USDA-ARS / USWBSI
FY03 Final Performance Report (approx. May 03 – April 04)
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Cover Page

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Year:	**FY2003 (approx. May 03 – April 04)**
FY03 ARS Agreement ID:	**59-0790-9-028**
FY03 ARS Agreement Title:	**Rapid Development of Specialty Spring Wheat Germplasm and Cultivars with Diverse Sources of FHB Resisance.**
FY03 ARS Award Amount:	**$ 48,505**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
VDUN	Rapid Development of Specialty Spring Wheat Germplasm and Cultivars with Diverse Sources of FHB Resistance.	$ 48,505
	Total Amount Recommended	**$ 48,505**

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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: ***Rapid Development of Specialty Spring Wheat Germplasm and Cultivars with Diverse Sources of FHB Resistance.***

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

Producers continue to express interest in possible alternatives to U.S. hard red spring (HRS) wheat (*Triticum aestivum* L.), which is traditionally produced primarily for a pan bread end-use market. Because of price incentives tied to production and new export opportunities, spring wheat producers are interested in servicing specialty or alternative end-use markets. However, specialty spring wheat germplasm lacks a high level of resistance to FHB, and for U.S. producers to economically grow specialty spring wheats, they require varieties having some level of resistance. Spring wheat breeders can also benefit by having new sources of FHB resistance available to them and by having them available in a form whereby direct hybridizations can be made to hexaploid wheat to transfer new sources of resistance.

We have been working to transfer host plant FHB resistance to specialty spring wheats from adapted spring wheats with the 'Sumai 3' source of resistance and from *Triticum dicoccoides* and 'Frontana' sources of resistance to diversify existing specialty wheat FHB resistance. To extend host plant resistance, we have also been combining these sources of resistance into single specialty wheat germplasm lines. Our approach to transferring the 'Sumai 3' resistance has been to hybridize specialty spring wheats with adapted North Dakota spring wheats expressing type II resistance, such as 'Alsen', and to rapidly produce doubled-haploid (DH) lines for testing in advanced nurseries. Our approach to transferring the *Triticum dicoccoides* resistance has been to first produce synthetic hexaploids from 'Langdon' durum substitution lines expressing the resistance, test the expression of resistance in the synthetics, and directly hybridize the synthetics to specialty spring wheat germplasm. We have produced the synthetics, screened them for resistance, and backcrossed the synthetic lines to 'Alsen' to select for the presence of both sources of resistance using molecular markers associated with the 'Sumai 3' and *Triticum dicoccoides* FHB quantitative trait loci (QTL).

Reciprocal disomic lines have been produced by hybridizing 'Frontana' wheat, reportedly with a type I source of FHB resistance, to 'Chris' monosomics. On average, lines should have a similar genetic background but differ in having a critical chromosome from either 'Frontana' or 'Chris'. Disomic lines are being screened for resistance to FHB to determine which critical chromosome(s) of 'Frontana' carries FHB resistance. The most resistant lines will be hybridized to the 'Alsen' backcross progeny to pyramid this source of resistance as well.

2. What were the most significant accomplishments?

We continued the rapid development of specialty spring wheats with diverse sources of FHB resistance. Hybrids were produced between 'Alsen', ND2710, ND2829, ND2831, and ND2891, all with the 'Sumai 3' source of FHB resistance, and white-kernel spring wheats, high grain protein spring wheats, and waxy spring wheats. These hybrids, representing two-way and three-way crosses were pollinated with maize to produce haploid plants, and the haploids were subsequently chemically doubled to produce seed, which was increased in an off-season nursery in New Zealand. In 2003, several of these putative FHB resistance DH lines were grown in statewide advanced yield trials to determine their agronomic adaptation to North Dakota. One DH line (NDSW0345) is especially promising since it has a white kernel color, resistance to the wheat stem sawfly, and it exhibited FHB resistance due to its Alsen source of resistance. It is entered in the 2004 Uniform Regional Yield Trial, the 2004 Regional Scab Nursery, and the 2004 ND statewide yield trials to obtain additional agronomic performance data.

Four wheat synthetic hexaploids were produced in an attempt to transfer a QTL, *Qfhs.ndsu-3AS,* expressing FHB resistance from *Triticum turgidum* L. var. *dicoccoides* to a hexaploid genetic background. The synthetics were produced by hybridizing a 'Langdon' durum wheat 3A *Triticum dicoccoides* chromosome substitution line [LDN(Dic-3A)]-32 containing the QTL to two accessions of *Triticum tauschii* (2n=2x=14, DD). To combine resistances, synthetic x 'Alsen' backcross-derived lines were also produced, and molecular markers were employed to try and confirm presence of both QTL. The *Xgwm2* marker for the *T. dicoccoides* source of FHB resistance and *Xgwm533*, a microsatellite marker linked to the 'Sumai 3' source of FHB resistance in 'Alsen' were successfully employed to confirm the possible existence of both loci in the 'Alsen' backcross-derived lines. Presently, four backcrosses have been made to 'Alsen', and lines have been pollinated with maize to produce DH lines. Both markers will be used to determine if these DH lines possibly have one or both sources of resistance, and if having both sources of resistance confers a higher level of resistance compared with having only a single QTL. A *Plant Breeding* article was published to describe the results of screening the synthetic hexaploids for resistance to FHB, and a *Crop Science* germplasm release was made for the synthetic lines so that they would be available to other regional spring wheat breeders.

Production of a set of reciprocal disomic lines has been completed. These lines were produced by hybridizing 'Frontana' as male and female to a set of 'Chris' monosomic lines and by selecting and selfing the resulting 41-chromosome plants . After selecting 42-chromosome plants for each cross, the final reciprocal disomic chromosome lines have similar genetic backgrounds, but they differ in having either a critical chromosome from 'Frontana' or a critical chromosome from 'Chris'. Since 'Frontana' is thought to express a type I resistance to FHB, we are attempting to identify which chromosome(s) of 'Frontana' carries a gene for resistance. Lines identified as expressing resistance will be crossed to the 'Alsen' backcross lines to combine this source of resistance with that from 'Sumai 3' and *Trititicum dicoccoides*. All reciprocal disomic lines were planted in a spring field experiment in 2004, and in a similar greenhouse experiment this spring. They will be evaluated for their reaction to FHB, and the results will be reported at the International FHB Forum in December.

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

Publications

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.

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. (*in press*).

Presentations

Gonzalez Hernandez, J.L., A. del Blanco, S. Ali, W.A. Berzonsky, and S.F. Kianian. 2003. Wangshuibai: A hexaploid wheat resistant to the spread of fusarium head blight. Poster Presentation, National Fusarium Head Blight Forum, Minneapolis, MN (Dec. 13-15).