

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY13 Final Performance Report
July 15, 2014**

Cover Page

PI:	G. 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:	FY13
USDA-ARS Agreement ID:	59-0200-3-006
USDA-ARS Agreement Title:	Transfer of FHB Resistance to NDSU Hard Red Winter Wheat Breeding Material.
FY13 USDA-ARS Award Amount:	\$ 21,422

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
HW-CP	Transfer of FHB Resistance to NDSU Hard Red Winter Wheat Breeding Material.	\$ 21,422
	FY13 Total ARS Award Amount	\$ 21,422

Principal Investigator

Date

* MGMT – FHB Management
 FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
 GDER – Gene Discovery & Engineering Resistance
 PBG – Pathogen Biology & Genetics
 BAR-CP – Barley Coordinated Project
 DUR-CP – Durum Coordinated Project
 HW-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: *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 new breeding program is being established which requires the 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. The available winter-hardy germplasm has only low levels of resistance to predominant diseases, in particular against FHB.

There is therefore a need to speedily introduce resistance genes from spring wheat and to develop bridging genotypes having the winter growth habit, FHB resistance and at least intermediate cold-hardiness. Such genotypes can then be used to complete the transfer of FHB resistance to winter wheat. The first goal is to focus on the better known and confirmed FHB QTL *Fhb1* and *Fhb5* (*Qfhs.ifa-5A*), and to attempt to disperse them into as wide an array of germplasm as possible. For the longer term, additional QTL are being targeted.

Donor genotypes carrying *Fhb1*, *Fhb2* and *Fhb5* from Sumai 3; a gene on chromosome 3A of Frontana and 5AS plus 5AL QTL ex spring wheat accession PI277012 were used in the first crosses. F₁ and segregating populations were used to derive random F₄, doubled haploid (DH) and single seed descent (SSD) inbred lines for evaluation as potential bridge parents. Where possible (and affordable), marker-assisted identification was used to enrich the populations with the target genes. The transitional materials are now being tested to identify those that would be the most useful in continued crosses.

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:

A large number of SSD inbred lines, DH lines and F₄-lines have been developed. These were then pre-screened for the winter growth habit and where applicable the presence of markers associated with *Fhb1* and *Fhb5*. The remaining winter types were then field-planted (Fargo) in an FHB screening nursery with two replications which included 525 SSD lines, 281 DHs and 354 F₄ selections. The trial is based on hill-plots and was artificially inoculated with FHB. Where enough seed was available, an observation row was also planted at Casselton, ND. Apart from their FHB resistance, the lines have also been selected for winter-survival. Not unexpectedly, the severe 2014 winter resulted in the loss of the majority of lines derived from spring X winter crosses; however, an adequate number survived.

Impact:

Useful new cross parents were developed and the first of these were already used in the 2014 crossing block. Additional potential parents are currently being evaluated for their FHB resistance and use in future crosses. In coming seasons the pre-bred lines will continue to be improved and employed, either as parents or as potential varieties:

- (a) Using marker-assisted backcrosses to introduce *Fhb1* into the very winter-hardy wheat Norstar, second backcross F₂ homozygotes for *Fhb1* and the height reducing gene *RhtB1b* were derived. In January 2014 these lines could be used in the first crosses with adapted, winter-hardy germplasm. The F₁ from the latter crosses will now be used in 3- and 4-way crosses with winter-hardy parents in January 2015 in an attempt to introduce *Fhb1* into as broad a range of germplasm as possible.
- (b) Three winter-habit doubled haploids from the cross (CM82036/Jerry) with unknown winter-hardiness that are homozygous *Fhb1*, *Fhb5*, were used in crosses with winter-hardy varieties. Once again the F₁ from the latter crosses will be used in three- and four-way crosses (2015) with adapted, winter-hardy cross parents.
- (c) The most promising selections from among the advanced lines (SSD, DH and F₄ selections) that are currently being tested for FHB resistance, will also be included as breeding parents in the 2015 crossing block.
- (d) In each of the subsequent seasons (2016+) the above material plus their cross-derivatives will be intensively used in continued crosses in an attempt to drastically raise the frequency of *Fhb1* and *Fhb5* in the breeding population.
- (e) Progenies were also obtained with respect to additional FHB QTL (*Fhb2* plus the Frontana and PI277012 QTL). In the absence of robust markers for these genes, their presence is detected through phenotyping following artificial inoculation in greenhouse and field trials. As a result their introgression proceeds more slowly than that of *Fhb1* and *Fhb5*.
- (f) In every season, promising cross combinations are taken from the most recent crossing block and used to develop further doubled haploid and single seed descent inbred lines in an attempt to produce improved parents as well as inbreds with commercial value.

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY13 award period. List the release notice or publication. Briefly describe the level of FHB resistance.

None.

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 FY13 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

None.