USDA-ARS | U.S. Wheat and Barley Scab Initiative

FY21 Performance Progress Report

Due date: July 26, 2022

Cover Page

Principle Investigator (PI):	Steve Scofield
Institution:	USDA-ARS
E-mail:	steve.scofield@usda.gov
Phone:	765-494-3674
Fiscal Year:	2021
USDA-ARS Agreement ID:	N/A
USDA-ARS Agreement Title:	Engineering Gene-for-Gene Resistance to Fusarium Head Blight in Wheat and Barley
FY20 USDA-ARS Award Amount:	$57,154
Recipient Organization:	USDA-ARS Crop Prod. & Pest Control Research 915 West State Street, West Lafayette, IN 47907-2054
DUNS Number:	N/A
EIN:	N/A
Project/Grant Period:	5/1/21 - 4/30/22
Reporting Period End Date:	4/30/2022

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
GDER	Engineering Gene-for-Gene Resistance to Fusarium Head Blight in Wheat and Barley	$57,154
	FY21 Total ARS Award Amount	$57,154

I am submitting this report as an: ☒ Annual Report ☐ Final Report

I certify to the best of my knowledge and belief that this report is correct and complete for performance of activities for the purposes set forth in the award documents.

Steven R Scofield

Aug 15, 2022

Principal Investigator Signature | Date Report Submitted

* BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
EC-HQ – Executive Committee-Headquarters
FST-R – Food Safety & Toxicology (Research)
FST-S – Food Safety & Toxicology (Service)
GDER – Gene Discovery & Engineering Resistance
HWW-CP – Hard Winter Wheat Coordinated Project
MGMT – FHB Management
MGMT-IM – FHB Management – Integrated Management Coordinated Project
PBG – Pathogen Biology & Genetics
TSCI – Transformational Science
VDHR – Variety Development & Uniform Nurseries
NWW –Northern Soft Winter Wheat Region
SPR – Spring Wheat Region
SWW – Southern Soft Red Winter Wheat Region

Project 1: Engineering Gene-for-Gene Resistance to Fusarium Head Blight in Wheat and Barley

---

1. **What are the major goals and objectives of the research project?**
   This overall objective for this project was to explore the application of Decoy-engineering to provide Gene-for-gene based hypersensitive resistance to Fusarium head blight.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address these three items below.)*

   a) **What were the major activities?**
      1. Wheat and Barley homologs of Arabidopsis PBS1 were identified and confirmed in functional assays.
      2. Candidate Fusarium graminearum effector proteases were identified.
      3. Strategies were explored for engineering secretion of novel effectors from F. graminearum to wheat.

   b) **What were the significant results?**
      1. A range of wheat and barley PBS1 homologs were identified. Functional assays were performed in Nicotiana benthamiana to confirm that these homologs mediate a hypersensitive response when AvrPphB is coexpressed.
      2. Bioinformatic approaches were used to identify candidate effector proteases from F. graminearum. Candidate effort proteases were chosen that were conserved among many Fusarium species, following the logic that these are likely to be required for virulence.
      3. F. graminearum lines with a knock in one of these effector proteases was shown to be less virulent, supporting its role as a virulence factor.

   c) **List key outcomes or other achievements.**
      This project has identified essential components for engineering the Decoy-engineering approaching wheat and barley. An effector protease that contributes virulence was identified and PBS1 homologs were identified in wheat and barley that can eventually be engineered to be cleaved by the candidate effector protease.

3. **What opportunities for training and professional development has the project provided?**
   A graduate student was support in Roger Innes' laboratory.

4. **How have the results been disseminated to communities of interest?**
   Posters at the MPMI and APS meetings.
   3 publications are being prepared now.

Publications, Conference Papers, and Presentations

Please include a listing of all your publications/presentations about your FHB work that were a result of funding from your FY21 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period** should be included.

Did you publish/submit or present anything during this award period?

☒ Yes, I've included the citation reference in listing(s) below.

☐ No, I have nothing to report.

Journal publications as a result of FY21 grant award

List peer-reviewed articles or papers appearing in scientific, technical, or professional journals. Include any peer-reviewed publication in the periodically published proceedings of a scientific society, a conference, or the like.

Identify for each publication: Author(s); title; journal; volume: year; page numbers; status of publication (published [include DOI#]; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).

None

Books or other non-periodical, one-time publications as a result of FY21 grant award

Report any book, monograph, dissertation, abstract, or the like published as or in a separate publication, rather than a periodical or series. Include any significant publication in the proceedings of a one-time conference or in the report of a one-time study, commission, or the like.

Identify for each one-time publication: Author(s); title; editor; title of collection, if applicable; bibliographic information; year; type of publication (book, thesis or dissertation, other); status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).

None

Other publications, conference papers and presentations as a result of FY21 grant award

Identify any other publications, conference papers and/or presentations not reported above. Specify the status of the publication.

TALKS:

Helm, M., Innes, RW., Hammond-Kosack, K., and Scofield, SR. (2021). Engineering gene-for-gene resistance to Fusarium Head Blight in cereal grains. *Proceedings of the 2021 National Fusarium Head Blight Forum*; Virtual. December 6-7, 2021. Retrieved from: https://scabusa.org/forum/2021/2021NFHBForumProceedings.pdf

Helm, M., Innes, RW., Hammond-Kosack, K., and Scofield, SR. "Engineering novel disease resistance traits in crop plants." Department of Botany and Plant Pathology, Purdue University, West Lafayette, IN, January 2020.

POSTERS:

Helm, M., Myers, A., Frailie, T., Machado-Wood, AK., Urban, M., Hammond-Kosack, KE., Innes, RW., and Scofield, SR. (2021). Identification and Functional Characterization of Secreted Effector Proteases from *Fusarium graminearum. Proceedings of the 2021 National Fusarium Head Blight Forum*; Virtual. December 6-7, 2021. Retrieved from: https://scabusa.org/forum/2021/2021NFHBForumProceedings.pdf

Helm, M., Myers, A., and Scofield, SR. "Molecular and Functional Analyses of the Barley NLR Immune Receptor, PBR1." 2020 American Phytopathological Society Meeting. August 2020.

Helm, M., Innes, RW., Hammond-Kosack, K., and Scofield, SR. "Engineering Gene-for-Gene Resistance to Fusarium Head Blight in Wheat and Barley." 2019 National Fusarium Head Blight Forum (USWBSI), Milwaukee, WI. December 2019.

Helm, M., Innes, RW., Hammond-Kosack, KE., and Scofield, SR. "Engineering Gene-for-Gene Resistance to Fusarium Head Blight in Wheat and Barley." Department of Botany and Plant Pathology Research Showcase, Purdue University, West Lafayette, IN. November 2019