

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

**Cover Page**

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<b>Fiscal Year:</b>	FY14
<b>USDA-ARS Agreement ID:</b>	59-0200-3-005
<b>USDA-ARS Agreement Title:</b>	Molecular Characterization and Pyramiding of Novel Scab Resistance Sources Adapted to the Northern Plains Growing Region.
<b>FY14 USDA-ARS Award Amount:</b>	\$ 28,230

**USWBSI Individual Project(s)**

<b>USWBSI Research Category*</b>	<b>Project Title</b>	<b>ARS Award Amount</b>
HW-CP	Validating Multiple FHB Resistance QTLs in Different Winter Wheat Backgrounds.	\$ 11,236
VDHR-SPR	Validating Multiple FHB Resistance QTLs in Different Spring Wheat Backgrounds.	\$ 16,994
	<b>FY14 Total ARS Award Amount</b>	<b>\$ 28,230</b>

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

HW-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: Validating Multiple FHB Resistance QTLs in Different Winter Wheat Backgrounds.**

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

The major issue addressed in this project is the development of germplasm with improved FHB resistance.

The approach we are using consist on developing large numbers of 4 way families, use the early generations to identify putative novel loci and to select the best families (screening of these families is done in collaboration with regional breeders and they are allowed to selected lines); from these families we develop double haploids that are screened and distributed for breeding.

**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:**

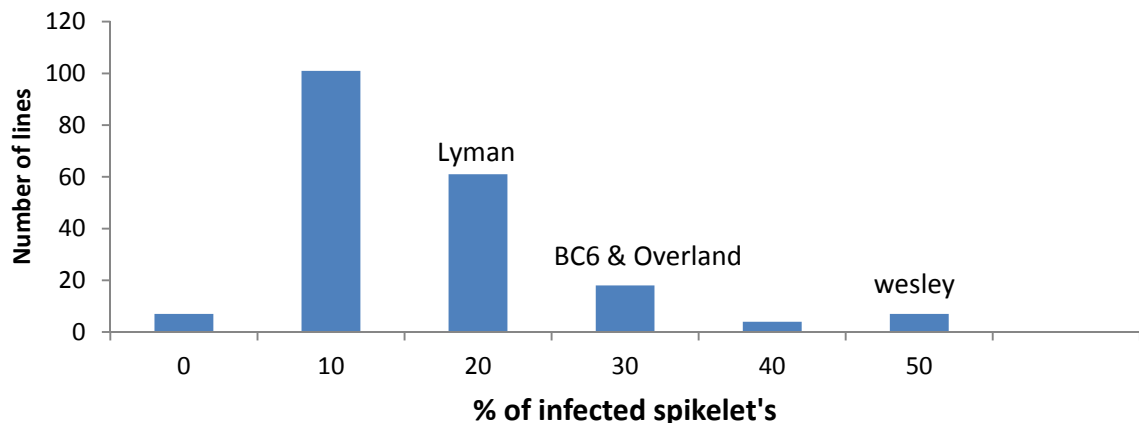
**Accomplishment:**

*Phenotypic screening of DH lines.*

To date, we have complete one season of the DH winter wheat lines from a greenhouse experiment.

Briefly, a total of 200 winter wheat double haploid (DH) lines including four checks (Lyman, BC6, & Overland resistant and Wesley Susceptible) were screened and evaluated in greenhouse nursery in Brookings, South Dakota (SD) this past winter and spring 2015. Unlike the spring population, there were many lines that showed 0% infection (a total of 7 lines). However, lines w651-2-5 and w452-3-3 (roughly 50% infection) was the most susceptible amongst the observed lines in greenhouse (see figure 5 for other observations).

**FBH screening in greenhouse**



We had planted the above population in North and South Dakota in 2014 Fall. Unfortunately unfavorable and unusual winter weather conditions (temperatures above freezing in January followed by a very sudden drop) lead a complete loss of the screening nursery. However, we were able to screen a good portion of the population in South Dakota and we are currently analyzing.

Because we were unable to get enough validate information we are now conducting screening in the greenhouse for the DH winter wheat population. We plan to have this population screened two more times in the greenhouse by the end of the year.

**Impact:** The best lines will be available to be used as parental material with increased FHB resistance. Since most the parents are adapted, we will be able to selected good FHB resistance sources with good agronomics.

**Project 2:** *Validating Multiple FHB Resistance QTLs in Different Spring Wheat Backgrounds.*

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

The major issue addressed in this project is the development of germplasm with improved FHB resistance.

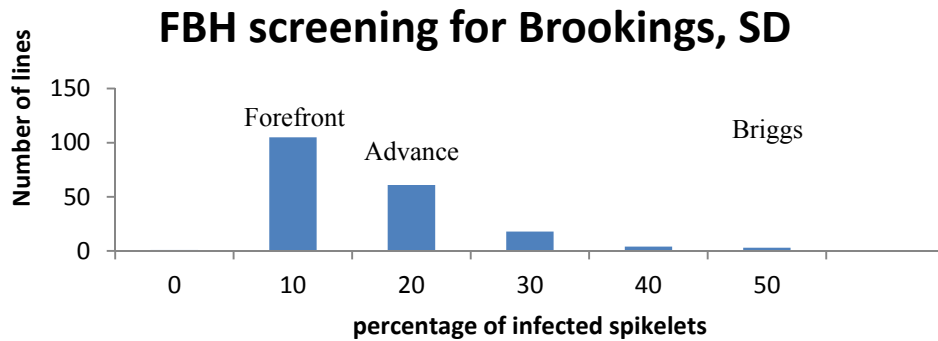
The approach we are using consist on developing large numbers of 4 way families, use the early generations to identify putative novel loci and to select the best families (screening of these families is done in collaboration with regional breeders and they are allowed to selected lines); from these families we develop double haploids that are screened and distributed for breeding.

**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:**

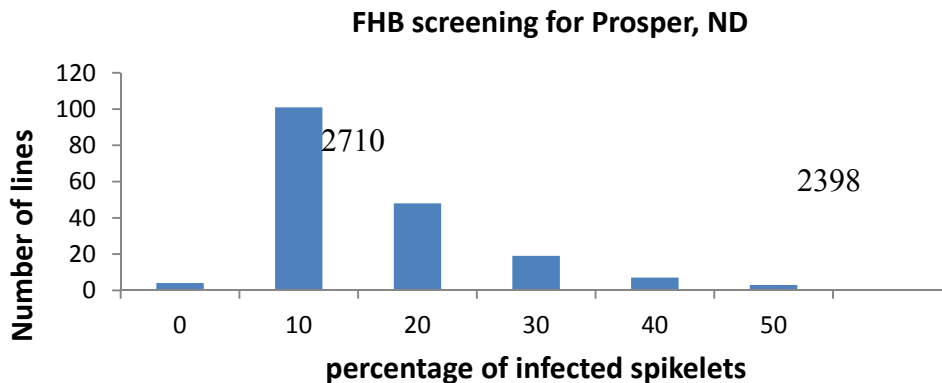
*Phenotypic screening of DH lines:* To date, we have done three field experiments with the spring wheat DH lines screening for FHB. The three experiments include locations in South Dakota, North Dakota and Minnesota. Each location had two replications and roughly 25 seeds per line in each row.

Briefly, a total of 192 spring wheat double haploid (DH) lines including three checks (Forefront & Advance resistant and Briggs Susceptible) were screened and evaluated in scab nurseries in Brookings, South Dakota (SD) summer 2014. Line s625-2-1 (0% infection) showed the most resistance and s716-14-5 (roughly 50% infection) was the most susceptible amongst the observed lines in SD (see figure 1 for other observations).



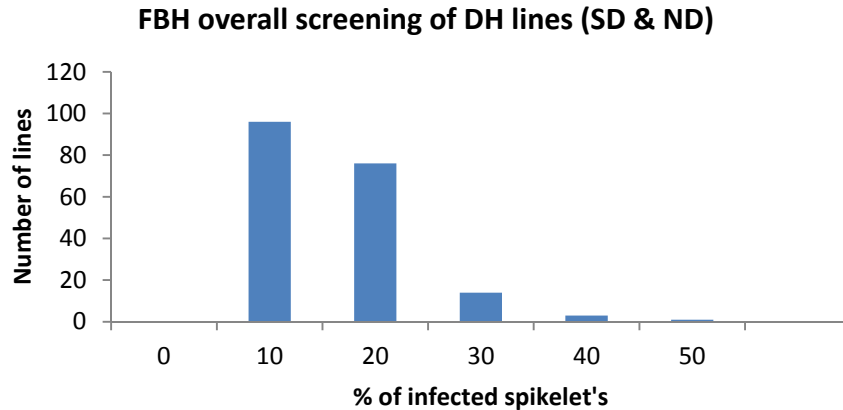
**Figure 1: Percentage of disease spikelet’s from DH lines with controls (Forefront & Advance resistant and Briggs Susceptible).**

The same experiment was replicated in Prosper, ND, where we screened and evaluated 183 DH lines and two checks (2710 resistant & 2398 susceptible) for scab during the same time as SD experiment. Unlike SD the ND location had four lines s625-2-2, s625-3-1, s625-6-6, s711-11-1 that show resistance that had infection rates 0 %. However, line s711-5-7 was the most susceptible at about 50% infection rate (see figures 2 for other observations).



**Figure 2: Percentage of disease spikelet’s from DH lines with controls (2710 resistant & 2398 susceptible).**

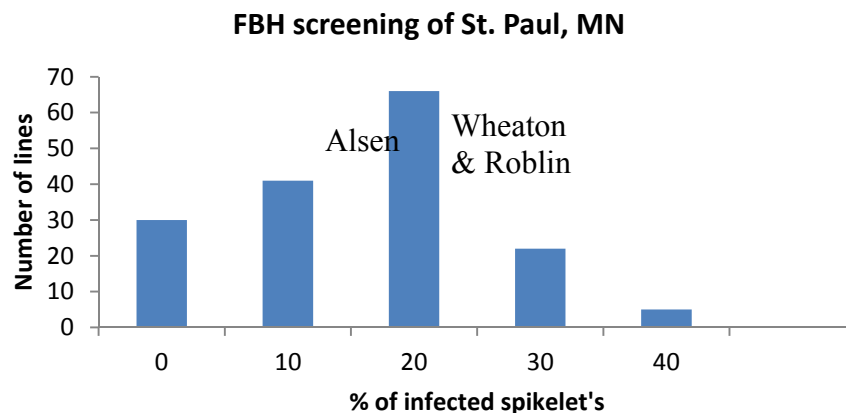
To further evaluate the DH lines we took the averages from both SD and ND lines that were represented in each location which was 190 lines including checks. The checks were taken from each other separately to keep a baseline for resistance and susceptibility. When combine line s625-2-5 showed the most resistant (less than 5 % infection rate) with is slightly better than already known resistant cultivar forefront which was around 6% infection rate overall. In contrast, line s716-14-5 (roughly 40% infection rate) showed more susceptibility then known susceptible cultivar 2398 (roughly 36%) over (see figure 3 for more information for overall observation of SD and ND).



**Figure 3: The overall percentage of disease spikelet’s from DH lines with controls (forefront, advance, and ND2710 resistant & Briggs & ND2398 susceptible).**

We had roughly 238 lines derived but either they didn’t produce enough seeds or didn’t grow in summer nurseries. A total of 185 lines that we screened in summer 2014 *Fusarium* nurseries are now in the process of being genotyped using SSR previously used when lines were derived. We have currently extracted DNA for each of the lines including the corresponding parents that were used in crosses. DNA has been quantified and run on gel electrophoresis. We have begun the PCR and will visualize get PCR to validation QTL’s as soon as possible.

We also planted 164 of the DH lines and three checks (Alsen resistant and Wheaton & Roblin susceptible) in St. Paul, MN in the *Fusarium* screening nursery. Thirty of the lines showed resistant to scab. Compared to know resistant lines in this nursery all 30 show more resistance. In contrast Roblin, Wheaton were the known susceptible and three line s711-2-3, s711-3-5 s711-6-3 showed the same susceptibility around 35% (see figure 4 for more information from MN location).



**Figure 4: Percentage of disease spikelet’s from DH lines with controls (Alsen resistant; Briggs, Wheaton and Roblin susceptible).**

The location presented analysis limitations because of how the rating system. FHB (infection) was very in this nursery. Due to limited seeds MN location didn't have an equal amount of lines as other locations did. Therefore, we were not able to compare this location to SD and ND because the lines were not equally disturbed (represented) and the rating system was totally different. The data obtain from SD and ND is easily comparable because the lines were equally represented in each location.

We currently have two replicated trials of the DH spring wheat lines in North & South Dakota respectively.

Additionally the best and worse lines (based on last year data) are planted in a fungicide x genotype trial in Brookings, SD.

**Impact:**

The best lines will be available to be used as parental material with increased FHB resistance. Since most the parents are adapted, we will be able to selected good FHB resistance sources with good agronomics. In addition, the fungicide x genotype trial will contribute to the development of 'packages' (cultivar and fungicide applications) for the growers.

### **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.**

We have distributed 200 spring wheat, and 200 winter wheat double haploids derived from selected 4 way crosses with multiple parents carrying different loci for FHB resistance. These lines have been made available to interested breeders in the region. Spring wheat DHs have been distributed to ND, MN and SD spring wheat breeding programs. Winter wheat DHs have been distributed to ND, SD, KSU and NE breeding programs and will be more widely distributed as more seed becomes available,

**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.**

- Eckard JT, Gonzalez-Hernandez JL, Caffè M, Berzonsky, W, Bockus WW, Marais, GF and Baenziger PS. 2015. Native Fusarium head blight resistance from winter wheat cultivars 'Lyman,' 'Overland,' 'Ernie,' and 'Freedom' mapped and pyramided onto 'Wesley'-*Fhb1* backgrounds. *Accepted in Molecular Breeding*. DOI: 10.1007/s11032-015-0200-1
- Eckard JT, Glover KD, Mergoum M, Anderson, J and Gonzalez-Hernandez JL. 2015. Multiple Fusarium head blight resistance loci mapped and pyramided onto elite spring wheat *Fhb1* backgrounds using an IBD-based linkage approach. *Accepted in Euphytica*. DOI: 10.1007/s10681-014-1333-8
- Eckard JT, Gonzalez-Hernandez JL, Chao S, Amand PS, Bai G. 2014. Construction of dense linkage maps "on the fly" using early generation wheat breeding populations. *Molecular Breeding* 34:1281-1300