USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY17 Final Performance Report – NCE for FY18
Due date: July 12, 2019

Cover Page

Principle Investigator (PI):	Elias Elias
Institution:	North Dakota State University
E-mail:	elias.elias@ndsu.edu
Phone:	701-231-8159
Fiscal Year:	2017 (NCE for FY18)
USDA-ARS Agreement ID:	59-0206-4-010
USDA-ARS Agreement Title:	Identify and Develop Durum Wheat Resistant to Fusarium Head Blight.
FY17 USDA-ARS Award Amount:	$ 129,068
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:	FAR0022040
Project/Grant Reporting Period:	5/5/18 - 5/4/19
Reporting Period End Date:	05/04/19

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
DUR-CP	Develop Durum Wheat Resistant to Fusarium Head Blight.	$ 102,905
DUR-CP	Identify Sources of Resistance to Fusarium Head Blight in Durum Wheat.	$ 26,163
	FY17 Total ARS Award Amount	$ 129,068

E. Elias — 6/27/2019

Principal Investigator — Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
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 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? *Address items 1-4) below for each goal or objective.*

1) major activities

- 2 lines were evaluated in the Uniform Regional Durum Nursery
- 13 lines were evaluated in the Elite Advanced Yield Trial
- 64 lines were evaluated in the Advanced Yield Trials
- 700 lines were evaluated in the Preliminary Yield Trials
- 78 populations were screened in the field and greenhouses
- 27 new populations were developed
- 2,407 lines were tested for DON
- 7,800 lines were evaluated in the FHB nursery in Prosper, ND
- 1,800 lines were evaluated in the FHB nurseries at Langdon, ND
- 1,056 lines were genotyped at the USDA-ARS Genotyping Center in Fargo, ND

2) specific objectives

The specific objective of this project is to develop germplasm that is resistant to FHB with good agronomic and quality traits that can be used by producers, millers, and the pasta industry. We will continue developing resistant germplam using native resistance, resistant wild relatives, and world collection accessions. We will evaluate the developed resistant germplasm for agronomic and quality traits. We will combine FHB resistance with low cadmium uptake in the newly developed germplasm.

3) significant results

- All material listed in major activities above was successfully screened in FHB field irrigated nurseries and the greenhouse.
- Several lines were successfully genotyped at the USDA-ARS Genotyping Center in Fargo, ND.
- 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 2019.

4) key outcomes or other achievements

Divide, Carpio, and Joppa, the moderately FHB resistant cultivars, continue to rank in the top three in durum planted acreage. Collectively they are planted on 54% of the acreage in North Dakota. In 2017, we released a new moderately resistant cultivar ND Riveland. 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. Based on FHB resistance, yield advantage, and the current planted acreage, the four cultivars will generate millions of dollars into the economy.

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

Two students rated scab nurseries.

4. 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 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 resistant 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? *Address items 1-4) below for each goal or objective.*

1) major activities

- 1,000 new lines were sent to China for evaluation.
- 23 lines were tested and advanced from crossing adapted germplasm with Tunisian 7.
- 63 lines were tested and advanced from crossing adapted germplasm with PI 277012.
- 130 lines were tested and advanced from crossing adapted germplasm with ICARDA accessions.
- 24 lines were tested and advanced from crossing adapted germplasm with *Tiriticum dicoccum.*
- 900 F_2 plants were genotyped from crosses of adapted lines with wild relatives.
- 14 F_4 populations were advanced from crossing adapted lines to various sources of
- Un-adapted moderately resistant accessions.
- 38 F5 populations were advanced from crossing adapted lines to various sources of Un-adapted moderately resistant accessions.

2) specific objectives

The major goal of the project is to identify new sources of tetraploid FHB resistant germplasm. A more specific objective is to screen the ICARDA material in order to identify resistant durum wheat and ultimately introgress the resistant genes into the cultivated durum wheat cultivars to reduce the threat of the FHB disease.

3) significant results

- ICARDA accessions were successfully screened in FHB field irrigated nurseries in China.
- Several experimental lines with FHB resistance from wild relatives and Tunisian sources of resistance were evaluated in yield trials for agronomic and quality traits

4) key outcomes or other achievements

Using wild relatives and unadapted germplasm normally is 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. What opportunities for training and professional development has the project provided?

Two students rated scab nurseries.

4. 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 FY17-NCE period. 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 FY17-NCE period?**

   No

   If yes, how many?

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY17-NCE period?**

   No

   If yes, how many?

3. **Have any post docs who worked for you during the FY17-NCE period and were supported by funding from your USWBSI grant taken faculty positions with universities?**

   No

   If yes, how many?

4. **Have any post docs who worked for you during the FY17-NCE period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**

   No

   If yes, how many?

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 FY17-NCE period. 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** (S, MS, MR, R, where R represents your most resistant check)	**FHB Rating** (0-9)	**Year Released**
ND Riveland	DUR	MR	4	2017

Add rows if needed.

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

Abbreviations for Grain Classes

Barley - BAR
Durum - DUR
Hard Red Winter - HRW
Hard White Winter - HWW
Hard Red Spring - HRS
Soft Red Winter - SRW
Soft White Winter - SWW

Publications, Conference Papers, and Presentations

Instructions: Refer to the FY17-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY17-NCE grant period. Only include citations for publications submitted or presentations given during your award period (5/5/18 - 5/4/19). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each reference/citation, you must indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in publication/ presentation. See example below for a poster presented at the FHB Forum:

> Conley, E.J., and J.A. Anderson. 2017. Accuracy of Genome-Wide Prediction for Fusarium Head Blight Associated Traits in a Spring Wheat Breeding Program. In: Proceedings of the XXIV International Plant & Animal Genome Conference, San Diego, CA.
> Status: Abstract Published and Poster Presented
> Acknowledgement of Federal Support: YES (poster), NO (abstract)

Journal publications.

Agnes Szabo-Hever, Qijun Zhang, Timothy L. Friesen, Shaobin Zhong, Elias M. Elias, Xiwen Cai, Yue Jin, Justin D. Faris, Shiaoman Chao and Steven S. Xu. 2018. Genetic Diversity and Resistance to Fusarium Head Blight in Synthetic Hexaploid Wheat Derived from *Aegilops tauschii* and Diverse *Triticum turgidum* Subspecies. Front. Plant Sci. 9:1-14.
Status: Published
Acknowledgement of Federal Support: Yes

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

Nothing to report

Other publications, conference papers and presentations.

Jitendra Kumar, Steven Xu, Elias M. Elias, Ruth Dill-Macky and Shahryar Kianian (2018). Epigenome modification in durum wheat provides fhb resistance. In: S. Canty, A. Hoffstetter, B. Wiermer and R. Dill-Macky (Eds). *Proceedings of the 2018 National Fusarium Head Blight Forum.* St. Louis, MO: U.S. Wheat & Barley Scab Initiative. p. 117.
Status: Abstract Published and poster presented
Acknowledgement of Federal Support: YES