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:	**59-0790-9-061**
FY03 ARS Agreement Title:	**Breeding and Geneitcs of Fusarium Head Blight Resistance in Barley.**
FY03 ARS Award Amount:	**$ 136,058**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
BIO	Developing marker information for genetic diversity and FHB resistance in barley.	$ 58,290
VDUN	Accelerated Development of Fusarium Resistant Barley Varieties.	$ 77,768
	Total Amount Recommended	**$ 136,058**

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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: ***Developing marker information for genetic diversity and FHB resistance in barley.***

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

Developing malting barley varieties with useful levels of resistance to FHB will require the accumulation of multiple genes from several sources of resistance. Our program is focused on identifying useful genes from diverse sources of resistance using molecular markers and developing strategies to employ marker assisted selection (MAS) to improve FHB resistance. We are using marker and phenotypic data to identify promising sources of resistance, map and validate QTL for FHB, fine map important regions, and test MAS strategies.

2. What were the most significant accomplishments?

Objectives:

1) Continue fine mapping QTL regions identified on chromosome 2H and chromosome 6H in Chevron x M69 mapping population.

We have developed a fine mapping population from a cross between a BC_5 line carrying a Chevron introgression in the target region and the recurrent parent M69 to more precisely locate QTLs for FHB and heading date (HD) that are coincident in BIN 8 of barley chromosome 2H. We have mapped 13 SSR markers in the interval containing the QTL with an average marker interval of 1.3 cM. We evaluated a set of 44 recombinant lines that were informative for the target region in two environments in 2003. A distinct QTL for HD was mapped to a marker interval of 0.2 cM and a peak for less distinct QTL for FHB was mapped 4.7 cM away. Phenotypic data from additional environments in 2004 should help to define the positions of these QTLs. We have developed a fine mapping population for the BIN 6 region of chromosome 6H that contains QTLs for grain protein concentration, kernel discoloration (KD) and FHB. This population is now in the F2 generation and map fine map construction is underway.

2) Develop near-isogenic lines (NILs) for FHB and DON resistance QTL identified in Frederickson x Stander mapping population.

We have developed several sets of NIL for a QTL on chromosome 3H that effects accumulation of DON after point inoculation in greenhouse assays. One pair of NILS have been crossed to develop a fine mapping population for this region.

3) Continue mapping FHB resistance in the Atahualpa x M81 population.

We have nearly finished a linkage map for the mapping population consisting of 85 SSR markers. We evaluated the population in China in 2003/2004 giving us phenotypic data from a total of one greenhouse and four field environments.

4) Construct a high resolution map of the region of chromosome 2 containing the v-locus.

We have constructed a fine mapping population to study the Vrs1 locus and a map of the region containing 7 markers. The population is being evaluated in 2 locations this summer (2004).

Project 2: ***Accelerated Development of Fusarium Resistant Barley Varieties.***

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

Resistant barley varieties will play an important role in the management of FHB. Developing malting barley varieties that are adapted to the Upper Midwest with useful levels of resistance to FHB will require extensive testing for resistance in FHB screening nurseries.

2. What were the most significant accomplishments?

Five expected results were outlined in the proposal.

1) *complete first year screen of ~2000 F5 lines in replicated scab trials in 2 locations*;

We evaluated 1937 F5 lines and selected 152 lines for DON testing, malting quality analysis, and seed increase in New Zealand. Eighty of these lines were sown in preliminary yield trials for 2004.

2) *complete second year screen of ~140 lines in 2 location, 3 rep trials;*

We evaluated 85 lines and selected 5 to be advanced to intermediate yield trials based on disease resistance, agronomic performance and malting quality.

3) *complete third year screen of ~30 lines in 3 location 3 rep trials;*
We evaluated 21 lines and selected 6 to be advanced to advanced yield trials based on disease resistance, agronomic performance and malting quality.

4) use MAS to generate lines with Chevron and Frederickson derived resistance;

We used MAS in three populations that segregated for a Frederickson allele at a QTL for FHB resistance on chromosome 6H. Selected lines (homozygous for the Frederickson allele) will be evaluated along with 20 lines homozygous for the alternative allele (for comparison) in FHB nurseries in the summer of 2004.

5) *identify resistant barley lines that can be used as parents in advanced cycle crosses and identify resistant barley lines with good agronomic and malting quality characteristics that can be designated as variety candidates*

We included 23 elite breeding lines from advanced cycle crosses for our 2003 crossing block. No breeding lines with the complet package of enhanced FHB resistance, good agronomic performance, and satisfactory malting quality were identified as variety candidates this year.

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.

Peer-Reviewed

Canci, P. C., L.M. Nduulu, R. Dill-Macky, G.J. Muehlbauer, D.C. Rasmusson, and K.P. Smith. 2004. Validation of Quantitative Trait Loci for Fusarium Head Blight and Kernel Discoloration Resistance in Barley. Mol. Breeding (in press).

Canci, P. C., L.M. Nduulu, R. Dill-Macky, G.J. Muehlbauer, D.C. Rasmusson, and K.P. Smith. 2003. Genetic relationship between kernel discoloration and grain protein concentration in barley. Crop Sci. 43: 1671-1679.

Mesfin, A., K.P. Smith, R. Dill-Macky, C.K. Evans, R. Waugh, C.D. Gustus, and G.J. Muehlbauer. 2003. Quantitative Trait Loci for Fusarium Head Blight Resistance in Barley Detected in a Two-Rowed by Six-Rowed Population. Crop Sci. 43:307-318.

Smith, K. P., C. K. Evans, R. Dill-Macky, C. Gustus, W. Xie , and Y. Dong. 2004. Host genetic effect on deoxynivalenol accumulation in Fusarium head blight of barley. Phytopathology (in press).

Wingbermuehle, W. J., Gustus, C., and Smith, K. P. Exploiting selective genotyping to study genetic diversity of resistance to Fusarium head blight in barley. 2004. Theor. Appl. Genet. 94:766-771.

Abstracts/Proceedings/Non-Peer Reviewed

Baluch, S. D., Muehlbauer, G. J., Smith, K. P., Somers, D. A., and Steffenson, B. J. 2004. Fine mapping the CRS1 region of chromosome 2(2H) of barley and analyzing a set of NILS for the VRS1 region for FHB severity. In: *Proceedings of the International Triticeae Mapping Initiative 2004 Summer Workshop. Minneapolis, MN May 22-25, 2004.*

Nduulu, L. M., Mesfin, A., Muehlbauer, G. J., Smith, K. P. 2003. Fine mapping of Fusarium Head Blight Resistance and Heading Date QTL in Barley. In: *Proceedings of the 2003 National Fusarium Head Blight Forum*. Minneapolis, MN 12/13/03 - 12/15/03

Sallam, A. H. and Smith, K. P. 2003. Investigating the Genetics of Resistance to FHB in Six-rowed, Hulless Barley Accession HOR211. In: *Proceedings of the 2003 National Fusarium Head Blight Forum*. Minneapolis, MN 12/13/03 - 12/15/03

Smith, K. P. 2003. The Fusarium head blight experience: research update from the US Wheat and Barley Scab Initiative. In *Proceedings of the 34th Barley Improvement Conference*. San Francisco, CA., Jan. 7-9, 2003, p. 7.

Smith, K.P. 2003. Assessing the genetic diversity of FHB resistance in barley using molecular markers. In: *Proceedings of the 2003 National Fusarium Head Blight Forum*. Minneapolis, MN 12/13/03 - 12/15/03

Smith, K.P, Nduulu, L., Gustus, C., Sallam, A., and Beaubien, K.. 2004. QTL mapping Fusarium head blight resistance in barley. In *Proceedings of the 9th International Barley Genetics Symposium*, Brno, Czech Republic, June 20-26, 2004, p. 884-889.

Steffenson, B. J. and Smith, K. P. 2004. Breeding barley for multiple disease resistance in the Upper Midwest region of the USA. In *Proceedings of the 9th International Barley Genetics Symposium*, Brno, Czech Republic, June 20-26, 2004, p. 294-301.