Cover Page

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Fiscal Year:	FY11
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality.
FY11 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**

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Principal Investigator   Date

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* 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 (NIR) 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 is now being used to evaluate FHB resistance types such as type II/type III resistance.

    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 was 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) and IR techniques to evaluate bulk DON levels in kernel.

    Our present research is focused to validate and refine SKNIR, FT-NIR, and IR 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):

<u>**Accomplishment:**</u>

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 lines.

We have also developed a technique to evaluate DON levels in bulk samples using a FT-NIR and IR 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.

<u>**Impact:**</u>

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.

(Form – FPR11)

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.

Hernandez Nopsa, J.F., Baenziger, P.S., Eskridge, K.M., Peiris, K.H.S., Dowell, F.E., Harris, S.D., Wegulo, S.N. 2012. Differential accumulation of deoxynivalenol in two winter wheat cultivars varying in FHB phenotype response under field conditions. Canadian J. Plant Path. Epidemiology. i*First*:1-10.

Peiris, K.H.S., Bockus, W., and Dowell, F.E. 2012. Infrared spectral properties of germ, pericarp and endosperm sections of sound and Fusarium damaged wheat kernels. Applied Spectroscopy. In Press.

Peiris, K.H.S. and F.E. Dowell. 2011. Study of infrared spectral properties of germ, bran and endosperm sections of sound and *Fusarium* damaged wheat kernels. Poster presented at the 2011 USWBSI conference.

Peiris, K.H.S., Y. Dong, W.W. Bockus and F.E. Dowell. 2011. A Single Kernel Near-Infrared (SKNIR) technique for comprehensive evaluation of Fusarium Head Blight (FHB) resistance in wheat germplasm and for evaluation of fungicide treatments for managing FHB in wheat. Poster presented at the 2011 USWBSI conference.