

USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY17 Final Performance Report
Due date: July 31, 2018

Cover Page

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| Principle Investigator (PI): | David Schmale |
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| Phone: | 540-231-6943 |
| Fiscal Year: | 2017 |
| USDA-ARS Agreement ID: | 59-0206-6-017 |
| USDA-ARS Agreement Title: | Diagnostic Testing Services for Deoxynivalenol in the Eastern U.S. |
| FY17 USDA-ARS Award Amount: | \$ 177,964 |
| Recipient Organization: | Virginia Polytechnic Institute and State University 1880 Pratt Drive, Suite 2006 Blacksburg, VA 24060 |
| DUNS Number: | 003137015 |
| EIN: | 54-6001805 |
| Recipient Identifying Number or Account Number: | 422288 & 422533 |
| Project/Grant Reporting Period: | 6/7/17 - 6/6/18 |
| Reporting Period End Date: | 06/06/18 |

USWBSI Individual Project(s)

| USWBSI Research Category* | Project Title | ARS Award Amount |
|----------------------------------|--|-------------------------|
| FST | Diagnostic Testing Services for Deoxynivalenol in the Eastern U.S. | \$ 66,292 |
| | FY17 Total ARS Award Amount | \$ 177,964 |



Principal Investigator

July 27, 2018

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

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Project 1: *Diagnostic Testing Services for Deoxynivalenol in the Eastern U.S.*

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

The overall goals of our project were to (1) provide diagnostic testing services for DON for wheat and barley samples associated with USWBSI-supported research projects in the eastern U.S. and (2) reduce DON contamination in wheat and barley.

2. What was accomplished under these goals? *Address items 1-4) below for each goal or objective.*

- 1) Major activities. In FY17, DON data was delivered for 3,348 wheat and barley samples from the following USWBSI investigators: Griffey, Glover, Mehl, Wegulo, Schmale, Marshall, and Holshouser. Rideout, Laskar, and Grybauskas originally planned to submit samples, but did not send any for analysis. Glover's numbers were greatly reduced because he lost an entire nursery to mother nature. The testing number does not include controls, checks, and re-runs. Most of the samples tested in FY17 were 100g kernel lots from FHB field trials, but some were smaller lots (~5g samples) from laboratory experiments. We also processed samples associated with DON during detoxification studies. Extraction, clean-up, and quantification of DON were conducted following standard protocols using a GC/MS. Research associate Niki McMaster and PI David Schmale attended the 2017 USWBSI meeting in Milwaukee.
- 2) Specific objectives. The specific objectives of the proposed research were to (1) provide analytical services necessary to develop new cultivars of wheat and barley with reduced potential for DON contamination and to (2) facilitate DON testing that will improve chemical and cultural practices necessary to reduce DON contamination in wheat and barley.
- 3) Significant results. The proposed project provided essential DON testing services for the USWBSI and supported the only USWBSI-associated DON testing lab in the eastern U.S. Many of the wheat and barley lines had not been tested previously for mycotoxins.
- 4) Key outcomes or other achievements. The research has contributed to the development and release of new FHB-resistant wheat and barley varieties, (2) ensured rigorous testing of both new and historical wheat and barley varieties for mycotoxin contamination. The Schmale Lab at Virginia Tech continues to be committed to the long-term management of a successful and productive mycotoxin testing lab for the USWBSI. DON testing services were coordinated, supported, and managed by a talented research associate (Niki McMaster).

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

McMaster helped develop a unit for advanced secondary school students that highlights the potential dangers of mycotoxins in feed and food products. Students worked in small groups to detect the mycotoxin (DON) from common grocery store products. A safe, easy-to-use enzyme-linked immunosorbent assay (ELISA) was used to determine if DON was present in these products. Students were asked to think about ways of mitigating these toxins in commercial scenarios, ranging from toxin removal strategies to policies to regulate them. This unit has been accepted for publication in the Science Teacher, and will be published in the August, 2018 issue.

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

Schmale gave a series of lectures on mycotoxins for about 130 undergraduate students at Virginia Tech. McMaster coordinated the lesson highlighted in (3), and communicated with USWBSI stakeholders via phone and email to coordinate sample collection, processing, and testing. Results were disseminated to stakeholders at the 2017 USWBSI meeting in Milwaukee.

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Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY17 award period. 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 FY17 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 FY17 award period?** Yes

If yes, how many? 1

3. **Have any post docs who worked for you during the FY17 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 FY17 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?

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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 FY17 award period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations. *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 |
|----------------------------|-------------|--|------------------------|------------------|
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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

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Publications, Conference Papers, and Presentations

Instructions: Refer to the FY17-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY17 grant. Only include citations for publications submitted or presentations given during your award period (6/7/17 - 6/6/18). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

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

Journal publications.

Wilson, N., Dashiell, S., McMaster, N., Bohland, C., and Schmale, D. 2018. Could Your Food be Contaminated with Toxins? Educating High School Students about Mycotoxins in Feed and Food Products. *The Science Teacher*.

Status: Accepted on May 3, 2018. Slated for the August 2018 issue.

Acknowledgement of Federal Support: YES (publication)

Wilson, N., McMaster, N., Gantulga, D., Soyars, C., McCormick, S., Knott, K., Senger, R., and Schmale, D. 2017. Modification of the Mycotoxin Deoxynivalenol Using Microorganisms Isolated from Environmental Samples. *Toxins* 9(4): 141. doi:10.3390/toxins9040141

Status: Published.

Acknowledgement of Federal Support: YES (publication)

S. N. Wegulo, E. Valverde-Bogantes, C. Bolanos-Carriel, H. Hallen-Adams, A. Bianchini, N. McMaster, and D. G. Schmale III. 2018. First Report of *Fusarium boothii* Causing Head Blight of Wheat in the United States. *Plant Disease*.

Status: Accepted on June 8, 2018.

Acknowledgement of Federal Support: YES (publication)

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

Other publications, conference papers and presentations.

Carlos Bolanos-Carriel, Heather Hallen-Adams, Stephen N. Wegulo, P. Stephen Baenziger, Kent M. Eskridge, Deanna Funnell-Harris, Nicole McMaster and David G. Schmale III. 2017. Toxin Gene Expression Analysis and Deoxynivalenol Concentration during Postharvest Storage of Wheat Grain from a *Fusarium* Head Blight Epidemic in Nebraska. In: Proceedings of the 2017 National *Fusarium* Head Blight Forum, Milwaukee, WI.

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES

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Fitzgerald, J., C. Griffey, W. Brooks, N. Carpenter, D. Van Sanford, J.P. Murphy, N. McMaster and D. Schmale III. 2017. Evaluation of Winter Barley Cultivar Nomini for Quantitative Resistance to Fusarium Head Blight. In: Proceedings of the 2017 National Fusarium Head Blight Forum, Milwaukee, WI

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES

Celia Jimenez-Sanchez, Nina Wilson, Nicole McMaster, Dash Gantulga, Ryan Senger and David Schmale. 2017. A Deoxynivalenol (DON) Transporter from a Library of DON-Detoxifying Microorganisms. In: Proceedings of the 2017 National Fusarium Head Blight Forum, Milwaukee, WI

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES

Nicole McMaster, Jan Grothe, Bhupendra Acharya, Hillary Mehl and David G. Schmale III. 2017. Stable Isotope Dilution Analysis for the Accurate Determination of Deoxynivalenol in Sorghum by GC-MS. In: Proceedings of the 2017 National Fusarium Head Blight Forum, Milwaukee, WI

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES

A Cell-Free Protein Synthesis System to Screen Enzymes that Modify the Mycotoxin Deoxynivalenol. 2017. Nina M. Wilson, Jiayuan Sheng, Nicole McMaster, Xueyang Feng, Ryan S. Senger and David G. Schmale III. In: Proceedings of the 2017 National Fusarium Head Blight Forum, Milwaukee, WI

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES

Stephen N. Wegulo, Carlos Bolanos-Carriel, Heather Hallen-Adams, P. Stephen Baenziger, Kent M. Eskridge, Deanna Funnell-Harris, Nicole McMaster and David G. Schmale III. 2018. Effects of fungicide chemical class and cultivar resistance on Fusarium head blight and deoxynivalenol in winter wheat under field and postharvest storage conditions. In: Proceeding of the 2018 Conference of Botany, Pakistan.

Status: Abstract Published and Presented?

Acknowledgement of Federal Support: YES

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FY17 FPR – USWBSI ADDENDUM DON Service Labs – Quality Control (QC) Data

Note: What is being requested is the across lab quality control data (separate QC from Trilogy).

Insert below Quality Control Data/Results from the FY17 Award Period (6/7/17 - 6/6/18):

Quality control data were collected at Virginia Tech through (a) the blind testing of samples with unknown DON levels (coordinated by the USWBSI through Trilogy Analytical Laboratories), and (b) the testing of subsamples of grain lots in each GC/MS run (to test for consistency among GC/MS runs). Known standards are run throughout the the GC/MS run to establish our standard curves.

- a. QC data for blind testing of samples from Trilogy Labs (coordinated by Trilogy Labs, and communicated through Sue Canty; nfo@scabusa.org). Lab ID ‘Lab3’ is the Virginia Tech lab (highlighted in grey). Lab IDs 1-4 are other USWBSI labs. Data are in ppm.

| Testing Period | Trilogy Sample | Trilogy Quant | Lab 1 | Lab 2 | Lab 3 | Lab 4-1 | Lab 4-2 |
|----------------|----------------|---------------|-------|-------|-------|---------|---------|
| August 2017 | Low | 1.20 | 1.38 | nd | 0.90 | 1.07 | 1.14 |
| | Med | 4.50 | 6.18 | nd | 3.71 | 3.71 | 4.12 |
| | High | 8.60 | 9.74 | nd | 7.21 | 7.36 | 7.62 |
| Sept 2017 | Low | 0.90 | 1.00 | nd | 0.86 | 0.85 | 0.84 |
| | Med | 3.60 | 3.70 | nd | 2.87 | 3.28 | 3.25 |
| | High | 9.30 | 10.30 | nd | 7.14 | 7.66 | 8.06 |
| Oct 2017 | Low | 0.70 | 0.60 | 0.62 | 0.55 | 0.46 | 0.44 |
| | Med | 2.70 | 2.60 | 2.11 | 1.45 | 1.89 | 1.91 |
| | High | 8.60 | 7.50 | 6.82 | 7.05 | 6.02 | 6.24 |
| Nov 2017 | Low | 1.20 | 0.86 | 1.05 | 0.94 | 1.24 | 1.28 |
| | Med | 3.80 | 3.28 | 4.33 | 3.08 | 3.27 | 3.34 |
| | High | 9.30 | 7.94 | 9.38 | 7.78 | 8.59 | 8.43 |
| Dec 2017 | Low | 1.00 | 0.79 | 0.82 | 0.82 | 0.98 | 1.05 |
| | Med | 4.50 | 2.23 | 4.95 | 3.84 | 4.14 | 4.11 |
| | High | 8.60 | 6.97 | 8.72 | 6.73 | 7.97 | 7.59 |
| Jan 2018 | Low | 1.00 | 1.10 | 0.65 | 0.80 | 1.15 | 1.34 |
| | Med | 3.60 | 4.10 | 1.98 | 2.76 | 3.42 | 3.64 |
| | High | 9.30 | 8.20 | 4.60 | 6.87 | 8.53 | 8.59 |
| Feb 2018 | Low | 1.60 | 1.30 | 1.20 | 1.30 | 1.59 | 1.79 |
| | Med | 3.80 | 3.46 | 3.10 | 3.59 | 3.63 | 3.70 |
| | High | 8.60 | 8.14 | 7.98 | 8.22 | 8.26 | 8.68 |
| March 2018 | Low | 1.20 | 0.70 | 0.78 | 0.84 | 1.17 | 1.20 |
| | Med | 3.60 | 2.70 | 1.97 | 2.63 | 3.15 | 3.35 |
| | High | 9.30 | 5.90 | 5.01 | 6.08 | 7.53 | 7.94 |
| April 2018 | Low | 0.50 | 0.11 | 0.64 | 0.47 | 0.55 | 0.57 |
| | Med | 2.90 | 2.02 | 1.88 | 2.15 | 2.63 | 2.59 |
| | High | 8.60 | 6.71 | 6.88 | 6.56 | 7.36 | 7.48 |

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b. QC data from internal checks of subsamples of grain lots from Trilogy (14-Apr-03 or 13-Nov-01) in each GC/MS run (to test for consistency among GC/MS runs). Trilogy sample 14-Apr-03 was measured 85 times, and determined to have an average DON concentration of 6.51ppm with a standard error of the mean of 0.052. Trilogy sample 13-Nov-01 was measured 81 times, and determined to have an average DON concentration of 5.04 ppm with a standard error of the mean of 0.045.

