

FY22 Performance Progress Report

Due date: July 26, 2023

Cover Page

USDA-ARS Agreement ID:	N/A
USDA-ARS Agreement Title:	Fusarium species and fungicides in winter wheat and barley
Principle Investigator (PI):	Christina Cowger
Institution:	USDA-Agricultural Research Service
Institution UEI:	N/A
Fiscal Year:	2022
FY22 USDA-ARS Award Amount:	\$92,900
PI Mailing Address:	USDA-ARS NCSU Department of Entomology and Plant Pathology 3409 Gardner Hall PO Box 7616, CB7616 Raleigh, NC 27695-7616
PI E-mail:	christina.cowger@usda.gov
PI Phone:	919-513-7388
Period of Performance:	May 1, 2022 - April 30, 2023
Reporting Period End Date:	April 30, 2023

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	Screening Winter NABSEN at a High-performance North Carolina Barley FHB Nursery	\$20,000
MGMT IM-CP	Testing fungicide efficacy & timing in a high-performance North Carolina FHB nursery	\$18,000
MGMT/PBG	Fusarium Species Diversity within Spikes and Fields: Implications for FHB Management	\$54,900
FY22 Total ARS Award Amount		\$92,900

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.

CHRISTINA COWGER Digitally signed by CHRISTINA COWGER
Date: 2023.06.05 14:19:25 -0400'

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: Screening Winter NABSEN at a High-performance North Carolina Barley FHB Nursery

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

The goal is to screen the winter NABSEN under FHB pressure for resistance to FHB.

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 2022-23 Winter NABSEN was screened by planting three replicates of randomized two-row plots in October 2022. Inoculations were performed in March 2023 with Fusarium-infected corn spawn, in three batches at one-week intervals to ensure that all maturities were equally inoculated. Mist-irrigation was provided.

Notes were taken on heading date and FHB symptoms (incidence and severity). Index was calculated along with mean, CV and LSD. Entire plots were hand-harvested and will be hand-threshed and debearded, and a 100-g subsample of the grain from each plot will be collected and ground for mycotoxin testing at U. Minnesota.

b) What were the significant results?

Data are still being gathered.

c) List key outcomes or other achievements.

Please see above.

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

Our graduate student Pete Oppenheimer has learned about screening germplasm under artificial FHB pressure.

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

Results are being provided to breeders.

Project 2: Testing fungicide efficacy & timing in a high-performance North Carolina FHB nursery

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

Provide results based on replicated field data to answer question about optimal timing for fungicide to reduce FHB in winter barley.

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 conducted a multi-year field experiment in our misted, inoculated FHB nursery at Raleigh, North Carolina, using three winter barley cultivars with different levels of resistance to FHB: Violetta (MR), Thoroughbred (MR/MS), and Flavia (S). All are medium- to late-maturing malting barley varieties that are in commercial cultivation and are being used in breeding programs. Violetta and Flavia are medium-late two-row varieties, while Thoroughbred is a medium-maturing six-row type that (unusually) has acceptable malt quality. Inoculation was with *Fusarium*-infected corn spawn applied in three batches at one-week intervals, starting approximately three weeks before anticipated heading of the earliest variety (Thoroughbred).

We used ten fungicide treatments. The treatments allowed comparisons of the efficacy of Miravis Ace to those of Prosaro and Caramba, and comparisons of three fungicide timings (spikes half emerged, spikes just fully emerged, and 6 days after spikes fully emerged). They will allowed estimation of the mean benefits of fungicide application, cultivar resistance, and the combination of the two in terms of yield, test weight, and DON reduction.

b) What were the significant results?

Late applications are more effective than early applications or applications at 100% heading. Early applications are statistically similar in DON concentration to the unsprayed control treatment.

c) List key outcomes or other achievements.

Please see above.

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

Technician Logan Clark learned statistical software to analyze results.

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

Publication in Plant Disease. Information included in field day presentations.

Project 3: Fusarium Species Diversity within Spikes and Fields: Implications for FHB Management

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

The major objectives of the FY22 research program were to 1) conduct a broad geographic survey of *Fusarium* and mycotoxin diversity in FHB symptomatic wheat and barley and 2) identify whether less aggressive pathogens affect FHB and DON outcomes caused by the aggressive *F. graminearum* if inoculated first or co-inoculated.

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?

Objective 1: in the spring and summer of 2022 we sampled 30 farms across the US in total, or specifically: 19 winter wheat fields in Illinois, 7 winter wheat fields in Virginia, as well as 3 winter wheat and 1 winter barley field in Maryland [VA and MD sampling coordinated/implemented by Raleigh group]. To date >1200 *Fusarium* strains have been isolated from infected spikelets using Nash-Snyder selective medium and are in the process of being archived as glycerol stocks, as well as identified by sequencing the TEF-1 α gene and chemotyped using the high-throughput Luminex system. In addition, we used an *in-silico* approach to identify a set of primers targeting a TEF-1 α gene region that can be used to identify *Fusarium* spp. diversity using a next-generation sequencing-based metabarcoding approach. We intend to use these primers on wheat and barley heads collected in the field to validate our culturing effort, as well as reveal additional minority *Fusarium* spp.

Objective 2: we in Raleigh have performed one field and three greenhouse inoculation experiments and are in progress on a fourth greenhouse experiment. In a paired greenhouse and field inoculation experiment, the winter wheat variety Shirley, which is high-yielding but susceptible to FHB, was inoculated with *F. graminearum* to determine FHB outcomes and DON accumulation. The focus was a test of whether pre- or co-inoculation with the less aggressive strains *F. poae* or *F. acuminatum* would reduce *F. graminearum* disease severity or DON production. Environment was a major determinant of the disease outcome.

b) What were the significant results?

Objective 2: In the greenhouse, no pre-inoculation or co-inoculation treatment of *F. graminearum* with a less aggressive strain reduced AUDPC or DON accumulation in the greenhouse. However, in the field, disease severity and DON were reduced 24.2% and 19.0%, respectively, when *F. acuminatum* was co-inoculated with *F. graminearum* relative to inoculation with *F. graminearum* alone. Disease severity also reduced 27.7% when *F. acuminatum* was pre-inoculated. Lastly, results from the field trial showed that disease incidence was significantly reduced when *F. poae* and *F. acuminatum* were co-inoculated with *F. graminearum*, as well as when *F. acuminatum* was pre-inoculated.

c) List key outcomes or other achievements.

Preliminary data have been collected. See b) above.

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

Our graduate student Pete Oppenheimer is focusing on both objectives 1 and 2 as part of his PhD thesis research.

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

Preliminary results are being shared at USWBSI fora and the 2022 APS meeting via posters.

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?

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).

Cowger, C., Read, Q. D., Clark, L., and Dong, Y. 2023. Optimal timing of fungicide application to manage Fusarium head blight in winter barley. Plant Dis. [10.1094/PDIS-01-23-0021-RE](https://doi.org/10.1094/PDIS-01-23-0021-RE).

Status: Pre-Print

Acknowledgment 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).

Nothing to Report

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.

Nothing to Report