ANALYSIS OF GENETIC STRUCTURE OF REGIONAL COMMON WHEAT VARIETIES USING SIGNAL GLIADIN AND GLUTENIN GENES

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SGE (Šašek, Černý, 1983) and SDS PAGE (Laemmli, 1970) methods were used to determine electrophoretic composition of gliadins and HMW glutenins of 100 regional varieties and old, deleted common wheat (*T. aestivum* L.) varieties of Czech-Moravian and Slovak regions. Allelic blocks of gliadin and HMW glutenin zones served for determination of the genetic structure of evaluated varieties and the occurrence of signal Gld and (HMW) Glu gene-markers of breadmaking quality, frost-hardiness and resistance to rusts was set out.

common wheat; regional variety; electrophoresis; gliadins; HMW glutenins; signal genes; genetic structure; breadmaking quality; frost-hardiness; resistance to rusts

INTRODUCTION

In the last 50 years original regional varieties of common wheat were substituted by bred varieties. The said change of varietal structure could manifest in loss – erosion of some economically valuable genes of original regional wheat varieties.

Genetic erosion became an impulse for keeping the gene pool of cultural species of plants in gene banks. The gene bank of the Research Institute for Crop Production (VÚRV) in Prague collects regional varieties of common wheat from the Czech-Moravian and Slovak regions.

The prerequisite for the use of the mentioned regional wheat varieties as gene resources is the characterization of their genetic structure and selection of different component forming populations of regional varieties. Gliadin and glutenin genes have a capacity to marker not only linged some genes of traits and properties important in terms of economy, but also the degree of polymorphism and heterozygosity of individual common wheat varieties (Šašek et al., 1985).

The study has been aimed at gliadin and glutenin polymorphism of original regional varieties of common wheat and selection of gliadin or glutenin lines from regional varieties – populations. The gliadin and glutenin lines obtained in homozygotic state are hence more available target for detection and use of genes of properties important from economic point of view.

MATERIAL AND METHODS

100 regional varieties and old, deleted bred varieties of common wheat (*T. aestivum* L.) originating from Bohemia, Moravia and Slovakia registered since 1931 and kept since 1951 at the Research Institute for Crop Production in Prague.

The survey of evaluated varieties is in Tab. I. Bulk seed samples of individual varieties à 100 g for analysis were provided by the Gene Bank of VÚRV Praha.

100 grains of each bulk sample were analyzed for electrophoretic structure of gliadins and 20 grains for electrophoretic structure of HMW glutenin subunits.

Electrophoresis of gliadins was conducted in starch gel (SGE) as published in literature (Šašek, Černý, 1983).

Allelic gliadin blocks were selected from electrophoretic gliadin spectra after the catalogue published (Sobko, Poperelja, 1986).

Electrophoretic HMW glutenin spectra were detected by modified procedure of vertical discontinuous electrophoresis in polyacrylamide gel under the presence of sodium dodecyl sulphate (Laemmli, 1970). Allelic blocks of zones or individual allelic zones of HMW glutenin subunits were indicated after the catalogue published (Payne et al., 1981).

RESULTS AND DISCUSSION

Results of electrophoretic analyses are presented in Tab. I in the form of collections of allelic gliadin blocks and HMW gliadin subunits of individual evaluated varieties.

Characteristics of individual gliadin and glutenin allelic blocks are in Tab. II.

Polymorphism in electrophoretic structure of gliadins

Most of evaluated varieties (60%) are the lines which are homogenous in electrophoretic spectra of gliadin and HMW glutenin subunits. This homogeneity markers a genetic structure of mentioned varieties (see Tab. I) as pure

homogenous and homozygotic lines in investigated signal protein genes, as well as in markered loci of economically important properties.

The varieties Česká přesívka, Hanácká bělka or Rokycanská sametka can serve as examples of such varieties.

The varieties Dětenická N 1827 and Podhorská běloklasá with 10% or 5% heterozygotic genotypes in one or more protein signal genes are potentially heterogeneous. In their progeny the split of more protein lines can be expected.

The varieties Bílá od Dukovan, Hodonínská universální, Slovenská intenzívna and Vígľašská osinatá (i.e. 4% of the total number of 100 varieties evaluated) are composed of one main gliadin line with a relative representation of about 90% and of one secondary gliadin line of about 10% frequency.

A total of 28% of the collection of varieties tested consists of two main lines, i.e. 28% of the tested collection of varieties. The varieties Hanácká osinatá, Chrudimka and Mandelíkova Ratbořská Mara serve as an example of these populations. Three-line varieties are represented in the collection analyzed by five varieties – Boleslavská bělka, Dobrovická červená 19, Nebojska, Slovenská 1784 and Židlochovická bezosinatá KM 12.

Maximal degree of gliadin polymorphism was found in the varieties Dregerova B/22, Hořická and Zora, consisting of four gliadin lines.

Polymorphism in electrophoretic structure of HMW glutenins

Polymorphism in the structure of storage proteins, gliadins above all, found in 40% of evaluated varieties, marks their genetic structure as a multiline population. Efficient use of these populations as genetic resources requires evidently separation of protein lines of which they are composed, and their idependant propagation and evaluation.

HMW glutenin subunits generally compared with gliadins are marked by lower polymorphism in electrophoretic structure (Šašek et al., 1987; Černý et al., 1989, 1990b). Electrophoresis of HMW glutenin subunits confirms this fact. Only four varieties of the evaluated collection of 100 varieties manifested polymorphism in electrophoretic structure of HMW glutenins: Dregerova B/22, Hořická, Semčická hustoklasá and Vígľašská červenoklasá, composed of two glutenin lines.

Marking of breadmaking quality

The possibilities of predicting the breadmaking quality of wheat using gliadin allelic blocks were evaluated by Sozinov, Poperelja (1979)

I. Survey of evaluated varieties and their electrophoretic structure of gliadins and HMW glutenins, expressed by sets GLD and (HMW) GLU allelic blocks

N.	Designation, name of variety	Line	% proportion of line	Gliadin allelic blocks of zones							Glutenin allelic blocks of zones		
				1-1A	2-1A	1B	1D	6A	6B	6D	1A	1B	1D
1	Balvarská bílá	A	100	4	1	1	7	N1	(1)	N1	1	6+8	2+12
2	Bílá od Dukovan	A	90	10	0	1	5	N6	1	1	0	7+9	2+12
		B	10					2					
3	Boleslavská bělka	A	88	9	2	1	1	2	1	1	0	7+8	2+12
		B	6			5							
		C	6			4							
4	Boleslavská vousatka	A	85	5	2	1	1	2	1	1	0	7+8	2+12
		B	15							(8)			
5	Bučianská červenoklasá	A	87	11	0	1	7	(3)	1	1	1	7+9	5+10
		B	13				2*	2		(1)			
6	Bučianská 106	A	100	10	2+3	5	9	2	1	1	0	20	2+12
7	Čalovská	A	100	14	0	4	4	2	(2)	1	1	7+9	2+12
8	Čejčská D III	A	100	9	(0)	1	8	2	2	N1	0	7+8	2+12
9	Červená perla	A	100	1	0	9	2*	N2	(2)	1	2*	7+9	5+10
10	Červená perla bezosinná	A	80	9	0	9	1	3	2	1	0	20	2+12
		B	20			5							
11	Česká přesívka	A	100	1	0	9	2*	N1	(2)	1	2*	7+9	5+10
12	Dětenická červená vouska	A	100	11	0	1	9	2	(2)	1	1	7+9	2+12
13	Dětenická hladká	A	90	9	0	1	1	1	1	N1	0	20	2+12
14	Dětenická N 1827	A	100	11	0	1	9	2	1	2	0	6+8	2+12

Continuation of Tab I.

N.	Designation, name of variety	Line	% proportion of line	Gliadin allelic blocks of zones							Glutenin allelic blocks of zones		
				1-1A	2-1A	1B	1D	6A	6B	6D	1A	1B	1D
15	Diana I	A	100	9	(0)	4	(5)	2	(1)	N6	0	7+9	5+10
16	Diana II	A	100	3	0	4	(5)	3	1	N6	0	7+9	5+10
17	Dobrovická 610	A	75	1	0	8	9	N2	(N7)	1	2	7+9	5+10
		B	25	(4)						(8)			
18	Dobrovická červená 19	A	70	5	3	8	3	N	1	2	1	7+9	2+12
		B	20	1	(0)	8	1	N2	N2	1			
		C	10	2	0	9	5	N2	1	1			
19	Dobrovická česká červenka	A	100	(5)	0	9	2*	3	1	(1)	0	7+9	5+10
20	Dobrovická přesívka P2	A	90	1	0	9	2*	N2	(2)	1	2*	7+9	5+10
		B	10	5				2	(1)				
21	Draga I	A	100	1	0	9	2	N2	1	1	0	7+9	2+12
22	Draga II	A	50	9	1	1	8	1	2	1	0	7+8	2+12
		B	50						N3				
23	Dregerova B/22	A	73	11	0	1	(2)	2	2	1	0	7+9	2+12
		B	9	11	0	1	(2)	N2	1	8	0	20	2+12
		C	9	1	0	1	2	(2)	2	1			
		D	9	9	2	1	2	2	1	1			
24	Dregerova IDA	A	100	9	0	5	2*	N2	2	1	0	7+9	2+12
25	Dregerova SG	A	100	5	2	4	1	N7	1	(8)	0	20	2+12
26	Hanácká bělka	A	100	2	3	5	2*	N2	1	1	1	7+9	2+12

Continuation of Tab. I

N.	Designation, name of variety	Line	% proportion of line	Gliadin allelic blocks of zones							Glutenin allelic blocks of zones		
				1-1A	2-1A	1B	1D	6A	6B	6D	1A	1B	1D
27	Hanácká osinatá	A	50	9	2	13	5	2	1	N1	1	22	2+12
		B	50		(3)	4	4						
28	Hodonínská osinatka	A	100	9	0	9	2*	2	(1)	N1	1	7+8	2+12
29	Hodonínská holice	A	100	9	1	1	8	1	N3	N1	0	7+8	2+12
30	Hodonínská universální	A	91	1	0	1	2	N7	1	2	0	6+8	5+10
		B	9						2				
31	Hořická	A	73	11	0	1	2*	2	1	2	0	20	2+12
		B	9	5	2	4	3	2	1	2	0	7+8	2+12
		C	9	10	2	1	3	2	1	2			
		D	9	9	2	3	2	1	1				
32	Hospodářská bezosinná	A	100	9	2	13	3	2	2	1	1	7+8	2+12
33	Chlumecká 12	A	100	1	0	4	2*	N2	(1)	1	2*	7+9	5+10
34	Chrudimka	A	65	11	0	1	2	N7	1	1	1	6+8	2+12
		B	35					N1					
35	Jinonická	A	100	9	3	4	1	1	1	1	1	20	2+12
36	Kaštická bezosinná	A	100	1	0	(9)	2	N2	(1)	1	1	20	5+10
37	Kaštická bílá Km 100	A	100	9	3	4	2*	2	1	1	0	7+9	2+12
38	Kaštická osinatka	A	100	9	2	4	8	2	1	1	0	7+9	2+12

Continuation of Tab. I

N.	Designation, name of variety	Line	% proportion of line	Gliadin allelic blocks of zones							Glutenin allelic blocks of zones		
				1-1A	2-1A	1B	1D	6A	6B	6D	1A	1B	1D
39	Kaštická přesívka	A	100	11	0	1	2*	1	1	N	0	7	5+10
40	Kelčanská bezosinná	A	100	9	0	1	5	N2	(1)	1	0	7+9	2+12
41	Kelčanská holice	A	83	9	2	1	7	1	1	2	2*	7+8	4+12
		B	17	4		7		3		1			
42	Kelčanská secalobastard	A	50	9	2	4	2	1	1	(2)	2	7+8	4+12
		B	50		0	1	5	3		1			
43	Kelčanská vouska	A	100	9	2	4	9	2	1	N10	0	6+8	2+12
44	Košútská	A	66	2	1	1	9	2	1	1	0	6+8	5+10
		B	34						N5	(1)			
45	Lada	A	83	9	(1)	1	8	2	1	(1)	0	7+8	2+12
		B	17	2	0								
46	Lena	A	100	9	3	4	1	2	N1	1	0	7+9	5+10
47	Liblická červenka	A	100	10	0	9	2*	3	1	1	0	7+9	2+12
48	Mandelíkova ratbořská mara	A	50	9	2	1	3	2	1	1	0	7+9	22+1
		B	50							2			2+12
49	Moravia hnědoklasá	A	100	11	0	(4)	2*	2	1	2	1	7+9	2+12
50	Nebojská	A	50	9	2	4	5	(1)	1	N1	1	7+9	5+10
		B	30		0			1					
		C	20	2	2+3	1		2		2			

Continuation of Tab. I

N.	Designation, name of variety	Line	% proportion of line	Gliadin allelic blocks of zones 1-1A	2-1A	1B	1D	6A	6B	6D	Glutenin allelic blocks of zones 1A	1B	1D
51	Non plus ultra	A	100	1	(1)	4	2	1	1	(2)	0	6+8	5+10
52	Novodvorská volba	A	80	11	3	5	2*	2	(2)	1	1	7+9	2+12
		B	20	N	0	4	6		2				
53	Nový život	A	100	11	0	1	1	1	1	N	0	6+8	5+10
54	Olomoucká 44	A	100	1	0	1	1	1	1	(8)	0	6+8	5+10
55	Oska	A	100	9	2	4	2*	2	1	1	0	7+9	5+10
56	Pavlovická 148	A	87	9	1	1	8	1	N8	N	0	7+8	2+12
		B	13					N1					
57	Podhorská běloklasá	A	95	9	0	1	2	2	1	2	0	7+9	2+12
58	Postoloprtská přesívka 15	A	87	11	0	(9)	2*	2	1	1	0	7+9	2+12
		B	13				2						
59	Postoloprtská přesívka 19	A	100	11	0	13	2*	N	1	N	0	7+9	2+12
60	Postoloprtská přesívka 102	A	100	9	0	(8)	2	2	1	N	0	7	2+12
61	Přerovská alba	A	100	9	3	4	2	2	(2)	1	0	7+8	2+12
62	Přesívka červený oujezd	A	50	1	0	(9)	2*	N2	2	1	0	7+9	2+12
		B	50	10	0	9	5*	2	2	2			
63	Pyšelka	A	66	9	2	4	1	2	1	1	0	20	2+12
		B	34					3					
64	Radošínská 3	A	100	11	0	1	9	2	1	2	0	7+8	2+12

Continuation of Tab. I

N.	Designation, name of variety	Line	% proportion of line	Gliadin allelic blocks of zones 1-1A	2-1A	1B	1D	6A	6B	6D	Glutenin allelic blocks of zones 1A	1B	1D
65	Radošínská dorada	A	75	4	0	1	9	2	1	1	1	7+9	5+10
		B	25	0	3	1	3	1	1	2			
66	Radošínská karola	A	100	4	0	1	9	2	1	2	1	7+9	5+10
67	Radošínská norma	A	100	14	0	9	5	2	1	1	2*	7+9	5+10
68	Radošínská poloraná	A	100	0	3	9	2	2	1	2	0	7+9	2+12
69	Rokycantská sametka	A	100	8	2	4	2	3	1	1	1	7+8	2+12
70	Selecty 206	A	100	14	3	5	2	2	1	1	0	7+8	5+10
71	Selecty červená vouska	A	100	11	0	1	9	1	1	1	1	7+9	2+12
72	Selecty chrudimka	A	80	11	0	1	2*	N7	1	1	1	6+8	2+12
		B	20							(8)			
73	Semčická hustoklasá	A	50	11	0	1	9	1	1	(N1)	1	20	2+12
		B	50	(5)	3	9	9	2	1	1	0	20	2+12
74	Slapská HC	A	100	9	(2)	4	2*	3	1	N	0	7+9	2+12
75	Slapská vouska	A	75	3	0	1	2	2	1	1	1	7+9	2+12
		B	25				2*	N2					
76	Slovenská 2	A	100	(0)	0	1	7*	(1)	2	N6	0	7+8	2+12
77	Slovenská 200	A	100	1	(1)	1	2	2	1	1	1	7+9	5+10
78	Slovenská 777	A	67	2	0	1	7	1	1	N1	1	7+9	2+12
		B	33	4									

Continuation of Tab. I

N.	Designation, name of variety	Line	% proportion of line	Gliadin allelic blocks of zones							Glutenin allelic blocks of zones		
				1-1A	2-1A	1B	1D	6A	6B	6D	1A	1B	1D
79	Slovenská 1784	A	60	2	0	1	7	2	1	1	1	7+9	2+12
		B	30					(1)		N			
		C	10	1									
80	Slovenská B	A	100	14	1	1	2*	1	1	2	1	7+9	2+12
81	Slovenská intenzívna	A	90	1	0	1	7*	2	2	1	0	7+9	2+12
		B	10	0									
82	Staroveská CA	A	100	3	(3)	4	3	2	1	1	0	22	2+12
83	Staroslovenská SA	A	100	N	(2)	1	3	2	1	1	0	6+8	2+12
84	Šumavská	A	100	11	0	(1)	2*	2	1	1	0	22	2+12
85	Trebišovská	A	67	15	0	1	7	2	2	2	0	22	2+12
		B	33	1	0	1	(2)	1	1	N			
86	Valtická osinatá 102	A	65	11	0	1	1	N1	1	N	(0)	22	2+12
		B	35				5			(2)			
87	Valtická osinatá B	A	50	3	1	1	2*	1	1	N	0	22	2+12
		B	50				5*						
88	Víglašská	A	100	15	0	1	5	1	2	N	0	7+9	5+10
89	Víglašská červenoklasá	A	75	11	0	1	2*	1	1	N	0	7+9	5+10
		B	25				5*				1	7+9	5+10
90	Víglašská hustoklasá	A	100	9	2	1	N	2	1	1	0	6+8	2+12

Continuation of Tab. I

N.	Designation, name of variety	Line	% proportion of line	Gliadin allelic blocks of zones							Glutenin allelic blocks of zones		
				1-1A	2-1A	1B	1D	6A	6B	6D	1A	1B	1D
91	Víglašská hustoklasá osinatá	A	90	14	3	(10)	5	1	1	(1)	0	7+9	5+10
		B	10	0						(N)			
92	Vrakunčanská	A	100	4	2+3	7	7	1	1	N1	0	6+8	2+12
93	Zborovická bělka General	A	100	(13)	3	4	2*	2	1	1	1	7+9	2+12
94	Zborovická hustoklasá	A	75	9	3	4	2*	N2	1	1	0	7+8	2+12
		B	25	2	0								
95	Zlatka	A	100	1	2+3	1	4	N1	(3)	1	1	7+8	5+10
96	Zora	A	30	13	0	8	2*	1	1	N	0	7+8	5+10
		B	30			9		2		1			
		C	20	9	(1)	1	8	N	1	1			
		D	20	6	0	1	1	2	1	1	0		
97	Židlochovická bezosinatá KM 12	A	40	10	0	1	2*	1	1	2	0	7+8	5+10
		B	40			5		2		1			
		C	20	9	0	5	1	1	1	2			
98	Židlochovická holice	A	100	11	0	1	N	2	(1)	2	0	7+8	2+12
99	Židlochovická jubilejná osinatá	A	100	11	0	1	2*	1	1	2	0	7+9	2+12
100	Židlochovická osinatá	A	100	11	0	0	3	2	1	2	0	7+9	2+12

II. Characteristics of GLD allelic blocks and allelic blocks of HMW GLU subunits

GLD allelic block		Number of zones, their relative electrophoretic mobility (REM) and their degree of colouring intensity ()*
1-1A	1	23.0(4)-27.5(4)-61.0(5)
	2	27.0(3)-30.0(1)-33.0(2)-36.5(1)-60.5(3)
	3	27.0(3)-28.5(1)-31.5(2)-57.0(4)
	4	59.5(4)-76.0(1)
	5	55.5(2)-58.0(2)
	6	23.0(3)-26.0(2)-27.5(4)-30.5(2)-32.0(2)-61.0(5)
	7	27.5(2)-30.0(2)-32.5(4)-57.0(4)-60.0(3)
	8	17.5(2)-23.0(3)-27.5(4)-77.5(2)
	9	57.0(4)-78.0(3)
	10	57.0(4)
	11	24.0(2)-27.0(4)-27.5(3)-30.5(3)-33.5(3)-35.5(3)-57.0(4)
	12	27.0(3)-28.5(1)-31.5(2)-59.5(4)
	13	27.0(3)-28.5(1)-31.5(2)
	14	23.0(3)-27.5(4)
	15	61.0(5)
	N1	27.0(3)-30.0(1)-33.0(3)-36.5(3)-39.5(1)-57.0(4)
2-1A	1	33.0(4)
	2	31.5(4)
	3	36.0(4)
	1+3	33.0(4)-36.0(4)
	2+3	31.5(4)-36.0(4)
	N	38.0(4)
1B	1	36.0(4)-54.0(5)-76.5(3)-79.5(1)
	2	35.5(3)-43.0(3)-45.0(3)-58.0(4)-72.0(1)-76.0(1)
	3	30.5(1)-34.5(5)-37.5(3)-42.0(5)-45.0(1)-48.5(3)-62.5(3)-66.0(3)
	4	33.5(3)-44.0(2)-54.0(5)-76.0(1)
	5	27.5(2)-32.0(1)-42.0(3)-54.0(5)
	7	33.0(3)-35.5(3)-43.0(3)-45.0(3)-58.0(4)-72.0(1)-76.0(1)
	8	27.5(2)-32.0(1)-37.5(2)-42.0(2)-46.0(1)-49.5(5)
	9	27.5(2)-32.0(1)-37.5(2)-42.0(1)-46.0(3)-49.5(5)
	10	42.0(3)-54.0(5)
	13	27.5(2)-32.0(1)-54.0(3)
	14	39.0(3)-43.0(3)-45.0(3)-58.0(4)-72.0(1)-76.0(1)
	15	27.5(2)-32.0(1)-43.0(2)-54.0(5)
	N	38.0(3)-42.5(3)-46.0(1)-49.5(5)

Continuation of Tab. II

GLD allelic block		Number of zones, their relative electrophoretic mobility (REM) and their degree of colouring intensity ()*
1D	1	13.5(2)-17.5(4)-21.0(3)-55.0(5)-61.5(2)
	1*	like 1 D1+ zone 62.0(5)
	2	17.5(4)-21.0(4)-55.0(5)-61.5(2)
	2*	like 1 D2+ zone 62.0(5)
	3	17.5(5)-21.0(4)-26.5(1)-38.0(1)-55.0(5)-62.0(3)
	4	12.5(3)-16.5(3)-19.0(3)-23.5(4)-55.0(5)-61.5(2)
	5	12.5(3)-16.5(3)-19.0(3)-23.5(3)-26.5(1)-38.0(1)-55.0(5)-61.5(2)
	5*	like 1 D5+ zone 62.0(5)
	6	17.5(4)-21.0(4)-23.0(3)-55.0(5)-61.5(2)
	7	12.5(3)-16.5(3)-19.0)3)-28.5(3)-55.0(5)-61.5(2)
	8	13.5(2)-17.5(4)-21.0(3)-23.0(3)-55.0(5)-61.5(2)
	9	13.5(2)-17.5(4)-21.0(3)-26.5(1)-38.0(1)-55.0(5)-62.0(4)
	10	12.5(3)-16.5(3)-18.0(1)-23.5(4)-55.0(5)-61.5(2)
	N1	12.5(4)-16.5(3)-21.0(1)-55.0(5)-61.5(2)
	N2	1 D2*
6A	1	76.5(1)-81.5(2)-85.0(2)-88.5(2)
	(1)	81.5(2)-85.5(4)-88.5(2)
	2	81.5(2)-85.0(5)-88.5(2)
	3	76.5(2)-81.5(1)-87.0(3)-91.0(4)-96.0(3)
	N	76.5(1)-86.0(3)-88.5(2)-91.0(4)-96.0(3)
	N1	72.5(4)-76.5(1)-86.0(3)-91.0(4)-96.0(3)
	N2	76.5(1)-86.0(3)-91.0(4)-96.0(3)
	N6	76.5(2)-79.0(4)-81.0(1)-87.0(3)-91.0)4)-96.0(3)
	N7	76.5(2)-81.0(1)-87.0(3)-91.0(4)
6B	1	56.5(1)-69.0(5)-70.5(2)-73.5(3)
	2	66.5(4)-72.0(4)
	3	58.0(1)-66.0(1)-69.5(2)-70.5(1)-73.5(3)
	N1	66.5(3)-74.5(4)
	N2	56.5(1)-69.0(5)-73.5(3)-90.5(2)
	N3	71(4)
	N5	66.5(3)-71.0(4)-74.5(3)
	N6	69(5)
	N7	66.5(3)-71.0(4)-74.5(3)-89.0(2)
	N8	66.5(3)-71.0(4)-90.5(2)

Continuation of Tab. II

GLD allelic block		Number of zones, their relative electrophoretic mobility (REM) and their degree of colouring intensity ()*
6D	1	63.5(3)-68.0(4)-74.0(4)-82.0(3)-85.0(3)-87.5(4)
	2	63.5(3)-68.0(4)-74.0(4)-82.0(2)-85.0(2)-90.5(3)
	8	63.5(5)-68.0(4)-74.0(4)-78.0(4)-82.0(3)-85.0(2)-87.5(4)
	N	63.5(4)-68.5(4)-75.0(4)-82.0(3)-85.0(2)-90.5(3)
	N1	68.0(4)-73.5(3)-82.5(2)-86.5(2)
	N6	68.5(4)-73.5(4)-82.0(3)-85.0(2)-87.0(4)
	N10	68.5(4)-73.5(4)-82.0(3)-85.0(2)-90.5(4)
GLU allelic block		**Number of zones, their relative electrophoretic mobility (REM) and their degree of colouring intensity ()***
1A	1	75(4)
	2*	85.5(3)
1B	7+8	100(5)-113(3)
	7+9	100(5)-116(2)
	6+8	95(3)-113(3)
	7	100(5)
	17+18	153(4)-164(3)
	13+19	102(4)-105(3)
	14+15	103(4)-106(3)
	20	103(4)
	21	96(3)
	22	113(4)
	N, N1	non-determined
1D	2+12	85(4)-124(4)
	2+N	1D2+N12 (modification)
	3+12	86(4)-124(4)
	4+12	86.5(4)-124(4)
	5+10	88(5)-120(4)

* = 1 – minimal colouring, 5 – maximal colouring

and S o z i n o v (1985). Point values of prediction of breadmaking quality were set out using sister lines by Š a š e k et al. (1989).

Prediction of breadmaking quality of wheat using signal genes of HMW glutenins were investigated by P a y n e et al. (1979), M o o n e n et al. (1982) and P a y n e (1983).

Point values of breadmaking quality prediction of allelic blocks of glutenis were taken over from the literature (P a y n e et al., 1987, 1988a, b; L u k o w et al., 1989; H a m m e r et al., 1992).

Č e r n ý et al. (1992a, b) and Š a š e k et al. (1994) checked the point values of breadmaking quality prediction of gliadin and glutenin allelic blocks by correlation test.

Validation of point value of breadmaking quality prediction of different allelic blocks of gliadins and HMW glutenins are present in Tab. III.

Based on point values of breadmaking quality prediction, a collection of varieties evaluated can be classified into several groups. Gliadin allelic block 1B1 – marker of high breadmaking quality was found in 53 varieties, i.e. in 53% of analyzed varieties and in 61 gliadin lines resp., of the total number 151 lines separated by electrophoresis from 53 varieties evaluated, i.e. in 40% of gliadin lines obtained. This proportion of varieties or gliadin lines bearing allele Gld 1B1 is markedly higher than is the representation of this allele in the present assortment of certified wheat varieties (Š a š e k , Č e r n ý , 1983; Č e r n ý et al., 1994).

Another allelic gliadin block 1B4, marking higher breadmaking quality, was found in 23 varieties (23%) and 26 gliadin lines (17%), respectively.

The frequency of this marker of higher adaptability and agronomic value is lower compared with present common wheat varieties of the Central European region (Š a š e k , Č e r n ý , 1995; Č e r n ý et al., 1994; Š a š e k et al., 1994, 1995).

The present occurrence of glutenin markers of higher breadmaking quality, i.e. allelic blocks 1A1 or 1A*, 1B7+8 or 1B17+18 and 1D5+10 was found in the varieties Bučianska červenoklasá, Červená perla and Zlatka. A favourable composition of glutenin markers of better breadmaking quality 1A1 or 1A2* or 1A0, 1B7+9, and 1B7+8 and 1D5+10, respectively, was manifested in 21 varieties (21%).

Combination of gliadin and glutenin markers of high breadmaking quality conditioned by additive interaction corresponding to gliadin and glutenin genes (Š a š e k et al., 1989) was manifested in the varieties Bučianska červenoklasá, Zlatka, and in the varieties Košútska, Radošínska Dorada, Radošínska Karola, Slovenská 200, Vígľašská, Vígľašská červenoklasá, resp., in lines C and D of the variety Zora and in the line A of the variety Židlochovická bezosinatá KM 12.

By crossing of evaluated varieties or their protein lines, respectively, provided solely with gliadin or solely glutenin markers of better breadmaking quality, hybrid lines with transgression in point value of breadmaking quality prediction can be obtained (Š a š e k et al., 1989; Č e r n ý et al., 1991). An

III. Point values of breadmaking quality prediction of wheat of GLD and HMW GLU allelic blocks

Locus	Allele	Point value of breadmaking quality prediction
Gliadin allelic blocks[1)]		
1-1A	1	0.5
	2	3.5
	3	2
	4	4
	5	3
	6	0.5
	7	5
	8	0.5
	9	3
	10	2
	12	2
	13	2
	14	3
	15	0.5
	16	0.5
	0	0
	N	(3)
	N1(2)	3
2-1A	0	0
	1	0
	2	0
	3	0
1B	1	8
	2	4.5
	3	0
	4	5.5
	5	5
	6	0
	7	6
	10	(5)
	15	5
1D	1	2
	2	1
	3	1

Continuation of Tab. III

Locus	Allele	Point value of breadmaking quality prediction
	4	3
	5	2.5
	6	1.5
	7	2
	8	0.5
	9	1.5
	10	(2)
	N	0
	N3	1.5
6A	1	1
	2	2
	3	3.5
	N1	3
	N2	3
6B	1	1.5
	2	3.5
	3	1.5
	N	1
	N2	3.5
	N5	3
	N8	3
6D	1	1.5
	2	3
	3	2.5
	4	2.5
	5	1
	6	1
	7	1
	8	1
	9	2
	N1	1.5
	N(2)	1.5
	N4	2.5
	N6	1
	N7	2.5

Continuation of Tab. III

Locus	Allele	Point value of breadmaking quality prediction
Allelic blocks of HMW glutenins[2)]		
1A	0	1
	1	3
	2*	3
1B	6+8	1
	7	1
	7+8	3
	7+9	2
	13+16	3
	14+15	1
	17+18	3
	20	1
1D	2+12	2
	3+12	2
	4+12	1
	5+10	4

Explanations: [1)] after Šašek et al. (1989), [2)] after Payne et al. (1988a, b), Lukow et al. (1989), Hammer et al. (1992)

evaluated collection of regional and old bred varieties of common wheat can be used in this way.

Evaluated varieties or their lines bearing gliadin and glutenin genes – markers of high or higher breadmaking quality can be used in breeding programmes of wheat varieties.

Frost-hardiness marking

Some gliadin genes, present in chromosomes 1A, 1D and 6D mark frost-hardiness (Šašek et al., 1984; Černý et al., 1990a).

The presence of both main markers of frost-hardiness, i.e. allelic gliadin blocks 1D5 and 6A3, were found solely in the variety Diana II and in the line B of the variety Kelčanská Secalo Bastard.

19 varieties in total are provided with one main marker of frost-hardiness, what means 19% of evaluated varieties.

The said varieties or their gliadin lines bearing frost-hardiness markers are genetic resources of frost-hardiness.

Secondary gliadin markers of frost-hardiness, i.e. genes Gld 1A1, Gld 1A2 and Gld 6D2, mark less efficient genes of frost-hardiness, occurred individually or totally in 37% of varieties evaluated.

Marking of resistance to stem rust of grass

Gliadin or secalin allelic block Gld 1B3 marks translocation 1R/1B bearing the gene of resistance to stem rust of grass Sr31 (Sozinov, 1985; Bartoš, 1991). Evaluated varieties do not involve in their electrophoretic gliadin spectrum the mentioned marker GLD 1B3. Regional varieties and prevailing part of first bred varieties are older than introduction of translocation 1R/1B in varieties of common wheat.

Černý et al. (1995) have stated by approximate method the correlation dependence among the genes for stem rust resistance and the signal genes Gld 1A15, Gld 1A3, Gld 1D5, corresponding to gliadin allelic blocks in electrophoretic spectrum of 18 evaluated varieties. The said authors referred to correlation between resistance to leaf rust of wheat and occurrence of blocks GLD 1D1 and GLD 6A2. These blocks were found in electrophoretic spectrum of 63 evaluated varieties in total. Similarly, the capacity of allelic gliadin blocks GLD 1B4 and GLD 1D9 to mark resistance to yellow rust of cereals was manifested. These blocks were recorded in spectrum of total 34 varieties.

New, till now not defined alleles of gliadin signal genes

In evaluated collection of regional and primary breeding varieties there were found new, till now not registered or rare alleles of gliadin signal genes.

In the locus GlD1-1A these are alleles 1-1A11, 1-1AN and 1-1AN1 and in the locus Gld 2-1A - allele 2-1AN. In the locus Gld 1B a new allele 1BN and rare 1B10 appeared.

In the locus Gld 1D, till not unknown alleles were identified. They are manifested by the change corresponding to registered allelic blocks, particularly by assigning the zone with REM 62.0 (5). These are alleles Gld 1D2*, Gld 1D5* and Gld 1D7*. Allele 1D2* is identical with the allele Gld 1N2 with that previously described (Šašek et al., 1995).

Three new alleles were found in the locus Gld 6A. These alleles manifest the blocks GLD 6AN, GLD 6AN6 and GLD 6A7. Evaluated collection of varieties allowed to find new alleles of the locus Gld 6B, i.e. the following alleles: 6BN, 6BN1, 6BN2, 6BN3, 6BN5, 6BN6, 6BN7 and 6BN8.

Finally, the locus Gld 6D was manifested in the evaluated collection of varieties by new, till now not recorded, alleles 6DN, 6DN6 and 6DN10.

The prerequisite for the use of new alleles of signal gliadin genes in breeding programmes of common wheat is testing and quantification of marker values of these alleles.

With reference to lower variance of genes identifying HMW glutenin subunits, only a new allele Glu 1D2+N and rarer allele Glu 1B22 were found by electrophoresis of these glutenins.

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Analýza genetické struktury krajových odrůd pšenice obecné pomocí signálních gliadinových a gluteninových genů.

Scientia Agric. Bohem., *27*, 1996 (3): 161–182.

Pomocí signálních genů, determinujících gliadiny a podjednotky gluteninů s VMH, byla sledována genetická struktura 100 krajových odrůd a starých restringovaných odrůd pšenice obecné (*T. aestivum* L.) českomoravského a slovenského regionu. Současně byly u těchto odrůd detekovány bílkovinné markery pekařské jakosti, mrazuvzdornosti a odolnosti ke rzím.

Ke stanovení elektroforetické skladby gliadinů bylo použito postupu SGE podle autorů Šašek a Černý (1983). Alelické gliadinové bloky byly vyčleněny podle autorů Sobko a Poperelja (1986). K separaci gluteninů s VMH bylo použito postupu SDS PAGE podle autora Laemmli (1970). Alelické bloky zón gluteninů s VMH byly zjišťovány podle autorů Payne et al. (1981)

Celkem 40 % hodnocených odrůd představuje populace polymorfní ve skladbě gliadinů a gluteninů s VMH, skládajících se ze dvou až čtyř bílkovinných linií. Účelné využití těchto populací jako genetických zdrojů vyžaduje vyčlenění a samostatné množení a hodnocení zjištěných bílkovinných linií.

V hodnoceném souboru odrůd byly zjištěny gliadinové a gluteninové linie, vybavené signálními geny – markery vyšší pekařské jakosti, mrazuvzdornosti a odolnosti ke rzi travní, ke rzi pšeničné a ke rzi žluté.

pšenice obecná; krajové odrůdy; elektroforéza; gliadiny; gluteniny s VMH; signální geny; genetická struktura; pekařská jakost; mrazuvzdornost; odolnost ke rzím

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