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RESEARCH ARTICLE
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Yield and Quality Potential of Wheat Hybrid Lines with West Pamir Landrace as Parental Form

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ABSTRACT

The current study aims to identify lines of spring bread wheat, promising in terms of yield and quality indicators, from hybrid combinations obtained using the Western Pamir landraces and wheat varieties developed through Kazakhstan's breeding programs. The studies were carried out in 2023 and 2024 at the field trial of the Kazakh Scientific Research Institute of Agriculture and Plant Growing (KSRIAP) located in the foothills of the Zailiysky Alatau (between 43°13'N and 76°41'E) in the conditions of natural moisture supply. Lines and parental forms were assessed by nine quantitative morphological and yield traits of plants, as well as for bakery-quality (Glu-1 score) based on the electrophoresis of seed storage proteins. The Bobilo landrace exhibited lower performance than the Kazakhstan-bred varieties in terms of grain weight per central spike, total grain weight/plant, and thousand-grain weight. Additionally, it had a low Glu-1 index score. Correlation analysis of 67 hybrid lines from reciprocal crosses between the Bobilo landrace and two Kazakhstan-bred varieties (Lutescens 32 and Kazakhstan 3) revealed a significant positive contribution of the number of productive tillers to yield (r=0.9), while no correlation was observed between yield and thousand-grain weight. Based on the Principal Components Analysis of yield elements, 6 lines were identified that showed grain weight per plant above the parental lines. Glu-1 score of the lines ranged from 8 to 10 points. Lines combining traits of Western Pamir landraces and Kazakhstan varieties represent valuable material for breeding new spring wheat varieties adapted to the regional conditions of both countries.

Keywords: Wheat, Landrace, Hybrid lines, Yield traits, Glu-1 score, Principal Components Analysis.

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INTRODUCTION

One of the most significant grain crops grown in world agriculture is wheat, which gives humanity essential nutrients, vitamins, and microelements. The largest areas of spring bread wheat crops in Kazakhstan are in the country's northern regions, where drought become more frequent in recent years, and limiting its yield. Selection of spring soft wheat for improved productivity, grain quality, and resistance to adverse external factors is preliminary task of Kazakhstan breeders (Babkenov et al., 2020). Developing wheat varieties with updated genetic material is necessary to enhance their yield and resistance to constantly changing environmental conditions (Zafar et al., 2024). Involvement of ecologically and geographically distant forms in breeding significantly expands the genetic diversity of the developed varieties. Over the past few decades, there has been a rise in interest in conserving landraces, with most recent research focusing on local adaptation, stress tolerance, yield stability and health benefits (Frankin et al., 2021). Wheat landraces, cultivated for a long time in harsh climatic conditions, represent an untapped reserve of diversity, sources of resistance to unfavorable growing conditions and properties that improve the quality of plant products (Husenov et al., 2021; Tehseen et al., 2022; Shamanin et al., 2023; Korpetis et al., 2023).

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The use of landraces in breeding is still limited, one of the reasons for this is the insufficiently high expression of phonological yield indicators during their initial assessment in field conditions. In comparison with modern wheat varieties, landraces are low-yielding (Zeven, 1998; Kara & Akkaya, 2023; Cheng et al., 2024; Scandurra et al., 2024).

Landraces generally exhibit lower yield potential, which often leads to their underestimation as valuable genetic resources in breeding programs (Ninou et al., 2014). Moreover, altering testing conditions further reduces their productivity, making it challenging to evaluate their potential as sources of yield-related traits through simple reseeding (Zafar et al., 2025). The breeding potential of landraces for yield traits in conditions different from the local habitat may not be realized due to the unfavorable genetic background effects of non-adapted genetic resources, which present limitations like susceptibility to lodging and diseases (Longin et al., 2014).

Although landraces have lower yields than commercial varieties, they do have some traits, such as the ability to tiller and high biomass, that can be utilized to choose varieties adapted to resource-saving methods (Ruiz et al., 2019). Until recently, insufficient genetic diversity studies using modern genomic analysis methods limited the identification of valuable genes for disease resistance, adaptability to unfavorable growing conditions, and processed product quality in wheat landraces for inclusion in breeding (Cheng et al., 2024). The large amount of genomic data obtained from landraces reveals their potential as sources of valuable genes and traits for breeding high-yielding varieties that can adapt to changing climate towards aridization (Lazaridi et al., 2024). Evaluation of 600 common wheat landraces from the ICARDA gene bank using SNP markers showed their high genetic diversity, resistance to abiotic and biotic stress factors and the possibility of their use as potential sources of new genes for genetic improvement of hexaploid wheat (Tehseen et al., 2022).

Analysis of landraces from Turkey, Pakistan and Iran revealed their significant genetic diversity and new loci of resistance to different powdery mildew isolates (Leber et al., 2024). Many researchers have noted insufficiently high baking quality of grain and flour of wheat landraces (Preiti et al., 2022). One of the protein indicators of wheat grain quality is the composition of high molecular weight glutenin subunits (WMSGs), which are encoded by the genes at the *Glu-A1*, *Glu-B1* and *Glu-D1* loci on the long arms of *1A,1B* and *1D* chromosomes (Payne, 1987). Initial screening of collections of landraces from China, Turkey, Iran and Afghanistan for this indicator showed predominance of varieties with subunits 7 and 8 encoded by Glu-B1b allele, 2 and 12 encoded by Glu-D1a allele and absence of WMSG encoded by Glu-A1c allele (Temızgul & Akbulut, 2019; Dai et al., 2020; Maryami et al., 2020). On the usage of 2550 genotypes generated across 10 years at the CIMMYT bread wheat breeding program the effect of the glutenin loci and their interactions on gluten quality and bread-making potential was estimated (Guzmán et al., 2022). Alleles *Glu-A1c, Glu-B1a, Glu-B1d, Glu-D1a*, were associated with an overall poor quality, so authors conclude the usefulness of determining the glutenin profile to improve the selection efficiency for wheat quality in breeding programs. Scoring system (Payne et al., 1987) provides a quantitative estimate of gluten quality, based on the allelic composition of the HMW-GS and the linked genes. This evaluation system is being refined (Tabbita et al., 2024), but it is still effective in the initial stages of breeding because it allows a preliminary evaluation of a complex trait such as quality on a few grains within a short time.

Wheat landraces are traditional crop populations developed by farmers through natural and human selection during their years of cultivation, with adaptation to the local environment and management approaches (Nadeem et al., 2021). Given the phenotypic and physiological characteristics of wheat landraces, they should be used as parental forms or lines for selection or hybridization within the framework of an interdisciplinary approach in agronomy, plant breeding, tissue culture techniques and genetic engineering applications (Ulukan, 2021). The autonomous province of Gorno-Badakhshan (GBAO, Western Pamir) occupies 44% of the territory of the Republic of Tajikistan. Mountains occupy its major part. Mountain villages are at 1600-1700m altitude above sea level (m.a.s.l). At altitudes ranging from 2,000 to 3,250 meters above sea level, local spring wheat varieties and barley and rye continue to be cultivated. These crops exhibit advantages, such as adaptation to temperature and light conditions, and disadvantages, including lodging susceptibility, disease vulnerability, and low baking quality. The specific high-altitude environment is characterized by low air humidity (30%), high solar radiation, sharp fluctuations between day and night temperatures, and low annual precipitation (approximately 100 mm), which occurs mainly between December and May. Over time, local wheat varieties such as Bobilo, Safedak, Surhaki, Kilyak, and Surkhusha have been selected for their ability to thrive under these harsh conditions, continuing to serve as a vital source of food and animal feed for local communities. However, their cultivation remains limited to small-scale farms in mountainous regions (FAO, 2015).

Western Pamir landraces can serve as sources of valuable adaptive traits and quality indicators; their inclusion in breeding will enrich the breeding pool and develop promising lines with new quality and productivity genetic associations. The objective of this study was to identify lines of spring bread wheat, promising in terms of yield and quality indicators, from hybrid combinations obtained using the Western Pamir landrace and wheat varieties developed through Kazakhstan's breeding program.

MATERIALS & METHODS

Plant Material

The objects of the study were 67 lines from reciprocal hybrid combinations (F6-F8) between Bobilo (a Western Pamir bread wheat landrace) and the spring bread wheat varieties (Kazakhstanskaya 3 and Lutescens 32) developed by the Kazakh Research Institute of Agriculture and Plant Growing (KRIAPG). Lutescens 32, resistant to lodging, with high-quality indicators and drought-resistant, is a mid-early ripening variety. Kazakhstanskaya 3, var. erythrospermum, is a mid-early ripening variety. The Bobilo landrace, var. horogense (Vav.) Mansf., early ripening and cold-resistant, is cultivated at 2000-3250 m.a.s.l.

Field Trials and Methods

The studies were conducted in 2023 and 2024 at the field station of KRIAPG located in the foothills of the Zailiyskiy Alatau (between 43°13'N and 76°41'E). The climate of the study site is sharply continental with natural moisture supply, the soils are light chestnut. The main growth stages influencing wheat productivity (tillering-flowering) occurred at the end of May and June during the growing season, which were characterized by a temperature regime higher than average annual temperature by more than 3 degrees and a low level of precipitation compared with average annual data (Fig. 1).

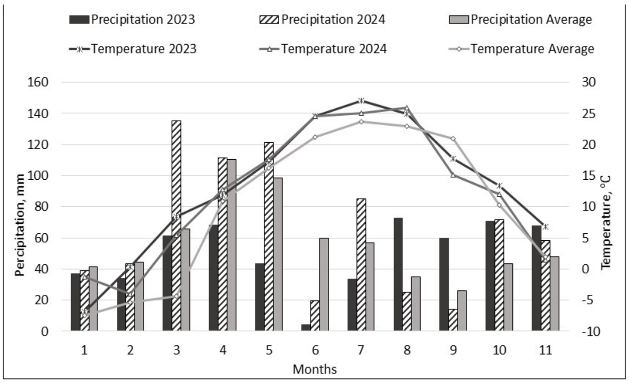

Fig. 1: Air temperature and precipitation in the field station of KSRIAPG, 2023, 2024.

Each plot contains 3 rows per sample, 22-25 seeds in each row 120cm long, distance between rows - 15cm. Nine quantitative morphological and yield traits such as plant height (PH), number of productive tillers (NPT), peduncle length (PL), main spike length (MSL), grains number in the main spike (GNMS), grains number per plant (GNP), grain weight of the main spike (GWMS), grain weight per plant (GWP) and 1000 grain weight (TGW) were studied.

Glutenins were isolated and fractionated in an alkaline medium according to the UPOV recommendations (UPOV, 2017). The HMW-GS are labeled according to the nomenclature of Payne and Lawrence (1983). Identification of high molecular weight glutenin subunits (HMWGS) was carried out in comparison with standard wheat varieties (Bezostaya 1, Pavon and Pitic). All data were processed using the R program (v4.4.1). Pearson correlation was calculated using the package "PerformanceAnalytics.". Boxplots were created using the packages "ggplot2 and dplyr.". The "ggfortify" package was used to perform principal component analysis (PCA) (R_Core_Team, 2024).

RESULTS

Quantitative Morphological and Yield Traits of Hybrid Lines and Parental Forms

Quantitative morphological traits such as PH, NPT, and PL varied significantly. Tables 1S to 4S show the maximum and minimum values of the productivity elements of the studied lines (39 lines from the combination Bobilo x Lutescens 32; Lutescens 32 x Bobilo and 29 lines from the combinations Bobilo x Kazakhstanskaya 3; Kazakhstanskaya 3 x Bobilo). Thus, the maximum PH in the lines from the reciprocal hybrid populations between Bobilo and Lutescens 32 reached 113.6cm (line BL2), while the height of the shortest line was 67.33cm (line BL33). The maximum NPT was noted in line BL20; PL varied from 25.5 (LB24) to 45.5cm (BL6). MDL reached 11.6cm in the line LB33. Line BL20, which stood out according to NPT, had the highest values of GNMS and GNP. The analysis of minimum and maximum values of lines productivity elements from combinations Bobilo x Kazakhstanskaya 3 and Kazakhstanskaya 3 x Bobilo (TS3) showed that the highest line was the KB45 line (101.2cm), the minimum PH value was in the KB36 line (59.8cm). NPT was significant in the KB32_2 line (8t). The highest PL value was characterized by the KB47_2 line (36.6cm) and the lowest - by the KB33 line (20cm). The KB33 line, at the same time, had the maximum number of GNMS (45). However, they were puny, affecting all quantitative line productivity indicators: GWMS, GWP, and TGW (TS1).

The MSL varied from 6.5cm for the KB34 line to 10.8cm for the KB48 and BK60 lines. The KB39 line had the highest GNP-164. It was also one of the productive lines from the hybrid combinations Kazakhstanskaya 3 x Bobilo. GWP and TGW are the leading resulting indicators by which the yield of varieties and breeding lines can be determined. Fig. 2 illustrates a box plot for GWP and TGW of the parental forms and their hybrids. Bobilo landrace and Kazakhstanskaya 3 and Lutescens 32 showed that under the conditions of KSRIAPG station, without irrigation, the varieties Kazakhstanskaya 3 (3.4g/plant) and Lutescens 32 (2.52g/plant, Fig. 2A) were characterized by the highest grain weight per plant. The GWP of Bobilo was very low and amounted to 1.54g. Among the hybrid lines isolated from the populations obtained in the course of reciprocal crosses of the Bobilo with the Kazakhstanskaya 3 variety (VK and KV) and with the Lutescens 32 variety (BL and LB), lines exceeding the parental lines of Kazakh selection were identified. A significant part of the lines had higher GWP than the Bobilo's. Some lines showed very low productivity.

Almost all lines had higher TGW than the Bobilo landrace (Fig. 2B); some lines exceeded the parent Kazakhstan variety in this trait.

Correlation Analysis

Correlation analysis of yield-related traits studied showed significant accessions (Fig. 3). PH was significantly correlated with the PL (r=0.64) and GWMS (r=0.32). A high positive correlation is observed between NPT and the main traits of plant yield - GNP and GWP (r=0.9). At the same

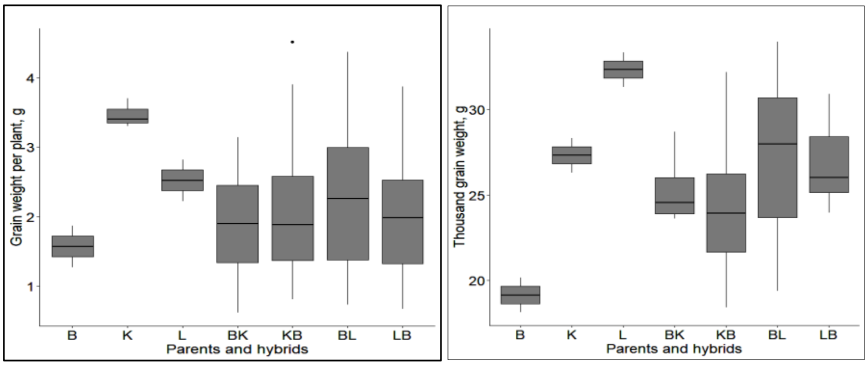

Fig. 2: A box plot for GWP (a) and TGW (b) of Bobilo (B), Kazakhstanskaya 3 (K), Lutescens 32 (L) and the 69 progeny lines. B-Bobilo, K-Kazakhstanskaya 3, L-Lutescens 32, BK, KB, BL, LB: hybrid combination derivatives.

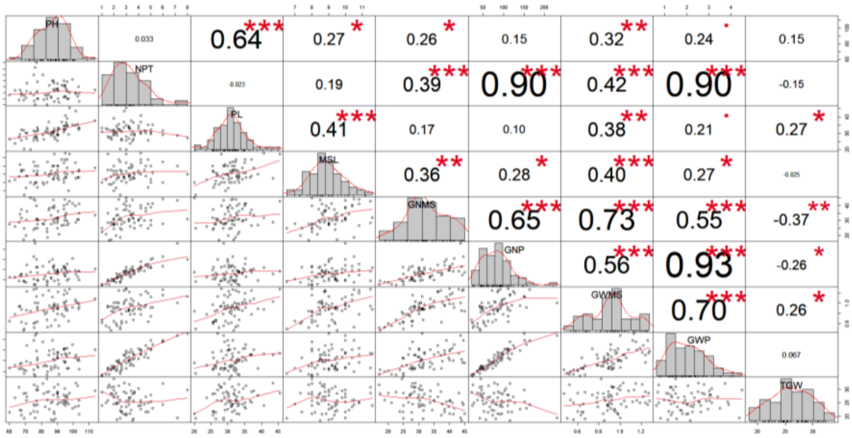

Fig. 3: Correlation coefficients among the nine studied traits in 69 hybrid and parental lines. Traits: PH - plant height (cm); NPT - number of productive tillers, PL - peduncle length (cm), MSL - main spike length (cm), GNMS - grains number in the main spike, GNP - grains number per plant, GWMS - grain weight of the main spike (g), GWP - grain weight per plant (g), TGW - thousand grain weight (g). Units of measured traits are shown on the perimeter of the Fig 3.

time, this trait negatively correlates with TGW (r=-15), PL is interconnected with MSL and GWMS (r=0.41 and 0.38, respectively). The same trait positively correlates with TGW (r=0.27). MSL affects many metrics, such as GNMS, GNMS, GNP, GWMS and GWP, the most significant correlation factors appeared with GNMS (r=0.36) and GWMS (r=0.40). Significant correlations were found between GNMS and GNP, GWMS, GWP - r=0.65, r=0.73, r=0.55, respectively. All these traits, grain number and weight in the main spike and the plant as a whole are negatively associated with the thousand grain weight. A high relationship is expected to be observed between the grain number and their weight per plant (r=0.93). GWMS affects GWP (r=0.70) and has a positive effect on seed size–thousands grain weight (r=0.27).

For each trait, the histogram distribution is present in the diagonal squares. Below the diagonal, scatterplots for correlations between trait pairs are shown as dots with corresponding curve lines for correlations. Above the diagonal, values of the correlation between trait pairs are presented. Higher correlation values are indicated by the bigger font and accompanied by red asterisks showing the level of significance of the correlations, which is as follows: *P<0.05; **P<0.01; and ***P<0.001.

Principal Components Analysis

Fig. 4 shows a PC biplot showing the relationship between 69 hybrid and parental wheat lines and nine quantitative morphological and yield traits. The PCA results based on the average values of the characteristics studied showed that PC1 and PC2 explained 66.78% of the total variation. PC1 explained 45.141% of the total variation, while PC2 explained 21.64% of the total variation. The graph clearly shows the relationship between the two groups of components, each of which shows a positive relationship. Thus, traits such as NPT, GNP, GWP, and GNMS, which are considered plant yield traits, are closely interrelated. At the same time, TGW does not show significant correlations with the above group of yield traits under these test conditions. PH, PL, and MSL comprise the second group of positively correlating components that did not significantly affect GWP.

Principal Components Analysis allowed us to identify hybrid recombinant lines that are superior in terms of grain yield per plant: Four lines from the combination of Kazakhstanskaya 3 x Bobilo (KB32_2, KB39, KB46, KB44) and two lines from hybrid combinations between Bobilo and Lutescens 32 (BL20 and LB27_2) were revealed by their high productivity in the studied traits. The results showed that the BL20 and KB32_2 lines had high GWP due to a large number of productive branches and, as a result, a large number of grains per plant. The KB39 line also had a large number of GWP due to productive branches, which also determined the high grain weight per plant.

Diversity of Hybrid Lines by Composition of High Molecular Weight Glutenin Subunits

Analysis of the composition of high molecular weight glutenin subunits in hybrid lines obtained as a result of hybridization of Bobilo landrace and the variety of Kazakhstan selection Lutescens 32 revealed all variants of HMWGS combinations encoded by the *Glu-A1*, *Glu-B1* and *Glu-D1* loci, except the "c" allele of the *Glu-B1* locus controlling the 7 + 9 subunit pair, which is present in the genome of the Lutescens 32 variety (Fig. 5). The lines combining the most valuable high-molecular-weight glutenin subunits (type 1) in terms of bakery quality, in total ranked 10 points by *Glu 1* score (Payne, 1987), amounted to 28.2%. The proportion of type 2 lines was 30.8%. The lines of the third and fourth variants lack a subunit encoded by the *Glu-A1* locus (null allele) in the spectrum of HMWG.

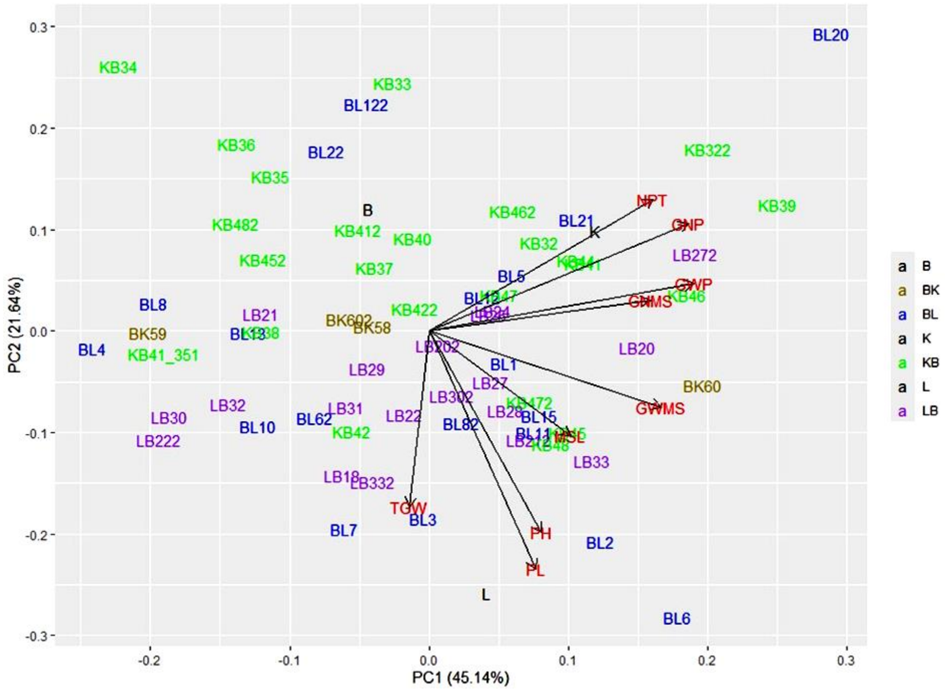

Fig. 4: PCA biplot for quantitative morphological and yield traits in wheat hybrid lines and parents. B-Bobilo, K-Kazakhstanskaya 3, L-Lutescens 32, BK, KB, BL, LB: hybrid combination derivatives.

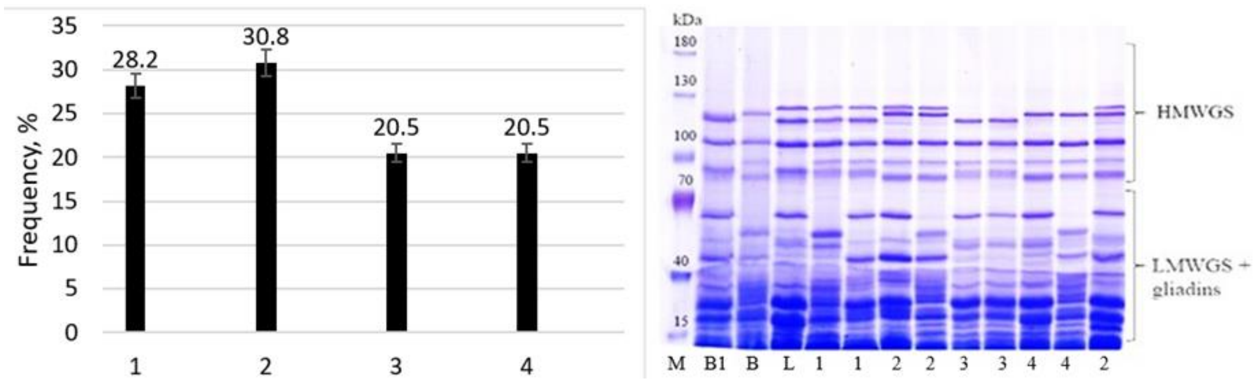

Fig. 5: HMWG composition diversity in hybrid lines from Bobilo x Lutescens 32 and Lutescens 32 x Bobilo combinations. B1 –Bezostaya 1, B-Bobilo, L-Lutescens 32; 1 type: 1, 7+8, 5+10; 2 type: 1, 7+8, 2+12; 3 type: 0, 7+8, 5+10; 4 type: 0, 7+8, 2+12.

Among the lines of hybrid populations obtained from crossing the Bobilo landrace and the Kazakhstan wheat variety (Kazakhstanskaya 3), six variants were identified that differ in the composition of HMWGS (Fig. 6). Of these, type 1, characterized by the presence of highly ranked on Glu-1 score HMWGS, amounted to 10.4%. The proportion of samples with a null allele of the *Glu-A1* locus was 34.4%. Of these, type 4 amounted to 6.9%. Landrace Bobilo has the exact composition of HMWGS.

Characteristics of Lines Isolated from Hybrid Combinations

According to the results of Principal Components Analysis, six lines were identified, of which 2 of the combinations between the Western Pamir landrace (Bobilo) and the bread wheat variety selected by KRIAPG Lutescens 32 (BL20 and LB27_2). From the combinations between Bobilo and the variety Kazakhstanskaya 3, 4 lines were distinguished (KB32_2, KB39, KB4,6 KB44). Table 1 shows the data of these lines for traits related to productivity and quality. Lines BL20 and LB27_2 were characterized by a combination of HMWGS parental forms: subunit 1 (*Glu-A1* locus) of Lutescens 32 and subunits 7 + 8 (*Gl -B1* locus), 2 + 12 (*Glu-D1* locus) of the Bobilo landrace. KB32_2 and KB44 lines also combined the protein components of both parents: subunits of HMWGS 2 * and 5 + 10 from the Kazakhstanskaya 3 and subunit pair 7 + 8 from the Bobilo. The glutenin quality score of these lines is 10. Lines KB39 and KB46 are analogs of the parent line Kazakhstanskaya 3.

DISCUSSION

Landrace varieties of crops, including wheat, as the primary food crop, are still not fully used in breeding. Much of the genetic diversity in landrace cereal varieties is still little known and less utilized. Most of this valuable diversity of landraces is conserved in farms and genetic collections. Landraces should be used in crosses for obtaining improved varieties, significantly to increase crop adaptation and productivity in the face of global climate change, to increase the sustainability of cereal production in the future (Marone et al., 2021). Extensive evaluation of the landraces and selection of lines with the best grain

Table 1: Lines distinguished by yield from hybrid combinations obtained with the participation of the landrace variety of the Western Pamirs - Bobilo

lines	PH	NPT	PL	MSL	GNMS	GNP	GWMS	GWP	TGW	HMWGS*
BL20	76	7.2	28.8	10	43.6	230.8	1	4.37	19.38	1, 7+8, 2+12
KB32_2	77	8	27	9	31	151	1.13	4.51	29.9	2*, 7+8, 5+10
KB39	75	6	31.5	10,5	44.5	164	1.26	3.9	24.42	2*, 7+9, 5+10
LB27_2	87	5	30	10	39	152	1.12	3.87	25.5	1, 7+8, 2+12
KB46	99.5	5.2	35.3	9.2	41.5	156.3	0.91	3.5	22.95	2*, 7+9, 5+10
KB44	81	6	29	8	28	116	1.15	3.74	32.2	2*, 7+8, 5+10

* The HMWGS are labeled according to the nomenclature of Payne and Lawrence (1983); PH - plant height (cm); NPT - number of productive tillers, PL - peduncle length (cm), MSL - main spike length (cm), GNMS - grains number in the main spike, GNP - grains number per plant, GWMS - grain weight of the main spike (g), GWP - grain weight per plant (g), TGW - thousand grain weight (g).

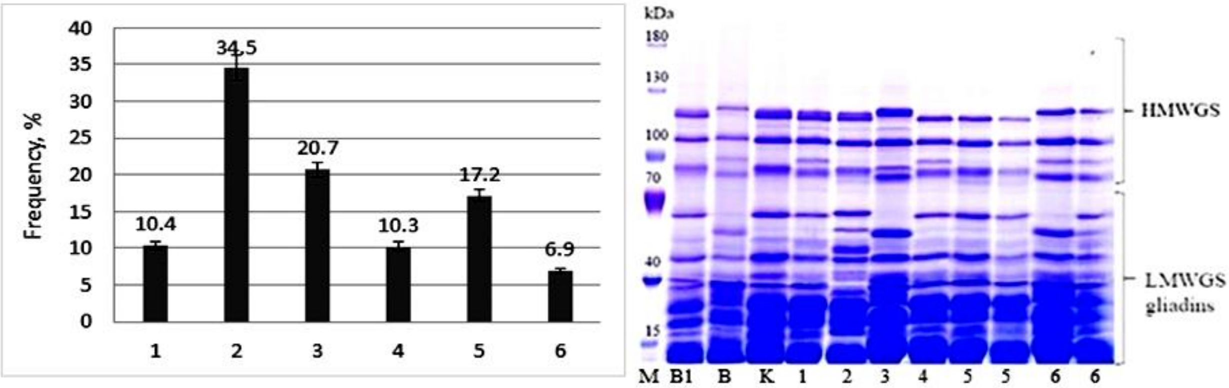

Fig. 6: Diversity of HMWGS composition in hybrid lines from Bobilo x Kazakhstanskaya 3 and Kazakhstanskaya 3 x Bobilo combinations. B1 –Bezostaya 1, B-Bobilo, K-Kazakhstanskaya 3; 1type: 2*, 7+8, 5+10; 2 type: 2*, 7+9, 5+10; 3 type: 2*, 7+9, 2+12; 4 type: 0, 7+8, 5+10; 5 type: 0, 7+9, 5+10; 6 type: 0, 7+8, 2+12

yield and other traits contributes to their inclusion in the crossing program and selection of varieties resistant to adverse environmental conditions (Baboev et al., 2021). One of the reasons for the limited involvement of landraces in the breeding process is the depression of their yield traits in other regional climatic conditions, while their assessment in terms of breeding value begins with the manifestation of yield traits (Zafar et al, 2023). We evaluated several wheat landraces of Gorno-Badakhshan region of Tajikistan, including the variety Bobilo, hybrid lines obtained with the participation of which were studied in the field trial of KSRIAP in the conditions of natural moisture supply. The variety showed very low level of such basic yield indicators as weight of grains per plant and weight of thousand grains (Fig. 2). Many researchers have noted that wheat landraces are inferior to modern varieties in terms of yield, especially under conditions of insufficient moisture supply (Frankin et al., 2021; Yildiz & Özkaya, 2024). At the same time, it is noted that some landraces had a lower yield loss compared to modern wheat under drought stress (Eser et al., 2024).

Nevertheless, when evaluating a more extensive set of old local wheat varieties from Turkey, Afghanistan, and Iran, the highest-yielding varieties were able to compete with modern varieties in selected trial sites (Morgounov et al., 2021). Selection of landrace varieties with comparable to modern varieties yields is promising for organic farming systems, low-input agriculture (Korpetis et al., 2023). Although yields of old local wheat varieties are lower than modern ones, these varieties have agronomic traits that are well suited for sustainable agriculture of small farms (Ortman et al., 2023). Landraces may be valuable for selecting adaptive signs of resistance to unfavorable growing conditions, diseases, and unique qualitative characteristics that can be identified and used only by analyzing hybrid combinations created with the participation of landrace varieties. Booting and flowering are very sensitive to drought phases of wheat development (Ma et al., 2017; Poskrebysheva & Ismagilov, 2020; Chowdhury et al., 2021).

In the field trials of parents and hybrid lines developed by reciprocal crossing of the Bobilo landrace, originated from the Western Pamir with varieties of Kazakhstan selection, these phases affected an unfavorable temperature and sedimentary regime. This was one of the reasons for the significant yield depression of the landrace variety Bobilo. Even varieties developed in the Southeast conditions of Kazakhstan showed reduced yield data, which testifies to climate change and the need to breed new varieties that can produce a consistently high yield. Correlation analysis of received data showed a significant positive relationship between the number of productive tillers and the mass of grains from the plant. Many authors point to the relationship between the number of productive tillers and yield (Raza et al., 2018; Ullah et al., 2021).

The number of productive tillers and grain weight from the main spike can be signs of high-yielding varieties (Ding et al., 2023). In the steppe zone of the North Kazakhstan region, middle-ripening and middle-early lines of spring bread wheat also show a correlation between yield and the number of productive stems (Aidarbekova et al., 2022). The same authors note a weak negative relationship of NPT in a dry year with a mass of 1000 grains, which coincides with our data. PCA biplot’s most important application is to identify the hybrids that have the highest value for one or more traits (Luković et al., 2020; Gholizadeh & Ghaffari, 2023; Tekin et al., 2024). Using this mathematical approach, hybrid populations obtained by reciprocal crossing of the Western Pamir landrace variety Bobilo and varieties of the Kazakhstan selection were identified as lines characterized by yield traits exceeding the original parental forms. The electrophoretic profile of wheat seed storage proteins is effectively used in assessing the specificity of wheat landraces (Buronov et al., 2023), analyzing hybrid material and detecting the presence of genetic material of parental forms (Metakovsky et al., 2024).

In wheat breeding, along with the yield, the grain quality of the evaluated lines is constantly monitored. The quality of wheat primarily depends on its storage protein quality, especially regarding gluten content and high-molecular-weight glutenin subunits (HMW-GS) (Dai et al., 2023; Khalid et al., 2023). Evaluation the composition of HMWGS can be used in the early breeding stages to assess, reject low-quality, and select promising genotypes. The landrace of Tajik and Afghan Badakhshan are characterized by the “b” allele of the *Glu-B1* locus, which controls the biosynthesis of the "x" subunit 7 and the "y" subunit 8. (Babissekova et al., 2024)This option is highly ranked by Payne gradation by contribution to glutenin quality, grade 3 points. At the same time, the landrace varieties are absent the slowly mobile subunit of glutenin encoded by the Glu-A1 locus, which negatively affects baking quality.

Allelic frequency of HMW-GS combinations, null, 7 + 8, and 2 + 12 was found to be the highest (63.3%) in 300 landraces from Xinjiang, China, which were evaluated by Sodium-dodecyl-sulfate polyacrylamide gel electrophoresis (Dai et al., 2020). Similarly high frequency of these alleles has been reported in wheat landraces from Iran (Maryami et al., 2020) and in Turkish bread wheat landraces (Temızgul & Akbulut, 2019). In contrast, the frequency of the gene *Glu-D1d,* controlling strong gluten subunits 5 + 10, occurred at a relatively low frequency (Morgounov et al., 2021). In general, the quality of Tajik varieties of bread wheat is still low, and the selection process is not effective enough to improve it (Husenov et al., 2015; Husenov et al., 2021). One possible reason for this is the heterogeneity of the analyzed material for protein labeling (Makhkamov et al., 2024). Lines distinguished by yield characteristics from hybrid combinations obtained with the participation of the Western Pamir landrace - Bobilo had a composition of HMWGS characterized by a high *Glu-1* score, which ranged from 8 to 10 points. In breeding terms, the incorporation of landraces into hybridization to improve micronutrient levels, grain yield, and bread quality is more effective than searching for individual plants (Heidari et al., 2016). The breeding strategy can follow the path of improvement of wheat landrace varieties by incorporation of traits/genes of interest, such as those controlling plant height or disease resistance (Morgounov et al., 2021). Lines with a combination of signs of the Western Pamirs (Tajikistan) landrace variety and varieties of Kazakhstan represent valuable material for selecting new spring wheat varieties adapted to the regional conditions of both countries.

Conclusion

The manifestation of the valuable genetic material of landraces is facilitated by their inclusion in hybridization with modern wheat varieties and the selection of lines with the desired features by field testing methods and quality markers. The Western Pamir spring bread wheat landrace (Bobilo) was used in hybridization with Kazakhstanskaya 3 and Lutescens 32 varieties of KRIAPG. 67 lines of reciprocal hybrid populations were assessed in 2023 and 2024 in the conditions of natural moisture supply for productivity elements and composition of HMWGS affecting grain quality. Principal components analysis of the data identified lines with yield rates greater than parent forms under non-irrigation growing conditions. The isolated lines had a HMWGS, corresponding to good baking quality. These lines can be starting breeding material or are directly included in the breeding process.

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