USDA-ARS / USWBSI
FY04 Final Performance Report
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Cover Page

PI:	**William Berzonsky**
Institution:	**North Dakota State University**
Address:	**Department of Plant Sciences** **370G Loftsgrad Hall** **Fargo, ND 58105**
E-mail:	**bill.berzonsky@ndsu.nodak.edu**
Phone:	**701-231-8156**
Fax:	**701-231-8474**
Year:	**FY2004** (approx. May 04 – April 05)
FY04 ARS Agreement ID:	**59-0790-4-094**
FY04 ARS Agreement Title:	**Using MAS and Breeding to Transfer Different Sources of FHB Resistance into Specialty Spring Wheat.**
FY04 ARS Award Amount:	**$ 72,818**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
BIO	Pyramiding Genes for FHB Resistance into Spring Wheat Using MAS and DH Production.	$ 32,850
VDUN	Rapid Development of Specialty Spring Wheat Cultivars with FHB Resistance.	$ 39,968
	Total ARS Award Amount	**$ 72,818**

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Principal Investigator Date

* BIO – Biotechnology
CBC – Chemical & Biological Control
EDM – Epidemiology & Disease Management
FSTU – Food Safety, Toxicology, & Utilization
GIE – Germplasm Introduction & Enhancement
VDUN – Variety Development & Uniform Nurseries

Project 1: ***Pyramiding Genes for FHB Resistance into Spring Wheat Using MAS and DH Production.***

1. What major problem or issue is being resolved and how are you resolving it?

Fusarium head blight (FHB) severely reduces end-use grain quality of hard spring wheat (HSW), and it is a major yield-limiting factor in the production region of the U.S. Northern Plains. Therefore a stable and durable level of genetic resistance is vital to wheat producers in the region. 'Alsen', a HSW cultivar with the 'Sumai-3' Type II source of FHB resistance, which limits fungal spread within the head, has quickly become the most widely grown spring wheat cultivar in North Dakota. Many other cultivars resist FHB damage, presumably due only to their having genes from Sumai-3. In anticipation that the fungal pathogen will eventually overcome the Sumai-3 source of resistance, we have been attempting to incorporate three different sources of resistance to FHB into single spring wheat genotypes. Resistance genes are derived from Alsen, *Triticum dicoccoides*, and 'Frontana'. Indications are that the genes from Alsen and *Triticum dicoccoides* function as Type II resistance genes, while the genes from Frontana may function to exclude the fungal pathogen or limit the development of DON in seed. Previously, BC_2F_1 Alsen backcross-derived individuals were selected which had the *Xgwm533* and *Xgwm2* markers, perhaps indicative of the FHB resistant QTL from Sumai 3 and *Triticum dicoccoides*, respectively. These hybridizations, subsequent backcrosses to Alsen, and the production of DH lines from them are intended to pyramid genes for FHB resistance from these diverse sources into spring wheats. Critical chromosome lines from Frontana having FHB resistance were identified, and these are being hybridized to the previously established backcross lines to pyramid the third source of resistance. We are attempting to use previously identified markers for the FHB resistance from Frontana, *Xgwm518* and *Xgwm644*, to follow the transfer of this source of resistance to lines having both the Alsen and *Triticum dicoccoides* sources of resistance.

2. What were the most significant accomplishments?

The backcross reciprocal monosomic lines of Frontana were screened in the greenhouse for a second time, having previously been screened in the field as well. Critical chromosome lines with 6A and 7A derived from Frontana once again showed a low percentage of tombstone kernels and low DON accumulation. These lines are being used in crosses to pyramid this source of resistance into the Alsen backcross derived lines, which presumably already carry both the Sumai-3 and *Triticum dicoccoides* sources of resistance. We anticipate publishing the results of the backcross reciprocal monosomic screening of Frontana lines in FY2005.

A series of BC_4F_1 derived lines from Alsen x *Triticum dicoccoides* synthetics were used to produce DH lines. A group of these lines were identified as having markers for both sources of resistance, while another group has been identified as having only the Alsen marker for resistance. A graduate student will screen both groups in a fall 2005 greenhouse test to determine if there are any differences in the level of FHB resistance expressed between the groups. We anticipate making a germplasm release of single genotypes, which presumably have two or three different sources of resistance as indicated by the presence of markers and the reaction of genotypes to FHB in the greenhouse. These genotypes could potentially be of significance to spring wheat breeders because they would have a similar adaptation to Alsen, but putatively carry additional, different sources of FHB resistance.

Project 2: ***Rapid Development of Specialty Spring Wheat Cultivars with FHB Resistance.***

1. What major problem or issue is being resolved and how are you resolving it?

The need to develop and produce specialty HSW cultivars, such as white wheat and wheat with unique starch and protein characteristics, has intensified with the maturation of domestic and international markets and with the activity of competitors to U.S. spring wheat in those markets. Over the period from 1998 to 2000, losses due to FHB were estimated in the billions of dollars in the U.S. spring wheat region, and each year a producer risks experiencing substantial crop losses due to FHB. Therefore, to grow specialty HSW cultivars without this high risk of damage and loss, spring wheat producers require a significant level of genetic resistance to FHB. Presently, no specialty spring wheat cultivars with a significant level of resistance to FHB are available to growers in the U.S. Northern Plains.

The goal of our project is to hasten the development of FHB resistant specialty wheat cultivars for the U.S. Northern Plains. We have approached this problem by seeking to develop specialty spring wheat cultivars with diverse sources of resistance to FHB as quickly as possible. After hybridizing resistant germplasm with specialty wheat lines, we have been using doubled-haploid (DH) production and an off-season nursery within a traditional breeding scheme to rapidly develop specialty wheat lines, which are evaluated for FHB resistance under field conditions. Lines developed from this rapid breeding methodology were included and tested in preliminary and advanced yield trial nurseries for the FY2004 reporting period. Sources of FHB resistance used include the Type II resistance of 'Sumai-3', derived from the adapted HSW cultivar 'Alsen'; the Type II resistance of *Triticum dicoccoides*; and the Type I/III/IV resistance derived from the HSW cultivar 'Frontana'. To avoid problems in initial crosses related to abnormal chromosome segregation, the *Triticum dicoccoides* source of resistance was first transferred and incorporated into synthetic hexaploids. Also, a reciprocal backcross monosomic method was used to identify the critical chromosome lines of Frontana which conferred resistance to FHB. The identified lines have been used in crosses with specialty wheats to attempt to transfer this source of resistance.

2. What were the most significant accomplishments?

The development of the synthetic hexaploid lines with the *Triticum dicoccoides* source of resistance, and the identification of critical chromosome lines from Frontana, which are involved in conferring FHB resistance, are significant accomplishments. The FHB reaction of the synthetics under greenhouse conditions was tested, and the results published in a peer-reviewed journal article. Four synthetics with the *Triticum dicoccoides* source of resistance were released as germplasm.

We have been using Alsen derived lines, the synthetics, and critical Frontana lines in crosses with specialty wheat lines. Production of doubled haploid lines and use of an off-season nursery has enabled us to advance as many as seven potential FHB resistant lines to preliminary and advanced yield trial nurseries in our specialty wheat breeding program. The synthetic hexaploid lines were released as germplasm so that other hexaploid wheat breeding programs could utilize the *Triticum dicoccoides* source of resistance in direct hybridizations without experiencing abnormal chromosome segregation.

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

(2004) **Berzonsky, W.A**., K.D. Hartel, S.F. Kianian, and G.D. Leach. 2004. Registration of four synthetic hexaploid wheat germplasm lines with resistance to fusarium head blight. Crop Sci. 44:1500-1501.

(2004) Hartel, K.D., **W.A. Berzonsky**, S.F. Kianian, and S. Ali. 2004. Expression of a *Triticum turgidum* L. var *dicoccoides* source of Fusarium head blight resistance transferred to synthetic hexaploid wheat. Plant Breed. 123:516-519.

(2004) Gebhard, B., **W.A. Berzonsky**, S. Ali, and G. Leach. Backcross Reciprocal Monosomic Analysis of Fusarium Head Blight Resistance in Frontana Wheat (*Triticum aestivum* L.). Poster Presentation, Second International Symposium on Fusarium Head Blight incorporating the 8th European Seminar, Dec. 2004, Orlando, FL.