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

Cover Page

Principle Investigator (PI):	Yanhong Dong
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Phone:	612-625-2751
Fiscal Year:	2020
USDA-ARS Agreement ID:	59-0206-0-177
USDA-ARS Agreement Title:	Diagonostic Services for DON
FY20 USDA-ARS Award Amount:	$ 337,590
Recipient Organization:	Regents of the University of Minnesota Suite 450 Sponsored FIN RPT-P100100001 Minneapolis, MN 55455-2003
DUNS Number:	555917996
EIN:	41 -6007513
Recipient Identifying Number or Account Number:	CON000000086307
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
FST-S	Diagnostic services for DON	$ 337,590
	FY20 Total ARS Award Amount	**$ 337,590**

07/25/2021

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

Project 1: *Diagnostic services for DON*

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

   The goal of this project is to provide rapid, cost-effective and accurate mycotoxin analysis - especially deoxynivalenol (DON) - for Fusarium Head Blight (FHB or scab) research projects.

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?**
   Analyzed DON and related mycotoxins in wheat, barley and fungal culture extract using GC-MS; grinded grain seeds; extracted DON from grain samples; derivatized DON for GC-MS analysis; and prepared purification columns.

   b) **What were the significant results?**
   Despite the lab closure between March 16 and June 10, 2020 due to COVID-19, we were able to analyze all 25,215 samples (**Table** 1) submitted to our lab from June 2020 to May 2021. The samples were submitted by 35 scab research groups from 21 states including Arkansas, Georgia, Idaho, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Missouri, Montana, New York, North Carolina, North Dakota, Ohio, Pennsylvania, Texas, Washington and Wisconsin. The samples included 23,891 regular mature grain samples (4-100 g) and 1,324 small size samples such as grain samples less than 4 g, single kernel, single spikelet, single head, small stem, and fungal culture extract. The target toxins included DON, 15-Acetyl-DON, 3-Acetyl-DON, and nivalenol. Zearalenone was analyzed for some samples from Dr. Pierce Paul's lab.

Table 1. Summary of 2020/2021 samples

PI	Number of Sample			Institution
	Analyzed	Estimated	Difference	
Andrew Green	0	1000	-1000	North Dakota State University
Brian Steffenson	3797	1000	2797	University of Minnesota
Carl Bradley	250	800	-550	University of Kentucky
Clay Sneller	533	260	273	Ohio State University
Corby Kistler	46	1500	-1454	University of Minnesota
Christina Cowger	110	400	-290	USDA-ARS, Raleigh, NC
Damon Smith	156	500	-344	University of Wisconsin-Madison
Darcy Telenko	218	320	-102	Purdue University
David Van Sanford	0	3000	-3000	University of Kentucky
Deven See/Karol Marlowe	105	0	105	Washington State University
Don Obert	215	0	215	Limagrain Cereal Seeds, IN
Elias Elias	1443	1200	243	North Dakota State University
Eric DeWolf	0	200	-200	Kansas State University
Eric Olson	2229	1200	1029	Michigan State University
Eric Stockinger	0	1000	-1000	Ohio State University
Frances Trail	103	300	-197	Michigan State University
Frankie Crutcher	191	800	-609	Montana State University
Gary Bergstrom	240	600	-360	Cornell University
Gary Muehlbauer	0	250	-250	University of Minnesota
Gongshe Hu	0	300	-300	USDA-ARS, Idaho
Guihua Bai	1399	1000	399	USDA-ARS, KS
Heather Kelly	0	48	-48	University of Tennessee
Jana Murche	159	0	159	KWS Cereals, IL
Jessica Rupp	0	800	-800	Kansas State Uniiversity
Jessica Rutkoski	1400	2000	-600	UIUC
Jianli Chen	271	500	-229	University of Idaho
Jim Anderson	941	1000	-59	University of Minnesota
Jinrong Xu	0	0	0	Purdue University
Juliet Marshall	1157	950	207	University of Idaho
Jyoti Shah	70	50	20	University of North Texas
Kaitlyn Bissonnette	168	200	-32	university of Missouri
Kevin Smith	1086	1500	-414	University of Minnesota
Mark Sorrells	344	400	-56	Cornell University
Martin Chilvers/Martin Nagelkirk	216	600	-384	Michigan State University
Mohamed Mergoum	1025	2000	-975	University of Georgia
Mohsen Mohammadi	0	400	-400	Purdue University
Nathan Kleczewski	215	300	-85	UIUC
Nidhi Rawat	1308	2500	-1192	University of Maryland
Paul Esker/Alyssa Collins	186	500	-314	Pennsylvania State University
Paul Murphy	847	1500	-653	North Carolina State University
Pierce Paul	1088	1500	-412	Ohio State University
Richard Esten Mason	1257	2000	-743	University of Arkansas
Ruth Dill-Macky	474	1500	-1026	University of Minnesota
Shahryar Kianian	0	115	-115	USDA-ARS, MN
Stephen Harrison	1506	2200	-694	Louisiana State University
Vijay Tiwari	435	0	435	University of Maryland
Yang Yen	0	500	-500	South Dakota State University
QA	27	27	0	
Total	**25215**	**38720**	**-13505**	

c) List key outcomes or other achievements.

The DON data has been used in all areas of scab research. By analyzing mycotoxins, the project provided support to barley and wheat breeding programs to develop resistant varieties, and to researchers to study disease mechanisms and to develop effective chemical and biological disease controls. Mycotoxin data provided to scab researchers by our laboratory gave them a means to evaluate the effectiveness of their efforts in fighting Fusarium Head Blight.

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.

The lab was closed between March 18 and June 10, 2020 due to COVID-19 pandemic. All the lab activities were stopped during this period, which caused a three-month delay for some researchers to receive their DON data. Due to social distancing requirements, we couldn't put more work hours on the project as we would like to. Fortunately, PIs have started sending ground samples to the lab since late August, which greatly facilitated DON analysis process and ensured researchers to receive data in a timely manner.

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

Nothing to report.

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

The results were emailed to researchers and were then disseminated to communities of interest via conference papers and presentations, and journal publications.

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
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
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.

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:

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.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

O'Mara, S.P., Broz, K., Dong, Y., Kistler, H. C. "*Fusarium graminearum* transporters important for resistance to xenobiotics, trichothecene accumulation, and virulence to wheat", *Phytopathology,* **2021,** DOI: 10.1101/2021.06.15.448535.
Status: Published
Acknowledgement of Federal Support: Yes

Su, W., Yang, C**.,** Dong, Y., Johnson, R., Page, R., Szinyei, T., Steffenson, B.J., Hirsch, C.D. "Hyperspectral imaging and improved feature variable selection for automated determination of deoxynivalenol in various genetic lines of barley kernels for resistance screening"**,** *Food Chem.* **2021,** 343, 128507 (https://doi.org/10.1016/j.foodchem.2020.128507)
Status: Published
Acknowledgement of Federal Support: Yes

Chhabra, B., Tiwari, V., Gill, B.S., Dong, Y. Rawat, N. "Discovery of a susceptibility factor for Fusarium head blight on chromosome 7A of wheat", *Theoretical and Applied Genetics,* **2021**, 134, 2273-2289 (https://doi.org/10.1007/s00122-021-03825-y).
Status: Published
Acknowledgement of Federal Support: Yes

Chhabra, B., Singh, L., Schoen, A., Wallace, S., Dong, Y., Tiwari, V., Rawat, N. "Screening of an EMS mutagenized population of a wheat cultivar susceptible to Fusarium head blight identifies resistant variants", *Plant Disease,* **2021,** DOI: 10.1094/PDIS-03-21-0670-RE
Status: Published
Acknowledgement of Federal Support: Yes

Carmack, W.J., Jesse, W., Clark, A.J., Lyerly, H.J., Dong, Y., Brown-Guedira, G., Van Sanford, D. "Optical Sorter-Augmented Genomic Selection Lowers DON Accumulation in Wheat", *Crop Sci,* **2021,** DOI: 10.1002/csc2.20494
Status: Published
Acknowledgement of Federal Support: Yes

Singh, L., Wight, J.P., Crank, J., Thorne, L., Dong, Y., Rawat, N. "Efficacy Assessment of a New Fungicide, Miravis Ace, for Conttrol of Fusarium Head Blight in Wheat", *Plant Health Progress,* **2020**, 21, 365-368 (https://doi.org/10.1094/PHP-06-20-0050-RS).
Status: Published
Acknowledgement of Federal Support: Yes

Larkin, D.L., Holder, A.L., Mason, D.E., Brown-Guedira, G., Price, P.T., Harrison, S., Dong, Y. "Genome-Wide Analysis and Prediction of Fusarium Head Blight Resistance in Soft Red Winter Wheat", *Crop Science,* **2020,** 60, 2882-2900 (DOI: 10.1002/csc2.20273)
Status: Published
Acknowledgement of Federal Support: Yes

Carmack, W.J., Clark, A.J., Dong, Y., Brown-Guedira, G., Van Sanford, D. "Optical Sorter-Based Selection Effectively Identifies Soft Red Winter Wheat Breeding Lines with *Fhb1* and Enhances FHB Resistance in Lines with and without *Fhb1*", *Frontiers in Microbiology,* **2020,** 11, article 1318 (https://doi.org/10.3389/fpls.2020.01318)
Status: Published
Acknowledgement of Federal Support: Yes

Verges, V.L., Lyerly, J., Dong, Y., Van Sanford, D. "Training Population Design with the Use of Regional Fusarium Head Blight Nurseries to Predict Independent Breeding Lines for FHB Traits", *Frontiers in Plant Science*, **2020,** 11, article 1083 (doi: 10.3389/fpls.2020.01083)
Status: Published
Acknowledgement of Federal Support: Yes

O'Mara, S.P., Broz, K., Boenisch, M., Zhong, Z., Dong, Y., Kistler, H.C. "The *Fusarium graminearum* t-SNARE *Sso1* is involved in growth, defense, and DON accumulation and virulence", *Molecular Plant-Microbe Interactions,* **2020,** 33(7), 888 (doi.org/10.1094/MPMI-01-20-0012-R).
Status: Published
Acknowledgement of Federal Support: Yes

Cowger, C., Beccari, G., Dong, Y. "Timing of susceptibility to Fusarium head blight in winter wheat", *Plant Disease.* **2020,** 104 (11), 2928-2939 (https://doi.org/10.1094/PDIS-03-20-0527-RE)
Status: Published
Acknowledgement of Federal Support: Yes

Singh, L., Wight, J.P., Dong, Y., Rawat, N. "Evaluation of a new SDHI Chemistry Based Fungicide product: Miravis Ace for efficacy on control of Fusarium Head Blight and Deoxynivalenol content in wheat", *Plant Health Progress.*
Status: Accepted
Acknowledgement of Federal Support: Yes

Gaire, R., Brown-Guedira, G., Dong, Y., Ohm, H., Mohammadi, M. "Pyramiding benefits of major QTL in Fhb7-introgressed wheat population identified by genome-wide association studies", *Plant Disease.*
Status: Accepted
Acknowledgement of Federal Support: Yes

Huang, Y. Yin, L., Sallam, A.H., Heinen, S., Li, L., Beaubien, K., Dill-Macky, R., Dong, Y., Steffenson, B.J., Smith, K.P., Muehlbauer, G.J. "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*.
Status: Submitted
Acknowledgement of Federal Support: Yes

Wallace, S., Chhabra, B., Dong, Y., Ma, X., Coleman, G., Tiwari, V., Rawat, N. "Exploring Fusarium head blight resistance in a winter triticale germplasm collection". *Plants*.
Status: Submitted
Acknowledgement of Federal Support: Yes

Gaire, R., Brown-Guedira, G., Dong, Y., Ohm, H., Mohammadi, M. "Genome-wide association studies for Fusarium head blight resistance and it's trade-off with grain yield in soft red winter wheat", Plant Disease.
Status: Submitted
Acknowledgement of Federal Support: Yes

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

Su, W., Yang, C., Dong, Y., Johnson, R., Page, R., Szinyei, T., Steffenson, B.J., Hirsch, C.D., Zhang, Z. "Hyperspectral Imaging and Machine Learning for Rapid Assessment of Deoxynivalenol of Barley Kernels", in the book titled: *"Nondestructive Evaluation of Agro-products by Intelligent Sensing Techniques"*, Chapter 5.
Status: Submitted
Acknowledgement of Federal Support: Yes

Other publications, conference papers and presentations.

Baldwin, B.A., Yimer, B.A., Baldwin, T.T., Dong, Y., Marshall, J.M. 2020. "Determining Fusarium Head Blight Resistance of Spring Barley in Idaho." In: Canty, S., A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum*(p.5), Virtual; December 7-11. Online: https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Page, R., Szinyei, T., Martin, M., Sallam, A., Matny, O., Wodarek, J., Dong, Y., Hayes, P., Steffenson, B. 2020. "Quantitative trait loci associated with resistance to Fusarium head blight and DON accumulation in barley populations derived from moderately resistant six- and two-rowed parents" In: Canty, S., A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum* (p.9), Virtual; December 7-11. Online: https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Yimer, B.A., Baldwin, S.A., Baldwin, T.T., Dong, Y., Marshall, J.M. 2020. "Evaluation of Winter Wheat Varieties and Selections for FHB Resistance in Southeast Idaho" In: Canty, S., A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum* (p.53), Virtual; December 7-11. Online: https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Su, W., Yang, C., Dong, Y., Johnson, R., Page, R., Szinyei, T., Hirsch, C.D., Steffenson, B.J. 2020. " Non-Destructive Detection of Deoxynivalenol in Barley Kernels using Hyperspectral Imaging and Machine Learning" In: Canty, S., A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum* (p.60), Virtual; December 7-11. Online: https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

Huang, Y., Yin, L., Sallam, A., Heinen, S., Li, L., Beaubien, K., Dill-Macky, R., Dong, Y., Steffenson, B.J., Smith, K.P., Muehlbauer, G.J. 2020. "Genetic Dissection of Quantitative Trait Loci Associated with Fusarium Head Blight Resistance, Grain Protein Content and Agronomic Traits in the Pericentromeric Region of Chromosome 6H in Barley" (p. 69). In: Canty, S., A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum* (p.69), Virtual; December 7-11. Online: https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Yes

PI: Dong, Yanhong
Project: Diagnostic services for DON

FY20 PR – USWBSI ADDENDUM
DON Service Labs – Quality Control (QC) Data

Note: What is being requested is the lab's quality control (i.e. check) data.

Insert below Lab's Quality Control Data/Results from the FY20 Award Period (5/15/20 - 5/14/21):

	Check 1	Check 2	Check 3
N[a]	272	681	170
Mean (ppm)	9.82	6.76	5.22
SD[b]	0.73	0.64	0.50
% CV[c]	7.5	9.4	9.5

[a]Number of check samples. [b]Standard deviation. [c]Coefficient of variance