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:	**59-0790-0-F076**
FY03 ARS Agreement Title:	**Facilitating international bread wheat, duruam wheat and barley exchange through CIMMYT.**
FY03 ARS Award Amount:	**$ 127,805**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
GIE	Facilitate international spring and winter bread wheat germplasm and information exchange through CIMMYT.	$ 92,683
GIE	Facilitate international spring durum wheat germplasm and information exchange through CIMMYT.	$ 17,561
GIE	Facilitate international spring barley germplasm and information exchange through CIMMYT.	$ 17,561
	Total Amount Recommended	**$ 127,805**

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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: ***Facilitate international spring and winter bread wheat germplasm and information exchange through CIMMYT.***

1. What major problem or issue is being resolved and how are you resolving it?
The overall goal of this collaboration is to increase genetic resistance to Fusarium Head Blight (FHB) as quickly as possible in commercially grown USA bread wheat varieties and thus significantly increase the production and yield stability of wheat in the United States of America.

Specifically, the objectives of the project are:

- To provide agronomically suitable FHB resistant germplasm to USWBSI collaborators through pre-breeding activities using synthetic wheats and major USA cultivars;
- To conduct a world-wide search for and acquisition of suitable FHB resistant germplasm and to make this available to the US Wheat and Barley Scab Initiative;
- To test germplasm at FHB hot-spot(s) in Mexico and through the CIMMYT International Wheat Improvement Network.

Researchers at CIMMYT are working on incorporating genetic resistance for FHB into commercially grown bread wheat varieties; specifically identifying and combining resistant types I (penetration), II (spread), III (low toxin content) and IV (tolerance, good grain filling in the presence of the disease). Sources of resistance from genetic sources have been identified in Brazil, Japan, Argentina, China and Romania, Ukraine, South Korea and Uruguay. These are acquired and then evaluated by CIMMYT in Mexico, China and Uruguay. Resulting data and resistant germplasm are shared with the USWBSI. Additional promising sources of Type II resistance have been identified in synthetic wheats.

The best sources of FHB resistance have been crossed with USA bread wheat parents and the most promising F6 germplasm will be shipped to USWBSI contacts. Web-access of global International Wheat Improvement Network data is anticipated during this project year.

The project aims to develop as quickly as possible, FHB resistant germplasm that will minimize the threat of Fusarium head blight to the producers, processors and consumers of bread wheat.

2. What were the most significant accomplishments?

- We marked and artificially hand-inoculated 10 spikes each of 434 spring bread wheat entries to evaluate for Type I resistance, and 10 spikes each of 3469 bread wheat entries for Type II resistance. A total of 334 resistant lines were selected. Of these, 186 were sent to Anne McKendry, and the remainder will be sent by the end of this year. Most introductions were from outside Mexico. Upon request entry files were shared with Yue Jin.
- Initially, 170 F5-F7 lines from backcrosses to five US varieties (Ivan, Reader, Russ, Verde, and Wheaton), exploiting synthetic hexaploid resistance were sent to Mohammed Mergoum. Later this year an additional 16 were sent. Upon request entry files were shared with Yue Jin.
- During the 2003-2004 winter cycle, we planted more than 2000 winter wheat entries, mostly from outside Mexico, for Type II resistance screening. Approximately 50% of the entries have been evaluated up to the present day, with work in full swing. About 10% of the entries are expressing high levels of resistance. These will be sent to the USWBSI.
- Of 96 CIMMYT-derived entries sent to the USWBSI screened with 9 markers by Manilal William and Tomohiro Ban at CIMMYT, 30% contained possible novel resistance loci not derived from Sumai3.
- So far, 36 of 1000 synthetic hexaploid wheats (D genome donor *Aegilops tauschii*) produced and screened have shown promise for Type II resistance (10-12% infection), equal or better than Sumai3; 15 of the 36 showed multiple stress resistance to various diseases. Diversity analysis using D genome microsatellites indicated that these lines have a high level of polymorphism. Advanced free-threshing synthetic derivatives with superior Type II resistance were identified.
- Currently, 171 DH lines from synthetic hexaploid wheat by susceptible crosses are being analyzed in CIMMYT and Michigan. In addition, another 11 DH populations involving novel resistance will be completed in late 2004.
- Amphiploids from crosses involving *Thinopyrum bessarabicum* and *Th. elongatum* contain Type II resistant equivalent to Sumai3. Addition lines with *Th. bessarabicum* indicated that this resistance is located on more than one chromosome. Using the recessive *ph1* locus, combined with haploidy and PCR diagnostic markers, homoeologous or non-homoeologous translocation derivatives were obtained. These translocation stocks are being introgressed into elite spring wheat backgrounds.
- Amphiploids involving *Th. elongatum* with bread wheat express Type II resistance, and are also being manipulated using the DH and *ph1* approaches.
- Toxin data was obtained on entries planted in Uruguay and China, with the latter shared with USWBSI. We identified materials with very low levels as candidates for crossing.
- A total of 5074 entries from diverse origins are presently planted in Toluca for FHB evaluation, including a core set of 500 landraces from 53 countries around the world.
- The best seven Triticales were crossed to Sumai3. Following another backcross, we will be applying the markers for the 3BS resistance to the segregating populations.
- All data means (including that on FHB response) for all of CIMMYT's international nurseries and yield trials are now available on the following CIMMYT websites
    - IWIN: http://www.cimmyt.org/english/webp/research/wheat/iwin/index.htm
    - Data download: http://www.cimmyt.org/wpgd/index.htm.
    - Fieldbook (in Excel): http://www.cimmyt.org/iwin/index.htm.

Project 2: ***Facilitate international spring durum wheat germplasm and information exchange through CIMMYT.***

1. What major problem or issue is being resolved and how are you resolving it?
The overall goal of this collaboration is to increase genetic resistance to Fusarium Head Blight (FHB) as quickly as possible in commercially grown USA durum wheat varieties and thus significantly increase the production and yield stability of durum wheat in the United States of America.

Specifically, the objectives of the project are:

- To provide agronomically suitable FHB resistant germplasm to USA collaborators through pre-breeding activities using synthetic introgression wheat stocks, elite lines and major USA cultivars;
- To conduct a world-wide search for and acquisition of suitable FHB resistant germplasm and to make this available to the US Wheat and Barley Scab Initiative; and,
- To test germplasm through the CIMMYT International Wheat Improvement Network.

Researchers at CIMMYT are working on incorporating genetic resistance for FHB into commercially grown durum wheat varieties. Sources of resistance from genetic sources are limited, but have been identified in CIMMYT main-stream breeding lines. Wide crosses will be used in which the D genome resistance of *Ae. tauschii* accessions will be transferred into the durum A genome. The most promising materials will be shipped to USWBSI contacts.

The project aims to develop as quickly as possible, FHB resistant germplasm that will minimize the threat of Fusarium head blight to the producers, processors and consumers of wheat.

2. What were the most significant accomplishments?

- We marked and artificially hand-inoculated 10 spikes each of 179 spring durum wheat entries for evaluating Type I and II resistance. The best 14 were sent to Elias Elias. Upon request entry files were shared with Yue Jin.
- We have made crosses of Sumai3 to these best 14 durum wheats. Following another backcross we will be applying the markers for the 3BS resistance to the segregating populations.
- *Th. Elongatum*, a diploid species of this pool, is also an excellent source for FHB resistance. We are continuing to produce the alien addition lines in a durum wheat background using doubled haploid production as a strategy to overcome the complexity of producing disomic additions via normal conventional procedures. Amphiploids of this species with durum wheat are Type II resistant (10-12%).
- Efforts have continued on the screening of the A and B genome hexaploids, but the level of resistance seen in these stocks is disappointing (Type II resistance is between 15-18% across only a few accessions). We have produced and screened 194 A genome hexaploids and 54 B genome hexaploids.
- It appears that a more appropriate strategy would be to introgress the D genome resistance for FHB into the durum wheats; a strategy that has some supporting cytogenetic evidence of preferential homoeologous pairing but needs further investigation before execution.

Project 3: ***Facilitate international spring barley germplasm and information exchange through CIMMYT.***

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

The overall goal of this collaboration is to increase genetic resistance to Fusarium Head Blight (FHB) as quickly as possible in commercially grown USA barley varieties and thus significantly increase the production and yield stability of barley in the United States of America.

Specifically, the objectives of the project are:

- To provide agronomically suitable FHB resistant germplasm to US collaborators through pre-breeding activities using major USA cultivars;
- To conduct a world-wide search for and acquisition of suitable FHB resistant germplasm and to make this available to the US Wheat and Barley Scab Initiative; and
- To test USA germplasm at CIMMYT-Toluca field station and/or through the CIMMYT International Wheat Improvement Network.

Researchers at CIMMYT are working on incorporating genetic resistance for FHB into commercially grown varieties; specifically identifying and combining resistant types I (penetration), II (spread), III (low toxin content) and IV (tolerance, good grain fill in the presence of the disease). Sources of resistance from genetic sources have been identified in Brazil, Japan, Argentina, China, Korea and Uruguay. These will be evaluated by CIMMYT in Mexico, China and Uruguay and included in the breeding programs. The best sources of FHB resistance have been crossed with US parents and segregating populations are being screened for other foliar diseases in Toluca, Mexico. The most promising materials are shipped to our USWBSI contacts.

The project aims to develop as quickly as possible, FHB resistant germplasm that will minimize the threat of Fusarium head blight to the producers, processors and consumers of barley.

2. What were the most significant accomplishments?

- We marked and artificially hand-inoculated 10 spikes each of 304 barley entries for evaluating Type I and II resistance. The best 170 (later expanded to 272) were sent to Rich Horsley. Upon request entry files were shared with Yue Jin.
- This germplasm was distributed as follows:
    - 50 entries for inclusion in the Zhejiang University (Hangzhou, China) FHB nursery,
    - 8 entries for inclusion in the 2004 North American Barley Scab Evaluation Nursery, and
    - Several early generation lines (e.g. F5 lines) for FHB nurseries in North Dakota and Minnesota.

  The data will be shared with USWBSI.
- Testing of the North American Barley Scab Evaluation Nursery in Toluca, Mexico.
- Crosses were made to major USA cultivars to transfer FHB resistance to agronomically suitable germplasm.
- A total of 2203 entries from diverse origin are presently planted in Toluca for FHB evaluation, a dramatic increase over the number of entries screened last cycle.

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:

- Lillemo M, Van Ginkel M, He ZH, Chen X, 2004: CIMMYT – China shuttle breeding for durable resistance to powdery mildew in wheat. 15th International Plant Protection Congress, Beijing, China, May 11-16, 2004.
- Lillemo M, Van Ginkel M, Crossa J, 2004. Interaction effects of locations and evaluation methods on Fusarium Head Blight in bread wheat. 15th International Plant Protection Congress, Beijing, China, May 11-16, 2004.
- Mujeeb-Kazi A. 2003. Wide Crosses for durum improvement. In: Durum Wheat Breeding: Current approaches and future strategies. Eds. Royo et al. (Haworth Press); IN PRESS
- Mujeeb-Kazi A. 2003. New genetic stocks for durum and bread wheat improvement. 10th IWGS, Paestum, Italy, pp. 772-774.
- Villareal RL and Mujeeb-Kazi A. 2003. Synthetic Wheats: Output for Sustainable Agriculture. Agronomy Abstracts (CD ROM).
- Mujeeb-Kazi A. 2003. Genetic Diversity and Wheat improvement for Sustainable Agriculture. Agronomy Abstracts (CD ROM).
- Van Ginkel, M., L. Gilchrist, F. Capettini, Mujeeb Kazi, W. Pfeiffer, M. William, T. Ban and M. Lillemo. 2003. Breeding for Fusarium Head Blight Resistance: an International Approach. Pp 289-293 in: Proceedings of USWBSI meetings, Minneapolis, USA, December 13-15, 2003.
- Van Ginkel, M., L. Gilchrist, F. Capettini, Mujeeb Kazi, W. Pfeiffer, M. William, T. Ban and M. Lillemo. 2003. International Approach to Breeding for Fusarium Head Blight Resistance. Pp 122 in: Proceedings of Canadian FHB Workshop, December 9-12, 2003. Winnipeg, Canada.
- Van Ginkel, M., L. Gilchrist, F. Capettini, Mujeeb Kazi, W. Pfeiffer, M. William, T. Ban and M. Lillemo. 2004. Breeding for Global Resistance to FHB. Proceedings of JIRCAS FHB Workshop. February 10-11, 2004, Tsukuba, Japan.
- William H. M., M. Crosby, R. Trethowan, M. van Ginkel, A. Mujeeb-Kazi, W. Pfeiffer, M. Khairallah and D. Hoisington. 2003. Molecular marker service laboratory at CIMMYT - an interface between the laboratory and the field. Pp 852-854 in: Proceedings 10th IWGS, Pasteum, Italy, September 1-6, 2003.