Active Wheat Germplasm Bank of Embrapa: current situation and future perspectives.

Adeliano Cargnin, Eduardo Caierão, Ricardo Lima Castro, Marcio Só e Silva, Pedro Luiz Scheeren, Luciano Consoli, Sandra Brammer, and Flavio Santana.

The Active Wheat Germplasm Bank (AGB–Wheat) located at Embrapa Trigo, Passo Fundo, RS, Brazil, was funded in 1978, and since that time is concerned with enhancement as well as biodiversity conservation of wheat and related species. Today there around 15,000 wheat accessessions, including related species, registered and stored at AGB-Wheat. At this moment, AGB-Wheat is under restructuring in order to resize the bank and eliminate of the redundance, which means the actual number of accession will be reduced in the future. Under conservation are species from the genera *Triticum*, *Aegilops*, *Agropyron*, *Elymus*, *Elytrigia*, and *Leymus*. The accession data are managed by an appropriate software system. As a routine, AGB-Wheat activities include diversity enhancement, conservation, characterization, and evaluation. In the last two years, 1,742 new accessions from Brazil and other countries were introduced into the AGB, and 1,130 access were distributed in exchange to different institutions including other Embrapa stations. During this time, we multiplied/regenerated and morphologically characterized 2,512 accessions in the field and in the greenhouse. The organization and validation of a core collection of 240 accessions will be increased in the near future to better represent the whole AGB collection. Characterization and evaluation related to the main concerns for wheat growing in Brazil, such as biotic stress (Fusarium head blight and wheat blast), abiotic stress (sprouting), and technological flour quality will be made on the core collection. In addition, molecular and cytological analyses will be done.

ITEMS FROM CROATIA

BC INSTITUTE FOR BREEDING AND PRODUCTION OF FIELD CROPS
Rugvica, Dugoselska 7, 10370 Dugo Selo, Croatia.
Department of Cereal and Forage Crops, Botinec, Zagreb, Croatia.
www.bc-institut.hr

Slobodan Tomasović, Rade Mlinar, Ivica Ikić, Branko Palaveršić, Katarina Jukić, Tomislav Ivanušić, and Marko Maricević.

A new generation of winter wheat cultivars developed at the Bc Institute Zagreb.

Work on breeding winter wheat at the Zagreb Bc Institute have been in progress continuously for more than 60 years. The results of this work are many cultivars registered in the Republic of Croatia and abroad. A new generation of winter wheat cultivars have been developed taking into account the needs and demands of the producers, including Bc Mira, Bc Renata, Dora, Marina, Bc Lidija, Bc Lira, Bc Irena, and Bc Anica.

Bc Irena dnd Bc Anica are the newest registered winter wheat cultivars from the Bc Institute in 2010 (Table 1 and Table 2, p. 8). The main characteristics of these cultivars is a broad genetic base that provides a high yield potential, stability, and very good grain and flour quality. These cultivars represent progress in wheat breeding. The results of the Committee for Variety Registration, small- and large-scale trials, and seed production confirm a high agronomic value of the newly released Bc winter wheats (Table 3, p. 8, and Figs. 1 and 2, p. 8). They have

Table 1. Yield results of the new winter wheat cultivar Bc Irena compared with the standard cultivars (The Committee for Variety Registration of the Republic of Croatia, 2007–10).

Cultivar	Yield results (t/ha)				Sana = 100	Žitarka = 100	Divana = 100
	2007–08	2008–09	2009–10	Average			
Bc Irena	9.069	7.690	5.234	7.331	101.0	104.7	121.7
Sana	9.201	7.124	5.456	7.260	100.0		
Žitarka	8.221	7.328	5.463	7.004		100.0	
Divana	6.962	6.416	4.688	6.022			100.0

surpassed the check for the most important yield components in these tests. Because of thier morphology and biology, these new cultivars are resistance to lodging and the most important wheat diseases. Bc Renata and Bc Lira also are suitable for ecological production and under rationalized technology achieve very good results. Dora, Marina, Bc Lidija, Bc Irena, and Bc Anica meet the requirements of the milling and baking industry, and Bc Mira, Bc Renata, and Bc Lira can be grouped into a class of high-quality cultivars (Table 4, p. 9). This new generation of Bc cultivars provides an opportunity for our farmers to sow and produce better material with increased quality, which is a step forward in wheat production, certainly the goal of breeding.

Table 2. Yield results of the new winter wheat cultivar Bc Anica compared with the standard cultivars (The Committee for Variety Registration of the Republic of Croatia, 2008–10).

Cultivar	Yield results (t/ha)			Srpanjka = 100	Žitarka = 100	Divana = 100
	2008–09	2009–10	Average			
Bc Anica	8.539	6.576	7.558	112.4	115.4	132.9
Srpanjka	7.956	5.492	6.724	100.0		
Žitarka	7.666	5.435	6.551		100.0	
Divana	6.590	4.788	5.689			100.0

Table 3. Yield results (t/ha) of 14 winter wheat cultivars in the large-scale trials of the Zagreb Bc Institute at the Ţupanja, Lovas, and Agromeđimurje locations in 2010.

Cultivar	Županja	Lovas	Agromeđimurje	Average
Marija	7.17	8.09	6.81	**7.36**
Sana	6.84	8.80	7.58	**7.74**
Zdenka	6.27	7.92	6.85	**7.01**
Prima	7.25	8.43	8.71	**8.13**
Bc Antea	6.87	7.88	7.04	**7.26**
Tina	7.23	8.54	7.71	**7.83**
Adriana	7.22	7.56	7.57	**7.45**
Bc Renata	6.47	8.10	7.45	**7.34**
Bc Mira	6.41	7.95	7.95	**7.44**
Dora	6.93	7.69	7.46	**7.36**
Marina	6.93	7.98	7.11	**7.24**
Bc Lidija	7.01	7.54	7.09	**7.21**
Mihelca	6.92	7.17	7.14	**7.08**
Bc Lira	6.14	6.54	7.06	**6.58**
Average of trial locations	**6.81**	**7.87**	**7.40**	

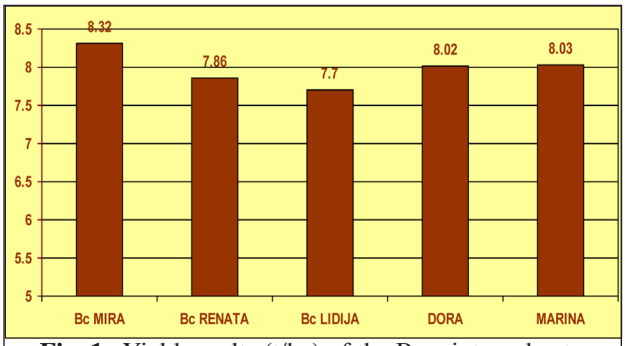

Fig. 1. Yield results (t/ha) of the Bc winter wheat cultivars in large-scale trials, 2009 and 2010.

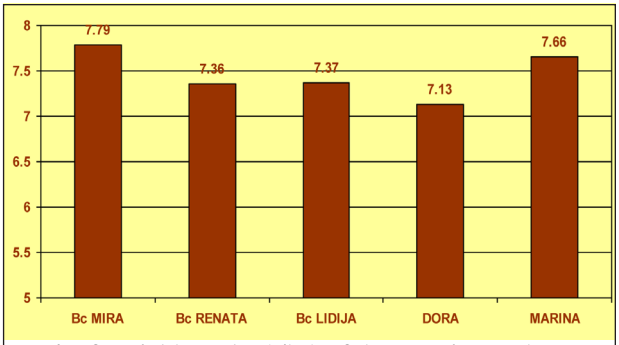

Fig. 2. Yield results (t/ha) of the Bc winter wheat cultivars in small-scale trials, 2009 and 2010.

Table 4. Test results of the milling and baking quality in large-scale trial at the Agromeđimurje location, 2009–10.

Cultivar	Sedimentation (mL)	Protein (%)	Wet gluten (%)	Falling number (sec)
Bc Lira	54	14.5	33.9	228
Bc Renata	49	13.7	31.14	218
Dora	42	13.3	28.3	242

Farinogram							Extensogram			
Water absorption (%)	Dough development time (min)	Stability (min)	Resistance (min)	Degree of softening (FJ)	Quality number	Quality group	Energy (cm^2)	Extensibility (mm)	Resistance (EJ)	R/E
65.4	4.0	2.8	6.8	50	72.5	A2	121.0	217	225	1.04
61.2	2.4	2.9	5.3	50	71.9	A2	101.3	211	225	1.07
65.5	2.1	0.6	2.7	60	63.5	B1	50.5	159	155	0.97

The effect of Fusarium head blight on grain yield reduction in wheat.

Fusarium head blight is the most important wheat disease in the world. Apart from reducing yields, FHB also affects grain quality by producing the mycotoxins deoxynivalenon and zearalenone. Because chemical protection is ineffective, breeding for resistance is the best means of control. We examined the influence of FHB on grain yield, 1,000-kernel weight, and test weight in winter wheat lines. Two identical experiments with 25 wheat lines were planted; one was artificially inoculated by spraying with a spore suspension of *F. graminearum*, and the other was under natural conditions. The trials were planted at Botinec in 2007 and 2008. Under natural conditions, infection with *F. graminearum* was mild, and average yields of 5,325.3 kg/ha in 2007 and 9,453.5 kg/ha in 2008 were achieved. Under artificial infection, average yields were lower by 24.0% in 2007 and 29.3% in 2008 (Table 5; Fig. 3, and Figs. 4 and 5, p. 10). Significant correlation coefficients were obtained between the infection severity and grain yield reduction (r = 0.48 and r = 0.76). Correlations also were found between infection severity and 1,000-kernel weight reduction (r = 0.58 and r = 0.42) and between infection severity and the reduction in test weight (r = 0.70 and r = 0.68) in 2007 and 2008, respectively. Fusarium head blight greatly influenced yield reduction, 1,000-kernel weight, and test weight in more susceptible wheat lines. Some wheat lines, on the contrary, did not show any substantial yield reduction even under severe infection. In the years of testing, high levels of resistance to FHB compared with the source of resistance in conditions of artificial infection were found in 11 winter wheat lines (Bc 8, Bc 9, Bc 4, Bc 20, Bc 18, and Bc 5 in 2007 and Bc 12, Bc 1,

Table 5. The effect of *Fusarium graminearum* on average grain yield (kg/ha), 1,000-kernel weight (g), and test weight (kg) of 25 winter wheat genotypes under conditions of artificial and natural spike infection at Botinec, Croatia, in 2007 and 2008.

Year	Grain yield		% reduction	1,000-kernel weight		% reduction	Test weight		% reduction
	Natural infection	Artificial infection		Natural infection	Artificial infection		Natural infection	Artificial infection	
2007	5,325.3	4,049.3	24.0	37.7	32.2	14.6	73.6	63.3	14.0
2008	9,453.5	6,680.2	29.3	42.8	35.6	16.9	71.6	63.1	11.9
Average	7,389.4	5,364.8	26.7	40.2	33.9	15.7	72.6	63.2	13.0

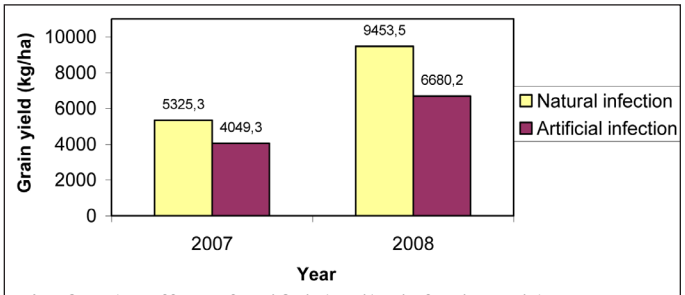

Fig. 3. The effect of artificial spike infection with *Fusarium graminearum* on average grain yeild in 25 winter wheat genotypes at Botinec, Croatia in 2007 and 2008.

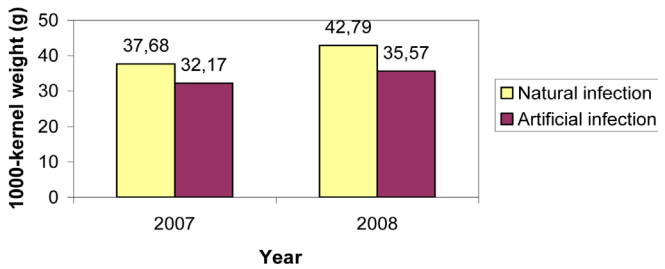

Fig. 4. The effect of artificial spike infection with *Fusarium graminearum* on average 1,000-kernel weight in 25 winter wheat genotypes at Botinec, Croatia in 2007 and 2008.

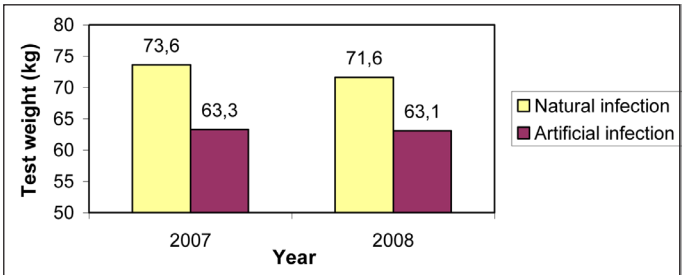

Fig. 5. The effect of artificial spike infection with *Fusarium graminearum* on average test weight in 25 winter wheat genotypes at Botinec, Croatia in 2007 and 2008.

Bc 9, Bc 17, and Bc 18 in 2008) and five winter wheat cultivars (Bc Mira, Bc Renata, Bc Lira, Dora, and Marina) (Table 6).

Acknowledgement. The above data were obtained as a result of the scientific project (Breeding wheat for yield, quality, and resistance to Fusarium head blight, 106-1780691-2155) partialy supported by the Croatian Ministry of Science, Education and Sports and represents a complementary part of program No. 1780691 (Research and improvement of genetic traits of field crops).

Table 6. A survey of winter wheat genotypes in cultivar trials with the highest level of resistance to Fusarium head blight (FHB) compared with the source of resistance under artificial infection conditions at Botinec, Croatia, in 2007 and 2008 (+ = moderately resistant; ++ = resistant).

Cultivar	FHB VRI (%)
2007	
Bc Renata	3.96 ++
Bc 8	5.96 ++
Bc 9	6.36 ++
Bc 4	6.91 ++
Bc 5	14.99 +
Bc Mira	15.01 +
Average	10.46
Source of resistance	
Roazon	14.62 +
(D48x42x6)2	20.67
Poncheau	7.22 ++
Average	14.17
Total average	12.31
2008	
Bc 12	10.77 ++
Bc Lira	11.28 ++
Bc 1	16.03 +
Bc 9	21.64 +
Bc 17	21.68 +
Bc 18	21.69 +
Average	17.18
Source of resistance	
Roazon	22.34 +
(D48x42x6)2	13.78 ++
Poncheau	4.08 +
Average	13.4
Total Average	15.29

Publications.

Ikić I, Maričević M, and Šarčević H. 2011. Genotypic differences in expression of seed and embryo dormancy in wheat. *In:* Proc 46th Croatian & 6th Internat Symp on Agric, Opatija, Croatia, 14-18 February, 2011, Book of Abstracts, p. 73.

Jukić K, Burek Svetec N, Gunjača J, Bukan M, Ikić I, Tomasović S, Mlinar R, Maričević M, and Šarčević H. 2011. Nitrogen fertilizer effect on expression of grain dormancy in wheat. *In:* Proc 46th Croatian & 6th Internat Symp on Agric, Opatija, Croatia, 14-18 February, 2011, Book of Proc, p. 399-403.

Mlinar R. 2007. Bc Mira-a new winter wheat variety. Sjemenarstvo 24(3-4):159-167 Zagreb (in Croatian with English summary).

Mlinar R and Ikić I. 2009. Bc Renata-a new winter wheat variety. Sjemenarstvo 26(3-4):131-141, Zagreb (in Croatian with English summary).

Šarčević H. Ikić I. Barić M, Tomasović S, Mlinar R, and Gunjača J. 2010. Expression of seed dormancy in croatian-grown winter wheats at different germination temperatures. *In:* Proc 8th International Wheat Conference, St. Petersburg, Russia, 30-31 May, 2010.

Tomasović S, Ikić I, Mlinar R, Jukić K, Ivanušić T, and Palaveršić B. 2010. Comparison of wheat varieties resistance to Fusarium head blight (FHB) under different environments. *In:* Proc Workshop for Variety Registration in Cereals for Fusarium resistance, 23-24 March, 2010, Szeged, Hungary, Book of Abstracts, p. 17.

Tomasović S. Palaveršić B. Ikić I. Mlinar R. Šarčević H. Jukić K, and Ivanušić T. 2010. Latest results in breeding winter wheat for resistance to Fusarium head blight in the Zagreb Bc Institute. *In:* Proc 11th European Fusarium Sem, Fusarium, Mycotoxins, Taxonomy, Pathogenicity and Host Resistance, 20-23 September, 2010, Radzikow, Poland, Book of Abstracts, p. 311.

ITEMS FROM ETHIOPIA

CIMMYT–ETHIOPIA AND THE ETHIOPIAN INSTITUTE FOR AGRICULTURAL RESEARCH
Debre Zeit, Ethiopia

Bekele Abeyo (CIMMYT) and Firdissa Iticha, Kebede Tadesse, Ayele Badebo, and Asefa Yilma.

A number of international nurseries were planted at various sites in Ethiopia during the 2009–10 cropping season. Off-season the nurseries were planted only at Debre Zeit because of the availability of irrigation. A total of 7,214 wheat lines were evaluated for stem rust resistance, including 806 durum wheat lines from CIMMYT, 2,107 bread wheat lines, 3,295 durum wheat lines, 974 synthetics from ICARDA, and 32 bread wheat lines from the Russian Federation. The nurseries were planted on time, were well managed, and infector rows well distributed. Because the temperature was warmer than normal, the disease pressure was higher. Only CIMMYT nursery data are presented in Table 1. Most of the lines tested during this season were durum wheat. Of the 622 total lines tested, 297 (or 48%) were found to have 20% or less infection rates. The data were submitted to the respective coördinating breeders at CIMMYT–Mexico.

Table 1. International nurseries tested at Debre Zeit, Ethiopia, during the off-season in 2009–10.

	Number tested	≤ 20^% sten rust	Comment
Durum wheat			
CD10 MCDZ	208	146 (70%)	Many resistant lines
F6 SR	175	131 (75%)	Many resistant lines
CD10_BHADERDZZ	35	2 (6%)	
CD10_DDPDZ	204	18 (9%)	
TOTAL	622	18 (9%)	
Bread wheat			
4th SRRNSN BW	184	79 (43%)	Many resistant lines
TOTAL	806	376 (47%)	

The main 2010 season was characterized by wide spread yellow rust epidemics on the major cultivars Kubsa and Galama. These two cultivars have served for over 15 years and can not be blamed. Efforts were made to spray fungicides to minimize damage. In addition, the new CIMMYT cultiars Picaflor and Danphe, with good resistance/tolerance to yellow rust, were released to replace the susceptible, older cultivars this year. Different nurseries were obtained from in 2010, including 1,190 bread wheats, 1,297 durum wheats, and 202 triticales from CIMMYT; 4,185 bread wheats and 318 durum wheats from ICARDA; 243 bread wheats from Egypt; and 2,100 durum wheats from the USDA. These nurseries were planted at different sites. Kulumsa is an area for wheat where many lines can express their yield potential by tolerating the high rust development. Holetta, a hot-spot for Septoria, is an ideal site for screening for Septoria resistant lines. Many CIMMYT international nurseries were tested at Holetta for quarantine purposes and most of them were found susceptible to the existing strain of Septoria. In the future, Septoria screening only will be evaluated at Holetta. Melkasa is the quarantine site for the semi-arid environments of the country. Last year, plentful rainfall during the growing season lead to a high incidence of stem and yellow rust at Melkasa. Debre Zeit is the screening site for durum wheat to the three rusts. Only data on CIMMYT materials are reported here. About 77% of the total bread wheat nurseries tested at Kulumsa, Melkasa, and Debre Zeit were found to have 20% or less infection rates of either stem rust or yellow rust. This is good news for the national program, where yellow rust epidemics have wiped out the popular cultivars from production. Durum wheat and triticale nurseries were planted at Debre Zeit and Holetta. The disease pressure at Debre Zeit was relatively high. As a result, only 341 durum wheat lines (26%) of the total 1,297 lines evaluated were found to have lower than or equal to 20% severity or infection rate for the two rusts. Triticale was found to better tolerate Septo-