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

FY21 Performance Progress Report

Due date: July 26, 2022

Cover Page

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Fiscal Year:	2021
USDA-ARS Agreement ID:	59-0206-0-180
USDA-ARS Agreement Title:	Determinants of Aggressiveness in Fusarium graminearum
FY20 USDA-ARS Award Amount:	$54,640
Recipient Organization:	University of Illinois Department of Crop Sciences 1102 S. Goodwin Ave., N533B Turner Hall Urbana, IL 60801
DUNS Number:	41544081
EIN:	37-6000511
Recipient Identifying Number or Account Number, if any:	AG020
Project/Grant Period:	5/15/21 - 5/14/23
Reporting Period End Date:	5/14/2022

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
PBG	Determinants of Aggressiveness in Fusarium graminearum	$54,640
	FY21 Total ARS Award Amount	$54,640

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

25July2022

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: Determinants of Aggressiveness in Fusarium graminearum

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

The major goal of this project is to identify genes that control the aggressiveness of *F. graminearum*. We will identify them by phenotyping and genotyping a population of *F. graminearum*.

The objectives are:

1) Aggressiveness characterization of at least 24 isolates in greenhouse assays.
2) Identify sequence variation among a population of isolates collected from wheat lines with different levels of resistance.
3) Identify *Fusarium graminearum* genes that are under selection by the host level of resistance.

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?

- We finalized data analysis for the phenotypic assays.
- We stablished and executed a bioinformatics pipeline for SNP scoring on the *F. graminearum* population.
- We stablished and executed a bioinformatics pipeline to identify genes under selection in *F. graminearum* due to host resistance.
- Writing of a thesis that reports the results and conclusions of this research.

b) What were the significant results?

- Isolates from a susceptible wheat line (N=31) were more aggressive than those collected from a resistant wheat line (N=25; Figure 1).
- No correlations were found between in-vitro and in planta traits. In-planta traits (disease severity, fusarium diseased kernels, and DON concentration) were significantly correlated to each other.
- A total of 334,297 SNPs were scored in the population of 56 *F. graminearum* isolates.
- A total of 22 *F. graminearum* genes were identified as being under selection by the wheat host.

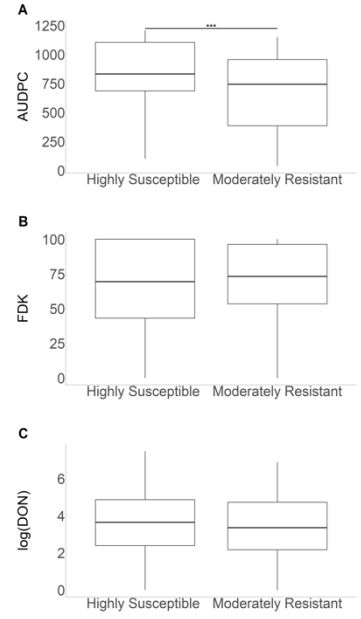

Fig 1. Boxplots of three phenotypes sorted by host resistance. The asterisks indicate significance between the wheat source's resistance levels, highly susceptible (N=31) and moderately resistant (N=25). **(A)** An AUDPC was calculated for each isolate from three disease ratings. **(B)** The percentage of damaged kernels was calculated for each wheat head to get FDK. **(C)** DON contamination was quantified as ppm from the kernels of each wheat head.

c) List key outcomes or other achievements.

- The population of *F. graminearum* 56 isolates was phenotyped for in-vitro and in planta traits related to aggressiveness.
- The results suggest that resistant wheat varieties have not selected for a population with primarily aggressive isolates.

- On highly susceptible wheat, aggressive isolates might outcompete weaker isolates leading to a population with primarily aggressive isolates.
- The level of wheat resistance added selection pressure to *F. graminearum* isolates as both populations had unique regions of the genome and genes under selection.
- Our results suggest that continued efforts to produce resistant wheat varieties will be durable and a long-term solution to FHB on wheat.

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

- A MS student (Mara Krone) has conducted all the research indicated above and is scheduled to graduate in the Summer of 2022. The student was funded by this project. She took courses in plant genetics, genomics, and plant pathology. The student presented her results at two conferences. The student was coached on conducting research on wheat and *Fusarium graminearum* by the PI.
- Two undergraduate students assisted with the preparation of experiments and data collection.

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

- A poster was presented at the annual APS meeting: Plant Health 2021 which was held online From Aug2 to Aug6.
- A poster was presented at the 2021 NFHB Forum which was held virtually from Dec 6 to Dec 7.

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).

None yet

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).

none

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.

Krone, M. J., and Mideros, S. X. 2021. Identifying the determinants of aggressiveness in *Fusarium graminearum*. Poster presentation. (Abstr.) Phytopathology 111:S2.1. doi: 10.1094/PHYTO-111-10-S2.1. Federal support was acknowledged in the poster.

Krone, M. J., and Mideros, S. X. 2021. The effect of wheat resistance on the aggressiveness of *Fusarium graminearum*. *Proceedings of the 2021 National Fusarium Head Blight Forum*; Virtual. December 6-7, 2021. Retrieved from: https://scabusa.org/forum/2021/2021NFHBForumProceedings.pdf