USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY08 Preliminary Final Performance Report (approx. May 08 – April 09)
No Cost Extension for FY09
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Cover Page

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Fiscal Year:	2008
USDA-ARS Agreement ID:	59-0790-5-079
USDA-ARS Agreement Title:	Factors and Mechanisms Favoring Deoxynivalenol Presence in Asymptomatic Wheat.
FY08 ARS Award Amount:	$ 9,688

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
FY08-KU-031	Deoxynivalenol Accumulation and Loss in Wheat with Fusarium Head Blight.	$ 9,688
	Total Award Amount	**$ 9,688**

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Principal Investigator Date

* CBCC – Chemical, Biological & Cultural Control
EEDF – Etiology, Epidemiology & Disease Forecasting
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GET – Genetic Engineering & Transformation
HGR – Host Genetics Resources
HGG – Host Genetics & Genomics
IIR – Integrated/Interdisciplinary Research
PGG – Pathogen Genetics & Genomics
VDUN – Variety Development & Uniform Nurseries

Project 1: *Deoxynivalenol Accumulation and Loss in Wheat with Fusarium Head Blight.*

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

It is well established that infection of wheat heads at anthesis by the head scab fungus *Fusarium graminearum* results in significant disease and deoxynivalenol (DON) in the grain formed. What is less well understood are the following a) how temperature effects this b) how post-anthesis moisture effects the final levels of DON in the grain, and c) why DON levels observed during grain fill often higher than those seen at harvest. These questions address the dynamics of deoxynivalenol accumulation and loss in wheat with Fusarium Head Blight. It is important to learn the answers to these questions as this information is necessary for accurate prediction of DON in harvested grain. Disease prediction and timely fungicide application have proven to be a useful management tools particularly when combined with other effective management practices such as use of moderately resistant cultivars. Disease level does not always correlate with DON level however, therefore information that could be used to create DON prediction tools is still needed. Our research addresses the factors and mechanisms that result in DON in harvested wheat grain.

We are looking at the role of temperature in DON formation at early times after infection and also on the impact of cultivar to this response. We grow wheat plants in the greenhouse and then transfer them to a temperature controlled growth chamber as flowering begins. The wheat heads are inoculated at a single, middle spikelet and then spikelets are harvested at various times after inoculation and evaluated for the presence of DON, deoxynivalenol-3-glucoside (DON-GLUC) and fungal colonization. We are also looking at the formation of (DON-GLUC) during early infection times and during grain development in the field using 6 cultivars of winter wheat.

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 conducted two replications of wheat inoculation experiments at two temperatures, 15 C and 22 C, in growth chambers using moderately resistant Alsen and susceptible Wheaton. We monitored DON, DON-GLUC and ergosterol at various times after infection at individual florets above and below the point of inoculation on the wheat head. Ergosterol is a fungal specific sterol used to assess biomass *in planta*. We observed significantly more biomass in Alsen grown at 22 C than when this cultivar was grown at 15 C. Inoculated Wheaton plants had less biomass at 15 C than those grown at 22 C but this difference was not significant. Temperature had only a small effect on DON accumulation in the susceptible cultivar Wheaton. However in Alsen, significantly more DON was produced at 15 C than at 22 C. In fact these plants had the highest level of DON but the least amount of

ergosterol. These results indicate that temperature and cultivar interact to impact DON accumulation. In this analysis we also observed formation of DON-GLUC in both cultivars.

Impact:

Our results indicate that optimal conditions for fungal growth and disease development may not be the same as those that lead to the highest levels of toxin. Indeed the interaction of temperature and cultivar to DON accumulation complicates the current picture for toxin development. These results should be reviewed and considered by breeders screening of cultivars for resistance and toxin accumulation.

Our results also suggest that factors that stress the fungus such as a moderately resistant host and cool temperatures can lead to higher than expected levels of DON. Those working to develop prediction models for DON and those breeding for reduced DON accumulation should examine this information.

The observation of DON-GLUC formation in both cultivars is of note and warrants further investigation.

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.

Willyerd, K. T., Archibald, D. D., Boroczky, K., De Wolf, E. D., and Kuldau, G. A. 2008. Detection of trichothecene mycotoxins and ergosterol within wheat florets using gas chromatography with electron capture detection. *Phytopathology* 98: S172. (abstract)

Willyerd, K. T., Archibald, D. D., Boroczky, K., De Wolf, E. D., and Kuldau, G. A. 2008. Effects of temperature on deoxynivalenol translocation and *F. graminearum* infection of wheat heads. In: Canty, S. M., E. Walton, A. Clark, D. Ellis, J. Mundell, and D. A. Van Sanford (Eds.), Proceedings of the National Fusarium Head Blight Forum; 2008 Dec. 2-4; Indianapolis, IN. Lexington, KY: University of Kentucky. Pp. 129-132.

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