USDA-ARS / USWBSI
FY04 Final Performance Report
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Cover Page

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Year:	**FY2004** (approx. May 04 – April 05)
FY04 ARS Agreement ID:	**59-0790-4-109**
FY04 ARS Agreement Title:	**Development of Markers Linked to FHB Resistance in Durum and Hexaploid Wheat.**
FY04 ARS Award Amount:	**$ 96,803**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
BIO	Development of Markers Linked to FHB Resistance in Hexaploid Wheat.	$ 63,678
BIO	Development of Markers Linked to FHB Resistance in Durum Wheat.	$ 33,125
	Total ARS Award Amount	**$ 96,803**

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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: ***Development of Markers Linked to FHB Resistance in Hexaploid Wheat.***

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

The ultimate goal of this project is to identify and develop breeder friendly markers to improve germplasm development as well as reduce the time needed to variety release in hexaploid wheat. Specific objectives of this current project are to: 1) identify QTL region(s) for FHB resistance in ND671/Wangshuibai RIL population; 2) analyze early generation lines derived from cltr9445, a Chinese source of resistance, for the presence of important FHB QTL regions; and 3) identify chromosomal regions introgressed into HRS wheat associate with FHB resistance derived from two *Triticum dicoccoides* accessions (PI478472 and PI48121).

2. What were the most significant accomplishments?

The ND671/Wangshuibai RIL population has now been mapped and analyzed. The results clearly indicate a major QTL on 3BS explaining 31% of phenotypic variation at 21 days after inoculation. This locus exhibited strong epistatic interactions with other loci on chromosome 3A, 5A, 6B and 7B. Individually these later loci were not significant. The results of this work has been submitted for publication.

With regard to the second objective the most challenging issue was to work with such large population as the on required in our first objective to analyze the genetics of the resistance to FHB in cItr9445. We did finish all phenotypic evaluations for the F3s and the F4s generations (500 and 600 plants respectively). We also finished all DNA extractions for all samples (1100 total), as well as quantification. Up to this date we have run 50+ markers through the genome in the F3 generation. The goal is to place 4-5 markers/chromosome. This phase will be finished by this fall. The second phase will make use of the information obtained in the F3 generation to generate in the F4 generation, a more detailed location of the gene/s responsible for the FHB resistance in cItr9445. The other challenge is the proper statistical analysis of data. We are weighting several options, from an ANOVA on a family basis to multivariate methods such discriminant analysis. The use of software developed from human genetics has additional complications due to different familiar composition in human and plant genetics.

With regard to the third objective phenotypic evaluations in the greenhouse for the lines used to study resistance derived from two *Triticum dicoccoides* accessions (PI478472 and PI48121) is now complete. We plan to evaluate these lines an additional season in the field FHB nursery. All DNA samples from these lines have been extracted and molecular marker analysis is now in progress.

Impact: Advanced lines carrying FHB resistance from Wangshuibai and associated molecular marker information are now available. These can be used by any breeding program to quickly develop resistant cultivars for the growers. Characterization of other sources of resistance by association mapping studies is in progress. At the conclusion of this work we expect to have similar information for many more sources of FHB resistance. The impact of this study will be to change how genetic analysis is performed and the speed by which the results can be applied.

Project 2: ***Development of Markers Linked to FHB Resistance in Durum Wheat.***

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

The ultimate goal of this project is to develop "breeder friendly" markers for FHB resistance in durum wheat to help accelerate the process of germplasm development and time to variety release. Specific objectives of the project are to 1) identify markers closely linked to FHB resistance loci; 2) develop a PCR-based marker system for screening large populations segregating for FHB; and 3) demonstrate the utility of these markers in populations developed by various breeding programs.

2. What were the most significant accomplishments?

To identify markers closely linked to FHB resistance loci we have been characterizing a number of populations and backcross derived material for introgression of valuable loci. Through this introgression we will not only be able to validate the effectiveness of various markers for FHB resistance selection but will also be able to identify and test the validity of any new markers being developed as part of various QTL analysis studies in this selection process. In this regard introgression of Sumai 3 resistance into elite durum backgrounds is continuing. A number of BC_3F_1 seeds have been harvested from various crosses carrying the markers linked to the 3BS QTL. They will now be used for advancement to BC_4F_1. Over 200 advanced BC_1F_6 lines containing the Sumai 3 resistance that have been repeatedly selected for disease and agronomic performance are now being evaluated in replicated field trials for possible release. We continually screen these material for FHB resistance through disease inoculation as well as marker selection. We have also been introgressing the 3AS FHB resistance QTL from *Triticum dicoccoides* into various durum backgrounds. We now have a number of lines in the BC_5F_2 stage that have been selected by both marker and disease inoculation. These materials are being advanced through selfing for increase in the winter nursery and then replicated field evaluation.

Continuing on the same objective of introgressing valuable loci, we have been evaluating the potential of Wangshuibai as a source of resistance in durum wheat. For this a recombinant inbred line population (F_6 derived) of 140 individuals from a cross of elite durum breeding line to Wangshuibai has been evaluated in two greenhouse seasons. DNA has been extracted and the markers identified in the hexaploid population (described in the first objective of hexaploid wheat progress report) are being used to screen these lines. This will allow us to study the introgression of valuable QTLs from Wangshuibai as well as any epistatic interactions detected in a hexaploid background in a tetraploid background. Analysis clearly indicate the presence of a major QTL on 3BS. This region has now been successfully transferred to durum wheat. No epistatic interactions observed in hexaploid wheat were detected in this population.

We continually screen new markers (i.e. EST derived primers or new microsatellite markers) for their use in our various introgression and mapping studies. These markers are first screened for their linkage relationship to the important FHB resistance regions. Then they are evaluated for their ease of application in a marker assisted selection scheme. This process will test the utility of these markers for screening large populations and their value in a breeding program designed for development of FHB resistance durum wheat.

Impact: A number of advanced durum lines with good tolerance to FHB have been developed and are being evaluated in replicated trials. These lines will be released to growers in the regions most affected by this disease helping alievate the associated yield losses and other problems.

Markers used in screening these lines are also available to the scientific community and can be used for similar introgressions in other wheat backgrounds.

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.

Gonzalez-Hernandez JL, del Blanco A, Ali S, Berzonsky WA, and Kianian SF. Genetics of the resistance to Fusarium head blight in the hexaploid wheat Wangshuibai: The role of epistatic interactions. Presented at the 2nd International Symposium on Fusarium Head Blight. 11-15 December 2004, Orlando Florida.

Chen X, Hu J, Kianian SF, and Cai X. Saturation mapping of the FHB resistance QTL *Qfhs.ndsu-3A* in tetraploid wheat. Presented at the 2nd International Symposium on Fusarium Head Blight. 11-15 December 2004, Orlando Florida.