USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY10 Final Performance Report
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Cover Page

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Fiscal Year:	FY10
USDA-ARS Agreement ID:	59-0206-9-065
USDA-ARS Agreement Title:	Combining Resistance Sources to Produce FHB Resistant Specialty Spring Wheat Varieties.
FY10 USDA-ARS Award Amount:	$ 33,907

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-SPR	Development of Spring White and Specialty Wheat Cultivars Resistant Scab Disease.	$ 33,907
	Total ARS Award Amount	**$ 33,907**

Mohamed Mergoum 07/05/2011
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
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: *Development of Spring White and Specialty Wheat Cultivars Resistant Scab Disease.*

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

   Fusarium head blight (FHB) causes significant losses in wheat grain yield and its quality due to the accumulation of fungal mycotoxins, such as deoxynivalenol (DON). In the US spring wheat region, these losses are estimated to billions of dollars afflicted to wheat growers, industry, and export market. Hard white and specialty spring wheat (HWSW) genotypes resistant to FHB are needed by regional producers to remain competitive in domestic and international markets. A successful wheat breeding approach has been to combine different sources of host FHB resistance, including Types I and II resistances, into a single genotype. This has been done successfully in the hard red spring wheat (HRSW) breeding program and should be implemented in our HWSW breeding program as well.

   The HWSW breeding program at NDSU is addressing this problem by initiating/ reinforcing the development of elite and adapted genotypes/ lines/cultivars and breeding populations that incorporate genetic resistance with desired agronomic and quality traits. The strategy used is based on importing/incorporating/pyramiding several types of genetic resistance to FHB, particularly from our adapted HRSW sources such as Glenn, Alsen, Steele-ND, etc. into adapted HWSW lines using classical breeding methods and appropriate novel technologies such as selected molecular markers. Based on our accomplishments, we strongly believe that genetic resistance is/will provides a strategic long-term, economically, and environmentally sound solution to the problem. In 2010-2011 growing cycle, our efforts have continued to generate new crosses and generating new populations involving parents with FHB resistance. We have also included some HWSW lines with FHB resistance in our trials. Our goal is to develop elite HWSW germplasm and cultivars that are adapted to ND in particular, and spring wheat region, in general.

   Also, to evaluate the function of types I resistance genes, a graduate student, Mr. Dalitso Yabwalo was in 2008 to conduct this research. Previously developed reciprocal backcross monosomic lines developed by hybridizing FHB resistant spring wheat 'Frontana' to a set of 'Chris' spring wheat monosomics, which are susceptible to FHB were used in Mr. Dalitso Yabwalo study. Significant accomplishments have been achieved and are listed below.

2. **List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):**

   <u>Accomplishment:</u>

   From the past USWBSI funds, several spring wheat lines including NDSW0714 and NDSW0715, were developed such that they contained one and two QTL for FHB resistance, respectively. Also, using other USWBSI funding, many HRSW cultivars have been developed in the last decades with excellent agronomic and quality performance and good

levels of FHB resistance. These include Glenn, Faller, Steele-ND, Howard, Barlow, and many other new lines recently released or are in the pipeline of our HRSW breeding program. These genotypes have been used extensively in generating more than 200 crosses and segregating populations in 2010. Selection from this material is being advanced in the HWSW breeding pipeline.

This current project is in its second year. Screening of white/specialty wheat genotypes under scab nursery conditions (artificial inoculation and mist irrigation) at three locations in ND was conducted in 2010. Based on 2010 data, many genotypes were selected and identified. Also, field data was supplemented by the molecular markers information from the USDA-ARS Fargo Genotyping Center to make final selection of resistant genotypes that combine different sources of resistance. This material is being advanced for tests in 2011 nurseries.

Mr Dalitso Yabwalo has finished his study on the evaluation of the monosomics lines to determine the function of both type I resistance. These results were submitted to Plant Breeding Journal for publication. The manuscript was accepted in 2010 and currently is in press. The results demonstrate that 3A is a major genomic region for FHB resistance; therefore, mapping and cloning efforts should focus on this chromosome. The results also indicated the involvement of chromosomes 6A and 4D in reducing FHB spread although to a lesser extent than 3A.

Impact:

The impact from developing HWSW cultivars adapted to ND in particular and the spring region in general is tremendous. Millions of dollars could be generated by growing such as cultivars as is in the case of our HRSW developed by NDSU HRSW breeding program. The results of this project will allow us to identify white and specialty wheat genotypes with good FHB resistance. Developing and making available HWSW cultivars with FHB resistance to our wheat growers in the spring wheat region is needed to allow our wheat growers and industry to remain competitive in domestic and international markets.

The results from the graduate student study and its impact is substantial for our breeding program and the other breeding programs dedicated to pyramid FHB resistance genes. The study indicated the importance of the type I FHB resistance from Frontana and its benefits in pyramiding genes for FHB, which will be demonstrated by a decrease in the level of disease severity over time. The above results provide information to us and other breeders if pyramiding genes will be useful in developing host plant resistance to FHB, and it ultimately will result in the release of a spring wheat germplasm line which combines two different genes for resistance to FHB. These results can be used also to demonstrate if molecular markers can be effectively employed to pyramid different genes, despite these genes expressing a similar Type II phenotypic resistance to FHB.

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

Previously, the NDSW0714 and NDSW0715 were released as germplasm using part of USWBSI funds.

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

Yabwalo, D.N.**, M. Mergoum**, and W.A. Berzonsky. 2011. Further characterization of the scab resistance of 'Frontana' spring wheat and the relationships between resistance mechanisms. **Plant Breeding *(In press)***

Abstract/Presentations

Dalitso N. Yabwalo, **M. Mergoum**, and W. Berzonsky. 2010. Chromosome Determining Types I and II Resistance to Fusarium Head Blight in Frontana Spring Wheat. *In* ASA-CSSA-SSSA-CSSS Abstracts 2010 [CD-ROM], Long Beach CA, USA.