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PHENOTYPIC VARIABILITY IN THE VEGETATIVE GENERATION OF GRAPE (*V. VINIFERA* L.) PROTOCLONES AND SELECTION WITH STABLE SIGNS

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SUMMARY

The following study sought to determine yield stability and quality traits in the vegetative generation of highly productive protoclones chosen through clonal selection in promising grape (*V. vinifera* L.) genotypes. In determining the degree of variability for various quantitative and qualitative traits, growing the selected protoclones of grapevines occurred under various environmental conditions. The newly identified clonal forms proved genetically more stable and homogeneous than their parental genotypes for phenotypic traits, and the degree of variability in their vegetative populations was much lower. The results further enunciated the relative stability of yield and quality parameters of highly productive clones, showing chief association with the clonal breeding.

Keywords: Grape (*V. vinifera* L.), promising populations, genetic variability, stability, yield and quality traits, quantitative and qualitative variables

Key findings: The newly identified clonal forms of the grape (*V. vinifera* L.) appeared genetically more stable and homogeneous than their parental genotypes for phenotypic traits. The degree of variability in their vegetative population was much lower, and the clonal selection was successful.

INTRODUCTION

In the past era, the grapevine cultivation transpired traditionally, and the cultivars were primitive, looking like wild grapes (*V. vinifera* L.). They formed identical populations with similar properties. Currently, some past grape cultivars were the populations obtained from sowing their seeds, selection, and vegetative reproduction to preserve their characteristics

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as plant genetic resources. Usually, local grape populations consist of many landraces and biotypes (Guliyev, 1993; Salimov, 2008; Alekberova *et al.,* 2023).

The grape biotype is an intermediate taxonomic unit between a cultivar-population and a clone, which is a set of individuals characterized by genetic kinship (similarity) in one or a few characteristics. Biotypes belonging to the same cultivar most often differed by biological characteristics (vegetation period, degree of stability, and vigor) and sometimes, morphological traits (bunch size, number of berries in a bunch, and berry size). Numerous variations exist in the populations of most ancient autochthonous grape cultivars. Grape variation is a genotypic change formed during reproduction and differs from other individuals of the population (Smirnov *et al.,* 1987; Huseynov and Aghayev, 2024).

Given that grape species have the highest ecological plasticity and polymorphism, the genotypes retain the characters peculiar to different species. Along with this, the various characteristics of grape cultivars undergo significant variations as influenced by the soil, the surrounding environmental conditions of the grown area, and the application of various agricultural technologies (Kazimova and Nabiyev, 2022; Sadigov *et al.,* 2024).

In general, based on the degree of variability in the biological, morphological, and technological signs of grapes, they divide into highly stable, less inconsistent, and highly inconsistent. The highly stable traits include color and density of prostrate hairs of a young shoot, color of an annual shoot, leaf shape, density of leaf fluffiness, and the degree of dissection of a leaf blade. Moreover, these traits comprise the shape of lower clasps, flower type, length ratio of a stamen to the pistil height, pistil shape, nature of flowering, stalk and bunch peduncle color, berry shape and size, and brown spots on berries' skin.

In grapevines, the weakly changing traits include petiole sinus teeth and length, main veins of a leaf, petiole sinus depth, and the size of clasps of a leaf blade. Other traits comprise the bunch, and anther length and width and stigmas' length and width in the epidermis of a leaf's lower surface. The highly variable traits are the upper clasps' shape, the depth of upper and lower clasps, a bunch's shape, and the number of seeds in a berry. Still, other traits are the area of leaf surface, yield elements, sugar content and titrated acidity of berry juice, mechanical composition of berries and bunches, and the number of berries per bunch (Gurasashvili, 2002; Candar, 2023; Candar *et al.,* 2023).

Currently, the considered appropriate in identifying grape varieties include the use of cytological, such as chromosome complex, nuclear-plasmic relationship, or pollen morphological, including pollen grain diameter and fertility rate. Other methods used anatomical markers, viz., the number of stomata per 1 mm area in the leaf axil, the number of chloroplasts in the complementary or covering cells in the stomata, and phenotypic markers. The use of phenotypic markers includes the color and degree of hairiness of young shoots, the color of annual shoots, the shape of the leaf, the degree of hairiness, the type of lower cuts, and the degree of slicing. These markers also check the leaf blade's upper surface, the stem size, the flower type, and the number of petals and stamens in the corolla. Such markers further probe the nature of the flower opening, the corolla color and shape, the comb and the stem, individual brown spots on the shell, and the viability of the seed (Gurasashvili, 2002). Therefore, the presented study aimed to determine the stability of quantitative and qualitative traits in the vegetative generation of highly productive protoclones picked through clonal selection in promising grape (*V. vinifera* L.) genotypes.

MATERIALS AND METHODS

Considering the prospects of clone selection, since 2010, research has been progressive to improve the local Marandi, Tabrizi, Madrasa, Girde kishmish, Ag kishmish, and the introduced Agadayi and Moldova grape varieties. Their planting and cultivation in Absheron, Shamakhi, Jalilabad, and Samukh use the clone selection methods. The conduct of this study was dependent on data collected in 2010–2018. All seven varieties were 14 years old and planted in the same vineyard, divided into rows. The total area of the vineyards is 12.46 ha and belonged to the Experimental Stations of the Scientific Research Institute of Viticulture and Enology and private farms. These varieties are currently among the most important varieties for the viticulture and winemaking industry in Azerbaijan. The vineyards consist of cordoned vines, planted with a 3 m × 1.5 m planting pattern (Salimov, 2008; Gurbanov and Salimov, 2011; Sharifov and Abdulalieva, 2014).

Clonal breeding proceeded through classical and improved methods (Troshin *et al.,* 2009). The assessment of the degree of accuracy of the difference between the indices of protoclones (mother plants) and clones, as well as among the indices of clones in regions, used the Student's t-test and the Wilcoxon-Mann-Whitney U-test (Gubler and Genkin, 1973; Rokitsky, 1973; Dospekhov, 1985). The study of yield indicators of cloned plants employed classical methods (Smirnov *et al.,* 1987). The research used the formulas proposed by Masyukova (1973) to determine the genotypic diversity in the population of clonal variations. The levels of phenotypic variability of the different cultivars and clonal forms in the population reached detection using variation statistics. It is common for the variability of variation series to seem insignificant (if the coefficient of variation does not exceed 10%), average (if the coefficient of variation is 10%–20%), and significant (if the coefficient of variation is higher than 20%). In some cases, to evaluate the degree of similarity of the breeding material, it was advisable to use an indicator that complements the coefficient of variation to 100. This indicator, called the similarity coefficient, incurred determination by the equation B = 100 - V.

RESULTS AND DISCUSSION

In viticulture, the clonal breeding aimed to achieve long-term stability in yield and quality traits and stability in selected highly productive clones in the vegetative generation. The study of the stability of selected clones' productivity was through several vegetative generations of clones and a comparative review of the different features of clone types under diverse environmental conditions. The recommended biometrical analyses helped the compilation of obtained data and established the levels of threshold of variability for individual traits of various genotypes in the clone cultivars.

Among the selected highly productive protoclones, only a few vines demonstrated relatively stable yields over the years (2010–2018). In 2016, the cuttings prepared from these vines continued being planted on the experimental site to study hereditary signs in the vegetative generation. In the population of each studied cultivar, the studied traits were the number of buds, the total number of opened eyes, the number of shoots with one, two, or three bunches, and the number of shoots without bunches. Other assessed traits are the total number of green shoots, bunches' number, yield coefficient of shoots and fruitful shoots, the number of fruitful shoots, weight of bunches, yield per vine and per hectare, and sugar content of the berry juice (Table 1).

In the population of the grape cultivar Marandi during dry pruning, the vines gave loads of eyes, in the amount of 52–61. During the budding period, the opened percentage was only 79.6% to 89.5% (43–51 eyes) of the total number of eyes. Shoots grown from the opened eyes revealed the poor-yielding shoots, such as shoots with one and two bunches. No shoots with three bunches existed. The results also revealed the number of shoots with one bunch was 17–32, with two bunches (1–8), and without bunches (12–48). The number of bunches varied between 21–41. The yield coefficient of shoots varied within 0.46–0.87, and the yield coefficient of productive shoots was within 1.05–1.32.

Past studies revealed a positive correlation between the average shoot length and the number of grapes (Stoev *et al.*, 1959). According to Winkler (1965), techniques that increase the vigor of shoot growth also boost their productivity. A certain correlation occurs between the length of the shoots, the number

Table 1. Productivity and quality indicators of the vegetative generation of protoclones (clone forms).

Traits \ Grape cultivars	Marandi	Girde kishmish	Agadayi	Madrasa	Moldova	Ag kishmish	Tabrizi
Total number of buds	55.3±0.54 (52-61)	56.0±0.72 (52-64)	52.3±0.66 (46-57)	49.8±0.72 (44-56)	55.2±1.02 (47-64)	53.2±0.96 (47-63)	49.7±1.02 (43-60)
Total number of opened eyes	46.7±0.48 (43-51)	47.8±1.08 (42-60)	43.1±1.08 (33-51)	40.3±0.60 (36-46)	46.1±0.72 (42-54)	44.4±0.96 (38-54)	39.7±0.78 (35-51)
Total number of opened eyes	84.5±0.57 (80.3-89.5)	85.5±0.83 80.0-93.8)	82.5±1.72 (62.3-91.1)	80.7±0.61 (75.5-85.7)	83.5±0.71 (78.7-90.6)	79.0±0.85 (78-92.2)	79.7±0.44 (77.6-85.0)
Number of shoots with one bunch	24.1±0.90 (17-37)	19.2±0.90 (13-28)	18.9±0.54 (16-25)	15.1±0.54 (10-19)	17.3±0.79 (11-24)	17.3±0.78 (12-25)	13.2±1.26 (1-22)
Number of shoots with two bunches	3.5±0.42 (1-8)	6.8±0.48 (3-11)	6.2±0.30 (4-9)	4.7±0.30 (3-8)	4.5±0.48 (1-9)	5.1±0.30 (3-8)	5.4±0.30 (3-8)
Number of shoots with three bunches	-	2.6±0.30 (0-5)	-	-	3.3±0.30 (1-6)	2.9±0.18 (1-4)	2.1±0.30 (0-5)
Number of shoots without bunches	25.1±2.16 (12-48)	19.4±0.90 (12-27)	17.8±0.72 (10-22)	20.5±1.14 (11-30)	21.0±0.72 (16-28)	19.1±0.48 (15-23)	18.4±0.96 (10-26)
Number of green shoots	46.7±0.48 (43-51)	47.8±1.08 (42-60)	43.1±1.08 (33-51)	40.3±0.60 (36-46)	46.1±0.84 (37-51)	44.4±0.96 (38-54)	39.7±0.96 (35-51)
Number of bunches	31.4±1.20 (21-41)	40.2±0.90 (32-47)	31.6±0.78 (26-39)	24.6±0.90 (18-33)	36.2±1.92 (21-53)	36.6±1.02 (26-45)	30.8±1.68 (20-48)
Yield coefficient of shoots	0.67±0.02 (0.46-0.87)	0.85±0.02 (0.62-1)	0.73±0.01 (0.62-0.85)	0.61±0.02 (0.44-0.79)	0.78±0.53 (0.47-1.0)	0.83±0.02 (0.66-1.07)	0.73±0.02 (0.57-1.00)
Yield coefficient of fruitful shoots	1.14±0.02 (1.05-1.32)	1.42±0.02 (1.20-1.63)	1.25±0.01 (1.16-1.31)	1.23±0.02 (1.15-1.47)	1.33±0.04 (1.11-1.76)	2.15±0.86 (1.20-15.5)	2.96±0.76 (1.33-14)
Number of fruitful shoots (%)	58.7±1.82 (43.5-73.9)	59.7±1.55 (48.1-73.9)	58.9±1.11 (51.1-69.7)	63.7±2.95 (37.8-87.0)	53.8±1.41 (43.2-66.7)	56.8±1.05 (46.2-63.8)	52.0±1.80 (42.9-73.0)
Weight of bunches (g)	346.8±5.99 (310-410)	354±6.59 (300-410)	375±5.99 (310-420)	323.0±1.12 (270-390)	347.8±29.9 (280-430)	354.3±21.0 (275-410)	409.7±37.1 (328-490)
Yield per vine (kg)	10.9±0.51 (6.72-15.2)	14.3±0.54 (9.92-18.9)	11.8±0.33 (9.80-14.8)	7.90±0.46 (5.22-12.9)	12.7±0.77 (5.88-18.7)	12.8±0.34 (10.2-15.8)	12.7±0.87 (8.20-22.8)
Yield per hectare (t/ha)	24.25±5.29 (14.93-33.77)	31.73±5.96 (22.04-42.00)	26.26±0.665 (21.78-32.89)	17.70±2.30 (14.82-28.66)	29.27±2.56 (13.07-57.35)	29.01±1.60 (22.66-35.33)	26.84±1.94 (18.22-50.66)
Sugar content (g/100 cm^3)	21.3±0.24 (20-24)	21.1±0.24 (20-24)	19.8±0.24 (18-22)	22.0±0.12 (21-23)	20.0±0.12 (19-21)	21.8±0.24 (20-24)	20.8±0.12 (20-22)

of bunches, and their average weight. More developed shoots have more clusters; however, this dependency does not manifest at par in different cultivars. Almost similar results came from reports by Salimov *et al.* (2015b).

By studying the yield indicators in the population of the grape cultivar Girde kishmish, it was evident that the total number of buds on the vines varies within 52–64, the total number of opened eyes (within 42–60), which makes 80%–93.8%. The number of shoots with one bunch varies from 13 to 28, the number of shoots with two bunches varies within 3–11, and the number of shoots with three bunches ranges from zero to five. On the fourth vine, the shoots with five bunches were also noteworthy. The number of shoots without bunches was 12–27, the number of green shoots was 42–60, and the number of bunches was 32–47. The highest yield coefficient of shoots (1) was apparent in the second vine, while the lowest (0.62) was in the 13th one. The bunches' weight is one of the important traits influencing the yield potential of grapevines. Overall, the small (150–250 g) bunches were notable in six grape cultivars (Khalbasar, Ag Pishraz, Pshraz Gara, Dnestrovskii Rozovyi, Dekabrski, and Dzandzhal Kara). However, the cultivar Taif Rozovyi had massive bunches (Salimov *et al.,* 2024).

In the population of grape cultivar Agadayi, by studying the average yield traits, it was visible that the total number of buds varies within 52.3 ± 0.66, and the total number of opened eyes was 43.1 ± 1.08, which makes 82.5% ± 1.72%. The number of shoots with one bunch varies within 18.9 ± 0.54 pieces, the number of shoots with two bunches is 6.2 ± 0.30, and the number of shoots without bunches is 17.8 ± 0.72. Other traits gave values as follows: the total number of green shoots (43.1 ± 1.08), the number of bunches (31.6 ± 0.78), the yield coefficient of shoots (0.73 ± 0.01), the yield coefficient of fruitful shoots (1.25 ± 0.01), and the number of fruitful shoots as a percentage (58.9 ± 1.11). Meanwhile, the weight of bunches was 375.0 ± 5.99 g, the yield from the bush was 11.8 ± 0.33 kg, the yield per hectare was 26.26 ± 0.665 t/ha, and the sugar content was 19.8 ± 0.24 g/100 cm^3. Salimov *et al.* (2015a) reported the Azerbaijani grapevine cultivars have the widest range of diversity by their morphological traits, with the genotypes distinguished by their berry color, shape, and size; flavor and aroma; ripening period; direction of use; processing; and storage specifications. In grapevines, the berry size was a recognized important factor in determining the quality of the grapevine cultivars (Matthews and Nuzzo, 2007).

In the grapevine cultivar Madrasa, the observations showed the total number of buds varied from 44 to 56, the number of opened eyes was 36–46, and the percentage terms were 75.5–85.7. The number of shoots ranged from 10 to 19 in one bunch and 3–4 with two bunches. No recorded shoots prevailed with three bunches. Shoots without bunches resulted on the fifth vine (11) and on the 14th vine (30). According to the obtained data, the smallest number of bunches (18) was prominent on the 10th vine, while the largest (33) was on the sixth one. The yield coefficient of shoots varies within 0.44–0.79, the yield coefficient of fruitful shoots within 1.15–1.47, and the number of fruitful shoots ranges from 37.8% to 87.0%. Past studies demonstrated the differences in berry size also result in variations in the composition of fruits, including tannins and anthocyanins (Ergonul *et al*., 2024; Fataliyev *et al*., 2024a, b). Furthermore, the wines produced from small berries have proven to exhibit higher concentrations of tannins and anthocyanins (Matthews and Nuzzo, 2007).

The yield traits' scrutiny in the population of grape cultivar Moldova gave results expressing the total number of buds varying in the range of 55.2 ± 1.02 and the total number of opened eyes ranging at 46.1 ± 0.72, which was 83.5% ± 0.71%. Other attributes gave values, i.e., the number of shoots with one bunch (17.3 ± 0.79), two bunches (4.5 ± 0.48), three bunches (3.3 ± 0.30), and without bunches (21.0 ± 0.72). The following qualities have scores, viz., the total number of green shoots (46.1 ± 0.84), the number of bunches (36.2 ± 1.92), the yield coefficient of shoots (0.78 ± 0.53), and fruitful shoots (1.33 ± 0.04). The number of fruitful shoots as a percentage is 53.8 ± 1.41, the weight of bunches is 347.8 ± 29.9 g, the yield per vine is 12.7 ± 0.77 kg, and the yield per hectare is 29.27 ± 2.56 t/ha. The sugar content was 20.0 ± 0.12 g/100 cm³. Previous studies determined the differences among the selected biotypes of the grapevine cultivar Saperavi as per main ampelographic characteristics. It 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).

The average yield traits in the population of grape cultivar Ag kishmish showed the total number of buds varies between 53.2 ± 0.96, and the total number of opened eyes is 44.4 ± 0.96, which was 79.0% ± 0.85%. The number of shoots with one bunch changes (17.3 ± 0.78). The number of shoots with two bunches is 5.1 ± 0.30, with three bunches (2.9 ± 0.18), while the number of shoots without bunches is 19.1 ± 0.48. Other qualities' scores are the total number of green shoots (44.4 ± 0.96), the number of bunches (36.6 ± 1.02), the yield coefficient of shoots (0.83 ± 0.02), and fruitful shoots (2.15 ± 0.86). The number of fruitful shoots in percent is 56.8 ± 1.05, the weight of bunches is 354.3 ± 21.0 g, the yield per vine is 12.8 ± 0.34 kg, the yield per hectare is 290.1 ± 16 kg/ha, and the sugar content is 21.8 ± 0.24 g/100 cm³. In grapes, the most crucial ampelographic characteristics for monitoring were the following: OIV153-İnflorescences: number of inflorescences per shoot; OIV202-Bunch: length; OIV203-Bunch: width; OIV223-Berry: shape; OIV222-Berry: uniformity of size; OIV303-Time of beginning 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; and OIV504-Yield per m^2 (Salimov *et al.,* 2024).

By assessing the yield-related traits in the population of grape cultivar Tabrizi, the total number of buds varies within 49.7 ± 1.02 pieces, and the total number of opened eyes was within 39.7 ± 0.78 pieces, which makes it 79.7% ± 0.44%. The number of shoots with one bunch is 13.2 ± 1.26, with two bunches (5.4 ± 0.30), with three bunches (2.1 ± 0.30), and without bunches (18.4 ± 0.9). The total number of green shoots is 39.7 ± 0.96, the number of bunches is 30.8 ± 1.68, the yield coefficient of shoots is 0.57 ± 0.73, and the yield coefficient of fruitful shoots is 2.96 ± 0.76, with the number of fruitful shoots as a percentage being 52.0 ± 1.80. Scores for other traits include the bunches' weight (409.7 ± 37.1 g), the yield per vine (12.7 ± 0.87 kg), the yield per hectare (26.84 ± 1.94 t/ha), and the sugar content (20.8 ± 0.12 g/100 cm³). In the grapevine cultivar Bastardo Magarachsky, determining the productivity traits and the degree of their variability revealed the populations of the said cultivar appeared with heterogeneity and the possibility of selecting high-productive protoclones (Studennikova and Kotolovets, 2023).

In comparing vine indicators in the population of the studied grape cultivars, the average vine traits in the population of each cultivar also underwent distinction and analysis comparatively. The results revealed the lowest number of buds (49.7 ± 1.02) emerged in the cultivar Tabrizi, while the highest (56.0 ± 0.72) resulted in the cultivar Girde kishmish. The comparative analysis exhibited that the average weight of the opened eyes in the population of each cultivar varies between 39.7 ± 0.78 (cv. Tabrizi) and 47.8 ± 1.08 (cv. Girde kishmish), and the percentage of the opened eyes varies from 79.0 ± 0.85 (cv. Ag kishmish) to 85.5 ± 0.83 (Girde kishmish). It was evident that the average number of shoots with one bunch differs in the range of 13.2 ± 1.26 to 24.1 ± 0.90, and with two bunches, the range was 3.5 ± 0.42 to 6.8 ± 0.48.

The results further authenticated that the grapevine cultivars Marandi, Agadayi, and Madrasa had no shoots with three bunches. As mentioned above, a coefficient of variation is an indicator of relative difference and similarity of a variable feature. The findings showed the coefficient of variation varies depending on the hereditary characteristics and the signs of variability in populations of the grape cultivars, including the genetic nature of the indicators (Table 2). The grapevine cultivars' quality also depends on the biochemical composition of the berries. On grape cultivars' harvesting, the Brix scale ranged from 19.0 to 23.0 in white grape

Table 2. Indicators of the degree of stability and variability of signs of the vegetative generation of protoclones (clones).

Traits	Degree of variation changeability of protoclones and their vegetative generation (clones) in cultivars-populations														Average for P.V. (%)	Average for C.V. (%)
	Marandi		Girde kishmish		Agadayi		Madrasa		Moldova		Ag kishmish		Tabrizi			
	P.V. (%)	C.V. (%)	P.V. (%)	C.V. (%)	P.V. (%)	C.V. (%)	P.V. (%)	C.V. (%)	P.V. (%)	C.V. (%)	P.V. (%)	C.V. (%)	P.V. (%)	C.V. (%)		
Number of bunches	32.4	14.2	18.6	12.4	26.5	11.6	48.2*	18.6	22.6	14.4	18.6	11.6	34.2	14.2	25.5	13.8
Yield coefficient of shoots	28.4	10.6	22.6	7.6	24.4	9.8	26.6	17.2	17.3	8.8	17.9	9.6	28.6	9.6	23.7	10.5
Yield coefficient of fruitful shoots	26.4	8.8	24.0	8.4	25.2	9.2	27.2	18.4	22.5	9.8	17.5	8.8	22.4	8.4	23.6	10.3
Number of fruitful shoots	24.8	9.4	23.6	9.8	24.3	8.7	25.8	16.6	21.6	11.2	16.8	9.5	23.4	8.2	22.9	10.5
Weight of bunches	38.4	12.5	34.8	10.6	28.6	12.3	52.4*	21.4	25.4	14.5	38.6	12.6	46.4	19.5	35.4	14.8
Yield index of shoot	25.6	10.4	25.0	7.2	24.8	8.8	24.8	17.8	23.8	10.3	19.2	10.0	25.4	10.4	24.1	10.7
Yield per vine	32.4	15.4	33.8	12.8	32.6	13.4	52.4*	21.4	27.8	16.7	36.6	12.4	38.2	21.2	33.6	16.2
Sugar content	14.6	12.5	14.8	13.6	12.7	9.8	24.4	15.2	13.8	11.3	14.4	9.8	16.7	12.4	15.9	12.1
min.	14.6	8.8	14.8	7.2	12.7	8.7	24.4	15.2	13.8	8.8	14.4	8.8	16.7	8.2	15.9	10.3
max.	38.4	15.4	34.8	13.6	32.6	13.4	27.2	21.4	27.8	16.7	38.6	12.6	46.4	21.2	35.4	16.2

Note: P.V. (%) = The degree of variation of the parent plant (protoclone), C.V. (%) = The degree of variation of the clone.

cultivars and 20.5 to 23.5 in red grape cultivars (Rieger, 2006). According to Brix scale enhancement, the alcohol content of the resulting wine also increases (Cox, 1999).

Foremost, the study considers the coefficient of variation for the population and clone variations. The results revealed the coefficient of variation of the protoclones (P, V%) was much higher than the coefficient of variation of the clone types (C, V%). Thus, the coefficient of variation of the protoclones of the cultivar Marandi was 14.6%–38.4%, cultivar Girde kishmish (14.8%–34.8%), Agadayi (12.7%–32.6%), Madrasa (24.4%–27.2%), Moldova (13.8%–27.8%), Ag kishmish (14.4%–38.6%), and the cultivar Tabrizi (16.7%–46.4%). The coefficient of variation of the clone forms of cultivar Marandi was 8.8%–15.4%, Girde kishmish (7.2%–13.6%), Agadayi (8.7%–13.4%), Madrasa (15.2%–21.4%), Moldova (8.8%–16.7%), Ag kishmish (8.8%–12.6%), and the cultivar Tabrizi (8.2%–21.2%). The total coefficient of variation of the protoclones' traits exceeded the total coefficient of variation of the clone forms, which amounted to 15.9%–35.4% (Table 3). Several factors occurred associated with the unique influence of vine vigor and have an impact on the bunch morphology, grape yield, and its biochemical composition (Bramley *et al*., 2011), procyanidin in the seeds (Edo-Roca *et al*., 2014b), and anthocyanin in the skin (Edo-Roca *et al*., 2014a).

Table 3. Statistical indicators of variability (phenotypic changeability) on yield indicators of genotypes in the first vegetative generation of protoclones (P_1-clones).

Variables	Madrasa	Agadayi	Tabrizi	Girde kishmish	Ag-kishmish	Marandi	Moldova
Factorial variance (dispersion)– C_x	3.7	40.2	0.60	30.2	11.7	42.2	0.52
Random variance – C_z	104.5	99.7	134.2	79.7	124.3	108.7	124.2
Total variance– C_y	107.9	140.0	134.8	120.0	127.5	160.0	144.6
Factorial variation– σ_x^2	0.40	4.47	0.07	3.42	0.58	8.48	0.09
Random variation – σ_z^2	2.10	1.66	2.68	1.46	2.90	3.68	2.76
Indicator of phenotypic diversity – η_x^2	0.034 (3.4%)	0.28 (28%)	0.004 (0.4%)	0.08 (0.8%)	0.054 (5.4%)	0.19 (19%)	0.009 (0.9%)
Error of the indicator – $m\eta_x^2$	0.174	0.20	0.18	0.16	0.174	0.18	0.21
Reliability of the indicator – Φ	0.19	2.15	0.022	2.02	0.19	3.12	0.028
Reliability according to the Fisher criterion – F	0.19	2.70	0.026	2.05	0.19	3.50	0.029
Threshold of reliability of the indicator – $\eta_x^2 = \eta_x^2 \pm \Delta$	0.033	0.28	0.004	0.08	0.033	0.19	0.009

CONCLUSIONS

The newly identified clonal forms proved genetically more stable and homogeneous than their parental genotypes for phenotypic traits, and the degree of variability in their vegetative populations was much lower. This indicator was the lowest in the grapevine cultivar Madrasa (3.4%), while the highest was in the cultivar Agadayi (28%). In other grape cultivars, the phenotypic diversity varies between 0.4% (cv. Tabrizi) and 19% (cv. Marandi). Although, this indicator was relatively high in the cultivars Agadayi and Marandi, while it was nonsignificant in other grape cultivars.

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