

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY09 Final Performance Report
July 15, 2010**

Cover Page

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Fiscal Year:	2009
USDA-ARS Agreement ID:	59-0790-8-071
USDA-ARS Agreement Title:	Management and Resistance Sources for Control of FHB in Barley.
FY09- USDA-ARS Award Amount:	\$ 84,736

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
BAR-CP	Development and Validation of FHB and DON Prediction Models for Barley.	\$ 6,877
BAR-CP	Transformation and Field Testing of Transgenic Barley Lines.	\$ 6,603
BAR-CP	Screening Advanced Breeding Lines for Scab Resistance Region Uniform Nurseries.	\$ 14,520
BAR-CP	Screening Hordeum Germplasm for Resistance to Fusarium Head Blight and DON Accumulation.	\$ 29,233
	Total Award Amount	\$ 84,736

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

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: *Development and Validation of FHB and DON Prediction Models for Barley.*

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

Producers in the upper Midwest need a prediction model for forecasting the risk of FHB in barley. An effective FHB risk advisory system is currently available for wheat but the model used to develop the system was based on environmental factors associated with disease occurrence levels in wheat. This advisory system may not be effective at predicting disease severity for barley because barley risk factors and duration of risk may differ from those of wheat. Additionally there is no model available for DON, the most important criteria used by the malting industry when deciding to purchase malting barley. Jeff Stein at South Dakota State University is coordinating a multistate effort to investigate the effect of environmental conditions on FHB severity and the accumulation of DON in barley. NDSU recorded disease and environmental parameters for 4 barley lines (Tradition, Robust, Quest, and Conlon) across 4 locations (Carrington, Dazey, Prosper and Fargo, ND). Disease severity, DON levels, heading date and environmental data was collected for these lines across all sites; environmental conditions were natural – no irrigation or inoculation. Weather data was collected from nearby NDAWN weather stations.

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: Disease and weather data were collected from Carrington, Dazey, Prosper and Fargo, ND – locations representing different environments, soil types and cropping systems. Information collected was: heading date, FHB incidence and severity, and DON accumulation in harvested samples. Weather conditions were generally dry at the four locations in 2009, and disease severity averaged less than 1% and DON levels ranged from .001 to 0.65 ppm. Data on disease severities, DON, and environment were sent to South Dakota State to be included in Dr. Stein's data set. See Dr. Stein's project report for the accomplishments achieved with this project.

Impact: The data collected in North Dakota will help researchers develop a prediction model for FHB severity and DON accumulation in barley. The forecasting system can be developed based one barley model similar to that developed for wheat. The information will be accessible to producers and crop advisors allowing more informed decisions on fungicide use.

Dr. Stein's report on this project.

Project Title: Validation and Refinement of DON Models in Barley for the Northern Great Plains

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PI: Jeffrey Stein; USDA-ARS Agreement #: 59-0206-9-060

Project 2: *Transformation and Field Testing of Transgenic Barley Lines.*

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

Commercially accepted barley lines grown in the upper Midwest are susceptible to FHB and have DON accumulation levels above acceptable industry standards. Breeding programs have made recent progress to bring disease severity and DON levels down, but these lines must be approved for malting quality. During a FHB epidemic the DON accumulation in these new lines may still be above the malting industry standards. Transgenic barley lines developed by L. Dahleen (USDA-ARS-Fargo, ND), M. Manoharan (UAPB) and A. Tilahun (UNI) are being examined to determine if they may provide better levels of resistance and reduction in DON than has been achieved with conventional breeding. Comparison will be made between resistant and susceptible checks and set of transgenic lines, including Conlon with Chi+FvGlu, Chi+t1p, Npr1 or FvGlu, Conlon BC lines with more than one of the genes, Lacey with Dogt1 and Golden Promise with gastrodianin. The field trial will be planted at the Langdon Research Extension Center in northeast ND, under guidelines required for transgenic research plots.

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: The NDSU barley pathology program is cooperating with Dr. Lynn Dahleen from the USDA-ARS facility in Fargo, to field screen transgenic materials she has developed. The NDSU barley pathology project planted the material, applied corn based inoculum, set up the misting system and maintained the nursery, all in Langdon, ND. Dr. Dahleen scored the transgenic materials and harvested the grain. See Dr. Dahleen's project report for the accomplishments achieved with this project

Impact:

Dr. Dahleen's report on this project.

Project Title: Field Tests of Transgenic Barley Lines

FY09 (approx. May 09 – April 10) FY09 Final Performance Report

PI: Lynn Dahleen

USDA-ARS Agreement #: 59-0790-8-071

Project 3: Screening Advanced Breeding Lines for Scab Resistance Region Uniform Nurseries.

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

The objective of this project is to promote collaboration between North American barley breeding programs to advance and distribute elite barley germplasm with resistance to *Fusarium* head blight. A limiting factor in the development of barley varieties with improved Type I resistance and lower DON accumulation is the number of screening nurseries available where the level of infection is sufficient to identify resistant lines from those that are susceptible. In addition, it is beneficial to screen multiple lines from different programs at common sites so head to head comparisons are valid. Advanced barley lines with FHB resistance were tested in mist-irrigated sites, as well as under normal rainfall conditions. Mist-irrigated nurseries also were artificially inoculated with *Fusarium graminearum* spores. The cooperative nursery is called the North American Barley Scab Evaluation Nursery (NABSEN). The 2009 NABSEN nursery contained the most advanced barley lines with putative FHB resistance and were grown in eight locations across the region where FHB is affecting the crop. In 2009, ND had three locations for this nursery – Fargo, Langdon, and Casselton. Other locations included St. Paul and Crookston, MN, Brandon, Manitoba, and Hangzhou, China. Casselton, ND had two nurseries both non-irrigated, while the Fargo and Langdon sites were misted. The nurseries included breeding lines with putative FHB resistance from NDSU 2-rowed and 6-rowed lines, and lines from the Univ. of Minnesota, Busch Ag, and Agriculture and Agri-Food Canada. FHB parameters, DON, and agronomic factors were recorded.

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: The nursery contained 50 lines, including 6 resistant and susceptible controls. FHB severity was very low at the Casselton, ND, St. Paul, and Crookston, MN dryland sites and moderately low at Fargo, but all other sites had adequate to good development of FHB to determine the relative levels of FHB resistance in the germplasm between the breeding programs. When averaged over all sites, including those outside of ND, one line from the North Dakota Univ. and four lines from the Univ. of Minnesota displayed FHB levels less than Chevron, the resistant 6-rowed check. One line each from North Dakota State Univ. and Canada 2-rowed material had FHB levels less than the resistant 2-rowed check, CI4196.

Impact:

Significant progress is being made toward developing FHB resistant barley cultivars. All North American barley breeders have access to the data collected in this project and are able to use the relative performance data to make decisions about continuing or dropping particular breeding lines. Breeders now have: 1) tests of the resistance stability of their breeding lines across a range of environments and disease pressures; 2) a measure of the resistance in their advanced lines compared to those of the other barley breeders in North America; and 3) access to unique germplasm with resistance to FHB and DON accumulation.

Project 4: *Screening Hordeum Germplasm for Resistance to Fusarium Head Blight and DON Accumulation.*

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

Resistance against FHB and DON accumulation in *Fusarium graminearum* infected barley currently relies on a limited number of resistance sources. Screening of the comprehensive barley germplasm collections from the US and Dutch center for genetic resources identified a limited number of potential new sources of resistance. Additional FHB resistance sources must be identified and characterized to expedite their use. This project accelerates screening of diverse *Hordeum* germplasm from previously unutilized barley germplasm collections. The material will be screened in replicated experiments at several location in NorthAmerica. To achieve this goal, 550 lines in 2007, 405 lines in 2008 and the best 13 lines were screened again in 2009 in irrigated and inoculated nurseries at Fargo and Langdon, ND, two areas that are climatically and geographically different. Experimental units in these nurseries consisted of single, short rows, and arranged in an RCBD with four replications. Checks were Stander (FHB susceptible 6- rowed cultivar), Chevron (FHB resistant 6-rowed cultivar), Conlon (FHB susceptible 2- rowed cultivar), and CIho 4196 (FHB resistant 2-rowed accession), as well as IBC11809 and PI38393. Entries were inoculated using two applications of grain spawn, once before head emergence and once prior to early dough. FHB severity was determined at the mid-dough stage on 20 spikes per row. Entries were scored for flowering date, height, and other important agronomic characteristics. DON analysis was done on harvested grain.

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: Disease pressure at Langdon was very high in 2009, and five lines of the 13 tested had DON levels lower than resistant checks. DON levels at Langdon, ND were very high. Five lines had lower DON levels compared to the resistant checks. DON levels ranged from 10.96 – 44.61 ppm in these five lines compared to Chevron which had a DON level of 52.06 ppm. At Fargo, severity levels were low and DON levels were comparable to the resistant checks.

Impact: Experimental material has been identified that have FHB and DON levels lower than current resistant checks. Those lines will now be tested in multiple field sites to ensure their resistance over different environmental conditions, and under a range of disease pressures. The best lines will be moved into the next stage of genotyping, to ensure that they are unique and crossed to breeding lines adapted to the upper Midwest.

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.

None

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.

P.L. Gross, Evaluation of the effects of swathing versus straight combining on FHB DON in barley at Fargo, ND 2007 *Phytopathology* 99:S47 (Abstract).