

FY21 Performance Progress Report

Due date: July 26, 2022

Cover Page

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Fiscal Year:	2021
USDA-ARS Agreement ID:	59-0206-0-172
USDA-ARS Agreement Title:	Developing FHB-resistant Winter Wheat for Texas and the Southern U.S.
FY20 USDA-ARS Award Amount:	\$92,675
Recipient Organization:	Texas A&M Agrilife Research Soil & Crop Sciences Dept. 2474 TAMU, College Station, TX 77845
DUNS Number:	847205713
EIN:	746000541
Recipient Identifying Number or Account Number, if any:	06-506196
Project/Grant Period:	5/15/21 - 5/14/22
Reporting Period End Date:	5/14/2022

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Developing FHB-resistant Hard Red Winter Wheat for Texas and the S. Great Plains	\$38,957
VDHR-SWW	Developing FHB-resistant Soft Red Winter Wheat for Texas and the Gulf-Atlantic Region	\$37,306
VDHR-SWW	Double Haploids to Expedite Development of FHB Resistant Soft Winter Wheat Varieties	\$16,412
FY21 Total ARS Award Amount		\$92,675

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.



Principal Investigator Signature

July 31, 2022
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: Developing FHB-resistant Hard Red Winter Wheat for Texas and the S. Great Plains

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

The overarching goal of this proposal is to use traditional breeding techniques and marker-assisted selection (MAS) to develop FHB-resistant HRW cultivars adapted to Texas and the Southern Great Plains. Our specific objectives are to 1) develop, screen, and release HRW that combine superior yield and end-use quality with tagged or native FHB resistance, 2) use MAS to complement traditional breeding methods and improve gain from selection, and 3) enter promising FHB-resistant lines into regional nurseries to facilitate development of resistant cultivars. New FHB-resistant HRW cultivars with high yield, tolerance to other stresses, and superior quality will provide effective means of resistance not only in Texas but also in other areas of the central and southern Great Plains where TAM wheat is adapted and where FHB levels require adequate host plant 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?

A mist-irrigated FHB evaluation nursery was successfully established at the main campus for evaluating incidence and disease severity. We have specifically evaluated the Southern Regional Germplasm Nursery (SRPN), Northern Regional Germplasm Nursery (NRPN), the Southern Scab Nursery in addition to Texas advanced yield trials in addition to our advanced trials and selected F2, F3, and F4 populations with known FHB resistance. This nursery had heavy scab infection.

Another nursery was planted near Dumas, TX. Wheat plots and head-rows were planted into heavy corn residue and irrigated with an overhead sprinkler system. The trial was surrounded with triticale as a wind-block to increase humidity. This nursery had a uniform medium infection of scab.

b) What were the significant results?

During our second year of testing in the scab misted nursery at College Station, we had uniform symptoms. The FHB index ranged from 3.5 to 8, based on a scale of 0 - 9 in the Southern Scab Nursery and the FDK ranged from 2.4% - 30% in the same nursery. The FHB index and FDK were not correlated this year ($r = 0.08$, ns).

The FHB index in the nursery near Dumas ranged from 1 to 6 with an average of 2.8. Although these index number were relatively low, they were consistent across the field and correlated highly with last year's values.

c) List key outcomes or other achievements.

Our second-year nursery showed that we can produce and apply inoculum appropriately, mist irrigate, establish symptoms, and take good readings of wheat head scab. The correlation between FHB index and heading was -0.66 ($P < 0.01$), which indicates that the later lines had lower FHB symptoms. This indicates that we need to

have better grouping of entries by heading for symptom evaluation. This also indicates that we need to apply the corn spawn earlier right at the beginning of stem elongation next year. FHB pressure was lower in the second year due to dryer than normal weather conditions across the region. This is confirmed by lower FDK ratings compared to year 1. The scab nursery at Dumas, TX had significant FHB symptoms and the known resistant and susceptible lines were consistent with data from previous nurseries. Two entries from the 2021 FHB screening nurseries were advanced to the USDA-ARS SRPN and they again tested resistant in the 2022 nurseries. The trials were rated for diseases index and FDK, and 100 lines will be sent to NDSU for DON testing.

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

Two technicians and several undergraduate students were trained in symptom rating, including, disease incidence, severity, and FDK, as part of this project.

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

So far, data of regional nurseries has been shared with colleagues in the HRW region. Results will be communicated in producers' meeting and field days. Any future significant outcomes of this project will also be highlighted in popular press articles. Furthermore, results will be communicated to scientific peers via peer-reviewed scientific journals upon the release of current candidates screened during 2021 and 2022.

Project 2: Developing FHB-resistant Soft Red Winter Wheat for Texas and the Gulf-Atlantic Region

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

The overarching goal of this proposal is to use traditional breeding techniques, a misted-nursery, and MAS to develop FHB resistant SRWW cultivars and to share germplasm with other Southern U.S. programs. Our specific objectives are to 1) develop, screen, and release SRWW that combine superior yield and end-use quality with tagged or native FHB resistance, 2) use MAS to complement traditional breeding methods and improve gain from selection, and 3) enter promising FHB-resistant lines into Southeastern University Grains (SunGrains) scab nurseries to facilitate development of resistant cultivars. New FHB-resistant SRWW cultivars with high yield potential, tolerance to other biotic and abiotic stresses, and superior end-use quality will provide effective means of resistance not only in Texas but also in other areas in the Southern U.S. where TAM wheat is adapted and where FHB levels require adequate host plant 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?

A mist-irrigated FHB evaluation nursery was established at the main campus for evaluating incidence and disease severity. We have specifically evaluated the Texas Soft Uniform Variety Trial (SUVT), Uniform Southern SRWW Nursery (USSRWWN), and the Southern Uniform Winter Wheat Scab Nursery (SUWWSN) in 2021– 2022, and we will continue to do the same during the 2022 – 2023, 2023 – 2024, and 2024 – 2025 wheat growing seasons. We will harvest seed for FDK evaluation, and we will send the seed to Minnesota for DON evaluation.

b) What were the significant results?

During the second year of testing in the scab misted nursery, we had excellent uniform symptoms. The FHB index ranged from 2 to 9, based on a scale of 0 - 9 in the Southern Scab Nursery and the FDK ranged from 0% - 20% in the same nursery. The FHB index and FDK were correlated ($r = 0.33$, $P < 0.01$). The best performers were lines possessing the *Fhb1* gene.

c) List key outcomes or other achievements.

Our second-year nursery showed that we can produce and apply inoculum appropriately, mist irrigate, establish symptoms, and take good readings of wheat head scab. The correlation between FHB index and heading was -0.13 ($P < 0.05$), which indicates that the later lines had lower FHB symptoms. This indicates that we need to have better grouping of entries by heading for symptom evaluation. This also indicates that we need to apply the corn spawn earlier right at the beginning of stem elongation next year. FHB pressure was lower in the second year due to dryer than normal weather conditions across the region. This is confirmed by lower FDK ratings compared

to year 1. There is an increase in the Fhb1 frequency in our germplasm; thanks to the USWBSI efforts. We ***expect to release this type of resistance in about two years from now.***

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

Two technicians and several undergraduate students were trained in symptom rating, including, disease incidence, severity, and FDK, as part of this project.

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

So far, data of regional nurseries has been shared widely with colleagues in the SunGrains. Results will be communicated in producers' meeting and field days. Any future significant outcomes of this project will also be highlighted in popular press articles. Furthermore, results will be communicated to scientific peers via peer-reviewed scientific journals upon the release of current candidates screened during 2021.

Project 3: Double Haploids to Expedite Development of FHB Resistant Soft Winter Wheat Varieties

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

Each year the southern VDHR breeding programs make multiple single- and three-way crosses to pyramid validated FHB QTL and other traits of interest. The goal of this project is to collectively develop and share DHs that lead to release of FHB resistant varieties more quickly than possible using traditional breeding protocol.

The objective of this project is to increase the rate of genetic gain by decreasing the cycle time using double haploids. This will be accomplished by creating DHs from crosses that combine multiple effective FHB QTL in high yielding adapted backgrounds and sharing selection from those among all collaborators.

Each of the VDHR breeding programs will use one or more crosses to develop 350+ double haploid lines per year. These lines will be genotyped in collaboration with the Eastern Regional Genotyping Center and collaboratively phenotyped through exchange after initial selection for basic adaptation.

2. What was accomplished under these goals or objectives? (For each major goal/objective, address these three items below.). This is a team project that was performed by the six institutions listed above.

a) What were the major activities?

Double Haploids were created from three crosses in 2021 that have *Fhb1* and other sources of resistance on one or both sides of the pedigree. These crosses also include genes/QTL for resistance to Hessian Fly, soil borne mosaic virus resistance, stripe rust, leaf rust, and stem rust as well as other genes important to the success of varieties in the southeastern US.

Selected DHs from each VDHR-SWW institution will be shared with all other cooperators for selection and variety development to obtain maximum benefit from the expenditure of resources.

The following are three Texas A&M DH populations that are currently in production.

Cross	Pedigree
WX20D004	GA15VDH-FHB-MAS22-18ESc41F/TX2017DDH116
WX20D072	TX2017DDH172/TX18D3308
WX21D008	TX16DDH579/NC14759FHB1H33

b) What were the significant results?

TX16DDH579 is a DH cultivar that was released this year. Two other DHs were tested in the SunGrains Gawn trial and one will be advanced to the Uniform Southern Nursery for testing in 2022-23. TX2017DDH193 contains *Fhb_4A_Neuse*. This line shows good FHB resistance.

c) List key outcomes or other achievements.

As we develop more DH lines with *Fhb* resistance genes, our program will have more lines with multiple FHB resistance genes for release.

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

Two technicians and several undergraduate students were trained in symptom rating, including, disease incidence, severity, and FDK, as part of this project.

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

Results will be communicated in producers' meeting and field days. Any future significant outcomes of this project will also be highlighted in popular press articles. Furthermore, results will be communicated to scientific peers via peer-reviewed scientific journals upon the release of current candidates screened during 2021.

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.

None.