

FY21 Performance Progress Report

Due date: July 26, 2022

Cover Page

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Phone:	701-239-1384
Fiscal Year:	2021
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
Recipient Organization:	USDA-ARS Northern Crop Science Laboratory 1307 N 18th St., Rm. 218, Fargo, ND 58102-2765
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
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
FY21 Total ARS Award Amount		\$71,400

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.

SHENGMING YANG Digitally signed by SHENGMING YANG
Date: 2022.06.23 15:23:05 -05'00'

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

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

- 1) To develop targeted gene knockouts in barley using CRISPR-mediated mutagenesis;
- 2) 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 transformation protocol in barley using the amenable genotype Gold Promise;
- 2) To improve transformation efficiency in recalcitrant genotype, such as Bowman and Conlon
- 3) To develop CRISPR-mediated mutagenesis in barley;
- 4) To develop an FHB inoculation assay in greenhouse,
- 5) To reproduce sufficient seeds for field trials.

b) What were the significant results?

- 1) We established a protocol of barley transformation with the amenable genotype Gold Promise;
- 2) We improved transformation efficiency in recalcitrant genotypes, such as Bowman and Conlon;
- 3) We developed CRISPR-mediated mutagenesis in barley using Golden Promise, Bowman and Conlon;
- 4) We obtained homozygous mutants derived from targeted mutagenesis.

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 two recalcitrant barley genotypes, Bowman and Conlon.

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

This project provided a postdoc and a graduate student with training of barley transformation and gene editing.

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

We presented our research progress at the 2021 National FHB Forum

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?

- 1) To develop a protocol for hairy root transformation in barley.
- 2) To regenerate transgenic barley plants from hairy roots.
- 3) 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.
- 4) We tested more barley genotypes, including Morex, Larker, Carre 180, and Tradition.

b) What were the significant results?

- 1) A stable protocol for barley hairy root transformation was developed.
- 2) The regeneration efficiency using hairy root is low.
- 3) The GRF-GIF chimera significantly facilitated transformation efficiency in recalcitrant genotypes, such as Bowman and Conlon.
- 4) The improved transformation efficiency in Bowman is comparable to that in Golden Promise.

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 and Conlon.

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

This project provided training for a postdoc and an undergraduate student in barley transformation and gene editing.

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

We presented our research progress at the 2021 National FHB Forum.

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).

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.

Alhashel, A., Baldwin, T., Rasmussen, J., Zhong, S., Friesen, T.L., Yang, S. Genetic engineering to improve Fusarium head blight resistance in barley. *Proceedings of the 2021 National Fusarium Head Blight Forum*; Virtual. December 6-7, 2021. Retrieved from: <https://scabusa.org/forum/2021/2021NFHBForumProceedings.pdf>