Research Article

www.ekinjournal.com

Ekin
Journal of Crop Breeding and Genetics

(2015) 1-2:32-37

KASIB spring common wheat genotype identification on glutenin and gliadin subunits

Aigul Abugalieva[1*] Alexei Morgounov[2] Javier Roberto Pena[2] Nina Volkovinskaya[1] Timur Savin[3]

[1] LLP Kazakh Research Institute of Agriculture and Plant Growing.
Corporation, KazAgroInnovation
[2] CYMMIT, Ankara, Turkey
[3] Kazakh National Agrarian University, Almaty, Kazakhstan
[*] Corresponding author e-mail: kiz_abugalieva@mail.ru

Citation:
Abugalieva A, Morgounov A, Pena JP, Volkovinskaya N, Savin T 2015. KASIB spring common wheat genotype identification on glutenin and gliadin subunits. Ekin J Crop Breed and Gen 1-2:32-37.

Received: 25.07.2014 ***Accepted: 11.10.2014*** ***Published Online: 30.07.2015*** ***Printed: 31.07.2015***

ABSTRACT

Based on the electrophoretic spectrum, analysis, 216 genotypes of spring wheat were identified as belonging to 25 types including 18 types of HMW-glutenin for 188 homogeneous cultivars. Most of the spring wheat KASIB could be characterized by the subunits 2 * 7+9 5+10 (40% genotypes), and subunits 2* 7+9 2+12– (30%) and subunits 1*7+9 5+10– (8%). The diversity appears to be determined by varying chromosome 1A and 1B at the 5 subunits and 1D-4 subunits HMG. Judging from the distribution of genotypes KASIB nurseries are mostly HMW-glutenin determining high quality baking by subunits: 1A-2 *(77-79%) and 1 (14-15%), at 1B-7+9 (81-82%) and 7+8(13-15%), by 1D –5+10 to 60%. A new subunit is to be included to this set ie., "4+10" for 1D for samples from Erythrospermum 55/94-01-20 (Pavlodar Research Institute, KASIB8-9), Fiton 41 (KASIB 8-9) relative to genofund of high-quality genotypes found in Kazakhstan. Cultivar "Iridost" is identified with alleles 5.5+10 on chromosome 1D, previously identified for cultivars Tselinogradka, Tselinnaya 24, Akmola 3. In cultivar Chelyaba, chromosome 1B set possessed only 6+8 subunit and in the mix for cultivars Lutescens 29-94; for genotypes: E-607 and E-757 - a rare characteristic subunit7*+8 was found. Genotypes OK -1, Fiton 25 and GVK 1916-9 carrying wheat-rye 1B/1R-translocation clustered distantly from all other genotypes. Wheat-rye translocation (IB/ IR) were identified more in samples for Omsk breeding and West Kazakhstan in each KASIB (exceptKASIB4-5), for all samples submitted "Kurgansemena" (except Lutescens415/00) and "Agrosemkonsalt" (KASIB8-9 and 10-11), as well as for LLP "Fiton" breeding samples (Fiton 41 and Fiton 43, including CIMMYT shuttle breeding material.

Keywords: spring wheat, the HMW and the LMW glutenin, gliadin, wheat-rye translocation, hardness, varieties identification, UPOV

Introduction

The UPOV embarks on having clear criteria for DUS-testing. For this purpose, a series of special research on the suitability and expediency of using the researched results of electrophoresis protein markers - first of all the grain prolamins were suggested (Cooke, 1995). In recent years, in the UPOV method for identifying varieties, electrophoresis analysis of seed storage proteins (27-29 sings) is used.

Information on HMW glutenin and gliadin data content offers to answer to the 3 DUS criteria: homogeneity, distinctness and stability. According to the UPOV recommendation, the results of HMW glutenin describe the 1A, 1B and 1D chromosomes for containing specific subunits, as it has been realized in context of Kazakhstan variety genofund (Abugalieva and, Pena, 2010; Abugalieva, and Morgounov, 2004).

Kazakhstan-Siberian nursery improvement programmes of spring wheat are being conducted under the auspices of the CIMMYT. It is important to identify and investigate these samples for distance, uniformity and stability. The main part of spring wheat is characterized by the subunit "2* 7+9 5+10" to 40% of all homogeneous; subunits "2* 7+9 2+12" - up to 30% and by the subunits "1 7+9 5+10"- up to 8% of variety samples. Relative to Kazakhstan's cultivars some genotypes were with new subunit 4+10 (1D) in Erythrospermum 55/94-01-20, Fiton 41 samples. Iridost cultivars were marked to posses relatively rare alleles 5.5 +10 on the chromosome 1D, previously identified for Tselinogradka, Tselinnaya 24, Akmola 3 cultivars. For genotypes: E-607 and E-757 - a rare subunit 7 * +8 was noticed. Uniformity level increased for the last 3 KASIB blocks 8-9; 10-11; 12-13 to 74-84%. Wheat-rye translocation were identified for all samples of SibSRIA (Omsk) and EastSRIA (Ust-Kamenogorsk) breeding lines in each KASIB for all samples submitted by "Kurgansemena" and "Agrosemkonsalt" for sample of LLP "Fiton" breeding.

Materials and methods

The material comprised cultivars and samples (KASIB 4-13) of Kazakhstan-Siberian network of spring common wheat improvements – 216 genotypes from 17 originators, grown up in 2 replications in 3-8 locations/ conditions of Kazakhstan and Siberia. During the decade five investigated sets (blocks) were identified for the composition of gliadin (1B/1R translocation), the composition of the HMW and the LMW glutenin and the hardness class. HMW glutenin composition is given in accordance with the UPOV rules on 27, 28 and 29 featured system testing for uniformity, distinctness and stability for. Content of high-molecular and the low molecular glutenin subunits determined by the method used in CIMMYT laboratories (J.R. Pena), gliadin component content analyzed according to Peruanski et al (1996). Hardness was determined by SKCS 4100 (Perten Instrument).

A variety of blocks was defined by a variation of 5 subunits on 1A and 1B to a chromosome and 4 subunits of HMG on 1D-(figure 1). Judging by distribution of genotypes the nurseries of KASIB are presented generally to HMW-glutenin which determines high baking quality: on 1A – 2* (77-79%) and 1 (14-15%); on 1B – 7+9 (81-82%) and 7+8 (13-15%); on 1D – 5+10 to 60% (Table 1).

In this set of rather high-quality genofund of Kazakhstan genotypes with new subunits 4+10 on 1D in Erithrospermum 55/94-01-20 samples (the Pavlodar SRIA, KASIB 8-9), Fiton 41 (KASIB 8-9) were found.

The Iridost cv is noted as the carrier of rather rare subunit 5.5+10 on the chromosome 1D as revealed earlier for cvs Tselinogradka, Tselinnaya 24, Akmola 3 (Abugalieva, Morgounov, 2004). All set of the Chelyaba cultivars figured to possess on 1B chromosome a part of HMW glutelin subunits 6+8 and in mix for Lutescent 29-94. For genotypes: E-607 and E-757 – a characteristic rare subunits 7 * + 8 (1B) was noticed.

KASIB blocks consist of cultivars-mixes from 16% (KASIB 12-13) to 60% (KASIB 6-7). The later is probably connected with that wherein, the analysis of HMW-glutelin was carried out for samples from each region separately whereas in other blocks – only in one district. The level of uniformity recorded for the last three KASIB 8-9 blocks; 10-11; 12-13 to 74-84%. In a section of originator the percent of polymorphism on HMW-glutenin cultivars fluctuates from 14% (East SRIS) to 50-60% (Kurgan SRIA, the Pavlodar SRIA and the Chelyabinsk SRIA). Low percentage of the mixed genotypes is noted for genotypes of East SRIA breeding, also for the Aktyubinsk RAES (20%), KazRIAPG (21%), Altai SRIA (25%). Thus, on HMW-glutenin 40-84% of genotypes depending on the KASIB block, 14% of genotypes as carriers of 1B/1R wheat and rye translocation can be identified.

The variability of HMW glutenin subunits on 1A, 1B and 1D are presented as follows on KASIB blocks from different originator (Figure 1).

Attention is needed on cultivars, presented as a mixture in terms of bringing them to the homogeneity in composition of HMW-glutenin subunits during the primary seed-based selection method according to the seed storage protein electrophoresis (Kozhemjakin et al, 1995; Abugaliyeva and Pena 2010). Information on the electrophoretic spectrum of seed storage proteins is also important as it has a technological relevance as a basis for gluten complex.

Using polyacrylamide gel electrophoresis for gliadin , 52 cultivars of wheat from 6 locations; 1-Akmola; 2-Pavlodar; 3-Kostanay; 4-Karaganda; 5-East Kazakhstan region; 6-Kazakh Institute of Agriculture for a KASIB 4-5 block (297 samples) were analyzed. Three cultivars: Sonata, Lutescens 574 and Lutescens 424 appeared homogeneous over

the spectrum of gliadin. Sufficiently homogeneous (have on 1 biotype) cultivars Irene, Chelyaba and №18 were also identified. The cultivars which have 3 types of spectrum are: Krasnoufimskaya 90, Sibirskaya12, Sibirskaya 123, Omskaya 34, Novosibirskaya 15, Lutescens 53-95, Altayakaya 50, Fora, Lutescens 219-94 and GVK 1860-80.

Concerning the analysis of gliadin electrophoretic spectrum: basically on 4 origins of KASIB 6, 7 (Fiton, Karabalik, Aktobe, Pavlodar) cultivars were found to be homogeneous along the spectrum of gliadin. Cvs Lutescens 94, Lutescens 1300, Altaiskaya 10 has a different range as compared to Pavlodar.

Many cultivars have the same subunits for the spectrum of gliadin: 1) GVK 1526-2, GVK 1860-12, Lutescens 1350, 53-90-98-2, Kurganskaya 5, 110 Malcevskaya; 2) Stepnaya 2, Stepnaya 15, 53-88-94-12, Altayskaya 105, Altayskaya 530 Chelyaba 2; 3) Zhenis, Lutescens 166-SP-94, Lutescens20, Lutescens 94; 4) Fiton 42, Fiton 156, Stepnaya 16, Lutescens 196/94-6; 5) Pamyati Ryuba, Omskaya 36, 27-90-98-2 (Figure 2).

Three genotypes; OK -1, Fiton 25, GVK 1916-9 were placed most distantly from all other clusters genotypes, of which two have wheat-rye 1B/1R-translocation.

Wheat-rye translocation were identified for samples from 1) SibSRIA (Omsk) breeding and East-Kz SRIA in each KASIB set (except KASIB 4-5), 2) for all samples submitted by “Kurgansemena” (except Lutescens 415/00), 3) presented by “Agrosemkonsalt”, also for the LLP “Fiton” breeding sample (Fiton 41, Fiton 43), including material based on the shuttle breeding (Lutescens 19 ChS). Out of 216 genotypes total detected 1B/1R translocation genotypes were 30 only (Table 2).

For Omskaya 37 cultivar originators showed also wheat-agropyron translocation (Belan et al, 2012) that describes the pedigree of Omsk breeding cultivars, presented also by “Kurgansemena” company.

Discussion

Cultivars classification by hardness in the testing and registration process is the key in the grain marketing system from the cultivar creation to commercial production, as it determines the cultivar belonging to specific technological class “end use” and requirements for its quality. According to the strict and strong standards of leading wheat exporting countries, only 203 out of 212 cultivars appeared to belong to hard and middle hard classification.. Block KASIB 6-7 included the highest percentage of cultivars and lines with unstable grain hardness index (up 15.2%), which was accompanied by a transition in the class “mixture” and “semi soft” for Altayskaya 105, Kurganskaya 5, Lutescens 1300, Fiton 42, Lutescens 53/95-98-1 Lutestsens 53/88-94-12 and in different growing conditions.

In block KASIB 4-5 the Lutescens 54 cultivar; Lutescens 30-94 and Erythrospermum 607 were characterized by a full range of variability in grain hardness from semisoft to hard depending on growing conditions (because of the heterogeneity of the initial ratio of soft / hard grains), in the KASIB 8-9 block up to 5% (Lutescens 53/95-98-1 and Lutescens 53/88-94-12) were soft and in KASIB 10-11 block – one genotype Aktobe 1574 was soft.

Kazakhstan-Siberian nursery for improvements of spring wheat works under the auspices of the CIMMYT. During the decade five investigated clusters have been identified on the composition of gliadin (1B/1R translocation), the composition of the HMW and the LMS glutenin and the hardness class. HMW glutenin composition is given in accordance with the rules of the UPOV on 27, 28 and 29 featured system testing for homogeneity, distinctness and stability for 188 homogeneous samples.

The main part of spring wheat could be characterized by the subunits “2* 7+9 5+10” to 40% of all homogeneous; subunits “2* 7+9 2+12” - up to 30% and by the subunits “1 7+9 5+10”- up to 8% of variety samples. Relative to varieties of the Kazakhstan genofund, genotypes with new subunit 4+10 to 1D in Erythrospermum 55/94-01-20, Fiton 41 samples were identified . Iridost variety was marked as carrier of relatively rare alleles 5.5 +10 on the chromosome of 1D, previously identified for Tselinogradka, Tselinnaya 24, Akmola 3 varieties. For genotypes: E-607 and E-757 - a rare subunit 7 * +8 was found . Uniformity level increased for the last 3 KASIB blocks 8-9; 10-11; 12-13 to 74-84%. Wheat-rye translocation were identified for all samples of SibSRIA and EastSRIA breeding in each KASIB for all samples submitted by “Kurgansemena”, “Agrosemkonsalt” and for sample of LLP “Fiton” breeding.

Table 1. Distribution of spring common wheat genotypes of five KASIB blocks 4-5; 6-7; 8-9; 10-11; 12-13 on the HMW-glutenin subunits frequency, %.

Chromosome	HMW-glutenin subunits	K-4-5	K-6-7	K-8-9	K-10-11	K-12-13
1A	2*	70	84	69	74	73
	1	16	10	17	12	15
	0	4	6	7	4	6
	2*/1	6	-	5	4	4
	1/2*	2	-	2	6	-
	0/2*	2	-	-	-	2
1B	7+9	66	84	79	80	80
	7+8	20	11	12	10	10
	17+18	2	5	5	-	2
	7*+8	4	-	-	2	2
	6+8	2	-	-	-	-
	7+9/6+8	2	-	-	-	-
	7+9/17+18	2	-	2	-	-
	17+18/7+8	2	-	-	-	-
	7+9/7+8	-	-	2	8	6
1D	5+10	43	56	50	48	50
	2+12	45	35	32	34	42
	5,5+10	-	-	5	-	-
	4+10	-	-	2	-	-
	4+10/2+12	-	-	2	-	-
	2+12/5+10	6	4	5	6	6
	5+10/2+12	6	5	-	12	2
	5,5+10/2+12	-	-	2	-	-
	4+10/5+10	-	-	2	-	-

Figure 1. The genetic potential of spring wheat KASIB 4-13 block quality from different originators on HMW-glutenin, 1B/1R translocation and hardness.

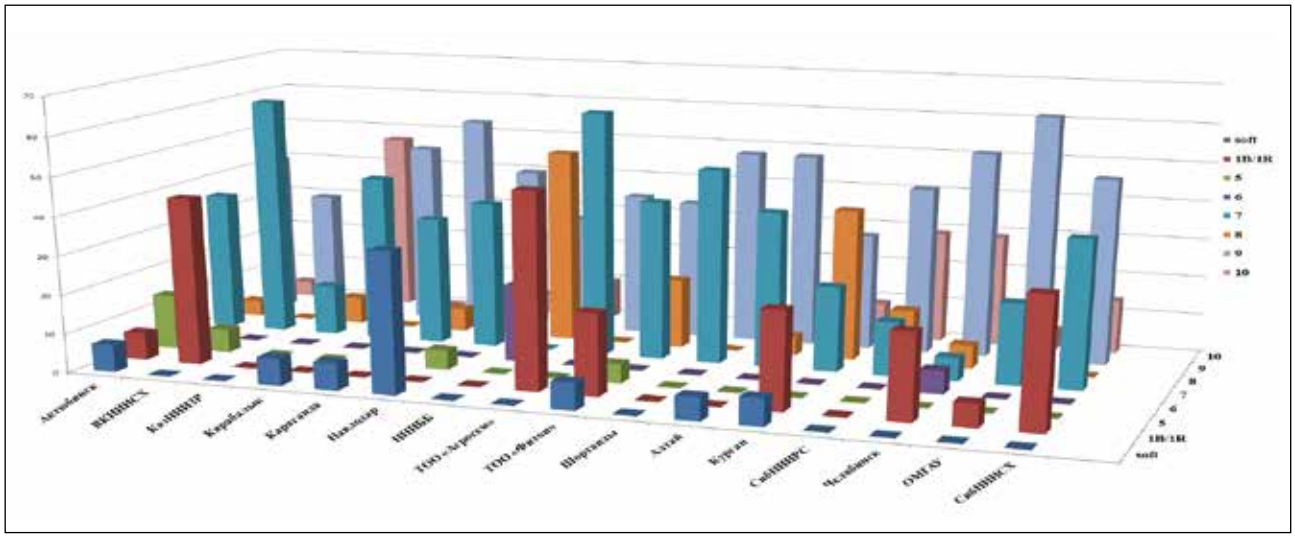

Figure 2. The dendrogramme of similarity-differences (Mere Hamming) of spring common wheat KASIB-6 samples on gliadin components

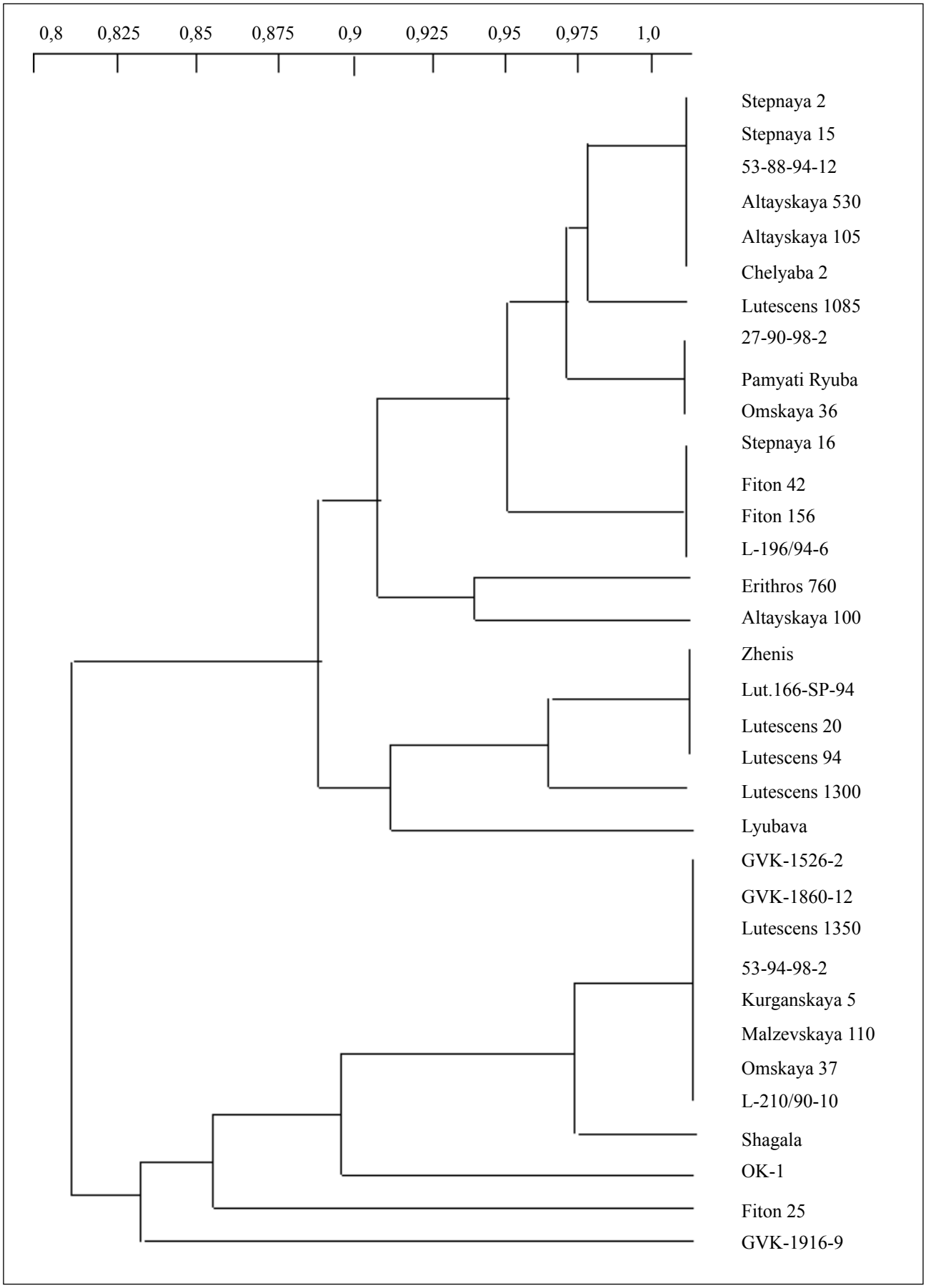

Table 2. Cultivars of spring wheat KASIB network with 1B/1R translocation

KASIB block	Cultivar	Originator
4-5	Chernyava 13	OMGAU, RU
	Chebarkulskaya	Chelyabinsk SRIA, RU
	Erithrospemum-746	RIBS (Otar, KZ)
6-7	GVK 1916-9	East Kazakhstan SRIA
	Lutescens 210/99-10, Omskaya 37	Siberian SRIA (Omsk)
	OK-1	Kurgan SRIA, RU
	Stepnaya 15 - mix	Aktobe SRIA, KZ
8-9	Predgornaya 70 – mix, GVK 1914-15	East Kazakhstan SRIA
	Fiton 41	Fiton, RU
	Severyanka, Lutescens 801	Agrosemconsalt, KZ
	Lutescens 529/00-10 C, Lutescens 307/97-23	Siberian SRIA, OMSK Sibernina SRIA, Novosibirks
10-11	Zaulbinka, Velyutinum 15	East Kazakhstan SRIA
	Severyanka 2	Agrosemconsalt, KZ
	Lutescens 363/96-4, Lutescens 360/96-6, Lutescens 290/99-7	Kurgansemena, RU
	Omskaya 39	Siberian SRIA, Omsk, RU
12-13	GVK 2033-7	East Kazakhstan SRIA
	Fiton 43, Lutescens C 19 ЧВ	Fiton, RU
	Line 96-99-14, Line 241-00-4	Kurgansemena, RU
	Omskaya 41, Lutescens 311/00-2(2)-6	Siberian SRIA, Omsk, RU
	Erithrospermum 23390	Chelyabinsk SRIA, RU

References

Abugalieva A., and Pena R.J. (2010) Grain Quality Spring and Winter Wheat in Kazakhstan. Asian and Australian of Plant Science & Biotechnology 4:87-90.

Abugalieva A.I., and Morgounov A.I. (2004) . Grain quality of spring wheat in Kazakhstan and Central Asia. Thesis, In Inter. Wheat Quality Conference "From Molecular Improvement to Consumer needs", Beijing, China.

Belan I.A., (2012) Rosseeva L.P., Badeeva E.D., Zelenski Y.I., Blohina N.P., Shepelev S.S. and Pershina L.A. Izuchenie hozyiastvenno cennih i adaptivnih priznakov u linii sorta yarovoj miyagkoj pshenici Omskaya 37, nesushih translokacii 1RS. 1BL and 7DL-7Ai. Vavilov journal 1:178-186.

Cooke R.J. (1995) Gel electrophoresis for the identification of plant varieties. *J.Chrom A*.698: 281-299.

Kozhemyakin E.V., (1995) Abugalieva A.I., Savin V.N. and Abugalieva S.I. Systemni podhod i geneticheskie marker v selekcii semenovodstve na primere hlebopekarnoi pshenici Triticum Aestivum L. Monography 4:63.

Peruanski Y.V. (1996), Abugalieva A.I., and Savin V.N. Metodi biohimicheskoi ocenki kollekcioonogo i selekcionnogo materiala. Almaty,123p.