# Study of Adaptive Features of Some Grape Varieties in the Conditions of Absheron in Terms of Yield Indicators

A. Guliyeva

Scientific Research Institute of Viticulture and Winemaking, Absheron, Azerbaijan.
aynura.guliyeva@vitis.agro.gov.az

**Abstract.** This study presents the results of a comprehensive investigation into the agrobiological, morphological, and technological characteristics of multiple table grape cultivars cultivated in the Absheron district of Azerbaijan. The research encompassed both local varieties, including Ag Pishraz, Gara Kechimemesi, Gara Pishraz, Gara Urza, Gara Khatyny, Gozal Uzum, Gomushimeme, Galshan, Ganja Kechimemesi, and Khalbasar, and introduced cultivars such as Danaburnu, Dekabrskii, Dzhandzhal Kara, Dnestrovskiy Rozovy, Doina, Ichkimar, Cardinal, Kuldzhinskii, Moldova, Italia, Taifi Rozovyi, and Tuya Tish. This diverse selection allowed for a thorough assessment of varietal performance under the specific agroecological and climatic conditions of the region.

A combination of classical and contemporary analytical methods was employed, including digital ampelographic characterization following international standards, statistical evaluation of phenotypic traits, and quantitative assessments of yield, fruit quality, and ecological adaptability. The study utilized non-parametric Mann–Whitney–Wilcoxon U-tests, parametric Student's t-tests, and Pearson's $\chi^2$ tests to ensure robust statistical validation. Furthermore, varietal potential was evaluated according to the OIV "ideal variety" framework, integrating morphological, physiological, and productivity parameters into a unified assessment.

The findings are highly relevant for sustainable viticulture and modern grape production, offering practical insights for selecting varieties with both high yield potential and ecological resilience. By combining precise digital profiling with rigorous statistical and agrobiological analyses, this research provides a model for evidence-based evaluation of grape germplasm. The results underscore the importance of identifying cultivars that can adapt to climatic variability while maintaining superior fruit quality, thus contributing to the long-term sustainability and competitiveness of the regional grape industry.

**Keywords:** table grapes, introduced cultivars, yield.

## 1. Introduction

For centuries, vineyard owners in Azerbaijan have introduced grape varieties from different parts of the world to their farms in order to produce high-quality grapes and grape products. Due to the country's favorable soil and climatic conditions, both local and introduced varieties have been cultivated, which has played a crucial role in the


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development of viticulture. The experience of countries with advanced viticulture demonstrates that a rich and diverse grape gene pool, constant enrichment of varietal collections with foreign introductions, and the creation of new varieties and hybrid forms are the main driving forces behind sustainable progress in this field[1-5].

In general, enriching the varietal composition of vineyards in any region and incorporating economically valuable genotypes suited to local conditions is most effectively achieved through introduction. The cultivation of different grape varieties under various soil and climatic conditions provides opportunities to study their reactions to environmental factors and select those best adapted to the given region[6]. During the introduction process, the ecological characteristics of the target area must first be considered, followed by a detailed examination of the biological features of the introduced variety, including its resistance to environmental stress factors. Research conducted within ampelographic collections allows obtaining preliminary data on the productivity, ecological plasticity, bioecological traits, and product quality of introduced grape varieties (Abdulaliyeva & Alakbarova, 2017; Cabaroglu, 2013;  Klimenko et., 2020;).

Along with local grape resources, the study and comprehensive evaluation of introduced varieties under specific soil and climatic conditions are essential for identifying economically efficient and market-oriented cultivars that meet modern requirements. Only grape varieties of high quality, strong storage and transport resistance, and compliance with international standards can compete successfully in today's fruit markets. Currently, global table grape breeding programs focus on developing varieties resistant to diseases and pests (including phylloxera), with early ripening, large berries (6–8 g), good keeping and transport quality, and high consumer appeal. For technical varieties, sugar content should not be less than 16 g/100 $cm^3$ for white cultivars and 17 g/100 $cm^3$ for black cultivars, while juice yield should reach 750–780 L/ton. The mass concentration of phenolic compounds should range from 0.5–1.0 g/$dm^3$ in white varieties and 1.0–1.25 g/$dm^3$ in black varieties. These parameters are considered key criteria in selection, introduction, and evaluation of adaptive and promising genotypes (Glantz, 1998)[7-8].

## 2. Materials and Methods

The research material comprised both local (Ag Pishraz, Gara Kechimemesi, Gara Pishraz, Gara Urza, Gara Khatyny, Gozal Uzum, Gomushimeme, Galshan, Ganja Kechimemesi, Khalbasar) and introduced (Danaburnu, Dekabrskii, Dzhandzhal Kara, Dnestrovskiy Rozovy, Doina, Ichkimar, Cardinal, Kuldzhinskii, Moldova, Italia, Pobeda, Prezentabil, Sultanina, Taifi Rozovyi, Tuya Tish) table grape cultivars grown under the agroecological conditions of the Absheron district. The study carried out a detailed investigation of their morphological and agrobiological traits, including the duration of the vegetation period, yield components, and the physico-chemical characteristics of berries, utilizing both traditional and contemporary methodological approaches[9-15]. Assessment of varietal potential was conducted according to the OIV "ideal variety" framework. Morphological and agrobiological characteristics such as vegetation period and yield components were examined using traditional and modern ampelographic descriptor methods (Salimov, 2019; Salimov et., 2020).

The assessment of varietal prospects was carried out according to the "new model" based on the OIV (International Organisation of Vine and Wine) ampelodescriptors (Salimov, 2016; Polulyakh & Volynkin, 2020). To guarantee the robustness and reliability of quantitative outcomes, nonparametric (Wilcoxon–Mann–Whitney U-test) and parametric (Student's t-test) statistical methods were applied, while quality-related data were analyzed using Pearson's $\chi^2$ criterion. Comprehensive mathematical and statistical processing enabled a digital characterization of the studied cultivars (Kazakhmedov et., 2020)[16,17].

The evaluation included a wide range of agrobiological and productivity indicators, such as total bud count, percentage of fertile buds, total green shoots, number of shoots without clusters, percentage and absolute number of fruitful shoots, shoot productivity coefficients, cluster weight, vine and hectare yield, and must sugar content. Considering the crucial role of yield and quality traits in determining both the economic significance and breeding value of table grapes, this study provides an in-depth appraisal of twenty-five local and introduced grape varieties cultivated at the Absheron Experimental Farm of the Azerbaijan Research Institute of Viticulture and Wine-making. Table 1: Indicators of yield and quality of introduced collectible grape varieties.

## 3. Results and Discussion

In order to determine the relationship between the established indicators of the studied grape varieties, a correlation analysis was carried out. As we can see, there are both positive and negative relationships between the studied indicators, differing in their degree. A high positive correlation was found between the total number of buds and the total number of green shoots (r=0.985), the number of sterile green buds (r=0.988), between the number of green shoots and the number of shoots without bunches (r=0.717), the number of yield shoots and the number of bunches (r=0.783) and the coefficient of yield of green shoots (r=0.796), between the number of bunches and the coefficient of yield of green shoots (r=0.816) and the coefficient of yield shoots (r=0.639), between the coefficient of yield of green shoots and the coefficient of yield shoots (r=0.891), between the total number of buds and the weight of the bunch (r=0.654) and plant yield (r=0.695), between the weight of the bunch and plant yield (r=0.802), between the total number of buds and the yield per hectare (r=0.658), between the bunch weight and the yield per hectare (r=0.875), between the plant yield and the yield per hectare (r=0.966). The values of the noted correlation coefficients have high statistical significance compared to the significance level (p) of 0.01. (Fig. 1-2).

In the graph presented, a strong positive correlation ($R^2$ = 0.971) is observed between the total number of green shoots and the total number of buds, indicating a very close linear dependence between these two parameters. This relationship suggests that as the number of green shoots increases, the total number of buds rises almost proportionally, demonstrating the close interconnection between vegetative growth and bud formation processes.

Such a high coefficient of determination ($R^2 = 0.971$) reflects minimal random variation and emphasizes that the variation in bud number is almost entirely explained by changes in the number of green shoots. In practical viticulture, this means that the intensity of shoot growth can serve as a reliable indicator of the plant's reproductive potential, as stronger and more numerous shoots tend to form a higher number of fertile buds.

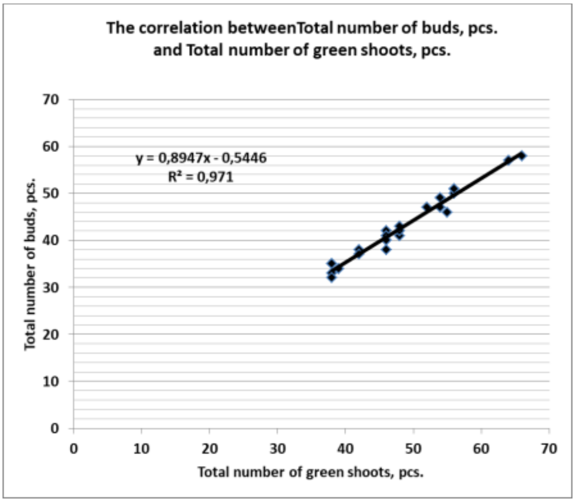


**Fig. 1.** The correlation relationship between the total number of buds and total number of green shoots.

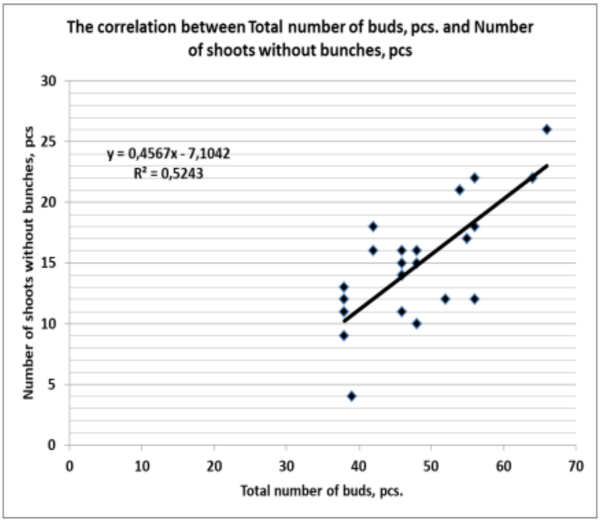


**Fig. 2.** The correlation relationship between the total number of buds and number of shoots without bunches.

This trend also highlights the importance of balanced vegetative development in grapevines: vigorous shoot formation ensures a sufficient photosynthetic surface and nutrient flow to developing buds, ultimately supporting stable yield formation. Therefore, the total number of green shoots can be considered a precise predictive parameter for evaluating the intensity of vegetative growth and potential productivity in different grape genotypes.

Moreover, the nearly perfect linearity of this correlation demonstrates that under Absheron conditions, the studied grape varieties maintain a consistent vegetative-reproductive balance, confirming the strong adaptive capacity of the genotypes examined.

**Table 1.** Indicators of yield and quality of introduced collectible grape varieties.

| Name of the variety | Total number of buds, pcs. | Number of budding eyes, % | Total number of green shoots, pcs. | Number of shoots without bunches, pcs | Number of yield shoots, | |
|---|---|---|---|---|---|---|
| | | | | | pcs. | % |
| Danaburnu (control) | 54 | 90,7 | 49 | 21 | 28 | 57,1±2,4 |
| Go-mushimeme | 56 | 89,3 | 50 | 22 | 28 | 56,0±1,6 |
| Gara urza | 46 | 82,6 | 38 | 14 | 24 | 63,0±2,5 |
| Gara kechimemesi | 48 | 85,4 | 41 | 16 | 25 | 61,0±1,2 |
| Gara khatyny | 42 | 90,5 | 38 | 16 | 22 | 57,9±1,3 |
| Gyozal uzum | 46 | 87,0 | 40 | 14 | 26 | 65,0±2,8 |
| Ganja kechimemesi | 48 | 87,5 | 42 | 10 | 32 | 76,2±3,2 |
| Galshan | 42 | 88,1 | 37 | 18 | 19 | 51,4±0,6 |
| Khalbasar | 38 | 92,1 | 35 | 11 | 24 | 68,6±1,8 |
| Ag pishraz | 38 | 86,8 | 33 | 12 | 21 | 63,6±2,6 |
| Gara pishraz | 38 | 84,2 | 32 | 9 | 23 | 71,9±3,2 |
| Moldova | 55 | 83.6 | 46 | 17 | 29 | 63,0±1,3 |
| Dekabrskii | 52 | 90,4 | 47 | 12 | 35 | 74,5±1,6 |

This relationship can thus be effectively used in breeding and agrobiological assessment studies to predict yield potential and to select cultivars with optimal growth dynamics.

In the presented graph, a moderate positive correlation ($R^2 = 0.5243$) is observed between the total number of buds and the number of shoots without bunches. This suggests that as the total number of buds increases, the number of non-fruiting shoots also tends to rise, though the relationship is not as strong or consistent as in the previous case. Such variability indicates that factors other than bud quantity - such as varietal characteristics or environmental conditions—may influence the formation of shoots without bunches.

## 4. Conclusion

The comparative evaluation of agrobiological and productive characteristics revealed that the studied grape varieties exhibit substantial genetic and environmental variability in terms of bud fertility, shoot development, cluster formation, and sugar accumulation. Such variability reflects the distinct genotypic responses of each cultivar to the agroecological conditions of the Absheron zone, where high summer temperatures, limited rainfall, and saline soils often serve as decisive selection factors.

The highest productivity per vine and per hectare was achieved by *Taifi rozovyi*, *Italia*, *Ichkimar*, and *Prezentabil*, which demonstrated not only superior yield potential but also favorable cluster morphology, optimal berry weight, and balanced sugar–acid composition. These varieties, therefore, reveal a high adaptive potential and suitability for intensive table grape cultivation under semi-arid Absheron conditions. Their consistent bud fertility and uniform ripening dynamics also indicate stability across growing seasons.

Varieties such as *Doina*, *Sultanina*, *Dekabrskii*, and *Pobeda* also exhibited advantageous combinations of yield components and quality indices, particularly regarding bunch compactness, berry uniformity, and sugar accumulation, making them valuable for both fresh consumption and processing.

In contrast, *Gozal uzum*, *Galshan*, and *Gara khatyny* demonstrated relatively weak productivity and less favorable reproductive behavior, which may be attributed to lower bud fertility coefficients or reduced tolerance to local abiotic stress factors. These varieties may require further agronomic optimization — such as improved pruning systems, regulated irrigation, or application of growth stimulants—to enhance their productive performance and ensure stable yields under the challenging environmental conditions of Absheron.

Overall, the obtained results emphasize that genotypic adaptability and agrobiological stability are key determinants for the successful selection of grape varieties suited to the dry subtropical conditions of Azerbaijan, particularly for modern table grape production systems.

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