USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY19 Performance Report
Due date: September 30, 2020

Cover Page

Principle Investigator (PI):	Clay Sneller
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Fiscal Year:	2019
USDA-ARS Agreement ID:	59-0206-8-208
USDA-ARS Agreement Title:	Improving SRWW Resistance to FHB using Traditional and Molecular Breeding
FY19 USDA-ARS Award Amount:	$ 114,563
Recipient Organization:	The Ohio State University Office of Research Office of Sponsored Programs Research Administration Building 1960 Kenny Road, 4th Floor Columbus, OH 43210
DUNS Number:	83-212-7323
EIN:	31-6025986
Recipient Identifying Number or Account Number:	GRT00052677/60066967
Project/Grant Reporting Period:	7/6/19 - 7/5/20
Reporting Period End Date:	7/5/2020

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-NWW	Utilizing Wheat Genes for FHB Resistance in Ohio	$ 65,403
VDHR-NWW	Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials	$ 18,024
VDHR-NWW	Use of Genomic Selection to Improve FHB Resistance and Yield in Northern SWW	$ 5,729
HWW-CP	Genomics Selection for Hard Winter Wheat	$ 25,407
	FY19 Total ARS Award Amount	**$ 114,563**

9/30/20

Principal Investigator 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

FY19 Performance Report
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Project 1: *Utilizing Wheat Genes for FHB Resistance in Ohio*

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

The major goal is to combine high yield and strong FHB resistance into new cultivars adapted to Ohio and the Midwest.

2. What was accomplished under these goals or objectives? *(For each major goal/objective, address items a-b) below.)*

a) What were the major activities?
The major activities were 1) screening >1,000 OSU breeding lines for resistance to FHB, 2) making > 100 crosses to combine high yield with strong FHB resistance, 3) advancing similar crosses through the breeding pipeline, and 4) using MAS and GS to introgress Fhb1 and select for good FHB resistance.

b) What were the significant results?
The 2019-2020 FHB nursery was very successful with excellent disease pressure and precision (for FHB anyways). Several lines with a desired combination of yield and FHB resistance were identified. In addition, we noted a high incidence of strong MR in the OSU germplasm.

c) List key outcomes or other achievements.
Two lines (OH15-191-52, OH15-131-31) were identified with > yield than the checks and with FHB resistance similar to Truman (Table 1). As in most recent years, ~80% of OSU lines have an FHB Index that is < that of the moderate resistant check Freedom. A highlight this year is that a 35-55% of OSU lines had an FHB Index less than that of Truman which has very strong moderate resistance (Figure 1).

Table 1. Results of three years of testing of OH breeding lines.

NAME	YLD	HD	HGT	TW	FHBN
OH15-191-52	84.9	144	37	55.5	22.6
OH15-131-31	81.5	143	36	53.7	19.7
OH15-42-1	80.7	144	36	**51.8**	32.6
OH09-207-68	79.8	141	41	55.7	21.1
KOKOSING	77	140	39	54.2	34.8
SYN483	75.6	141	36	54.2	47.5
TRUMAN	.	147	.	.	14.9
FREEDOM	.	146	.	.	35.1
PIONEER2545	.	145	.	.	69.7

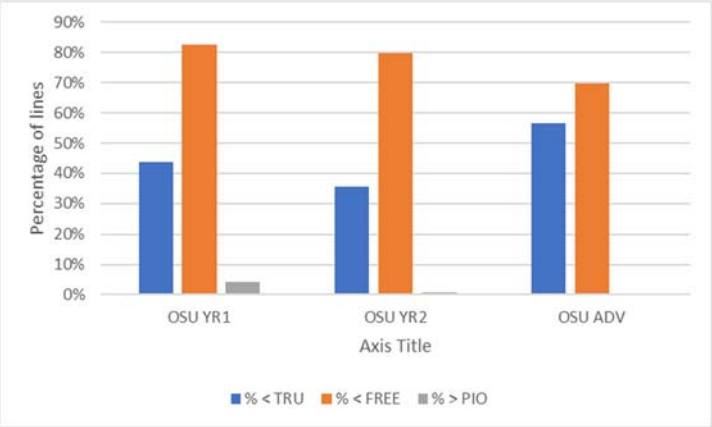

Figure 1. Percentage of OSU breeding lines at different stages of testing (Year 1, Year 2, Year 3) with resistance comparable to the "resistant" (TRU), moderate resistant (FREE), and susceptible (SUS) checks.

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

We were impacted by covid as it took considerable longer to hire summer help due to slow downs and new rules imposed by OSU HR. This required us to take a few shortcuts in collecting FHB data by forgoing rating severity and incidence in the field. We also pooled grain samples from 2 reps versus 3 reps for FDK and DON ratings. IN addition we were not able to get our genotypic data from the genotyping lab in tome to execute the first backcross in the spring of 2020 as the lab was shutdown.

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

The project is training two PhD students and one visiting scholar. In addition, we train 5-8 summer students

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

Results from the current breeding trials have not been disseminated. Data from the past trials contributed to one publication. The results from the 2020 screening of the Official Variety Trial has been published by OSU extension and is available on-line.

Project 2: *Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials*

1. **What are the major goals and objectives of the research project?**
   This project aims to assess the FHB resistance of advanced breeding lines from 8 public breeding programs (IL,IN, MI, KY, OH, NY, VA, NE) and two private companies (KWS, Limagrain) in a uniform trial. The project also assesses the FHB resistance of all entries in the official variety trials (OVT) from IL, MI, KY. OH, and NY.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address items a-b) below.)*

   a) What were the major activities?
   The cooperative trials had 87 entries that were evaluated at a total of 9 environments. The data was summarized, and a preliminary report was submitted to each participant. The breeders in MI, NY, OH, KY, and IL evaluated the FHB resistance of lines in their OVT. Entries in the UE, 5STAdv, 5STPre, Mason-Dixon trials were also assessed for FHB resistance by various collaborators.

   b) What were the significant results?
   High levels of FHB resistance were noted in the two USWBSI uniform trial with 99% of the lines having an Index value that was equal to or lower than that of Freedom and 39% had an index value that was not statistically different than that of Truman.

   c) List key outcomes or other achievements.
   A key outcome was obtaining FHB ratings on the OVT in five states as this information is vital for growers to select wheat lines with high yield and FHB strong resistance. In addition, the screening of advanced breeding lines suggest that breeders are making good progress at improving FHB resistance in elite gene pools.

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

   The research will be affected by COVID in that the number of samples that can be submitted for DON testing has been reduced and genotyping has been delayed due to the lab shutdown.

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

   At OSU, the project is training two PhD students and one visiting scholar. In addition, we train 5-8 summer students

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

The results of the 2018-2019 USWBSI uniform trials has been sent to all cooperators and posted on the USWBSI website. Results from the 2018-2019 OVT have been disseminated to growers via extension websites, grower meetings, hardcopies, and ScabSmart.

Project 3: *Use of Genomic Selection to Improve FHB Resistance and Yield in Northern SWW*

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

   The major goal is to establish genomic selection in the NWW-CP using a common platform.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address items a-b) below.)*

   a) What were the major activities?
   Lines predicted to have good and poor FHB resistance were screened for FHB resistance in 2019-202 nurseries. The results have not yet been analyzed to data. Phenotypic data from past trials has been compiled for this analysis.

   b) What were the significant results?
   We used genomic selection to predict the value of the lines in the P+NUWWSN. The correlation of predicted value with observed values were high, ranging from 0.44 to 0.71 for the various FHB traits.

   c) List key outcomes or other achievements.
   Data has been compiled and several manuscripts are being prepared.

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

   This research was not greatly affected by covid-19

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

   At OSU, the project is training two PhD students and one visiting scholar. In addition, we train 5-8 summer students

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

   The results have not been disseminated

Project 4: *Genomics Selection for Hard Winter Wheat*

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

We hypothesize that screening HRW from NE and SD in Ohio can results in greater disease pressure and better FHB scoring than what can be obtained in the Great Plains. We also hypothesize that a GS model trained with Ohio FHB data on HRW can predict the FHB reaction of other HRW from NEW and SD.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address items a-b) below.)*

a) What were the major activities?
The major activity in Ohio was planting and rating the FHB resistance of 400 HRW (200 each from NE and SD) in Ohio.

b) What were the significant results?
Good disease pressure was obtained with the susceptible check having an FHB index of 61.8. The Blups of the FHB Index value of the HRW lines ranged from -0.1 to 81.7 range of FHB (Fig 1.)

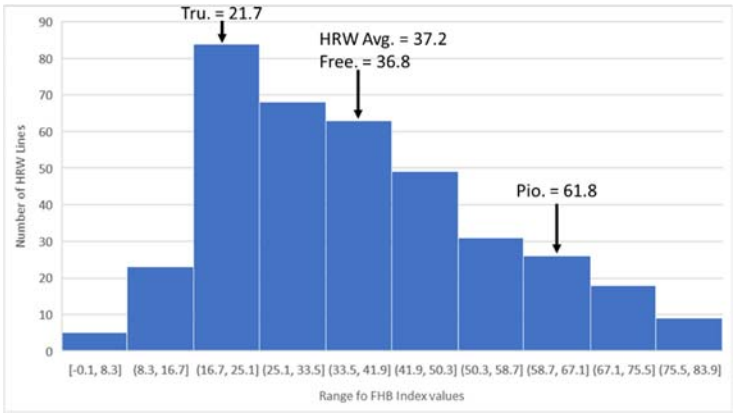

Figure 1. Distribution of FHB index value of 400 HRW lines assessed for FHB in Wooster Ohio. The value for the resustant check (Tru), moderate resistant check (Free) and susceptible check (Pio) are shown.

c) List key outcomes or other achievements.
A substantial number of the HRW lines showed moderate resistance to FHB with 21% having a lower index than Truman and 53% have a lower index than Freedom.

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

Due to reduced staffing we collected grain sample for FDK and DON from 2 reps instead of 3 reps

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

At OSU, the project is training two PhD students and one visiting scholar. In addition, we train 5-8 summer students

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

The results have not been disseminated

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY19 award period (7/6/19 - 7/5/20). 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

   If yes, how many? One

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?**
   No

   If yes, how many?

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?**
   No

   If yes, how many?

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

   If yes, how many? One

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. 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** (S, MS, MR, R, where R represents your most resistant check)	**FHB Rating** (0-9)	**Year Released**
OH15-191-52	SRW	MR	22.6=2	2020
OH15-131-31	SRW	MR	19.7=2	2020

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

Publications, Conference Papers, and Presentations

Instructions: Refer to the FY19-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 (7/6/19 - 7/5/20**) 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:

> De Wolf, E., D. Shah, P. Paul, L. Madden, S. Crawford, D. Hane, S. Canty, R. Dill-Macky, D. Van Sanford, K. Imhoff and D. Miller. 2019. "Impact of Prediction Tools for Fusarium Head Blight in the US, 2009-2019." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 12), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
> Status: Abstract Published and Poster Presented
> Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

Borrenpohl, D., M Huang, E Olson, and C Sneller. 2020. The value of early stage phenotyping for wheat breeding in the age of genomic selection. Theor Appl Genet. https://doi.org/10.1007/s00122-020-03613-0
Status: Published
Acknowledgement of Federal Support: Yes, ARS/USWBSI and NIFA

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

Other publications, conference papers and presentations.

Borrenpohl, D., M Huang, E Olson, and C Sneller. 2019. "The value of early stage phenotyping for wheat breeding in the age of genomic selection." In: S. Canty, A. Hoffstetter, H. Campbell and R. Dill-Macky (Eds.), *Proceedings of the 2019 National Fusarium Head Blight Forum* (p. 86), Milwaukee, WI; December 8-10. University of Kentucky, Lexington, KY.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: Abstract – Yes/ Poster – No