

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY11 Final Performance Report
One-Year No Cost Extension (NCE) through FY12
July 16, 2013**

Cover Page

PI:	Senay Simsek
Institution:	North Dakota State University
Address:	Department of Plant Sciences 209 Harris Fargo, ND 58105
E-mail:	senay.simsek@ndsu.edu
Phone:	701-231-7737
Fax:	
Fiscal Year:	FY11 (NCE for FY12)
USDA-ARS Agreement ID:	59-0206-0-073
USDA-ARS Agreement Title:	Effect of FHB on Wheat Quality.
FY11 USDA-ARS Award Amount:	\$ 30,184

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
FSTU	Characterization of Bound Deoxynivalenol in Wheat.	\$ 13,790
VDHR-SPR	Determination of the Relationship between FHB and Spring Wheat Quality.	\$ 16,394
	Total ARS Award Amount	\$ 30,184

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: *Characterization of Bound Deoxynivalenol in Wheat.*

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

It is important to point out that several factors could affect the fate of a mycotoxin during food processing including the food matrix, pH, moisture content, process temperature, natural or spike contamination, and concentration of the toxin. During food processing, heating, fermentation or other ingredients, such as enzymes, can potentially alter the mycotoxins. Bakery processing has been reported to reduce DON contamination; however, it has also been suggested that DON is highly stable during the baking processes. The overall goal of this research was to determine the fate of both deoxynivalenol (DON) and its conjugated mycotoxin deoxynivalenol-3-glucoside (D3G) during milling and baking processes using GC and LC-MS-MS. The effects of various enzyme treatments on DON levels in wheat have also been investigated.

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:

There is no study literature that investigates the fate of D3G during milling and baking process. Our results indicated that milling decreased the D3G content; similar to what is found for DON in wheat flour. D3G detected in the flour was 23.7% lower than detected in the whole wheat. There were no significant differences ($P < 0.05$) in the D3G detected in the dough samples. However, the baked bread had significantly ($P < 0.05$) less D3G detected than the dough. Experiments were conducted to determine the effect of enzyme hydrolysis on DON detection in whole wheat. There were significant differences ($P < 0.05$) between the wheat treated with α -amylase, cellulase, protease, and xylanase. DON detection levels were significantly ($P < 0.05$) higher after treatment with protease (16%) and xylanase (39%) compared to the wheat composite. Our results suggest that DON may be bound or embedded to the cell wall matrix or protein component of the wheat kernel due to the rise in detection of DON after these enzyme treatments.

Impact:

There has been conflicting results in the literature in terms of changes in DON concentrations during baking process. This study confirmed that DON increased after baking. Fate of bound mycotoxins during milling and baking was investigated for the first time and displayed similar profile to that of DON.

Project 2: *Determination of the Relationship between FHB and Spring Wheat Quality.*

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

The effect of Deoxynivalenol (DON) on quality characteristics of a hard red spring wheat cultivar was investigated in this study. DON levels were controlled by using various fungicidal treatments on 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):

Accomplishment:

Test weight showed a negative correlation with DON. Protein content of flour showed a positive correlation and flour color (L value) showed a negative correlation. Fusarium damage had a significant impact on gluten quality that is evident from lower gluten index. Extensigraph curves showed that fusarium decreased the resistance to extension and area under the curve and increased the extensibility. Alveograph curves also exhibited similar trend. Baking characteristics such as mixing time and dough handling also showed negative correlations with DON. These observations suggest that proteases from fusarium act on gluten proteins especially the fractions responsible for dough strength thereby reducing the overall dough quality.

Impact:

Studies have shown the detrimental effect of fusarium head blight on various qualities using different wheat varieties. However, it is important to gain thorough understanding of how the disease and its associated mycotoxin DON impacts a single wheat variety from one location so that the genetic and environmental differences are eliminated. The objective of this research is to determine how different levels of DON impacts the yield, kernel parameters, rheological properties and bread baking quality of a hard red spring wheat cultivar.

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:

- 1) Simsek, S., Burgess K., Whitney K.L., Yan, G., Qian, S.Y. 2012. Analysis of deoxynivalenol and deoxynivalenol-3-glucoside in wheat. *Food Control*. 26:297-292

Presentations:

- 1) Whitney, K., Halley, S., Ohm, J., Simsek, S. 2010. Effect of Fusarium head blight on spring wheat quality. NC213 Grain Quality Annual Meeting. Kansas City, MO.
- 2) Whitney, K., Halley, S., Ohm, J., Simsek, S. 2010. Effect of Fusarium head blight on hard red spring wheat quality and correlation with accumulation deoxynivalenol in grain after fungicide treatment. AACC International Meeting. Savannah, GA. *Cereal Foods World* 55:A75.
- 3) Burgess, K., Whitney, K.L., Simsek, S. 2011. Fate of wheat mycotoxins during milling and baking process. National Environmental Health Association (NEHA) 75th Annual Educational Conference & Exhibition. Columbus, OH.
- 4) Burgess, K., Simsek, S. 2010. Analysis of mycotoxins in wheat. ND EPSCOR State Conference. Grand Forks, ND.
- 5) Simsek, S. 2012. Effect of naturally occurring wheat enzymes on mycotoxins. NC213 Grain Quality Annual Meeting. Minneapolis, MN.
- 6) Simsek, S. 2011. Mycotoxin in wheat. NC213 Grain Quality Annual Meeting. Kansas City, MO

Thesis:

Kimberly Burgess. MS Degree Student. Graduated on May 26, 2011.
Major: Food Safety
Thesis Title: Analysis of deoxynivalenol and deoxynivalenol-3-glucoside in wheat.
Advisor: Dr. Senay Simsek