

HARVEST AND QUALITY OF GRAPES OF DIFFERENT CLONES OF THE CABERNET SAUVIGNON VARIETY IN THE CODRU WINE-GROWING REGION OF THE REPUBLIC OF MOLDOVA

Gheorghe NICOLAESCU, Olga MOGÎLDEA, Cornelia VOINESCO, Mariana GODOROJA,
Gheorghe MATCU, Dumitru VARTIC, Andrei KIMAKOVSKI

Technical University of Moldova, 48, Mircesti Street, Chisinau, Republic of Moldova

Corresponding author emails: gheorghe.nicolaescu@fh.utm.md, gh.nicolaescu@gmail.com

Abstract

The improvement of grape varieties is inevitable in increasing the yield of grapes and the quality of wine. A wide range of clones within each grape variety are currently highlighted. The purpose of our research is to study the behavior of different clones of the Cabernet Sauvignon variety in the Mereni wine-growing area, the Codru wine-growing region of the Republic of Moldova. The Mereni wine-growing area includes the localities of the Anenii Noi district (approx. 30 km SE from the Chisinau city), it is characterized by uneven, warm winters and dry summers with low precipitation. The studied clones demonstrate the adaptability to the conditions of the Codru wine region and the obtaining of high quality wines.

Key words: clones, Republic of Moldova, viticulture, wine varieties.

INTRODUCTION

The grape variety have an important role on the quality of the wine, as it determines the organoleptic characteristics of the wines, such as aroma, taste, colour and body. Each grape variety has its own characteristics and can therefore produce a wine with a unique taste, aroma and texture. Among the factors that influence the quality of the wine are: pedoclimatic conditions, growing technology, but the grape variety has a major impact on the characteristics of the wine. In addition, how the grapes are handled and the winemaking process can also influence the final quality of the wine. But without a proper choice of grape variety, it is very difficult to get a top-quality wine (Kimakovski et al., 2023; Кимаковски et al., 2023; Voinesco et al., 2023).

The development of the grapes and winemaking sector is influenced by a series of subjective and objective factors of different origins: technological, ecological, political, informational, financial, etc. (Midari et al., 2022).

Moldova is a country with a tradition in wine production and is known throughout the world for the quality of its wines. The grape and winemaking sector is strategic for the Republic

of Moldova economy. The wine-growing regions of Moldova are located in the central and southern part of the country (Nicolaescu et al., 2022; Nicolaescu et al., 2023)

The following wine regions are approved by law:

Codru - is considered the most important wine region in Moldova. The wines produced in this region are known for their full and balanced aroma and taste.

Valul lui Traian - located in the southern part of the republic. It is known for its wines, with delicate aromas of flowers and fruits.

Stefan Voda - located in the southeastern part of Moldova, this region is known for its strong and elegant red wines, produced from varieties such as Cabernet Sauvignon, Merlot and Pinot Noir, etc. (Mogîldea et al., 2023).

Cabernet Sauvignon is a grape variety native from the Bordeaux region of France, but which is successfully grown around the world. Cabernet Sauvignon is a red grape variety and is considered one of the noblest grape varieties due to its organoleptic qualities and the ability to produce wines with the potential for long period of maturation. The wines from Cabernet Sauvignon grapes are known to have a strong taste of dark fruits such as strawberries, cherries and blackberries with aromas of spices

such as vanilla and cinnamon. The wines from Cabernet Sauvignon are also characterized by their rich body and strong tannins, which give them a dry and persistent taste (Voinesco et al., 2023).

The purpose of the research reflected in this article consists in:

- studying the current state and prospects for the development Cabernet sauvignon variety in the Codru Wine Region of the Republic of Moldova (clones, technology, vineyards areas, yield, quality of grapes and wine etc.).

MATERIALS AND METHODS

The studies reflected in this article were carried out on different clones of the Cabernet Sauvignon variety grown in different wine-growing regions (Stefan Vodă, Gagauzia, Anenii Noi, Hâncești, Ialoveni etc.) during the years 2017-2022.

Also, the following databases and information were used:

- National Bureau of Statistics (NBS) of the Republic of Moldova;
- National Office of Vine and Wine (NOVW) etc.

MS Office Excel (2019) was used for the mathematical processing of the data.

RESULTS AND DISCUSSIONS

The wine register of the Republic of Moldova was approved and implemented by HG 292/2017.

According to the GD, the Wine Register is a departmental register and is part of the state registers. The wine register represents a systematized totality of data on wine plots with an area of more than 0.15 ha, on wine units and on the traceability of wine products.

In the Republic of Moldova, in according to the Catalog of Plant Varieties for the 2023 year, are permitted the following clones of the Cabernet Sauvignon variety are grown - R-5, ISV F-5, 07, 15, E-153, 169, 191, 216, 337, 338, 341, 685 (Machidon et al., 2023; Voinesco et al., 2023).

The clone 169 of Cabernet Sauvignon variety, is a French clone. The clone 169 has good berry size, high vigour, and a well-balanced acid to sugar ratio. The wine can be higher in

alcohol content depending on the winemaking technology and style. Clone 169 of Cabernet Sauvignon variety was created to produce a big and bold Cabernet wine with intense complexity. The color is a vibrant, deep red. The mouth feel tends to be bold and linger. This grape is definitely for the adventurous winemakers.

The clone 337 of Cabernet Sauvignon variety is best known as one of the premier French clones. The clone 337 gives good yield, the clusters with small intense berries, and very fruit forward flavors. The wines from the clone 337 create a lush mouthfeel, they have deep color, and intense dark fruit tasty, chocolate, and intense tannins. Smooth, fine-grained tannins coat the palate, where the more opulent character of this clone really comes out, reducing the impression of Cabernet Sauvignon typicity.

The clone 191 of Cabernet Sauvignon variety is best known as one of the premier French clones. The clone 191 gives low level of yield, the clusters with small intense berries. Fertility is low to medium. The vigour of vines is medium. Sugar content in berries is high, but acidity is medium. Potential colour and tannic structure of wines are high.

Table 1. Distribution of areas with Cabernet Sauvignon variety according to administrative districts

No.	District	Vineyard's areas, ha	The share of districts in the total area of the variety, %
1	Anenii Noi	293.67	5.86
2	Basarabasca	116.12	2.32
3	Briceni	0.00	0.00
4	Cahul	859.63	17.14
5	Cantemir	336.62	6.71
6	Călărași	3.63	0.07
7	Căușeni	230.49	4.60
8	Cimișlia	167.84	3.35
9	Criuleni	12.50	0.25
10	Dondușeni	0.00	0.00
11	Drochia	0.00	0.00
12	Dubăsari	0.00	0.00
13	Edineț	0.00	0.00
14	Fălești	0.00	0.00
15	Florești	0.49	0.01
16	Glodeni	0.00	0.00
17	Hîncești	256.41	5.11
18	Ialoveni	43.08	0.86
19	Leova	277.81	5.54
20	Nisporeni	2.78	0.06
21	Oenița	0.00	0.00
22	Orhei	5.54	0.11
23	Rezina	0.00	0.00
24	Rîșcani	0.00	0.00
25	Sîngerei	0.00	0.00
26	Soroca	0.00	0.00

No.	District	Vineyard's areas, ha	The share of districts in the total area of the variety, %
27	Strășeni	54.65	1.09
28	Soldănești	0.00	0.00
29	Ștefan Vodă	716.07	14.28
30	Taraclia	626.75	12.50
31	Telenești	6.42	0.13
32	Ungheni	0.60	0.01
33	UTA Găgăuzia	906.85	18.08
34	Mun. Bălți	0.00	0.00
35	Mun. Chișinău	29.03	0.58
36	Mun. Tiraspol	67.63	1.35
		5014.62	100.00

Source: NBS & NOVW, processed by authors

The Cabernet Sauvignon variety according to the wine register of the Republic of Moldova occupies 100 ha, which are distributed different in the wine regions.

The vineyards area occupied by the Cabernet Sauvignon variety in the Codru grape and wine region is 1154.45 ha, or 23.02%. The largest area of vineyards with the Cabernet Sauvignon variety is the Leova, Hincești, Anenii Noi districts (Table 1, Figure 1).

The area occupied by the Cabernet Sauvignon variety in the Ștefan Vodă grape and wine region is 1014.19 ha or 22.22%. The largest area of vineyards with the Cabernet Sauvignon variety is the Ștefan Vodă, Căușeni districts (Table 1, Figure 1).

The area occupied by the Cabernet Sauvignon variety in the Valul lui Traian grape and wine region is 2845.97 ha or 56.75%. The largest area of vineyards with the Cabernet Sauvignon variety is the Taraclia, Gagauzia, Cahul districts (Table 1, Figure 1).

In the reference years, an increased harvest potential was found in Clone 169 and Clone 337, a lower harvest potential in Clone 191.

Fertility was higher in clone 169 and clone 191 compared to clone 337.

As a result of the statistical processing of the Cabernet Sauvignon harvest data according to the meteorological conditions of the year through the correlation and regression analysis method, the linear regression equations were obtained for each year separately and as a whole (Table 2).

The regression characteristics for the linear regression equations reflected in Table 2 are reflected in Table 3.

The average correlation coefficient of 0.42 proves the existence of a low positive

correlation, with an influence level of 18% and the error value - 0.19 (Table 3).

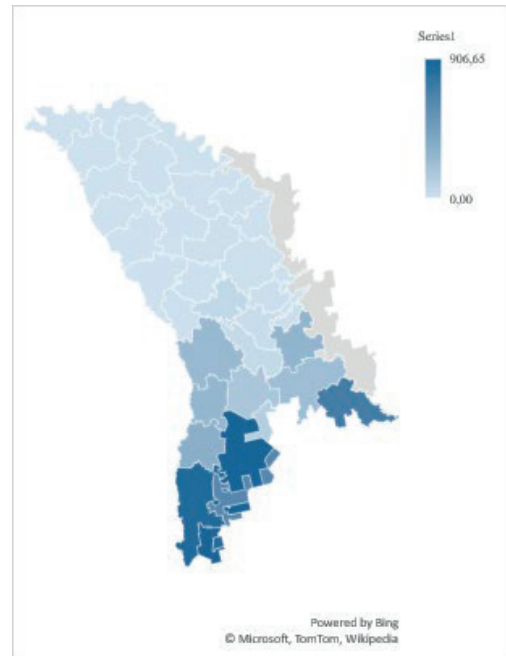


Figure 1. The map of distribution of areas with Cabernet Sauvignon variety according to administrative districts (Source: NBS & NOVW, processed by authors)

Table 2. Linear regression equation ($y = a + bx$) between the sum of active temperatures and the harvest of Cabernet Sauvignon grapes in dependence of year meteorological condition Characteristics of regression analysis

Year	Linear regression equation ($y = a + bx$)
2017	$y = -0.0055 + 1.8198x$
2018	$y = 0.0053 + 1.6925x$
2019	$y = 0.0009 + 1.7371x$
2020	$y = -0.004 + 1.3235x$
2021	$y = -1.3239 + 1.3239x$
2022	$y = -0.0057 + 1.8885x$
average	$y = -0.0022 + 1.6205x$

Source: Processed by authors

The sugar content registered a higher level in clone 169 and clone 191 compared to clone 337. As a result of the statistical processing of the Cabernet Sauvignon sugar content data according to the medium temperature through the correlation and regression analysis method, the linear regression equations were obtained for each year separately and as a whole (Table 3, Figure 2).

Table 3. Characteristics of regression analysis for dependence between the sum of active temperatures and the harvest of Cabernet Sauvignon grapes

Year	Correlation coefficient	Determination coefficient (the square of the correlation coefficient)	Error
	r	$d_{yx}=r^2$	Sr
2017	0.44	0.19	0.19
2018	-0.22	0.0	0.21
2019	0.22	0.05	0.21
2020	0.41	0.18	0.20
2021	0.38	0.18	0.19
2022	0.31	0.17	0.23
average	0.42	0.18	0.19

Source: Processed by authors

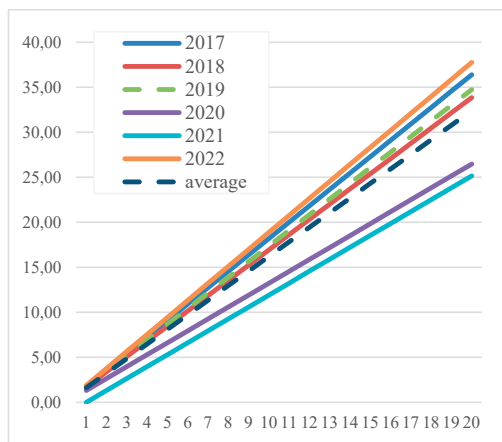


Figure 2. The correlative dependence between the sum of active temperatures and the harvest of Cabernet Sauvignon grapes (Source: Processed by authors)

Table 5. Characteristics of regression analysis for dependence between the medium temperature and the sugar content of Cabernet Sauvignon grapes

Year	Correlation coefficient	Determination coefficient (the square of the correlation coefficient)	Error
	r	$d_{yx}=r^2$	Sr
2017	0.75	0.56	0.14
2018	0.58	0.34	0.17
2019	0.48	0.23	0.19
2020	0.51	0.26	0.18
2021	0.74	0.55	0.14
2022	0.68	0.46	0.15
average	0.73	0.53	0.15

Source: Processed by authors

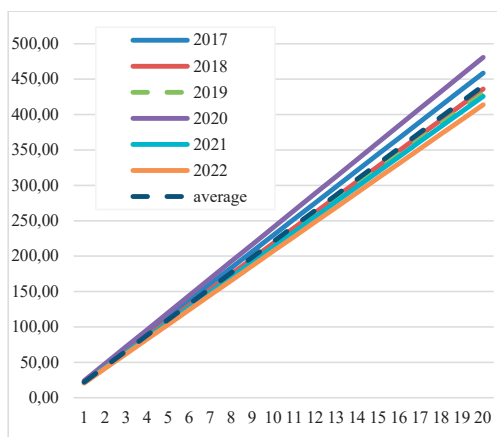


Figure 3. The correlative dependence between the medium temperature and the sugar content of Cabernet Sauvignon grapes (Source: Processed by authors)

The regression characteristics for the linear regression equations reflected in Table 4 are reflected in Table 5.

The average correlation coefficient of 0.73 proves the existence of a high positive correlation, with an influence level of 53% and the error value - 0.15 (Table 5, Figure 3).

Table 4. Linear regression equation ($y = a + bx$) between the medium temperature and the sugar content of Cabernet Sauvignon grapes in dependence of year meteorological condition

Year	Linear regression equation ($y = a + bx$)
2017	$y = -0.0102 + 22.932x$
2018	$y = -0.0022 + 21.805x$
2019	$y = -0.0011 + 21.4964x$
2020	$y = -0.0139 + 24.0404x$
2021	$y = -0.0095 + 21.2859x$
2022	$y = -0.0092 + 20.6946x$
average	$y = -0.0076 + 22.0423x$

Source: Processed by authors

CONCLUSIONS

The Cabernet Sauvignon variety is the most widespread wine variety in the Republic of Moldova.

Most vineyards are established with planting material imported from nurseries in Italy, France, etc.

The largest area of vineyards with the Cabernet Sauvignon variety is the Ștefan Vodă, Căușeni districts (Ștefan Vodă Region); Leova, Hincești, Anenii Noi districts (Codru Region) and Taraclia, Gagauzia, Cahul districts (Valul lui Traian Region)

In the reference years, an increased harvest potential was found in Clone 169 and Clone 337, a lower harvest potential in Clone 191.

Fertility was higher in clone 169 and clone 191 compared to clone 337.

The sugar content registered a higher level in clone 169 and clone 191 compared to clone 337.

The average correlation coefficient of 0.42 proves the existence of a low positive correlation, with an influence level of 18% and the error value – 0.19.

The average correlation coefficient of 0.73 proves the existence of a high positive correlation, with an influence level of 53% and the error value – 0.15.

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(https://www.legis.md/cautare/getResults?doc_id=114402&lang=ro)