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

FY21 Performance Progress Report

Due date: July 26, 2022

Cover Page

Principle Investigator (PI):	Guixia Hao
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Phone:	309-681-6520
Fiscal Year:	2021
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
Recipient Organization:	USDA-ARS Mycotoxin Prevention and Applied Microbiology 1815 N University St., Peoria, IL 61604
DUNS Number:	N/A
EIN:	N/A
Recipient Identifying Number or Account Number, if any:	
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	Boosting Wheat and Barley Type I Resistance to FHB	$50,707
	FY21 Total ARS Award Amount	$50,707

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.

Guixia Hao _____ 6/28/22 _____

Principal Investigator Signature Date Report Submitted

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‡ 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: Boosting Wheat and Barley Type I Resistance to FHB

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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 severity was assessed at 7 and 14 days after inoculations. Heads were collected and ground for DON analysis.
- We tested ROS induction in wheat leaves from eight wheat varieties: four FHB susceptible and four moderately resistant varieties. We further examined ROS responses in different wheat and barley head tissues: 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 were correlations between ROS induction level in wheat rachis nodes, FHB and DON with statistical analysis.
- We treated wheat and barley with chitin/chitosan and determined the treatment effect on FHB and mycotoxin contamination.
- We determined defense gene expression in rachis nodes and wheat heads treated with chitin, and wheat heads infected with Fusarium graminearum.

b) What were the significant results?

- No ROS burst was observed in wheat leaves or lemmas treated with chitin. There were low-level ROS in paleae, and relatively higher ROS induced in rachises and rachis nodes.
- Compared to wheat leaves, high-level ROS production was induced by chitin in barley leaves. However, low-level ROS were induced in barley lemmas, paleae, rachises and rachis nodes.

- 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.
- The effect of chitin/chitosan treatment on FHB and DON was variety dependent.
- Wheat defense genes were induced in wheat heads and rachis nodes treated with chitin; however, several of these chitin-induced genes were not induced in wheat heads infected with *F. graminearum*.

c) List key outcomes or other achievements.

- We discovered that chitin triggers tissue and species- specific ROS in wheat and barley.
- Higher ROS was induced in rachis nodes of FHB susceptible wheat varieties than moderately resistant varieties

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

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

4. 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)

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).

Hao G, Tiley H, and McCormick S. (2022) Chitin Triggers Tissue-Specific Immunity in Wheat Associated with Fusarium Head Blight. Front. Plant Sci. 13:832502. doi:10.3389/fpls.2022.832502
Acknowledgement of Federal Support: YES

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).

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.

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