

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

Cover Page

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Fiscal Year:	FY14
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality.
FY14 USDA-ARS Award Amount:	\$ 19,200

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Using Single Kernel NIR Sorting Technology to Enhance Quality of Breeding Lines.	\$ 19,200
	FY14 Total ARS Award Amount	\$ 19,200

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: *Using Single Kernel NIR Sorting Technology to Enhance Quality of Breeding Lines.***1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

Nondestructive, rapid and objective methods for the evaluation of FHB damage in wheat are very important for improvement of the wheat breeding efforts and to streamline development of better and stable FHB resistant cultivars. We have developed near infrared spectroscopy (NIRS) techniques for identification of Fusarium damaged kernels and estimation of deoxynivalenol levels in single wheat kernels and bulk samples. Our present research is focused on (1) finding ways to improve NIRS calibrations to determine DON levels in single wheat kernels and bulk grain samples and (2) developing new methods for screening varieties for different FHB resistance components by using our NIRS single kernel DON evaluation technique.

We have noted that NIR absorption by water in wheat kernels can interfere with NIR absorptions by DON present in Fusarium damaged kernels thereby affecting the performance of NIR calibrations when grain samples have higher moisture levels or wide moisture content variation. We are studying NIR absorptions of dry and moist wheat kernels with or without Fusarium damage using Fourier Transformed NIR (FTNIR) spectroscopy in order to identify specific NIR absorptions of Fusarium damaged kernels that are not affected by the moisture levels of the kernels. We hope to use the results from these studies for improvement of DON calibrations.

Every year a large number of wheat samples originating from FHB nursery evaluation trials are subjected to DON evaluation by standard laboratory methods which are costly, destructive and time consuming. Since FHB nursery evaluation trials are conducted under heavy disease pressure the harvested grain samples often have very high DON levels especially in FHB susceptible varieties. We are investigating the potential of using FTNIR spectroscopy for rapid estimation of the DON content of bulk grain samples. Such a technique may be used for pre-screening FHB nursery samples to separate the harvested samples into low-DON and hi-DON groups thereby the low-DON samples from potential FHB resistant varieties may be subjected to further evaluation using standard laboratory methods.

Present breeding programs mostly rely on type I (Resistance to initial infection) and type II (Resistance to the spread of the pathogen) FHB resistance components for the evaluation of wheat germplasm for FHB resistance. The importance of other types of resistance mechanisms such as resistance to toxin accumulation (RTA) have been recognized, however, there are no methods available to wheat breeders for screening breeding materials for RTA. Therefore, we investigated the feasibility of using our NIRS single kernel DON evaluation technique in artificially inoculated wheat spikes grown under greenhouse conditions. We observed that kernels in spikelets of wheat spikes artificially inoculated with the same volume of spore suspension of a particular *Fusarium graminearum* strain and grown under similar environmental conditions under a green house accumulate significantly different DON levels. This shows that this NIR method for single kernel evaluation of DON accumulation in artificially inoculated wheat spikes can be used for screening wheat varieties for RTA.

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:

Using three wheat cultivars with different FHB resistance levels we have demonstrated that single kernel DON analysis of kernels in spikelets of artificially inoculated wheat spikes by NIRS can be used to screen varieties for FHB resistance for DON accumulation. We believe this is a significant achievement since there are no common methods currently available for evaluation of wheat varieties for RTA. This new method will not only allow plant breeders to evaluate wheat germplasm for RTA rapidly and nondestructively, but also other resistance components such as type I and type II FHB resistance can also be evaluated. We have submitted a manuscript on this technique to Cereal Chemistry.

Impact:

A graduate student working with K-State wheat breeders has been using this NIRS technique for the evaluation of RTA and type II FHB resistance in some winter wheat breeding lines from 2013/2014 growing season. He will continue evaluating those lines for another season.

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? No**

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? No**

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.*

N/A

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.

Peiris, K. H. S., W. W. Bockus and F. E. Dowell (2014) FT-NIR Optical Characteristics of Sound and *Fusarium* Damaged Wheat at Two Moisture Content Levels. Poster Abstract presented at 2014 USWBSI meeting, St. Louis, Missouri.

Peiris, K. H. S., W. W. Bockus and F. E. Dowell (2015) Near infrared spectroscopic method for evaluating resistance to deoxynivalenol accumulation in wheat. Abstract accepted for oral presentation at International Grain Quality & Food Security Conference to be held in Manhattan, Kansas August 3-6, 2015.

Peiris, K. H. S., W. W. Bockus and F. E. Dowell (2015) Near infrared spectroscopic evaluation of single kernel deoxynivalenol accumulation and *Fusarium* head blight resistance components in wheat. Paper accepted for publication in *Cereal Chemistry*.