USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY20 Annual Performance Progress Report
Due date: August 31, 2021

Cover Page

Principle Investigator (PI):	Clay Sneller
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Fiscal Year:	2020
USDA-ARS Agreement ID:	59-0206-0-149
USDA-ARS Agreement Title:	Improving SRWW Resistance to FHB using Traditional and Molecular Breeding
FY20 USDA-ARS Award Amount:	$ 261,570
Recipient Organization:	The Ohio State University Research Foundation Accounting Dept. 1960 Kenny Road, 4th Floor Columbus, OH 43210
DUNS Number:	07-165-0709
EIN:	31-6401599
Recipient Identifying Number or Account Number:	GRT00060449
Project/Grant Reporting Period:	6/6/20 - 6/5/21
Reporting Period End Date:	6/5/2021

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Innovated Selection Plan to Improve the FHB Resistance of Hard Winter Wheat	$ 16,577
VDHR-NWW	Discovering, Understanding, and Utilizing Wheat Genes for FHB Resistance in Ohio	$ 62,984
VDHR-NWW	Coordinated Phenotypes of Soft Wheat Germplasm for the Midwest	$ 18,024
VDHR-NWW	Implementing Genomic Selection within the NWW Coordinated Project	$ 135,664
VDHR-NWW	Assessing FDK, DON, and Fusarium graminearum Biomass in Soft Winter Wheat Grain	$ 28,321
	FY20 Total ARS Award Amount	**$ 261,570**

8/31/2021

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

FY20 Annual Performance Progress Report
PI: Sneller, Clay
USDA-ARS Agreement #: 59-0206-0-149
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Project 1: *Innovated Selection Plan to Improve the FHB Resistance of 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 these three items below.)*

a) What were the major activities?

The major activity in Ohio was rating the FHB resistance of 400 HRW (200 each from NE and SD) in Ohio and planting an additional 430 lines in the fall of 2020.

b) What were the significant results?

Good disease pressure was obtained in 2020 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.)

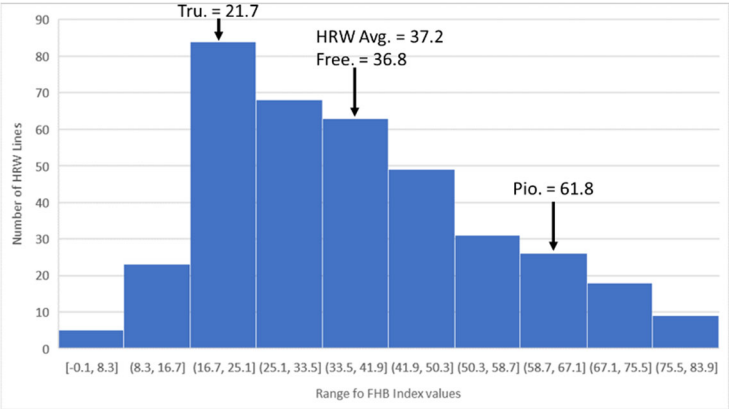

Figure 1. Distribution of FHB index value of 400 HRW lines assessed for FHB in Wooster Ohio. The value for the resustant check (Tru), moderate resistant check (Free) and susceptible check (Pio) are shown.

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 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.**

   No

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

   OSU trained 3 PhD students

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

   Data was sent to NE and SD

Project 2: *Discovering, Understanding, and 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 these three items 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 in the 2019-2020 season 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

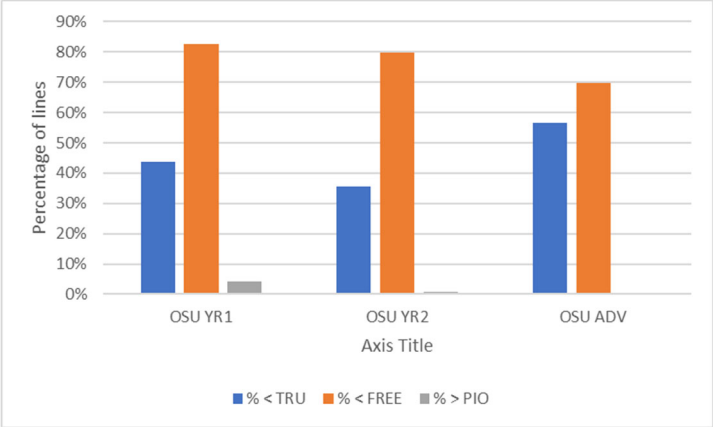

Figure 1. Percentage of OSU breeding lines at different stages of testing (Year 1, Year 2, Year 3) with resistance comparable to the "resistant" (TRU), moderate resistant (FREE), and susceptible (SUS) checks.

3. **Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns 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.**

   No

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

   OSU trained 3 PhD 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 3: *Coordinated Phenotypes of Soft Wheat Germplasm for the Midwest*

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 these three items 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 2019-2020 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 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.**

   No

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

   OSU trained 3 PhD students

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

The results of the 2019-2020 USWBSI uniform trials has been sent to all cooperators and posted on the USWBSI website. Results from the 2019-2020 OVT have been disseminated to growers via extension websites, grower meetings, hardcopies, and ScabSmart.

Project 4: *Implementing Genomic Selection within the NWW Coordinated Project*

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 these three items below.)*

   a) **What were the major activities?**
   The major activities were 1) enter phenotypic data from past yield and FHB trials into T3, 2) coordinate the genotyping of >4,500 lines with a common genotyping platform, 3) call SNPs on >18,000 lines, 4) generate predicted values on all lines including all lines in the 2020-2021 field trials.

   b) **What were the significant results?**
   The genotypic data and phenotypic data were used to predict trait values for all lines. The pooling of samples for genotyping allowed the group to receive very low cost genotyping.

   c) **List key outcomes or other achievements.**
   We generated predicted values for yield, test weight and FHB resistance for >18,000 lines. These values were made available to all breeders.

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.**

   No

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

   OSU is training 3 PhD students

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

   All predicted values were distributed to all breeders

Project 5: *Assessing FDK, DON, and Fusarium graminearum Biomass in Soft Winter Wheat Grain*

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

   To assess the relationship between index, FDK, DON, and fungal biomass

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?**
   We collected grain samples from 4 locations of all entries in the 2019-2020 P+NUWWSN. The samples were rated for FDK and we obtain DON values. Primers to estimate fungal biomass were ordered

   b) **What were the significant results?**
   We regressed DON onto index and DON onto FDK within each of the four location. We noted that some lines repeatedly had lower DON than predicted by their Index of FDK values, suggesting they were resistant to toxin accumulation.

   c) **List key outcomes or other achievements.**
   The results suggest that some lines have resistance to toxin accumulation, relative to their Index and FDK values. This could be due to low fungal biomass, and thus low DON production or by detoxifying the toxin.

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 as we were delayed in ordering the primers as we were not able to access the lab on time to assess the value of the primers

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

   The project train 1 PhD student

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

   No results have been disseminated

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY20 award period (6/6/20 - 6/5/21). 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 ☐ Not Applicable
   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 ☐ Not Applicable
   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 ☐ Not Applicable
   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 ☐ Not Applicable
   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 (6/6/20 - 6/5/21). 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
OH15-191-52	SRW - Soft Red Winter	MR - Moderately Resistant	3	2021
OH13-88-61	SRW - Soft Red Winter	MR - Moderately Resistant	4	2021
OH14-222-49	SRW - Soft Red Winter	MR - Moderately Resistant	3	2021
OH15-131-31	SRW - Soft Red Winter	MR - Moderately Resistant	2	2021
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 (6/6/20 - 6/5/21**) 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.

Sneller, C, C. Ignacio, B. Ward, J. Rutkoski, M. Mohammadi. 2021. Using genomic selection to leverage resources among breeding programs: consortium-based breeding. Agronomy *1*(8), 1555; https://doi.org/10.3390/agronomy11081555
Status: Published
Acknowledgement of Federal Support: No

Rutkoski J, C Sneller, et al. 2021. Genetic trends in Fusarium head blight resistance due to 20 years of winter wheat breeding and cooperative testing in the Northern US. Plant Disease https://doi.org/10.1094/PDIS-04-21-0891-SR
Status: Published
Acknowledgement of Federal Support: Yes

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

None

Other publications, conference papers and presentations.

None