USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY20 Annual Performance Progress Report
Due date: July 29, 2021

Cover Page

Principle Investigator (PI):	Stephen Wegulo
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Fiscal Year:	2020
USDA-ARS Agreement ID:	59-0206-0-191
USDA-ARS Agreement Title:	Integrated Management of Fusarium Head Blight and DON in Winter Wheat and Barley
FY20 USDA-ARS Award Amount:	$ 15,981
Recipient Organization:	University of Nebraska Sponsored Programs 312 N 14th, Alexander West Lincoln, NE 68588-0430
DUNS Number:	55-545-6995
EIN:	47-0049123
Recipient Identifying Number or Account Number:	25-6222-1021-001
Project/Grant Reporting Period:	5/15/20 - 5/14/21
Reporting Period End Date:	5/14/2021

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
MGMT	Integrating Strategies to Mitigate Fusarium Head Blight and DON in Winter Wheat	$ 15,981
	FY20 Total ARS Award Amount	**$ 15,981**

July 28, 2021

Principal Investigator — Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
R- Research
S – Service (DON Testing Labs)
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

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Project 1: *Integrating Strategies to Mitigate Fusarium Head Blight and DON in Winter Wheat*

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

The overall goal of this research was to integrate cultivar resistance with fungicide application to effectively manage FHB and DON in winter wheat. The specific objectives were:

1) Evaluate the integrated effects of fungicide treatment and genetic resistance on FHB and DON in winter wheat with emphasis on a new fungicide, Miravis Ace®.
2) Enhance communication and end user education/outreach on integrated management of FHB and DON.

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?

A field experiment was conducted to investigate the effects of cultivar resistance and fungicide application on FHB and DON in winter wheat. The experiment was located at the University of Nebraska Havelock Research Farm near Lincoln, Nebraska. The experimental design was a split plot in randomized complete blocks with four replications, with cultivars as whole-plots and fungicide x inoculation treatments as sub-plots. Four cultivars adapted to Nebraska were used: Overland (moderately resistant), Millennium (moderately resistant), Roubidoux (susceptible), and Wesley (susceptible). The fungicide x inoculation treatments were 1) untreated, inoculated check; 2) Prosaro® (6.5 fl. oz.) at anthesis, inoculated; 3) Miravis Ace (13.7 fl. oz.) at anthesis, inoculated; 4) Miravis Ace at Feekes 10.3, inoculated; 5) Miravis Ace (13.7 fl. oz.) at anthesis followed by Tebuconazole (4.0 fl oz/A 4-6 days later; and 6) untreated, non-inoculated check. Fungicides were applied with a CO_2-powered backpack sprayer set at 35 psi, equipped with four Teejet 800-1 VS nozzles, and calibrated to deliver 20 gallons of fungicide-water mixture per acre. In treatments 1 to 5, plots were spray-inoculated with spores of *Fusarium graminearum* (1×10^5 spores/mL) 24 hours after fungicide application at anthesis. To enhance inoculum buildup in the plots as well as disease development, corn kernel inoculum was spread weekly on the soil surface starting at three weeks before anthesis. FHB intensity was assessed at the soft dough growth stage. At and following harvest, yield, test weight, *Fusarium*-damaged kernels (FDK), and DON concentration were determined. A weather station at the experiment site recorded weather data starting in mid-April through harvest.

b) What were the significant results?

Low levels of FHB developed due to unfavorable weather conditions. The susceptible cultivars Robidoux and Wesley had significantly higher (P = 0.05) FHB index (1.6% and

1.5%, respectively) than the moderately resistant Millennium and Overland (0.8% and 0.4%, respectively). FDK results were similar, with the susceptible Robidoux and Wesley having significantly higher FDK (16% and 13%, respectively) than the moderately resistant Overland and Millennium (5% and 3%, respectively). Test weight was significantly higher in the moderately resistant Millennium (58 lb/bu) than in the susceptible Wesley (53 lb/bu), but was similar between Overland and Robidoux (57 lb/bu for both cultivars). Prosaro applied at anthesis and Miravis Ace applied at Feekes 10.3 and at anthesis resulted in a significantly lower index (1.0%) than the control (2.4%). Prosaro and Miravis Ace significantly reduced FDK (4-10%) compared to the control (14%). DON was negligible at < 0.20 ppm in 92 out of a total of 96 plots and ≤ 0.64 ppm in the remaining 4 plots.

c) List key outcomes or other achievements.

The combination of moderate cultivar resistance and application of the fungicides Prosaro and Miravis Ace at anthesis most effectively reduced FHB index and FDK.

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

- COVID-19 increased workload and made everything more difficult and time consuming. For instance, research technologist Julie Stevens did risk assessments and wrote up safety and training protocols that she had Environmental Health and Safety check. She made PowerPoint presentations to train students instead of doing it in person. She spent time renewing travel authorizations.

- We were unable to access buildings at Havelock Research Farm, therefore we did more by hand and using smaller equipment rather than using farm equipment (like tractors and mowers), to prepare the field for harvest. Our visits to the farm were restricted and we had to have permission to go there.

- Julie was unable to collect FHB samples in the field because it was unsafe for her to be in the combine with the driver. Although it is not the driver's job, he did us a favor and collected samples and drove, but it took twice the time to harvest, and could have resulted in mistakes being made.

- Postharvest we had to do a lot more work outside in order to stay safe. Our crew worked slower in the heat and they had to take frequent breaks or risk heat fatigue.
- It was harder to move equipment as we couldn't safely do so in a group.

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

Research technologist Julie Stevens attended the 2020 National FHB Forum as part of her professional development. Undergraduate student workers gained research training and experience working on the project.

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

Information on FHB and other wheat diseases and their management was disseminated through Nebraska Extension's CropWatch newsletter.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY20 award period (5/15/20 - 5/14/21). 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 FY20 award period?**
   ☐Yes ☒No
   If yes, how many? Click to enter number here.

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY20 award period?**
   ☐Yes ☒No
   If yes, how many? Click to enter number here.

3. **Have any post docs who worked for you during the FY20 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**
   ☐Yes ☒No
   If yes, how many? Click to enter number here.

4. **Have any post docs who worked for you during the FY20 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**
   ☐Yes ☒No
   If yes, how many? Click to enter number here.

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 FY20 award period (5/15/20 - 5/14/21). 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	FHB Rating (0-9)	Year Released
N/A	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
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Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year

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

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Publications, Conference Papers, and Presentations

Instructions: Refer to the PR_Instructions for detailed more instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY20 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period (5/15/20 - 5/14/21**) 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. See example below for a poster presentation with an abstract:

> Winn, Z.J., Acharya, R., Lyerly, J., Brown-Guedira, G., Cowger, C., Griffey, C., Fitzgerald, J., Mason R.E., & Murphy, J.P. (2020, Dec 7-11). Mapping of Fusarium Head Blight Resistance in NC13-20076 Soft Red Winter Wheat (p. 12). In: Canty, S., Hoffstetter, A. and Dill-Macky, R. (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum*. https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf.
> Status: Abstract Published and Poster Presented
> Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

Valverde-Bogantes, E., Bolanos-Carriel, C., Hallen-Adams, H.E., McMaster, N., Schmale III, D., & Wegulo, S.N. (2020). Aggressiveness and deoxynivalenol production of Nebraska isolates of *Fusarium boothii* and *F. graminearum*. *Plant Health Prog*, *21*:97-102.
Status: Published.
Acknowledgement of Federal Support: YES

Bolanos-Carriel, C., Wegulo, S.N., Baenziger, P.S., Funnell-Harris, D., Hallen-Adams, H. & Eskridge, K.M. (2020).Effects of fungicide chemical class, fungicide application timing, and environment on Fusarium head blight in winter wheat. *Eur. J. Plant Pathol. 58*:667-679.
Status: Published.
Acknowledgement of Federal Support: YES

Baenziger, P.S., Graybosch, R.A., Rose, D.J., Xu, L., Guttieri, M.J., Regassa, T., Klein, R.N., Kruger, G.R., Santra, D.K., Hergert, G.W., Wegulo, S.N., Jin, Y., Kolmer, J., Hein, G.L., Bradshaw, J., Chen, M.-S., Bai, G., Bowden, R.L., El-Basyoni I., & Lorenz, A. (2020). Registration of 'NE10589' (Husker Genetics Brand Ruth) hard red winter wheat. *J. Plant Regist. 14*:388-397.
Status: Published.
Acknowledgement of Federal Support: YES

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

Nothing to report.

Other publications, conference papers and presentations.

Luis, J.M., Ng, S.J., Bergstrom, G., Bissonnette, K., Bowen, K., Bradley, C., Byamukama, E., Chilvers, M., Collins, A., Cowger, C., Darby, H., DeWolf, 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., Young-Kelly, H., & Paul, P.A. (2020, Dec. 7-11). Fusarium head blight management coordinated project: Integrated management trials 2018-2020 (pp. 38-43). In: Canty, S., Hoffstetter, A. and Dill-Macky, R. (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum*. https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf.
Status: Published
Acknowledgement of Federal Support: Yes

Luis, J.M., Ng, S.J., Bergstrom, G., Bissonnette, K., Bowen, K., Bradley, C., Byamukama, E., Chilvers, M., Collins, A., Cowger, C., Darby, H., DeWolf, 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., Young-Kelly, H., & Paul, P.A. (2020, Dec. 7-11). Fusarium head blight management coordinated project: Uniform fungicide trials 2018-2020 (pp. 44-48). In: Canty, S., Hoffstetter, A. and Dill-Macky, R. (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum*. https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf.
Status: Published
Acknowledgement of Federal Support: Yes

Funnell-Harris, D., Duray, Z., Dill-Macky, R., O'Neill, P., Sattler, S., Wegulo, S. & Tatineni, S. (2020, Dec. 7-11). Discovering gene expression changes linked to phenylpropanoid-based FHB resistance (Page 68). In: S. Canty, A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum*, https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (Abstract and Poster)

Wang, F., Wegulo, S., Stevens, J., Belamkar, V., & Baenziger, P.S. (2020, Dec. 7-11). Breeding for Fusarium head blight resistance of wheat *Triticum aestivum*) by marker-assisted selection and genomic selection (Page 78). In: S. Canty, A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum*, https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf.
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