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:	59-0206-0-154
USDA-ARS Agreement Title:	Development of Scab Resistant Cultivars for Kansas
Principle Investigator (PI):	Jessica Rupp
Institution:	Kansas State University
Institution UEI:	CFMMM5JM7HJ9
Fiscal Year:	2021
FY21 USDA-ARS Award Amount:	$67,785
PI Mailing Address:	Kansas State University, Department of Plant Pathology 4024 Throckmorton, Manhattan, KS 66506-5500
PI E-mail:	jrupp@k-state.edu
PI Phone:	785-532-1378
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
HWW-CP	Development of Scab Resistant Cultivars for Kansas	$67,785
	FY21 Total ARS Award Amount	$67,785

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.

DN: cn=Jessica L. Shoup Rupp, o=Kansas State University, ou=Department of Plant Pathology, email=jrupp@ksu.edu, c=US
Date: 2023.07.24 09:31:39 -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 aim 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.

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.

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

The FHB screening nursery provided training opportunities for 4 graduate students and 5 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, harvest 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.) Twelve students from across the US toured the nursery and learned about FHB and phenotyping.

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, 2021" and "Kansas Performance Tests with Winter Wheat Varieties". Both publications are available as "hard copy" or online. Thirteen 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 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?

X 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).

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. 2021. Wheat variety disease and insect ratings, 2021. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. Pub. No. MF991. Status: Published Acknowledgement of Federal Support: No (not generally done for this type of publication)

Andersen Onofre, K., De Wolf, E.D. 2021. Foliar fungicide efficacy ratings for wheat disease management, 2021. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. Pub. No. EP130. Status: Published Acknowledgement of Federal Support: No (not generally done for this type of publication) Technical Reports: Status: Published Acknowledgement of Federal Support: Yes

Mangel, D., Bruce, M., Davis, M., Fritz, A., Zhang, G., and Rupp, J.L., (2021) Reaction of Kansas Intrastate Nursery winter wheat accessions to Fusarium head blight, 2020. Plant Disease Management Report (PDMR). CF178. Status: Published Acknowledgment of Federal Support: Yes

Ranabhat, N., Bruce, M., Davis, M., Baenzinger, P.S., Wegulo, S., Halley, S., and Rupp, J.L., (2021) Reaction of Kansas, Colorado, and Nebraska winter wheat accessions to Fusarium head blight (FHB), 2020. Plant Disease Management Report (PDMR). CF207 Status: Published Acknowledgment of Federal Support: Yes

Mangel, D., Bruce, M., Davis, M., Carver, B., Rudd, J., Ibrahim, A., and Rupp, J.L., (2021) Reaction of Oklahoma and Texas winter wheat accessions to Fusarium head blight, 2020. Plant Disease Management Report (PDMR). CF205. Status: Published Acknowledgment of Federal Support: Yes

Beyer, N., Bruce, M., Davis, M., Seghal, S., Marias, G., Cook, J., Bruckner, P., and Rupp, J.L., (2021) Reaction of Montana, North Dakota, and South Dakota winter wheat cultivars to Fusarium head blight (FHB), 2020. Plant Disease Management Report (PDMR). CF206. Status: Published Acknowledgement of Federal Support: Yes

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., Registration of 'KS FY21 Hamilton' Hard Red Winter Wheat, Journal of Plant Registrations, manuscript ID is JPR 2021-04-0040-CRC.R1. Status: 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.

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.

Proceedings:
Dahal, A., Treffler, L., Turner, K., and J. Rupp, "Evaluating Kernza for resistance to FHB," 2021 Kernza Conference, Salina, KS. April 21-23, 2021. Acknowledgement of Federal Support: Yes