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

Cover Page

Principle Investigator (PI):	Andrew Green
Institution:	North Dakota State University
E-mail:	andrew.j.green@ndsu.edu
Phone:	701-231-8478
Fiscal Year:	2018
USDA-ARS Agreement ID:	59-0206-8-200
USDA-ARS Agreement Title:	Development of Hard Spring Wheat Cultivars Resistant to Fusarium Head Blight
FY18 USDA-ARS Award Amount:	$ 122,465
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:	FAR0028564
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
VDHR-SPR	Development of Hard Spring Wheat Cultivars Resistant to Fusarium Head Blight.	$ 122,465
	FY18 Total ARS Award Amount	$ 122,465

_____ 27 June 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

FY18 Performance Report
PI: Green, Andrew
USDA-ARS Agreement #: 59-0206-8-200
Reporting Period: 5/5/18 - 5/4/19

Project 1: *Development of Hard Spring Wheat Cultivars Resistant to Fusarium Head Blight.*

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

1. Continue to develop varieties adapted to the Northern Plains spring wheat region which are at least moderately resistant to Fusarium head blight.
2. Screen breeding lines, varieties, and uniform nurseries in misted, inoculated nurseries, and test those entries for DON accumulation.
3. Characterize non-Fhb1 resistance present in breeding program through marker-assisted selection and phenotyping.
4. Identify germplasm which is low in DON accumulation in addition to having a low visual rating score for disease presence.
5. Introgress novel germplasm from pre-breeding into adapted spring wheat backgrounds with suitable end-use quality for breeding and cultivar development.
6. Utilize marker assisted selection for FHB resistance in cooperation with the USDA-ARS genotyping facility

2. What was accomplished under these goals? *Address items 1-4) below for each goal or objective.*

Objective 1. Continue to develop varieties adapted to the Northern Plains spring wheat region which are at least moderately resistant to Fusarium head blight.
Major Activities: Increased breeding locations sites by 25%.
Specific Objectives: Increase locations while maintaining similar plot numbers.
Significant Results: Two successful FHB nurseries (one lost due to lack of disease).
Key Outcomes/Achievements: Elite lines containing FHB resistance and agronomic suitability prevalent in advanced yield tests.

Objective 2. Screen breeding lines, varieties, and uniform nurseries in misted, inoculated nurseries, and test those entries for DON accumulation.
Major Activities: We conducted FHB screening of every experimental line in the program at three misted, inoculated nurseries. We also began screening each entry in our inoculated nurseries for Fusarium Damaged Kernels (FDK).
Specific Objectives: Regarding FHB resistance, we aim to only advance lines which show moderate resistance. This is determined by a combination of visual disease ratings, test weight of grain, and Deoxynivalenol accumulation. Significant Results: Our results in 2018 were good enough to make advancement decisions in the breeding program, and publicize the results from released varieties in the annual variety trial results and variety selection guide.
Key Outcomes/Achievements: Experimental lines advanced through the breeding program had a lower mean FHB disease rating than the average of the check varieties in our nurseries.

Objective 3. Characterize non-Fhb1 resistance present in breeding program through marker-assisted selection and phenotyping.
Major Activities: Preliminary Genome Wide Association Analysis performed by X. Li.

(Form – PR18)

Specific Objectives: Identify and begin to develop markers for non-Fhb1 resistance.
Significant Results: Genomic regions of promise identified- in depth sequencing of 'Glenn' needed.
Key Outcomes/Achievements: Similar genomic regions identified in other work- follow-up needed with goal of developing diagnostic markers for use in the breeding program.

Objective 4. Identify germplasm which is low in DON accumulation in addition to having a low visual rating score for disease presence.
Major Activities: Screened all lines for DON and FDK.
Specific Objectives: Advance lines which are low in DON accumulation and visual rating.
Significant Results: DON data obtained for all experimental genotypes in program in at least one nursery.
Key Outcomes/Achievements: Breeding advancements made with DON and FDK as significantly weighted factors.

Objective 5. Introgress novel germplasm from pre-breeding into adapted spring wheat backgrounds with suitable end-use quality for breeding and cultivar development.
Major Activities: Advanced 45 F_3 populations with novel resistance genes from selection in inoculated nursery. Populations developed by X. Cai.
Specific Objectives: To obtain adapted experimental lines with high levels of unique FHB resistance.
Significant Results. Populations more closely resemble agronomic target phenotype after two generations of selection.
Key Outcomes/Achievements: Breeding progress made toward testing of new lines.

Objective 6. Utilize marker assisted selection for FHB resistance in cooperation with the USDA-ARS genotyping facility
Major Activities: Genotyping done privately in 2018 due to turnover and government shutdown at USDA-ARS facility.
Specific Objectives: Marker Assisted Selection for Fhb1, Fhb2, and 3A QTL.
Significant Results: Data obtained for advancement decisions anyhow.
Key Outcomes/Achievements: 25% of genotyped PYT lines amplified for Fhb1.

3. **What opportunities for training and professional development has the project provided?**
We employ 3-5 temporary student workers at various times throughout the school year, most of which were supported in some way by this project. They assist with all aspects of the breeding program, from harvest, threshing, cleaning, processing kernel samples, DON grinding, crossing, planting preparation, and seed lab data collection.

4. **How have the results been disseminated to communities of interest?**
Results from our misted, inoculated nurseries are used to produce the FHB ratings in the annual variety trial results and variety selection guide. At approximately 6 field days and multiple winter meetings each year, the PI discusses FHB resistance of relevant varieties using this data. One of the top priorities of our program is genetic resistance to important diseases,

and we communicate this goal, along with the importance of FHB resistance every time there is an opportunity.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY18 award 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 FY18 award 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 FY18 award period?**

    No.
    If yes, how many?

3. **Have any post docs who worked for you during the FY18 award 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 FY18 award 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 <u>full or partial</u> support through the USWBSI during the <u>FY18 award period</u>. 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

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 FY18-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY18 grant. 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 presentation with an abstract:

> Conley, E.J., and J.A. Anderson. 2018. 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. N/A

Books or other non-periodical, one-time publications. N/A

Other publications, conference papers and presentations.

Green, A.J., Leier, J.L., Lin, Y., Zhong, S., Li, X. Friskop, A., Xu, S., Cai, X., Frohberg, R., Stack, R., and Mergoum, M. 2018. Breeding for FHB Resistance in North Dakota: More Questions than Answers. In: Proceedings of the 2018 National Fusarium Head Blight Forum.
Status: Abstract published and talk presented.
Acknowledgement of Federal Support: Yes (talk) Yes (Abstract)

Leier, J.L., and A.J. Green. 2018. Fusarium Head Blight Resistance in Hybrid Hard Red Spring Wheat. In: Proceedings of the 2018 National Fusarium Head Blight Forum.
Status: Abstract published and poster presented.
Acknowledgement of Federal Support: Yes (poster) Yes (Abstract)