

USDA-ARS | U.S. Wheat and Barley Scab Initiative
FY21 FINAL Performance Progress Report

Due date: July 26, 2023

Cover Page

USDA-ARS Agreement ID:	59-0206-0-132
USDA-ARS Agreement Title:	Management of Fusarium Head Blight in Small Grains
Principle Investigator (PI):	Ruth Dill-Macky
Institution:	University of Minnesota
Institution UEI:	KABJZBBJ4B54
Fiscal Year:	2021
FY21 USDA-ARS Award Amount:	\$43,156
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Period of Performance:	5/6/21 - 5/5/23
Reporting Period End Date:	5/5/2023

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
MGMT-IM	Minnesota Component of the FHB Integrated Management Coordinated Project	\$26,246
GDER	A Field Nursery for Testing Transgenic Spring Wheat and Barley from the USWBSI	\$16,910
FY21 Total ARS Award Amount		\$43,156

I am submitting this report as a: 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

7/25/2023

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: Minnesota Component of the FHB Integrated Management Coordinated Project

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

Demethylation inhibitor (DMI) fungicides have been proven to be the most effective for Fusarium head blight (FHB) and deoxynivalenol (DON) management, providing more than 70% reduction of both FHB index and DON. This research project was part of a large coordinated effort, established in 2018, to examine the efficacy of Miravis Ace[®], which is one of a new class of fungicides (succinate dehydrogenase inhibitors). If this fungicide proves to be effective it will provide an additional option for the chemical control of FHB and reduce the risk of resistance developing to the widely used DMI fungicides.

The specific objectives of this FHB Management Coordinated Project (MGMT_CP) were to:

- Evaluate the integrated effects of fungicide treatment and genetic resistance on FHB and DON in hard red spring wheat, with emphasis on a new (non-DMI) fungicide, Miravis Ace
- Compare the efficacy of Miravis Ace when applied at heading or at anthesis to that of standard anthesis application of Prosaro[®] or Caramba[®]
- Generate data to further quantify the economic benefit of FHB/DON management strategies
- Develop more robust “*best-management practices*” for FHB and DON
- Generate data to validate and advance the development of FHB and DON 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?

We participated annually in the two nationally coordinated experiments in the MGMT-CP, the integrated management (IM) and uniform fungicide (UF) trials in 2021 and 2022. In combination, the data from these trials has contributed to the national efforts of the USWBSI to test Miravis Ace across grain market classes and growing conditions. In each year experiments were established at two locations (St Paul and Crookston) for hard red spring wheat. The experiments were completed following the experimental design as established by the coordinating group.

b) What were the significant results?

In each year of the project 2021 and 2022 we generated significant levels of FHB and obtained data. The IM trial in St Paul in 2021 was lost to the adverse weather conditions. The data from all seven completed trials has been compiled and submitted to the project coordinator. The data demonstrated that Miravis Ace is as effective as any other product in the control of FHB and DON in hard red spring wheat.

c) List key outcomes or other achievements.

Based on the data from 2018 -2020 in Minnesota and other research programs we expect that our data from the 2021 and 2022 field seasons will support the use of Miravis Ace in

the management of FHB and DON and provide a rationale for how we best use this new chemistry effectively.

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

No graduate students worked on this project. Undergraduate student researchers utilized this project to gain experience in field-based research techniques.

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

The results of these studies will be published as part of a national publication on integrated management guidelines for FHB and DON. Regionally, results have been delivered to growers, dealerships, county extension educators and others in the wheat and barley production industries through extension programs. In addition, data from these trials will be used to advance the development and validations of FHB and DON risk assessment models.

Project 2: A Field Nursery for Testing Transgenic Spring Wheat and Barley from the USWBSI

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

This project had the objective of establishing an annual nursery to provide a central field-testing site for transgenic spring wheat and barley lines developed by researchers in the USWBSI.

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?

No nursery was conducted in 2021 or 2022 as no entries were received. Monitoring for volunteers, as required to follow the compliance requirements of the 2019 APHIS permits continued throughout the 2022 field season and no transgenic volunteers were observed. The required monitoring period ended and thus this project is now complete.

b) What were the significant results?

2019 was the final trial year in which data were collected. Monitoring of the site for volunteers was continued for additional full growing seasons in accordance with the APHIS permits. This involved an in-person site inspection every 21 days throughout the growing season from the time the ground thawed till the first hard frost. With the final year of monitoring successfully completed the site was released from the APHIS permit requirements in spring 2022.

c) List key outcomes or other achievements.

All APHIS permit requirements have been met and the site of the nursery has been transferred to another research program.

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

None. Given the nature of this project, only personnel with authorization to work with the transgenic nurseries and with APHIS and IBC authorization are allowed on the trial site.

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

The USWBSI-funded PIs with wheat and barley entries in the 2019 nursery have been provided their data and copied on all communications with regard to the ongoing post-harvest site monitoring through 2022 that was necessary to meet our APHIS permit obligations.

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 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).

Huang, Y., Yin, L., Sallam, A.H., Heinen, S., Li, L., Beaubien, K., Dill-Macky, R., Dong, Y., Steffenson, B.J., Smith, K.P., and Muehlbauer, G.J. (2021). Genetic dissection of a pericentromeric region of barley chromosome 6H associated with Fusarium head blight resistance, grain protein content and agronomic traits. *Theoretical and Applied Genetics*, 134:3963-3981. DOI: <https://doi.org/10.1007/s00122-021-03941-9>

Acknowledgment of federal support: Yes

McLaughlin, J.E., Darwish, N.I., Garcia-Sanchez, J., Tyagi, N., Trick, H.N., McCormick, S., Dill-Macky, R., and Tumer, N.E. (2021). A lipid transfer protein has antifungal and antioxidant activity and suppresses Fusarium head blight disease and DON accumulation in transgenic wheat. *Phytopathology*, 111:671-683. DOI: <https://doi.org/10.1094/PHYTO-04-20-0153-R>
Acknowledgment of federal support: Yes

Books or other non-periodical, one-time publications as a result of FY21 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 award

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

Singla, S., Palmer, N., Bernhardson, L., O'Neill, P., Gries, T., Duray, Z., Dill-Macky, R., Sattler, S., Wegulo, S., and Funnell-Harris, D., (2022). Constitutive expression of SbCCoAOMT in the phenylpropanoid pathway can improve resistance to Fusarium head blight in wheat. In: *Proceedings of the 2022 National Fusarium Head Blight Forum*, Tampa, Florida December 6-7, 2022, p. 59.

Singla, S., Duray, Z., Dill-Macky, R., O'Neill, P., Bernhardson, L., Sattler, S., Wegulo, S.N., and Funnell-Harris D.L. (2022). Role of phenylpropanoid pathway genes in conferring resistance to Fusarium head blight of wheat. APS Annual Meeting (Plant Health 2022), Pittsburg: August 6-10, 2022. *Phytopathology*: 112, S3.101.

Hirsch, C.D., Cooper, J., Wodarek, J., Page, R., Min, A., Abdulridha, J., Dill-Macky, R., Smith, K.P., Anderson, J.A., Yang, C., and Steffenson, B.J. Utilizing a high-throughput field-based rover for high fidelity and high temporal resolution of FHB phenotyping. In: *Proceedings of the 2021 National Fusarium Head Blight Forum*, Online: December 6-7, 2021, p. 18.

Singla, S., Duray, Z., Dill-Macky, R., O'Neill, P., Bernhardson, L., Tatineni, S., Sattler, S., Wegulo, S., and Funnell-Harris, D., (2021). Phenylpropanoid-based resistance to Fusarium head blight in wheat. In: *Proceedings of the 2021 National Fusarium Head Blight Forum*, Online: December 6-7, 2021, p. 54.

Singla, S., Duray, Z., Dill-Macky, R., O'Neill, P., Bernhardson, L., Tatineni, S., Sattler, S., Wegulo, S.N., and Funnell-Harris D.L. (2021). Investigating phenylpropanoid-based Fusarium head blight resistance in wheat. 2021 APS North Central Division Meeting. Online/Ames, Iowa: June 15-16, 2021.