USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY13 Final Performance Report
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Cover Page

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Fiscal Year:	FY13
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Transgenic Barley for FHB Resistance.
FY13 USDA-ARS Award Amount:	$ 65,510

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	High Efficiency Method for Generating FHB-Resistant Barley: Removing Bottlenecks in the Pipeline for Deploying FHB Resistance Genes.	$ 8,465
BAR-CP	Field Tests of Transgenic Barley Lines.	$ 6,790
BAR-CP	Backcrossing of Promising Transgenes into Cultivars/breeding Lines with FHB Resistance.	$ 34,852
GDER	Development and Testing of Improved Enzymes for Transgenic Control of FHB.	$ 15,403
	FY13 Total ARS Award Amount	**$ 65,510**

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: *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?**

   Multiple candidate genes that may reduce FHB and/or DON have been identified through USWBSI-funded research, using Physcomitrella and VIGS in wheat. We are using transgenic approaches to insert and express these genes in barley. Homozygous lines are being developed and will be tested in the ND and MN transgenic FHB nurseries.

2. **List the most important accomplishments and their impact (i.e. how are they 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 developed 31 transgenic plants for six of the 10 constructs for this project. Transgenes include two RNA polymerase 2 genes, a snakin, an ethylene response factor, a brassinosteroid insensitive gene, and a receptor kinase gene. The first 2 lines from these experiments were increased and entered into the 2014 Transgenic FHB nurseries.

   Impact:

   Development and field testing of these lines will show whether these genes provide resistance to FHB and/or DON.

Project 2: *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 approaches have the potential to increase resistance to FHB and reduce DON in barley. We are conducting replicated field trials of transgenic barley lines developed by multiple labs supported by the USWBSI. Collaborator lines are in the cultivar Golden Promise, so we crossed their lines three times to the adapted cultivar Conlon and developed homozygous lines for field testing beginning in 2012.

2. **List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

Accomplishment:

2013 field trials included lines expressing a hordothionin gene or a gastrodianin gene. This was the second year of testing of these genes, and neither reduced FHB or DON.

Impact:

These transgenic FHB field trials provide accurate assessment of transgene effects on FHB and DON levels in infected barley. 2013 results confirm that hordothionin and gastrodianin do not reduce disease and toxin levels in transgenic barley.

Project 3: *Backcrossing of Promising Transgenes into Cultivars/breeding Lines with FHB Resistance.*

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

Two transgenic lines (321 and 823) have shown reduced DON in field trials compared to their non-transgenic parent Conlon, while barley breeders have started releasing new cultivars that show reduced FHB and DON compared to previous cultivars. The goal of this project is to transfer the transgenes from 321 and 823 into Quest and ND20448 and field test to determine whether the resistance/low DON from the transgenes is additive to the resistance incorporated through the breeding programs.

2. **List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

Accomplishment:

Three crosses between Quest and 321 or 823 were completed along with two crosses between ND20448 and 823. Only one cross between ND20448 and 321 has been completed. Two- and six-rowed lines are being selected from each backcross for field comparison in 2014 and beyond.

Impact:

These lines provide initial materials to determine whether the transgenes in 321 and 823 can boost resistance and reduce DON compared to the resistance being bred in by traditional methods.

Project 4: *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?**

   Research has shown that Tri101 from *F. graminearum* could be altered to improve activity and stability. Collaborator Ivan Rayment has provided us with constructs containing the wild-type and improved *Tri101* genes. We are inserting the genes into barley to test effects on DON contamination in FHB-infected barley.

2. **List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:**

   Accomplishment:

   Additional plants transformed with the wild type and modified Tri101 have been generated and leaf tissue sent to the collaborator. Progeny tests are underway to develop lines for field tests.

   Impact:

   None yet

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 FY13 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

1. Koeritz, E.J., Elakkad, A.M., Muehlbauer, G.J., Li, X., **Dahleen, L.S**., Abebe, T., Skadsen, R.W., Dill-Macky, R. Testing transgenic spring wheat and barley lines for reaction to Fusarium head blight: 2013 Field nursery report. In: Canty, S., Clark, A., Salat, Y., Van Sanford, D., editors. Proceedings of the National Fusarium Head Blight Forum, East Lansing, MI/Lexington, KY: U.S. Wheat and Scab Initiative. National Fusarium Head Blight Forum, December 3-5, 2013, Milwaukee, WI. p. 70. 2013.

2. **Dahleen, L.S**. 2013 North Dakota transgenic barley research and FHB nursery report. In: Canty, S., Clark, A., Salat, Y., Van Sanford, D., editors. Proceedings of the National Fusarium Head Blight Forum, East Lansing, MI/Lexington, KY: U.S. Wheat and Scab Initiative. National Fusarium Head Blight Forum, December 3-5, 2013, Milwaukee, WI. p. 65. 2013.

3. Bregitzer, P., **Dahleen, L.S**., Thomson, J.G., Trail, F., Schwarz, P. Down with DON: Strategies for precise transgene delivery and RNAi-based suppression of Fusarium. In: Canty, S., Clark, A., Salat, Y., Van Sanford, D., editors. Proceedings of the National Fusarium Head Blight Forum, East Lansing, MI/Lexington, KY: U.S. Wheat and Scab Initiative. National Fusarium Head Blight Forum, December 3-5, 2013, Milwaukee, WI. p.64. 2013.