

USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY20 Annual Performance Progress Report
Due date: July 29, 2021

Cover Page

Principle Investigator (PI):	Guixia Hao
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Phone:	309-681-6520
Fiscal Year:	2020
USDA-ARS Agreement ID:	N/A
USDA-ARS Agreement Title:	Boosting Wheat and Barley Type I Resistance to FHB
FY20 USDA-ARS Award Amount:	\$ 50,707
Project/Grant Reporting Period:	5/1/20 - 4/30/21
Reporting Period End Date:	4/30/2021

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
GDER	Boosting Wheat and Barley Type I Resistance to FHB	\$ 50,707
FY20 Total ARS Award Amount		\$ 50,707

Guixia Hao

Principal Investigator 7/13/21
Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
R- Research
S – Service (DON Testing Labs)
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: Boosting Wheat and Barley Type I Resistance to FHB

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

The goal of this project is to improve FHB resistance to initial *F. graminearum* infection and to reduce mycotoxin contamination, by boosting plant immunity.

The objectives of this proposal are:

Objective 1: Determine the expression of selected effector genes, FHB incidence and mycotoxin content in wheat and barley with different ROS induction ability.

Objective 2: Determine the effect of chitosan treatment on FHB and mycotoxin production.

Objective 3: Determine the differences in the underlying mechanisms of chitin-mediated defense signaling between wheat and barley, and identify targets for enhancement of wheat and barley FHB resistance.

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?

We tested ROS induction in barley leaves from four barley varieties. FHB virulence assays were performed by dip inoculation with PH-1. FHB was assessed at 7 and 14 days after inoculations. Heads were collected and ground for DON analysis.

We tested ROS induction in eight wheat varieties: four FHB susceptible and four moderately resistant varieties. We also tested ROS responses in different wheat and barley tissues: leaves, paleae, lemmas, rachises, and rachis nodes.

We performed FHB assays on 7 wheat varieties by point inoculation. Heads were collected at 21 days after inoculation and ground for DON analysis.

We examined if there are correlation between ROS, FHB and DON using 7 wheat varieties.

We treated wheat and barley with chitin/chitosan and tested the treatment effect on FHB and mycotoxin contamination.

We determined defense gene expression in rachis nodes and wheat heads with chitin treatment, and wheat heads infected with *Fusarium graminearum*.

b) What were the significant results?

No ROS burst was induced by chitin in wheat leaves or lemmas. A low-level ROS in paleae, a typical ROS was induced in rachises and rachis nodes. Compared to wheat tissues, high-level ROS production was induced by chitin in barley leaves, low-level ROS in lemma, paleae, rachis and rachis nodes.

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A positive correlation was observed between ROS levels in wheat rachis nodes and FHB spread.

No correlation was observed between ROS levels in wheat rachis nodes and DON level, or ROS level in barley leaves and FHB severity.

We found that the effect on FHB and DON by chitin/chitosan treatment was variety-dependent.

We found that the effect on FHB and DON by chitin/chitosan treatment was variety-dependent.

Wheat defense genes were induced in wheat heads and rachis nodes treated with chitin; however, several chitin induced genes were suppressed in wheat heads infected with *F. graminearum*.

c) List key outcomes or other achievements.

We discovered ROS induced by chitin are tissue and species- specific in wheat and barley.

3. Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns and/or restrictions, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.

Yes. Due to COVID-19 pandemic, some experiments, such as chitin and chitosan treatments, have been postponed.

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

One technician (Ellie Tiley) has been trained in molecular biology and ROS assays including DNA isolation, RCR and RT-PCR, preparation fungal culture for inoculation, inoculation and scoring of virulence assays, dissecting barley and wheat floral tissues.

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

Oral presentation at 2nd International Conference on Plant Science & Research, Nov. 2-3, 2020 (Virtual)

Poster presentation at the 2020 National Fusarium Head Blight Forum, Dec. 7-11, 2020 (Virtual)

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY20 award period (5/1/20 - 4/30/21). 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 FY20 award period?**

Yes No

If yes, how many? [Click to enter number here.](#)

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY20 award period?**

Yes No

If yes, how many? [Click to enter number here.](#)

3. **Have any post docs who worked for you during the FY20 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**

Yes No

If yes, how many? [Click to enter number here.](#)

4. **Have any post docs who worked for you during the FY20 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**

Yes No

If yes, how many? [Click to enter number here.](#)

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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 FY20 award period (5/1/20 - 4/30/21). All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations.

NOTE: 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	FHB Rating (0-9)	Year Released
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
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Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year

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

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Publications, Conference Papers, and Presentations

Instructions: Refer to the PR_Instructions for detailed more instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY20 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period (5/1/20 - 4/30/21)** should be included. If you did not publish/submit or present anything, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each citation, you **must** indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in the publication/presentation. See example below for a poster presentation with an abstract:

Z.J. Winn, R. Acharya, J. Lyerly, G. Brown-Guedira, C. Cowger, C. Griffey, J. Fitzgerald, R.E. Mason and J.P. Murphy. 2020. "Mapping of Fusarium Head Blight Resistance in NC13-20076 Soft Red Winter Wheat." In: S. Canty, A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum* (p. 12.), Virtual; December 7-11. Online: https://scabusa.org/pdfs/NFHB20_Proceedings.pdf.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

Nothing to report.

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

Nothing to report.

Other publications, conference papers and presentations.

Hao, G.,Tiley, H., Usgaard, T., and McCormick, S. 2020. "Chitin triggered- immune responses in wheat and barley' (p. 83). In: Canty, S., A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum*. East Lansing, MI: U.S. Wheat & Barley Scab Initiative.

Status: Abstract Published and Poster Presented

Acknowledgement of Federal Support: YES (Abstract and Poster)

Hao, G. 2020. Chitin-Triggered Immunity in Wheat and Barley and Its Role During Fusarium Head Blight. 2nd International Conference on Plant and Research.

Status: Talk Presented

Acknowledgement of Federal Support: YES