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

FY22 Performance Progress Report

Due date: July 26, 2023

Cover Page

USDA-ARS Agreement ID:	59-0206-2-111
USDA-ARS Agreement Title:	Fusarium Head Blight Research in Delaware
Principle Investigator (PI):	Alyssa Koehler
Institution:	University of Delaware
Institution UEI:	T72NHKM259N3
Fiscal Year:	2022
FY22 USDA-ARS Award Amount:	$69,307
PI Mailing Address:	16483 County Seat Hwy Georgetown, DE 19947
PI E-mail:	akoehler@udel.edu
PI Phone:	302-865-2585 ext. 571
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
MGMT IM-CP	Evaluation of FHB Management Strategies in DE following the MGMT Protocol	$20,857
MGMT	Assessment of Fungicide Sensitivity in Field Populations of Fusarium Causing FHB	$48,450
	FY22 Total ARS Award Amount	$69,307

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.

7/26/23

_____ _____

Principal Investigator Signature | Date Report Submitted

ǂ 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: Evaluation of FHB Management Strategies in DE following the MGMT Protocol

---

1. **What are the major goals and objectives of the research project?**
   Winter wheat and malting barley are important crops to small grain producers in Delaware. Fusarium Head Blight is the top disease concern of growers in the region. Many growers utilize risk model forecasting and rely on the application of fungicides when environmental conditions favor high risk for FHB. The release of a new fungicide, Miravis® Ace, drew attention from growers and new combination products continue to enter the market. There is need for local data on performance of these new products. This project followed the FHB ManagementCoordinated Project (MGMT_CP) to address the following objectives:

1) Evaluate the integrated effects of fungicide treatment and genetic resistance on FHB and DON in all major grain classes, with emphasis on new combination fungicides, Prosaro Pro and Sphaerex.
2) Compare the efficacy of Prosaro Pro and Sphaerex to that of Prosaro, Caramba, and Miravis Ace.
3) Generate data to further quantify the economic benefit of FHB and DON management programs.
4) Generate data to validate and advance the development of FHB risk prediction models.

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?
   As part of this project, 4 trials were conducted following the MGMT_CP. A malting barley trial with two cultivars and a winter wheat trial with two cultivars were planted to assess fungicide performance on susceptible and moderately resistant varieties (objective 1). Using a susceptible variety of wheat and a susceptible malting barley cultivar, two additional trials were established to analyze fungicide efficacy of designated products (objective 2). After fungicide application, plots were monitored and rated for FHB incidence and severity, flag leaf disease severity, yield, test weight, kernels damaged by FHB, and DON level. Trial results were shared with Dr. Pierce Paul for further analysis in support of objectives 3 and 4. State results were also disseminated through extension programming, plant disease management reports, and at winter meetings.

   b) What were the significant results?
   Environmental conditions limited disease severity in 2022, but there were still interesting responses, particularly concerning DON levels. In the Violetta malting barley trial, DON reduction was observed in multiple treatments (Figure 1) and the highest yield was observed with a dual application treatment of Miravis Ace fb tebuconazole (Figure 2). In the wheat fungicide trial, differences were observed in DON that

supported growing data that applications at 10.3 do not adequately reduce DON, even if FHB incidence or severity are reduced (Figure 3). Highest yields were observed in treatments with an application 5 days after anthesis (Figure 4).

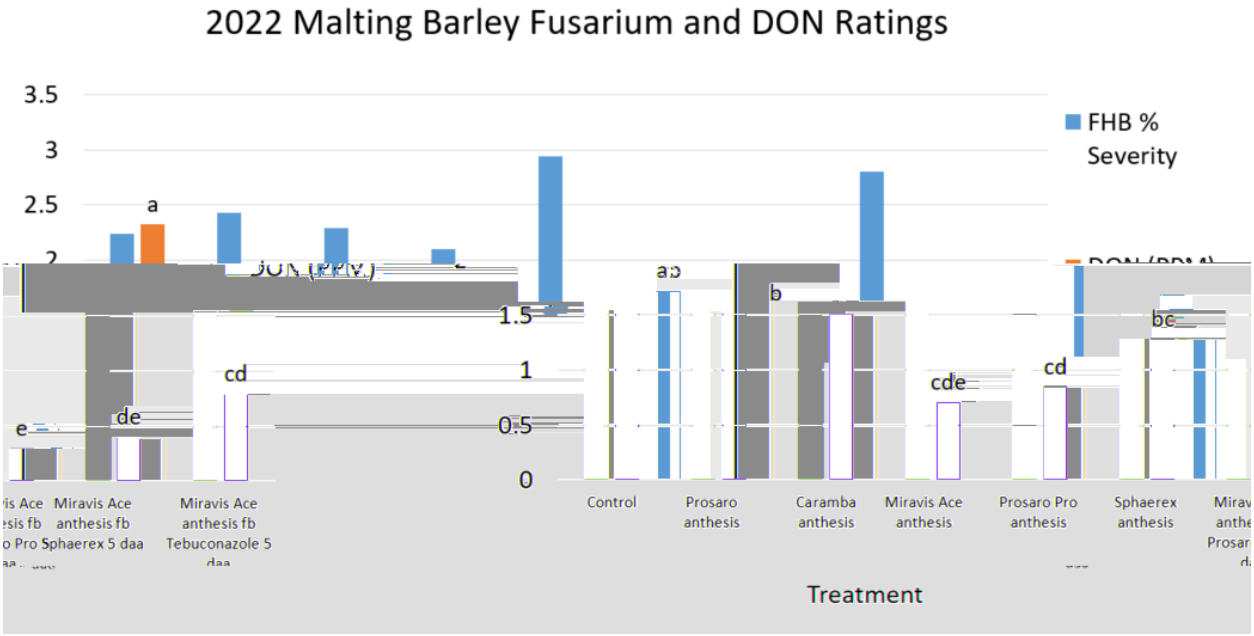


Figure 1: Fusarium head blight severity and DON levels in Georgetown, DE Violetta malting barley

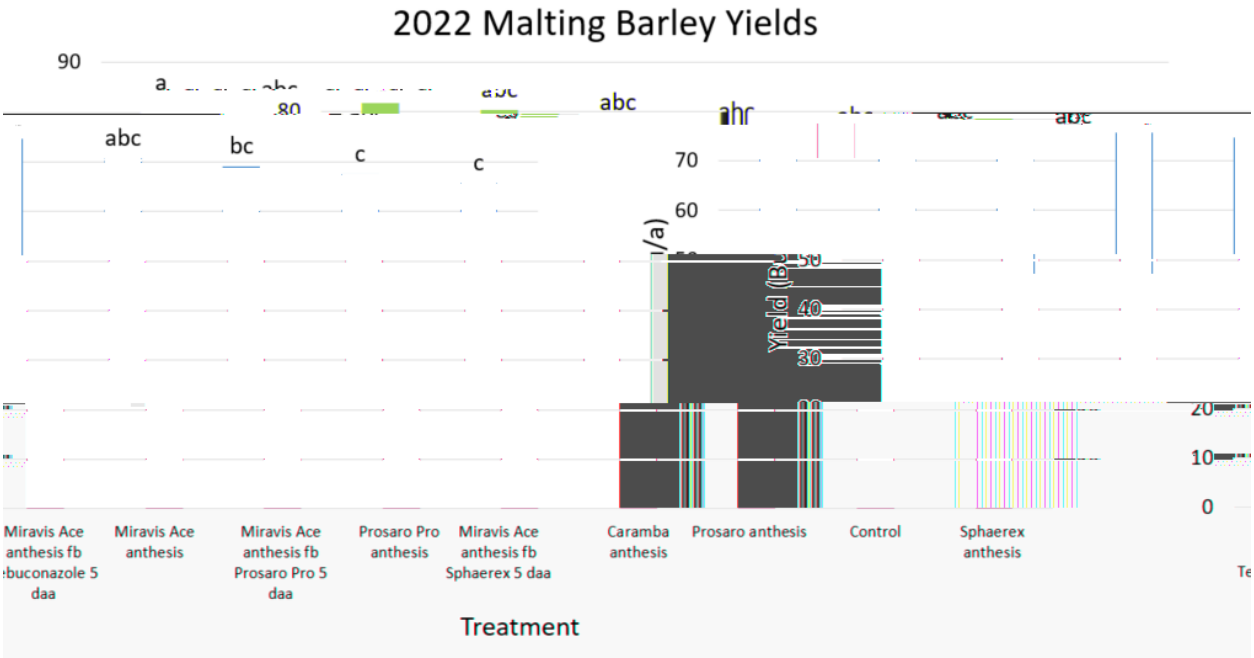


Figure 2: Violetta malting barley yields in Georgetown, DE

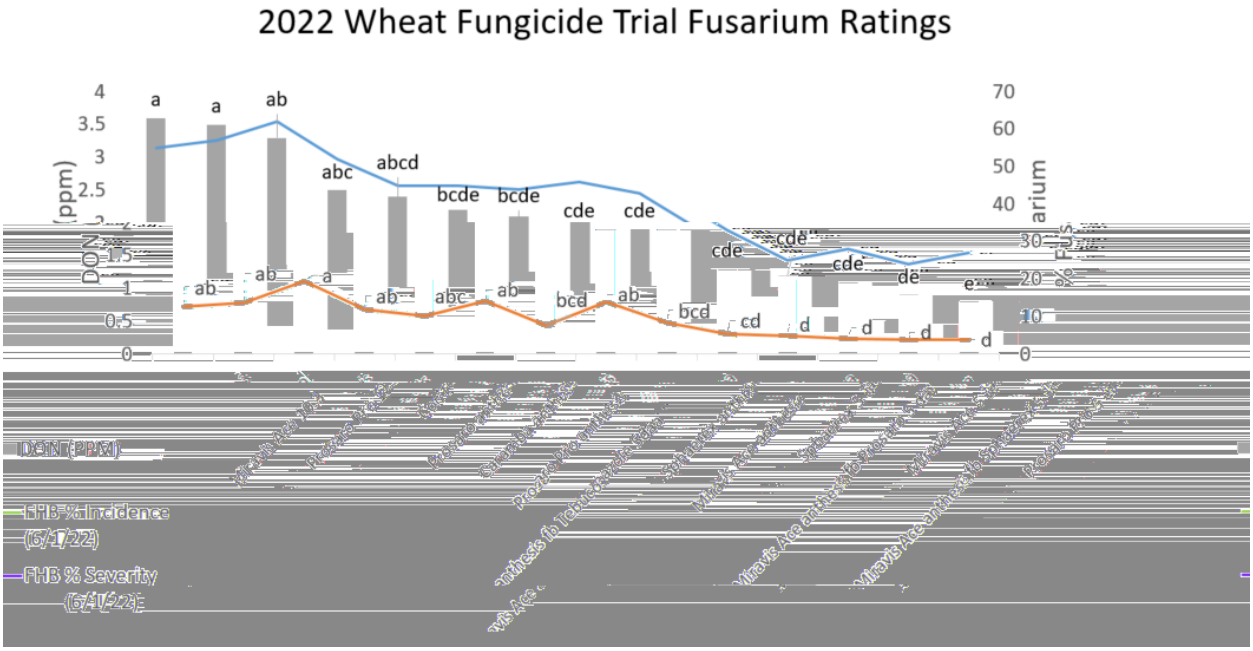


Figure 3: FHB ratings and DON response in winter wheat in Georgetown, DE

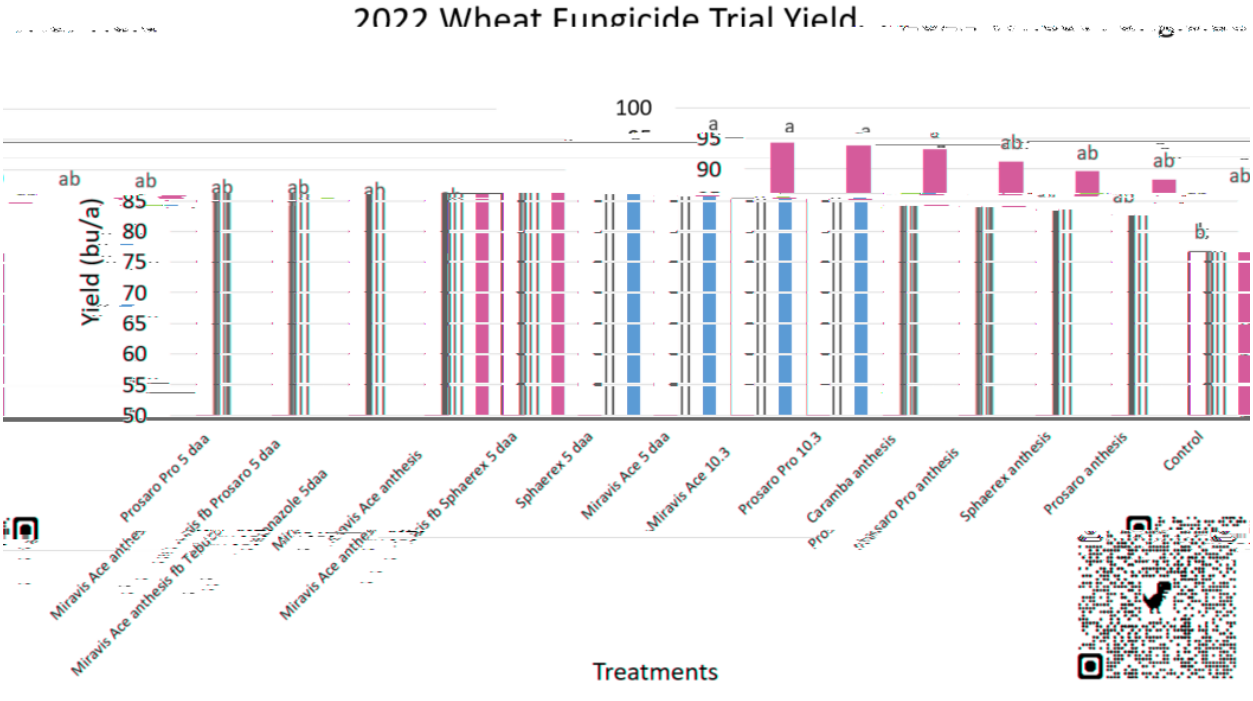


Figure 4: Winter wheat yield in Georgetown, DE

c) List key outcomes or other achievements.

Expected Outcome: Regional product performance for the effects of fungicide treatment and genetic resistance on FHB and DON, with emphasis on new combination fungicides, Prosaro Pro and Sphaerex.

Actual Outcome: Data on new combination fungicides was generated and provided information that could be shared at winter meetings.

Expected Outcome: Regional performance on efficacy of Prosaro Pro and Sphaerex to that of Prosaro, Caramba, and Miravis Ace.

Actual Outcome: Products were assessed and timing remained an important consideration for DON.

Expected Outcome: Contribute data to further quantify the economic benefit of FHB and DON management programs.

Actual Outcome: Despite a low disease pressure year, it was an excellent year for comparing DON responses. Data was contributed to a pooled data set for continued economic analysis.

Expected Outcome: Contribute data to validate and advance the development of FHB risk prediction models.

Actual Outcome: Data was contributed and interactions of frost damage, relatively low disease symptoms, but higher DON values will be used to help improve model development.

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

Data from the project was presented at the Maryland Grain Improvement Board Meeting in December 2022 and at Delaware Ag Week in January 2023. Delaware Ag Week provides training and pesticide certification credit to hundreds of stakeholders. The graduate student associated with the project was able to participate in fungicide application and disease rating, publish Plant Disease Management Reports, building professional networks and increase familiarity with the FHB system.

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

Updates on disease risk, efficacy of new products, and optimal application periods were disseminated through articles in the University of Delaware's Weekly Crop Update, which reaches over 700 growers, consultants, and stakeholders and provides a platform to discuss disease concerns and other production issues. Small grain research updates, including the results from this project were presented in the small grains session of Delaware Ag Week held in January 2023. Updates were also shared via social media platforms and two Plant Disease Management Reports have been accepted for publication. A poster was presented by the graduate student involved with this work at the APS Annual meeting held in Pittsburgh in August 2022. Nationally, these results were used in support of a wheat fungicide efficacy guide that is updated annually through the NCERA-184 working group and published through the Crop Protection Network. https://cropprotectionnetwork.org/publications/fungicide-efficacy-for-control-of-wheat-diseases

Project 2: Assessment of Fungicide Sensitivity in Field Populations of Fusarium Causing FHB

---

1. **What are the major goals and objectives of the research project?**
   Fungicides are commonly used as part of an integrated management plan to reduce Fusarium head blight caused predominantly by the fungus, *F. graminearum*. In 2019, Syngenta released Miravis® Ace, a premix fungicide that contains an active ingredient in the "second generation" succinate dehydrogenase fungicide class (adepidyn (pydiflumetofen); SDHI, FRAC group 7) and a triazole, for use in suppressing FHB. This is the first fungicide containing an active ingredient other than a DMI labelled for use in suppressing FHB; however, additional second-generation SDHI active ingredients have been used for several years to suppress numerous fungal diseases in wheat and cropping systems such as corn and soybeans. SDHI resistance has been observed in other pathosystems, including diseases in wheat and barley; however, no studies have examined populations of *F. graminearum*. The goal of this project was to generate baseline sensitivities for pydiflumetofen in *F. graminearum* populations across wheat and barley production regions in the US. Objectives include:

   1) Establish centralized testing locations and protocols for fungicide sensitivity testing for Fusarium isolates as part of the USWBSI
   2) Develop baseline sensitivity and associated virulence of current and historic isolates of *Fusarium* to SDHI and DMI fungicides collected from FHB symptomatic wheat in US wheat production areas
   3) Place unique and/or valuable isolates into a national storage facility to facilitate collaboration between MGMT and PBG RACs

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?

   <u>Objectives 1 and 2</u>
   Dr. Martin Chilvers and I established centralized testing at each of our respective locations (Figure 5). Video calls and virtual meetings were conducted to coordinate email correspondence for sample request, isolate collection, and approaches for fungicide sensitivity screening. Samples from extension specialists across the US have been solicited via email and through awareness at presentations during the 2022 FHB Forum.

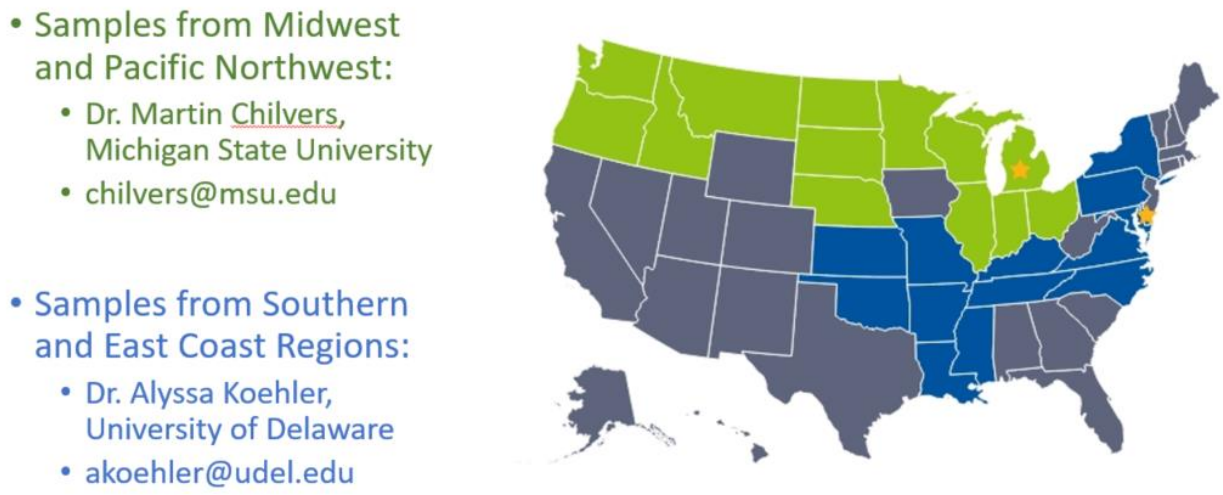


Figure 5: Centralized testing locations at the University of Delaware (blue) and Michigan State (green)

Objective 3

Dr. Chilvers and I have been in touch with USDA colleagues and there have been multiple zoom meetings to connect across projects and determine how to best approach isolate storage. Due to space limitation, we will need to prioritize valuable isolates and we will work across the MGMT and PBG RACS to characterize isolates and make these decisions regarding long term storage.

b) What were the significant results?

FHB levels have been low across much of the US over the past two seasons, but we have still been able to have good initial participation. We currently have over 300 isolates from 2020-21, of which a selection of 177 from 16 states were initially selected for baseline efficacy screening. In addition to these isolates, 14 historic isolates from Kansas and NY were included for comparison (Figure 6). In this initial screening EC50 values ranged from 0.005 ug/ml to 1.789 ug/ml, with a historic mean of 0.35 ug/ml, 2020 mean of 0.4 ug/ml, and 2021 mean of 0.37 ug/ml. The results of this portion of the project have been written up and will soon be submitted for publication. In 2022, with the establishment of regional centers, additional isolates were contributed from North Carolina, Maryland, Delaware, Pennsylvania, New York, Kansas, Kentucky, and Louisiana totaling over 270 isolates from wheat and malting barley.

In 2022, malting barley was the focus of our fungicide screening. Following meetings with the Chilvers lab, we began to investigate the use of YBA medium (10g/L yeast extract, 10g/L peptone and 20g/L sodium acetate in distilled water) in place of traditional PDA medium to improve uniformity of *Fusarium* growth in culture. We were pleased with the improved uniformity (Figure 7) and plan to continue using YBA in all future trials.

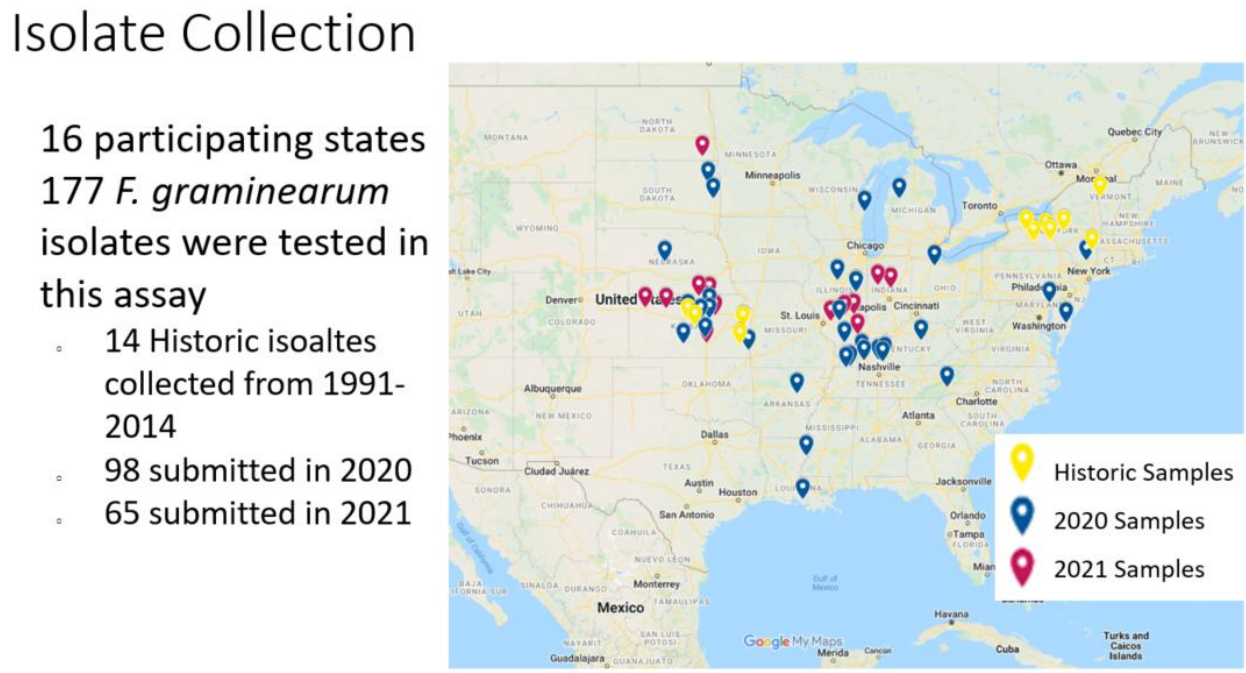
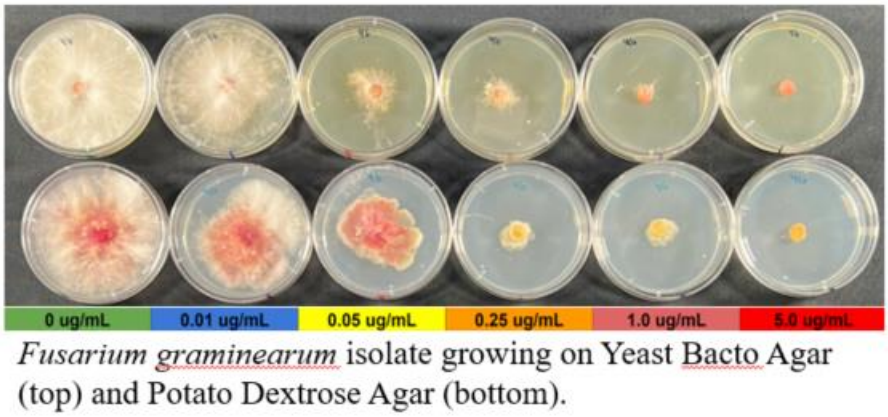


Figure 6: Location of initial FHB isolates



Fusarium graminearum isolate growing on Yeast Bacto Agar (top) and Potato Dextrose Agar (bottom).

Figure 7: Comparison of growth on YBA versus PDA

Prior to conducting malting barley fungicide assays, isolates were identified to species, with five primary species identified (Figure 8). The greatest species diversity was observed in isolates from New York. EC50 values were consistent across most species, but were highest in *F. acuminatum* (Figure 9). Following these trials the next set of 47 isolates containing 2022 wheat isolates from PA, KY, KS, MD, and NC was selected. Fungicide screening has been conducted and isolates are pending sequencing results to sort EC50 values by species.

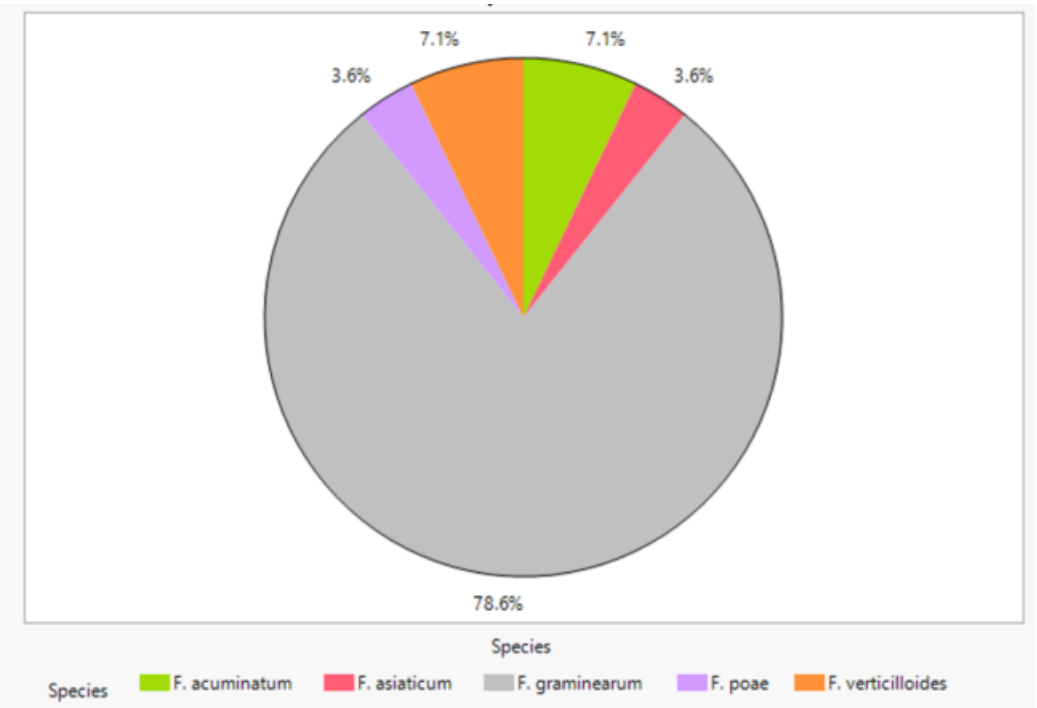


Figure 8: Composition of *Fusarium* species associated with malting barley in 2022 screening

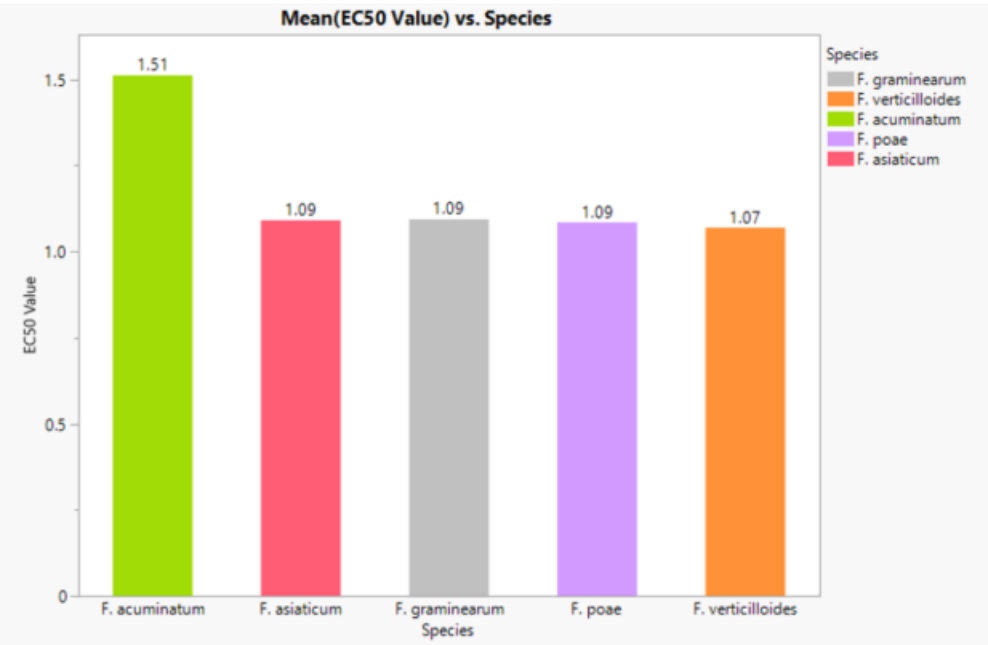


Figure 9: EC50 values of isolates from malting barley in YBA mycelial assay testing

c) List key outcomes or other achievements.

Two centralized testing locations were established and we have improved the protocols for fungicide sensitivity testing. Our next step will be to move toward discriminatory dose screening to be able to screen larger numbers of isolates in a more high-throughput manner.

Baseline efficacy within wheat and malting barley isolates have begun to be established across multiple states and in comparison to historic isolates. Two publications are in progress that will document these findings and provide a foundation for continued work.

Conversations have been initiated to discover the process and resources available to secure high value isolates in national storage facilities and to work across MGMT and PGB projects to maximize utility of isolate collections.

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

The graduate student associated with this project was able to present at the 2022 FHB Forum to build professional networks and disseminate project results. He graduated in winter 2023, with a job offer before graduation, largely in part to the skill set gained by this project. Two manuscripts are nearing submission which will further the reach of project results to date.

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

Updates on fungicide sensitivity were disseminated through articles in the University of Delaware's Weekly Crop Update, which reaches over 700 growers, consultants, and stakeholders and provides a platform to discuss disease concerns and other production issues. An overview of this project was presented at the National FHB forum, which also provided an opportunity to solicit additional samples. Updates on project results were also highlighted at Delaware Ag Week held in January 2023. Once manuscripts are published, research summaries will also be prepared for publication with the Crop Protection Network to further broaden the audience receiving project results.

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).

Cinderella J., Anderson K., Bergstrom G.C, Bockus W.W., Bradley C.A., Breunig M., Byamukama E., Chilvers M.I, Cowger C., Faske T.R., Friskop A.J., Kelly J., Kleczewski N.M., Mideros S., Paul P.A., Price T., Rawat N., Rupp J., Shim S., Stevens J., Telenko D., and Koehler A.M. 2023. Establishment of *Fusarium graminearum* baseline fungicide sensitivity levels to pydiflumetofen from wheat in the United States. *In preparation for submission to Plant Disease.*

Cinderella J., Rawat N., Bergstrom G., and Koehler A.M. 2023. Baseline fungicide sensitivity levels of *Fusarium* isolates to pydiflumetofen in east coast malting barley. *In preparation for submission to Plant Disease.*

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).

Extension Articles:

Koehler A.M. Fusarium Head Blight Management, Delaware Weekly Crop Update. 4.1.22
Koehler A.M. Fusarium Risk Tool, Delaware Weekly Crop Update. 4.7.22
Koehler A.M. Wheat and Barley Disease Updates, Delaware Weekly Crop Update. 4.21.22
Koehler A.M. FHB Management, MD Agronomy News, 4.22.22
Koehler A.M. Small Grain Disease Updates, Delaware Weekly Crop Update. 4.28.22
Koehler A.M. Small Grain Sorting Symptoms and FHB Disease Updates, Delaware Weekly Crop Update. 5.6.22
Koehler A.M. Disease Updates for Small Grains, Delaware Weekly Crop Update. 5.13.22
Koehler A.M. Scouting Fields for Frost Damage and Fusarium Head Blight, Delaware Weekly Crop Update. 5.19.22
Koehler A.M. FHB Updates, Delaware Weekly Crop Update. 5.27.22
Koehler A.M. Preparing for 2023: Small Grains Disease Management, Delaware Weekly Crop Update. 9.16.22

Koehler A.M. Preparing for 2023: Small Grains Disease Management, MD Agronomy News. 10.1.22

Factsheets:

Cinderella J. and Koehler A.M. 2022. Fusarium Head Blight. University of Delaware Factsheet.

Koehler A.M. 2022. Observation Times for Common Small Grain Diseases in the Mid-Atlantic. University of Delaware Factsheet.

Koehler A.M. 2022. Small Grain Early Season Symptom Chart. University of Delaware Factsheet.

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.

Koehler A.M. (2022). Coordinated Fungicide Sensitivity Project.. Proceedings of the 2022 National Fusarium Head Blight Forum. Tampa, FL. December 4-6, 2022. Retrieved from: https://scabusa.org/forum/2022/2022NFHBForumProceedings.pdf. Presented virtually.

Cinderella J., G.C. Bergstrom, and Koehler A.M. (2022). Baseline sensitivities of *Fusarium* species to pydiflumetofen in east coast malting barley. Proceedings of the 2022 National Fusarium Head Blight Forum. Tampa, FL. December 4-6, 2022. Retrieved from: https://scabusa.org/forum/2022/2022NFHBForumProceedings.pdf

Cinderella J. and Koehler A.M. 2022. Evaluation of fungicide efficacy timing to manage malting barley diseases in Delaware. APS National Meeting, Pittsburgh, PA.

Cinderella J. and Koehler A.M. 2023. Assessment of fungicides for control of barley head diseases in Georgetown, DE, 2022. *Accepted to Plant Disease Management Reports*.

Cinderella J. and Koehler A.M. 2023. Assessment of fungicides and application timings for control. *Accepted to Plant Disease Management Reports*.