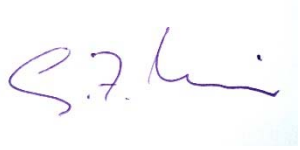
USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY14 Final Performance Report
July 15, 2015

Cover Page

PI:	Gideon Francois Marais
Institution:	North Dakota State University
Address:	Department of Plant Sciences Dept. 7670 PO Box 6050 Fargo, ND 58108-6050
E-mail:	gideon.marais@ndsu.edu
Phone:	701-231-8155
Fax:	
Fiscal Year:	FY14
USDA-ARS Agreement ID:	59-0200-3-006
USDA-ARS Agreement Title:	Transfer of FHB Resistance to NDSU Hard Red Winter Wheat Breeding Material.
FY14 USDA-ARS Award Amount:	$ 19,261

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HWW-CP	Transfer of FHB Resistance to NDSU Hard Red Winter Wheat Breeding Material.	$ 19,261
	FY14 Total ARS Award Amount	**$ 19,261**



06/03/2015

Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
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
WES-CP – Western 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: *Transfer of FHB Resistance to NDSU Hard Red Winter Wheat Breeding Material.*

1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

A winter wheat breeding population is being established which necessitates the acquisition, development and utilization of parental stock that will enable breeding of new varieties with adequate disease resistance, a high level of winter-hardiness, adaptation to North Dakota growing conditions and good processing properties. In North Dakota, winter-hardiness and FHB resistance are primary breeding objectives, however the available germplasm at the onset of the project had low levels of resistance to predominant diseases, in particular against FHB. Some of the better known and confirmed sources of FHB resistance were therefore targeted for introgression and included *Fhb1*, *Fhb2* and *Ofhs.ifa-5A* ex Sumai 3; QTL on 3A ex Frontana; QTL on 5AS and 5AL ex PI277012. These genes occurred primarily in spring wheat backgrounds.

During 2012-13, bridging genotypes were generated for the transfer of some or all of the above FHB resistance genes. Accessions (primarily spring wheat) with one or more of the target genes were crossed with one of six winter-hardy wheats adapted to North Dakota. F_1 hybrids were used to initiate doubled haploid (DH) production and single seed descent (SSD) inbreeding. The current project aimed to continue to evaluate the DH and SSD lines thus generated for their winter-hardiness, resistance and plant phenotype and then to involve the better lineages in crosses with a wider range of adapted winter wheat parents.

2. List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:

Accomplishment:

Approximately 290 DH and ± 350 SSD inbred lines that had been pre-selected for winter growth habit were evaluated for FHB resistance during the summer of 2014. Some of the lines have also been pre-selected (markers) for the presence of *Fhb1* and *Ofhs.ifa-5A.*

1. A hill-plot trial (2 replications) was artificially inoculated and selected for FHB resistance at Fargo, ND. Disease symptoms were evaluated and the better lines were selected.
2. Most of the lines were also planted as an un-replicated nursery (8 ft rows) at Casselton. This nursery got naturally infected with FHB and also showed heavy infestations of bacterial leaf streak. The lines were evaluated for plant agrotype, winter-survival, resistance to FHB and other diseases.
3. Based on the combined data 14 lines were chosen for inclusion in the 2015 regional HRWW FHB Screening Nursery while 96 were entered into replicated and un-replicated trials for continued evaluation at Casselton in 2015.

Impact:

Although the FHB data that were gathered represented only one season of testing and need to be confirmed in future trials, promising winter types with good, intermediate levels of FHB resistance and winter-hardiness could be selected and the best were extensively employed in crosses.

In Fargo, ND, the past two winters (in particular the winter of 2014/15) were characterized by severe winter-kill. Field planting of the better selections has helped to identify an even smaller subset of the hardiest selections. At the same time, the inclusion of 14 of the lines in the annual FHB nursery proved fortunate as FHB data will still be obtained from the Kansas and Nebraska FHB nurseries. Thus, a better defined and smaller set of parents will be available for the 2016 crossing cycle.

Accomplishment:

Nineteen lines (15 having *Fhb1* and *Ofhs.ifa-5A* as indicated by marker results) and four lines that may have 5AS and 5AL QTL ex PI277012 (based on phenotypic data) were included as cross parents in the 2015 crossing block and were used in approximately 385 crosses. The F_2 from the latter crosses will be field planted in the fall of 2015 and subjected to single plant selection in 2016.

Impact:

The combination of resistance genes *Fhb1* and *Ofhs.ifa-5A*, and to a lesser extent the 5AL and 5AS QTL from PI277012, were disseminated to a large number of cross combinations. All of the crosses that were made involved winter-hardy winter wheat parents that included advanced breeding lines, released varieties and backcross derivatives with novel leaf and stem rust resistance genes. This is a significant first step towards improving the overall FHB resistance of the breeding population. In subsequent cross cycles the aim will remain to continuously improve the agrotype and FHB resistance of the breeding parents while striving to obtain and incorporate more FHB resistance genes.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY14 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 FY14 award period?** Yes

   If yes, how many? one.

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY14 award period?**

   If yes, how many? No

3. **Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**

   If yes, how many? No

4. **Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**

   If yes, how many? No

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY14 award period. List the release notice or publication. Briefly describe the level of FHB resistance. *If not applicable because your grant did NOT include any VDHR-related projects, enter N/A below.*

N/A

Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in the FY14 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Sharma Poudel, R. and G. F. Marais (2014). Pyramiding *Fhb1* with Useful Rust Resistance Genes in a Winter-hardy Wheat Genetic Background. National FHB Forum, St. Louis, Missouri, USA, Dec 7-9, 2014.

Sharma Poudel, R. (2015). The acquisition of useful disease resistance genes for hard red winter wheat improvement. Master of Science thesis, North Dakota State University of Agriculture and Applied Science.