

FY22 Performance Progress Report

Due date: July 26, 2023

Cover Page

USDA-ARS Agreement ID:	59-0206-2-100
USDA-ARS Agreement Title:	Managing Fusarium Head Blight (FHB) Through Lab and Field Studies
Principle Investigator (PI):	Martin Chilvers
Institution:	Michigan State University
Institution UEI:	R28EKN92ZT9
Fiscal Year:	2022
FY22 USDA-ARS Award Amount:	\$91,777
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PI E-mail:	chilvers@msu.edu
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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	Integrated Management of FHB and DON in Soft Winter Wheat and Winter Barley in MI	\$27,756
MGMT	Assessment of Fungicide Sensitivity in Field Populations of Fusarium Causing FHB	\$64,021
FY22 Total ARS Award Amount		\$91,777

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.



Principal Investigator Signature

Jul-26-2023

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: Integrated Management of FHB and DON in Soft Winter Wheat and Winter Barley in MI

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

- 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?

Wheat and barley head scab trials were implemented for the 2022 season, including fungicide applications, head scab ratings, harvest, sample preparation for DON analysis, communication of data with Dr. Pierce Paul for further analysis and use in refining FHB risk prediction models. The project findings were summarized and used in extension meetings and field meetings to improve head scab management.

The 2023 crop was planted in the fall of 2022, including two wheat and two barley varieties for trials to address the four objectives listed above.

b) What were the significant results?

Despite relatively low levels of head scab due to dry conditions and teething issues with our new lateral irrigation system in 2022, we still managed to collect valuable data with respect to the project objectives. The figure below demonstrates data from one of the trials documenting DON suppression of “new and old” fungicide products, two pass fungicide programs and a product dose response test.

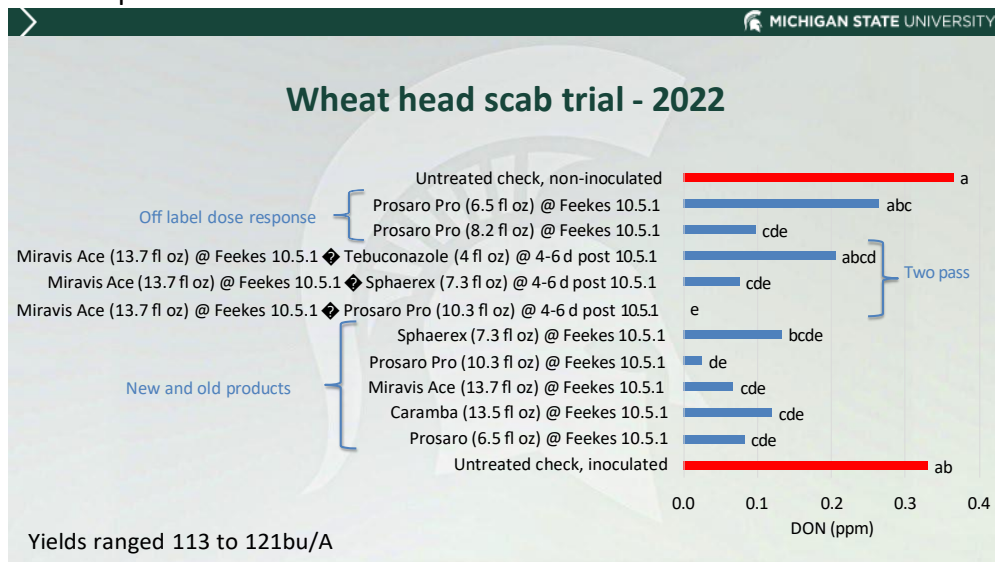


Figure: FHB fungicide trial conducted on soft white winter wheat cultivar “Ambassador”

c) List key outcomes or other achievements.

This data and data from the USWBSI collective were invaluable in discussions with farmers and agribusiness personnel around head scab management.

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

The entire lab participates in head scab trial rating. This provides an opportunity for undergraduate, graduate students and postdocs to become familiar with the project. We discuss treatments and why the trial is conducted, and what we can learn from the trials.

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

As detailed below the research results from the trials conducted at Michigan State University and from the USWBSI collective are presented at field days and winter extension meetings to improve farmer and agribusiness understanding of head scab management, including the importance integrated disease management of variety resistance and judicious fungicide use, as well as product performance and best practices and use of the head scab risk prediction model.

Wheat fungicide efficacy information is updated annually through a national fungicide efficacy chart and discussions with members of the NCERA-184 group and published through the Crop Protection Network. I regularly share this guide with farmers and industry: <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?

Objective 1. Establish centralized testing locations and protocols for fungicide sensitivity testing for *Fusarium* isolates as part of the USWBSI

Objective 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

Objective 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?

Obj 1 and 2

Dr. Alyssa Koehler and I established our laboratories as centralized testing locations for *Fusarium* isolate fungicide sensitivity. We have had video calls and meetings to coordinate sample solicitation, isolate collection, and fungicide sensitivity testing strategies. We have solicited head scab sample submissions from our fellow extension pathologists across the country.

APHIS permits were renewed through the new e-permit system to allow import of isolates and infected wheat and barley heads from across the country.

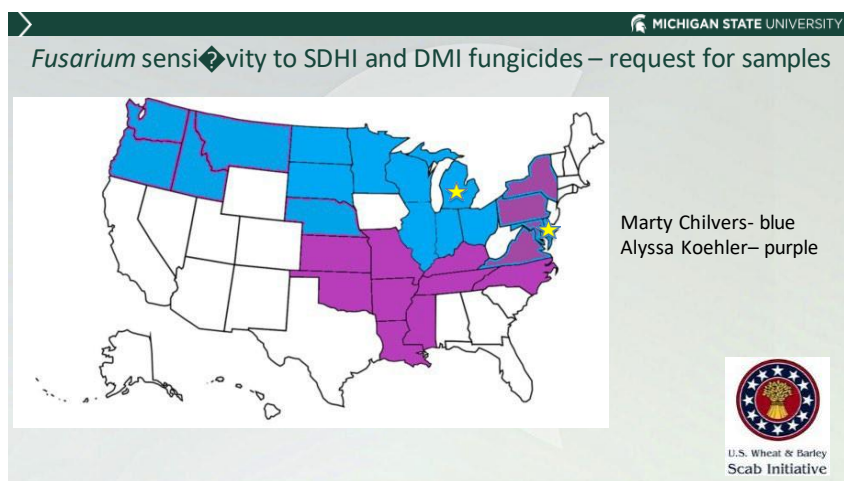


Figure: Demonstration of how Dr. Alyssa Koehler and myself are planning to divide and conquer *Fusarium* fungicide sensitivity testing for the US, with our two labs acting as regional testing facilities.

Obj 3

We have participated in conversations with our USDA colleagues with respect to which isolates might be valuable and how many and how these might be plated into a national storage facility to facilitate collaboration between MGMT and PBG RACS.

I have also had discussions with Dr. Chris Toomajian from the University of Kansas for the sharing of isolates of interest from our Michigan collection of over 500 *Fusarium* isolates.

b) What were the significant results?

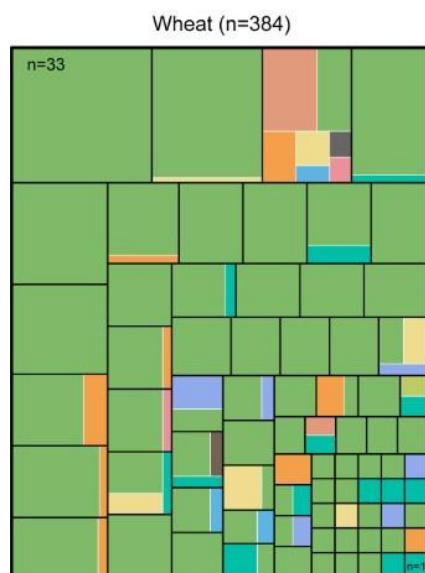
Although relatively low levels of head scab have been experienced for the last two seasons. At MSU we have been provided with 23 unique sample locations from across 4 states and a total of 234 samples. We are working through these head samples and performing *Fusarium* isolations. In discussions with colleagues, we have also been granted access to historical collections from a number of states.

A visiting PhD student, Mr. Sungyu Choi visiting my lab from Dr. Hyunkyung Sang’s lab in Chonnam National University in Korea worked on medium for fungicide sensitivity testing. Although we had previously used half strength potato dextrose agar, we seemed to get better uniformity growth and fungicide inhibition data from YBA medium (10g/L yeast extract, 10g/L peptone and 20g/L sodium acetate in distilled water). We will utilize YBA in comparison to half strength PDA in a few more trials until we are confident that YBA will be a better medium for the fungicide sensitivity testing.

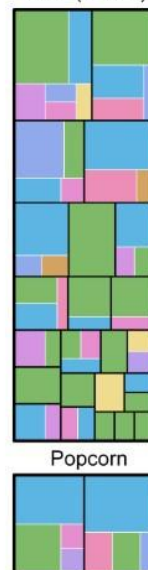
c) List key outcomes or other achievements.

We are working on preparing manuscripts from the dissertation chapters of Mikaela Breunig’s PhD dissertation. These manuscripts include highly relevant data to the overall *Fusarium* fungicide sensitivity project including an in depth look at *Fusarium* species composition from across Michigan’s wheat and maize and their corresponding fungicide sensitivity of 445 *Fusarium* isolates.

Species Composition



Corn (n=129)



Species Complex

Species Identification

FSAMSC (sambucinum)

- *F. graminearum*
- *F. cerealis*
- *F. culmorum*
- *F. sporotrichioides*
- *F. poae*



EFSC (fujikuroi)

- *F. fujikuroi*
- *F. awaxy*
- *F. proliferatum*
- *F. verticillioides*
- *F. subglutinans*



ETSC (tricinctum)

- *F. tricinctum* species complex
- *F. acuminatum*
- *F. avenaceum*
- *F. tricinctorum*



- *F. incarnatum-equiseti* species complex
- *F. oxysporum* species complex



Figure: *Fusarium* species composition as collected from wheat and corn between 2011 and 2019. From Mikaela Breunig's 2021 PhD dissertation.

In addition to the isolation of *Fusarium* from head scab samples described above. We have also been able to collect fungal and oomycete isolates from roots of wheat seedlings. The isolations were performed across eight site years in Michigan from two varieties of non-treated wheat seed. Of relevance to this USWBSI project, approximately half of the fungal isolates recovered from the roots of wheat seedling were Fusaria. Including, isolates of *F. graminearum*, *F. sporotrichioides*, members of the *Fusarium tricinctum* species complex, and members of the *F. incarnatum-equiseti* species complex. Seedling pathogenicity and fungicide tests with these isolates are currently being conducted. These experiments will provide valuable data on the role of *Fusarium* spp. not only as they affect head scab but also their role in seedling infection and root rot. This data will improve our understanding of *Fusarium* in the wheat system.

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

A postdoc has been heavily involved in the project, and will attend the head scab 2023 meeting. A graduate student has been recruited to work on this project beginning in the spring of 2024. The lab also has 4 undergraduate students that are involved in assisting with the project.

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

A presentation was given at the 2022 annual head scab meeting. Peer reviewed publications have been published for related work and more are in process. The work has also been used to communicate to farmers and industry about the status of fungicide sensitivity within *Fusarium* and the potential risk fungicide resistance poses.

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).

Breunig, M., Nagelkirk, M., Byrne, A., Wilbur, J. Steinke, K., Chilvers, M.I. Accepted Mar 16, 2022. Meta-analysis of yield response to applications of fungicides made at different crop growth stages in Michigan winter wheat. Plant Health Progress. <https://doi.org/10.1094/PHP-09-21-0118-RS> Federal support not acknowledged. Primary support came from the Michigan Wheat Program.

Breunig, M., Chilvers, M.I. 2022. Comparison between prothioconazole and prothioconazole-dethio in poison plate mycelial growth assays of *F. graminearum*. Plant Health Progress <https://doi.org/10.1094/PHP-06-21-0087-RS>. Federal support not acknowledged. Primary support came from the Michigan Wheat Program.

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:

1. What's that black mold on my wheat? MSUE News Jul 6, 2023. <https://www.canr.msu.edu/news/what-s-that-black-mold-on-my-wheat>
2. Watch out for these wheat viruses! Michigan Wheat Program – Wheat Wisdom. July 5, 2023. <https://mailchi.mp/miwheat/volume-8-issue-7-wheat-wisdom-july-5-8127925?e=f3a6b318ac>
3. Foliar disease and head scab management in wheat. Michigan Wheat Program – Wheat Wisdom May 23, 2023

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.

Scientific presentation:

1. *Fusarium* species composition and fungicide sensitivity in Michigan. 2022 National Fusarium Head Blight Forum. Tampa, FL. Dec 4-6, 2022

Extension presentations:

1. Wheat disease status and outlook. Interview with Nicole Heslip – Brownfield ag news. Jun 13, 2023
2. Wheat Foliar Disease and Head Scab Management. MSUE Virtual Breakfast. May 4, 2023. 213 participants <https://www.youtube.com/watch?v=I-TanpnqtEE&t=51s>
3. Opportunities and challenges of disease management. MSUE Monday night webinar. Mar 20, 2023. 125 participants
4. Diseases of field crops. Virtual for crop insurance adjusters. Mar 9, 2023. 97 participants
5. Field crop disease management and IPM. Williamston. Jorgensen Farm Elevator. Mar 7, 2023. 110 participants
6. MSUE Disease Updates. Saginaw Valley Research and Extension Center. Feb 16th 2023. 130 participants
7. Disease update for LG seeds, at Michigan Corn Office, Dewitt, Feb 15, 2023 40 participants
8. Corey Seed Crop Shop. Fenton, MI. Feb 8, 2023. 50 participants
9. Field Crop Disease Update. MSUE IPM meeting. Dundee, MI Feb 7, 2023. 60 participants
10. AgPhD Radio Interview – Plant Health. Feb 6, 2023
11. The 2 F's of wheat management: Fungicides and Fertility. Great Lakes Crop Summit. Mt Pleasant, MI. Jan 25, 2023 100 participants
12. Field Crop Disease Update. MSUE IPM meeting. Dowagiac, MI Jan 24, 2023. 90 participants
13. Barley disease management. Michigan's great beer state conference and trade show. Kalamazoo, MI. Jan 13, 2023. 30 participants
14. Field Crop Disease Update. MSUE IPM meeting. Bad Axe, MI Jan 9, 2023. 90 participants
15. Field Crop Disease Update. MSUE IPM meeting. Ithaca, MI Jan 4, 2023. 40 participants
16. Field crop disease updates, discussion and questions. Bracey Ag Services, Quincy, MI. Sep 1, 2022. 110 participants
17. MSUE extension meeting. Three Rivers. Disease management discussion across corn, soybean and wheat. Aug 22, 2022. 38 participants