

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY08 Final Performance Report (approx. May 08 – April 09)
July 15, 2009**

Cover Page

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Fiscal Year:	2008
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Functional Dissection of the Pathways contributing to FHB Resistance by Virus-Induced Gene Silencing.
FY08 USDA-ARS Award Amount:	\$ 60,077

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
GDER	Functional Dissection of the Pathways contributing to FHB Resistance by Virus-Induced Gene Silencing.	\$60,077
	Total Award Amount	\$ 60,077

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
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
 SPR – Spring Wheat Region
 NWW – Northern Winter Wheat Region
 SWW – Southern Sinter Wheat Region

Project 1: *Functional Dissection of the Pathways contributing to FHB Resistance by Virus-Induced Gene Silencing.*

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

Fusarium head blight (FHB) is one of the major diseases that threaten US wheat and barley producers. Unfortunately, all known resistance to FHB is complex, based on multiple quantitative trait loci (QTL) that make partial contributions to resistance. Combining these QTL loci into high yielding wheat lines and eliminating the yield reducing traits linked to some of the QTLs has proven to be a slow process. Development of resistant varieties would be accelerated by knowledge of the specific genes that make essential contributions to FHB resistance.

We have developed a virus-induced gene silencing (VIGS) system based on Barley Stripe Mosaic virus (BSMV) that can switch-off, or silence, genes in hexaploid wheat so that the gene's function can be inferred by observing the effects of its silencing. Because VIGS is homology-dependent, it can silence related gene copies that encode mRNAs with >85% homology, making it ideal for creating knockouts in hexaploid wheat where at least three copies of each gene may be expressed from the A, B and D genomes.

We have demonstrated the utility of BSMV-VIGS for functionally identifying genes involved in several disease resistance systems in hexaploid wheat. In these experiments, a candidate gene is silenced in a plant that is normally resistant to a particular pathogen. After silencing is established, the plant is challenged with this pathogen. If the plant becomes susceptible, we have strong evidence that the candidate gene has an essential function in this resistance pathway.

In our USWBSI-funded work, we are using our VIGS assay to screen genes that were selected as candidates for having functions in FHB resistance. The genes are chosen based on their patterns of expression during *Fusarium* infection, as well as other bioinformatics data suggesting likely involvement in FHB resistance. Determination of which wheat genes make crucial contributions to FHB resistance will help us understand the biological basis of resistance and, therefore, point us toward ways to improve 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:

Our FY08-funded work has demonstrated a significant role for the ethylene-signaling pathway in FHB resistance. We have found that individually silencing the ACS, EIN2 or ERF genes results in FHB resistant plants becoming susceptible.

Impact:

The findings described above provide a clear path for attempting to engineer a novel form of FHB resistance. We are currently in the process of testing if overexpressing ACS, EIN2 and ERF will result in susceptible genotypes becoming resistant.

Additionally, my lab continues to facilitate the adoption of our FHB-VIGS assay by FHB research groups in the US and around the world.

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:

University of Minnesota, Department of Genetics, January 23, 2008

3rd International Symposium of Fusarium Head Blight, Szeged, Hungary, Sep 3, 2008.

Purdue University, Department of Botany and Plant Pathology, October 8, 2008.

US Wheat and Barley Scab Initiative 2008 National Scab Forum 2008, Indianapolis, November 25, 2008

Cold Spring Harbor Laboratory Plant Genomes Workshop March 5, 2009

Consultative Group for International Agricultural Research (CGIAR) 2009 Science Forum, Wageningen, The Netherlands, June 15, 2009.

Peer Reviewed Publications:

Scofield, SR and Nelson R. (2009) Resources for Virus-induced Gene Silencing in the *Poaceae*. *Plant Physiology* 149: 152-157.

Held, M. Penning B., Kessans S, Yong W., Brandt, A, **Scofield S.**, and Carpita N. (2008) Viral-induced gene silencing of cellulose synthase and cellulose synthase-like genes in barley reveals common regulatory control points involving small interfering RNAs. *Proc. Natl. Acad. Sci. USA* 105: 20534-9.

Cakir, C. and **Scofield, S.** (2008) Evaluating the ability of the Barley stripe mosaic virus-induced gene silencing system to simultaneously silence two wheat genes. *Cereal Research Communications* 36: 217-222.

Sindu A, Chintamanani, S, Brandt, A.M., Zanis, M. **Scofield, SR** and Johal, G. (2008) A guardian of grasses: Specific origin and conservation of a unique disease resistance gene in the grass lineage. *Proc. Natl. Acad. Sci. USA* 105: 1762-1767.

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If your FY08 USDA-ARS Grant contained a VDHR-related project, include below a list all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance. If this is not applicable (i.e. no VDHR-related project) to your FY08 grant, please insert 'Not Applicable' below.

Not Applicable