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STUDY OF TECHNOLOGICAL AND BIOCHEMICAL INDICATORS OF DURUM WHEAT (*T.durum* Desf.) SAMPLES CULTIVATED IN ABSHERON CONDITIONS

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Wheat grain quality indicators used in the final product are important aspects of breeding and processing. These indicators are highly valued in production. The key quality indicators are gluten, protein, and vitreousness, which indirectly determine the rheological properties of flour.

The goal of our research was to identify sources of economically valuable traits in winter durum wheat for subsequent use in the breeding process. The study used 35 varieties of durum wheat and the Maya variety (standard variety) grown on the experimental plot of the Institute of Genetic Resources (40.413010N east longitude and 49.833421E north latitude) of the Absheron Peninsula.

In terms of protein content, 44.4% of all samples showed results above the 3-year average, while the remaining 55.6% had values below the average. Sample No. 4 (v. obscurum) had a relatively high gluten content (35.0%) and the highest protein content (17.2%) among all samples. It was found that the largest proportion of samples (47.2%) had a 1000-kernel weight below the average, while 44.4% of samples were at the average level, and 8.3% significantly exceeded it. Results show that the high covariance observed among the variables is significantly explained by the first three components of the PCA, and the genotypes are separated into three main phenotypic clusters of high quality, medium quality, and low quality along these components. One of the main areas of durum wheat breeding is improving grain quality. A study of the quality characteristics of winter durum wheat varieties, including local and introduced accessions stored in the Institute of Genetic Resources' Genbank, resulted in the identification of seven accessions, along with the standard Maya variety: *v. niloticum, v. obscurum, v. melanopus, v. melanoleucurum, v. lyubicum, v. albo provinciale, v. provinciale.* These identified accessions are of interest for breeding durum wheat for high grain quality in our conditions.

Keywords: *durum wheat, gluten, protein, vitreousness, quality, selection.*

INTRODUCTION

Durum wheat is the tenth most important crop in the world, accounting for approximately 4-6% of the global wheat harvest, with an annual production of 35-40 million tons. Mediterranean countries are the largest producers of durum wheat and also the main consumers of grain products made from this crop.

Durum wheat is valued for its high grain quality. It surpasses soft wheat in protein, essential amino acids, starch, dextrins, sugars, vitamins B, E, PP, and minerals (Вьюшков и др., 2012).

The main areas of durum wheat breeding are further productivity improvement; adaptability and drought tolerance; grain quality (grain weight, vitreousness, protein and gluten content and quality); resistance to lodging and diseases (brown and stem rust, common and loose smut, powdery mildew); and lodging resistance. The breeding process includes key areas such as studying the source material, identifying sources and donors of economically valuable traits, targeted selection of parental forms for hybridization, selection of the best genotypes, and their evaluation based on a range of traits in breeding nurseries.

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The frequency of high-quality grain formation under various growing conditions is considered one of the main criteria determining the merit of a variety and its suitability for cultivation. This is especially important for durum wheat (Тихонов и др., 2005).

Durum wheat is prized for its high-quality grain. When producing the highest-quality pasta, durum wheat is the only raw material characterized by high strength, an amber-yellow color, low cooking time, minimal dry matter loss during cooking, a pleasant flavor, and nutritional value. The biological value of durum wheat pasta significantly exceeds that of soft wheat.

Durum wheat contains strong and high gluten content which provides necessary cooking characteristics for good quality pasta production. The quantity of protein and the quality of gluten in durum wheat is very important for the al dente (an Italian term that means "to the tooth" and refers to the ideal consistency for cooked pasta and rice) parameter of pasta production process (Shakir et al., 2025).

Durum wheat flour is used to produce premium grades of pasta, semolina, and the finest confectionery. It's important to remember that grain, with its high protein and carotenoid content, is the foundation of high-quality products. Durum wheat is prized for its large grain size and high glassiness, as well as its high protein and gluten content, which ensures excellent processing properties and nutritional value in pasta and results in a higher semolina yield. The genetic characteristics of the varieties significantly influence the quality of the finished product. Weather conditions, especially during grain filling and formation, diseases, pests (such as the scaly-sided bug), and the level of agricultural practices are also important factors (Meena et al., 2025).

Durum wheat is superior to common wheat in terms of protein, starch, dextrins, sugars, B vitamins, vitamin E, ribosomal protein acid, and mineral content. High-quality coarse-grained semolina (semola), used to produce high-quality semolina and wheat groats, is obtained from the glassy, amber-yellow grains of durum wheat with high protein content. It is important to note that genetic variability serves as the basis for selecting and using favorable alleles in breeding programs to improve grain quality.

Evaluation of genetic parameters such as the genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability, and genetic progress as a percentage of the mean (GAM) helps breeders understand patterns of trait inheritance and develop effective selection strategies (Patel. *et al.,* 2023).

Durum wheat (*Tr.durum* Desf.) grain quality remains a key breeding objective for our republic. Durum wheat grain quality is known to be largely determined by the gluten protein complex, consisting of gliadins and glutenins. The gliadin-encoding loci Gli-1 and Gli-2 most often result in extensive allelic variation.

Glutenins are classified into high- and low-molecular-weight subunits (HMW-GS and LMW-GS), encoded primarily by the Glu-1 and Glu-3 loci, respectively. Both groups contribute to the strength and viscoelastic properties of gluten. It should be noted that their relative influence varies depending on the allelic composition and genetic background.

Utebayev M. and others note that the identification of gliadin, high-molecular-weight, and low-molecular-weight glutenin alleles in durum wheat revealed significant genetic diversity. Native and SDS-electrophoresis of prolamins remains an accessible and informative method for analyzing gluten protein composition (Utebayev et al., 2026).

To accelerate the creation of homogeneous populations with diverse traits, cell biotechnology methods needed to be further optimized and refined. Doubled haploid production technology, and possibly clonal micropropagation, could successfully preserve valuable genetic material from distant hybrids in breeding. Divashuk et al., in their research, found that high-throughput genotyping of polymorphisms yielded valuable information about the genetic structure of a durum wheat collection for genes influencing important agricultural traits (Дивашук и др., 2026).

The suitability of grain for the manufacture of food products, including bread, is mainly determined by its composition. The greatest focus of research in this context is the influence of the physicochemical properties of the constituents of glutens and gliadins. These are proteins responsible for the rheological parameters of the dough, since they have the ability to trap air bubbles and form a porous structure of finished products, and also affect the elasticity of the dough (Poladova et al., 2024).

By using distantly related genotypes to increase genetic diversity, obtain new recombinant variants, and improve quantitative and qualitative indicators, the likelihood of heterosis increases, and as a result, the likelihood of offspring with new characteristics increases (Sadqova və b., 2024; Gregová et al., 2021).

Durum wheat is the second most widely produced and consumed grain crop in the world. However, in our republic, its average yield (5.2 t/ha) remains relatively low. Numerous factors contribute to this, including limited access to improved varieties, the prevalence of diseases, annual temperature regimes, uneven rainfall distribution, and suboptimal agricultural practices. Furthermore, farmers often have limited information on the performance of durum wheat genotypes under biotic and abiotic stress. For example, A.G. Lozhkin et al. note that, among cereals, the ideal type should include those plants that ensure the accumulation of the largest grain yield and its stability over the years under various weather conditions. In their research, they found that, the best formation of grain gluten was observed in agroclimatic conditions in 2015 and 2016 (Lozhkin A.G. et al., 2020).

A comprehensive approach to studying breeding material for the development of competitive domestic varieties, as well as improving existing varieties that combine high yield, technological qualities, and adaptive properties, is the primary goal of our geneticists and breeders.

The goal of our research was to identify sources of economically valuable traits in winter durum wheat for subsequent use in the breeding process.

MATERIALS AND METHODS

The study used 35 varieties of durum wheat and the Maya variety (standard variety) grown on the experimental plot of the Institute of Genetic Resources (40.413010N east longitude and 49.833421E north latitude) of the Absheron Peninsula. The Absheron Peninsula is located in eastern Azerbaijan and represents the southeastern end of the Greater Caucasus. It is bordered by the Caspian Sea to the north, south, and east and bounded by Gobustan to the west. The Absheron Peninsula is divided into two parts based on topography. The larger western part, consisting of hills, is located at an altitude of up to 350 meters above sea level, while the smaller eastern part, consisting of plains, is located at an altitude of up to 35 meters. Absheron has a dry subtropical climate, with very hot summers, sunny autumns, and mild winters. Absheron is characterized by abundant solar insolation. Winds are the main element of Absheron's climate. The strongest northerly wind here is Khazri. The average annual air temperature range on the peninsula is 22-23°C. According to long-term data, the average temperature in Absheron in January is 3.8°C, and the average temperature in July is 22.6°C.

No significant deviations from long-term temperature data were observed during the study years.

Annual precipitation in Absheron is 200-250 mm, with 60-70% of this precipitation falling during cold periods. Overall, the peninsula receives insufficient precipitation throughout the year, and the precipitation that does fall is unevenly distributed across the seasons. Air humidity in Absheron remains relatively constant throughout the year.

As part of the grain quality assessment, 1000-grain weight, percentage composition and fiber deformation measurement (FDM) and nitrogen content were determined. Grains were randomly selected, counted and weighed. An average sample weighing approximately 50 g was

taken to determine gluten content. The sample was cleaned of impurities: debris, husks, spoiled and immature grains before being crushed in a laboratory mill and passed through a series of sieves with holes of different diameters. The physical parameters of the grain in the samples – 1000-grain mass and virtuousness were determined by accepted methods (Ds-10842-64; 10987-64; 10840-64). The quantity and quality of raw and dry gluten (Ds-9404-060) were determined based on the standard method

Protein content was determined by the Kjeldahl method using a Kjeltec 8400 (FOSS, Denmark) automatic analyser (Методы, 1977).

A normalized matrix of mean feature values was used to construct a quality dendrogram. Distances between objects were calculated using the Euclidean metric, and clustering was performed using the UPGMA method in «Statistica 12». Correlations between quality parameters (protein content, gluten, and GSI) and parameters (thousand-kernel weight and vitreousness) were determined using the Pearson method at $p < 0.05$. All laboratory and field measurements were performed in triplicate. Data are presented as mean ± standard error (± SE). The significance of differences between variants was tested ANOVA using R statistical (R version 4.5.1; R Core Team, 2024) and Duncan's test was used to rank mean values ($p < 0.05$).

RESULTS AND DISCUSSION

As can be seen from the table, 36.11% of the samples had 100% vitreousness, in addition, most of the samples showed a high result, being 98-99% vitreousness. However, 5.6% of the samples had an unsatisfactory vitreousness index. The vitreousness of the grains characterizes its consistency and serves as an indirect criterion for assessing the properties of wheat as a pasta-cereal crop (Table 1).

Table 1.

Average three-year quality indicators for durum wheat varieties 2022-2024.

S. numb	Samples	Protein %	Physical properties		Gluten %	GDI d.i.
			vitreousness %	weight of 1000 grains gr.		
1	*v. leucomelan*	12,4	99	44,0	35,0	110
2	*v. hordeiforme*	15,6	100	42,0	42,0	95
3	*v.niloticum*	15,7	56	54,0	37,0	100
4	*v.obscurum*	17,2	86	43,2	35,0	105
5	*v.albo provinciale*	15,1	98	49,2	35,2	105
6	*v. provinciale*	12,1	100	44,0	34,0	105
7	*v. hordeiforme*	12,5	100	30,4	34,0	115
8	*v. hordeiforme*	14,6	99	40,4	39,0	95
9	*v.affine*	12,5	97	44,8	29,0	100
10	*v.murciense*	13,7	100	46,4	38,0	95
11	*v.melanopus*	13,0	96	47,6	34,0	100
12	*v.aegepteacum*	14,6	99	49,2	29,6	105
13	*v.murciense*	16,0	100	40,0	46,0	95
14	*v.obscurum*	16,4	100	42,0	44,0	80
15	*v.niloticum*	16,4	97	40,0	40,0	110
16	*v.melanopus*	16,3	100	48,0	42,0	120
17	*v.mut.apulicum*	16,5	100	42,4	47,0	115
18	*v.lyubicum*	14,6	99	44,0	46,0	95
19	*v.albo provinciale*	15,5	100	42,4	40,0	90
20	*v.aegepteacum*	14,5	98	34,4	38,0	100

21	*v.melanoleucurum*	13,9	99	47,2	30,0	115
22	*v.affine*	14,3	100	47,2	31,0	100
23	*v.murciense*	12,6	97	33,6	33,0	100
24	*v.murciense*	10,5	93	44,8	11,0	120
25	*v.murciense*	11,5	98	39,2	19,0	115
26	*v.melanopus*	12,5	97	33,2	23,0	120
27	*v.erytromelan*	13,1	98	40,0	24,0	120
28	*v.mut.hordeiforme*	13,1	97	41,6	24,0	110
29	*v. leucomelan*	11,1	96	48,0	26,0	115
30	*v. hordeiforme*	14,7	100	45,2	33,0	100
31	*v.erytromelan*	12,5	100	44,4	31,0	110
32	*v.courulescens*	11,4	99	47,6	30,0	120
33	*v.melanopus*	13,0	98	38,4	37,0	105
34	*v.mut. melanopus*	14,7	100	46,8	38,0	100
35	*v. leucomelan*	11,8	99	56,4	21,0	110
36	St.Maya	14,9	99	50,4	32,0	105

Durum winter wheat grain, with its high vitreousness, absorbs 15-20% more water and germinates somewhat more slowly than the poorly vitreous and floury grain of winter soft wheat. Therefore, durum wheat is very sensitive to soil moisture deficiency. It does not tolerate drought well in the autumn (Власова, 2013).

In terms of protein content, 44.4% of all samples showed results above the 3-year average, while the remaining 55.6% had values below the average. Sample No. 4 (v. obscurum) had a relatively high gluten content (35.0%) and the highest protein content (17.2%) among all samples. It was found that the largest proportion of samples (47.2%) had a 1000-kernel weight below the average, while 44.4% of samples were at the average level, and 8.3% significantly exceeded it. However, this sample's vitreousness was 86%, which is considered unsatisfactory for durum wheat in general. As a result, unfortunately, the gluten deformation index (105 on the apparatus) for this sample left much to be desired.

The protein content of wheat grains varies significantly depending on various factors, such as soil and climate conditions, the length of the growing season, and others. Despite these fluctuations, winter durum wheat has an important nutritional composition and, along with spring wheat, plays a significant role in the food industry, particularly in the production of pasta and groats (Kibkalo, 2022).

The average gluten content of winter durum wheat samples was consistently high and ranged from 11.0% (*v.murciense*) to 47.0% (*v.mut.apulicum*). High values (≤40.0%) were noted in 8 winter durum wheat samples: (№ 2, № 13, № 14, № 15, № 16, № 17, №18, № 19).

An analysis of long-term grain production data shows that the causes of low protein and gluten content in wheat grain are related to poor crop cultivation practices, insufficient mineral nutrition, primarily nitrogen, especially during high yields, and errors in nitrogen fertilizer application. Such problems are often exacerbated by meteorological factors.

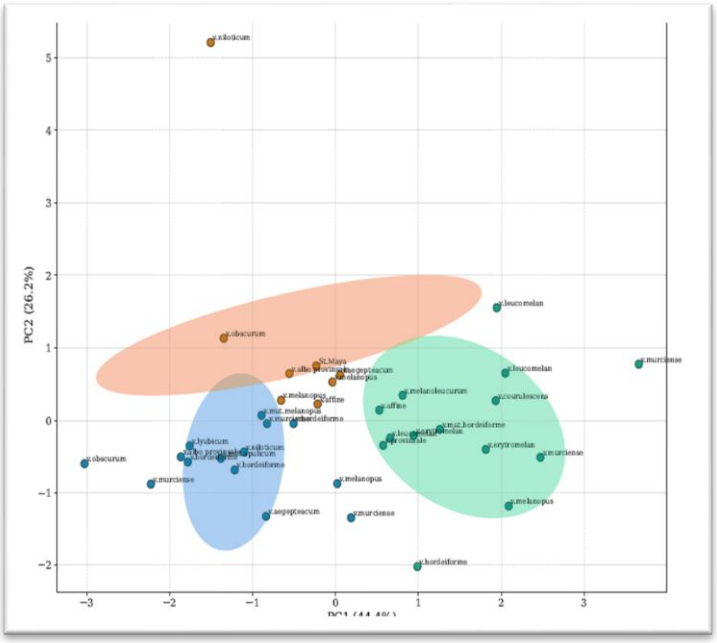
Therefore, when growing food wheat, it is important to plant it among the best predecessor crops, use optimal fertilizer types, rates, and timing, and implement a comprehensive set of protective measures (Гладышева, 2018).

Thousand-grain weight is a multifaceted indicator that determines the productivity of an ear or plant and characterizes a variety's response to drought conditions. It also relates to grain quality and influences the yield of flour or semolina. Typically, seeds with a high thousand-grain weight possess sufficient nutrient reserves and exhibit high sowing and yield properties. Grain size is significantly dependent on growing conditions. The same genotype exhibits variable behavior in different environmental conditions; from this perspective, its response can be understood as a change in phenotype under the influence of environmental factors.

The 1000-grain weight of several accessions: *v. niloticum* (54.0 g), *v. leucomelan* (56.4 g) and the standard variety Maya (respectively No. 3, No. 35, No. 36 (st.variety)), was relatively high. In total, the average weight of 1000 grains was 43.7 grams, and against this background, according to the table, we found that the largest proportion of samples (47.2%) are characterized by a weight of 1000 grains below the average value, while 44.4% of samples are at the level of the average, and 8.3% significantly exceed it.

As we know, the quality of gluten is more important than its quantity, and the GDI indicator is one of the main indicators in durum wheat. Usually, a negative correlation is shown between high gluten content and GDI indicator, but exceptions are possible here too. Examples of such examples include *v. obscurum* and *v. albo provinciale*, since in the *v. obscurum* sample, as we mentioned above, the gluten content was 44.0%, and the GDI indicator was 80 d.i., in the *v. albo provinciale* sample these indicators were 40.0% and 90 d.i.(respectively). Of the samples, *v. hordeiforme* №2 (42.0% gluten), *v. hordeiforme* №8 (39.0% gluten), *v. lyubicum* (46.0% gluten) can also be considered satisfactory in terms of GDI indicators. The *v.murciense* sample was the weakest sample with a low gluten content (11.0%) and a low GDI indicator (120 d.i.). Among the samples with a high gluten content and an unsatisfactory GDI indicator (120 d.i.), it is worth noting *v.melanopus* (gluten content 42.0%) and *v.courulescens* (gluten content 30.0%) among the samples with a high gluten content and an unsatisfactory GDI indicator. The gluten content was also low in the other samples with an unsatisfactory GIS indicator (*v.melanopus* (23.0%) and *v.erythromelan* (24.0%)). This, in turn, once again demonstrates that quality indicators depend on various factors.

The method of principal component analysis (PCA) applied in this study is aimed at



systematization of the multidimensional phenotypic diversity of 36 varieties of durum wheat on the basis of their biochemical, technological and physical properties, as well as at the identification of patterns of clustering.

Figure 2. Principal Component Analysis Based on Quality Indicators Durum Wheat Varieties of 36

The analysis results show that the high covariance observed among the variables is significantly explained by the first three components of the PCA, and the genotypes are separated into three main phenotypic clusters of high quality, medium quality, and low quality along these components (Figure1).

1. PC1 (blue) – Principal Component of Technological Quality Parameters;

The first component of the PCA (PC1; 44.4%) explains the main part of the total biochemical and technological diversity observed between genotypes. The biological contribution profile of PC1 shows that the component is formed mainly depending on: protein content, functional strength of the gluten complex, rheological properties of flour, water absorption capacity during technological processes. The wide variation in PC1 indicates that genotypes are divided into high-quality, medium-quality and poor-quality groups. Genotypes located in the positive direction of PC1 are rich in protein and gluten, rheological stable and have high technological quality. These genotypes form a high-quality cluster and are considered superior donor material in breeding programs.

Genotypes included in this cluster: *v. niloticum, v. obscurum, v. melanopus, v. melanoleucurum, v. lyubicum, v. albo provinciale, v. provinciale,* St. Maya.

2. PC2 (green) – Phytotypic Effect Component of Grain Physical Structure and Morphological Characteristics

The second component of PCA (PC2) explains the variation in physical-morphological characteristics between varieties. PC2 is mainly formed by the influence of variables related to:

Grain structure, physical integrity, mechanical stability,water absorption dynamics. Genotypes located in the negative zone along PC2 are morphologically weak, have unstable physical structure and exhibit variable behavior in technological processes. These genotypes form a cluster of low physical quality.

Genotypes included in this cluster: *v. murciense, v. aegeteacum, v. erythromelan, v. mut. melanopus, and the poorly performing v. hordeiforme and v. melanopus sub-variants.*

3. PC3 (orange) – Phenotypic Zone Component of Intermediate Forms

The third component of PCA (PC3) reflects finer phenotypic variation and distinguishes genotypes with intermediate biochemical and morphological characteristics. PC3 is mainly formed by: relative variability in gluten subfractions, moderate stability of protein structure, moderate forms of rheological behavior, balanced distribution of physical characteristics. This component defines a medium-quality cluster that stands in a transitional position between high and low extreme phenotypes, but maintains internal stability. These genotypes are used as complementary and stable base material in selection processes.

The genotypes included in this cluster are: *v. affine, v. hordeiforme, v. mut. apulicum, v. leucomelan, v. mut. hordeiforme, v. courulescens.*

PCA results show that the observed phenotypic diversity among wheat genotypes is driven by the combined effects of biochemical (protein and gluten), rheological (KDE and Glassiness) and morphological (grain structure) parameters. These multidimensional correlations lead to the natural separation of genotypes into three stable clusters. In short, high-tech genotypes are considered superior on PC1, medium-level and balanced genotypes are considered stable on PC3, and genotypes with low physical performance are considered weak on PC2.

These results form a reliable biostatistical basis for the purposes of selection, improvement, and agronomic evaluation of wheat genetic resources and play an important role in identifying superior traits across genotypes.

As a result of all these analyses, genotypic phenotypic variation was performed on five main quality parameters.

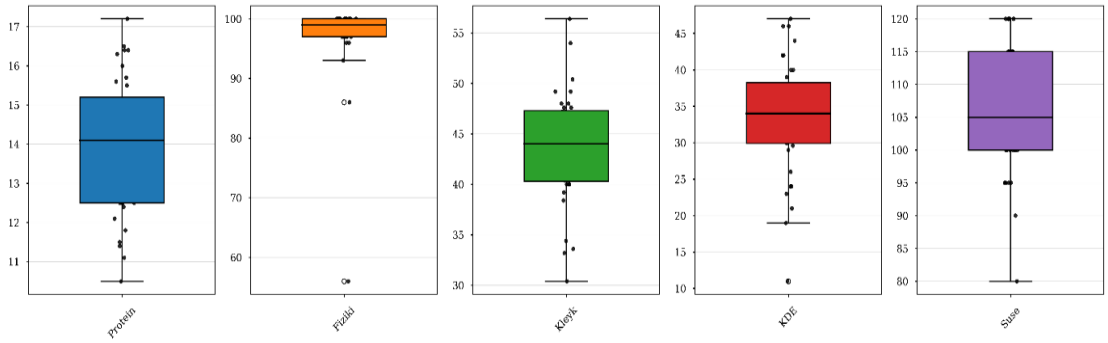


Figure 3. Multidimensional variation dynamics of protein, physical, gluten, GSI and vitreousness indicators across wheat genotypes.

The presented boxplot panel demonstrates the variation structure of the 36 studied wheat genotypes in five main technological and biochemical parameters (protein, physical, gluten, GDI and vitreousness). Each parameter plays the role of a critical functional indicator that determines the baking quality, rheological behavior and technological performance of the genotypes (Figure 2).

Protein

As is known, protein content varies moderately between genotypes. Genotypes with high protein levels form a high gluten network during the baking process and are technologically superior.

The boxplot of the physical parameter shows that most of the genotypes are concentrated in the high value interval. However, some extreme values confirm the heterogeneity of the grain structure and the difference in mechanical strength between the genotypes.

Gluten (Gluten index): The gluten parameter reflects the functional strength of the gluten complex. The wide dispersion here indicates significant phenotypic diversity between the genotypes in terms of both the quality and structural stability of gluten.

GİS (Glutenin/Gliadin balance): The boxplot of the GDI indicator demonstrates one of the largest variations. Since this variable plays a key role in the formation of the viscoelastic properties of the dough, the dispersion creates a wide functional basis for selection.

Vitrility (Water absorption capacity): The vitreousness index indicates the ability of the genotypes to absorb water. This parameter affects both the stable formation of the dough during baking and the correct control of technological processes. The wide variation observed confirms that this trait has strong variability at the genetic and biochemical levels.

CONCLUSION

The figure clearly shows that the genotypic diversity is high for each of the five main indicators. As a result, this diversity reflects the formation of the main structure in the PCA cluster. The obtained numerical results play an important role in the selection of genotypes with high, medium and poor technological indicators and allow the formation of a biostatistical basis for breeding programs.

One of the main areas of durum wheat breeding is improving grain quality. A study of the quality characteristics of winter durum wheat varieties, including local and introduced accessions stored in the Institute of Genetic Resources' Genbank, resulted in the identification of seven accessions, along with the standard Maya variety: *v. niloticum, v. obscurum, v. melanopus, v. melanoleucurum, v. lyubicum, v. albo provinciale, v. provinciale.*

These identified accessions are of interest for breeding durum wheat for high grain quality in our conditions.

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ABŞERON ŞƏRAİTİNDƏ BECƏRİLƏN BƏRK BUĞDA (*T.durum* Desf.) NÜMUNƏLƏRİNİN TEXNOLOJİ VƏ BIOKİMYƏVİ GÖSTƏRİCİLƏRİNİN ÖYRƏNİLMƏSİ

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Buğda dənin keyfiyyət göstəriciləri seleksiya və emalın vacib aspektlərindəndir. Dənin əsas keyfiyyət göstəricilərinə unun reoloji xüsusiyyətlərini dolayı yolla müəyyən edən qlüten, zülal və şüşəvarilik daxildir. Tədqiqatımızın məqsədi payızlıq bərk buğdanın təsərrüfat əhəmiyyətli xüsusiyyətlərinin mənbələrini müəyyən etmək və gələcək seleksiyada istifadə etməkdir. Genetik Ehtiyatlar İnstitutunun Abşeron yarımadasında yerləşən təcrübə sahəsində (40.413010Ş şərq uzunluğu və 49.833421Ş şimal enliyi) becərilən 35 bərk buğda nümunəsi və standart kimi götürülmüş Maya sortu tədqiqatda istifadə olunmuşdur. Zülal tərkibi baxımından bütün nümunələrin 44,4%-i 3 illik orta göstəricidən yuxarı, qalan 55,6%-i isə orta göstəricidən aşağı nəticələr nümayiş etdirmişdir. 4 nömrəli nümunə (*v. obscurum*) nisbətən yüksək qlüten tərkibinə (35,0%) və bütün nümunələr arasında ən yüksək zülal tərkibinə (17,2%) malik olmuşdur. Məlum olmuşdur ki, 1000 dənin kütləsinə görə orta qiymət 43,7qr - dır. Bu nəticədən daha yüksək göstəriciyə malik nümunələr 8,3%, bu nəticəyə yaxın olan nümunələr 44,4%, aşağı olanlar isə 47,2% təşkil etmişdir. Nəticələr göstərir ki, dəyişənlər arasında müşahidə olunan yüksək kovarians PCA – nın ilk üç komponenti ilə əhəmiyyətli dərəcədə izah olunur və genotiplər bu komponentlərə görə üç əsas fenotipik qrupa bölünür: yüksək, orta və aşağı keyfiyyətli. Bərk buğda seleksiyasının əsas istiqamətlərindən biri də dənin keyfiyyətinin yaxşılaşdırılmasıdır. Genetik Ehtiyatlar İnstitutunun Genbankında saxlanılan yerli və introduksiya olunmuş payızlıq bərk buğda nümunələri və standart Maya sortunun keyfiyyət göstəricilərinin analizi nəticəsində bütün əlamətlərə görə yüksək göstəriciyə malik yeddi nümunə seçilmişdir: *v. niloticum, v. obscurum, v. melanopus, v. melanoleucurum, v. lyubicum, v. albo provinciale və v. provinciale.* Müəyyən edilmiş bu nümünələrdən bizim şəraitdə yüksək keyfiyyətli dən məhsulu almaq üçün gələcək seleksiyada istifadə etmək məqsədəuyğundur.

Açar sözlər: *bərk buğda, qlüten, zülal, şüşəvarilik, keyfiyyət, seleksiya*

ИССЛЕДОВАНИЕ ТЕХНОЛОГИЧЕСКИХ И БИОХИМИЧЕСКИХ ПОКАЗАТЕЛЕЙ ОБРАЗЦОВ ТВЕРДОЙ ПШЕНИЦЫ (*T.durum* Desf.), ВОЗДЕЛЫВАЕМЫХ В УСЛОВИЯХ АПШЕРОНА

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Показатели качества зерна пшеницы, используемые в конечном продукте, являются важными аспектами селекции и переработки. Ключевыми показателями качества зерна являются клейковина, белок и стекловидность, которые косвенно определяют реологические свойства муки. Целью нашего исследования было выявление источников хозяйственно-ценных признаков у озимой твердой пшеницы для последующего использования в процессе селекции. В исследовании использовались 35 сортов твердой пшеницы и сорт Майя (стандартный сорт), выращенные на экспериментальном участке Института генетических ресурсов (40.413010N восточной долготы и 49.833421E северной широты) Апшеронского полуострова. По содержанию белка 44,4% всех образцов показали результаты выше среднего значения за 3 года, у остальных 55,6%. образцов, результаты были ниже среднего. Образец № 4 (*v. obscurum*) имел относительно высокое содержание клейковины (35,0%) и самое высокое содержание белка (17,2%) среди всех образцов. Было установлено, что наибольшая доля образцов (47,2%) имела массу 1000 зерен ниже среднего уровня, в то время как 44,4% образцов находились на среднем уровне, а 8,3% значительно его превышали. Результаты показывают, что высокая ковариация, наблюдаемая между переменными, значительно объясняется первыми тремя компонентами PCA, а генотипы разделяются на три основных фенотипических кластера: высокого, среднего и низкого качества, в соответствии с этими компонентами. Одним из основных направлений селекции твердой пшеницы является улучшение качества зерна. Исследование качественных характеристик сортов озимой твердой пшеницы, включая местные и интродуцированные образцы, хранящиеся в Генбанке Института генетических ресурсов, позволило идентифицировать семь образцов наряду со стандартным сортом Майя: *v. niloticum, v. obscurum, v. melanopus, v. melanoleucurum, v. lyubicum, v. albo provinciale, v. provinsale.* Выявленные образцы представляют интерес для селекции твердой пшеницы с целью получения зерна высокого качества в наших условиях.

Ключевые слова: *твердая пшеница, клейковина, белок, стекловидность, качество, селекция.*

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