Advances in Biology & Earth Sciences
Vol.10, No.2, 2025, pp.303-313
https://doi.org/10.62476/abes.102303

ASSESSMENT OF BIOMORPHOLOGICAL AND ECONOMICALLY IMPORTANT TRAITS OF SOME LOCAL GRAPE VARIETIES AND CLONES OF AZERBAIJAN

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Abstract. This paper highlights results of comprehensive study of high-yielding clonal forms (27/11, 30/03, 3-22/4, 4-5/28, 4-18/17, 3-2/12, 5/2-14, 9/2-14, 6/1-02 and No. 18/1-02) based on morphological, biological and economic-technological features, as well as the main provisions of clone selection and vegetative changes occurring in grapevines. In addition, the article reflects the results and analyzes of mathematical-statistical studies (U, x2 and Student-t criterion) conducted to check the degree of honesty of the difference between grape varieties and their clones according to certain indicators. Based on the grouping of yield, only one form (Cehrayi kishmish cultivar) had low yield, while other cultivars and clone forms had medium (Ag oval kishmish, Ag kishmish, Gara kishmish, Sultani kishmish, clone 3-2/12), high (clones 30/03, 4-18/17, 3-22/14) and very high (5/2-14, 9/2-14, 6/1-02, 18/1-02, 27/11, 4-5/28 clones) yield. It has been determined that clonal variations have higher yield than their parents.

Keywords: *Selection, grapevine, berry, ampelographic collection, initial variety, ecological-geographical origin.*

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Received: *19 February 2025;* ***Accepted:*** *13 May 2025;* ***Published:*** *6 August 2025.*

1. Introduction

Seedless grape varieties has a number of valuable characteristics for fresh use, as well as high-quality dried products (raisins), juice, wine, jam, compote and other products are produced from them. Raisins are the most valuable among these products. Seedless grape varieties are suitable not only for drying, but also for fresh consumption as table grapes (Somkuwar *et al*., 2023; Salimov *et al*., 2024a). The absence of seeds in grapes significantly improves the dietary and nutritional quality of grapes. The most widespread and economically important of them are Korinka and Ag oval raisin varieties. Around 80% of the world's vineyards of raisin grape varieties are the areas where the Ag oval raisin grape variety is cultivated (Salimov *et al*., 2024b).

Currently, there is a great demand for seedless grape varieties with high dietary and nutritional value in connection with the production of quality food products. This issue was specially mentioned in the 69-73rd General Assembly of the International Organization of Grapes and Wine (OIV). Also, at the symposium on grape selection held in Germany in 1991, the most attention was focused on the creation of seedless grape varieties (Christensen *et al*., 2020; Salimov *et al*., 2025).

Despite the great importance of raisin grape varieties in world viticulture, only about 150 varieties are available. These raisin genotypes are belonging to the eastern ecological-geographical group (*convar orientalis subconvar antasiatica* Negr.) and korinka type (Greek grape) seedless grape varieties belonging to the Black Sea basin group (*convar pontica* Negr.). The exciting advances in molecular genetics in recent years have provided plant breeders and specialists involved in the plant resources conservation with novel techniques for identification of genetic diversity of the plant genetic resources (Mammadova *et al*., 2024a; 2024b). Despite the fact that the berries of those varieties are mostly small (with the exception of seedless varieties of new hybrid origin), they are characterized by high taste quality and sugar content. Seedless grape varieties are widely planted and cultivated in Iran, Greece, Turkey, Australia, USA (California). Large bunched raisin varieties are distinguished by their beautiful bunches, high taste quality and resistance to transportation, but they are characterized by their relatively small berries, resistance to diseases and pests, frost, drought, etc. (Angulo *et al*., 2018; Khalid *et al*., 2023; Nazik *et al.*, 2025).

Azerbaijan is rich in raisin varieties (Asgari, Ag oval kishmish, Ag kishmish, Cehrayi kishmish, Girmizi kishmish, Gehveyi kishmish, Girda kishmish, Gara kishmish, Dash kishmish, Mermer kishmish, Absheron kishmishi, Khircha kishmish, Sabza, Sultani kishmish, etc.). Unfortunately above-mentioned shortcomings (fragility, resistance to diseases and pests, frost, drought, etc. stress factors) are characteristic for the raisin grape varieties of Azerbaijan. Taking these into account, breeding programs were carried out for their clone selection in order to improve existing valuable raisin grape varieties. For this purpose the method of individual clone selection and the method of studying the variations formed as a result of shoot variability were used. Thus, by the individual clonal selection in viticulture, the vegetative generation of each of the high-yielding grape vines are studied separately, to determine whether they are hereditary or not and those with valuable economic indicators inherited from them are selected.

Currently, special attention is paid to the selection of seedless (raisin) grape varieties in world viticulture. The role of clonal selection is indispensable in the improvement of raisin grape varieties and obtaining seedless genotypes.

2. Material and methods

Experiments were carried on individual clone selection of local raisin grape varieties (Ag oval kishmish, Cehrayi kishmish, Ag kishmish, Sultani kishmish, Gara kishmish) cultivated in the collection garden of the Azerbaijan Scientific-Research Institute of Viticulture and Winemaking. Along with grape vine varieties a number of high-yielding clonal forms (27/11, 30/03, 3-22/4, 4-5/28, 4-18/17, 3-2/12, 5/2-14, 9/2-14, 6/1-02 and 18/1-02) selected from the population of these raisin grape varieties were used for evaluation.

Clones - No. 27/11 and 30/03 were selected from Ag oval kishmish, No. 3-22/4 and 4-5/28 Cehrayi variety, No. 4-18/17 and 3-2/12 Ag kishmish, No. 5/2-14 and 9/2-14 Gara kishmish and No. 6/1-02 and 18/1-02 clones were selected from Sultani kishmish variety.

The biomorphological and economically important characteristics of varieties and clones were studied following methods suggested by Lazarevskiy (1963). In the research work, the common grape vines cultivars were used as a control and studied in a comparative manner with the corresponding clonal variations. In order to check the level of integrity of the difference between clones and parent plants, a comparative statistical

analysis was performed using non-parametric U (Wilcoxon-Manna-Whitney) and parametric Student's t-criteria for quantitative traits and -x^2 (chi-square) methods for qualitative indicators (Gubler & Genkin, 1973). Since the amount of sugar in the juice of berries is inversely correlated with the productivity of plants, it is not appropriate to target only productivity indicators in clone selection. Therefore, in the selection and evaluation of high-yielding clones in the population of grape varieties, in addition to individual productivity and quality indicators, the productivity index was used, which is determined based on the change and combination of 3 main important indicators in the vine - the density of the vine, the productivity of the bush and the sugar content in the juice of the grape vine. It is a coefficient that reflects the real amount of sugar accumulation in a berry and it allows the selection of high-yielding genotypes without reducing the quality of the product (Wang *et al*., 2015; Breksa *et al*., 2020).

Bunch productivity or bunch productivity index, is calculated by the ratio of the total yield of the grape vine or the amount of sugar content in the product of the bush to the total number of green bunches or the product of the bunch yield coefficient by the average mass of bunches (Note: for this evaluation, all the initial bunches and green bunches on the vines should be kept).

$$SP = I_{SP} = \frac{T_{plant}}{N_{shoots}}, \quad or$$

$$SP = I_{SP} = P_1 * M_{bunh}$$

SP - shoot productivity;
I_{SP} - shoot productivity index;
T_{plant} - total yield, qram;
N_{shoots} - number of green shoots per plant;
P_1 - productivity index of shoot;
M - bunch weight, gram.

According to the amount of sugar in the product of the grape vine, the productivity is calculated as follows:

$$SP = I_{SP} = \frac{M_{sugar}}{N_{shoots}}$$

SP - shoot productivity;
I_{SP} - shoot productivity index;
M_{sugar} - total sugar content of yield per plant, gram;
N_{shoots} - number of green shootsper plant;

The yield of shoot is determined mainly according to 5 groups of productivity (according to the amount of sugar in the total product of the bush): 1) very low yield (with up to 10 grams of sugar in a bunch), 2) low yield (with 11-20 grams of sugar in a bunch), 3) medium yield (with 21-30 grams of sugar in a bunch), 4) high yield (with 31-40 grams of sugar), 5) very high-yielding grapes (fruits with 41-50 grams of sugar and more). Under optimal conditions, the index of dense productivity in grape vines fluctuates around 250 grams in technical varieties (with 18-20% sugar content in juice) and 300 g in table varieties (with 14-15% sugar content in juice) based on the dry mass of the bunch (Odinayev *et al*., 2021).

Based on the value of this selection index, individual selection and comparative analysis of clone grape vines is carried out. Based on the study of the variation statistics (coefficient of variation, etc.) of individuals of the population on the density productivity

index, were evaluated at a high level of differentiation and the selection of high-yielding plants was carried out in a justified manner. Selection and evaluation work is carried out during four years. In this period, the typicality and high phenotypic stability of plants in terms of morphological features are also characterized.

3. Results and discussion

Selection of clones in grape vines is a complex and responsible matter. Many scientists highly value yield coefficients (total yield and bunch yield), which are usually one of the main indicators that express the yield characteristics of the grape vine, in the selection of high-yielding clones. However, from many years of research in viticulture, it has been known that the selection of clones on this trait significantly reduces the efficiency of the work. Because it is known from long-term studies that the amount of sugar in berries decreases as the productivity of the bush usually increases. There is a negative correlation between the productivity and sugar content of the grapevine. Zhang et al. (2014), during the study of productivity and sugar content indicators of different plants in the population of cultivars during the selection of a number of clones, determined that the correlation between the indicators fluctuates between 0.12 and 0.33. During the research conducted on the varieties-populations grown in Absheron conditions, it was determined that the correlation between productivity and sugar content in berries is 0.53 ($p<0.05$).

In order to clarify this issue once again, for the purpose of selecting high-yielding clones from the population of the Ag kishmish variety planted and cultivated in Absheron conditions, the productivity and the amount of sugar in the berries of about 120 plants and their mutual relationship were investigated and the degree of conditional dependence between these indicators was determined according to the Dekar coordinate system (Figure 1).

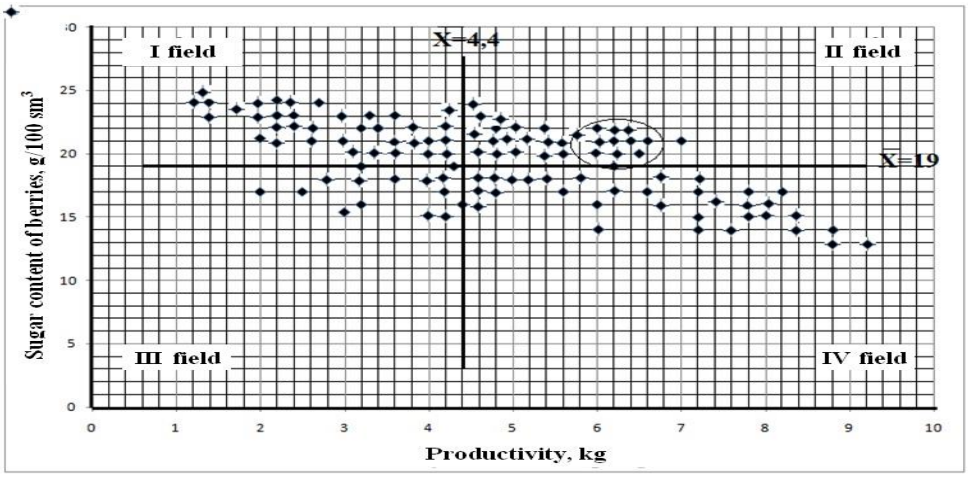

Figure 1. Degree of conditional dependence between the productivity and the amount of sugar

The areas showing the dependence relationships between the indicators are divided into 4 squares (fields). The plants distributed in the first field (square) have relatively low productivity and high sugar content, the plants distributed in the II field (square) have relatively high productivity (4.4-6.8 kg) and high sugar content (19-24 g/100 cm^3), the

vines in the III field (square) have relatively low productivity and low sugar content and the vines in the IV field (square) have relatively high productivity and low sugar content. Apparently, the most valuable plants are the bushes distributed in square II because they are distinguished by their high productivity and ability to accumulate sugar. Selection of high-yielding rootstock clones (protoclones) is appropriate for this purpose. However, these plants make up 30-35% of the total plants. Among these plants, the more valuable ones - high and very high-yielding plants (the yield of one bush is more than 6 kg and the yield per hectare is more than 130 s/ha) - 10-12 bushes (9-13% of the total plants). If selection of clones is carried out by this method, it lowers the quality of individual selection work.Therefore, in the selection of high-yielding clones, it is more appropriate to use a more complex indicator - high productivity or high productivity index. Based on this indicator, it is possible to comprehensively evaluate the genotypes in the grape population in terms of quantitative and qualitative indicators and reliably select a large number of highly productive clones (rootstocks or protoclones). For this, the plants in the population of each grape variety should be evaluated separately for complex characteristics.

Table 1. Morphological indicators of bunches and berries of studied grapevine cultivars and clones

Cultivars and clones	Bunch size, sm				Berrie size, mm			
	Length	CV, %	Width	CV, %	Length	CV, %	Width	CV, %
	$\bar{X} \pm S_{\bar{x}}$		$\bar{X} \pm S_{\bar{x}}$		$\bar{X} \pm S_{\bar{x}}$		$\bar{X} \pm S_{\bar{x}}$	
Ag oval kishmish	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
Cehrayi kishmish	15,4±0,58	19,6	9,6±0,35	19,0	12,2±0,36	15,3	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	24,5	11,1±0,38	17,8	13,0±0,29	11,6	10,8±0,29	14,0
Ag kishmish	15,0±0,43	15,0	10,3±0,28	14,1	11,8±0,28	12,3	9,8±0,19	10,0
4-18/17	23,7±0,48	10,5	12,2±0,24	10,2	14,2±0,28	10,3	11,0±0,24	11,3
3-2/12	16,3±0,28	8,9	11,1±0,24	11,2	14,0±0,28	10,4	11,0±0,34	16,0
Gara kishmish	16,6±0,75	21,4	7,8±0,38	19,8	16,8±0,26	5,4	13,8±0,18	4,0
5/2-14	31,4±0,42	11,6	13,4±0,28	11,6	19,2±0,32	5,7	16,0±0,20	4,0
9/2-14	27,6±0,48	8,8	18,8±0,24	10,4	18,0±0,27	3,8	15,4±0,19	3,9
Sultani kishmish	23,2±0,66	19,2	10,2±0,26	39,2	15,5±0,25	5,0	12,6±0,14	4,6
6/1-02	25,8±0,52	10,6	12,6±0,22	26,9	21,6±0,29	4,2	15,6±0,20	5,8
18/1-02	29,6±0,37	13,6	17,3±0,24	24,2	19,2±0,26	4,2	14,2±0,17	4,6

Taking this into account, initially high-yielding protoclones (productive and high quality rootstocks - 27/11, 30/03, 3-22/4, 4-5/28, 4-18/17, 3-2/12, 5/2-14) from the population of Ag oval kishmish, Ag kishmish, Cehrayi kishmish, Gara kishmish and Sultani kishmish grapevine varieties 9/2-14, 6/1-02 and 18/1-02) were evaluated and selected according to individual quantitative and qualitative characteristics and their biomorphological, phytopathological and technological characteristics were determined sequentially. The vegetative progeny of those protoclones, i.e. clones, are named by their respective numbers.

After the clone grape vines started to produce fruit, their morphological, biological and economically important indicators were determined during 2004-2010 years and it was determined whether the traits were hereditary in the vegetative generation. In the selection of high-yielding clones in the clone breeding program, the determination of the biometric measurements of bunches and berries is important. It was determined that the

size of bunches and berries and the number of berries in studied grape varieties are significantly lower compared to their clonal forms. This, in turn, influenced the significantly higher mass of bunches and berries in clone variations (Table 1).

In order to evaluate the prospects of the studied varieties and selected clone plants, the productivity and quality indicators of the product were comparatively studied (Table 2).

Table 2. Productivity indicators of first vegetative generation of clones selected from highly productive protoclones

Varieties and clones	Number of buds	Number of opened buds, %	Number of productive shoots, %	Number of bunches per shoot	Productivity iddex of shoot	Productivity index of productive shoots	Mean weight of bunches	Toatl plant productivity, kg			Productivity per hectare, s/ha
								$\bar{X} \pm S_{\bar{X}}$	$*t_{0,05}/\ t_{fact}$ (based on student (t) criteria)	*P (based on W criteria)	
Ag oval kishmish	54	76,8	68,2±0,53	28±0,56	0,68	1,00	168,0±9,95	4,6±0,70	-	-	102,2
27/11	50	80,0	70,0±1,25	34±0,84	0,85	1,21	260,0±3,47	8,8±0,12	2,05/5,92	p<0,001	195,5
30/03	55	95,0	38,0±1,38	30±0,46	0,57	1,50	298,0±2,39	8,6±0,11	2,05/5,63	p<0,001	191,1
SED_{05} =2,73; SED_{01} =3,84											
Cehrayi kishmish	42	90,4	42,1±2,20	17±0,62	0,44	1,08	185,5±3,98	3,4±0,11	-	-	75,5
3-22/14	45	87,2	43,5±1,87	21±0,72	0,55	1,26	275,0±8,98	5,8±0,10	2,05/16,0	p<0,001	128,8
4-5/28	45	85,0	53,0±1,90	33±0,86	1,00	1,65	214,3±3,79	6,8±0,16	2,05/17,0	p<0,001	151,1
SED_{05}=2,92; SED_{01} =5,06											
Ag kishmish	42	86,0	43,5±1,98	17±0,53	0,46	1,11	227,0±10,70	3,8±0,16	-	-	84,4
4-18/17	53	87,2	41,9±1,60	23±0,61	0,49	1,18	294,0±8,08	6,6±0,12	2,05/14,00	p<0,001	146,7
3-2/12	51	90,7	50,7±3,20	35±0,87	0,76	1,50	183,3±4,74	6,4±0,13	2,05/12,62	p<0,001	142,2
SED_{05} =3,15; SED_{01} =5,44											
Gara kishmish	40	88,6	34,3±0,92	14±0,42	0,40	1,67	263,6±2,47	3,7±0,16	-	-	82,2
5/2-14	42	92,4	33,3±0,95	26±0,62	0,67	2,00	412,4±5,03	10,7±0,41	2,05/15,91	p<0,001	237,8
9/2-14	42	94,4	32,5±0,64	18±0,51	0,45	1,38	560,6±6,17	10,0±0,41	2,05/12,05	p<0,001	222,2
SED_{05} = 6,44; SED_{01} =14,82											
Sultani kishmish	42	90,6	39,5±0,61	15±0,41	0,39	1,00	276,6±4,52	4,1±0,14	-	-	91,1
6/1-02	44	96,3	40,5±0,67	24±0,62	0,57	1,41	362,4±6,48	8,7±0,14	2,05/23,00	p<0,001	193,3
18/1-02	42	97,4	34,2±0,57	18±0,46	0,44	1,28	456,8±7,01	8,2±0,21	2,05/16,40	p<0,001	182,2
SED_{05} = 3,68; SED_{01} =7,24											

*** -** degree of significant difference between clones and parents
SED - Smallest existed different

It was found that 76.8 (Ag oval kishmish) -97.4% (clone variation No. 18/1-02) of the buds kept in the grape vines were opened and pods developed from them. Depending on the biological characteristics of the varieties, some of the green shoots formed on the grape vines were fertile and the other sterile.

During the research, it was determined that the amount of yielding pods in the studied variety and clone variations varied from 38.0 (30/03 clone variation) to 70.0% (27/11 clone variation).

One of the most important productivity elements of grape varieties is the number of bunches on plant. This indicator is quite different in the studied variety and clone variations, 14 in Gara kishmish, 15 in Sultani kishmish, 17 in Cehrayi kishmish and Ag kishmish varieties, 18 in 9/2-14 and 18/1-02 clones, 24 in 6/1-02 clone, 26 in 5/2-14 clone, 28 in Ag oval kishmish variety, 21 in the 3-22/14 clone variation, 23 in the 4-18/17 clone

variation, 30 in the 30/03 clone stem, 33 in the 4-5/28 clone variation, 34 in the 27/11 clone form and 35 in the 3-2/12 clone variation. In general, the number of bunches was significantly higher in clonal forms than in their parents.

The shoot productivity coefficient is one of the most important productivity indicators of grape vine varieties. This indicator expresses the ratio of flower clusters on the grape vine to the total number of spikes. It was found that the dense bar coefficient fluctuates between 0.39-0.68, being much lower in the vines of the parent varieties and 0.44-1.00, being much higher in their clone variations. It was determined that the yield coefficient in the investigated grape varieties and clonal variations fluctuated between 1.0 (Ag oval kishmish) and 1.65 (4-5/28 clone grape vines).

The average mass of the bunches is one of the most important indicators in the formation of the productivity of the stem. During the research, it was found that the average mass of the cluster was 168.0 g in Ag oval kishmish, 188.3 g in 3-2/12 clone variation, 185.5 g in Cehrayi kishmish, 214.3 g in 4-5/28 clone variation, 227 g in Ag kishmish variety, 260.0 g in 27/11 clone variation, Gara kishmish 263.3 g, 3-2/14 clone variation 275 g, Sultani kishmish 276.6 g, 4-18/17 clone variation 294 g, 30/03 clone variation 298.0 g, 6/1-02 clone variation 362.4 g, 5/2-14 clone fvariation 412.4 g, 18/1-02 clone variation is 456.8 g and 9/2-14 clone variation is 560.6 g. Apparently, clonal forms produce larger clusters than their parents (except for the 3-2/12 clonal variation) and this trait is inherited in the vegetative generation.

The productivity of the garpevine was 3.4 kg in the Cehrayi kishmish raisin variety, 3.7 kg in the Gara kishmish variety, 3.8 kg in the Ag kishmish variety, 4.1 kg in the Sultani kishmish variety and 4.6 kg in the Ag oval kishmish variety, which was much lower than the selected clone variations. The yield of the selected clone grape vines was significantly higher than that of the common grape vines of Cehrayi kishmish, Ag kishmish and Ag oval kishmish varieties, 5.8 kg in clone 3-22/4, 6.4 kg in clone 3-2/12, 6.6 kg in clone 4-18/17, 6.8 kg in clone 4-5/28 and 30/03 clone form 8.6 kg, 27/11 clone form 8.8 kg, 18/1-02 clone variation 8.2 kg, 6/1-02 clone variation 8.7 kg, 9/2-14 clone variation 10 kg, 5/2-14 clone variation 10.7 kg.

The clonal forms showed very high productivity. During the study, it was determined that the productivity per hectare fluctuates between 75.5 (Cehrayi kishmish) and 237.8 s/ha (5/2-14 clone variation) in the varieties and clone variations studied. During the research, the amount of productive and bunchless (one, two, three-cluster) buds formed on the grape vines of the variety and clone was also determined. It was found that the varieties of Ag oval kishmish and Gara kishmish have only one cluster, Cehrayi kishmish, Sultani kishmish, Ag oval kishmish and 27/11, 30/03, 3-22/14, 18/1-02, 6/1-02, 9/2-14 and 5/2-14 clone forms have one and two clusters. In the clones No. 4-5/28, 4-18/17, 3-2/12, both one-, two- and three-cluster buds have developed.

While the difference between the selected high-yielding clonal variations compared to the varieties of Cehrayi kishmish and Ag kishmish cultivars with one-, two- and three bunches was not mathematically honest, the difference between Ag oval kishmish and Sultani kishmish and their clonal forms, including Gara kishmish and clone 5/2-14, was significantly reliable (Table 3).

Table 3. Comparative characteristics of productive shoots in clones and varieties *(based on x^2*-criteria)

Varieties and clones	Number of productive and bunchless shoots, %				Number of green shoots
	Shoots with one bunch	Shoots with two bunches	Shoots with three bunches	Bunchless shoots	
Ag oval kishmish	68.2	---	-	31.8	41
27/11	55.0***	15.0*	-	30.0***	40
30/03	19,0***	19,0**	-	62,0***	53
Cehrayi kishmish	37,6	4,5	-	57,9	38
3-22/14	32,0***	11,5***	-	56,5***	39
4-5/28	29,0***	13,7***	10,3***	47,0***	38
Ag kishmish	37,8	4,7	--	57,5	36
4-18/17	36,2***	4,5***	1,2***	58,1***	46
3-2/12	32,8***	10,4***	7,5***	49,3***	47
Gara kishmish	28,6	5,7	-	65,7	35
5/2-14	7,7*	25,6*	-	66,7***	39
9/2-14	20,0***	12,5***	-	67,5***	40
Sultanı kishmish	39,5	-	-	60,5	38
6/1-02	23,8***	16,7*	-	59,5***	42
18/1-02	24,4***	9,8**	-	65,8***	41

1) *** - p > 0.05, ** - p < 0.05, * - p < 0.001
2) p-indicates significant difference between clones and varieties

From the conducted studies, it was found that both cultivars and the clonal variations have high sugar accumulation (Table 4). Thus, the amount of sugar content in berries is 18.5 g/100 cm^3 in the 30/03 clone form, 19.4 g/100 cm^3 in the 27/11 clone form, 19.6 g/100 cm^3 in the 5/2-14 clone form, 19.8 g/100 cm^3 in the Ag oval kishmish variety and 6/1-02 clone variety, 4-5/28 clone 20 g/100 cm^3, 21.2 g/100 cm^3 in 3-22/14 and 3-2/12 and 18/1-02 clone variations, 21.5 g/100 cm^3 in 4-18/7 clone, 22.1 g/100 cm^3 in Cehrayi kishmish, 22.6 g/100 cm^3 in Ag kishmish variety, Sultani kishmish variety had 23.6 g/100 cm^3, 9/2-14 clone had 22.8 g/100 cm^3 and Gara kishmish variety had 24.2 g/100 cm^3.

The "dense productivity index" which expresses the potential possibilities of interaction between the quantitative and qualitative characteristics of the clone forms, including the new hybrid forms and the abundance of the product, the satisfactory quality, was studied and compared separately for each variety and clone forms. This indicator was calculated based on the dry mass of the bunch and the amount of sugar in the product (Table 4).

Table 4. Some biochemical and economically important traits of grapevine varieties and clones

Varieties and clones	Sugar content of berries, g/100 sm^3	Acid content of berries, g/dm^3	Prodictivity index of shoot, g	Producctivity index of shoot, g (based on sugar content)	Mass of 100 berries, g	$t_{0,05}$/ t_{fact}
	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$				
Ag oval kishmish	19,8±0,84	5,00±0,38	112	22,6	120,0±3,18	-
27/11	19,4±0,37	4,80±0,41	220	42,8	173,3±3,11	2,12/11,98
30/03	18,5±0,29	4,86±0,41	162	31,4	181,0±2,45	2,12/11,25
Cehrayi kishmish	22,1±0,54	3,84±0,20	89	18,0	121,8±2,67	-
3-22/14	21,2±0,45	4,16±0,31	148	32,0	164,0±2,62	2,12/11,41
4-5/28	20,0±0,76	4,28±0,34	179	43,0	171,0±4,37	2,12/7,23
Ag kishmish	22,6±0,24	3,80±0,14	106	23,6	111,3±3,21	-

4-18/17	21,5±0,29	4,20±0,27	143	31,0	150,0±3,77	2,12/7,80
3-2/12	21,2±0,80	4,26±0,27	136	29,5	138,6±3,32	2,12/7,30
Gara kishmish	24,2±0,28	4,56±0,08	106	25,6	156,6±1,23	-
5/2-14	19,6±0,18	4,86±0,09	274	53,8	226,2±1,44	2,12/36,63
9/2-14	22,8±0,23	5,12±0,11	250	57,0	210,4±1,14	2,12/32,2
Sultani kishmish	23,6±0,36	3,48±0,13	108	25,5	183,6±1,28	-
6/1-02	19,8±0,21	4,74±0,12	207	41,0	240,0±1,22	2,12/31,90
18/1-02	21,2±0,20	5,96±0,22	200	42,4	232,0±1,01	2,12/29,2

The grain yield was the lowest in the Cehrayi kishmish variety (18 g sugar) and the highest in the 9/2-14 clone variation (57.0 g sugar). In other varieties and clones, this indicator varies between 22.6-53.8 g. Based on the grouping of yield, it can be said that only one form (Cehrayi kishmish cultivar) was low yielding, while other cultivars and clone forms were medium (Ag oval kishmish, Ag kishmish, Gara kishmish, Sultani kishmish, clone 3-2/12), high (clones 30/03, 4-18/17, 3-22/14) and very high (5/2-14, 9/2-14, 6/1-02, 18/1-02, 27/11, 4-5/28 clones) show fertility. It was found out that the yield of the studied cultivars and clones varies between 89 (Cehrayi kishmish) and 274 g (5/2-14 clone form) (on the basis of the dry weight of the bunch in the grape vine). In general, this indicator varied from 89 to 112 g in the grape vine varieties, being lower than in their clones. In the case of clone variations, this indicator was significantly higher and was between 136-274 g. This shows that the selected clones, in addition to showing high productivity, has a satisfactory level of sugar in berries (typical of table varieties).

Some uvological indicators of the studied variety and clone forms were also determined. Thus, during the research, it was found that the number of berries in the bunches varies between 140-270.

The mass of 100 berries is one of the signs characterizing the size of berries. This indicator is 111.3 g in the parent forms - Ag kishmish, 120.0 g in Ag oval kishmish, 121.8 g in Cehrayi kishmish variety, 156.6 g in Gara kishmish and 183.6 g in Sultani kishmish, while it is significantly higher in their vegetative clone offspring, 138.6 (3-2/12 clone)-240.0, respectively. It was clarified that the increase in clonal variation compared to its parents was between 19.7-30.8% according to the mass index of 100 berries. Statistical analysis revealed that the difference between cultivars and their clones according to this indicator is significantly honest.

Table 5. Feasibillty indicators of studied grapevine varieties and clones

Varieties and clones	Productivity per hactare, s/ha	The cost of one quintal of product, manat	Total profit from one hectare, manat	Cost per hectare, manat	Net income, manat (from 1 hectare)	Profitability, %
Ag oval kishmish	102,2	20,3	5110	2070	3040	146,3
27/11	195,5	10,6	9775	"-----"	7705	371,7
30/03	191,1	10,8	9555	"-----"	7485	363,0
Cehrayi kishmish	75,5	27,4	3775	"-----"	1705	82,5
3-22/14	128,8	16,0	6440	"-----"	4370	212,5
4-5/28	151,1	13,7	7550	"-----"	5480	265,0
Ag kishmish	84,4	24,5	4220	"-----"	2150	104,0
4-18/17	146,7	14,1	7335	"-----"	5265	254,6
3-2/12	142,2	14,6	7110	"-----"	5040	242,5
Gara kishmish	82,2	25,2	4110	"-----"	2040	98,5

5/2-14	237,8	8,7	11890	"-----"	9820	474,4
9/2-14	222,2	9,3	11100	"-----"	9030	436,2
Sultani kishmish	91,1	22,7	4555	"-----"	2485	120,0
6/1-02	193,3	10,7	9665	"-----"	7595	367,0
18/1-02	182,2	114	9110	"-----"	7040	340,0

The economically important indicators of grapevine varieties and clonal forms were studied in order to determine the economic importance of selected clonal variations and cultivation perspective (Table 5). It has been determined that clonal variations have higher yield than their parents. Profitability was 82.5% in Cehrayi kishmish, 98.5% in Gara kishmish, 104% in Ag kishmish, 146.3% in Ag oval kishmish, 120.0% in Sultani kishmish, while it was much higher in their clonal variations: 212.5% in 3-22/14 clone form, 242.5% in 3-2/12 clone form, 254.6% in 4-18/17 clone strain, 265.0% in 4-5/28 clone variation, 340.0% in 18/1-02 clone form, 363.0% in 30/03 clone form, 367.0% in 6/1-02 clone form and 371.7% in 27/11 clone form, It was 436.2% in 9/2-14 clone stem and 474.4% in 9/2-14 clone variation. Apparently, clone forms have high economic indicators.

It was found out that the selected and studied clones are superior to the common grapevines in terms of most quantitative and qualitative indicators.

4. Conclusion

During the assessment of productivity of genotypes in populations of grapevine varieties, analysis of correlations between productivity elements and a number of biomorphological traits, it was determined that there is a positive correlation between the productivity, size and mass of bunches and berries, the number of bunches, the average mass of bunches, the mass of 100 berries, the number of berries in a bunch, the number of buds on the grapevine.

Extensive cultivation of the studied clonal variations in newly created wine farms will significantly improve productivity and product quality. Taking into account the positive economic and selection characteristics of the selected high-yielding clones, the sions were supplied and planted for the purpose of studying the inheritance of traits in the vegetative generation and presenting them to the State Commission for the Testing and Protection of Selection Achievements of Agricultural Plants.

References

Angulo, O., Christensen, L.P., Fidelibus, M.W., Heymann, H. & Cathline, K. (2018). Yield, quality, sensory attributes and consumer acceptance of seedless muscat raisin grapes dried on the vine or on trays. *American Journal of Enology and Viticulture*, *2*(Suppl 2), 35-41.

Breksa, A.P., Takeoka, G.R., Hidalgo, M.B., Vilches, A., Vasse, J. & Ramming, D.W. (2010). Antioxidant activity and phenolic content of 16 raisin grape (Vitis vinifera L.) cultivars and selections. *Food Chemistry*, *121*(3), 740-745.

Christensen, L.P. (2000). Raisin grape varieties. *Raisin Production Manual*, 3393.

Gubler, E.V., Genkin, A.A. (1973). Application of nonparametric statistical tests in medical and biological research. *Medicine*, 141. (In Russian).

Khalid, S., Nadeem, A., Shaheen, S., Mammadova, R. & Bakhsh, A. (2023). Crop protection for sustainable agriculture in the era of climate change. In *Climate-Resilient Agriculture, Vol*

1: Crop Responses and Agroecological Perspectives, 349-361. Cham: Springer International Publishing.

Lazarevskiy, M.A. (1963). *Study of Grape Varieties*. Rostov University Publishing House, 163. (In Russian).

Mammadova, R., Akparov, Z., Amri, A., Bakhsh, A., Alo, F., Alizade, S., ... & Yunisova, F. (2024b). Genetic diversity analysis of Azerbaijani bread wheat (Triticum aestivum L.) genotypes with simple sequence repeat markers linked to drought tolerance. *Genetic Resources and Crop Evolution*, 1-9.

Mammadova, R., Amri, A., Akparov, Z., Alo, F., Sheikhzamanova, F., Abbasov, M., ... & Alizade, S. (2024a). Evaluation of genetic diversity using SSR markers and link with drought response of Azerbaijani durum wheat (*Triticum durum* Desf.) genotypes, *Genetic Resources and Crop Evolution*, *71*(5), 2203-2212.

Nazik, N., Ch, A.A., Yin, Z., Mammadova, R., Suleimanova, G., Rao, A.Q. & Bakhsh, A. (2025). CRISPR/Cas-mediated genetic ımprovements in vegetable crops. In *Drought Stress: Review and Recommendations*, 347-368.

Odinayev, M., Buriev, K., Sultonov, K. & Eralieva, S. (2021). Analysis of mechanical properties, biochemical composition and technological parameters of grape (Vitis) raisin varieties in conditions of Uzbekistan. In *E3S Web of Conferences*, 284, 03023.

Salimov, V., Mammadova, R., Burak, M., Alizade, S., Sharifova, S., Bakhsh, A., ... & Hamidova, M. (2024). Inter simple sequence repeat (ISSR) based genetic and morphological polymorphism of Azerbaijani grape (Vitis vinifera) genotypes. *Genetic Resources and Crop Evolution*, 1-13.

Salimov, V.S., Huseynov, M.A. (2025). Polymorphism features in grape (Vitis vinifera L.) variety Bayanshira populations. *SABRAO Journal of Breeding and Genetics*, *57*(2), 516-528.

Salimov, V.S., Huseynova, A.S., Abdulaliyeva, S.Ş., Alekberova, M.M. & Aslanova, F.A. (2024). Agrobiological parameters of some local and introduced collectible grape varieties, grown in the conditions of the Absheron district. *Chelonian Research Foundation, 19*(01), 283-293.

Somkuwar, R.G., Ghule, V.S., Sharma, A.K. & Naik, S. (2023). Evaluation of grape varieties for raisin purposes under tropical conditions of India. *Grape Insight*, 75-80.

Wang, D., Cai, J., Zhu, B. Q., Wu, G.F., Duan, C.Q., Chen, G. & Shi, Y. (2015). Study of free and glycosidically bound volatile compounds in air-dried raisins from three seedless grape varieties using HS–SPME with GC–MS. *Food chemistry*, 177, 346-353.

Zhang, Q., Wang, S., Li, L., Inoue, M., Xiang, J., Qiu, G. & Jin, W. (2014). Effects of mulching and sub-surface irrigation on vine growth, berry sugar content and water use of grapevines. *Agricultural Water Management*, 143, 1-8.