

FY21 Performance Progress Report

Due date: July 26, 2022

Cover Page

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Fiscal Year:	2021
USDA-ARS Agreement ID:	59-0206-0-133
USDA-ARS Agreement Title:	Breeding and Genomic Selection for Fusarium Head Blight Resistance in Spring Wheat
FY20 USDA-ARS Award Amount:	\$144,876
Recipient Organization:	University of Minnesota Department of Agronomy and Plant Genetics 411 Borlaug Hall, 1991 Upper Buford Circle St. Paul, MN 55108
DUNS Number:	555917996
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Recipient Identifying Number or Account Number, if any:	CON000000086283
Project/Grant Period:	5/13/21 - 5/12/23
Reporting Period End Date:	5/12/2022

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-SPR	Breeding Fusarium Head Blight Resistant Spring Wheat	\$144,876
FY21 Total ARS Award Amount		\$144,876

I am submitting this report as an: Annual Report 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.



Principal Investigator Signature

June 16, 2022

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: Breeding Fusarium Head Blight Resistant Spring Wheat

1. What are the major goals and objectives of the research project?

1. Develop Fusarium head blight resistant wheat germplasm and varieties adapted for commercial production in Minnesota and the surrounding region.
2. Characterize the level of FHB resistance of all wheat varieties grown in the region.
3. Utilize genomic selection to improve the efficiency of identifying and discarding FHB susceptible lines.

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?

Objectives 1-2: Scab nurseries were established at two field sites, Crookston and St. Paul, in 2021. A total of 1,300 genotypes + checks were evaluated in 1 to 3 replications for a total of 3,488 plots across the two locations. We evaluated the FHB reaction of external germplasm from the 2021 Uniform Regional Scab Nursery (28 lines) and 2021 Regional Performance Nursery (28 lines) and 39 named varieties in our statewide performance trials. We completed Visual Scabby Kernel (VSK) assessment of all materials from these nurseries and received DON data from select materials, predominantly the most advanced nurseries. FHB ratings (1-9 scale) were assigned to all the named varieties.

Objective 3: We obtained GBS data from 1,623 of 1,946 candidate F₅ lines using GBS. Genomic predictions were formulated from a training population of a subset of 265 lines and parents that were phenotyped for FHB field disease severity, VSK and test weight. Marker-assisted selection was also used to characterize parental lines (done in-house) and the F₅ lines (in cooperation with the USDA-ARS Small Grains Genotyping Center in Fargo). We routinely use DNA markers to screen for genes that provide resistance to Fusarium head blight, leaf rust, Ug99 stem rust resistance, semi-dwarfing, and high molecular weight glutenins that are necessary for good baking quality. The Genotyping Center provided data on 8 gene-specific markers on 1,943 F₅ lines and 51 parents of F₅ materials, generating 15,952 marker data points. We used the MAS data from the 8 markers, genomic predictions for FHB, and observations from our winter nursery in New Zealand, including seed size measurements to select a set of 468 lines for entry into preliminary yield trials in spring 2021. In addition, since Fall 2021 we screened 648 individual F₁ plants from topcrosses and backcrosses and 51 parents from Fall 2021 and Spring 2022 crossing blocks for as many as 61 markers in-house, generating a total of 9,440 datapoints.

b) What were the significant results?

- The St. Paul FHB screening nursery was excellent, providing highly discriminatory data. The Crookston nursery did not develop enough symptoms to warrant in-field scoring more than three weeks after heading time. Nevertheless, we harvested the

nursery for VSK assessment and were pleasantly surprised by high levels of scabby kernels and highly discriminatory data. From the 2021 FHB nursery data and results from previous years, the FHB resistance of 32 spring wheat cultivars was assessed and reported.

- We used genomic selection at the F₅ stage for FHB to help select lines to advance to preliminary yield trials. As was the case last year, this data was critically important because in-person evaluation of our pre-yield trial lines in our New Zealand winter nursery was not possible due to COVID-19 travel restrictions.
- Experimental line MN15005-4 was approved for public release with the name 'MN-Rothsay'. MN-Rothsay (Prosper/MN08301-6//Norden) has a good combination of yield and protein and has straw strength almost as good as Linkert. FHB rating has been tentatively assigned as a '4', moderately resistant on our 1-9 scale, which is an improvement over 'Linkert' (5), the variety it is intended to replace.

c) List key outcomes or other achievements.

- d) High yielding wheat varieties with high grain protein content, good straw strength and good FHB resistance are in demand by wheat growers because they greatly increase the profitability of wheat production in Minnesota. Recent releases include 'Linkert' (2013), 'Bolles' (2015), 'Shelly' (2016), 'Lang-MN' (2017), 'MN-Washburn' (2019), 'MN-Torgy' (2020), and 'MN-Rothsay' (2022). University of Minnesota developed spring wheat varieties accounted for an estimated 31.4% of Minnesota's 1.21 million spring wheat acres in 2021, including 'Linkert' which was the no. 3 variety and MN-Torgy 5th. More than 379,000 acres of MN-developed spring wheat varieties also were grown in North Dakota in 2021. Germplasm from our breeding program is being used as parents by private and public breeding programs in the region. Our goal is to continue to release high yielding, disease resistant varieties with good end-use quality. In addition, we coordinate the testing of ~40 public and private released hard spring wheat varieties per year in statewide trials to assess their performance in yield nurseries, end-use quality assessments, and reactions to important diseases. This information is critical to growers to make informed choices among varieties.

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

All members of my project, regardless of what species they work on (wheat, intermediate wheatgrass, or field pennycress) help with inoculation and scoring of our FHB nurseries. This provides them with knowledge of the importance of this disease and our screening methodologies.

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

Wheat cultivar performance, including FHB reaction, of 38 spring wheat cultivars was assessed and reported to growers via print media, web-accessible publications, winter meetings, and field day presentations. We routinely enter five lines in the regional FHB nursery and a variety candidate performance nursery. The data of these nurseries is publicly available and other participants in the nursery have access to cross with this germplasm.

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 grant 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 FY21 grant 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 grant award

Identify any other publications, conference papers and/or presentations not reported above. Specify the status of the publication.