USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY12 Final Performance Report
July 16, 2013

Cover Page

PI:	Steve Scofield
Institution:	USDA-ARS
Address:	915 West State Street West Lafayette, IN 47907-2054
E-mail:	scofield@purdue.edu
Phone:	765-494-3674
Fax:	765-494-3452
Fiscal Year:	FY12
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Functional Dissection of FHB Resistance in Wheat and Barley.
FY12 USDA-ARS Award Amount:	$ 47,000

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
GDER	Engineering Improved Fusarium Head Blight Resistance.	$ 47,000
	Total ARS Award Amount	**$ 47,000**

Steven R Scofield
Principal Investigator

July 11, 2013
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: *Engineering Improved Fusarium Head Blight Resistance.*

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

   This project is aimed at identifying wheat genes that make key contributions to Fusarium head blight (FHB) resistance and then to test if engineering wheat to express these genes at elevated levels will confer significantly improved FHB resistance. We employ a novel functional test that silences, or down-regulates candidate genes in wheat that is normally resistant to FHB. We then challenge the silenced plants in FHB assays to see if they remain resistant, or become susceptible. If plants become susceptible when a candidate gene is silenced, this is a strong indication that the gene has a critical function in FHB resistance. This assay has identified a number of wheat genes that hold great promise for engineering improved FHB resistance.

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:

   Virus-induced gene silencing experiments identified several classes of wheat genes that are required for FHB resistance. The gene class for which we have achieved the greatest information are genes required for ethylene (ET) biosynthesis or ethylene-induced signaling. Silencing genes required for ET biosynthesis or ET-induced signaling result in FHB resistant genotypes becoming susceptible and susceptible genotypes becoming even more susceptible. These findings have been confirmed using chemical inhibitors of ET perception, a method that is completely independent from our virus-induced gene silencing (VIGS) assay. More significantly, we have performed experiments in which FHB susceptible wheat is treated with ACC, the chemical precursor to ET. After this treatment the plant converts ACC to ET causing increased ET-signaling and a significant increase in FHB resistance is observed. This finding strongly supports our strategy that overexpression of genes promoting ET-signaling will confer improved FHB resistance. Transgenic wheat plants have been generated that overexpress these genes and they are now being tested to see if they confer improved levels of FHB resistance.

   Impact:

   The contemporary Fusarium head blight (FHB) research literature is composed primarily of gene expression studies that identify genes whose expression changes during interactions of wheat and barley with *Fusarium graminearum*. Genes that display differential expression in resistant and susceptible interactions are assumed to be candidates for playing key roles in the interaction. Obviously, many of the changes in gene expression are only a consequence of the interaction and are not controlling the outcome. Our work provides a path forward to test which of these candidate genes actually plays crucial roles in resistance or susceptibility.

This functional genomics approach is having significant impact for researchers working to understand and improve the resistance of cereals to FHB.

Our work identifying a essential function for ethylene signaling, when published soon, will correct a paper published in 2009 that reported the opposite role for ethylene-signaling. Our work will provide new direction to researchers who may have set off on an erroneous path. However, we believe the greatest impact of this work will be in guiding us to effective strategies for engineering improved FHB resistance.

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.

Presentations:

Presentation to the Noble Foundation Virology Symposium, May 5, 2012, Ardmore, OK.

Presentation to the E-COST Virus-induced Gene Silencing Training School, June 24, 2012, Rothamsted Research Centre, Harpenden, England.

Poster presentation at the 2012 National Scab Forum, Orlando, FL, December 4, 2012.