, Kernza Meeting, Salina, KS 2022.
6. **Dahal, A.,**** Bruce, M., Turner, K., Rupp J., (2022). Molecular and Morphological Characterization of Fusarium spp. found in Kernza. Student Poster Presentation, Kernza Meeting 2022, Salina, KS
7. **Rupp, J.,** (2022). Applied Wheat Pathology at Kansas State University, Farm Bureau Annual Wheat Advisory Meeting, February 24, 2022.

**Extension Publications with Contributions of Data**

Extension Publications: Lingenfelser, J., Auld, A., Davis, H., De Wolf, E., Fritz, A., Knapp, M., Lollato, R., Whitworth, J., Winne, S., Adee, E., Esser, A., Kimball, J., Larson, M., Haag, L., Mengarelli, L., Sassenrath, G., Schlegel, A., Seaman, C., Zhang, G., Knopf, J. and Bohnert, C. 2021. Wheat Performance Tests with Winter Wheat Varieties: Report of Progress. Kansas Agricultural Experiment Station; No.1151. Status: Published Acknowledgement of Federal Support: No, (not generally done for this type of publication)

Andersen Onofre, K., De Wolf, E.D., Lollato, R. and Whitworth, J. R. 2022. Wheat variety disease and insect ratings, 2021. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. Pub. No. MF991.

Andersen Onofre, K., De Wolf, E.D. 2022. Foliar fungicide efficacy ratings for wheat disease management, 2021. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. Pub. No. EP130