USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY09 Final Performance Report
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Cover Page

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Fiscal Year:	2009
USDA-ARS Agreement ID:	NA
USDA-ARS Agreement Title:	Exploring The Role of Ethylene Signaling in FHB Resistance and Susceptibility.
FY09- USDA-ARS Award Amount:	$ 48,000

USWBSI Individual Project(s)

USWBSI Research Category*	**Project Title**	**ARS Adjusted Award Amount**
GDER	Exploring the Role of Ethylene Signaling in FHB Resistance and Susceptibility.	$ 48,000
	Total Award Amount	**$ 48,000**

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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 Winter Wheat Region
SWW – Southern Sinter Wheat Region

Project 1: *Exploring the Role of Ethylene Signaling in FHB Resistance and Susceptibility.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**
   Although genetic loci are known which confer resistance to Fusarium head blight (FHB), nothing is known about the specific gene products that make essential contributions to FHB resistance. The goal of our work is to identify wheat genes that encode products required for FHB resistance. This goal was not achievable prior the start of our efforts because functional analysis of wheat genes has been greatly complicated by the hexaploidy of wheat and its recalcitrance to transformation. We are overcoming these obstacles through development and application of a virus-induced gene silencing (VIGS) assay that allows us to down-regulate genes of interest without having to generate a transgenic plant. Also, as VIGS is sequenced-based it is able to silence multiple copies of genes simultaneously, thereby overcoming the issues of hexaploidy. Using VIGS to down-regulate chosen genes in normally resistant plants allows us to determine if this gene's expression is essential for FHB resistance. We obtain strong evidence that a gene plays an essential role in FHB resistance if a resistant genotype becomes susceptible after VIGS.

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:

   In previous USWBSI-funded work, we found that using BSMV-VIGS to down-regulate the expression of three different genes involved in ethylene-induced signaling in wheat that is normally resistant to FHB, resulted in conversion to susceptibility. We have recently confirmed the essential role for ethylene-induced signaling through a means that is completely independent of VIGS. In the new study we treated the variety Ning 7840, which expresses type II resistance to FHB, with a chemical inhibitor of ethylene receptors, while a set of control plants was given a mock treatment. Treatment with the inhibitor began one week prior to anthesis and then continued 2 weeks after anthesis. At anthesis both sets of plants were subjected to single floret inoculation with *Fusarium graminearum* and then the outcome of the interactions were determined 3 weeks later. This experiment detected a very clear requirement for normal function of the ethylene signaling pathway, as control plants remained resistant, while the experiment group became highly susceptible.

   On the strength of our initial VIGS work implicating the ethylene response in FHB resistance, we started work to overexpress key ethylene signaling genes in susceptible wheat varieties in an effort to engineer FHB resistance. We have now constructed full-length clones of these key ethylene signaling components and are beginning transformations of wheat.

   Impact:

   Our work with the ethylene receptor inhibitor confirms the role of ethylene signaling in defense against FHB. This work is the first to demonstrate the crucial role of ethylene signaling in defense against FHB and suggests a clear strategy for engineering resistance

against FHB. A very important additional point is that as these confirmatory results come through experiments not involving VIGS, they validate our VIGS-based approach to rapidly screen for genes involved in 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.

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

Cakir, C., Gillespie, M., and **Scofield, SR**. (2010) Rapid Determination of Gene Function by Virus-induced Gene Silencing in Wheat and Barley. Crop Sci. 50: 77-84.