

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: | 59-0790-9-038 |
| FY03 ARS Agreement Title: | Breeding and Marker Assisted Selection for Fusarium Head Blight Resistance in Wheat. |
| FY03 ARS Award Amount: | \$ 118,049 |

USWBSI Individual Project(s)

| USWBSI Research Area* | Project Title | ARS Adjusted Award Amount |
|------------------------------|--|----------------------------------|
| BIO | Development & Evaluation of FHB Resistant Near-isogenic Lines using Marker Assisted Selection. | \$ 51,220 |
| VDUN | Selective Breeding for Scab Resistance in Soft Red Winter Wheat. | \$ 66,829 |
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| | Total Amount Recommended | \$ 118,049 |

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 & Evaluation of FHB Resistant Near-isogenic Lines using Marker Assisted Selection.*

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

The project goals are to develop and evaluate near-isogenic lines of soft red winter (SRW) wheat carrying favorable alleles at three quantitative trait loci (QTL) from W14 and Futai8944 conferring resistance to FHB, and to discern the contribution and interaction of these QTLs in two SRW wheat backgrounds, Ernie and Roane. These goals are being achieved by molecular marker assisted backcrossing. Two donor parents W14 and Futai 8944 were crossed with two recurrent parents Roane and Ernie, respectively, and four BC₄F₁ populations were ultimately obtained via single floret inoculation in greenhouse during each cycle. The BC₄F₁ to BC₄F_{2:3} individuals were evaluated simultaneously for scab resistance in greenhouse tests and for marker composition at three identified QTLs. The homozygous BC₄F_{2:3} NILs were also simultaneously evaluated in an inoculated field nursery for FHB resistance and agronomic similarity to their respective recurrent parent. Three greenhouse experiments were conducted from June, 2003 to May 2004. A total of 1550 plants including 155 BC₄F₁, 645 BC₄F₂ and 750 BC₄F_{2:3} individuals were evaluated for type II resistance and genotyped for the SSR markers previously identified at three QTLs on chromosomes 2BS, 3BS and 5AL in W14. In addition, the 110 BC₄F_{2:3} NIL selections were evaluated for FHB resistance in two replicated tests in Blacksburg.

2. What were the most significant accomplishments?

Near-isogenic lines of soft red winter wheat conferring resistance to FHB derived from Chinese wheat lines W14 and Futai8944 at three quantitative trait loci are being developed in SRW wheat backgrounds Ernie and Roane, which have moderate FHB resistance. These NILs include all SSR allele combinations of the three QTLs: Six SSR loci on 3BS (Barc75, Xgwm533A, B, C, Barc133, Xgwm493), three SSR loci on 5AL (Barc100, Xgwm156, and Barc186), and one SSR locus (Barc91) on 2BS. Epistatic interactions between Xgwm533A, B and Barc186, Xgwm533C and B91, previously identified in W14 mapping populations, were further confirmed in the BC₄F_{2:3} populations. NILs developed from this study will provide wheat breeders and molecular biologists with unique genetic stocks and associated molecular markers facilitating marker assisted selection, pyramiding of FHB resistance genes, and the capability of cloning scab resistance genes. Some of these NILs may have potential for release as cultivars following field testing.

Project 2: *Selective Breeding for Scab Resistance in Soft Red Winter Wheat.*

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

The project goal is to accelerate development of adapted and commercially viable scab-resistant SRW wheat varieties by identifying and incorporating diverse sources of type-II resistance into elite genotypes. This goal is being achieved by: 1) identifying and selecting scab-resistant wheat lines derived via traditional and accelerated breeding methods from crosses among adapted and non-adapted lines possessing diverse types of resistance; 2) evaluating backcross progeny for scab resistance, marker composition, and resemblance to respective recurrent parents and; 3) evaluating newly developed scab-resistant and/or scab-tolerant wheat lines for effectiveness of scab resistance in inoculated mist-irrigated field nurseries and for other important agronomic traits via multi-location and multi-year testing.

2. What were the most significant accomplishments?

The project goal is being achieved successfully by identifying and incorporating diverse sources of resistance into elite genotypes using traditional, backcross, doubled haploid and marker assisted breeding methods. This spring, 268 advanced wheat lines were evaluated at Blacksburg, VA in a replicated scab assessment test and in non-replicated observation yield tests at Warsaw and Blacksburg, VA. These lines include 115 derived via traditional crossing and/or topcrossing, 123 backcross derived lines, and 30 doubled haploid lines. These lines were derived from diverse types of crosses between many non-adapted type II scab resistance sources (ChangJiang8809, Er-Mai9, Futai8944, Futai9002, Ning7840, Ning9016, Saikai165, Shaan85, VR95B717, W14, Wuhan1, Yan-Ahi9, Yangmai6 and Yumai7) with adapted SRW wheat varieties or lines such as Madison, Jackson, Pioneer 2684, Ernie, Freedom, Roane, McCormick, Renwood 3260, Sisson sib, Agripro Mason, and GA891283LE18. Among the 268 advanced lines, 90 have expressed good scab resistance, and 32 of these lines also are agronomically desirable and have good potential for release as cultivars. In addition, 19 scab resistant experimental wheat lines were tested in preliminary yield trials and six lines were tested in advanced yield trials at three locations in Virginia. Ten Virginia experimental lines were evaluated for scab resistance in the Uniform Northern or Southern FHB Regional Wheat Screening Nurseries. At Warsaw, 6,500 headrows were evaluated for agronomic traits and resistance to other prevalent diseases, and 150 segregating populations developed for incorporating and combining Type II and other types of scab resistance into SRW wheat backgrounds were evaluated in an irrigated scab nursery at Mt. Holly, VA. One hundred new crosses were made to incorporate scab resistance into superior SRW backgrounds. Three greenhouse experiments were conducted from June 2003 to May 2004. A total of 1794 plants were evaluated for type II resistance, including 399 plants of 133 advanced lines (entries in the Northern and Southern Uniform FHB Nurseries plus parental lines), 645 BC₄F₂ and 750 BC₄F_{2:3} individuals of two elite backgrounds. The BC₄F_{2:3} individuals were also characterized for molecular markers associated with scab resistance.

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.

Chen, J., R.M. Biyashev, C.A. Griffey, and M.A. Saghai Maroof. 2003. QTL mapping of Fusarium head blight resistance in wheat. pp. 593. In: Proc. of 1st Central Asian Wheat Conference. June 10-13, 2003. Almaty, Kazakhstan.

Chen, J., C.A. Griffey, J.A. Wilson and M.A. Saghai Maroof. 2003. QTL mapping and marker assisted selection for Fusarium head blight resistance in a Chinese wheat line W14. pp. 342-345. In: Proc. of 10th International Wheat Genetics Symposium. Sept. 1-6, 2003. Paestum, Italy.

Chen, J., C.A. Griffey, M.A. Saghai Maroof, J.A. Wilson, D. Nabati, and R.M. Biyashev. 2003. Molecular mapping and marker assisted selection for Fusarium head blight resistance in a Chinese wheat line W14. Invited oral presentation. pp. 7-9. In: 2003 National Fusarium Head Blight Forum Proceedings. Dec. 13-15, 2003. Bloomington, MN, USA.

Wilson, J.A., C.A. Griffey, J. Chen, D. Nabati, and T. Pridgen. 2003. Success of alternative breeding methods in transferring Fusarium head blight resistance to soft red winter wheat. pp. 295-299. In: 2003 National Fusarium Head Blight Forum Proceedings. Dec. 13-15, 2003. Bloomington, MN, USA.