

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

Cover Page

PI:	Lynn Dahleen
Institution:	USDA-ARS
Address:	Northern Crop Science Lab P.O. Box 5677 SU Station State University Station Fargo, ND 58105
E-mail:	Lynn.Dahleen@ARS.USDA.GOV
Phone:	701-239-1384
Fax:	701-239-1369
Fiscal Year:	FY10
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Transgenic Barley for FHB Resistance.
FY10 USDA-ARS Award Amount:	\$ 47,915

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	Field Tests of Transgenic Barley Lines.	\$ 6,790
BAR-CP	High Efficiency Method for Generating FHB-Resistant Barley: Removing Bottlenecks in the Pipeline for Deploying FHB Resistance Genes.	\$ 21,125
GDER	Development and Testing of Improved Enzymes for Transgenic Control of FHB.	\$ 20,000
	Total ARS Award Amount	\$ 47,915

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: *Field Tests 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?**

Transgenic barley lines are being developed that express genes that might reduce FHB and/or DON. Greenhouse FHB tests do not accurately predict barley field performance. Some of the transgenes have been inserted into the cultivar Golden Promise, which is not adapted to the Northern US barley growing regions. This project is testing transgenic barley from three labs in one of the North Dakota FHB nurseries. Genes inserted into Golden Promise are being crossed into the adapted cultivar Conlon so they can be tested in the field.

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: Four Golden Promise transgenic lines were crossed twice to Conlon in 2009-2010 and grown successfully in the FHB nursery. An additional cross to Conlon was completed in the fall of 2010 in preparation for 2011 field trials.

Impact: Transfer of these genes into Conlon barley has allowed field testing of two transgenes in the field that could not be accurately tested in Golden Promise.

Accomplishment: Field trials of 14 transgenic lines identified two lines that consistently had 40% less DON than wild-type Conlon in four years of testing in ND and one year in MN.

Impact: These are the first transgenes showing consistent effects on DON in the field. The lines showing reduced DON are being crossed with new cultivars and breeding lines that have FHB resistance to see if the transgenes provide an additive effect.

Project 2: *High Efficiency Method for Generating FHB-Resistant Barley: Removing Bottlenecks in the Pipeline for Deploying FHB Resistance Genes.*

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

Potential FHB resistance genes are being identified using virus-induced gene silencing in wheat and gene over-expression in *Physcomitrella*. We are inserting these into barley using both *Agrobacterium*-mediated and particle bombardment transformation methods. As transgenic lines are developed, they will be tested for FHB and DON levels in field trials.

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 transgenic lines from these experiments are being generated with genes identified through virus-induced gene silencing in wheat.

Impact: none yet

Project 3: *Development and Testing of Improved Enzymes for Transgenic Control of FHB.***1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

Deoxynivalenol mycotoxin is a major problem with FHB infection in barley. The trichothecene acetylase Tri101 from *Fusarium sporotrichioides* has been used with limited success in transgenic wheat and barley to reduce DON. The PI on this project, Dr. Ivan Rayment, has isolated the *F. graminearum* version of this gene and has made changes in the DNA to produce a more active and heat stable version of this enzyme. We are inserting these genes into barley using Agrobacterium-mediated and particle bombardment transformation to test the effects of the gene in vivo.

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: We have had only limited success with inserting these genes into barley. The first transgenic plants developed did not show protein expression, so they have not yet been useful for testing the proteins. Additional plants have been generated that are being tested for gene and protein expression.

Impact: Limited to date. As more robust transformants are developed, they will be tested in field trials to determine the effects of the *F. graminearum* Tri101 and the modified enzymes on FHB and DON levels.

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.

1. Dill-Macky, R., Elakkad, A.M., **Dahleen, L.S.**, Skadsen, R.W. and Abebe, T. Testing transgenic spring barley lines for reaction to Fusarium head blight: 2010 field nursery report. In: S. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds.) Proceedings of the National Fusarium Head Blight Forum; 2010 Dec 7-9; Milwaukee, WI. Lexington, KY: University of Kentucky. p. 16. 2010
2. Newmister, S.A., **Dahleen, L.**, McCormick, S. and Rayment, I. Development and testing of improved enzymes for transgenic control of FHB. In: S. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds.) Proceedings of the National Fusarium Head Blight Forum; 2010 Dec 7-9; Milwaukee, WI. Lexington, KY: University of Kentucky. p. 27. 2010.
3. Ng, E.-H., Abebe, T., Jurgenson, J.E., Dill-Macky, R., **Dahleen, L.** and Skadsen, R. Greenhouse evaluation of transgenic barley expressing gastrodianin for resistance to Fusarium head blight. In: S. Canty, A. Clark, A. Anderson-Scully, D. Ellis and D. Van Sanford (Eds.) Proceedings of the National Fusarium Head Blight Forum; 2010 Dec 7-9; Milwaukee, WI. Lexington, KY: University of Kentucky. p. 28-32. 2010.