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

Cover Page

Principle Investigator (PI):	Shengming Yang
Institution:	USDA-ARS
E-mail:	Shengming.Yang@usda.gov
Phone:	701-239-1384
Fiscal Year:	2020
USDA-ARS Agreement ID:	N/A
USDA-ARS Agreement Title:	Improvement of Barley Resistance to Fusarium Head Blight
FY20 USDA-ARS Award Amount:	$ 71,400
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
BAR-CP	Functional Validation of the Barley Fhb1 Ortholog in Susceptibility to FHB	$ 41,400
GDER	Genotype-independent Transformation in Barley assisted with Agrobacterium Rhizogenes-transformed Hairy Roots	$ 30,000
	FY20 Total ARS Award Amount	**$ 71,400**

SHENGMING YANG Digitally signed by SHENGMING YANG
Date: 2021.07.26 09:06:31 -05'00'

Principal Investigator 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

FY20 Annual Performance Progress Report
PI: Yang, Shengming
USDA-ARS Agreement #: N/A
Reporting Period: 5/1/20 - 4/30/21

Project 1: *Functional Validation of the Barley Fhb1 Ortholog in Susceptibility to FHB*

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

   - To develop targeted gene knockouts in barley using CRISPR-mediated mutagenesis;
   - To obtain the transgene-free barley mutants with resistance to FHB.

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) To formulate a protocol of barley transformation with the amenable genotype Gold Promise;
      2) To improve transformation efficiency in recalcitrant genotype, such as Bowman
      3) To develop CRISPR-mediated mutagenesis in barley;
      4) To develop an FHB inoculation assay in greenhouse.

   b) **What were the significant results?**
      1) We developed a stable protocol for barley transformation in Golden Promise and Bowman.
      2) We transferred the wheat FHB1 gene to Golden Promise, and obtained transgenic plantlets.
      3) We knocked out the barley ortholog of FHB1 (HvHRC) in Golden Promise and Bowman. Transgenic plants have been obtained.
      4) We tested and finalized the dip inoculation method with greenhouse-growing plants.

   c) **List key outcomes or other achievements.**
      1) We established a stable and efficient protocol for barley transformation and CRISPR-mediated gene editing.
      2) We successfully transformed a recalcitrant barley genotype.

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, our research was impacted by the pandemics. Due to the restriction on work schedules, we lost all the induced calli in 2020. From last October, our lab was resumed to a relatively normal schedule. All personnel in the lab have been vaccinated, and I do not think the pandemic will affect the research any more.

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

This project provide a postdoc and an undergraduate student with training of barley transformation and gene editing.

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

No.

Project 2: *Genotype-independent Transformation in Barley assisted with Agrobacterium Rhizogenes-transformed Hairy Roots*

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

- To develop a protocol for hairy root transformation in barley;
- To regenerate transgenic barley plants from hairy roots
- To test if the GRF-GIF chimera increases transformation efficiency in barley

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) We tested hairy root transformation efficiency with several *A. tumefaciens* strains.
2) We conducted barley regeneration with transgenic hairy roots.
3) We constructed new vectors with the GRF-GIF chimera to improve barley transformation efficiency.

b) What were the significant results?

1) We developed a stable protocol for hairy root transformation in barley with the A. rhizogenes strain *ARqua1*.
2) We regenerated barley plant from transgenic hairy root, although with a low efficiency.
3) We conducted gene expression and CRISPR-mediated gene editing with vectors containing the GRF-GIF chimera.

c) List key outcomes or other achievements.

1) We developed a stable protocol for hairy root transformation in barley.
2) We increased transformation efficiency using the GRF-GIF chimera and obtained transgenic plants with recalcitrant genotypes, such as Bowman.

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, our research was impacted by the pandemics. Due to the restriction on work schedules, we lost all the induced calli in 2020. From last October, our lab was resumed to a relatively normal schedule. All personnel in the lab have been vaccinated, and I do not think the pandemic will affect the research any more.

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

This project provide a postdoc an undergraduate student with training of barley transformation and gene editing.

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

No

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? 1

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.

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
Nothing to report.	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
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

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

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/NFHBF20_Proceedings.pdf.
Status: Abstract Published and Poster Presented
Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

None.

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

None.

Other publications, conference papers and presentations.

None.