USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY15 Final Performance Report
Due date: July 15, 2016

Cover Page

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Fiscal Year:	2015
USDA-ARS Agreement ID:	N/A
USDA-ARS Agreement Title:	Functional Dissection of FHB Resistance in Wheat and Barley.
FY15 USDA-ARS Award Amount:	$ 57,000

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
GDER	Harnessing the Basal Defense Pathway to Improve Fusarium Head Blight Resistance.	$ 57,000
	FY15 Total ARS Award Amount	**$ 57,000**

Steven R Scofield

July 7, 2016

Principal Investigator Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
EC-HQ – Executive Committee-Headquarters
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: *Harnessing the Basal Defense Pathway to Improve Fusarium Head Blight Resistance.*

1. What are the major goals and objectives of the project?

1) We propose to conduct an RNA-Seq study to thoroughly define the transcriptional changes triggered in wheat, which are able to provide effective resistance to FHB when susceptible genotypes are pretreated with ACC.
2) Genes identified in the RNA-Seq analysis as having significantly differential expression will be tested for function in wheat by FHB-VIGS assays.
3) Transgenic plants that overexpress genes in the lignin biosynthetic pathway will be generated and tested to assess if they confer improved FHB resistance.
4) Complete the evaluation of the transgenic wheat plants that were generated during the previous funding period. These transgenics overexpress wheat ethylene-responsive transcription factors as well as the wheat PRR, BAK1, which were all shown to contribute to FHB resistance in VIGS assays. The transgenics will be tested in both type I and II FHB assays in the greenhouse, as well as in the USWBSI transgenic FHB nursery.
5) Test whether or not ethylene signaling is essential for FHB resistance in barley.

2. What was accomplished under these goals?

Significant progress was achieved in the development of a Fusarium crown rot (FCR) assay in wheat and a comparison of this pathosystem to the Fusarium head blight (FHB) assay. Interest in the FCR interaction emerged from our prior work which demonstrated that FCR resistance shows the same dependence on ethylene-signaling that FHB does. The FCR assay has a number of experimental advantages, the greatest being that: 1) it is performed in seedlings instead of adult plants, and 2) it can be scored more robustly.

RNA-seq analyses of FCR and FHB resistant and susceptible interactions were conducted and a small number of genes were found to be shared in common between the resistant interactions. Significantly, several of the genes induced in both interactions appear to be involved in DON metabolism, and suggest new strategies for improving FHB and FCR resistance.

Although not a part of the objectives of this proposal, additional progress relevant to FHB management was achieved. Work by others, had shown that the essential oil, thymol, has anti-FHB activity, however the extreme hydrophobicity of this compound made it difficult to employ in practice. We observed that formation of thymol microemulsions may significantly improve the practicality of using this naturally-derived compound to control FHB.

3. What opportunities for training and professional development has the project provided?

A post-doc and graduate student have been trained as a consequence of this project.

4. How have the results been disseminated to communities of interest?

My graduate student has presented a poster at the 2016Plant and Animal Genome Conference in San Diego and at the 2016 American Phytopathological Conference in Tampa.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY15 award period. The term "support" below includes any level of benefit to the student, ranging from full stipend plus tuition to the situation where the student's stipend was paid from other funds, but who learned how to rate scab in a misted nursery paid for by the USWBSI, and anything in between.

1. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their MS degree during the FY15 award period?**

   No students working on MS degrees.

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY15 award period?**

   No. One student who has been supported by USWBSI funds is expected to earn her Ph.D. in December 16

3. **Have any post docs who worked for you during the FY15 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**

   No

4. **Have any post docs who worked for you during the FY15 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**

   No

Release of Germplasm/Cultivars

Instructions: In the table below, list all germplasm and/or cultivars released with full or partial support through the USWBSI during the FY15 award period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations. *Leave blank if you have nothing to report or if your grant did NOT include any VDHR-related projects.*

Name of Germplasm/Cultivar	**Grain Class**	**FHB Resistance** (S, MS, MR, R, where R represents your most resistant check)	**FHB Rating** (0-9)	**Year Released**

Add rows if needed.

NOTE: List the associated release notice or publication under the appropriate sub-section in the 'Publications' section of the FPR.

Abbreviations for Grain Classes

Barley - BAR
Durum - DUR
Hard Red Winter - HRW
Hard White Winter - HWW
Hard Red Spring - HRS
Soft Red Winter - SRW
Soft White Winter - SWW

Publications, Conference Papers, and Presentations

Refer to the FY15-FPR_Instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY15 grant. If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

Journal publications.

Gill, TA, Li, J, Doppler, M and **Scofield, SR**. Thymol-based sub-micron emulsions exhibit antifungal activity against *Fusarium graminearum* and inhibit Fusarium head blight (FHB) in wheat. Journal of Applied Microbiology (in press).
Status: Accepted
Acknowledgement of Federal Support: YES

Walter, S, Kahla, C, Arunachalam, C, Perochon, A, Khan, MR, **Scofield, SR**, Doohan, FM. A wheat ABC transporter contributes to both grain formation and mycotoxin tolerance. J. Exp. Bot. 66(9): 2583-93. 2015.
Status: published
Acknowledgement of Federal Support: No

Perochon, A, Jianguang, J. Kahla, A, Chanemougasoundharam, A, **Scofield, SR**, Wallington, E, Bowden, S, and Doohan, FM. *TaFROG* encodes a *Pooideae* orphan protein that interacts with SnRK1 and enhances resistance to mycotoxigenic fungus *Fusarium graminearum*. Plant Physiol. 169(4): 2895-906. 2015.
Status: published
Acknowledgement of Federal Support: No

Gunupuru, LR, Ali, SS, Doohan, FM and **Scofield, SR**. Virus-induced gene silencing (VIGS) in barley seedling leaves. Bio-protocol 5(12): 1506-8. 2015.
Status: published
Acknowledgement of Federal Support: No

Books or other non-periodical, one-time publications.

Nothing to report

Other publications, conference papers and presentations.

Presented the talk "Functional genomics in wheat" at the Plant Genome Congress of Asia, April 12, 2016 in Kuala Lumpur, Malaysia.
Status: Presented
Acknowledgement of Federal Support: Yes