

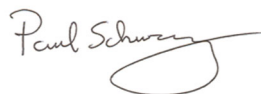
**USDA-ARS/  
U.S. Wheat and Barley Scab Initiative  
FY19 Final Performance Progress Report  
Due date: July 29, 2021**

**Cover Page**

<b>Principle Investigator (PI):</b>	Paul Schwarz
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<b>Fiscal Year:</b>	2019
<b>USDA-ARS Agreement ID:</b>	59-0206-8-201
<b>USDA-ARS Agreement Title:</b>	Evaluation of Barley and Malt for DON and Deoxynivalenol-3-Glucoside
<b>FY19 USDA-ARS Award Amount:</b>	\$ 152,485
<b>Recipient Organization:</b>	North Dakota State University Office of Grant & Contract Accounting NDSU Dept 3130, PO Box 6050 Fargo, ND 58108-0650
<b>DUNS Number:</b>	80-388-2299
<b>EIN:</b>	45-6002439
<b>Recipient Identifying Number or Account Number:</b>	FAR0028542
<b>Project/Grant Reporting Period:</b>	5/5/19 - 5/4/21
<b>Reporting Period End Date:</b>	5/4/2021

**USWBSI Individual Project(s)**

<b>USWBSI Research Category*</b>	<b>Project Title</b>	<b>ARS Award Amount</b>
FST-S	Evaluation of Barley and Malt for DON and Deoxynivalenol-3-Glucoside	\$ 152,485
<b>FY19 Total ARS Award Amount</b>		<b>\$ 152,485</b>



July 29, 2021

Principal Investigator

Date

\* MGMT – FHB Management  
 FST – Food Safety & Toxicology  
     R – Research  
     S – Service (DON Testing Lab)  
 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: Evaluation of Barley and Malt for DON and Deoxynivalenol-3-Glucoside**

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

The goal of this project is to provide barley breeders, pathologists, and other researchers working on the development of Fusarium resistant barley, with affordable, accurate and timely DON analysis.

**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?**

2019-2020: Approximately 8,600 samples were analyzed for USWBSI researchers during the reporting period (exclusive of checks/standard curves=979). Fifteen UWSBSI researchers, in six states were served. If the eastern Spring Barley Nursery (ESBN) is included the total number of researchers and states increases to twenty-one and twelve, respectively.

The majority of samples were submitted by five barley breeding programs (ND, MN, MT, ID, CO) and one barley pathology project (ND).

USWBSI Projects		
Collaborator	Location	Samples
Brueggeman	NDSU - Fargo	1242
Chapara	NDSU - Langdon	96
Forster	NDSU - Minot	36
Friskop	NDSU Fargo	36
Horsley	NDSU - Fargo	1247
Horsley	Eastern Barley Nursery	225
Ransom	NDSU- Fargo	0
Rao	NDSU - Fargo	0
Schatz	NDSU- Carrington	104
Schwarz/Jin	NDSU -Fargo	107
Smith	UMN	82
Baldwin	USDA-Aberdeen	3559
He	USDA-Aberdeen <sup>1</sup>	0
Satterfield	USDA-Aberdeen	0
Timmerman	Busch Ag Resources	1979
Sherman	MSU	547

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Collaborator	Location	Samples
Paul	OSU	354
Standard Curve		522
Check Samples		454
Trilogy		3
Total		9617
<b>FHB Related – Outside of USWSI</b>		
Turner	The Land Institute <sup>2</sup>	824

<sup>1</sup>Some USDA-Idaho samples were submitted by Brueggeman lab. We believe this includes 600 for Hu.

<sup>2</sup>Wheat grass samples from the Land Institute were analyzed last, and they were charged for materials/supplies.

2020-2021

Approximately 13,600 barley samples were analyzed for nineteen scientists representing nine institutions/organizations. This was an increase in the number of cooperators over past years, and occurred because of reallocation of samples from the U of MN laboratory. There were some issues with samples from multi-researcher projects, not being submitted by the PI. This issue has largely been clarified. Total samples analyzed 14,838 was not much different than the estimate of the original grant (13,972).

**DON Analysis 2020-21**

Collaborator	Allotted	samples	completed	Under/Over
Tom Baldwin-NDSU	1000	1725	1725	725
Venkata Chapara-NDSU	200	76	76	-124
Alyssa Collins-Penn St.	258	144	144	-114
Christina Cowger-USDA	182	182	182	0
Frankie Crutcher-Mont. St.	500	219	219	-281
Eastern Malting-NDSU (Horsley)	250	389	389	139
Shana Forster-NDSU	50	6	6	-44
Andrew Friskop-NDSU	72	237	237	165
Rich Horsley-NDSU	2000	3637	3637	1637

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<b>Collaborator</b>	<b>Allotted</b>	<b>samples</b>	<b>completed</b>	<b>Under/Over</b>
Gongshe Hu-USDA	500	270	270	-230
Kathy Klos-USDA	3000	1950	1950	-1050
Joel Ransom-NDSU	100	0	0	-100
Jiajia Rao-NDSU	150	395	395	245
Kathy Satterfield-USDA		170	170	170
Blaine Schatz-NDSU Carrington	80	0	0	-80
Paul Schwarz-NDSU	500	189	189	-311
Jamie Sherman-Mont. St.		0	0	0
Kevin Smith-UofM	1500	1424	1424	-76
Mark Sorrells-Cornell	700	644	644	-56
Marie Timmerman- BARI	2000	1949	1949	-51
Total	13042	13606	13606	564
Standard Curves and Checks	930	1232	1232	302
<b>Grand Total</b>	<b>13972</b>	<b>14838</b>	<b>14838</b>	<b>866</b>

**b) What were the significant results?**

Samples were analyzed, and results returned in a time period of August to May in each reporting period.

**c) List key outcomes or other achievements.**

Intra-lab QC was improved in the 2020-221 reporting period.

**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.**

Yes, this work was impacted by COVID-19. In-person classes at NDSU were stopped as of March 23, 2020. Because of this we lost 2 time-slip undergraduate students, who were largely responsible for weighing and grinding samples. In addition, the two staff (Mr. Gillespie and Dr Jin) began to work separate shifts as to minimize contact in the lab. All factors combined slowed analyses, although the majority of samples had been completed. 2020-2021 samples began to arrive in July 2021. Staff continued to work separate shifts through October of 2020. The main impacts of COVID-19 in 2020-2021 were reduced availability of student labor (for grinding of samples), and issues with supplies frequently being back-ordered. Another impact was the 4-5 month delayed

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install on the Agilent triple quadrupole mass spectrometer. Agilent has still not completed the on- site training.

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

In 2019-2020, two undergraduate students, one graduate student and one post-doctoral researcher assist in the laboratory. Undergraduate students have learned basic laboratory skills, while graduate students have learned methods for DON, DON-3-glucoside and other trichothecenes, as well as, laboratory quality control. The post-doctoral researcher has been provided with opportunities to learn mycotoxin analysis by GC, GC-MS, LC-MS, rt-PCR for Fusarium measurement, some aspects of laboratory management and has also conducted independent research on FHB.

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

Data is provided directly to collaborating scientists. Information on DON and other trichothecenes in barley, malt and beer has been disseminated by presentations at conferences and webinars.

## Training of Next Generation Scientists

**Instructions:** Please answer the following questions as it pertains to the **FY19 award period (5/5/19 - 5/4/21)**. 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 FY19 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 FY19 award period?**

Yes     No

**If yes, how many?** [Click to enter number here.](#)

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?**

Yes     No

**If yes, how many?** [Click to enter number here.](#)

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?**

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 **FY19 award period (5/5/19 - 5/4/21)**. 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
Not applicable to this project.	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
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

**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 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 (5/5/19 - 5/4/21)** 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:

Z.J. Winn, R. Acharya, J. Lyerly, G. Brown-Guedira, C. Cowger, C. Griffey, J. Fitzgerald, R.E. Mason and J.P. Murphy. 2020. "Mapping of Fusarium Head Blight Resistance in NC13-20076 Soft Red Winter Wheat." In: S. Canty, A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum* (p. 12.), Virtual; December 7-11. Online: [https://scabusa.org/pdfs/NFHBF20\\_Proceedings.pdf](https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf).

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES (Abstract and Poster)

### Journal publications.

Z. Jin, S. Solanki, G. Ameen, T. Gross, R.s. Poudel, P. Borowicz, R.S. Brueggeman, and P. Schwarz. "Expansion of internal hyphal growth in Fusarium Head Blight infected grains contributes to the elevated mycotoxin production during the malting process."

Molecular Plant – Microbe Interactions. 2021, Online:

<https://apsjournals.apsnet.org/doi/10.1094/MPMI-01-21-0024-R>

Status: in proof

Acknowledgement of Federal Support: Yes

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

Jin, Z., and Schwarz, P. (2020). Advances in postharvest storage and handling of barley: Methods to prevent or reduce mycotoxin contamination. Pages 227–264 in Achieving Sustainable Cultivation of Barley. G. Fox and C. Li, editors. Burleigh Dodds Science Publishing. <https://doi.org/10.19103/as.2019.0060.15>

Status: Published

Acknowledgement of Federal Support: NO

### Other publications, conference papers and presentations.

Jin, Z., Solanki, S., Tang, R., Gillespie, J., Borowicz, O., Brueggeman, R. and Schwarz, P. 2019. Fungal localization and mycotoxin production in Fusarium infected grain and malt kernels. Patterns of fungal distribution in Fusarium infected barley, rye and triticale



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grain and malt. In: Canty, S., A. Hoffstetter, B. Wiermer and R. Dill-Macky (Eds.), Proceedings of the 2019 National Fusarium Head Blight Forum (p.40). East Lansing, MI: U.S. Wheat & Barley Scab Initiative.

Status: Published

Acknowledgement of Federal Support: YES (Abstract and Poster)

Jin, Z., Solanki, S., Tang, R., Brueggeman, R. and Schwarz, P. 2019. Patterns of fungal distribution in *Fusarium* infected barley, rye and triticale grain and malt. In Proceedings of the 2019 American Society of Brewing Chemists Annual Meeting. ASBC, St Paul, MN

Status: Published

Acknowledgement of Federal Support: YES (Abstract and Poster)

Moraes, W., Ng, S.G, Schwarz, P., Madden L., and Peirce, P. 2019. Pre-harvest rainfall and harvesting strategy effects on the quality of Fusarium Head Blight affected grain. In: Canty, S., A. Hoffstetter, B. Wiermer and R. Dill-Macky (Eds.), Proceedings of the 2019 National Fusarium Head Blight Forum (p.18). East Lansing, MI: U.S. Wheat & Barley Scab Initiative.

Status: Published

Acknowledgement of Federal Support: YES (Abstract and Poster)

Z. Jin and P. Schwarz. 2020. "Effects of Fusarium infection timing on the production of deoxynivalenol in barley grain and malt" Processing of the 2020 National Fusarium Head Blight Forum (p. 58.), virtual; December 7-11. Online:

[https://scabusa.org/pdfs/NFHBF20\\_Proceedings.pdf](https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf)

Status: Abstract published and Poster presented

Acknowledgment of Federal Support: Abstract (Yes), Poster (Yes)

Z. Jin and P. Schwarz. 2021. "Characterization of trichothecene mycotoxin development during the malting of Fusarium infected barley and other grains." American Society of Brewing Chemists Webinar. Invited speaking, Virtual; March 4. Online:

<https://www.asbcnet.org/lab/webinars/webinars/Pages/trichothecene-mycotoxin.aspx>

Status: Webinar summary published and presentation delivered

Acknowledgment of Federal Support: Webinar summary (No), Presentation (Yes)

PI: Schwarz, Paul

Project: Evaluation of Barley and Malt for DON and Deoxynivalenol-3-Glucoside

**FY19-NCE 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 FY19-NCE Award Period (5/5/19 - 5/4/21):**

**FY19 Check Samples**

Std. ID	Matrix	No. of times analyzed	Average DON ppm	CV %
7	malt	64	6.03	16.08
12	barley	68	2.90	22.13
15	malt	51	28.66	15.66
17	barley	101	0.88	31.00
20	malt	73	3.31	18.87
22	barley	42	0.01	
29	malt	73	28.74	17.53
31	malt	71	17.05	18.19
32	malt	71	46.02	17.98
44/45	barley	61	30.84	22.88
Mix	barley	61	32.03	22.09
corn	corn	62	5.51	29.83
Myco-20	standard	96	1.05	28.76
Myco-200	standard	104	11.96	27.51
Myco-2000	standard	112	102.15	39.63
<b>Total</b>		1110		23.44

**PI:** Schwarz, Paul

**Project:** Evaluation of Barley and Malt for DON and Deoxynivalenol-3-Glucoside

**FY20 Check Samples**

Table I. Quality Control Data on Malt DON Internal Checks.

DON results						
DON level	Low	Middle	Middle	High	High	High
Sample	malt	malt	malt	malt	malt	malt
ID#	20	7	31	15	29	32
<b>average</b>	<b>1.93</b>	<b>3.99</b>	<b>10.32</b>	<b>17.36</b>	<b>16.80</b>	<b>26.06</b>
Std dev	0.21	0.41	0.97	2.13	1.83	3.00
<b>cv</b>	<b>10.94</b>	<b>10.31</b>	<b>9.40</b>	<b>12.29</b>	<b>10.91</b>	<b>11.50</b>
Min	1.71	3.58	9.35	15.22	14.97	23.07
Max	2.14	4.40	11.29	19.49	18.63	29.06
N	84	129	108	117	105	107

Table II. Quality Control Data on Barley and Corn DON Internal Checks.

DON Results						
DON level	Clean	Low	Low	High	High	Middle
Sample	barley	barley	barley	barley	barley	corn
ID#	22	12	17	44/45	mix	corn
<b>average</b>	<b>0.02</b>	<b>2.12</b>	<b>0.55</b>	<b>20.26</b>	<b>23.48</b>	<b>4.29</b>
Std dev	0.03	0.22	0.03	2.75	3.22	0.64
<b>cv</b>		<b>10.56</b>	<b>5.21</b>	<b>13.56</b>	<b>13.71</b>	<b>14.96</b>
Min	-0.02	1.90	0.52	17.52	20.26	3.65
Max	0.05	2.35	0.58	23.01	26.70	4.94
N	70	126	22	122	148	94

**Summary:** Over 1000 check samples were analyzed during each reporting period. A marked improvement in coefficients of variance were seen in FY 20. This likely reflects improvements in laboratory QC measures. Results in FY19 may have also been impacted as lab staff were working at different times (to maintain one person/lab) which reduced coordination.