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

# Cover Page

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|---|---|
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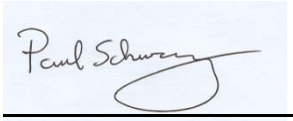
| **Fiscal Year:** | FY10 |
| **USDA-ARS Agreement ID:** | 59-0206-9-068 |
| **USDA-ARS Agreement Title:** | Determination and Characterization of Deoxynivalenol in Barley. |
| **FY10 USDA-ARS Award Amount:** | $ 155,452 |

**USWBSI Individual Project(s)**

| USWBSI Research Category* | Project Title | ARS Award Amount |
|---|---|---|
| FSTU-S | Malting Barley Deoxynivalenol Services. | $ 155,452 |
| | **Total ARS Award Amount** | **$ 155,452** |



July 15, 2011
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:** *Malting Barley Deoxynivalenol Services.*

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

Mycotoxin analyses are essential for most researchers working on FHB of cereals. However, in barley DON is a major economic factor, and new varieties must display increased resistance to DON accumulation as well as to FHB. Screening barley lines for DON is requisite for any breeding program intending to develop varieties for the upper Midwestern USA. DON analytical services are primarily provided to three barley varietal developmental programs. These breeding programs stated a need for the analysis of approximately 12,000 samples in FY10. Supporting research and extension work has typically required an additional 3,000 to 4,000 samples. In total, eleven collaborating scientists were served. The major issue is to provide DON analytical services in a cost effective, timely and accurate manner. Funds provided by the USWBSI have allowed us to hire additional personnel and to subsidize the cost of analysis.

Research on bound DON (DON-3-glucoside) is important to efforts on food safety and breeding for FHB resistance. Wheat and barley have been shown to have the ability to detoxify deoxynivalenol (DON) by forming glycosides. The presence of these DON-glucosides, or bound DON in barley and wheat are a cause for concern, as by definition, bound DON is that which escapes detection by the routinue analytical methods. The evidence that suggests bound DON may be released into the free form under some food processing conditions, through enzymolysis in malting and brewing, or in digestion raises concerns that the potential toxicity of samples is being underestimated. Breeder's lines that show partial resistance or lower DON accumulation through the formation of DON-glucosides may be of questionable value, if free DON is simply being offset by bound DON.

**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:** Approximately 11,100 samples (excluding standards) were analyzed from May 2010 to May 2011. More than one half of these analyses were from barley varietial development programs (n=6,403). Approximately 2,500 wheat were analyzed for the NDSU Veterinary Diagnostic Lab and NDSU Wheat Quality Lab. Additional analysis were conducted for personnel involved in extension/crop production work (n= 2150) and for barley FHB research projects. Samples analyzed as part of the 2010 regional barley crop quality survey (n=247) indicated that average levels of DON (0.40 mg/kg) were comparable to those seen in recent years. The highest value observed was 4.8 mg/kg, but over half the samples tested were below 0.10 mg/kg. Periodic check samples (barley and malt) are analyzed by all USWBSI funded diagnostic laboratories as a means of quality assurance, to help assure that comparable results are obtained in each laboratory

Forty samples from the NABSN nurseries in Langdon and Osnabrock, ND were tested for DON-3-glucoside by LC-MS/MS. The DON values of samples ranged from 1.51 to 101.75 mg/kg. Levels of DON-3-glucoside ranged from non-detectable to 1.04 mg/kg. A coefficient of determination ($r^2$) of 0.83 was observed between levels of DON and DON-3-glucoside. All samples containing DON-glucoside, also had very high levels of DON.

**Impact:** This project provides essential support to all barley breeding programs working on the development of FHB-resistant varieties for the Midwestern USA. The occurrence of FHB and DON is a primary factor in the dramatic decrease in barley acreage that has been observed over the past 15 years

**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.**

Burlakoti, R., Neate, S., Adhikari, T., Gyawali, S., Salas, B., Steffenson, B.J., and Schwarz P. Trichothecene profiling and population genetic analysis of Gibberella zeae from barley in North Dakota and Minnesota. Phytopathology 101(6):687-695, 2011.

Delgado, J.A., Schwarz, P.B., Gillespie, J., Rivera-Varas, V.V., Secor, G.A. Trichothecene mycotoxins associated with potato dry rot caused by *Fusarium graminearum*. Phytopathology. 2010, 100: 290-296, 2010

**PI:** Schwarz, Paul
**Project:** Malting Barley Deoxynivalenol Services.

# FY10 FPR – USWBSI ADDENDUM
# DON Service Labs – Quality Control Data

**Insert below Quality Control Data/Results from the FY10 Award Period (May 10-May 11):**

| NDSU Barley and Malt Sample Collaborative for USWBSI | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 collaborative labs receive 2 barley and 2 malt samples 3-4 times per year | | | | | | | | | | |
| | | | | | | | | | | |
| | Apr-10 | Apr-10 | Apr-10 | Apr-10 | | | Aug-10 | Aug-10 | Aug-10 | Aug-10 |
| | Barley 86 | Malt 86 | Barley 87 | Malt 87 | | | Barley 88 | Malt 88 | Barley 89 | Malt 89 |
| | | | | | | | | | | |
| NDSU | 0.22 | 0.56 | 0.21 | 0.54 | | NDSU | 5.47 | 0.60 | 1.42 | 0.16 |
| N | 10 | 10 | 10 | 10 | | N | 11 | 11 | 11 | 11 |
| Avg. | 0.21 | 0.57 | 0.20 | 0.64 | | Avg. | 4.54 | 0.63 | 1.13 | 0.28 |
| Std. Dev. | 0.10 | 0.10 | 0.06 | 0.11 | | Std. Dev. | 0.76 | 0.20 | 0.13 | 0.34 |
| CV | 46.16 | 17.89 | 30.91 | 17.15 | | CV | 16.74 | 31.33 | 11.11 | 121.25 |
| Z-value | 0.10 | -0.10 | 0.17 | -0.91 | | Z-value | 1.22 | -0.15 | 2.23 | -0.35 |
| Min | 0.00 | 0.43 | <0.10 | 0.51 | | Min | 2.69 | 0.40 | 1.00 | 0.10 |
| Max | 0.30 | 0.80 | 0.28 | 0.90 | | Max | 5.47 | 1.00 | 1.42 | 1.20 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | Dec-10 | Dec-10 | Dec-10 | Dec-10 | | | Mar-11 | Mar-11 | Mar-11 | Mar-11 |
| | Barley 90 | Malt 90 | Barley 91 | Malt 91 | | | Barley 92 | Malt 92 | Barley 93 | Malt 93 |
| | | | | | | | | | | |
| NDSU | 3.95 | 0.63 | 0.18 | 8.19 | | NDSU | 1.18 | 0.12 | 0.17 | 0.60 |
| N | 10 | 10 | 10 | 10 | | N | 9 | 9 | 9 | 9 |
| Avg. | 5.40 | 0.60 | 0.31 | 7.43 | | Avg. | 1.20 | 0.12 | 0.17 | 0.63 |
| Std. Dev. | 2.33 | 0.41 | 0.15 | 3.92 | | Std. Dev. | 0.28 | 0.04 | 0.07 | 0.09 |
| CV | 43.20 | 68.22 | 48.03 | 52.69 | | CV | 23.05 | 37.17 | 39.51 | 13.52 |
| Z-value | -0.62 | 0.07 | -0.87 | 0.19 | | Z-value | -0.07 | 0.00 | 0.00 | -0.33 |
| Min | 3.95 | 0.29 | 0.10 | 3.93 | | Min | 0.86 | <0.10 | <0.10 | 0.50 |
| Max | 11.80 | 1.70 | 0.60 | 17.10 | | Max | 1.60 | 0.18 | 0.30 | 0.77 |
| | | | | | | | | | | |