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VARIABILITY OF GLIADIN BLOCKS IN HYBRID DERIVATIVES OF MIGUSHOVA WHEAT AND COMMON WHEAT

Abstract

The electrophoretic spectra of gliadin components of Triticum miguschovae Zhir., B_1F_4 progeny from crossing Migushova wheat (A^bA^bGGDD) with common wheat varieties Vdala and Panna, winter common wheat varieties T. aestivum L. (A^uA^uBBDD) Aurora, Vdala, Leleka, Nikonia, Odeska 267, Panna, Selyanka, Tira, were studied. Comparison of the electrophoretic spectra of gliadins of the parent plants that were used to obtain F_1 hybrids revealed the presence of differences in some components of the spectrum for both pairs – Migushova wheat x *Vdala and Migushova wheat* x *Panna. For the first crossbreeding combination, 17 components out of 25 were polymorphic for the spectra of the parental plants. For the second crossbreeding combination, 10 out of 27 were polymorphic. In the gliadin spectra of B_1F_4 grains, a combination of parental components was found, which confirms the hybrid origin of B_1F_4 grains. In the spectra of F_4 grains, polymorphisms that are characteristic for Migushova wheat prevailed. The only exceptions were components 14 and 24, for which the polymorphism "0", characteristic of the spectrum of the Vdala variety, prevailed. Components 7 and 21 were not present in the spectra of parental plants of both crosses, but they appeared in the electrophoretic spectra of B_1F_4 descendants. The version of the cross-pollination of hybrids T. miguschovae* x *T. aestivum had to be rejected due to the complete sterility of such hybrids, known from previous years of work with hybrids of Miguschova wheat and common wheat. That is, components 7 and 21 are the novelty. For hybrids from the crossing of Miguschova wheat with the Panna variety, the tendency of the dominance of the spectrum components characteristic for Miguschova wheat is preserved, although here too there are exceptions: for components 8 and 18, the polymorphism "1" characterizes Panna and it is most often registered in the spectra of grains. In the spectra of hybrids from this cross, the newest components 7 and 21 are also present. Component 21 is found in almost all spectra with rare exceptions. Component 7 is present in the descendants of four out of six F_3 hybrids from the crossing of Migushova wheat with Vdala, and among the hybrids with Panna it is present in the spectra of 11 out of 12 F_3 hybrids. Other novel components are 26 and 27. They are present in the spectra of B_1F_4 grains, which originated from a single F_3 plant No. 621. It can be assumed that the molecular event that resulted in the appearance of novel components in the gliadin spectrum occurred precisely in this plant. Its F_4 descendants can be involved in further studies at the level of nucleotide sequences of gliadin genes to clarify the nature of molecular processes that occur in genomes of hybrid origin and become the source of the emergence of novel traits.*

Keywords: common wheat, Migushova wheat, gliadins, hybrid genome, novel traits.

Introduction

Artificial introgressive hybridization is the crossing of individuals belonging to different biological species. It is widely used in plant breeding, in particular, in common wheat, to introduce genes of alien origin into the genome of cultivated plants, i.e., varieties. Such genes are designed to improve the cultivated species in terms of selectively important traits. First of all, such traits are resistance to biotic and abiotic environmental factors [1,2]. It is believed that the numerous wild relatives of wheat are an inexhaustible source of useful genes, and they can be transferred to the wheat gene pool through introgressive hybridization [3–8]. Migushova wheat is an artificially developed amphidiploid of Militina wheat with the A^bA^bGG genome and Tausch aegilops with the DD genome and differs from common wheat (A^uA^uBBDD) in two of the three subgenomes [9]. Its attractive properties are high protein content in the grain [10] and resistance to Fusarium wilt [11]. Fusarium wilt is a cereal disease that is gradually emerging as a fungal disease of wheat [12–15]. Plants affected by fusarium wilt do more than just reduce productivity. They produce grain that is toxic to humans and animals when consumed [16]. Currently, very limited sources of genetic resistance to fusarium wilt are known, and one such source is Migushova wheat [11]. Crossing common wheat with Migushova wheat is characterized by poor congruence, as first-generation hybrids are almost self-sterile and produce kernels with an average frequency of 0.5 kernels per spike. Fertility is restored very slowly in subsequent generations.

In recent years, it has been found that so-called novel traits, i.e. gradations of traits that were not inherent in any of the cross components, may appear among the descendants of wide crosses. It has been suggested that the consequence of introgressive hybridization is not only the transfer of alien genetic material to the genome of the recipient cross component, but also the promotion of genetic instability of the genome of hybrid origin, which can be considered the manifestation of novel traits [17–23]. At what level, genetic or epigenetic, the expansion of variability occurs remains to be determined [24–27].

Gliadins are an optimal genetic model on which the expansion of genetic variability of the hybrid genome in comparison with the cross components can be studied. Due to the cluster nature of the corresponding genes and the presence of six paralogs/orthologs in the genome [28], gliadins seem to be a very convenient system for rapid and inexpensive screening of hybrid progeny to verify their hybrid origin and possible detection of genotypes by gliadin genes, the appearance of which cannot be explained only by the recombination of the genetic material of the original cross components. The article presents the results of studying the gliadin spectra of the progeny of B_1F_4 *Triticum miguschovae* x *T. aestivum* to confirm the hybridity of their genomes. The phenomenon of asymmetric combination of gliadin spectrum components and the appearance of new components, relative to the parental spectra, are analyzed and discussed.

Materials and methods of the study

The source of gliadin proteins was: winter varieties of common wheat (*Triticum aestivum* L., genome A^uA^uBBDD) Aurora, Vdala, Leleka, Nikonia, Odeska 267, Panna, Selyanka, Tira; Migushova wheat (*Triticum miguschovae* Zhir., genome A^bA^bGGDD); seed progeny B_1F_4 (hereinafter F_4) from B_1F_3 plants (hereinafter F_3) from crossing Migushova wheat with common wheat varieties and performing one backcross with common wheat (Table 1). Four random grains were taken from each F_3 plant, and the gliadins isolated from them were subjected to electrophoretic analysis.

Wheat storage proteins gliadins were isolated from single dry wheat grains with 70% ethyl alcohol. Extracted for 1.5 hours, 60 μl of the upper supernatant phase was taken and evaporated at 60 °C in a dry heat oven for 24 hours. The dry precipitate was dissolved in 50 μl of 5.5 M urea solution. Electrophoretic separation of gliadins was performed in a vertical polyacrylamide gel (PAAG) according to the Brzezinski method [29]. Gels were prepared for separation and concentration. For polymerization of gels, solutions of TEMED and PSA catalysts were used in an amount of 20 μl and 200 μl, respectively. Samples with extracted gliadins were added to individual slots of the concentrating gel in 20 μl. Electrophoretic separation was carried out from anode to cathode for 7 hours: U = 300 V; I = 15 mA – until entering the gel for separation; U = 300 V; I = 30 mA – until the end of the electrophoresis process. The glass with the gel sewn to it was washed with running water and fixed in a solution with a dye overnight. The zones of gliadin activity are visualized as dark blue stripes on a light blue background. Gels with the results of electrophoresis are suitable for storage and analysis.

Table 1

Origin of the F_3 hybrids studied

Field numbers of hybrids F_3	**Hybrid from crossing *T. miguschovae* with a variety of common wheat**
401–405, 438, 439,1086, 1088, 1090–1094, 1096–1099	Vdala
377, 379, 381, 383–399, 406–416, 418, 419, 421–426, 428, 429, 431, 432, 434–437, 441–443, 1077, 1078, 1085	Panna

The results of electrophoresis were recorded by describing the electrophoretic spectrum of the samples in the 1/0 system (component of the spectrum is present/component is absent). The basis for the numbering of the components were the spectra of Migushova wheat, common wheat varieties Vdala and Panna, whose gliadin spectra were available on each slide. To standardize the description, after obtaining the spectra of all samples, all detected components were numbered from 1 (the heaviest component) to 27 (the lightest component). This registration system allows you to compare any samples by gliadin spectrum without studying the genetic control of individual components, since the products of six cluster genes (GliA1, GliB1, GliD1, GliA2, GliB2, GliD2) are separated [28].

Results and discussion

Based on the results of gliadin separation in PAAG, electrophoretic spectra of gliadin components were obtained for Miguschovae wheat (Tables 2 and 3, column 2), common wheat varieties Vdala (Table 2, column 3) and Panna (Table 3, column 3), and F_4 grains from the *T. miguschovae* x Vdala (Table 2) and *T. miguschovae* x Panna (Table 3) crosses. The description of the spectra in Tables 2 and 3 is presented according to the system 1 (component present)/0 component absent. Gliadins of hexaploid wheat are encoded by six genes, two for each of the three subgenomes, and free combination of these genes is expected in hybrid plants, since they are located on different chromosomes, the 1st and 6th homoeologous groups [28]. The initial analysis consisted of comparing the spectra gliadins isolated separately from each of the four F_4 grains from each F_3 plant listed in Table 1. This comparison did not reveal any differences in the gliadin spectra of F_4 grains obtained from F_3 hybrids. Therefore, in Tables 2 and 3, each F_3 hybrid is represented by only one spectrum common to all F_4 grains.

Further analysis of electrophoretic spectra consisted in comparing the spectra of F_4 grains with the gliadin spectra of the plants that were parents in the original crosses. Such a comparison revealed a difference (polymorphism) in some components of the gliadin spectrum for both crosses: Migushova wheat x Vdala and Migushova wheat x Panna. In Tables 2 and 3, the components of the gliadin spectra by which the parent plants differ are marked in pink. For the Migushova wheat x Vdala, 17 polymorphic components out of 24 presented in Table 2 were found. For the Migushova wheat x Panna, 10 out of 27 were found (Table 3). Characterization of the gliadin spectra of F_4 grains by these spectral components, which differed for the plants of the initial cross, makes it possible to confirm the hybrid nature of their genomes: the spectra contain various combinations of gliadin spectrum components, polymorphic according to the 1/0 system, which characterize Migushova wheat and the common wheat varieties Vdala or Panna, with which it was pollinated, obtaining F_1 hybrids.

Table 2 shows that the spectra of F_4 grains are prevailed by polymorphisms that are characteristic of Migushova wheat. And this does not depend on which state “1” or “0” is characteristic of the gliadin spectrum of Migushova wheat. Therefore, the established tendency of the asymmetry of the gliadin spectrum towards the prevalence of components characteristic of Migushova wheat cannot be explained simply by the increase in class “1” due to the entry into it of both homozygotes for this polymorphism and heterozygotes. An exception was found: for components 14 and 24, the polymorphism “0” inherent in the gliadin spectrum of the Vdala variety prevails.

The tendency of the prevalence of spectrum components characteristic of Migushova wheat is also preserved for hybrids from the crossing of Migushova wheat with the Panna variety. There is also an exception here: for components 8 and 18 in the gliadin spectra of grains, polymorphism “1” is most often recorded, and it characterizes the Panna spectrum (Table 3). Thus, the asymmetry of hybrids from the crossing of Migushova wheat as a maternal component with common wheat varieties as a parental one according to the morphological characteristics of the ear, which was revealed according to the evaluation data of F_3 hybrids, is fully confirmed when considering the gliadin spectra of parental plants and their hybrids.

An important feature of the gliadin spectra of F_4 grains is the presence in them of components that were not present in the spectra of the parent plants, Migushova wheat and common wheat varieties. In Tables 2 and 3, the corresponding components are marked with a green color. These are components 7 and 21, which are recorded in the gliadin spectra of hybrids of both cross combinations. Component 21 is found in almost all spectra with a few exceptions. Component 7 is present in the spectra of F_4 hybrids, which originate from four of the six F_3 hybrids taken for study, from the cross of Migushova wheat with the Vdala variety. In Tables 2 and 3, the origin of F_4 hybrid grains from different F_3 plants can be seen in the table headers, top row. For the crossing of wheat Migushova x Panna hybrids with the newest component of the gliadin spectrum 7 were derived from 11 of the 12 F_3 hybrids taken for study.

When an illegitimate component (one that should not have been present judging by the spectra of the parent plants) appears in the gliadin spectra, an assumption naturally arises about the possible cross-pollination of the hybrids during the growing season. It was to verify this assumption that the gliadin spectra of common wheat varieties that grew in the field together with the F_3 hybrids were studied. However, although components 7 and 21 are indeed present in the spectra of some of the varieties studied, the assumption of cross-pollination had to be abandoned. Firstly, because of the high frequency of the presence of these components among the offspring. This shows that the novel component appeared in the early hybrid generations (F_1 and F_2), and the hybrids of these generations were grown in an artificial climate room where no common wheat varieties except Vdala and Panna were grown. Secondly, long-term experience in attempts to obtain hybrids between Migushova wheat and common wheat varieties shows without any exceptions that it is very difficult to cross Migushova wheat with common wheat.

After artificial pollination of emasculated Migushova wheat flowers with common wheat pollen, hybrid grains can be obtained with a frequency of 0.3–0.5 per spike, and not with all common wheat genotypes. In particular, of the seven (Vdala, Leleka, Nikonia, Odeska 267, Panna, Selyanka, Tira) varieties involved in crosses with Migushova wheat, the result was achieved only for two varieties. Hybrid grains are characterized by wrinkling (poorly developed endosperm) and not all of them survive germination. F_1 plants remain highly sterile and require backcrossing, sometimes twice. Therefore, the appearance in the gliadin spectra of B_1F_4 seeds (after one backcross) of components that are new in relation to the spectra of the parent plants of the initial cross should be considered as an example of a novel trait. The appearance of a novel trait indicates the course of some molecular processes that accompany the formation and consolidation of hybrid genomes. Currently, many molecular mechanisms are known that could be considered responsible for the emergence of such novel traits. Verification of the possibility of participation of such mechanisms is a matter of further research. Now we can only assume that this mechanism worked in the early hybrid generation, which is why the novel components of the spectrum turned out to be widespread in almost all F_4 hybrids.

Other novel components are 26 and 27. They are clearly visible in the spectra of grains that came from one F_3 plant No. 621 of the cross of Migushova wheat with the Panna variety. It can be assumed that the molecular event that resulted in the appearance of novel components in the gliadin spectrum occurred precisely in this plant. Its F_4 descendants can be used for further research at the DNA level into the nature of molecular processes that occur in genomes of hybrid origin and become the source of the emergence of novel traits.

Conclusions

The presence in the gliadin spectra of F_4 grains of various combinations of components of the spectra of Migushova wheat and common wheat varieties Vdala and Panna, polymorphic according to the gliadin spectrum description system 1/0, indicates the hybrid nature of the studied grains. The gliadin spectra of F_4 grains were prevailed by polymorphisms characteristic of Migushova wheat, which coincides with the phenotypic asymmetry of F_3 hybrids according to morphological features, established during the cultivation of these plants in the field. The gliadin spectra of hybrid grains include novel components that were not present in the spectra of the parent plants. The frequency of their distribution in hybrids indicates that the molecular events that led to their appearance occurred in F_1–F_2 hybrids. The novel components of spectra 26 and 27 arose in the F_3 generation. Verification of gliadin spectra allows identifying hybrid plants, the genome of which can become the object of further research to establish the nature and course of molecular events that occur in genomes of hybrid origin and can serve as a source of the emergence of new traits.

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Table 2

Description of electrophoretic spectra of gliadin components in PAAG in F_3 grains of the *T. miguschovae* x Vdala cross combination.
Here and in Table 3, “1” means the presence of a component, “0” – absence.
The first line of the table header indicates the numbers of F_2 hybrids, the second line – F_3

Component number	*T. miguschovae*	Vdala	525				566		501	534		531			502				
			401	402	403	405	438	439	1086	1088	1090	1091	1092	1093	1094	1096	1097	1098	1099
1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1
2	1	1	0	0	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
7	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0
8	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
10	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
11	1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
12	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0
15	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
17	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
18	0	1	1	1	1	0	0	0	1	1	0	0	0	0	1	1	1	1	1
19	1	0	0	0	0	0	1	0	0	0	1	1	1	1	0	0	1	0	0
20	1	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
21	0	0	1	1	1	0	1	1	0	0	0	0	0	0	1	1	0	0	0
22	1	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
23	1	0	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0
24	1	0	1	1	1	0	1	0	0	0	0	1	1	1	1	1	1	1	1
25	1	0	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0

Table 3

Description of electrophoretic spectra of gliadin components in PAAG in F_3 grains of the *T. miguschovae* x Panna cross combination

Component number	*T. miguschovae*	Panna	621							626								616					425
			377	379	381	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	405
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	0	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0
7	0	0	0	0	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1	1	0
8	0	1	1	0	0	1	0	1	0	1	1	0	0	0	1	1	1	0	0	0	1	1	1
9	1	1	1	0	1	0	1	0	1	1	1	1	1	1	1	0	0	1	1	1	1	0	1
10	1	0	0	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	1	0	0	1	1	1	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0
12	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1	1	1	0	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	1	1	0	1
15	0	1	0	1	0	1	0	1	1	1	1	0	0	1	0	0	0	1	0	0	0	1	0
16	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1
17	0	1	0	1	1	1	1	1	0	1	1	0	0	1	1	1	1	1	1	0	1	1	0
18	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	0	1	1	1
19	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
20	1	1	1	0	0	1	0	1	1	0	1	1	1	1	1	1	0	1	1	0	1	0	1
21	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
22	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1
23	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24	1	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
25	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
26	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3 (continued)

Component number	*T. miguschovae*	Panna	630								629				631	625						
			406	407	408	409	410	406	411	412	413	414	415	416	418	419	421	422	423	424	425	426
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	0	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	1	1	0	0	0	0	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0
7	0	0	0	1	1	0	0	0	1	1	1	1	1	0	1	1	0	1	1	1	1	1
8	0	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	0	1	1	1	1	0
9	1	1	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0
10	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	1	0	0	1	0	0	0	0	0	1	1	1	1	1	0	1	1	1	1	0	1	1
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1
15	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
16	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17	0	1	1	0	0	0	1	1	0	1	1	1	1	1	0	1	1	1	1	0	1	1
18	0	1	0	1	1	0	0	0	1	1	1	1	0	0	1	1	1	1	0	1	0	1
19	1	1	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	1	1	1	0
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
21	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
23	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
25	1	0	0	1	0	0	0	0	1	0	1	1	0	1	1	1	1	1	1	1	1	1
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3 (continued)

Component number	*T. miguschovae*	Panna	628			636					624			617		
			428	429	431	432	434	435	436	437	441	442	443	1077	1078	1085
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	1	1	0	0	1	0	1	0	0	0	1	0	1	1	0	1
7	0	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1
8	0	1	1	1	0	1	0	1	1	1	0	1	1	0	1	0
9	1	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0
10	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	1	0	1	1	0	1	1	1	1	0	0	1	1	0	1	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
15	0	1	0	0	0	1	0	0	0	0	0	0	0	1	1	1
16	1	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0
17	0	1	0	1	0	1	1	1	1	0	1	1	0	0	0	0
18	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
19	1	1	1	0	0	0	0	0	0	1	1	0	0	1	1	1
20	1	1	1	1	1	1	1	0	1	1	0	1	1	0	1	0
21	0	0	1	1	1	1	0	1	1	1	1	0	1	1	1	1
22	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1
23	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
25	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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МІНЛИВІСТЬ ГЛІАДИНОВИХ БЛОКІВ У ГІБРИДНИХ ПОХІДНИХ ПШЕНИЦІ МІГУШОВОЇ ТА ПШЕНИЦІ М'ЯКОЇ

Вивчено електрофоретичні спектри гліадинових компонентів для *Triticum miguschovae* Zhir., нащадків B_1F_4 від схрещування пшениці Мігушової з сортами пшениці м'якої Вдала та Панна, озимих сортів пшениці м'якої *T. aestivum* L. (A^uA^uBBDD) Аврора, Вдала, Лелека, Ніконія, Одеська 267, Панна, Селянка, Тіра.

Порівняння електрофоретичних спектрів гліадинів батьківських рослин, використаних для отримання гібридів F_1, виявило наявність різниці за деякими компонентами спектра для обох пар – пшениця Мігушової х Вдала та пшениця Мігушової х Панна. Для першої пари компонентів, що виявилися поліморфними для спектрів батьківських рослин, було 17 із 25, для другої пари – 10 із 27. У гліадинових спектрах зернівок B_1F_4 виявили поєднання компонентів, притаманних батьківським рослинам, що дали гібриди F_1, що свідчить про гібридне походження зернівки B_1F_4.

У спектрах зернівок F_4 домінують поліморфізми, властиві пшениці Мігушової. Винятком є лише компоненти 14 і 24, за якими домінує поліморфізм «0», властивий спектру сорту Вдала. Компонентів 7 та 21 у батьківських рослин цього схрещування не було, але на електрофоретичних спектрах нащадків B_1F_4 вони з'явились. Версію про перезапилення гібридів *T. miguschovae* x *T. aestivum* довелось відкинути через повну стерильність таких гібридів, відому з попередніх років роботи з гібридами пшениці Мігушової та пшениці м'якої. Тобто 7 та 21 компоненти новітні.

Для гібридів від схрещування пшениці Мігушової з сортом Панна тенденція домінування компонентів спектра, властивих пшениці Мігушової, зберігається, хоча і тут також є винятки: за компонентами 8 та 18 поліморфізм «1» характеризує Панну, і саме він найчастіше реєструється в спектрах зернівок. У спектрах гібридів від цього схрещування також наявні новітні компоненти 7 та 21. Компонент 21 трапляється практично у всіх спектрах за рідкісними винятками. Компонент 7 наявний серед нащадків чотирьох із шести гібридів F_3 від схрещування пшениці Мігушової з Вдалою, а серед гібридів із Панною він наявний у спектрах 11 з 12 гібридів F_3. Іншими новітніми компонентами є 26 та 27. Вони наявні в спектрах зернівок B_1F_4, які пішли від однієї рослини F_3 № 621. Можна припустити, що молекулярна подія, наслідком якої стала поява новітніх компонентів у гліадиновому спектрі, відбулася саме в цій рослині. Її нащадки F_4 можуть бути залучені для подальших досліджень на рівні послідовності нуклеотидів гліадинових генів для з'ясування питання щодо природи молекулярних процесів, які відбуваються в геномах гібридного походження та стають джерелом виникнення новітніх ознак.

Ключові слова: пшениця м'яка, пшениця Мігушової, гліадини, гібридний геном, новітні ознаки.

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