VITICULTURE STUDIES

Viticulture Studies (VIS)
2022, 2(2): 81 – 93
https://doi.org/10.52001/vis.2022.13.81.93

Research Paper

Examination of Variability in Morphological and Biological Characteristics of Some Grape Varieties of Azerbaijan

Vugar Salimov[1], Movlud Huseynov[1], Afat Huseynova[1], Vusala Shukurova[1], Elnura Musayeva[1], Aida Najafova[1], Uzeyir Agayev[1], Varis Guliyev[2]

[1]Scientific Research Institute of Viticulture and Wine-making, Baku, Azerbaijan
[2] Institute Bioresources from Nakhchivan sector of the National Academy of Sciences of Azerbaijan, Nakhchivan, Azerbaijan

How to cite: Salimov, V., Huseynov, M., Huseynova, A., Shukurova, V., Musayeva, E., Najafova, A., Agayev, U., Gulıyev, V. (2022). Examination of variability in morphological and biological characteristics of some grape varieties of Azerbaijan. Viticulture Studies (VIS), 2(2): 81 – 93 https://doi.org/10.52001/vis.2022.13.81.93

Article History:
Received: 30.05.2022
Accepted: 07.07.2022
First online: 28.07.2022

Corresponding Author
vugar_salimov@yahoo.com

Keywords
Grapes
Variety
Clone
Ampelography
Biomorphology

Abstract

The article is devoted to the research of polymorphism peculiarities and variability of local grape varieties, which were first discovered as a result of scientific expeditions, organized in 1998-2020 in various vine-growing regions of the Azerbaijan. The study includes the grape varieties, grown in the ampelographic collection of the Azerbaijan Research Institute of Viticulture and Wine-making.

As a result of the research it was found that the gene pool of grapes of Azerbaijan is characterized by a large varietal diversity and polymorphism.

Morphological, biological and economic-technological features of the new discovered 45 local grape varieties were studied for the first time, However, their classification features and geographical background were also clarified. The digital description was conducted on 66 international ampelodescriptors. By clustering of the descriptor indicators, assessment of variability of hereditary characteristics of these grapevine varieties was conducted.

As shown by the results of cluster analysis, polymorphism in grape varieties is observed mainly on agrobiological, economic and technological grounds.

Introduction

Azerbaijan is considered to be the center of origin and formation of grape culture, the oldest center of viticulture and wine-making. Grapes (Vitis L.) is one of the most common plants of the flora of Azerbaijan, which is characterized by a wealth of forms and varieties.

The Azerbaijani people have an ancient culture of agriculture and rich experience in processing grapes. The local populationpurposefully engaged in viticulture and wine-making for centuries. Through national selection, the agrobiological diversity of Azerbaijan has been replenished with hundreds of valuable indigenous grape varieties with different hereditary properties. Azerbaijan's population from olden times widely cultivated grapes in order to obtain various food and industrial products (jam, richal, doshab, vinegar, abgora, suchug, raisins, juice, sherbet, wine, alcohol), and also to develop various branches of agriculture (Mammadov, Suleymanov, 1978; Panahov, Salimov, 2012; Amanov et al., 2012).

Genotypes of grapes of Azerbaijan are characterized by a large polymorphism. Their populations, which are formed from different biotypes, clones, forms and variations, are genetic carriers of economically valuable and important breeding features. Therefore, it is necessary to identify, accumulate, protect reliably and use purposefully each genotype of grapes available in the gene pool. Maximizing the potential of these genotypes can meet the need for viticulture and wine-making sector and ensure the stable development of the industry.

Plant genetic resources, which are an important part of biological diversity, including the gene pool of grapes, should undoubtedly serve to meet today's needs. However, many species, varieties and forms of grapes in the future may become donors of signs, having great value in terms of breeding, biotechnology and genetic engineering (Salimov, 2009; Akberov et al., 2010).

It should be noted that the accumulation and rational use of genetic resources of grapes, the identification of donor genotypes and attract them to the target breeding programs, the development of new high-yielding and high-quality grape varieties resistant to biotic and abiotic environmental conditions, enrichment of the gene pool of grapes with economically valuable and breeding significant samples, the study of the origin, variation and polymorphism in grape populations, improvement by clonal selection of valuable grape varieties with weakened for various reasons (anthropogenic, environmental, genetic, etc.) deteriorated hereditary characteristics, the study of patterns of heredity and variability in hybrid populations and hybrid generations of grapes, the study of harvesting planting material and the organization of nursery, the implementation of a digital description of local varieties and hybrids of grapes in accordance with the requirements of OIV, on the basis of this the creation of a worldwide database and international Vitis catalog, the development of theoretical and practical recommendations and proposals for the widespread introduction of promising grape varieties are the most relevant issues in the field of viticulture, which have important value. Unfortunately, the solution of such important problems has not yet been given due attention. Now there is a need for a comprehensive study.

Taking this into account, the large-scale research works on accumulation of genetic resources of grapes, study of ampelographic, molecular genetic, phytosanitary and other features of the grape plant, as well as on assessment of biological diversity and study of their suitability for breeding works were carried out in Azerbaijan in 1998-2015 (Salimov, 2009; Salayeva et al., 2010; Salimov, 2011a, 2011b; Salimov & Qurbanov, 2012; Amanov et al., 2012; Salimov & Musayev, 2012; Salimov & Gurbanov, 2012; Salimov et al., 2015b; Pipia et al., 2012; Maghradze et al., 2015; Lorenzis et al., 2015; Salimov et al., 2015a).

Materials and Methods

The materials of the study were 59 indigenous varieties, 23 variations and 31 clonal forms of grapes found during scientific expeditions to various regions of Azerbaijan, which are grown in the collection garden of the Azerbaijan Research Institute of Viticulture and Wine-making of the Ministry of Agriculture of the Republic of Azerbaijan.

First discovered grapes was researched with the use of ampelographic descriptors offered by the International Organization of Vine and Wine (OIV) for studying the properties and signs of grapevine genotypes. They were also digitally described (OIV, 2009; Troshin & Zvyagin, 2005; Salimov, 2014).

After the grouping of grape varieties on different ampelographic descriptors, by Ward method of Cluster in PAST (Palaeontological Statistics software package for education and data analysis software 2007), a dendrogram was composed (Hammer et al., 2001).

When studying the clonal diversity of populations both classical and modern research methods were used (Soldatov, 1984; Troshin, 2001; Troshin & Zvyagin 2005; Salimov, 2008; Wasylyk, 2008; Gurbanov & Salimov, 2010; Borisenko et al., 2015).

To select clonal forms among the plants of a particular population of grapes, genotypic and variational changeability were studied according to the method of O. V. Masyukova (Masyukova, 1973).

Mathematical and statistical processing of the obtained data and validation of the experiments were carried out by nonparametric (x2-criterion, Wilcoxon-Mann-Whitney criterion) and parametric (t-criterion of Student) methods (Rokitsky, 1973; Gubler & Genkin, 1973).

Results and Discussion

In the process of long-term evolution and cultivation of grapes in certain organs of the grape plant (leaf, flower, bunch, berry, seed, etc.) there are a number of morphological changes.

Depending on the characteristics of changes in phonotypic and genotypic characteristics, their hereditary nature, the degree of polymorphism occurring in the morphological, biological and technological characteristics, as well as some other factors, intrapopulation changes are manifested in the form of variations, biotypes, morphotypes and clones.

Therefore, during the years of the research one of the set goals was to identify and study diversity of local grapevine populations at different taxonomic levels (variation, biotype, morphotype, varietal form, clone).

Mutational changes occurring in most indigenous grape varieties as a result of long-term cultivation, lead to the formation of numerous intra-changes and variations.

A group of organisms that grow in one particular micro areas and have the same hereditary genotype (i.e., close in origin), which are similar to the phenotypic point of view (i.e., similar in morphological, biological and economic characteristics), is considered as a biotype. According to some authors, a biotype is a set of morphologically close clones and therefore can be considered as an intermediate taxonomic unit between a variety and a clone. Biotypes consisting of one species mainly differ in biological and technological characteristics (duration of vegetation period, resistance, strength, growth, fruiting elements, uvological indicators, etc.), and sometimes they vary on morphological characteristics (size of bunches, number of berries per bunch, berry size, weight of one berry, etc.) (Guliyev, 1993; Salimov, 2011a, 2014; Borisenko et. Al., 2015).

As it became known from long researches, the gene pool of grapes of Azerbaijan is very rich. It is characterized by a diversity of forms and a large polymorphism in terms of features and indicators. According to recent studies, about 550 grape varieties are grown in the Republic of Azerbaijan. Approximately 370 of them are varieties of local origin (Salimov, 2009; Salimov & Gurbanov, 2012; Panahov & Salimov, 2012).

As a result of scientific expeditions, organized during the years of research in various vine-growing zones of Azerbaijan, 59 local traditional grape varieties were found (ampelographic features of 45 varieties were described for the first time). These grape varieties were included in the ampelographic collection. After a detailed study of the biomorphological, economic and technological properties of these cultivars, they were digitally described by 66 ampelodescriptors for the first time. It was found that the grape varieties by their morphological characteristics, biological and economic characteristics are largely different from each other.

Ampelodescriptors can identify distinctive or similar features of one genotype with other genotypes of the gene pool as a digital set of diagnostic features that reflect the individual characteristics of each grape variety. Therefore, grapevine varieties, first discovered during the research, was extensively studied and described in accordance with the international ampelodescriptors. As a result, a cluster dendrogram was developed (Fig. 1-4) according to the following signs: morphological characteristics of the young shoots and leaves (20 ampelodescriptors); morphological

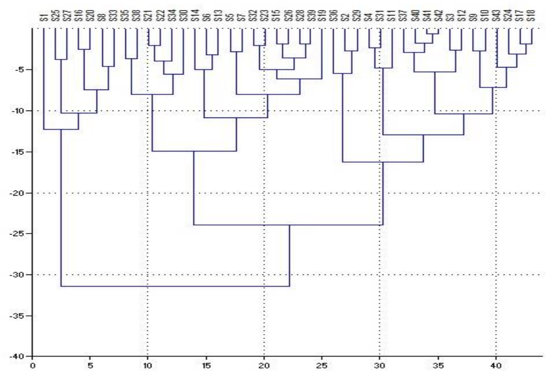

Figure 1. Cluster dendrogram of 20 ampelodescriptors on morphological characteristics of young shoots and leaves

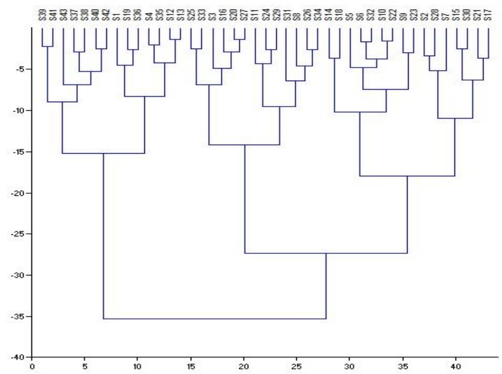

Figure 2. Cluster dendrogram of 20 ampelodescriptors on morphological characteristics of flowers, berries and seeds

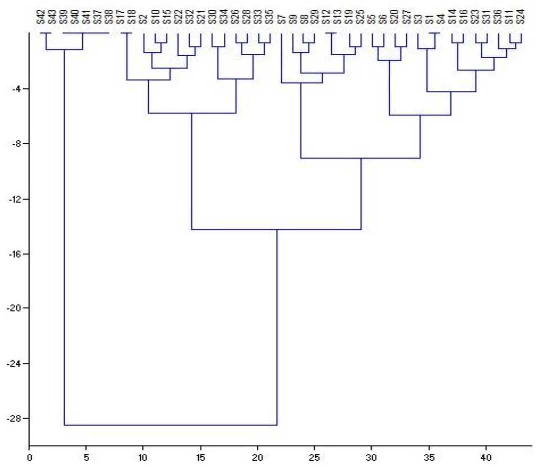

Figure 3. Cluster dendrogram of 11 ampelodescriptors on morphological characteristics of seeds

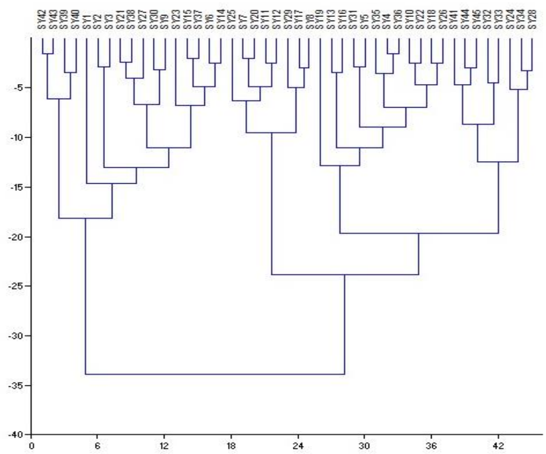

Figure 4. Cluster dendrogram of 15 ampelodescriptors on agrobiological, economic and technological characteristics

characteristics of flowers, clusters and berries (20 ampelodescriptors); morphological characteristics of seeds (11 ampelodescriptors); agrobiological and economic-technological characteristics (15 ampelodescriptors) – a total of 66 signs.

On the sign of young shoots and leaves the grape varieties were subdivided into two subclusters. 7 grape varieties were included in the first subcluster. The main part of the studied varieties (38) was included in the second subcluster. A similar result was obtained on the sign of seeds. In the cluster dendrogram of 20 ampelodescriptors on the morphological characteristics of flowers, bunches and berries two groups are formed. The first group included 14 varieties, and the second group included 31 ones.

During the study of polymorphism and variation changeability, it was found that intrapopulation phenotypic differences were most observed in the following 12 signs: size and shape of bunches and berries, number of berries in one bunch, weight of one bunch, weight of hundred berries, fertility rate of shoot, duration of vegetation season, time of ripening, degree of shedding of flowers and reducing size of berries. For 8 populations (on the Gara shany (Shany black), Mahmudu, Novrast, Agadayi and Ag kishmish (Kishmish white) grape varieties it was identified 2 variations per each variety, on the Tabrizi variety it was identified 3 variations, on the Chehrayi kishmish (Kishmish pink) variety – 4 variations, on the Ag shany (Shany white) variety – 6 variations) was chosen 23 varieties, differing in positive characteristics. A method for using these criteria as phenotypic markers has been developed. In identifying the diversity of genotypes, or, in other words, variations and biotypes in populations of ancient grape varieties, it is advisable to use these characteristics and properties as the main indicators (Table 1).

Currently, in the world viticulture science a clonal selection remains valid (Podvalenko, 2009). In the population of each grape variety there are genotypes with large or small deviations (changes). Such genotypes are called as protoclones (parents of clones).

Clonal selection of grapes is usually approached from the point of view of two aspects: genetic and phytosanitary. Genetic aspect: Clone breeding is an effective system that allows to select and reproduce biotypes improved in terms of yield, quality and some other economically important aspects from variations existing within one variety. This technique provides an accurate work of level of changes in clones (selected representatives of grape varieties) and their phenotypic manifestations in vegetative generations. After selection of valuable biotypes in environment specific for base variety of each individual, vineyards (clon manifold) are laid. In these vineyards under the supervision of experts during three years researches are carried out. It allows to reveal genotypic and phenotypic variations with the changes of morphological, physiological and economic value which have

Table 1. The main features and indicators differentiating the variations in the populations of grape varieties

The main signs and indicators on whichintrapopulation phenotypic differences are shown	Grape varieties and variations in their population							
	Ag shany 6 variation	Chehrayi kishmish 4 variation	Tabrizi 3 variation	Gara shany 2 variation	Mahmudu 2 variation	Novrast 2 variation	Agadayi 2 variation	Ag kishmish 2 variation
Morphological signs of leaf	++	-	+	-	-	-	-	-
Shape of bunch	+	++	-	+ +	++	+	+	++
Size of bunch	+	+	+	+ +	+	+ +	+	++
Mass of bunch	+	+	+	+	++	+ +	+	++
Density of bunch	+	+	++	++	+		++	++
Shape of berry	+	++	+	-	-	+	++	-
Size of berry	+	+	+	-	+	+ +	+	-
Color of berry	+	++	-	+	-		+	-
Number of berries in a bunch	+ +	++	+	+ +	++	+ +	+	++
Mass of 100 berries	+	+	+	-	+	+ +	+	+
Shoot fruiting ratio	+	++	+	-	+	+	-	++
Vegetation period	+ +	++	+	-	++	+	-	+

Note: - – there are no differences on a sign;
+ – there are differences on a sign;
+ + – the most important features and indicators distinguishing a variation.

occurred at them. Phytosanitary aspect: Before the selection process, i.e. at the stage of initial selection of biotypes, in order to identify the main viral diseases, individuals undergo a visual phytosanitary inspection. Then, in parallel with genetic selection, appropriate diagnostic tests (ELISA test) are carried out and it allows to detect at an early stage some specific viral diseases.

After three years of genetic and phytosanitary tests, biotypes with positive differentiation in context of varietal diversity and free from the symptoms of dangerous viral diseases are identified, then candidate clones are selected and a stage of their reproduction begins.

During the research it was found that the populations of ancient local grape varieties are also different intra-variety differences. Thus, traditional grape varieties cultivated in Azerbaijan have different genotypes of both positive and negative character. It is known that in the process of evolution under the influence of anthropogenic, environmental, genetic and other factors, some hereditary indicators of a number of grapevine varieties and forms deteriorated and the population turned into a mixture of genotypes of different hereditary nature.

Therefore, study of ancient grape varieties, selection of valuable genotypes and improvement of grape varieties by clone breeding is of particular relevance.

Selection of protoclones in clonal selection is based on various phenotypic and genotypic characteristics. Selection of high-yielding, high-quality genotypes resistant to biotic and abiotic factors with permanent hereditary characteristics is a significant matter. Selection against a background of a plurality of features of grape plants being carriers of necessary features, definition of features affecting a formation of yield and quality of grapes, identification of components playing a major, direct role in the development of these features is extremely important.

Researches on clonal selection carried out by us mainly by a method of selection of high-yielding genotypes. A goal in this method is to achieve high yields, but we must not lose sight of quality and sustainability of grape plants. Therefore, definition and study of indicators that reflect the relationship of signs of quantity and quality and make it possible to carry out a comprehensive assessment of plants in the selection process, is extremely important from a scientific and practical point of view.

Through the research it was found that a yield index of a shoot (loading of bush with shoots, bush yield, sugar content of berry juice), as an indicator expressing a level of sugar accumulation of berries on one shoot, allows to select genotypes with high yields without reducing a quality of crop, as well as to comprehensively assess genotypes of a population in terms of quantity and quality and to allocate a large number of high-yielding bushes-clones (protoclones).

During the research, main criteria were identified that realize potential of plants in a population of ancient local grape varieties by their economically valuable and breeding significant features, and directly affect yield and quality of grapes. Degree of correlation between them was revealed. By studying yield index of a shoot and heritability of characteristics of protoclones in the first vegetative generation, by a way of evaluation of them in different soil and climatic conditions and comparative study of genotypic diversity using mathematical-statistical method of analysis, 31 high yielding protoclones, differing from each other in yield, quality of crops, immunological and other characteristics were selected from 14 grape populations.

In order to maintain quality of crop at proper level, it is very important to determine a ratio of shoot yield during selection of high yielding protoclones. Yield of shoot implies of sugar content in bunches that are at the same shoot. Yield index of a shoot is formed on the basis of loading of bush with buds, yield indicator and level of sugar content. This index is considered one of main parameters in selection of clones (Salimov, 2008, 2014; Gurbanov, Salimov, 2010, 2014; Salimov et al 2015a).

During the studies it was found that the average yield index of the shoot ranges from 14 g×sugar (the Mahmudu variety) and 72.0 g×sugar (protoclon 2/6). At the control varieties this indicator was much lower than in the selected protoclones. The average yield index of the shoot at the Ag shany (Shany white) variety was 32.7 g×sugar; at the Gara shany (Shany black) variety – 27.0 g×sugar; at the Tabrizi variety - 21,1 g×sugar; at the Kishmish white oval variety - 21.3 g×sugar; at the Tayfi pink variety - 33.5 g×sugar; at the Hamburg Muscat variety - 16.7 g×sugar; at the Novrast variety – 22.1 g×sugar; at the Gyrmyzy Saabi (Saabi red) variety – 25.7 g×sugar; at the Chehrayi kishmish (Kishmish pink) variety - 24.2 g×sugar; at the Ag kishmish (Kishmish white) variety - 27.7 g×sugar; at the Ala shany variety – 19.6 g×sugar; at the Ag Khalili (Khalili white) variety – 25.9 g×sugar; at the Mahmudu variety - 14.0 g×sugar; at the Agadayi variety – 16.3 g×sugar. The selected protoclones by yield of shoot was assessed as medium-yielding (shoot with the contents of 21-30 g×sugar in the bunch of grapes), yielding (shoot with the contents of 31-40 g×sugar in the bunch of grapes) and high-yielding (shoot with a content of 40-50 g×sugar and more in the bunch of grapes).

It was found that the yield of shoots at the protoclones at number 11/7; 2/6; 30/03; 3/28; 3/32; 2-26/16; 1-3/14; 1/12; 2/16; 2/30; 5/3; 5/8 was average, at the protoclones at number 4/9; 2/1; 1/12; 1/4; 27/11; 30/03; 2-22/8; 3-22/14; 4-5/28; 4-18/17; 3-2/12; 1-5/16 was high, at the protoclones at number 1/9; 2/6; 22/05; 20/03; 15/18; 24/06; 30/74; 3-12/16 was very high.

It became clear that the sugar content of the studied varieties and clones varies on average varied between 16.8 (Mahmudu) and 22.4 g/100 cm3 (protoclone 1/9) and that protoclons accumulate sugar in a smaller quantities than the control varieties (with the exception of protoclones of the Ag shany (Shany white) variety at number 1/9; 2/6; 22/05 and protoclones of the Mahmudu variety).

Correct identification of the most important attributes of quantity is of great importance in selection and evaluation of high-yielding clones and protoclones. Yield elements are considered as the main criterion in the individual selection of grape varieties and play a crucial role in determining the clones. It is known that the share of individual elements of yield indicators in formation of potential and actual yield of grape varieties is different. In order to determine the potential impact of some quantitative characteristics on yield and quality of the crop, to identify the main phenotypic characteristics of quantity during selection of high-yielding clones, by mathematical and statistical analysis it was determined the level of correlation between them.

During the study it was found that between some quantitative indicators of grape varieties and their elements of productivity there is a positive correlation at different levels. Despite the fact that there is a positive correlation between the load of bush with buds, the average weight of the bunch and the yield of the bush, the number of fruit-bearing shoots, the average weight of the bunch and the yield of the bush, the average reliable dependence was noted on the load of bush with buds ($r=0.34$; $p>0.05$), on the number of bunches per bush ($r=0.54$; $p>0.05$), on the mass of 100 berries ($r=0.44$; $p>0.05$) and on the average weight of the bunch ($r=0.77$; $p>0.05$). It was found that there is an inverse correlation between the yield of shoot and sugar content. Thus, when determining high-yielding genotypes it is necessary to study such quantitative indicators as the load of bush with buds, the number of bunches on the bush, the mass of 100 berries and the average weight of bunches because they are the main criterion expressing a sign of quantity, in other words, the phenotypic markers. Clone breeding is based on the level of variability of certain valuable traits and properties of genotypes in the population of grape varieties.

Regardless of what the nature of the variability between genotypes, mutational or modificational, it was carried out the primary assessment of the population in order to identify promising for clonal selection grape varieties that differ in one or another characteristics and it was determined the degree of phenotypic diversity of varieties on yield indicator through the use of different

Table 2. Statistical indicators of clone diversity (phenotypic variability) in yield of genotypes in populations of valuable grape varieties

Indicators	The Agadayi variety (2001-2004 years)	The Gara shany variety (2001-2004 years)	The Tabrizi variety (1998-2004 years)
Number of plants in population	56 plants (total for years 224 plants)	48 plants (total for years 172 plants)	22 plants (total for years 154 plants)
Factorial dispersion - C_x	316.6	630.9	265.5
Random dispersion - C_z	511.4	112.3	744.3
Total dispersion - C_y	828.0	473.2	1009.8
Factorial variation - σ_x^2	5.76	13.4	12.64
Random variation - σ_z^2	3.04	0.78	5.64
Indicator of influence strength of clonal selection - η_x^2	0.38 (38%)	0.85 (85%)	0.26 (26%)
The error of influence strength of clonal selection – $m\eta_x^2$	0.20	0.05	0.12
Reliability of the indicator of influence strength - Φ	1.90	17.0	2.17
The reliability of the Fisher criterion - F	1.90	17.2	2.24
The limit of the reliability of the underlying index - $\eta_x^2 = \eta_x^2 \pm \Delta$	0.38±0.306	0.85±0.083	0.26±0.23

methods. So, with the aim of identifying genotypic diversity of plants in the population of the studied grapevine varieties on the rate of productivity and in order to determine the influence of clonal variability of plants in the population of the grapes, it was conducted mathematical-statistical analysis of the varieties Gara shany (Shany black), Tabrizi and Agadayi (Table 2).

During the study, it was found that the yield of bushes in the population of the Agadayi variety, depending on the year and the biological characteristics of the plant, is very different. Thus, the yield of bushes in the population of this variety varies in a wide range – between 0.8-11.5 kg. During the mathematical and statistical analysis, it was found that the variation in the yield of bushes in the population of the Agadayi variety, due to clone variability, is natural. It became clear that among the general factors affecting the formation of the yield of the grape bush, the share of clone variability is 38.0%.

The studies have shown that the variability in yield among the plants in the population of the Gara shany (Shany black) variety is quite high. The degree of influence of clonal variability observed in the plants of the study population is much higher than influence strength of other factors, and it is 85%. This fact gave the opportunity to conduct work on clonal selection in population of the Gara shany variety most efficiently. Clone breeding is based on the level ( ) and on the type of variability of certain valuable traits and properties of genotypes in the population of grape varieties. When determining the level of phenotypic diversity in yield, it was found that the genotypic diversity in the population of the Tabrizi variety is 26% (=0.26), in the population of the Agadayi variety it is 38% (=0.38), and in the population of the Gara shany variety it is 85%.

During the selection of high-yielding clones, elements of bush yield were used as the main signs of quantity. The results of studies have shown that the selected new clones of grapes on number, size and weight of bunches, as well as on the yield per bush and per hectare significantly exceed the usual bushes of control varieties. Thus, the yield from the bush at new clones ranged between 4.4-13.8.

This figure in conventional bushes of the same varieties was 2.8-6.8 kg, which means an increase of 25.0-66.3% compared to the parent forms. By mathematical and statistical analysis, both parametric (Student's t-criterion) and nonparametric method, it was proved that the difference in the average yield of the bush between the control varieties and clone variations is largely reliable (Table 3).

In the analysis of the average yield of the studied clone bushes by year, it was found that they annually show a fairly high yield and that the coefficient of variation for this indicator (V=9.8%) is much lower compared to the control varieties (V=26.5%). And this shows that among the clone forms the diversity on the indicator of yield per bush is relatively small.

In comparison with the parent plants, large bunches formed on the clone bushes and an increase of 0.95-53.7% was noted. So, the weight of bunches varied in the range of 180.4-502.0 g., and the difference between clonal variations and parent plants was largely reliable (by U-criterion $p<0.01$ and $p<0.001$; V=10.4%). It also became known that the bushes-clones (30/74, 3/32, 3-12/16, 4-18/17, with the exception of bushes 5/3 and 5/8), fruit-bearing shoots develop in greater numbers than on the parent bushes (0.18–56.6%), and the difference between them from a mathematical and statistical point of view is largely reliable. Clone bushes (with the exception of the clone variation 2-26/16) demonstrated superiority over parent plants also in the number of bunches (6,7– 61.8%). The difference between clones and control varieties for this indicator was largely reliable (t factual > t theoretical). The ratio of fruiting shoots of cultivars and clonal variations ranged between 0.32 mm to 1.23, and the ratio of the yield of shoots varied between 1.0 to 2.0.

Coefficient of variation in indicators such as the number of bunches (11.5%), the number of fruit-bearing shoots (12.0%) and the average weight of the bunch (6.8%) of clonal forms of grapes was much lower than the control varieties (V=17.7-22.3%). It shows low level of variation of clonal forms on the listed signs. The quality analysis was carried out for the number of fruiting (with one, two and three bunches)

Table 3. Indicators of productivity of the selected high-yielding clone bushes

Varieties and clones	Number of fruit-bearing shoots, %	The average number of bunches per bush, PCs.	The average weight of bunches, g.	Yield per bush, kg		
				$\bar{X} \pm S_{\bar{x}}$	Accuracy of the difference in control	
					$t_{0,05}/t_{fact.}$	P
Ag shany (Shany white)	56.6±1.90	20±1.93	182.6±17.2	3.6±0.24	-	-
By clones	76.7±0.69	28±0.52	254.6±2.97	6.9±0.37	2.05/10.7	p<0.001
Qara shany (Shany black)	48.6±1.81	18±0.53	136.0±3.28	2.8±0.45	-	-
By clones	58.3±1.24	33±0.69	209.7±2.20	6.5±0.09	2.05/7.9	p<0.001
Tabrizi	48.0±0.70	26±2.15	146.5±14.0	3.6±0.50	-	-
By clones	60.7±1.19	42.7±0.85	235.7±2.83	9.6±0.15	2.05/11.3	p<0.001
Ag oval kishnish (Kishmish white oval)	68.2±0.53	28±0.56	168.0±9.95	4.6±0.70	-	-
By clones	54.0±1.32	32±0.65	279.0±2.98	8.7±0.11	2.05/5.8	p<0.001
Tayfi pink	51.3±0.93	18±1.03	376.0±19.2	6.8±0.44	-	-
By clones	46.5±0.83	28±0.45	475.3±4.07	13.2±0.22	2.05/12.5	p<0.001
Hamburg muscat	50.6±1.87	23±1.73	162.0±8.23	4.6±0.28	-	-
By clones	62.4±1.75	34±1.20	234.0±5.04	7.1±4.18	2.05/6.4	p<0.001
Novrast	26.7±2.07	17±1.57	246.0±11.64	4.8±0.18	-	-
By clones	30.8±0.88	21±0.61	436.0±5.87	8.4±0.20	2.05/12.9	p<0.001
Gyrmyzy Saabi (Saabi red)	45.5±1.62	20±0.63	260.0±4.56	5.6±0.17	-	-
By clones	40.2±1.88	30±1.07	378.0±7.37	12.0±0.54	2.05/11.3	p<0.001
Chehrayi kishmish (Kishmish pink)	42.1±2.20	17±0.62	185.5±3.98	3.4±0.11	-	-
By clones	48.2±1.88	27±0.79	244.7±6.39	6.3±0.13	2.05/16.5	p<0.001
Ag kishmish (Kishmish white)	43.5±1.98	17±0.53	227.0±10.70	3.8±0.16	-	-
By clones	46.3±2.40	29±0.74	238.7±6.41	6.5±0.12	2.05/13.3	p<0.001
Ala shany	46.2±2.65	16±1.07	252.0±7.38	4.3±0.08	-	-
By clones	57.4±23.3	22±2.28	354.0±6.55	7.8±0.51	2.05/6.7	p<0.001
Ag Khalili (Khalili white)	53.6±3.53	21±0.81	190.0±6.81	4.2±0.18	-	-
By clones	53.7±1.99	30±1.08	250.5±5.93	7.4±0.16	2.05/12.7	p<0.001
Mahmudu	25.7±2.06	13±0.79	208.0±6.52	2.8±0.15	-	-
By clones	44.3±2.17	26±1.56	281.2±7.10	6.8±0.27	2.05/12.8	p<0.001
Agadayi	42.0±3.40	14±1.23	228.0±11.24	3.6±0.21	-	-
By clones	36.9±1.42	23±0.62	307.0±7.47	6.5±0.20	2.05/11.5	p<0.001

and infertile shoots in varieties and clones using the x2-criterion, as a result of which it was found that the level of reliability of the difference between them for this indicator is different ($p>0.05$; $p<0.05$; $p<0.01$; $p<0.001$).

One of the main genetic and phenotypic markers-signs used in the selection of high-yielding clones are morphometric indicators of bunches and berries. When conducting the research it was found that the size of bunches on average varies between 14.6 × 10.5 cm (Ag oval kishmish - Kishmish white oval) and 32.0 × 17.5 cm (clone 30/74). Relatively small bunches were observed in cultivars Ag shany (Shany

Table 4. Morphological parameters of bunches and berries of grapevine varieties and clones

Varieties and clones	Bunch size, cm				Berry size, mm			
	length	V, %	width	V, %	length	V,%	width	V, %
	$\bar{X} \pm S\bar{x}$		$\bar{X} \pm S\bar{x}$		$\bar{X} \pm S\bar{x}$		$\bar{X} \pm S\bar{x}$	
Ag shany (Shany white)	15.0±0.63	22.3	11.7±0.34	15.4	20.0±0.29	7.6	17.6±0.39	11.7
1/9	24.1±0.53	11.7	13.5±0.24	9.4	23.2±0.35	8.0	19±0.36	10.0
2/6	21.0±0.63	15.9	12.7±0.19	7.9	21.2±0.19	4.6	16.4±0.19	6.1
22/05	26.2±1.11	22.5	12.7±0.29	12.1	23.4±0.22	5.0	16.0±0.19	6.3
20/03	26.3±0.82	16.5	14.7±0.26	9.4	25.1±0.29	6.1	21.1±0.29	7.3
15/18	18.0±0.82	24.0	12.0±0.29	12.8	24.5±0.38	8.2	17.7±0.39	11.7
Gara shany (Shany black)	21.8±0.34	8.3	12.2±0.25	10.8	17.8±0.29	8.6	17.1±0.24	7.4
11/7	22.0±0.48	11.2	13.0±0.30	12.2	22.0±0.39	9.4	20.7±0.34	8.7
2/6	19.3±0.87	23.9	12.3±0.32	13.8	22.2±0.55	13.1	21.4±0.58	14.4
4/9	23.1±0.36	8.3	12.6±0.33	13.9	21.5±0.28	6.9	20.8±0.35	8.9
Tabrizi	15.1±0.43	15.1	10.8±0.28	13.7	16.2±0.31	10.1	13.3±0.27	10.8
2/1	21.4±0.44	10.9	12.5±0.17	7.2	18.7±0.40	11.3	14.9±0.26	9.2
1/12	22.5±0.38	9.0	12.3±0.25	10.8	22.2±0.26	6.2	18.2±0.26	7.6
1/4	23.5±0.28	6.3	14.6±0.33	12.0	20.8±0.24	6.1	16.2±0.28	8.9
Ag oval kishnish (Kishmish white oval)	14.6±0.34	12.3	10.5±0.28	14.1	11.0±0.19	9.2	8.8±0.28	16.9
27/11	20.8±0.43	11.0	12.6±0.24	10.1	13.2±0.27	10.8	10.2±0.22	11.4
30/03	23.3±0.58	13.2	13.0±0.24	9.8	14.4±0.31	11.4	11.0±0.14	7.3
Tayfi pink	22.8±0.48	11.2	15.0±0.28	9.9	22.7±0.28	6.5	17.6±0.26	7.8
24/06	26.5±0.63	12.6	15.6±0.27	9.2	24.1±0.43	9.5	17.8±0.31	9.0
30/74	32.0±0.58	9.6	17.5±0.19	5.8	29.6±0.53	9.5	22.0±0.39	9.2
Hamburg muscat	16.1±0.34	11.2	11.3±0.24	11.3	18.8±0.25	7.0	18.1±0.24	6.8
3/28	23.3±0.28	6.4	14.2±0.43	16.0	21.2±0.26	6.5	19.8±0.12	3.2
3/32	28.5±0.72	13.4	16.7±0.43	13.6	25.0±0.24	5.0	24.3±0.33	7.2
Novrast	16.6±1.01	31.6	12.0±0.43	18.6	24.4±0.48	10.2	15.6±0.24	8.0
2-26/16	27.4±0.58	11.0	16.0±0.28	9.1	31.0±0.28	4.7	20.4±0.38	9.6
2-22/8	24.8±0.67	14.0	15,5±0.38	12.7	33.4±0.53	8.3	21.2±0.28	6.8
Gyrmyzy Saabi (Saabi red)	15.3±0.58	19.7	12.5±0.39	16.2	26.0±0.63	12.6	19.0±0.53	14.5
3-12/6	212.7±0.53	12.7	13.4±0.28	10.9	29.8±0.48	8.4	17.7±0.24	7.0
Chehrayi kishmish (Kishmish pink)	15.4±0.58	9.6	9.6±0.35	9.0	12.2±0.36	5.3	9.8±0.34	18.0
3-22/14	24.6±0.67	14.2	15.2±0.28	9.6	15.7±0.24	7.9	13.0±0.19	7.6
4-5/28	17.4±0.82	14.5	11.1±0.38	7.8	13.0±0.29	1.6	10.8±0.29	14.0
Ag kishnish (Kishmish white)	15.0±0.43	15.0	10.3±0.28	4.1	11.8±0.28	2.3	9.8±0.19	10.0
4-18/17	23.7±0.48	10.5	12.2±0.24	0.2	14.2±0.28	0.3	11.0±0.24	11.3
3-2/12	16.3±0.28	18.9	11.1±0.24	11.2	14.0±0.28	10.4	11.0±0.34	16.0
Ala shany	17.8±0.26	17.6	14.5±0.22	7.8	19.6±0.28	7.4	18.4±0.39	11.0
1-3/14	25.0±0.39	18.1	14.9±0.29	10.3	25.5±0.24	2.9	24.5±0.14	3.0
Ag Khalili (Khalili white)	14.7±0.29	10.3	11.8±0.19	8.4	17.0±0.24	7.3	12.0±0.19	8.2
1-5/16	19.0±0.41	11.2	13.7±0.19	7.2	19.7±0.35	9.2	13.2±0.26	10.2
Mahmudu	15.0±0.53	18.4	12.2±0.24	10.2	19.6±0.19	5.0	19.2±0.20	5.4
1/12	20.6±0.41	10.3	13.7±0.14	5.3	22.0±0.39	9.2	21.6±0.42	10.1
2/16	20.5±0.43	11.0	14.4±0.24	8.7	24.2±0.43	9.2	23.0±0.43	9.7
2/30	22.5±0.38	8.8	15.8±0.30	9.9	22.0±0.37	8.7	21.3±0.34	8.3
Agadayi	18.2±0.53	15.1	10.2±0.58	29.6	18.3±0.28	8.0	17.4±0.29	8.7
5/3	21.6±0.67	16.1	13.1±0.63	25.0	21.0±0.43	10.6	20.2±0.40	10.3
5/8	27.7±1.06	19.9	15.1±0.39	13.4	27.6±0.72	13.6	22.8±0.72	16.4

white), Tabrizi, Hamburg muscat (16.1 × 11.3 cm), Novrast (16.6 × 12.0 cm), Gyrmyzy Saabi (Saabi red), Chehrayi kishmish (Kishmish pink), Ag kishmish (Kishmish white), Ag Khalili (Khalili white), Mahmudu and clone number 3-2/12, and large bunches were observed in the bushes-clones at number 24/06, 30/74, 3/32, 2-26/16, 1-3/14, 5/8. For other varieties and clones, the size of the bunch varied from 17.4 × 11.1 cm (clone 4-5/28) to 24.8 × 15.5 cm (clone 2-22/8) (Table 4).

It was found that the selected high-yielding clones are characterized by larger bunches compared to the control varieties. Due to the fact that the large size of the bunch directly has a positive impact on yield, this indicator was evaluated as one of the main criteria for selection. The coefficient of variation in the size of bunches of clones, varying in the range V%=11.1-13.2% (in control varieties V,%=13.6-15.6%), is characterized by small estimates. This shows that genetic diversity in clonal populations is relatively small and is evidence of persistence on this basis.

As a result of the study of the mechanical composition of the varieties and clones of grapevine, it was found that the clonal variations exceed the control varieties in terms of juice yield, the number of berries in the bunch, the mass of 100 berries. So, the number of berries in bunches at clone variations amounted to 65-204 pieces, the yield of juice, relative to the total weight of grapes was 72.5-93,0%, the share of berries in bunches made 91.0-98.4%, and the weight of 100 berries made up 138.6-516.8 g, which proves the superiority of the clonal forms over the parent varieties.

By correlation analysis it was found that there is a positive correlation among the number of berries in the bunch ($r=0.45$, $p>0.05$), weight of 100 berries ($r=0.56$, $p>0.05$) and the weight of the bunch. However, there is an inverse correlation ($r=-0.90$, $p>0.05$) among the number of berries in the bunch, the weight of 100 berries and the number of berries in 100 grams of the bunch. Therefore, weight of 100 berries and number of berries in bunches are the main quantitative indicators in the formation of the yield of the clone bushes.

Through mathematical and statistical analysis, it was proved that the difference in the weight of 100 berries between clone variations and parent plants (control varieties) is largely reliable (t fact.>t 0,05).

Representatives of the V. vinifera species have high environmental plasticity and polymorphism. But, despite this, local varieties and forms of grapes, included here, retain the features and characteristics of the species. In general, on the sign of variability, the morphological, biological and technological parameters of grape plant are divided into highly resistant (stable), low-changing and highly changing ones.

Highly resistant characteristics include color of young shoot and density of prostrate hairs on the tip, color of annual shoot, shape and density of prostrate hairs at the leaf, number of lobs, type of lower sinuses, degree of cutting of the clasps, sex of flower, ratio of length of stamens to height of pistil, shape of the pistil, nature of blooming inflorescences, color of stalk and petiole of bunch, parameters and shape of berry, single brown spots on the skin of berries, etc. (a total of 40 signs).

Presence of teeth in the petiole sinus, length of the main veins on the leaf blade, length of the petiole, depth of the petiole sinus, size of the corners of the leaf blade, length and width of the bunch, length and width of pollen grain of the pistil or anther, length and width of the stigmas, located on the epidermis of the lower side of the leaf blade and some other signs (a total of 16 signs) refer to low-changing signs.

Type of the top sinuses of the leaf, depth of sinuses of the leaf blade, shape of the bunch, number of seeds in the berry, surface area of the leaf, yield elements, sugar content and titratable acidity in the juice of the berry, mechanical composition of the berries and bunches, number of berries in the bunch and other signs are considered highly changing signs.

Acknowledgments

The authors thank editors and reviewers for contribution to the final version of the text.

Conflict of Interests

The authors declare that there is no conflict of interests.

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