ITEMS FROM CROATIA

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Technological quality estimates of the new winter wheat lines developed by the Zagreb Bc Institute.

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The main objective of the wheat breeding in the Bc Institute is development of the high-yielding cultivars with good rheological and baking flour quality. In the breeding process, quality presents a very complex and variable quantitative trait that are greatly affected by ecological factors. The estimate of the final value estimate of a wheat cultivar does not depend on a large number of genes controlling only quality, but on the genes controlling different resistance traits, which is why progress in breeding is a demanding and long process. During 2004–05, 16 new winter wheat lines were tested for production characteristics in small-scale trials at three locations (Botinec, Rugvica, and Lovas). The experimental material included the following wheat lines: Bc 5204/02, Bc 9327/99, Bc 9362/99, Bc 5320/02, Bc 5308/02, Bc 319/01, Bc 306/01, Bc 5325/02, Bc 9345/99, Bc 5263/02, Bc 5137/02, Bc 5167/02, Bc 1553/01, Bc 5090/02, Bc 5210/02, and Bc 5227/02. These lines were tested and compared against the standard cultivars for yield, Sana and Soissons, and grain quality, Žitarka and Renan. After the average values of the most important agronomic traits were analyzed, two lines, Bc 9327/99 and Bc 9362/99, were separated prior to submission for testing by the Croatian Board for Registration, Approbation and Protection of Varieties. Based on the final test results, these new Bc lines combine high yield capacity (Table 1) and desirable grain and flour traits (Tables 2 and 3 (p. 44)) and were released for production under the names **Bc Mira** and **Bc Renata**.

Table 1. Grain yield analysis of new winter wheat cultivars Bc Renata and Bc Mira in comparison with checks (Source: Commission for Varieties Recognition in the Republic of Croatia from 2005–07).

Cultivar	Year of study (t/ha)			Average	Divana	Žitarka	Sana
	2004–05	2005–06	2006–07	(t/ha)	(= 100)	(= 100)	(= 100)
Bc Renata	8,054	8,341	6,726	7,707	141.96	105.49	104.52
Bc Mira	7,769	7,867	7,315	7,650	140.91	104.71	103.74
Sana	6,600	8,399	7,123	7,374			100.00
Žitarka	7,636	7,326	6,955	7,306		100.00	
Divana	6,076	5,918	4,294	5,429	100.00		

Table 2. Results of kernel and flour quality testing of new winter wheat cultivars Bc Renata and Bc Mira in comparsion with checks at Osijek, Croatia, 2006 (Source: Commission for Varieties Recognition in the Republic of Croatia, 2006).

	Bc Renata	Bc Mira	Sana	Žitarka	Divana
Protein (%)	11.96	12.77	11.86	12.60	15.38
Sedimentation (ml)	42	42	28	35	66
Quality class	II	II	III	II	I
Wet gluten (%)	23.5	30.0	23.7	28.6	33.0
Dry gluten (%)	8.54	9.10	8.54	9.92	11.40
Milling value (%)	70.9	68.5	69.3	65.6	68.9
Falling number (sec)	386	406	376	403	428
Water absorption (%)	59.5	65.0	63.5	69.0	67.5
Degree of softening (FJ)	110	80	140	95	30
Quality number	45.3	58.3	36.0	53.3	74.6
Quality group	B-2	B-1	C-1	B-2	A-2
Energy (cm^2)	142.8	90.9	72.9	93.7	145.3
Extensibility (mm)	157	174	147	153	193
Resistance (EJ)	450	250	280	320	290
O/E	2.9	1.4	1.9	2.1	1.5
Maximum viscosity (AJ)	1,280	1,280	1,780	1,190	1,510

From the obtained results of preliminary and official results, developing new wheat cultivars at the Bc Institute has been successful. These newly registered, highly productive cultivars produce excellent technological results and, therefore, deserve attention by the agricultural community and production.

Table 3. Results of kernel and flour quality testing of new winter wheat cultivars Bc Renata and Bc Mira in comparsion with checks at Zagreb, Croatia, 2006 (Source: Commission for Varieties Recognition in the Republic of Croatia, 2006).

	Bc Renata	Bc Mira	Sana	Žitarka	Divana
Protein (%)	11.56	13.48	10.79	12.15	14.73
Sedimentation (ml)	44	42	35	35	66
Quality class	II	I	III	III	I
Wet gluten (%)	22.8	31.8	28.3	28.3	33.9
Dry gluten (%)	7.94	9.61	9.87	9.87	10.93
Milling value (%)	73.0	71.1	73.3	73.3	72.0
Falling number (sec)	331	400	357	357	376
Water absorption (%)	58.5	66.0	64.5	68.0	68.5
Degree of softening (FJ)	85	70	110	65	20
Quality number	56.4	60.4	50.6	66.7	83.7
Quality group	B-1	B-1	B-2	B-1	A-2
Energy (cm^2)	161.9	68.5	67.9	78.7	123.5
Extensibility (mm)	190	179	175	171	222
Resistance (EJ)	390	200	200	245	230
O/E	2.1	1.1	1.2	1.4	1.1
Maximum viscosity (AJ)	1,130	1,100	1,550	950	1,320

Selection of winter wheat lines with good resistance to Fusarium head blight.

Fusarium head blight is one of the most serious fungal diseases occurring in wheat production. In addition to reducing the yield, FHB affects grain quality because certain mycotoxins have a harmful effect on the health of humans and domestic animals. Breeding for resistance to FHB by producing resistant cultivars is the most effective means of control. We tested new wheat lines for resistance to *F. graminearum* by artificial inoculation before submitting them for official testing and to select resistant lines for further use in our breeding efforts. The new wheat lines were tested for resistance at the experimental field in Botinec. Most lines were tested in preliminary trials without replication, and the most promising were tested in exact small-scale trials. In the preliminary trial that included 194 genotypes, evaluation was made using the visual index (VRI %). The most FHB-resistant lines were 2692/05 (0.0), 5601/06 (0.13), 5597/06 (0.13), 2512/04 (0.25), 5561/06 (0.25), 5608/06 (0.25), 2417/04 (0.5), 6068/06 (0.5), 7739/05 (0.75), 4888/06 (1.38), 2559/05 (1.5), and 6065/04 (1.88) (Table 4). The small-scale trial included 25 genotypes and also included standards for resistance (Roazon, Poncheau, and $(D48 / 42x6)_2$ (Fig. 1). The following lines were resistant: 9362/99 (0.54), 5377/05 (1.15), 6045/04 (2.0), 2596/05 (6.17), 9327/99 (7.08), and 2368/05 (9.71). Selection of lines under artificial inoculation with FHB proved as an effective additional criteria for value determination of individual winter wheat lines.

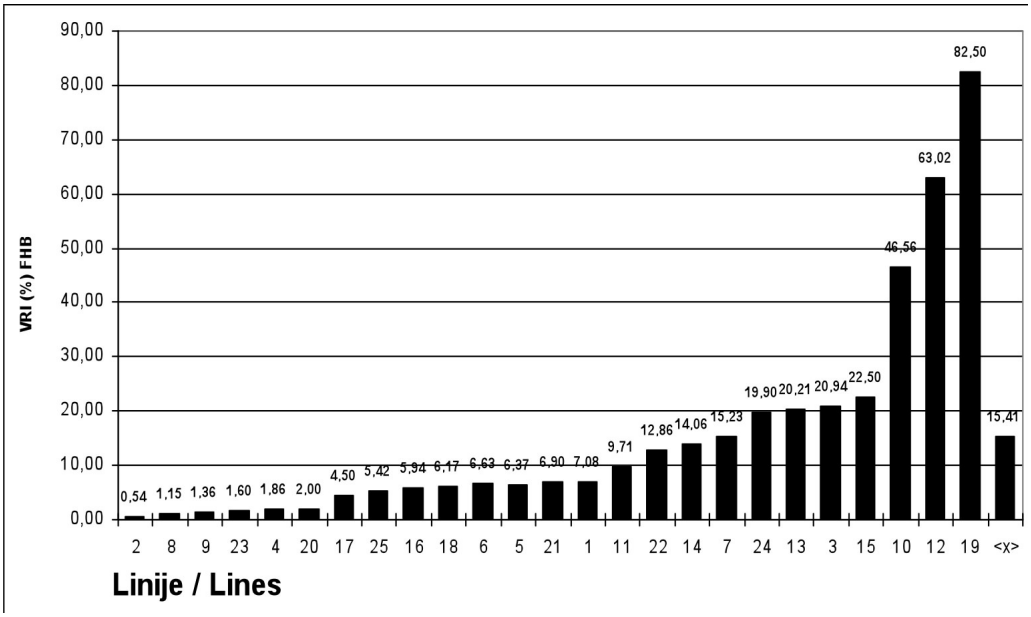

Fig. 1. Investigation results of resistance to Fusarium head blight of prospective winter wheat lines from exact variety trial in comparison with sources of resistance in conditions after artificial infection, Botinec, 2007.

Table 4. Resistance to Fusarium head blight (FHB) after artificial infection of prospective winter wheat lines from the Exact Variety Trial, Botinec, 2007. R, resistant; MS, moderately resistant; MS, moderately susceptible; S, susceptible; VS, very susceptible; 4, Poncheau; 13, Roazon; and 16, $(S_{48X42X6})_2$.

	FHB VRI (%)	Score
2	0.54	R
8	1.15	R
9	1.36	R
23	1.60	R
4	1.86	R
20	2.00	R
17	4.50	MR
25	5.42	MR
16	5.94	MR
18	6.17	MR
6	6.63	MR
5	6.73	MR
21	6.90	MR
1	7.08	MR
11	9.71	M
22	12.86	MS
14	14.06	MS
7	15.23	MS
24	19.90	S
13	20.21	S
3	20.94	S
15	22.51	S
10	46.56	VS
12	63.02	VS
19	82.50	VS

able lines. Breeding material (F_1–F_{12}) consisting of 659 combinations and 2,350 ear progenies was established. In 2006, six lines were selected from preliminary investigations for exact variety trial for further work in 2006-07 (standard Clercal). Analysis of the trials showed that the best line in 2007 was Bc 6315/06; with a yield of 5,636 kg/ha, it was superior to the standard cultivar Clerical by 21.6% (4,636 kg/ha). This line is being tested by the Croatia Board for Registration, Approbation and Protection of Varieties. Good results were ob-

Breeding winter triticale in the Zagreb Bc Institute.

The winter triticale breeding program was initiated at the Bc Institute in early 1990 and was aimed at developing variety with high and stable yields and good grain quality. The genetic base consisted of 1,156 genotypes and was formed and tested for several years both in the experimental field in Botinec and in the laboratory. Selected material was crossed followed by breeding using the pedigree method for testing agronomically valu-

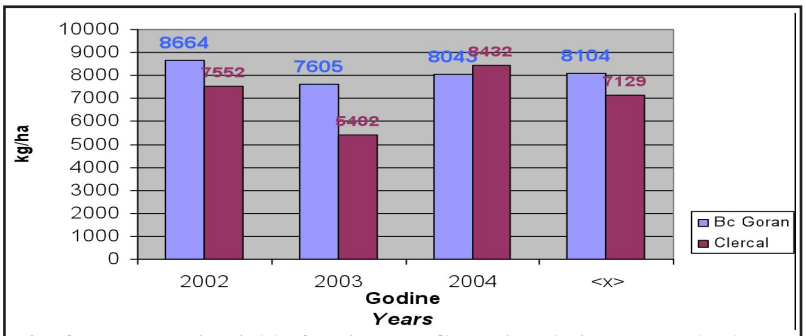

Fig. 2. Mean grain yield of variety Bc Goran in relation to standard variety Clercal in investigations of the Croatia Board for Registration, Approbation and Protection of Varieties, 2002-04.

Table 5. Mean grain yield (kg/hl) of Bc Goran at five locations (Lovas, Osijek, Kutjevo, Nova Gradiška, and Zagreb) in relation to standard cultivar Clercal in investigations of the Croatia Board for Registration, Approbation and Protection of Varieties, 2002–04.

	Cultivar		Relative yield (Clerical=100%)	Difference (in kg) to Clercal
	Bc Goran	Clercal		
2002	8664	7552	11,72	+1112
2003	7605	5402	140,78	+2203
2004	8043	8432	95,39	-389
Mean	8104	7129	116,96	+975

Table 6. The description of the cultivar Bc Goran.

Type of spike	cylindrical with a clear awn
Vegetation	mid–early
Height (cm)	115–121
Resistance to low temperatures	clearly winter type
Resistance to drought	very good
Resistance to lodging	very hard, elastic stem
Resistance to diseases	very good
1,000-kernel weight (g)	45–47
Hectoliter weight (kg/hl)	71–76
Protein (%)	14.31
Fiber (%)	2.43
Lipid (%)	2.11
Minerals (%)	1.84
NET easily utilized carbohydrates (%)	79.31
Use	humans and domestic animal feed and industrial processing
Optimal sowing time	1–20 October
Sowing rate (viable kernels/m^2)	500–550

tained by the following lines in an extremely dry season in 2007: Bc 6322/06 (7,168 kg/ha), Bc 2791/05 (6,316 kg/ha), Bc 6310/06 (5,324 kg/ha), and Bc 1276/99 (4,700 kg/ha), which will all be used in further breeding. Triticale breeding results at the Bc Institute so far include the registered cultivar Bc Goran, the production of which has already spread (Fig. 2 and Table 6, p. 45). Additionally, there has been a considerable interest in this variety also in the neighboring countries of Bosnia and Herzegovina and Slovenia.

Publications

Ikić I, Mlinar R, Tomasović S, Jukić K, and Šarčević H. 2007. Evaluation of technological quality of the new Bc winter wheat lines developed by the Zagreb Bc Institute. *In:* Proc 4th Internat Cong Flour – Bread ´07 and the 6th Croatian Cong Flour Prod and Processing Tech (Ugarčić–Hardi Ž, et al., Eds), Opatia, Croatia, Abstract Book.

Mlinar R. 2007. Autothons varieties of small grains. *In:* Conf Native Breeds and Varieties as part of Natural and Cultural Heritage, under the Auspices of the Government of the Republic of Croatia, Šibenik, 13-16 November. Book of Abstracts

Tomasović S, Mlinar R, Ikić I, Jukić K, and Palaveršić B. 2007. Breeding wheat for resistance to Fusarium head blight. Cereal Res Commun 35(2):1209-1212.

Tomasović S, Mlinar R, Ikić I, and Puškarić K. 2005. Newly registered winter wheat and barley varieties developed by the Zagreb Bc Institute. *In:* Works of the Faculty of Agricultural University of Sarajevo, L(55/2):119-126.

ITEMS FROM GERMANY

LEIBNIZ–INSTITUT FÜR PFLANZENGENETIK UND KULTURPFLANZENFORSCHUNG — IPK
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Spike morphology genes.

Genes determining spike morphology in wheat (multirow spike; MRS) and rye (monstrosum; mo) were studied. Phenotypic analysis revealed segregation ratios of 3 (wild type) : 1 (mutant) in both species. Applying molecular markers, the mutants were mapped in comparable positions on the short arms of chromosomes 2D and 2R of wheat and rye, respectively. The distance to the centromere is about 10 cM. We suggest that the loci are homoeoallelic. Furthermore, it should be noted that a spike morphology gene from a *T. turgidum* supernumerary spikelet stock has been described on the short arm of chromosome 2A at a highly comparable distance from the centromere.

Anthocyanin pigmentation.

Different organs of the plant, including anthers, auricles, coleoptiles, culm, grains, or leaves, can show anthocyanin pigmentation. Anthocyanins are secondary metabolites playing an important role in UV protection of plant tissues. Molecular-mapping studies suggested that two groups of genes for anthocyanin pigmentation exist in wheat. The first group includes genes *Rc*, *Pc*, *Pan*, *Plb*, and *Pls* determining anthocyanin pigmentation of coleoptile, culm, anthers, leaf blades, and leaf sheath, respectively. They are closely linked to each other and represent homoeoloci on the short arms of chromosomes 7A, 7B, and 7D, and a putative homoeologous set for the same traits on chromosomes 5A, 4B, and 4D, all corresponding to the probable candidate genes coding for Myb protein homologous to the maize gene *C1*. The second group includes *Pp* and *Ra*, which determine anthocyanin pigmentation of the pericarp and auricles, respectively. These genes do not cluster with the others (and not one to another), no homoeoloci have been found for them yet, and