

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY08 Final Performance Report (approx. May 08 – April 09)
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Cover Page

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Fiscal Year:	2008
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality.
FY08 USDA-ARS Award Amount:	\$ 24,440

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
HW-CP	Single Kernel Sorting Technology for Enhancing Scab Resistance and Grain Quality.	\$24,440
	Total 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
HW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
 SPR – Spring Wheat Region
 NWW – Northern Winter Wheat Region
 SWW – Southern Sinter 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?

Wheat scab caused by *Fusarium spp* has become a major constraint in the wheat industry by affecting crop yields and quality of grain products. Development of Fusarium resistant/tolerant wheat varieties is a cost effective and safe way to address this critical issue facing the wheat industry.

Objective identification of scabby, or Fusarium Damaged Kernels (FDKs) and estimation of the DON levels of FDKs are two important things needed in evaluating varieties for scab resistance or for assessing grain samples for quality. At present, visual methods are used to classify FDKs from sound kernels. However, it is possible for visually-sound kernels to have higher DON levels while visually-scabby kernels can be free from DON.

Visual methods alone are not adequate to identify FDKs. Estimation of DON levels is expensive, requires numerous chemicals for extracting and assaying DON, and is also difficult to perform on single kernels. Near Infrared Spectroscopy (NIRS) can be used as a rapid and non destructive method to identify FDKs and to estimate DON levels of single kernels rapidly. Hence we are developing NIRS techniques to identify FDKs and estimate DON levels in single wheat kernels in order to facilitate evaluation of germplasm for varietal improvement.

Single kernel scab and DON calibrations were developed using an automated single kernel NIR system for classification of sound and FDKs and to estimate DON levels of single wheat kernels. Attempts are now being made to minimize error levels in single kernel DON estimation.

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 developed calibrations to sort single kernels based on their scab level or DON levels. Scab calibration was used to sort FDKs in 108 lines from NDSU twice in 2008. SKNIR successfully sorted sound kernels from FDKs that had higher DON levels as revealed by subsequent DON analysis of the sorted fractions at University of Minnesota. The results showed that SKNIR sorting is important in understanding the dynamics of DON composition in a grain sample that might be important in comprehensive evaluation and selection of a variety for FHB resistance. In a collaborative study with UNL to test our scab and DON calibrations, we sorted samples with varying known proportions of manually sorted sound and scabby kernels coming from 2007 and 2008 growing seasons. Scab calibration was used to sort kernels based on the scab level and thereafter kernels were sorted on DON levels. Sorted fractions were sent to UNL for DON analysis. We have also investigated the NIR absorbance of DON and that of FDKs and sound kernels and shown that some of the

differences in NIR absorbance between sound and FDKs are caused by NIR absorbance of DON in FDKs.

We also studied the distribution of scab symptoms and mycotoxin levels (DON and 15-ADON) among single kernels in artificially inoculated wheat heads in two varieties. Results revealed that patterns of mycotoxin distribution are markedly different for the two varieties. We also found asymptomatic kernels with high DON levels as well as scabby kernels without DON in FHB infected wheat heads.

Impact:

This technology can be used to objectively measure FDK in samples to aid breeders in rapidly screening lines for scab resistance. The technique can also be used to rapidly estimated DON levels, thus reducing cost of evaluating samples. This method also gives the distribution of FDK and DON within samples, providing breeders with additional information about the levels and types of infections in samples.

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.

1. Peiris, K.H.S., Dowell, F.E. NIR absorbance characteristics of deoxynivalenol and of sound and *Fusarium* damaged wheat kernels. Submitting to JNIRS Log. 241302.
2. Peiris, K.H.S, Pumphrey, M.O., Dong, Y., Maghirang, E.B., Berzonsky, W., Dowell, F.E. Near-infrared spectroscopic method for identification of *Fusarium* damage and DON in single wheat kernels. In author draft 3/09. To be submitted to *Euphytica*.
3. Wegulo, S.N., Dowell, F.E. 2008. Near-infrared versus visual sorting of *Fusarium*-damaged kernels in winter wheat. *Canadian Journal Plant Science*. 88(6):1087-1089. Log No. 227755.
4. Peiris, K.H.S., Pumphrey, M.O., and Dowell, F.E. 2009. Single kernel analysis of *Fusarium* head blight symptoms and mycotoxins in infected wheat heads. Poster presented at the AACCI meeting, Baltimore, MD.
5. Neway Mengistu, Stephen Baenziger, Stephen Wegulo, Janelle Counsell, and Floyd Dowell. Using optical sorting techniques to select for lower scab disease in segregating populations. 2008 USWBSI conference.
6. Stephen N. Wegulo and Floyd E. Dowell. Evaluation of visual and optical sorting of *Fusarium*-damaged kernels in winter wheat. 2008 USWBSI conference. Log No. 225181.
7. K.H.S. Peiris and F.E. Dowell, NIR optical characteristics of Deoxynivalenol. 2008 USWBSI conference. Log No. 234385.
8. K.H.S Peiris, M.O. Pumphrey, Y. Dong, S. Wegulo, W. Berzonsky, P.S. Baenziger and F.E. Dowell. Progress on Development and Application of Single Kernel NIR Sorting Technology for Assessment of FHB Resistance in Wheat Germplasm. 2008 USWBSI conference. Log No. 234380
9. Peiris, K.H.S, M.O. Pumphrey, Y. Dong and F.E. Dowell 2008. NIRS method for precise identification of *Fusarium* damaged wheat kernels. AACCI Poster, September 21-24, Honolulu, HI. Meeting Abstract. *Cereal Foods World* 53:A73. Log no. 233423
10. Wegulo, S.N., Dowell, F.E. 2008. Evaluation of visual and optical sorting of *Fusarium* damaged kernels in winter wheat. Paper presented at the American Phytopathological Society Annual Meeting, St. Paul, MN, July 26-30. *Phytopathology* 6:S167. Log No. 225181.
11. Dowell, F.E., Maghirang, E.B., and Baenziger, P.S. 2006. Single kernel sorting technology for enhancing scab resistance and grain quality. Proceedings of the 2006 National *Fusarium* Head Blight Forum. Sheraton Imperial Hotel, Research Triangle Park, NC, December 10-12. Pg 96. Log No. 203174

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12. Dowell, F.E., Maghirang, E.B., Baenziger, P.S., McKendry, A.L., Milus, E.A., Horevaj, P., Wegulo, S.N., Breathnach. 2007. Applying single kernel sorting technology to developing scab resistant lines. Proceedings from the National Fusarium Head Blight Forum. Proceeding. Kansas City, MO. Log no. 217567.

If your FY08 USDA-ARS Grant contained a VDHR-related project, include below a list all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance. If this is not applicable (i.e. no VDHR-related project) to your FY08 grant, please insert 'Not Applicable' below.

Not Applicable.