USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY10 Final Performance Report
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Cover Page

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| 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)

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

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.

