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

Cover Page

Principle Investigator (PI):	Elias Elias
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Fiscal Year:	2020
USDA-ARS Agreement ID:	59-0206-0-121
USDA-ARS Agreement Title:	Identify and Develop Durum Wheat Resistant to Fusarium Head Blight
FY20 USDA-ARS Award Amount:	$ 177,889
Recipient Organization:	North Dakota State University Office of Grant & Contract Accouting NDSU Dept 3130, PO Box 6050 Fargo, ND 58108-0650
DUNS Number:	80-388-2299
EIN:	45-6002439
Recipient Identifying Number or Account Number:	FAR0031955
Project/Grant Reporting Period:	5/5/20 - 5/4/21
Reporting Period End Date:	5/4/2021

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
DUR-CP	Develop Durum Wheat Resistant to Fusarium Head Blight	$ 145,520
DUR-CP	Identify Sources of Resistance to Fusarium Head Blight in Durum Wheat	$ 32,369
	FY20 Total ARS Award Amount	**$ 177,889**

E. Elias 7-26-2021

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

Project 1: *Develop Durum Wheat Resistant to Fusarium Head Blight*

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

The relevance of the project's objectives to the goals and research priorities of the USWBSI are as follows:

a) Breeding FHB-resistant durum wheat (Action VDHR goals 1-3 and CP priority 3-4);
b) Screen durum populations/experimental lines for FHB resistance in greenhouses and irrigated field nurseries (Action VDHR goal 2 and CP priority 1);
c) Evaluate experimental lines for DON (Action VDHR goal 2 and CP priority 4);
d) Use marker assisted selection at the USDA-ARS Genotyping Center in Fargo, ND for selection of valuable loci (Action VDHR goal 2-3 and CP priority 2);
e) Evaluate identified FHB resistant lines for quality (Action VDHR goal 2 and CP priority 3-4); and
f) Develop new populations by crossing adapted germplasm to newly identified sources of resistance (Action VDHR goal 1-3 and CP priority 3-4).

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?

- 9 lines were evaluated in the Uniform Regional Durum Nursery
- 54 lines were evaluated in the Elite Advanced Yield Trial
- 113 lines were evaluated in the Advanced Yield Trials
- 1,600 lines were evaluated in the Preliminary Yield Trials
- 42 populations were screened in the field and greenhouses
- 49 new populations were developed
- 1,839 lines were tested for DON
- 5,600 lines were evaluated in the FHB nursery in Prosper, ND
- 1,200 lines were evaluated in the FHB nurseries at Fargo, ND

b) What were the significant results?

- All material listed in major activities above was successfully screened in FHB field irrigated nurseries and the greenhouse.
- All experimental lines in yield trials were evaluated for agronomic and quality traits.
- Several experimental lines from yield trials were evaluated for low cadmium uptake.

- Several experimental lines with moderate resistance combined with low cadmium uptake were selected and advanced for evaluation in 2020.

c) List key outcomes or other achievements.

Divide, Carpio, Joppa, and ND Riveland the moderately FHB-resistant cultivars, continue to rank in the top four in durum planted acreage. In 2020, collectively they were planted on 67% of the acreage in North Dakota. ND Riveland has the lowest disease severity when compared to all cultivars grown in ND. It also has lower DON than all the cultivars with the exception of Joppa. In 2021, we expect ND Riveland to be grown on large durum acres in North Dakota because of its high yield potential, excellent quality, lower FHB severity and low cadmium uptake. Based on FHB resistance, yield advantage, and the current planted acreage, the four cultivars will generate millions of dollars into the state economy.

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.

Because of traveling restrictions we had to eliminate the Langdon, ND location and modify our strategies. All segregating populations and yield trials that normally are planted and evaluated for FHB in the Langdon location now they are planted in Prosper and Casselton locations that are near Fargo, ND.

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

Two students rated scab nurseries.

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

Gave presentations at Field Days hosted by NDSU Research Centers and to trade teams through the ND Wheat Commissions.

Project 2: *Identify Sources of Resistance to Fusarium Head Blight in Durum Wheat*

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

The relevance of the project's objectives to the goals and research priorities of the USWBSI are as follow:

1) Screen diverse durum accessions from ICARDA for reaction to FHB in an FHB screening nursery located at the Jiangsu Academy of Agricultural Sciences in Nanjing, China (Action VDHR goals 1-3 and CP priority 1);
2) Re-evaluate the accessions exhibiting high levels of resistance in the preliminary screening test in the greenhouse and field screening nurseries in North Dakota (Action VDHR goals 1-3 and CP priority 1) ;
3) Determine whether the new sources of resistance carry novel resistant loci by marker haplotyping using the existing markers associated with known resistance QTL (Action VDHR goals 3 and CP priority 2);
4) Make crosses using the resistant lines and distribute them to durum wheat breeders (Action VDHR goals 1-3 and CP priority 3).

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?

- 1,082 lines were sent to China for evaluation.
- 8 populations with 143 lines were tested and advanced from crossing adapted germplasm with PI 277012.
- 6 lines were tested and advanced from crossing adapted germplasm with ICARDA Accessions and 25 new crosses were made.
- 7 populations with 183 lines were tested and advanced from crossing adapted germplasm with *Triticum dicoccum.*
- 21 F_2 populations were advanced from crossing adapted lines to various sources of un-adapted moderately resistant accessions.
- 18 F_3 populations were advanced from crossing adapted lines to various sources of un-adapted moderately resistant accessions.
- 13 F_4 populations were advanced from crossing adapted lines to various sources of un-adapted moderately resistant accessions.
- 11 F_5 populations were advanced from crossing adapted lines to various sources of un-adapted moderately resistant accessions.
- 11 F_6 populations and 6 F_5 were advanced in New Zealand winter nursery from crossing adapted lines to various sources of un-adapted moderately resistant accessions.

b) What were the significant results?

Several experimental lines with FHB resistance from wild relatives and Tunisian sources of resistance were evaluated in yield trials for agronomic and quality traits

c) List key outcomes or other achievements.

Using wild relatives and unadapted germplasm is normally associated with linkage drag. However, from crossing adapted lines to various sources of un-adapted moderately resistant accessions, several experimental lines with lower linkage drag were selected and evaluated in yield trials.

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.

Because of Covid-19 we were not able to travel to evaluate the China FHB nursery. The accessions will be replanted in 2020 in the China nursery.

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

Two students rated scab nurseries.

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

Gave presentations at Field Days hosted by NDSU Research Centers and to trade teams through ND Wheat Commissions.

Training of Next Generation Scientists

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

FY20 Annual Performance Progress Report
PI: Elias, Elias
USDA-ARS Agreement #: 59-0206-0-121
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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 (5/5/20 - 5/4/21). 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
ND Stanley	DUR - Durum	MS - Moderately Susceptible	5	2021
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 (5/5/20 - 5/4/21**) 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.

Jitendra Kumar, Krishan M. Rai, Seyedmostafa Pirseyedi, Elias M. Elias, Steven Xu, Ruth Dill-Macky & Shahryar F. Kianian*. 2020. Epigenetic regulation of gene expression improves Fusarium head blight resistance in durum wheat. Nature, Scientific Reports. https://doi.org/10.1038/s41598-020-73521-2.
Status: Published
Acknowledgement of Federal Support: YES

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

Nothing to report

Other publications, conference papers and presentations.

Rumhau Wang, Justin Hegstad, Steven Xu, Elia Elias, Shaobin Zhang and Xuehui Li (2020). Developing durum wheat resistant germplasm using interspecific crosses and phenotypic selection at early generations. In: S. Canty, A. Hoffstetter, and R. Dill-Macky (Eds). *Proceedings of the 2020 National Fusarium Head Blight Forum* (p. 22.), Virtual: December 7-11. Online: https://scabusa.org/pdfs/NFHBF20 Proceeding.pdf.
Status: Abstract Published and poster presented
Acknowledgement of Federal Support: YES (Abstract and Poster)