

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY08 Final Performance Report (approx. May 08 – April 09)
July 15, 2009**

Cover Page

PI:	Scott Halley
Institution:	North Dakota State University
Address:	Langdon Research Extension Center 9280 107th Ave NE Langdon, ND 58249
E-mail:	Scott.Halley@ndsu.edu
Phone:	701-256-2582
Fax:	701-256-2580
Fiscal Year:	2008
USDA-ARS Agreement ID:	59-0790-8-069
USDA-ARS Agreement Title:	Developing Managing Strategies to Reduce Effects of FHB in the Great Plains.
FY08 USDA-ARS Award Amount:	\$ 53,143

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
BAR-CP	Spray Application Technology Evaluations for Enhanced Fungicide Efficacy.	\$10,378
BAR-CP	Sequential Fungicide Applications and Improved Genetics to Control FHB.	\$ 9,757
BAR-CP	Grower Demonstration of Integration of Genetics and Fungicide Application.	\$ 5,913
MGMT	Spray Application Technology Evaluation for Enhanced Fungicide Efficacy on HRSW.	\$ 15,729
VDHR-SPR	Regional Uniform Scab Nursery - Langdon Location.	\$ 6,280
MGMT	Uniform Tests of Biocontrol Agents for Fusarium Head Blight.	\$ 5,086
	Total Award Amount	\$ 53,143

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
 HWW-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

(Form FPR08)

Project 1: *Spray Application Technology Evaluations for Enhanced Fungicide Efficacy.*

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

Fungicide is applied to small grains for control of Fusarium head blight (FHB) using ground application equipment that has two distinct delivery methods. One system, a hydraulic delivery system, has shown to be a good spray delivery method which has been studied and reported. The second system is an air-spray system which uses a high velocity air system to carry the spray to the target. The parameters tested include air delivery speed, drop size and orifice delivery angle relative to the orientation of the grain head. This research project is studying the most efficacious delivery parameter combinations with the air delivery system. The studies are designed to test the results with a factorial arrangement and replication so each individual parameter is evaluated with all other parameter options or combinations. This project will determine barley and hard red spring wheat grain head coverage, fungicide efficacy for reducing effects of FHB on head disease and deoxynivalenol accumulation in the grain and yield and other grain quality parameters.

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 second year of the three year study has effectively resulted in elimination of some parameter combinations as providing most efficacious fungicide application. An additional year of study will define the most effective combinations of parameters.

Impact:

Growers who utilize air delivery systems will be able to improve the performance of fungicide by using the most effective parameters when the project is complete. An extension brochure for distribution to producers is planned after the research is complete.

Project 2: *Sequential Fungicide Applications and Improved Genetics to Control FHB.*

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

Fungicide application to barley has been inconsistent at times. Planted barley acreage has shifted to western regions to escape the effects of FHB. New breeding material with increased resistance to FHB is being developed by the major barley breeding programs and needs evaluation. In addition evaluating the effects of sequential fungicide applications on the later developing tillers has not been researched.

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:

A resistant line from the NDSU barley breeding program was compared to ‘Tradition’ barley for yield and response to sequential application of fungicides. The experimental line compared favorably in yield to Tradition and has had lower deoxynivalenol accumulation. In addition the deoxynivalenol level in the later developing tillers was very high and would account for some of the inconsistencies of fungicide application for control of FHB on barley. An additional year of study is ongoing.

Impact:

The experimental line is currently being tested for potential use for malt production. The sequential fungicide application significantly reduced the deoxynivalenol accumulation in the late developing tillers and offers potential as an additional tool if modifications to the fungicide label will permit a second application.

Project 3: *Grower Demonstration of Integration of Genetics and Fungicide Application.*

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

This study integrated three strategies and demonstrated the benefits of managing FHB barley using multiple strategies to reduce the effects. The strategies tested in year one of the project included comparing a traditional malt type barley with an experimental that had increased resistant to deoxynivalenol accumulation; applying a fungicide at one of three growth stage timings; and applying the fungicide with a sprayer configuration with nozzle oriented vertically with one with the nozzles directed to maximize deposition on the barley head.

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:

Agronomically, the experimental barley cultivar performed equally or better than the traditional cultivar although the anticipated resistance to deoxynivalenol accumulation was not evident in this study. The most effective time of fungicide application was different between the two cultivars. The amount of dye deposited on the grain heads was about 40% greater when the fungicide was applied with nozzles oriented to direct the fungicide to spray the sides of the grain heads, nozzles angled forward toward the direction of travel and downward 30 degrees from horizontal.

Impact:

The study will be repeated again in 2009. Further evaluation of barley lines to determine the most effective application timing may be warranted.

Project 4: *Spray Application Technology Evaluation for Enhanced Fungicide Efficacy on HRSW.*

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

Fungicide is applied to small grains for control of Fusarium head blight (FHB) using ground application equipment that has two distinct delivery methods. One system, a hydraulic delivery system, has shown to be a good spray delivery method which has been studied and reported. The second system is an air-spray system which uses a high velocity air system to carry the spray to the target. The parameters tested include air delivery speed, drop size and orifice delivery angle relative to the orientation of the grain head. This research project is studying the most efficacious delivery parameter combinations with the air delivery system. The studies are designed to test the results with a factorial arrangement and replication so each individual parameter is evaluated with all other parameter options or combinations. This project will determine barley and hard red spring wheat grain head coverage, fungicide efficacy for reducing effects of FHB on head disease and deoxynivalenol accumulation in the grain and yield and other grain quality parameters.

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 first and second year of the study showed that several delivery parameter options could effectively improve fungicide efficacy but all options were not equal. One additional year of study on hard red spring wheat is ongoing.

Impact:

Small grain producers will improve economic return and the public will have a safer product to consume. The results from this study and a similar one on barley will be reported to growers in an extension publication after the results of the studies are analyzed.

Project 5: *Regional Uniform Scab Nursery - Langdon Location.*

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

The major hard red spring wheat breeding programs lack enough qualitative evaluations for resistance to FHB in material near release. Langdon provides one of the most consistent environments to evaluate material.

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 (repeat sections for each major accomplishment):

Accomplishment:

An evaluation was made of material submitted by the major hard red spring wheat public and private breeding programs in the northern plains. Disease levels were intense at Langdon and a wide range in resistance to FHB and deoxynivalenol accumulation was determined. In addition, subsets of material from the University of Minnesota, USDA ARS (St.Paul), NDSU, SDSU and Montana hard red spring wheat breeding programs and the NDSU durum programs were also visual assessed.

Impact:

The level of FHB resistance to lines close to release in the region has been determined and growers and breeders can use the data to determine the regions suitable for production of their lines.

Project 6: *Uniform Tests of Biocontrol Agents for Fusarium Head Blight.*

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

Growers that raise crops with organic methods have no means other than cultivar resistance, which is not satisfactory to control FHB under some environmental conditions. The evaluation of biocontrol agents offer potential alternative to fungicide for reduction in the effects of FHB. We have evaluated several potential biocontrol agents for effectiveness against FHB infection alone and in combination with fungicide.

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:

Biocontrol agents were not as effective as Prosaro fungicide for control of FHB but some agents did appear to reduce the affects of FHB by a magnitude from the untreated control.

Impact:

Future evaluations will be required to determine if any cultivar interactions with the biocontrol agents occur. The biocontrol agents may also provide complementary efficacy when applied several days after an application of fungicide when environmental conditions warrant. Pre-harvest interval requirements of fungicides limit the duration of their effectiveness without repeat application and would require label modification before they could be applied at late growth stages.

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.

McMullen, M., Halley, S., Schatz, B., Meyer, S., Jordahl, J., and Ransom, J. **2008**. Integrated strategies for Fusarium head blight management in the United States. *Cereal Research Comm.* 36, Suppl. B: 563-568.

Halley, S., Van Ee, G., Hofman, V., Panigrahi, S. and H. Gu. **2008**. Fungicide deposition measurement by spray volume, drop size, and sprayer system in cereal grains. *Applied Engineering in Agriculture.* 24 (1):15-21.

Oliver, R.E., X. Cai, T.L. Friesen, S. Halley, R.W. Stack, and S.S. Xu. **2008**. Evaluation of Fusarium head blight resistance in tetraploid wheat (*Triticum turgidum* L.). *Crop Sci.* 48:213-222

Halley, S., Hofman, V., Horsley, R. and G. Van Ee. **2008**. Additive benefits of genetics, fungicide rate, and application system for controlling FHB in barley, Langdon 2006. *PDMR* 2:CF001.

Halley, S. **2008**. How application technology for FHB has changed over the decade. Proceedings of the 2008 National *Fusarium* Head Blight Forum. U.S. Wheat and Barley Scab Initiative. Indianapolis, Indiana. Abstract for Invited Talk.

Paul, P., Madden, L., McMullen, M., Hershman, D., Sweets, L., Wegulo, S., Halley, S., Osbourne, L., Ruden, K., and B. Padgett. 2008. Integrated management of FHB and DON in small grain: **2008** uniform trials. Proceedings of the 2008 National *Fusarium* Head Blight Forum. U.S. Wheat and Barley Scab Initiative. Indianapolis, Indiana. p. 52-55.

Jochum, C., Yuen, G., Ruden, K., Bleakley, B., Morgan, J., Osbourne, L., Sweets, L., Halley, S. and K. Kinzer. **2008**. 2008 results from the uniform evaluation of biological agents for the control of Fusarium head blight on wheat and barley. Proceedings of the 2008 National *Fusarium* Head Blight Forum. U.S. Wheat and Barley Scab Initiative. Indianapolis, Indiana. p. 32-35.

A presentation was also given to the public at the North Dakota State Barley Show at Osabrock, North Dakota (75 attendees) and a demonstration at the North Dakota State University's Langdon Research Extension Center field day (150 attendees) in March and July respectively .

FY08 (approx. May 08 – April 09)

FY08 Final Performance Report

PI: Halley, Scott

USDA-ARS Agreement #: 59-0790-8-069

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.