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POLYMORPHİSM FEATURES IN GRAPE (*VITIS VINIFERA* L.) VARIETY BAYANSHIRA POPULATIONS

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SUMMARY

The presented research provides detailed information about ampelodescriptor signs, morphological, biological, and technological features of the indigenous grape (*Vitis vinifera* L.) variety Bayanshira, originating from the ancient center of viticulture Ganja-Dashkasan Zone of Azerbaijan. The study also includes the enocarpological and enochemical indicators of its bunches and berries and the population structure and varietal variability of the said grape variety. One of its recorded biotype had the excessive falling of flowers and many fruits and declining plant yield, making the commercial quality of the crop as unsuitable. Thus, for the remaining biotypes, the overall assessment of prospects ranged from 5.59 to 6.89 points. For biotype-6, this figure was significantly lower, amounting to 4.18 points. The yield per plant in biotype-6 was low at 4.4 kg, while for the other biotypes, this figure was significantly higher (6.1 to 12.4 kg). Except for biotype-6, the remaining biotypes along with yield indicators and quality parameters also meet the requirements, and it is advisable to reproduce and grow them on the grapevine farms.

Keywords: Grape (*V. vinifera* L.), varieties, local variety, bunch, berries, fruit yield, morphological and biological features, breeding

Key findings: In grape (*V. vinifera* L.) variety Bayanshira populations, the study identified and selected eight primary biotypes. Assessment of diversity in the Bayanshira populations, along with the opportunity to recognize the biotypes with superior and low performance, prepares the ground for enhancing the fruit yield with improved quality and to rescue the populations from various hereditary pathologies.

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INTRODUCTION

The grapevine (*Vitis vinifera* L.) is one of the most widely cultivated plants in the world. The centers of origin of the grape plant seemed to be North America, East Asia, and Europe (This *et al.,* 2006). Based on several sources, the Caucasus region (primarily the Southern) and adjacent territories (Anatolia), the Middle East, and Iran were generally the considered geographical area where the grape plant's domestication occurred for the first time in the Neolithic era, about 8,000 years ago (Forni, 2012; Pipia *et al.,* 2012; Salimov and Musayev, 2012).

The gene pool of our region—the Republics of the South Caucasus, especially Azerbaijan—is vastly rich in wild types and cultivated grape varieties (Myles *et al.,* 2011; Bacilieri *et al.,* 2013; Imazio *et al.,* 2013). The genetic diversity of grapevine germplasm in the South Caucasus has gained studies by numerous researchers using molecular and ampelographic analyses (Ekhvaia and Akhalkatsi, 2010; Maghradze *et al.,* 2015; Maul *et al.,* 2015).

The results obtained by molecular analysis of a large set of grapevine accessions provided information on genetic diversity and relationship among cultivars growing in two different grapevine growing areas, Caucasus and Eastern Europe. According to this work, an assumption indicates a clear connection between proles pontica and proles orientalis. Among the analyzed samples, the cultivars from Azerbaijan appeared the most different (De-Lorenzis *et al.,* 2015).

The samples of 56 putative biotypes of Sangiovese, 14 putative biotypes of Montepulciano, and the two most common black Italian varieties, bore analysis using SSR markers to recognize for authentic identification. According to the findings, the grapevine germplasm belonged to three different varieties, i.e., Sangiovese, Sanforte, and Montepulciano. Subsequent studies using the molecular markers (AFLP, SAMPL, M-AFLP, and I-SSR*) to assess their intra-varietal genetic variability revealed geographical differences among the evaluated biotypes, and could be a powerful tool applicable to all the cultivars of grapevines (Alessandro *et al.,* 2022).

The classification of 51 ampelographic descriptors of 51 genotypes of seven traditional varieties of grapevine were presumably autochthonous to the Crete Island. From them, 113 SSR alleles amplified with 13 SSR loci gave the average number of alleles per locus at 10.23, which indicate extensive genetic polymorphism (Evangelia *et al.,* 2023). The three-sigma method and the asymmetry and kurtosis indicators' formulation helped assess the hypothesis about the regularity of distribution of quantitative characteristics used on 500 bushes of the grapevine variety Bastardo Magarachsky. This determined the productivity indicators and the degree of their variability. Their investigations revealed the heterogeneity of the populations of variety Bastardo Magarachsky, and the possibility of selecting high-productive protoclones (Studennikova and Kotolovets, 2023).

As mentioned, Azerbaijan is one of the oldest centers of grapevine domestication. In Azerbaijan, numerous literary sources have confirmed vine cultivation in the ancient past. Further confirmations result from the tools and household items found during archaeological excavations, the remains of various organs of the grape plant, and the deposits of tartar on the walls of the wine storage vessels (Ibrahimov, 1998; Salimov *et al.,* 2022; Kazimova and Nabiyev, 2022).

One of the main viticultural regions of Azerbaijan is the Ganja-Dashkasan Zone, with the greater potential for agricultural resources. The local population engages in viticulture and winemaking at all stages of historical development. Through folk breeding, dozens of table and technical grape varieties have succeeded development, which have found wide application in everyday life and production. Ganja-Dashkasan Zone is the birthplace of more than 30 varieties of folk selection of table and technical directions of use. The most productive and technical variety of the grapevine (*V. vinifera* L.) was 'Bayanshira,' with the promising table variety 'Tabrizi' as the most ancient indigenous varieties of this zone (Asadullayev *et al.,* 1981; Sharifov, 2013).

The grapevine variety Bayanshira planting accounted for about 30,000 hectares of the total area of grape plantations in Azerbaijan. The variety Bayanshira served as a base material for the preparation of white table wines and champagne materials. One should note most of the white wines produced came from the grapevine variety Bayanshira, and also used fresh. Its harvest storage stands for a long time on vines and special devices, popularly called 'bandag.' A result of long-term cultivation and natural mutation has developed polymorphism in the population of this grapevine variety, and the mixed mutation comprises various variations, biotypes, morphotypes, and clones.

In determining the direction of use and technological suitability of the product of the variety, the uvological evaluation of the bunches and berries of fresh grapes commenced. Furthermore, the preparation of different types of wine samples from them ensued, with their physicochemical analysis using modern methods.

MATERIALS AND METHODS

The research used initial forms, biotypes, and clonal variations of the grape (*V. vinifera* L.) variety Bayanshira grown in the Districts of Beylagan (Dashburun village, old grape orchard). Other materials include Fuzuli (homesteads, old grape orchards) and Shamakhy (production vineyard of LLC "Shirvan wines" and an experienced vineyard of Shamakhy Experimental Station of Viticulture and Winemaking). Likewise, Ganja (ampelographic collection of the Ganja Experimental Station of Viticulture and Winemaking) and Absheron (collection vineyard of the Azerbaijan Research Institute of Viticulture and Winemaking), as well as, processed products obtained from said grapes served as material for the latest work.

The "new model for assessing prospects," developed and proposed by the International Organization of Vine and Wine (OIV), is the most effective and operational method for assessing the prospects of grape varieties of specific agroclimatic conditions for their technological suitability (Salimov, 2016, 2019). The 'ideal variety' model design sought to assess the prospects of technical grape varieties, including 14 ampelodescriptors, divided into three groups, i.e., stability (25%), yield capacity (25%), and quality (50%). Evaluation of the technical grapes using this model allows us to determine its technological suitability and the direction of its use (Lazarevsky, 1959; Troshin and Magradze, 2013). Using the said model assessed the prospects of the grapevine technical variety Bayanshira.

RESULTS AND DISCUSSION

Eight identified and selected biotypes helped study the degree of polymorphism in the populations of the grapevine (*V. vinifera* L.) variety Bayanshira, differing in their morphological, biological, and technological features (Tables 1 and 2) (OIV, 1984). In the promising work, ampelographic descriptor signs of the variety Bayanshira's eight biotypes comprised the number of bunches on the shoot (OIV-201), length of a bunch (OIV-202), density of a bunch (OIV-204), number of berries in a bunch (OIV-205), length of a berry (OIV-220), and width of a berry (OIV-221) (Tables 3, 4, and 5). Stoev *et al.* (1959) found a positive correlation between the average shoot length and the number of grapes. According to Winkler (1965), techniques increasing the vigor of shoot growth also increase their productivity. A specific correlation appeared between the length of the shoots, the number of bunches, and their average weight. More developed shoots have more clusters; but, this dependence does not manifest itself equally in different cultivars. Almost similar results came from Salimov *et al.* (2015b).

The prospects of the biotypes belonging to the grapevine variety Bayanshira sustained scrutiny as per the innovative model 'ideal variety,' which includes 14 indicators (Table 6). The results enunciated the studied biotypes have an overall score for prospects below the maximum score provided by the 'ideal grade' model (9 points). Thus, the overall

Table 1. Changes in the population of the Bayanshira variety by biotypes (Part 1/2).

Indicators	Grape biotypes							
	Biotype 1	Biotype 2	Biotype 3	Biotype 4	Biotype 5	Biotype 6	Biotype 7	Biotype 8
Coloring of the upper surface of a leaf	dark green	dark green	Green	yellowish-green	yellowish-green	Green	dark green	light green
Dissection of a leaf blade (depth of sinuses)	Medium	medium or deep	Medium	Medium	shallow or medium-depth	Shallow	shallow or medium-depth	Medium- depth or deep
Berry color	light green	light green	Green	Yellow	Amber	yellowish-green	Golden	White
Berry shape	Roundish	roundish or slightly ovate	Roundish	flat or compressed	slightly ovate	Roundish	slightly ovate	Roundish
Berry size (mm)	20.2 × 19.6	21.3 × 19.6	23.4 × 22.2	21.2 × 22.4	22.4 × 18.8	23.4 × 22.0	21.4 × 17.8	19.4 × 19.0
The ratio of the length of a berry to its width	1.03	1.08	1.05	0.95	1.19	1.06	1.20	1.14
Bunch size (cm)	22.1 × 9.2	20.8 × 14.6	18.5 × 8.4	26.5 × 12.6	23.2 × 10.5	24.0 × 8.2	17.2 × 7.7	22.6 × 7.4
Bunch shape	cylindrical – conical	Conical	cylindrical – conical	widely conical	Conical	cylindrical or conical	Cylindrical	Cylindrical
Bunch density	medium dense	medium dense or dense	very dense	Dense	medium dense	very loose	medium dense or loose	medium dense
Reduction of berries in size	Weak	Weak	Medium	Weak	Medium	Strong	Weak	Weak
Degree of falling of inflorescences (%)	36	42	32.4	16.4	36.8	78.6	52.4	48.2
Yield capacity (kg/vine)	7.4 (6.6-8.2)	7.7 (6.8-8.6)	6.1 (5.2-7.0)	11.0 (9.2-12.6)	12.0 (9.6-14.5)	4.4 (3.6-5.2)	9.8 (8.2-11.4)	12.4 (10.6-14.2)

Table 2. Changes in the population of the Bayanshira variety by biotypes (Part 2/2).

Indicators	Grape biotypes							
	Biotype 1	Biotype 2	Biotype 3	Biotype 4	Biotype 5	Biotype 6	Biotype 7	Biotype 8
Coefficient of productivity of shoot (K_1)	1.14	1.26	0.86	1.30	1.36	0.82	1.20	1.38
Coefficient of productivity of productive shoot (K_2)	1.46	1.52	1.36	1.66	1.88	1.15	1.72	1.92
Productive shoots (%)	52.6	56.8	54.4	74.4	86.6	56.4	85.2	88.4
Time of full ripening of berries (day/month)	20-30.09	20-30.09	20-30.09	20-30.09	30.09-10.10	10-20.09	30.09-10.10	30.09-10.10
Growing season (vegetation period) (days)	166	168	164	168	172	152	174	170
Sugar content (g/100 cm^3)	18.5	18.6	19.4	17.5	17.6	21.4	18.2	17.4
Titrated acidity (g/dm^3)	5.36	6.66	7.02	7.14	7.52	4.65	8.02	7.92
Average weight of a bunch (g)	286.4	325.6	314.4	426.8	446.8	208.6	368.8	438.6
Number of berries in a bunch (pcs.)	175	180	198	246	268	126	206	234
Weight of a single berry (g)	2.08	2.26	2.46	2.88	3.06	2.82	2.44	2.32
Output of juice from berries (%)	68.4	72.4	67.6	77.4	82.4	48.4	70.6	84.6
Vigor of vine growth (cm)	286.6	236.8	368.6	242.4	266.8	386.6	312.6	294.6
Degree of ripening of shoots (s%)	98.4	96.8	91.6	98.8	96.6	82.4	80.6	92.4

Table 3. Ampelodescriptor signs of biotypes in the population of the Bayanshira variety (Part 1/3).

Signs	OIV code	Gradations	Biotypes of the Bayanshira variety							
			Biotype 1	Biotype 2	Biotype 3	Biotype 4	Biotype 5	Biotype 6	Biotype 7	Biotype 8
Number of bunches per shoot	201	1- 1 bunch 2- 1-2 bunches 3- 2-3 bunches 4- more than 3 bunches	2	2	1	2	2	1	2	2
Bunch length	202	1- very short (up to 8 cm) 3- short (8-12 cm) 5- medium (12-16 cm) 7- long (16-20 cm) 9- very long (more than 20 cm)	9	9	7	9	9	9	7	9
Bunch width	203	1- very narrow (up to 4 cm) 3- narrow (4-8 cm) 5- medium (8-12 cm) 7- wide (12-16 cm) 9- very wide (20 cm and more)	5	7	5	7	5	5	3	3
Bunch density (density of arrangement of berries in a bunch)	204	1- very loose 3- loose 5- medium density 7- dense 9- very dense	5	5	9	7	5	1	5	5
Number of berries in a bunch	205	1- very few (50 berries) 3- few (100 berries) 5- in average quantity (150 berries) 7- a lot of (200 berries) 9- very much (more than 250 berries)	7	7	7	9	9	5	9	9
Peduncle length	206	1- very short (up to 3 cm) 3- short (3-5 cm) 5- medium (5-7 cm) 7- long (7-9 cm) 9- very long (9-11 cm)	1	3	3	3	5	5	1	5
Degree of lignification of peduncle	207	1- weak 2- medium 3- strong	3	2	2	2	1	1	3	1
Bunch shape	298	1- oblong 2- oblong-conical 3- conical 4- branched 5- winged	3	3	3	3	3	3	3	3

Table 4. Ampelodescriptor signs of biotypes in the population of the Bayanshira variety (Part 2/3).

Signs	OIV code	Gradations	Biotypes of the Bayanshira variety							
			Biotype 1	Biotype 2	Biotype 3	Biotype 4	Biotype 5	Biotype 6	Biotype 7	Biotype 8
Degree of reduction size of berries	620	1- absent 3- weak (up 10%) 5- medium (10%-20%) 7- strong (20%-30%) 9- very strong (more than 30%)	3	3	5	3	5	7	3	3
Berry length	220	1- very short 3- short 5- medium 7- long 9- very long	7	7	9	7	7	9	7	7
Berry width	221	1- very narrow (up 10 mm) 3- narrow (10-17 mm) 5- medium (17-24 mm) 7- wide (24-31 mm) 9- very wide (31 mm and more)	5	5	5	5	5	5	5	5
Uniformity of berries in shape and size	222	1- berries are heterogeneous in shape and size 2- berries are uniform in shape and size	2	2	2	2	2	2	1	2
Berry shape	223	1- flat 2- roundish 3- slightly ovate 4- oblong-elliptical 5- cylindrical 6- ovate 7- obovate 8- ovoid 9- horn-shaped 10-finger-shaped	2	2	2	2	6	2	6	2
Berry color	225	1- white-yellow-green 2- pink 3- red 4- gray 5- dark red-violet 6- dark blue-black 7- red-black	1	1	1	1	7	1	1	1
Flesh juiciness	232	1- little juicy 2- juicy								
Juice output from berries	233	1- very low (up 50%) 3- low (51%-65%) 5- medium (66%-77%) 7- high (76%-90%) 9- very high (more than 91%)	5	7	5	7	7	1	5	7
Flesh firmness	234	1- soft 2- firm	1	1	1	1	1	1	1	1

Table 5. Ampelodescriptor signs of biotypes in the population of the Bayanshira variety (Part 3/3).

Signs	OIV code	Gradations	Biotypes of the Bayanshira variety							
			Biotype 1	Biotype 2	Biotype 3	Biotype 4	Biotype 5	Biotype 6	Biotype 7	Biotype 8
Flesh density	235	1- very loose 3- loose 5- medium 7- dense 9- very dense	3	5	5	5	5	5	3	5
Berry taste	236	1- neutral 2- muscat 3- reminiscent of the taste of the Isabella variety 4- characteristic of the variety 5- reminiscent of the taste of bird grapes 6- grassy	4	4	4	4	4	4	4	4
Berry flavor	237	1- neutral 2- weakly expressed 3- slightly fragrant 4- fragrant 5- with a faint nutmeg smell 6- with a strong nutmeg smell 7- other flavors	2	2	2	2	2	2	2	2
Degree of seed development in a berry	241	1- no seeds 2- rudimentary 3- fully developed	3	3	3	3	3	3	3	3
Weight of a single berry	503	1- very small (less than 1 g) 3- small (1.1-3 g) 5- medium (3.1-5 g) 7- large (5.1-7 g) 9- very large (more than 12 g)	3	3	3	3	5	3	3	3
Number of seeds in a berry	623	1- one 3- one-two 5- two-three 7- three-four 9- four and more	5	5	5	5	5	3	5	7

Table 6. Evaluation of the prospects of the Bayanshira technical grape variety according to the innovative model "ideal variety."

OIV Descriptor Codes	A group of signs and their evaluation in points	Phenotypic signs	Correction factor	Points by model "ideal variety"	Biotype 1	Biotype 2	Biotype 3	Biotype 4	Biotype 5	Biotype 6	Biotype 7	Biotype 8
233	Quality - 4.5 points	Juice output (%)	0.02	0.18	0.1	0.14	0.1	0.14	0.14	0.02	0.1	0.14
505		Sugar content of must (g/100 cm^3)	0.04	0.36	0.28	0.28	0.28	0.2	0.2	0.32	0.28	0.2
506		Titrated acidity (g/dm^3)	0.04	0.36	0.12	0.2	0.2	0.2	0.2	0.2	0.2	0.2
304-1		Indicator of technical maturity	0.06	0.54	0.42	0.42	0.42	0.42	0.54	0.54	0.54	0.54
-		Content of phenolic compounds (g/dm^3)	0.05	0.45	0.35	0.45	0.35	0.45	0.25	0.35	0.45	0.35
-		Content of biologically active substances (g/dm^3)	0.04	0.36	0.28	0.28	0.28	0.36	0.36	0.12	0.28	0.36
-		Tasting score in points	0.25	2.25	1.75	2.25	1.75	2.25	2.25	0.75	1.75	2.25
504	Yield -2.25 points	Yield capacity	0.15	1.35	1.35	1.35	1.05	1.35	1.35	0.75	1.35	1.35
153		K_1- yield coefficient of a shoot	0.05	0.45	0.1	0.1	0.05	0.1	0.1	0.05	0.1	0.1
153-1		K_2- yield coefficient of a yield shoot	0.05	0.45	0.1	0.1	0.1	0.15	0.15	0.05	0.15	0.15
600	Stability - 2.25 points	Frost resistance	0.08	0.72	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
459		Resistance to gray rot	0.03	0.27	0.15	0.09	0.05	0.15	0.15	0.21	0.09	0.15
452		Resistance to mildew	0.07	0.63	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
455		Resistance to oidium	0.07	0.63	0.35	0.49	0.35	0.35	0.49	0.21	0.35	0.49
Total: 9 points		The total quantity of points for biotypes			5.96	6.76	5.59	6.73	6.79	4.18	6.25	6.89

assessment of the prospects of biotypes in points was 4.18 (biotype 6), 5.59 (biotype 3), 5.96 (biotype 1), 6.25 (biotype 7), 6.73 (biotype 4), 6.76 (biotype 2), 6.79 (biotype 5), and 6.89 (biotype 8). The results also revealed biotype 8 (6.89) scored the highest number of points, and biotype 6 (4.18) scored the lowest.

All the grapevine biotypes had low scores in titratable acidity, yield coefficients K_1 and K_2, and frost resistance, which ultimately affected their overall score. The prospects indicators' analysis showed the juice output of the studied biotypes amounted to 0.02% (biotype 6) to 0.14% (biotypes 2, 4, 5, and 8). It was significantly lower than the indicator of the ideal variety (0.18%). The sugar content of most of the biotypes was also lower than the ideal grapevine variety.

By determining the color of the upper surface of a leaf in the studied grapevine biotypes, the results exhibited the color of the upper side of the leaves varies between green and its various shades. For example, in biotypes 1 and 2, the upper surface of the leaves had dark green, and in biotypes 4 and 5, the upper surface was yellowish-green. From results of studying the degree of dissection of the leaf blade (depth of leaf sinus), the leaf sinuses in grapevine biotype 1 were medium, in biotype 6, it was small, while in other biotypes, the leaf sinuses were small and medium depths.

During the study, calculating the productivity and quality indicators of each of the studied local and introduced table grapevine cultivars ensued. It revealed the total number of inflorescences per shoot varies from one (Apoi Khagog, Taif Rozovyi, Sultanina, and Pobeda) to four (Doina). The biological productivity of grapevines (mass of organic product) depends on the area of the leaf surface of the plant, the efficiency of its photosynthetic activity, and the duration of bunch formation. One of the indicators influencing the formation of the actual (real) yield of grapevine is the weight of bunches. According to this indicator, cultivars had a wide range of variation. In the studied grapevine cultivars, the bunch weight determination relied on the OIV 502 ampelographic descriptor. Apparently, no cultivars with tiny bunches (less than 100 g) emerged. Small (150–250 g) bunches were visible in six cultivars and forms (Khalbasar, Ag Pishraz, Pshraz Gara, Dnestrovskii Rozovyi, Dekabrski, and Dzandzhal Kara). The cultivar Taif Rozovyi had massive bunches (Salimov *et al.,* 2024).

The results based on the berry color of the biotypes showed biotypes 1 and 2 have light green berries, biotype 3 has green berries, biotype 4 has yellow, biotype 5 has amber, biotype 6 has yellowish-green, biotype 7 has golden, and biotype 8 has white berries. Concerning the berry size, the highest indicators appeared in biotype 3. The length and width of the berries in this biotype were 23.4 and 22.2 mm, respectively. The lowest indicators of berry size were notable in the biotype 8 (19.4 and 19.0 mm, respectively). It was also apparent Azerbaijani grapevine cultivars have a broad range of diversity by their morphological characteristics. Thus, they are separable by their color, shape, and size of berries, flavor and aroma, ripening period, direction of use, processing, and storage specifications (Salimov *et al.,* 2015a).

In grapevine, the berry size dominates as an essential factor in determining the quality of grapevine cultivars (Matthews and Nuzzo, 2007). Past studies demonstrated differences in berry size also result in variations in the fruit composition, including tannins and anthocyanins. Furthermore, the wines produced from small berries have exhibited higher concentrations of tannins and anthocyanins (Matthews and Nuzzo, 2007).

Identifying the shape of the bunch, the results revealed most studied biotypes were dominantly cylindrical, conical, and cylindrical-conical bunches. Regarding the density of the arrangement of berries in a bunch among the studied biotypes of grapevine, fairly large differences emerged. In biotypes 1, 2, 5, 7, and 8, the bunches were of medium density, biotype 4 were dense, while biotype 6 has very loose bunches. Previous results determined the differences among the selected biotypes of the grapevine variety Saperavi as per main ampelographic characteristics. This made it possible to identify the most promising biotype for size, density, and weight of the bunch, berry size, and yield (Klimenko *et al.,* 2020).

In addition to the above grapevine parameters, examining the dry matter content and the amount of titrated acidity in the biotypes of the variety Bayanshira transpired. The highest dry matter content (21.4 Brix) resulted in biotype 6, while the lowest (17.4 Brix) was in biotype 8. The lowest index of titrated acidity was notable in biotype 6 (4.65 g/dm^3), with the topmost index noted in biotype 7 (8.02 g/dm^3). Huseynov *et al*. (2019) determined that Brix values in technical grape varieties varied between 16.6% to 21.6%. The grapevine cultivar quality also depends upon the biochemical composition of the berries. On grape cultivars harvesting, the Brix scale ranged from 19.0 to 23.0 in white cultivars and 20.5 to 23.5 in red cultivars (Rieger, 2006). According to the Brix scale enhancement, the alcohol content of the resulting wine revealed elevated (Cox, 1999).

Grape juice is an important factor, playing a key role in determining the technological suitability of technical grape varieties. Bayanshira is a technical grape variety; hence, obtaining the juice from its harvest is valuable. By determining the juice output (OIV-233) in the biotypes of the Bayanshira variety, the lowest indicator appeared in biotype 6 (50% or less), which corresponded to the OIV-233-1 code. In biotypes 1, 3, and 7, the juice output index varied from 66% to 77% (OIV-233-5), and in biotypes 2, 4, 5, and 8, it varied within 76%–90% (OIV-233-7). During the studies, the juice yield receives a poor rating if up to 50%, low (51%–65%), medium (66%–75%), high (76%–90%), and very high, if above 91% (ampelodescriptor — OIV 233) (Salimov, 2019). Based on this, one can assume the juice yield was normal in most studied grape biotypes, except biotype 6.

The phenolic compound content ranged from 0.25 to 0.45 g/dm^3. The lowest phenolic index appeared in biotype 5 (0.25 g/dm^3). In biotypes 2, 4, and 7, the phenolic compounds index was 0.45 g/dm^3, which corresponds to the indicators of an ideal grape variety. In the grape biotypes, the content of biologically active substances varied between 0.12 and 0.36 g/dm^3. According to an 'ideal variety' model, the biologically active substances content should be 0.36 g/dm^3. The tasting score of the ideal grape variety should be 2.25 points. In the studied grape biotypes, the tasting score varied, ranging from 0.75 to 2.25 points. The lowest score (0.75 points) occurred for biotype 6. The biotypes 2, 4, 5, and 8 showed fairly high values for tasting scores (1.75, 2.25 points). For yield, six biotypes corresponded to the indicator of the ideal variety (1.35 points) and biotypes 3 and 6 had lower yields than the ideal variety (1.05 and 0.75, respectively).

During the research, it was noteworthy that the total score for perspective is lowest in the Saperavi variety (5.24), and the highest is 6.94 points in the Bayanshira variety. In general, the score of the ideal variety, whose components' rating is the highest, equalling to nine points. Visibly, according to the 'ideal variety model,' the prospective scores of the studied grape varieties are relatively low. This is due to the low disease, pest and frost resistance indicators of technical grape varieties, and as a result, those evaluated varieties gave a low score for these characteristics (Huseynov *et al.,* 2019).

For the shoot yield coefficient (K_1), the studied biotypes lagged far behind the ideal variety. Thus, in the biotypes, the yield coefficient of the shoot ranged from 0.1 to 0.05, while in the 'ideal variety model,' it should be 0.45. The yield coefficient of the yield shoot (K_2) in biotypes, varying at the range of 0.1-0.15, also turned out as lower than the ideal variety (0.45). In all the grape biotypes, the frost resistance index was 0.4, while the ideal variety should have 0.72. The degree of resistance to gray rot based on the model of the ideal variety should be 0.27. However, in studied biotypes, this indicator varied between 0.05-0.21. Studied biotypes lagged after the ideal variety for the degree of resistance to mildew and oidium. In biotypes, the mildew resistance surfaced at 0.21 points, which was much lower than the ideal variety (0.63). Resistance to oidium by biotypes varied, with the range of 0.21-0.49 points. However, for an 'ideal variety' model, this indicator should be 0.63 points.

Ampelographic characterization performance on 21 grapevine cultivars succeeded. For each of these cultivars (genotypes), in situ ampelographic observations proceeded for two growing seasons (2021–2022). The most crucial ampelographic characteristics needing monitoring were OIV153-İnflorescence: number of inflorescences per shoot; OIV202-Bunch: length (peduncle excluded); OIV203-Bunch: width; OIV223-Berry: shape; OIV235-Berry: firmness of flesh; OIV222-Berry: uniformity of size; OIV303-Time of start of berry ripening (veraison); OIV351-Vigor of shoot growth; OIV501-Percentage of berry set; OIV502-Bunch: weight of a single bunch; OIV503-Berry: single berry weight; OIV504-Yield per m^2; OIV505-Sugar content of must; and OIV-506-Total acid content of must (Osman *et al*., 2023; Huseynov and Aghayev, 2024; Salimov *et al.,* 2024).

CONCLUSIONS

In the grape (*V. vinifera* L.) variety Bayanshira populations, the study identified and selected eight primary biotypes for assessment. The results revealed biotype 6 proved unsuitable due to excessive falling of flowers, large number of peas, and low plant yield and commercial quality. In the remaining biotypes, the overall assessment of prospects ranged from 5.59 to 6.89 points. Based on yield and quality indicators that also meet the requirements of an ideal variety, the latest work suggested reproducing and growing the seven biotypes on grapevine farms.

ABBREVIATIONS

AFLP - Amplified fragment length polymorphism
SAMPL - selective amplifications of microsatellite polymorphic *loci*
M-AFLP - microsatellite-amplified fragment length polymorphism
I-SSR - Inter simple sequence repeat

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REFERENCES

Alessandro Z, Stefano M, Giacomo M, Antonio C, Angelo C, Paolo S (2022). Study of inter- and intra-varietal genetic variability in grapevine cultivars. *Plants* 11(3): 397. https://doi.org/10.3390/plants11030397.

Asadullayev A, Suleymanov J, Veliyev S (1981). Increasing yields and improving the quality of grapes. *Azerneshr.* pp. 218. (in Azerbaijani).

Bacilieri R, Lacombe T, Le-Cunff L, Di Vecchi-Staraz M, Laucou V, Genna B, Péros JP, This P, Boursiquot JM (2013). Genetic structure in cultivated grapevines is linked to geography and human selection. *BMC Plant Biol.* 13: 25. https://doi.org/10.1186/1471-2229-13-25.

Cox J (1999). From Vines to Wines. Storey Publishing, North Adams, Massachusetts. pp. 232.

De-Lorenzis G, Maghradze D, Biagini B, Di Lorenzo GS, Melyan G, Musayev M, Savin G, Salimov V, Chipashvili R, Failla O (2015). Molecular investigation of Caucasian and Eastern European grapevine cultivars (*V. vinifera* L.) by microsatellites. *Vitis J. Grap Res.* 54: 13–16.

Ekhvaia J, Akhalkatsi M (2010). Morphological variation and relationships of Georgian populations of *Vitis vinifera* L. subsp. sylvestris (C.C. Gmel.) *Hegi. Flora.* 205(9): 608–617. https://doi.org/10.1016/ j.flora. 2009.08.002.

Evangelia VA, Ioannis M, Theodora DP, Aliki K, Maria P, Emmanouil AT, Michael N, Andreas GD (2023). Analysis of vine-producing *Vitis vinifera* L. biotypes, autochthonous to Crete (Greece), employing ampelographic and microsatellite markers. *Life* 13(1): 220. https://doi.org/10.3390/life13010220.

Forni G (2012). The origin of Old World viticulture. In: D. Maghradze, L. Rustioni, J. Turok, A. Scienza, and O. Failla (Eds.). Caucasus and Northern Black Sea Region Ampelography. *Vitis* 53: 27–38.

Huseynov MA, Aghayev UJ (2024). Qualitative parameters of grapevine (*Vitis vinifera* L.) cultivars grown in the Mountainous Shirvan Region of Azerbaijan. *SABRAO J. Breed. Genet.* 56(5): 1994-2003. http://doi.org/10.54910/sabrao2024.56.5.22.

Huseynov MA, Salimov VS, Nasibov HN (2019). The effect of varietal diversity on technological and quality parameters of grape juice. *Azerb agric sci.* 1: 122–128.

Huseynov MA, Salimov VS, Nasibov HN (2019). The influence of variety varieties on the technological and quality parameters of grape juice. *Azerb. Agric. Sci.* 1: 122–128. (in Azerbaijani).

Ibrahimov NA (1998). Technology of Azerbaijani wines. *Azerneshr*. pp. 319. (in Azerbaijani).

Imazio S, Maghradze D, De-fLorenzis G, Bacilieri R, Laucou V, This P, Scienza A, Failla O (2013). From the craddle of grapevine domestication: Molecular overview and description of Georgian grapevine (*Vitis vinifera* L.) germplasm. *Tree Genet. Genom.* 9: 641–658. https://doi.org/10.1007/s11295-013-0597-9.

Kazimova İ, Nabiyev A (2022). Determining quality indicators of table grape varieties during storage in a refrigerating chamber in different variants. *East.-Eur. J. Enterp. Technol.* 6(120): 34–43. doi.10.15587/1729-4061.2022.268025.

Klimenko VP, Studennikova NL, Kotolovets ZV (2020). Ampelographic features of biotypes of grape variety 'Saperavi'. *Magarach* 24(3): 196–200. doi:10.35547/IM.2020.22.3.002.

Lazarevsky MA (1959). Grape Variety. State Publishing House, pp. 428. (in Russian).

Maghradze D, Salimov V, Musayev M, Ocete CA, Melyan G, Chipashvili R, Failla O, Ocete R (2015). Sanitary status of the Eurasian wild grapevine in the South Caucasian region. *Vitis* 54: 203–205.

Matthews MA, Nuzzo V (2007). Berry size and yield paradigms on grapes and wine quality. Proceedings of the International Workshop on Advances in Grapevine and Wine Research. pp. 423–435.

Maul E, Töpfer R, Carka F, Cornea V, Crespan M, Dallakyan M, de Andrés Domínguez T, de Lorenzis G, Dejeu L, Goryslavets S, Grando MS, Hovannisyan N, Hudcovicova M, Hvarleva T, Ibáñez J, Kiss E, Kocsis L, Lacombe T, Laucou V, Maghradze D, Maletić E, Melyan G, Mihaljević MZ, Muñoz-Organero G, Musayev M, Nebish A, Popescu CF, Regner F, Risovanna V, Ruisa S, Salimov V, Savin G, Schneider G, Stajner N, Ujmajuridze L, Failla O (2015). Identification and characterization of grapevine genetic resources maintained in Eastern European collections. *Vitis* 54: 5–12.

Myles S, Boyko AR, Owens CL, Brown PJ, Grassi F, Aradhya MK, Prins B, Reynolds A, Ming-Chia J, Ware D, Bustamante CD, Buckler ES (2011). Genetic structure and domestication history of the grape. Proc. National Acad. Sci, USA 108 (9): 3530–3535. https://doi.org/10.1073/pnas.1009363108.

OIV (1984). Code des caracteres descriptifs des varietes et especes de *Vitis.* Dedon, Paris, pp. 128.

Osman A, Sitohy M, Mohsen FS, Abbas E (2023). Green biochemical protection of postharvest table grapes against gray mold (Botrytis cinerea) using 7s proteins. *SABRAO J. Breed. Genet*. 55(5): 1729-1742. http://doi.org/10.54910/sabrao2023.55.5.25.

Pipia I, Gogniashvili M, Tabidze V, Beridze T, Gamkrelidze M, Gotsiridze V, Melyan G, Musayev M, Salimov V, Beck J, Schaal B (2012). Plastid DNA sequence diversity in wild grapevine samples (*Vitis vinifera subsp*. sylvestris) from the Caucasus region. *Vitis* 51(3): 119–124.

Rieger M (2006). Introduction to Fruit Crops. *Grape (Vitis spp).* pp. 229–250.

Salimov V, De Lorensis G, Asadullayev R (2015a). Ampelographic characteristics and molecular investigation of Azerbaijani local grape varieties by microsatellites. *Alban J Agric Sci.* 14(4):420–430.

Salimov V, Huseynov M, Huseynova A, Shukurova V, Musayeva E, Najafova A, Agayev U, Guliyev V (2022). Examination of variability in morphological and biological characteristics of some grape varieties of Azerbaijan. *Vitic. Stud.* 2: 81–93. https://doi.org/10.52001/vis.2022.13.81.93.

Salimov V, Mammadova R, Burak M, Alizade Sh, Sharifova S, Bakhsh A, Amrahov N, Hamidova M (2024). Inter simple sequence repeat (ISSR) based genetic and morphological polymorphism of Azerbaijani grape (*Vitis vinifera*) genotypes. *Genet Resour Crop Evol*. 72:1–13. https://doi.org/10.1007/s10722-024-02110-3.

Salimov V, Musayev M (2012). Viticulture and winemaking of Azerbaijan (Caucasus and Northern Black Sea Region Ampelography). *Vitis* pp. 85–88.

Salimov V, Musayev M, Asadullayev R (2015b). Ampelographic characteristics of Azerbaijani local grape varieties. *VITIS-J Grap Res Germ.* 54:121–123.

Salimov VS (2016). Ampelodescriptor characteristics of the "ideal variety" in viticulture and a new model for assessing the prospects of varieties. *Proc. Cent. Bot. Gard. ANAS.* 15: 10–23. (in Azerbaijani).

Salimov VS (2019). Ampelographic screening of grapes. *Muallim.* pp. 319. (in Azerbaijani).

Sharifov FH (2013). Viticulture. *Sharg-Garb.* pp. 584. (in Azerbaijani).

Stoev KD, Marmarov PT, Benchev IB (1959). Chromatographic analysis of sugars and free amino acids in the sap of grapevines. *Sov Plant Physiol.* 6:424–430.

Studennikova NL, Kotolovets ZV (2023). Study of intra-varietal variability in the population of ‘Bastardo Magarachskiy’ grape variety. *Плодоводство и виноградарство Юга России.* 79(1): 34–44. doi: 10.30679/2219-5335-2023-1-79-34-44.

This P, Lacombe T, Thomas MR (2006). Historical origins and genetic diversity of wine grapes. *Trends Genet.* 22: 511–519.

Troshin LP, Magradze DN (2013). Ampelographic Screening of the Grape Gene Pool. Kuban State Agrarian University. pp. 120.

Winkler AJ (1965). General Viticulture. University of California Press, California.