USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY14 Final Performance Report
July 15, 2015

Cover Page

PI:	Clay Sneller
Institution:	Ohio State University
Address:	Department of Horticulture and Crop Science OARDC 1680 Madison Ave Wooster, OH 44691
E-mail:	sneller.5@osu.edu
Phone:	330-263-3843
Fax:	330-263-3841
Fiscal Year:	FY14
USDA-ARS Agreement ID:	59-0206-4-034
USDA-ARS Agreement Title:	Discovering, Understanding, and Utilizing Wheat Genes for FHB Resistance in Ohio.
FY14 USDA-ARS Award Amount:	$ 81,992

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-NWW	Discovering, Understanding, and Utilizing Wheat Genes for FHB Resistance in Ohio.	$ 59,338
VDHR-NWW	Coordinated Phenotyping of Uniform Nurseries and Official Variety Trials.	$ 17,510
VDHR-NWW	Implementing Genomic Selection for FHB Resistance in Soft Winter Wheat (SWW) Adapted to the Corn Belt.	$ 5,144
	FY14 Total ARS Award Amount	**$ 81,992**

Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
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
WES-CP – Western 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: *Discovering, Understanding, and Utilizing Wheat Genes for FHB Resistance in Ohio.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

   Host resistance to FHB must be combined with high yield for growers to accept FHB resistant cultivars. This can be done by screening the breeding lines that are in development, building parents with good resistance and yield levels, and by designing crosses amongst such parents.

2. **List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

   Accomplishment:

   1. Screened 1,694 OSU breeding lines for FHB resistance. Over 70% of all entries had an FHB index ≤ that of Freedom (Figure 1).

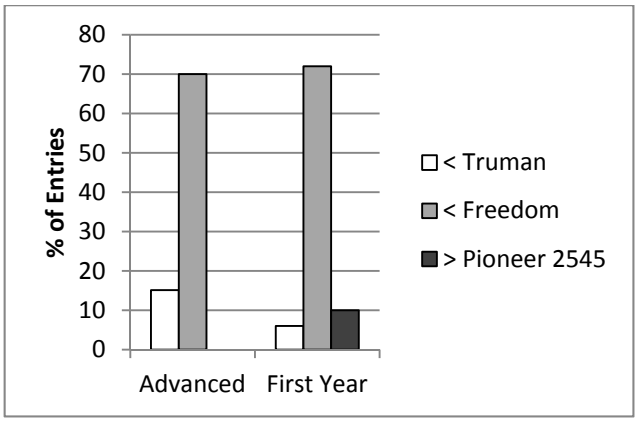

   Figure 1. Percentage of entries in first year yield trials and advanced yield trials with various levels of FHB Index.

   2. Many lines were advanced from crosses of elite SRWW that had the resistant allele at Fhb1 backcrossed into them. Based on markers, progeny from these crosses will be fixed for resistance at Fhb1.

   Impact:

   The high percentage of advanced lines with at least moderate resistance provides an excellent probability of finding the desired combination of yield and FHB resistance. We are increasing the seed of several lines with good yield and good FHB resistance. The use of MAS should improve the efficiency of breeding for FHB resistance.

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

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

   Accurately predicting the FHB resistance of a breeding line or cultivar requires extensive phenotyping in field trials. The OSU program has coordinated a uniform trial of ~120 SRWW lines that are tested in 8-15 locations per year. The lines come from ~13 public and private breeding programs. This provides robust data on FHB resistance so the breeders can make informed decisions on what lines to release and which to use as parents.

   In addition to breeding lines, we also screen the OSU Official Variety Trial (OVT) for FHB resistance.

2. **List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

   Accomplishment:

   In 2014 season we evaluated 120 SRWW lines. A summary was prepared and distributed to cooperators in August of 2014. A final report was sent to all cooperators in early 2015 when we received the last FDK and DON data. Highlights of the report included

   - Over 69% of the entries in the PNUWWSN and the NUWWSN had an FHB index < that of Freedom (this was 90% last year)
   - Just 2% of the PNUWWSN and 5% of the NUWWSN entries had an FHB index < that of Truman (vs 35% and 14% last year)
   - 90% of the PNUWWSN and 65% of the NUWWSN entries had less DON than Freedom
   - 63% of the PNUWWSN and 35% of the NUWWSN entries had less DON than Truman

   In addition to the uniform tests, cooperators evaluated the FHB resistance of lines in 6 additional uniform yield trials as well as all entries in the Official Variety Trials of each participating state.

   Impact:

   The screening of the breeding material continues to shows the progress that SRWW breeders have made in improving FHB resistance. This is manifested in the results of the OVT where 80% of the commercially available cultivars appear to be at least moderately resistant to FHB.

Project 3: *Implementing Genomic Selection for FHB Resistance in Soft Winter Wheat (SWW) Adapted to the Corn Belt.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

   Phenotypic selection for FHB resistance is slow in winter wheat with a breeding cycle taking perhaps 5 years. Marker-assisted selection appears to be primarily effective for a few FHB QTL, of which most are not widely present in Eastern soft wheat. The QTL for FHB resistance in SRWW mainly have small effects and are not very amenable to MAS. Genomic selection is a tool that can reduce the breeding cycle to one year and can affect all genes (small and large effects) that impact FHB. Thus we are implementing GS for FHB resistance in SRWW.

2. **List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

   Accomplishment:

   We made xx crosses among the best lines from the training population (TP). We derived 1002 F2 plants from 52 of those crosses. DNA was extracted and genotyped using GBS technology. A prediction model was built using the TP data and rrBLUP and used to obtain the genomic estimated breeding value (GEBV) of each F2. Based on all traits we chose the best F2s and crossed among them resultsing in 195 crosses. The F1s of these crosses are being selfed during the summer of 2015 to produce F2 seed for the second cycle of GS.

   The accuracy of GS was assessed in the TP using cross validation. Accuracy ranged from 0.65 to 0.70 across the seven FHB traits. The GEBVs of the TP and F2 can be compared. As shown in the figure below, the F2 population has a considerable lower range of GEBVs than does the TP and the average GEBV is lower (more desirable) in the F2 than in the TP. Also the F2s have virtually no individuals with highly susceptible (eg positive) GEBVs: GS has eliminated the undesirable types. No F2 is better then the best line in the TP. This may in part be due to the fact that they are F2 and not inbred. This means they are heterozygous at ~1/2 their loci and thus do not have the maximum genetic value at those loci while inbred lines would have the maximum value at those loci.

   Impact:

   The results to date indicate that GS can be a very useful tool for improving FHB resistance in SRWW. The population will go through three more cycles of GS to further improve FHB resistance. At each stage we will deitribute seed of the best F2-derived lines to all members of the NWW and SWW CP, as well as anyone else who is interested.

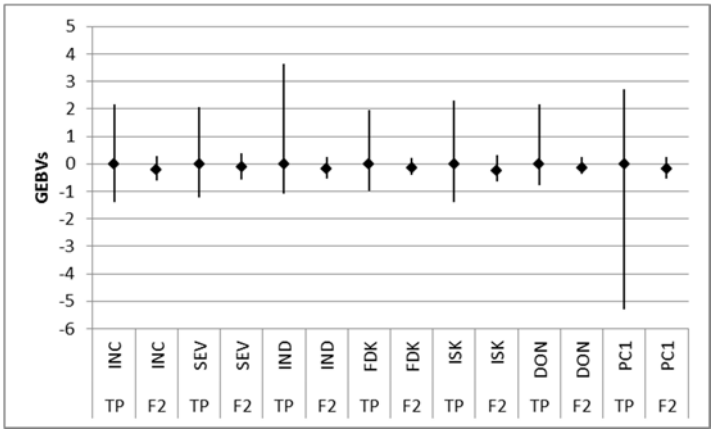

Figure 1. Range and Average GEBV of training population (TP) lines anf F2 from the first cycle of GS.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY14 award period. 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 FY14 award period?**
   NO
   If yes, how many?

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY14 award period?**
   NO
   If yes, how many?

3. **Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**
   None

   If yes, how many?

4. **Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**
   None

   If yes, how many?

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY14 award period. List the release notice or publication. Briefly describe the level of FHB resistance. *If not applicable because your grant did NOT include any VDHR-related projects, enter N/A below.*

None were released

Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in the FY14 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Cabrera, A., E. Olson, B. Brisco, F. Kolb, E.A. Brucker, A. Krill, M.P. Arruda, M. Sorrells, D. Van Sanford, A. Clark, A. McKendry and **C. Sneller.** 2014. "Phenotypic Analysis of FHB Resistance in a Soft Wheat Population for Genomewide Analyses." In: S. Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), *Proceedings of the 2014 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 75.

Cabrera, A., M. Huang, E. Olson, B. Brisco, F. Kolb, E.A. Brucker, A. Krill, M.P. Arruda, M. Sorrells, D. Van Sanford, A. Clark, A. McKendry and **C. Sneller.** 2014. "Preliminary Analysis of Genomic Selection for FHB Resistance." In: S. Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), *Proceedings of the 2014 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 76.

Hoffstetter, A.L., A. Cabrera, M. Huang and **C.H. Sneller.** 2014. "Using Association Analysis and Genomic Selection to Improve Fusarium Head Blight Resistance in Soft Red Winter Wheat." In: S. Canty, A. Clark, N. Turcott and D. Van Sanford (Eds.), *Proceedings of the 2014 National Fusarium Head Blight Forum.* East Lansing, MI/Lexington, KY: U.S. Wheat & Barley Scab Initiative. p. 82.