USDA-ARS / USWBSI
FY03 Final Performance Report (approx. May 03 – April 04)
July 15, 2004

Cover Page

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Year:	**FY2003 (approx. May 03 – April 04)**
FY03 ARS Agreement ID:	**59-0790-9-043**
FY03 ARS Agreement Title:	**An Integrated Approach for Developing Scab Resistant Barley.**
FY03 ARS Award Amount:	**$ 103,649**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
VDUN	Accelerated Development of Scab Resistant Barley Varieties.	$ 84,390
VDUN	Evaluation of barley germplasm resistance to Fusarium head blight resistance in an off-season nursery in China.	$ 19,259
	Total Amount Recommended	**$ 103,649**

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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

(Form – FPR03)

Project 1: ***Accelerated Development of Scab Resistant Barley Varieties.***

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

Fusarium head blight (FHB), primarily incited by *Fusarium graminearum*, adversely affected the quality of barley grown in eastern North Dakota and northwestern Minnesota the last 11 years. Quality of harvested grain was reduced because of blighted kernels and the presence of deoxynivalenol (DON), a mycotoxin produced by the pathogen. Seeding resistant cultivars is the only promising method of controlling FHB in barley because cultural and chemical controls of FHB have been unsuccessful. Introduced barley cultivars grown in field nurseries in China and North Dakota from 1994 to 2001 were identified with putative FHB resistance. My breeding program is incorporating FHB resistance from several of these sources into elite malting barley germplasm. Production of doubled-haploid (DH) lines and development of markers for molecular marker assisted selection are being used to accelerate development of FHB resistant cultivars.

2. What were the most significant accomplishments?

Five breeding lines (ND204773, ND20493, ND20508, ND20542, and ND20547) have been identified that have 25-75% less DON than Robust. Heading date and plant height of these experimental lines are similar to that of Robust. Malt quality of ND20508 and ND20547 is approaching that of Robust.

A better understanding of the critical region of chromosome 2HL controlling FHB resistance and DON accumulation was achieved. The QTL for resistance located in bin 10 must be present in order to have stable FHB resistance across environments. A limiting factor with this QTL is the tight linkage between it and the *hcm1* locus controlling plant height. All resistant plants with the bin QTL are unacceptably tall. Recombinants between the two loci have not been obtained even with F_2 populations of 18,000 plants. Crosses are being made to susceptible semidwarf plants. Our goal is to identify FHB resistant plants with height controlled by the semidwarf genes.

Project 2: ***Evaluation of barley germplasm resistance to Fusarium head blight resistance in an off-season nursery in China.***

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

The ultimate goal of this project is to develop malting barley cultivars resistant to Fusarium head blight. Breeding materials from three upper Midwest barley improvement programs and the ICARDA/CIMMYT barley breeding program were screened in an off-season nursery at Zhejiang University – Hangzhou, China. This nursery has been used for screening upper Midwest barley germplasm since 1995 and about 3,500 entries are screened each year. Materials included in the 2003-04 nursery were breeding lines developed at North Dakota State University, mapping populations developed at North Dakota State University and the University of Minnesota, and elite lines from three upper Midwest barley breeding programs and ICARDA/CIMMYT.

The Hangzhou, China nursery allows us to conduct a field screen for FHB resistance where FHB is the only head blighting disease. Head blight caused by bacteria or fungal pathogens such as *Cochliobolus sativum* often confound the results observed in the upper Midwest U.S. Another unique feature about the nursery is that the range in heading date between barley lines with a spring, winter, or facultative growth habit is less than two weeks. Thus, germplasm with all three types of growth habit can be screened in the same nursery. Finally, the "best" germplasm from several different barley-breeding programs is screened at a common location. Thus, the FHB resistance of all elite germplasm can be directly compared, and breeders can identify lines they wish to advance in their programs or obtain from other breeders to use as parents for their next cycle of crossing.

2. What were the most significant accomplishments?

Disease levels were moderate and fairly uniform throughout the nursery. Breeding lines identified with putative FHB resistance in North Dakota the last two growing seasons were confirmed to be resistant in the Hangzhou nursery. Lines from the ICARDA/CIMMYT breeding program were evaluated in the nursery for the second time under a cooperative agreement.

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.

Refereed Publications

Urrea, C.A., R.D. Horsley, B.J. Steffenson, and P.B. Schwarz. 2004. Agronomic characteristics, malt quality, and disease resistance of barley germplasm lines with partial Fusarium head blight resistance. Crop Sci. (accepted).

Dahleen, L.S. , H.A. Agrama, R.D. Horsley, B.J. Steffenson, P.B. Schwarz, A. Mesfin, and J.D. Franckowiak. 2003. Identification of QTLs associated with Fusarium head blight resistance in Zhedar 2 barley. TAG 108:95-104.

Abstracts

Lamb, K.E., and R.D. Horsley. 2003. Heritability, genetic gain, and correlated response of Fusarium head blight and deoxynivalenol accumulation in barley accession C03-3230-24. *In* Agronomy Abstracts. ASA, Madison, WI.

Schwarz, P.B., B.J. Steffenson, R.D. Horsley, J. Barr, and J. Gillespie. 2003. Relationships between Fusarium head blight infection and barley and malt quality. ASBC Newsletter.

Invited Presentations

FHB research results from the NDSU six-rowed barley breeding project. Presentation at Zhejiang University, Hangzhou, China in May 2004.