USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY19 Performance Report
Due date: July 24, 2020

Cover Page

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Fiscal Year:	2019
USDA-ARS Agreement ID:	59-0206-9-117
USDA-ARS Agreement Title:	Management of Fusarium Head Blight in Small Grains.
FY19 USDA-ARS Award Amount:	$ 48,996
Recipient Organization:	Regents of the University of Minnesota Suite 450 Sponsored FIN RPT-P100100001 Minneapolis, MN 55455-2003
DUNS Number:	555917996
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Recipient Identifying Number or Account Number:	CON000000079712
Project/Grant Reporting Period:	5/6/19 - 5/5/20
Reporting Period End Date:	5/5/2020

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
MGMT	Minnesota Component of the FHB Integrated Management Coordinated Project	$ 29,148
GDER	A Field Nursery for Testing Transgenic Spring Wheat and Barley from the USWBSI	$ 19,848
	FY19 Total ARS Award Amount	**$ 48,996**

Ruth Dill-Macky

7/24/2020

Principal Investigator Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
EC-HQ – Executive Committee-Headquarters
BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Soft Winter 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 such as prothioconazole, metconazole, and tebuconazole are the most effective for Fusarium head blight (FHB) and deoxynivalenol (DON) management. When applied at or up to 6 days after anthesis to moderately resistant cultivars, these fungicides provide more than 70% reduction of both FHB index and DON, relative to an untreated, susceptible check. Preliminary results from trials conducted over the past few years showed that Miravis Ace® (adepidyn; pydiflumetofen), a new succinate dehydrogenase inhibitor fungicide that is currently being labeled for use in wheat, has comparable efficacy against FHB and DON to the DMI fungicides Prosaro® and Caramba® when applied at anthesis (Feekes 10.5.1) or at 50% head emergence (Feekes 10.3). This project represented the Minnesota participation in two experiments proposed in the overall MGMT-CP, an integrated management trial (IM) and a uniform fungicide trial (UFT). In combination these trials have contributed to the overall effort to test Miravis Ace across grain market classes and growing conditions.

2. What was accomplished under these goals or objectives? *(For each major goal/objective, address items a-b) below.)*

a) What were the major activities?

We participated in the two experiments proposed in the overall MGMT-CP, an integrated management trial (IM) and a uniform fungicide trial (UFT). In combination these will contribute to the overall effort to test Miravis Ace across grain market classes and growing conditions. Experiments were established at two locations (St Paul and Crookston) for two grain classes (hard red spring wheat and barley) and completed following the experimental design as established by the coordinating group

b) What were the significant results?

We generated useful levels of FHB and obtained data from the two locations in wheat and one location in barley where the experiments were established. The barley IM trial in St Paul was lost to lodging during a thunderstorm. The toxin analyses for the three 2019 trials that were harvested were completed in July 2020. The data files will be compiled for submission to the project coordinator once the 2020 field season wraps up in late August.

c) List key outcomes or other achievements.

Results of these experiments will be used to advance the development of best management practices for FHB and DON.

3. Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.

The field trials were completed during the 2019 field season but the DON testing of the three IM trials that were harvested and the two UFT trials was delayed following the closure of campus this spring. Those analyses were completed and the data returned from Yanhong Dong's UMN lab in June and July. The data analysis will therefore be delayed until the 2020 fieldwork is completed. It is anticipated that this will happen in August or September.

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

Undergraduate researchers utilized this project to gain experience in field-based research techniques.

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

The data collected from these trials, along with trials conducted by other colleagues as part of the integrated management coordinated project funded by the USWBSI, will ultimately be used in a meta-analysis that will be published in peer-reviewed scientific journals. The outcome of this large collaborative research effort will ultimately provide information of the efficacy of fungicide treatments for FHB that would not be obtainable by any individual scientist.

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 items a-b) below.)*

a) What were the major activities?

The 2019 field screening nursery consisted of 67 wheat and 8 barley entries evaluated in adjacent experiments at UMore Park, Rosemount MN. Trial entries and untransformed parental controls* were submitted by the University of Minnesota, Rutgers University, University of North Texas and the USDA-ARS. The trial was planted on May 17, 2019. All plots were inoculated to coincide with anthesis for wheat and head emergence for barley. A second inoculation was applied three days after the initial inoculation (d.a.i.) for each plot with the last inoculations conducted on July 15. The inoculum was a composite of 26 *F. graminearum* isolates, applied at a concentration of 100,000 macroconidia.ml^{-1} with Tween 20 (polysorbate) added at 2.5 $ml.L^{-1}$ as a wetting agent. Mist-irrigation was applied from the first inoculation on June 29 through July 22 to facilitate FHB development. FHB incidence and severity were assessed visually. Approximately forty heads where harvested from each plot, threshed and the seed cleaned by hand. The wheat grain was used to determine the percentage of visually scabby kernels (VSK) and then all samples (wheat and barley) were ground and submitted for deoxynivalenol (DON) analysis.

b) What were the significant results?

Mean FHB severities for the wheat untransformed parental and/or checks Alsen, Bobwhite, CB037, Linkert, RB07, Rollag, and Sumai 3 were 41%, 61%, 52%, 35%, 39%, 37%, and 34%, respectively. The mean FHB severity for the susceptible wheat check Wheaton was 53%. The mean FHB severity for the untransformed parent barley check Rasmusson was 43% while the barley checks Quest and Stander had a mean FHB severities of 23% and 62%, respectively.

The FHB severity data indicated that resistance was improved in some transformed lines compared to the untransformed checks. The DON data generally aligned with the observed levels of disease. Specific results were delivered to the cooperators and presented in the poster at the USWBSI forum in December 2019.

c) List key outcomes or other achievements.

In 2019 we conducted a successful nursery. The PI's submitting entries had their data ahead of the USWBSI forum and we presented the field data in a poster at that meeting.

3. Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.

No. All work in this project was completed by December 2019.

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

None. Given the nature of the project, only personnel with considerable experience in running transgenic nurseries and with APHIS and IBC authorization are allowed on the trial site.

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

The USWBSI-funded PIs with wheat and barley entries in the nursery have been provided their data and copied on all communications with APHIS regarding post-harvest site monitoring as necessary to meet permit obligations.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY19 award period (5/6/19 - 5/5/20). The term "support" below includes any level of benefit to the student, ranging from full stipend plus tuition to the situation where the student's stipend was paid from other funds, but who learned how to rate scab in a misted nursery paid for by the USWBSI, and anything in between.

1. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their MS degree during the FY19 award period?**
   No

   If yes, how many?

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY19 award period?**
   No

   If yes, how many?

3. **Have any post docs who worked for you during the FY19 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**
   No

   If yes, how many?

4. **Have any post docs who worked for you during the FY19 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**
   No

   If yes, how many?

Release of Germplasm/Cultivars

Instructions: In the table below, list all germplasm and/or cultivars released with full or partial support through the USWBSI during the FY19 award period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations.

NOTE: Leave blank if you have nothing to report or if your grant did NOT include any VDHR-related projects.

Name of Germplasm/Cultivar	**Grain Class**	**FHB Resistance** (S, MS, MR, R, where R represents your most resistant check)	**FHB Rating** (0-9)	**Year Released**

Add rows if needed.

NOTE: List the associated release notice or publication under the appropriate sub-section in the 'Publications' section of the FPR.

Abbreviations for Grain Classes

Barley - BAR
Durum - DUR
Hard Red Winter - HRW
Hard White Winter - HWW
Hard Red Spring - HRS
Soft Red Winter - SRW
Soft White Winter - SWW

Publications, Conference Papers, and Presentations

Instructions: Refer to the FY19-FPR_Instructions for detailed more instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY19 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period (5/6/19 - 5/5/20**) should be included. If you did not publish/submit or present anything, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each citation, you **must** indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in the publication/ presentation.

Journal publications.

McKee, G., Cowger, C., Dill-Macky, R., Friskop, A., Gautam, P., Ranson, J., and Wilson, W. (2019). Disease management and estimated effects on DON (deoxynivalenol) contamination in Fusarium infested barley. *Agriculture*, 9:155.
Status: Published
Acknowledgement of Federal Support: Yes

Anderson, J.A., Wiersma, J.J., Reynolds, S.K., Caspers, R., Linkert, G.L., Kolmer, J.A., Jin, Y., Rouse, M.N., Dill-Macky, R., Smith, M.J., Dykes, L., and Ohm, J.-B. (2019). Registration of 'Shelly' Hard Red Spring Wheat. *Journal of Plant Registrations*, 13:199-206.
Status: Published
Acknowledgement of Federal Support: Yes

Paul, P.A., Salgado, J.D., Bergstrom, G.C., Bradley, C.A., Byamukama, E., Byrne, A.M., Chapara, V., Cummings, J.A., Chilvers, M.I., Dill-Macky, R., Friskop, A.J., Kleczewski, N.M., Madden, L.V., Nagelkirk, M., Stevens, J., Smith, M.J., Wegulo, S.N., Wise, K.A., and Yabwalo, D.N. (2019). Integrated effects of genetic resistance and prothioconazole + tebuconazole application timing on Fusarium head blight in wheat. *Plant Disease*, 103:223-237.
Status: Published
Acknowledgement of Federal Support: Yes

Books or other non-periodical, one-time publications.

Nothing to report

Other publications, conference papers and presentations.

De Wolf, E., Shah, D., Paul, P., Madden, L., Crawford, S., Hane, D., Canty, S., Dill-Macky, R., Van Sanford, D., Imhoff, K., and Miller, D. (2019). "Impact of prediction tools for Fusarium head blight in the US, 2009-2019." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 12), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Paul, P.A., Ng, S.J., Bergstrom, G., Bissonnette, K., Bowen, K., Bradley, C., Byamukama, E., Chilvers, M., Collins, A., Cowger, C., Darby, H., De Wolf, E., Dill-Macky, R., Esker, P., Friskop, A., Kleczewski, N., Koehler, A., Madden, L., Marshall, J., Mehl, H., Moraes, W., Nagelkirk, M., Rawat, N., Smith, D., Telenko, D., Wegulo, S., and Young-Kelly, H. (2019). "Fusarium head blight management coordinated project: Integrated management trials 2018-2019." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (pp. 20-24), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Paul, P.A., Ng, S.J., Bergstrom, G., Bissonnette, K., Bowen, K., Bradley, C., Byamukama, E., Chilvers, M., Collins, A., Cowger, C., Darby, H., De Wolf, E., Dill-Macky, R., Esker, P., Friskop, A., Kleczewski, N., Koehler, A., Madden, L., Marshall, J., Mehl, H., Moraes, W., Nagelkirk, M., Rawat, N., Smith, D., Telenko, D., Wegulo, S., and Young-Kelly, H. (2019). "Fusarium head blight management coordinated project: Uniform fungicide trials 2018-2019." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (pp. 25-29), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Dill-Macky, R., Curland, R.D., Zargaran, B., Muehlbauer, G.J., Bethke, G., Funnell-Harris, D., Shah, J., McLaughlin, J., and Tumer, N. (2019). "Testing transgenic spring wheat and barley lines for reaction to Fusarium head blight: 2019 field nursery report." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (pp. 46-47), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Funnell-Harris, D., Duray, Z., Sattler, S., Wegulo, S., Dill-Macky, R., and Tatineni, S. (2019). "Response of wheat constitutively expressing monolignol biosynthesis genes to Fusarium head blight." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.),

Proceedings of the 2019 National Fusarium Head Blight Forum (pp. 48-49), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Huang, Y., Yin, L., Sallam, A., Heinen, S., Beaubien, K., Dill-Macky, R., Dong, Y., Steffenson, B., Smith, K.P., and Muehlbauer, G.J. (2019). "Genetic analysis of Fusarium head blight severity, malting quality and agronomic traits in the centromeric region of chromosome 6H in barley." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 51), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: No

McLaughlin, J.E., Tyagi, N., Trick, H.N., McCormick, S., Dill-Macky, R., and Tumer, N.E. (2019). "Non-specific lipid transfer proteins (nsLTPs) have antifungal and anti-ROS properties that enhance resistance of wheat to *Fusarium graminearum* infection and deoxynivalenol exposure." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 54), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Baldwin, T., Baldwin, S.A., Kress, E., Dill-Macky, R., Sorrells, M.E., Gross, P., Brueggeman, R., Griffey, C., Fitzgerald, J., Marshall, J., and Bregitzer, P. (2019). "Fusarium head blight biomass measurements in barley from 2018 U.S. nurseries." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 85), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Kumar, J., Rai, K.M., Pirseyedi, S.M., Xu, S., Elias, E.M., Dill-Macky, R., and Kianian, S. (2019). "Epigenetic modifications: a novel source of FHB resistance in durum wheat." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (pp. 98-99), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Salgado, J.D., Bergstrom, G.C., Bradley, C.A., Bowen, K.L., Byamukama, E., Byrne, A., Collins, A.A., Cowger, C., Cummings, J., Chapara, V., Chilvers, M., Dill-Macky, R., Darby, H.M., Friskop, A.J., Kleczewski, N.M., Madden, L.V., Marshall, J.M., Mehl, H.L., Nagelkirk, M., Stevens, J., Smith, D.L., Smith, M.J., Wegulo, S.N., Wise, K.A., Yabwalo, D., Kelly, H.M., and Paul, P.A. (2019). **"**Effects of two-treatment fungicide

programs on grain yield and quality of Fusarium head blight-affected wheat." In: Abstracts of Presentations, 2019 APS Annual Meeting, Cleveland, OH, August 3-7, 2019, *Phytopathology*, 109: S2.65.

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: No