

**USDA-ARS/  
U.S. Wheat and Barley Scab Initiative  
FY12 Final Performance Report  
July 16, 2013**

**Cover Page**

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<b>Fiscal Year:</b>	FY12
<b>USDA-ARS Agreement ID:</b>	NA
<b>USDA-ARS Agreement Title:</b>	Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality.
<b>FY12 USDA-ARS Award Amount:</b>	\$ 24,400

**USWBSI Individual Project(s)**

<b>USWBSI Research Category*</b>	<b>Project Title</b>	<b>ARS Award Amount</b>
HWW-CP	Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality.	\$ 24,400
	<b>Total ARS Award Amount</b>	<b>\$ 24,400</b>

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Principal Investigator

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Date

\* MGMT – FHB Management  
 FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain  
 GDER – Gene Discovery & Engineering Resistance  
 PBG – Pathogen Biology & Genetics  
 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

**Project 1:** *Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality.*

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

Availability of rapid, non destructive and objective FHB resistance screening methods can enhance the FHB resistant wheat cultivar development process by allowing plant breeders and plant pathologists to screen large number of wheat germplasm in a short period of time. The major focus of our research program is to develop novel FHB resistance screening techniques using near infrared spectroscopy (NIRS) to enable comprehensive and rapid evaluation of FHB resistance of wheat. Our research also aims to demonstrate the ability of NIRS to detect DON in single wheat kernels.

We developed techniques to determine FHB damage and DON levels in single wheat kernels using our Single Kernel Near-infrared (SKNIR) instrument. Now we are conducting studies to nondestructively determine bulk DON levels in small grain samples and distribution of DON levels among kernels in small kernel samples. We also study single kernel DON variation among kernels along infected wheat spikes using our SKNIR single kernel DON estimation technique.

We are also investigating the use of Fourier Transform Near-infrared Spectroscopy (FTNIR) to determine DON levels and moisture content (MC) of bulk grain samples from FHB nursery trials. These scab nursery samples, especially those from FHB susceptible cultivars, usually have high DON contents as those are grown under heavy disease pressure. This will allow us to estimate bulk DON and MC of grain samples in about 30 seconds and to classify those samples as high or low DON samples at a given moisture content.

We will continue those studies to improve those single kernel and FTNIR bulk DON estimation techniques for comprehensive evaluation of wheat for FHB resistance.

**2. List the most important accomplishment and its impact (i.e. how is it 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 Fourier Transform Infrared Spectroscopy (FTIR) we have demonstrated that DON is mostly concentrated in the bran and germ of *Fusarium* infected wheat kernels and that DON in such kernels interact with the infrared light resulting in different infrared absorption patterns. Therefore, DON present in single kernels can also influence NIR light absorption. This confirms the validity of using NIRS to assess *Fusarium* damage and DON levels in single wheat kernels.

We have demonstrated that single kernel DON analysis by our SKNIR instrument can be extended to estimate bulk DON levels in small grain samples as well as to study the DON distribution among all kernels as well as among DON containing kernels (DCK) of small kernel samples. This will allow plant breeders to comprehensively evaluate wheat germplasm for FHB resistance levels. Further it will allow us to probe into FHB resistance mechanisms while retaining kernels for further generation advancement.

Our FTNIR studies with bulk grain samples from scab nursery trials showed that bulk DON and moisture levels of grain samples can be estimated rapidly.

### **Impact:**

Our SKNIR method to determine FDK % of kernel samples are used to estimate FDK % of wheat samples whenever plant breeders need their samples analyzed. We have also analyzed samples for FDK% for startup research for a new high speed sorting instrument.

The new single kernel analysis techniques can be used to pre-screen wheat breeding lines and cultivars as well as to evaluate efficacy of fungicides or other agronomic practices to control FHB. Further, the single kernel DON distribution among kernels and among DCK in grain samples helps explore the underline FHB resistance mechanisms such as resistance to spread of disease and resistance to DON accumulation.

The FTNIR technique to estimate bulk DON level in grain samples will allow rapid pre-screening of cultivars in scab nursery trials to identify highly susceptible cultivars for culling. This will help reduce the number of samples and costs of laboratory DON analysis as such analyses could be performed on selected low DON cultivars thereby reducing the costs of wheat cultivar evaluation for FHB resistance.

**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 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.**

### **Peer-reviewed articles**

Peiris, K. H. S., W. W. Bockus and F. E. Dowell 2012. Infrared Spectral Properties of Germ, Pericarp, and Endosperm Sections of Sound Wheat Kernels and Those Damaged by *Fusarium graminearum*. *Applied Spectroscopy* 66(9): 1053-1060.

Hernandez Nopsa, J. F., Baenziger, P. S., Eskridge, K. M., Peiris, K. H. S., Dowell, F. E., Harris, S. D., and Wegulo, S. N. 2012. Differential accumulation of deoxynivalenol in two winter wheat cultivars varying in FHB phenotype response under field conditions. *Can. J. Plant Pathol.* 34:380-389.

Wegulo, S. N., Bockus, W. W., Hernandez Nopsa, J. F., Peiris, K. H. S., and Dowell, F. E. 2013. Integration of fungicide application and cultivar resistance to manage *Fusarium* head blight in wheat. Pages 35-54 in: *Fungicides - Showcases of Integrated Plant Disease Management from Around the World*. M. Nita, Ed. InTech, Rijeka, Croatia.

K. H. S. Peiris, Y. Dong, W. W. Bockus and F. E. Dowell 2012. Single Kernel Near-Infrared Analysis Technique for Comprehensive Evaluation of Wheat Kernel Samples for *Fusarium* Head Blight Resistance. Submitted to *Cereal Chemistry*.

### **Presentations**

Peiris, K. H. S. and F. Dowell 2012. Estimating single kernel deoxynivalenol levels by near infrared spectroscopy for evaluating *Fusarium* head blight resistance in wheat. Poster presented at 1<sup>st</sup> ICC India International grains Conference, New Delhi, India.

Peiris, K. H. S., Y. Dong, W. W. Bockus and F. E. Dowell 2013. Estimation of Bulk Deoxynivalenol and Moisture Content of Wheat Grain Samples by FT-NIR Spectroscopy. ASABE Annual Meeting Paper # 1593402.

Peiris, K. H. S., Y. Dong, W. W. Bockus and F. E. Dowell 2013. Estimation of Bulk DON Content of Small Grain Samples for Comprehensive Evaluation of *Fusarium* Head Blight Resistance in Wheat. ASABE Annual Meeting Paper # 1593384.