

**USDA-ARS/  
U.S. Wheat and Barley Scab Initiative  
FY06 Final Performance Report (approx. May 06 – April 07)  
July 16, 2007**

**Cover Page**

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<b>Fiscal Year:</b>	2006
<b>USDA-ARS Agreement ID:</b>	59-0790-6-057
<b>USDA-ARS Agreement Title:</b>	Engineering Barley with Antifungal Gene Gastrodianin to Enhance Resistance to Scab Disease.
<b>FY06 ARS Award Amount:</b>	\$ 14,343

**USWBSI Individual Project(s)**

<b>USWBSI Research Area *</b>	<b>Project Title</b>	<b>ARS Award Amount</b>
GET	Engineering Barley with Antifungal Gene Gastrodianin to Enhance Resistance to Scab Disease.	\$ 14,343
	<b>Total Award Amount</b>	<b>\$ 14,343</b>

**July 10, 2007**

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Principal Investigator

\_\_\_\_\_  
Date

\* CBCC – Chemical, Biological & Cultural Control  
EEDF – Etiology, Epidemiology & Disease Forecasting  
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain  
GET – Genetic Engineering & Transformation  
HGR – Host Genetics Resources  
HGG – Host Genetics & Genomics  
PGG – Pathogen Genetics & Genomics  
VDUN – Variety Development & Uniform Nurseries

**Project 1: Engineering Barley with Antifungal Gene Gastrodianin to Enhance Resistance to Scab Disease.**

**1. What major problem or issue is being resolved and how are you resolving it?**

Transformation of barley with pathogenesis-related proteins, such as chitinases, glucanases, and thaumatin-like proteins (TLPs) did not significantly improve resistance to *Fusarium graminearum*. There is a need to enhance resistance of barley using genes that specifically block *F. graminearum* infection. We have transformed Golden Promise barley with an antifungal gene gastrodianin known to inhibit growth of *F. graminearum* and other saprophytic fungi. Gastrodianin was isolated from the orchid *Gastrodia elata*. *F. graminearum* infection of barley kernels proceeds through the husk (lemma and palea) and the apex of florets. Thus, the best strategy to limit infection is to express anti-*Fusarium* genes in the husk and epidermis of the kernel. We have used a spike-specific *Lem2* promoter (isolated from Morex barley) to target expression of gastrodianin at the infection site.

**2. List the most important accomplishment and its impact (how is it being used?).  
Complete all three sections (repeat sections for each major accomplishment):**

**Accomplishment:** Golden Promise barley was transformed using the biolistic method. Plants were co-transformed with plasmids pAHC25 (containing *GUS* and *bar* genes) and pLem2VGM2 (containing *GFP* and gastrodianin). Both *GFP* and gastrodianin are driven by the spike-specific *Lem2* promoter. Thirteen T<sub>0</sub> transformants have been recovered. All transformants expressed *GFP*. Initial screening of T<sub>0</sub> plants by PCR showed integration of the gastrodianin gene in the genome of Golden Promise. A polyclonal antibody was raised and western blotting and ELISA will be performed to determine accumulation of the gastrodianin protein in transgenic plants.

**Impact:** Expression of gastrodianin in the spike of barley is expected to limit *F. graminearum* infection. High level constitutive expression of proteins is an energy-demanding process and interferes with normal growth processes resulting in dwarf plants. Restricting expression of gastrodianin to the spike tissue using the tissue-specific *Lem2* promoter should minimize possible toxic effects of the protein on growth of barley plants.

**As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?**

Transgenic plants expressing gastrodianin will be valuable resources for developing elite barley varieties that are less susceptible to *F. graminearum* through breeding. Ultimately, development of resistant varieties can increase yield and quality of grain under conditions that favor scab disease.

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USDA-ARS Agreement #: 59-0790-6-057

**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.**

None