USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY09 Final Performance Report
July 15, 2010

Cover Page

PI:	Etienne Duveiller
Institution:	CIMMYT
Address:	Km 45 Carretera Mex-Veracruz El Batan, Mexico CP 56120 MEXICO
E-mail:	E.Duveiller@cgiar.org
Phone:	650-833-6655
Fax:	650-833-6656
Fiscal Year:	2009
USDA-ARS Agreement ID:	59-0790-8-065F
USDA-ARS Agreement Title:	Molecular Marker Evaluation of International Fusarium Spring Wheat Nurseries.
FY09- USDA-ARS Award Amount:	$ 10,636

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Adjusted Award Amount
VDHR-SPR	Development, Evaluation and Distribution of International Fusarium Spring Wheat Nurseries.	$ 10,636
	Total Award Amount	**$ 10,636**

Principal Investigator **Etienne Duveiller** Date: **June 29, 2010**

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Winter Wheat Region
SWW – Southern Sinter Wheat Region

Project 1: *Development, Evaluation and Distribution of International Fusarium Spring Wheat Nurseries.*

1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

Despite progress in breeding for resistance to Fusarium head blight, scab remains a major threat to wheat production in most wheat producing areas of the world including the United States. Resistance often relies on resistance from Sumai #3. New sources of resistance are found but are scarce. Also, most resistance sources besides Sumai #3 are of type-II. Using molecular tools to test for the presence or absence of known and widely used sources of resistance including Sumai #3 QTLs, new sources of resistance can be introduced in wheat breeding programs.

Working with CIMMYT and participating to international nurseries, US breeders can access broadly adapted spring wheat materials with high yield potential and improved resistance to scab, and are able to submit their materials for testing in Mexico and other collaborating countries. In 2008 after distribution to 13 collaborators, the Fusarium International Elite Spring Wheat Nursery (FIESWN) and the Fusarium International Preliminary Spring Wheat Nursery (FIPSWN) were merged to the Fusarium International Elite and Preliminary Spring Wheat Nursery (FIEPSN) containing 29 entries. This was decided after a lower amount of entries was received from cooperators.

In collaboration with Dr. Shiaoman Chao (USDA-ARS Fargo) all entries were haplotyped to identify the presence (or absence) of 10 FHB resistance QTLs. Eighteen DNA markers located on chromosomes 2D, 3A, 3B, 4B, 5A and 6B were used. In addition, 300 promising advanced lines from CIMMYT's spring wheat breeding programs were haplotyped using the same markers in view to know the most valuable ones for FHB resistance.

The project was a proof of concept to show that haplotyping for scab resistance is a valuable decision tool to effectively assemble more diverse and targeted nurseries whilst reducing the number of entries sharing the same Qtls.

2. List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):

<u>Accomplishment:</u>

The FIEPSN was prepared for distribution after increasing seed in Mexicali North West Mexico, which is required for all CIMMYT wheat international nurseries. This constrain delays the shipping of nurseries and access of materials particularly if after shipping, introduced materials need to be increased in greenhouse in US according to quarantine regulations. The materials in the nursery have been field tested in El Batan Mexico in 2008 and 2009. FHB index and DON contamination have been assessed. In both years, leaf samples were collected and DNA was extracted from the FIEPSN entries and other candidate genotypes. DNA was sent to the collaborating USDA-ARS laboratory (Fargo, North Dakota) for haplotype analysis. Results of field screening and haplotyping were shared at the USWBSI forum in Orlando in December 2009.

The FHB index of genotypes included in the FIEPSN ranged from 0.87 % (Sumai #3) to 68.95 % (Gamenya) in 2008 and from 0.06 % (Sumai #3) to 93.7 % (Gamenya) in 2009, respectively (Table 1). An outstanding drought spell in July 2009 resulted in lower FHB indices for most genotypes in comparison to 2008 in spite of a higher FHB severity observed in Gamenya (very susceptible check). Drought conditions apparently did not affect DON accumulation. No correlation was observed between FHB index and DON content in both years: r = 0.27 (2008) and r = 0.05 (2009).

Haplotyping results highlighted the diversity of resistance sources in the FIEPSN. Only four genotypes had the QTLs from Sumai #3. This suggests that new sources of resistance to FHB are becoming available (Table 1). None of the ten QTLs was present in three lines: BW872, Heli-114 and N-84-5. Most genotypes had the resistance QTL from Wuhan 1 on chromosome 2D, whereas no entry harbored the resistance QTL from *T. dicoccoides* located on chromosome 3A.

The majority of markers worked well and results were consistent. However, in four cases results differed between years. This suggests that either these lines were not fixed yet, or that a sampling error may have occur in the field or during DNA extraction.

Impact:

The collection, evaluation and access of new promising wheat lines with scab resistance from around the world have been possible through the FIEPSN. U.S. wheat breeding programs gained access to new sources of resistance. The second year evaluation of the materials confirmed results from first year screening, and allowed for a better characterization of genotypes.

Haplotyping proves to be a reliable and powerful tool to determine the level of diversity among promising lines for a specific trait like scab resistance. The value of combining field results with information on known QTLs based on molecular markers has been demonstrated by the collaboration of USDA-ARS Fargo and CIMMYT. It showed that new sources of resistance are available and improved resistance based on genes other than from Sumai #3 is present in tested advanced lines. This approach leads to more diversity in terms of use of resistance genes for FHB, and enables more targeted breeding. After the project CIMMYT will use molecular markers for scab resistance as a standard procedure to evaluate the most promising lines for scab and to assemble future Scab Resistance Screening Nurseries. This will reduce distribution and shipping costs by focusing on materials showing only relevant genotypic differences and good field resistance.

After the enthusiastic endorsement of this nursery by breeders, the return of data from cooperators participating to this collaborative effort and contribution with new entries has been limited for the 2nd year. The long turnover required from seed increase in Mexico to field testing in US due quarantine requirements is probably the principal limitation.

Table 1: Two year results of evaluation of field resistance, DON accumulation and haplotyping of the Fusarium International Elite And Preliminary Spring Wheat Nursery (FIEPSN) from 2008 and 2009.

No.	Genotype	Origin	2008		2009		Sumai #3			Frontana		Wuhan 1		CJ9 306	*T. dicocc.*	
			FHB index [%]	DON [ppm]	FHB index [%]	DON [ppm]	3B	5A	6B	3A	5A	2D	4B	2D	3A	7A
1	**226**	Iran	57.59	3.20	1.13	2.30						X				
2	**250062**	Argentina	7.29	1.60	1.15	**0.00**					X					X
3	**ABALONE**	Brazil	10.40	1.00	0.63	0.77						X				
4	**BW872**	Canada	14.29	1.60	1.52	0.18										
5	**CD-111**	Brazil	6.90	2.00	4.59	2.10			-			X				
6	**D2-31_T**	Austria	6.71	1.20	0.46	3.30	X	X	X			X				X
7	**E2-1_T**	Austria	12.12	0.98	2.59	1.30	X		X			X				X
8	**E2-106_U**	Austria	15.20	3.50	5.32	**19.90**										X
9	**E3-34_U**	Austria	2.51	1.70	2.20	6.10				X	X					
10	**E3-71_T**	Austria	14.74	0.94	0.09	**0.00**				X	X					
11	**EMB16/CBRD//CBRD**	CIMMYT	4.27	0.63	25.27	8.20						(X)				
12	**GAMENYA (Check)**	Australia	**68.95**	1.51	**93.68**	1.70										
13	**GONDO/CBRD**	CIMMYT	1.36	0.33	0.33	1.10						(X)				
14	**HELI-114**	Austria	15.13	1.00	0.16	1.70										-
15	**INIA CHURRINCHE**	Argentina	11.05	1.00	11.84	0.69						X				
16	**INIA CONDOR/ORL99192**	Uruguay	6.34	1.20	2.28	1.60						X				(X)
17	**M 87 2-454-12-14 MT**	USA	11.84	1.70	0.77	0.29	X									
18	**M 95 1-672-4-8 M**	USA	15.55	1.50	2.39	0.93		X	X							
19	**N-78-14**	Iran	6.80	**4.80**	5.71	1.50								X		
20	**N-84-14**	Iran	31.19	3.30	6.20	2.60						X				
21	**N-84-17**	Iran	18.61	2.70	4.28	2.80					(X)	X				
22	**N-84-18**	Iran	7.93	1.70	0.56	3.00						X		X		
23	**N-84-20**	Iran	14.28	3.10	8.18	0.61						X				
24	**N-84-3**	Iran	4.13	4.70	11.93	0.60			-					X		
25	**N-84-4**	Iran	3.60	3.10	9.28	2.60						X				
26	**N-84-5**	Iran	3.22	2.60	5.48	5.70										
27	**OCORONI F 86 (Check)**	CIMMYT	39.26	-	1.92	1.60			-							
28	**SUM3/THB**	CIMMYT	1.03	**0.22**	0.23	0.92	X	X	X			X				X
29	**SUMAI #3 (Check)**	CIMMYT	**0.87**	0.66	**0.06**	**0.00**	X	X	X			X		X		X

Include below a list all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance.

CIMMYT does not release materials but shares germplasm with collaborators.

Table 1 shows the materials of the FIEPSN with FHB index and DON contamination results from Mexico from 2008 and 2009. It also shows the QTLs detected in these materials with help from Dr. Shiaoman Chao (USDA-ARS Fargo). Many genotypes show relatively high to moderate resistance without carrying the Sumai #3 QTLs.

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 the grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Schlang, N., Mezzalama, M., Chao, S., Dreisigacker, S, and Duveiller, E. (2009): Results from the Second Fusarium International Spring Wheat Nursery (FIEPSN). Proc. of the 2009 National Fusarium Head Blight Forum, Orlando, Florida, 7.-9. Dec. 2009, p 145.