

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

Cover Page

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Fiscal Year:	2020
USDA-ARS Agreement ID:	59-0206-0-181
USDA-ARS Agreement Title:	Realtime Field Scab Assessment with Color and Spectral Imaging Systems on a Phenocart
FY20 USDA-ARS Award Amount:	\$ 68,366
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:	CON000000086375
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
EC-HQ	Realtime Field Scab Assessment with Color and Spectral Imaging Systems on a Phenocart	\$ 68,366
FY20 Total ARS Award Amount		\$ 68,366



07/29/2021

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: *Realtime Field Scab Assessment with Color and Spectral Imaging Systems on a Phenocart*

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

The **overall goal** of this project is to develop a real time high-throughput phenotyping method on a phenocart for field FHB assessment.

The specific **objectives** are to:

- 1) hasten and streamline image processing procedures to increase phenotyping efficiency;
- 2) enable real time field FHB assessments on the phenocart with on-board image computing;
- 3) verify deep learning models for more robust performance with crop field trials;
- 4) assess the feasibility of DON content detection in intact harvested wheat and barley seed by spectral imaging in comparison to GC-MS spectrometry.

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?

- 1) Conducted image preprocessing, annotation, deep learning model training and validation for the assessment of FHB severity for wheat in the field.
- 2) Collected lab DON hyperspectral reflectance images (HSI) from wheat seed samples.
- 3) Designed a quadruped ground robot for traveling in the agricultural field by remote control and obtain images from trial plots.

b) What were the significant results?

- 4) Improved an image processing protocol called Wheat-Net, including the training of deep learning algorithms, for field wheat and barley spike detection using color imagery. A paper was submitted to the Journal of Computer and Electronics in Agriculture and is under review.
- 5) The quadruped ground robot is a low-cost solution that shows more potential of versatile data collection in uneven field condition. The quadruped is expected to be used in the crop season of 2022.

c) List key outcomes or other achievements.

Paper submitted for review – see ‘Publications - Journal.’

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.

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Yes, both field and lab data collection was significantly postpone due to university shutdown as well as labor and resource shortage caused by COVID-19 pandemic. The pandemic has continuous impact to the ground-truth data collection, which is the key for image processing and detection modeling.

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

An undergraduate student intern from Lewis Stokes North Star STEM Alliance at the University of Minnesota was hosted in my group to develop the quadruped. He gained a lot of experience with control, circuiting and Python programming. He presented his work in the annual Lewis Stokes North Star STEM Alliance Symposium on 7/30/2021.

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

Findings and achievements have been presented in the 2020 FHB annual forum to the audience by two poster presentations.

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? 1

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.](#)

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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 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
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:

Winn, Z.J., Acharya, R., Lyerly, J., Brown-Guedira, G., Cowger, C., Griffey, C., Fitzgerald, J., Mason R.E., and 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.

Zhang, J., Min, A., Steffenson, B., Su, W., Hirsch, C.D., Anderson, J., Wei, J., & Yang, C. 2021. Wheat-Net: An Automatic Dense Wheat Spike Segmentation Method Based on An Optimized Hybrid Task Cascade Model. Submitted to the *Journal of Computer and Electronics in Agriculture*.

Status: Submitted for review.

Acknowledgement of Federal Support: YES.

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

Nothing to report.

Other publications, conference papers and presentations.

Su, W.-H., Yang, C., Dong, Y., Johnson, R., Page, R., Szinyei, T., Hirsch, C.D., & Steffenson, B.J. (2020, Dec. 7-11). Non-destructive Detection of Deoxynivalenol in Barley Kernels Using Hyperspectral Imaging and Machine Learning (p. 51). 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: Poster presented.

Acknowledgement of Federal Support: YES.

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Su, W.-H., Zhang, J., Yang, C., Page, R., Szinyei, T., Hirsch, C.D., & Steffenson, B.J. (2020, Dec. 7-11). Rapid Assessment of Wheat Fusarium Head Blight Using Color imaging and Deep Learning (p. 60). 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: Poster presented.

Acknowledgement of Federal Support: YES.