USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY10 Final Performance Report
July 15, 2011

Cover Page

PI:	Floyd Dowell
Institution:	USDA-ARS
Address:	Center for Grain and Animal Health Research (CGAHR) 1515 College Avenue Manhattan, KS 66502
E-mail:	floyd.dowell@ars.usda.gov
Phone:	785-776-2753
Fax:	785-537-5550
Fiscal Year:	FY10
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality.
FY10 USDA-ARS Award Amount:	$ 24,440

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality.	$ 24,440
	Total ARS Award Amount	**$ 24,440**

_____
Principal Investigator 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?

Development of *Fusarium* resistant/tolerant wheat varieties requires the screening of kernel samples from a large number of germplasm/crosses for *Fusarium* damage and deoxynivalenol (DON) levels. At present visual methods are mostly used for evaluation of *Fusarium* damaged kernels (FDK) while gas chromatography- mass spectrometry or ELISA based methods are used for determination of DON levels. Visual FDK analysis is subjective and laborious while chemical DON determination methods are destructive and expensive. We have developed near infrared based single kernel techniques using our Single Kernel Near Infrared (SKNIR) system for rapid, nondestructive and objective evaluation of FDK and DON levels in small grain samples for screening FHB resistance. The accuracy of these techniques has been validated using grain samples with predetermined levels of FDKs from the UNL.

Studies conducted also showed that the SKNIR technique can be used to estimate bulk DON levels in small kernel samples based on single kernel analysis. In addition to the bulk sample DON level, it is also possible to see the distribution of DON amongst the single kernels. This is very valuable information that is impossible with GC-MS or ELISA based methods, unless such methods are used for analysis of each single kernel that is obviously very uneconomical and almost impractical when large number of bulk samples are to be analyzed. This information on distribution of SKNIR single kernel DON levels within samples may be used to evaluate FHB resistance types such as type II/type III resistance.

Working with SDSU researchers, we developed a SKNIR technique to evaluate the DON levels in wheat bran by analyzing single kernel DON levels in grain samples before and after pearling. This technique is being used to evaluate DON levels in the bran of near-isogenic red and white seeded wheat lines.

We have also developed a Fourier-Transformed Near-Infrared (FT-NIR) technique to evaluate bulk DON levels in kernel samples by using Perkin Elmer Spectrum 400 FTIR/FTNIR spectrometer. This technique requires about 100-150g of grain to fill a Petri Dish and DON levels could be estimated in about 30 seconds. This technique will be further validated in this season.

Our present research is focused to validate and refine the above mentioned SKNIR and FT-NIR techniques to estimate DON levels in kernel samples. Such techniques will allow plant breeders to comprehensively evaluate varieties/crosses rapidly and nondestructively for both FHB resistance and for resistant mechanisms operating in the varieties. These technologies may be helpful to enhance the efficiency of wheat breeding programs for the development of FHB resistant varieties by reducing both time and cost of sample screening for FDK and DON levels.

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:

We have developed techniques to evaluate DON levels of kernel samples for assessing FHB resistance in wheat varieties in numerous ways.

Our techniques have been used to objectively and non destructively assess %FDK in kernel samples, to estimate DON levels in single kernels, and to estimate bulk DON levels and distribution of DON among kernels in small grain samples. These analyses help breeders to evaluate germplasm more comprehensively.

Another SKNIR technique has been developed to estimate DON levels in wheat bran by analyzing single kernel DON in raw and pearled grain samples. We have used this technique to evaluate near-isogenic red and white seeded lines from SDSU by analyzing 170 grain samples.

We have also developed a new technique to evaluate DON levels in bulk samples using a FT-NIR spectrometer. This method will be helpful to rapidly screen (~ 30 seconds/sample) high DON bulk samples such as those coming from scab nursery trials, fungicide evaluation trails etc.

Impact:

The single kernel techniques were used to assess FDK and DON levels in wheat samples, to evaluate the distribution of DON among single kernels and to estimate DON in wheat bran. Application of these rapid, nondestructive and low cost DON evaluation techniques helps improve the efficiency of wheat breeding programs and evaluation of other agronomic practices for reduction of DON in harvested grains.

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., M. O. Pumphrey, Y. Dong and F. E. Dowell (2011) Fusarium Head Blight Symptoms and Mycotoxin Levels in Single Kernels of Infected Wheat Spikes. Cereal Chemistry 88(3):291-295.

Stephen N. Wegulo, William W. Bockus, John Hernandez Nopsa, Erick D. De Wolf , Kent M. Eskridge, K. H. S. Peiris, and Floyd E. Dowell (2011) Effects of Integrating Cultivar

Resistance and Fungicide Application on Fusarium Head Blight and Deoxynivalenol in Winter Wheat. Plant Disease 95 (5):554-560.

Peiris, K.H.S and Dowell, F.E. (2011) Determining Weight and Moisture Properties of Sound and Fusarium-Damaged Single Wheat Kernels by Near Infrared Spectroscopy. Cereal Chemistry 88(1): 45-50.

Peiris, K.H.S, Pumphrey, M.O., Dong, Y., Maghirang, E.B., Berzonsky, W., Dowell, F.E. (2010) Near-infrared spectroscopic method for identification of *Fusarium* damage and DON in single wheat kernels. Cereal Chemistry 87(6): 511-517.

Abstracts

Wegulo, S. N., W. W. Bockus, J. Hernandez Nopsa, E. D. DeWolf, K. H. S. Peiris and F. E. Dowell (2010) Control of FHB and DON by Prosaro fungicide in moderately resistant and susceptible winter wheat cultivars. In: S. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2010 Dec 7-9; Milwaukee, WI. Lexington, KY: University of Kentucky. p. 108.

K. H. S. Peiris, W. W. Bockus and F. E. Dowell (2010) Application of Single Kernel NIR technology for evaluation of wheat cultivars and fungicides for FHB management. In: S. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2010 Dec 7-9; Milwaukee, WI. Lexington, KY: University of Kentucky. pp. 159-160.

K. H. S. Peiris, Y. Dong, S. Wegulo, W. Berzonsky, W. W. Bockus, P. S. Baenziger and F. E. Dowell (2010) Development of Single Kernel NIR technology for evaluation of FHB resistance and for identification of reduced DON in harvested wheat grain. In: S. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2010 Dec 7-9; Milwaukee, WI. Lexington, KY: University of Kentucky. pp. 161-162.

Peiris, K. H. S., W. W. Bockus and F. E. Dowell (2010) Nondestructive Single Kernel DON Analysis of Wheat for FHB Resistance Evaluation. AACC International Meeting, Savannah, Georgia, USA. Cereal Foods world 55:A64

Presentations

Peiris, K. H. S. (2011) Single Kernel Near-Infrared Analysis for the Evaluation of Fusarium Head Blight Resistance in Wheat. Invited seminar presented for 2011 Spring. Seminar Series of Grain Science-AACCI, Manhattan Section. February 09, 2011.