

RESEARCH ON THE AGROBIOLOGICAL AND TECHNOLOGICAL VALUE OF SOME OLD ROMANIAN VINE VARIETIES IN THE CONTEXT OF CLIMATE CHANGES IN THE ODOBEȘTI VINEYARD, VRANCEA COUNTY

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Abstract

The issue of returning to the ancestral varieties from the old sortiment specific to Romanian vineyards in the context of global warming and the conservation of biodiversity in wine-growing areas, represents one of the main directions of scientific research. The old Romanian grape varieties are currently preserved in ex situ germplasm collections (ampelographic collections) at the research units in the viticulture field. This paper presents preliminary results regarding the agrobiological and technological characteristics of four old autochthonous grape varieties (Vitis vinifera L.) for white wines ('Galbenă de Odobești', 'Cruciuliță', 'Pârciu' and 'Gordin'), in the climatic conditions of the year 2024 in Odobești vineyard, Vrancea county. In the drought conditions of year 2024, these varieties demonstrated a high fertility potential (63.2-89.6% fertile shoots) and valuable technological characteristics, with a production that varied between 2.26 kg/vine for 'Pârciu' variety and 4.43 kg/vine in 'Cruciulita' variety, under the conditions of a good accumulation of sugars in the berries (>190 g/L) and a balanced total acidity (>5.1 g/L as tartaric acid).

Key words: ancestral varieties, stress factors, agrobiological and technological value.

INTRODUCTION

The practice of intensive viticulture in recent decades has greatly affected the biodiversity of the vine, causing the loss of local varieties and intravarietal variability, a phenomenon known as genetic erosion (OIV-VITI Resolution 677-2022). Worldwide, it is estimated that there are between 6,000 and 7,000 vinifera varieties, of which only a small part are authorized for planting (5-10%), so that currently there is a trend towards standardization of wine production. In the past, each wine-growing region had its own assortment of grape varieties (traditional) that differentiated the wine-growing areas in terms of varietal and the wines obtained. These old varieties are emblematic of each wine-growing area and are an integral part of the vine and cultural history of the respective areas (Dhananjay et al., 2021). The neglect or gradual abandonment of these historical grape varieties, and the emphasis on so-called "international" grape varieties, was mainly due to the susceptibility to disease and low yields exhibited by the native varieties.

In fact, in recent years there has been a global effort to rehabilitate forgotten grape varieties, threatened with extinction, due to the dominance of the great international grape varieties that represent only a small part of the biodiversity of the vine (Mannini, 2004; Volynkin et al., 2019; Fatalivev et al., 2023).

In Spain, for example, after three decades of research, the Ancestral Varieties project is responsible for the rediscovery of almost 50 varieties, six of which could have real oenological potential. The main objective of this initiative is not only to bring back old varieties generations after they were last used, but it is also an exercise in viticultural archaeology to recover our heritage. The advantages of growing these varieties include their ability to better withstand heat, drought and disease (Karoglan Kontić et al., 2009). They also tend to reach maturity either later or earlier and avoid sugar levels rising out of sync with overall phenolic ripening and excessively high alcohol levels (Kallithraka et al., 2005; Makuev, 2022; Faralli et al., 2024). Global warming, as an extreme climatic phenomenon, is also felt in the cultivation of

vines, which leads to the reconsideration of the assortments of cultivated varieties (Jones, 2005; Fraga et al., 2012; Santos et al., 2020).

This is why even for the varieties from the old assortments of Romanian vineyards, that gave the note of originality specific to each vineyard, disappeared from the local wine assortment or less cultivated today ('Cruciuliță', 'Pârciu', 'Gordin', 'Braghină', 'Negru vârtos', 'Plăvaie', 'Mustoasă', 'Berbecel', 'Razachie' etc.), laborious work is required that requires both identification and conservation, but also reevaluation in current ecoclimatic conditions. Thus, it will be necessary to consider redefining zoning works and introducing ancestral varieties that have proven useful over time into the current assortments in Romanian vineyards (Oşlobeanu et al., 1991).

Research on the behavior of ancestral Romanian varieties under climate changes is one of the current topics for viticultural research in our country (Rotaru et al., 2018).

MATERIALS AND METHODS

The research was carried out within the ampelographic Collection of the Research and Development Station for Viticulture and Oenology (RDSVO) Odobeşti, with geographical coordinates 45°45' north latitude, 27°06' east longitude and an altitude of 150 m. The study was carried out in year 2024.

The biological material was represented by four old Romanian grapevine varieties, which were part of the old assortment of the Odobeşti vineyard, Vrancea county: 'Galbenă de Odobeşti', 'Cruciuliță', 'Pârciu' and 'Gordin' (Figure 1). Each genotype was represented in this study by three repetitions with five vines each. The studied cultivars were grafted onto the Kobber 5 BB rootstock. The pruning system practiced was the Dr. Guyot, with a fruit load between 30-36 buds/vine, distributed on strings of 8-9 buds and fruiting cones with 2-3 buds, and a semi-tall management form.

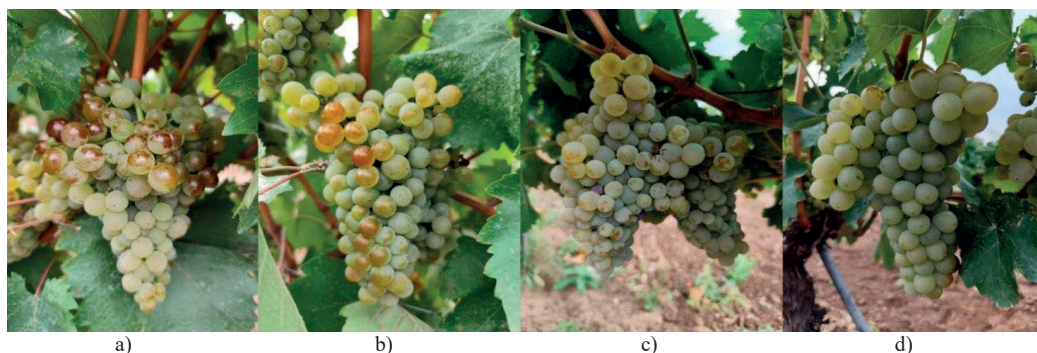


Figure 1. The ancestral vine varieties studied: a) 'Galbenă de Odobeşti'; b) 'Cruciuliță'; c) 'Pârciu'; d) 'Gordin'

To evaluate the agrobiological potential under the conditions of the 2024 wine year, observations and determinations were made regarding: the phenological spectrum, growth vigor through measurements of shoots during the period of intense growth; fertility and productivity elements by calculating the percentage of fertile shoots (FS%), fertility coefficients (relative fertility coefficient - Rfc and absolute fertility coefficient - Afc) and productivity indices (relative productivity index - Rpi and absolute productivity index - Api); behavior to the main vine diseases and stress factors (frost, drought) by scoring from 1 to 9 according to the resistance scale developed by

the OIV (2009). To determine the technological potential, determinations were made regarding the quantity (kg/vine, t/ha) and quality of grape production (g/L sugars using the refractometric method OIV-MA-AS2-02; 2012), g/L as tartaric acid using the potentiometric method), analysis of the physicochemical composition of 100 berries, technological indices of grapes. The results were statistically interpreted using the Student's test (TTEST) in the Microsoft Excel program, for analysis of variance, using the average of the four cultivars as a control.

The climatic data for the study period were provided by the AgroExpert weather station and

the multiannual climatic database of the R.D.S.V.O. Odobești (1946-2023).

RESULTS AND DISCUSSIONS

Climatic conditions. The evolution of the thermal regime and precipitation in the viticultural ecosystem of the Odobești vineyard in the 2024 wine year is presented in Table 1. Global warming, a phenomenon that has strongly characterized the last decades, has considerably influenced the evolution of the annual thermal regime and during the vegetation season. From a thermal and hydrological point of view, the 2024 wine year was considered one of the warmest and driest years in the last decade. The thermal regime of the vegetation period was deeply excessive, the values recorded for the thermal balances - $\Sigma^{\circ}\text{t}$ active; $\Sigma^{\circ}\text{t}$ useful - (3879.7 respectively 2089.7), being clearly superior to the multiannual values (3231.6 respectively 1554.2). The average air

temperature (21.4°C), the average maximum temperatures (27.9°C) and the average minimum temperatures in this period (15.3°C) recorded values much higher than the multiannual data for these elements (18.2°C, 24.6°C, and 12.5°C, respectively). During this period, 71 days with maximum temperatures above 30°C were recorded, of which 24 days with temperatures above 35°C.

In the wine year 2024, the rainfall regime was deeply deficient throughout the vegetation period, except for September, when a surplus of 12.3 mm was recorded. The amount of precipitation recorded in this period (245.8 mm) represents only 63.7% of the multiannual value for this period (385.7 mm), with 6 days with precipitation greater than 10 mm recorded. The relative air humidity recorded a value almost 10 percent lower (54.3%) than the multiannual value (63.7%). The duration of sunshine during this period accumulated 1719.0 hours, higher than the multiannual value (1498.1 hours).

Table 1. The main climatic conditions during the grapevine growing season (SCDVV Odobești, 2024)

Month	Average temperatures (°C)		Average extreme temperatures (°C)		Sum of temperatures useful - $\Sigma^{\circ}\text{tu}$ (°C)		Rainfall sum (mm)		Sunstroke (hours)		Hygrosopicity of air (%)	
	multi-annual	2024	min.	max.	Multi-annual	2024	multi-annual	2024	multi-annual	2024	multi-annual	2024
April	11.1	15.5	10.0	21.6	69.4	172.7	48.4	33.9	188.8	261.5	62.8	55.9
May	16.8	16.6	10.4	22.8	217.6	205.1	72.5	28.8	238.6	269.0	65.4	56.7
June	20.2	24.2	17.5	31.2	313.7	425.3	85.9	50.4	265.3	315.5	64.0	56.9
July	22.2	26.8	20.1	33.5	377.1	520.0	76.8	51.8	301.1	352.0	63.2	47.8
Aug.	21.7	25.4	19.2	32.5	362.8	477.8	58.9	24.0	284.3	316.0	62.0	48.3
Sept.	17.1	19.6	14.7	25.6	213.6	288.8	45.0	57.3	220.0	205.0	66.5	60.2
Average /sum	18.2	21.4	15.3	27.9	1554.2	2089.7	387.5	246.2	1498.1	1719.0	64.0	54.3

Phenological spectrum

The phenological evolution of the four ancestral indigenous varieties was influenced by the specific climatic conditions of the 2024 wine year (Table 2).

Due to the high temperatures recorded in March and April, disbudding was recorded early in the first decade of April, with 10-15 days earlier compared to 2023, between April 2 for the 'Cruciuliță' variety and April 6 for the 'Gordin' variety (Figure 2).

Flowering was recorded in the third decade of May, with 8-12 days earlier than in 2023, between May 24 for the 'Galbenă de Odobești' variety and May 27 for the 'Pârciu' variety (Figure 3).

Grape veraison was recorded in the last decade of July - the first decade of August, with 10 - 15 days earlier compared to 2023, between July 30 for the 'Galbenă de Odobești' variety and August 3 for the 'Gordin' variety.

Due to dry climatic conditions, the full ripening of the grapes was recorded between August 21 for the 'Pârciu' variety and 26 August for the 'Galbenă de Odobești' variety, with 12 to 18 days earlier compared to 2023.

The leaf fall for the four varieties occurred in the last decade of October, thus, under the conditions of the 2024 wine year, the duration of the vegetation period for the studied varieties varied between 198 and 208 days.

Table 2. The phenological spectrum of the ancestral varieties studied (Odobești, 2024)

Ancestral grape variety	Phenological phases					During the vegetation days
	Disbudding	Flowering	Grapes veraison	Technological maturity	Fall leaves	
'Galbenă de Odobești'	3 - 7.IV	22 - 26.V	28.VII - 1.VIII	25 -27.VIII	25 - 29.X	202 - 206
'Cruciuliță'	31.III - 4.IV	23 - 27.V	29.VII - 2.VIII	24 - 26.VIII	23 - 26.X	203 - 206
'Pârciu'	3 - 7.IV	25 - 29.V	30.VII - 2.VIII	20 - 22.VIII	20 - 25.X	198 - 203
'Gordin'	4 - 8.IV	24 - 28.V	1 - 4.VIII	25 -27.VIII	26 - 30.X	203 - 208



Figure 2. 'Galbenă de Odobești' variety - phenological aspects

Fertility and productivity characteristics. The main characteristics of the fertility elements of the old grape varieties studied in the Odobești wine-growing area under the conditions of the 2024 wine year are presented in Table 3.

Under the climatic conditions of 2024, the ancestral grape varieties 'Galbenă de Odobești', 'Cruciuliță', 'Pârciu' and 'Gordin' recorded values of the fertile shoot coefficient and of the relative and absolute fertility coefficients close to the values described by the specialized literature in the Odobești vineyard. The fertile shoot coefficient (FS) varied between 63.2% for the 'Pârciu' variety and 89.1% for the 'Cruciuliță' variety.

The fertility potential of these varieties was also confirmed by the values obtained for the relative and absolute fertility coefficient (Rfc and Afc). The highest values of fertility coefficients (relative and absolute) were recorded for the

'Cruciuliță' variety (Rfc -1.63 and Afc - 1.83). Relative to values for the average weight of the berry clusters, the productivity indices (relative and absolute) recorded higher values for 'Cruciuliță' variety (296.0 respectively 332.3) and 'Gordin' variety (288.8 respectively 321.1) and lower values for the varieties 'Galbenă de Odobești' (227.5 respectively 262.2) and Pârciu (144.7 respectively 229.5).

Table 3. The fertility and productivity characteristics (Odobești, 2024)

Ancestral grape variety	Fertile Shoots (%)	Fertility coefficients		Weight of bunch (g)	Productivity indices	
		Rfc	Afc		Ipr	Ipa
'Galbenă de Odobești'	87.0	1.28	1.47	177.7	227.5	261.2
'Cruciuliță'	89.1	1.63	1.83	181.6	296.0	332.3
'Pârciu'	63.2	0.87	1.38	166.3	144.7	229.5
'Gordin'	89.6	1.52	1.69	190.0	288.8	321.1



Figure 3. 'Cruciuliță' variety - phenological aspects

The growth vigor. To evaluate the vegetative growth of the varieties under study, measurements were periodically (every 7 days) taken on the shoots during the vegetative growth period, respectively after the flowering phenophase until their intensive growth phase (period May 24 - July 1) (Table 4).

Table 4. The growth vigor according to OIV descriptors (Odobești, 2024)

Ancestral grape variety	No. of shoots/vine	Average shoot length (cm)	Shoot growth vigor (OIV 351)
'Galbenă de Odobești'	19.3	110.9	5 (medium)
'Cruciuliță'	18.3	101.2	3-5 (weak-medium)
'Pârciu'	16.3	77.0	3- (weak)
'Gordin'	17.4	90.8	3- (weak)

Due to the dry climatic conditions of the 2024 wine year, the vegetative growth of the four varieties was weak, below the values recorded in the specialized literature. At an average number of shoots per vine ranging between 16.3 for 'Pârciu' variety and 19.3 for 'Galbenă de Odobești' variety, the average shoot length varied between 77.0 cm for 'Pârciu' variety and 110.9 cm for 'Galbenă de Odobești' variety, being classified according to the OIV 351 descriptor as varieties with weak and weak to medium growth.

The biological resistance to the main cryptogamic diseases was established by assessing the grades from 1 to 9 according to the resistance scale developed by O.I.V (International Organisation of Vine and Wine). Under the vegetation conditions of 2024 and the application of six phytosanitary treatments, the four ancestral Romanian varieties showed good (7-9) and very good (9) tolerance to the attack of the main grapevine diseases (Table 5).

Table 5. Behavior to the main grapevine diseases (OIV descriptor list for grape varieties and Vitis species, 2nd edition - 2009), Odobești, 2024

Ancestral grape variety	Downy mildew (<i>Plasmopara viticola</i>)		Powdery mildew (<i>Uncinula necator</i>)		Gray rot (<i>Botrytis cinerea</i>)	
	Leaf OIV 452	Grape OIV 453	Leaf OIV 455	Grape OIV 456	Leaf OIV 458	Grape OIV 459
'Galbenă de Odobești'	7-9	7-9	7-9	7-9	9	9
'Cruciuliță'	9	7-9	7-9	7-9	9	9
'Pârciu'	9	9	9	7-9	9	9
'Gordin'	9	7-9	7-9	9	9	9

Drought resistance (OIV 403). According to the OIV descriptor list for grape varieties and Vitis species, 2nd edition, 2009. Under the conditions of the 2024 growing season, considered based on recorded climatic data, one of the driest years in the Odobești vineyard, the studied ancestral Romanian grapevine varieties did not present specific manifestations of thermal and water stress (withering of the shoot tips, yellowing leaves at the base of the trunk, wilting of grapes etc.), demonstrating high to very high tolerance to the phenomenon of atmospheric and pedological drought (Table 6).

Table 6. Behavior at drought according to OIV descriptors (Odobești, 2024)

Ancestral grape variety	OIV 403	Expression level
'Galbenă de Odobești'	9	Very high
'Cruciuliță'	7-9	High - Very high
'Pârciu'	7-9	High - Very high
'Gordin'	7-9	High - Very high

Quantity and quality of production. The results obtained regarding the technological potential of the four old Romanian varieties in the wine year 2024 revealed that the level of climatic factors existing in the ecosystem, but also the genetic factor, influenced the values of the elements that define the potential and actual productivity, grape production, but especially its quality (Table 7). Under the conditions of the 2024 wine year, the average grape mass recorded values lower than those recorded in the specialized literature for these varieties in the Odobești vineyard, ranging between 166.3 g for 'Pârciu' variety and 190.0 g for 'Gordin' variety (Figures 4 and 5).

Determined by the average weight of the grape and the number of grapes per vine, the grape production per vine varied between 2.26 kg for 'Pârciu' variety and 4.43 kg for 'Cruciuliță' variety, resulting in an average production calculated per hectare ranging between 8.560 kg for 'Pârciu' variety and 16.770 kg for 'Cruciuliță' variety, productions lower than those recorded in the specialized literature for these varieties. The dry climate recorded in the Odobești wine-growing area during grape ripening influenced the accumulation of sugars in the berries, the values recorded being higher than those specified in the specialized literature

(Constantinescu et al., 1959; 1962) for the varieties studied, these being between 190 g/L for 'Gordin' variety and 219 g/L for 'Pârciu'

variety, with intermediate values for 'Cruciuliță' variety (202 g/L), and 'Galbenă de Odobești' variety (210 g/L).

Table 7. The quantitative and qualitative characteristics of the grapes (Odobești, 2024)

Ancestral grape variety	No. grapes/vine	Weight of bunch (g)	Grape production		Sugar content of the must (g/L)	Total acidity (g/L tartaric acid)	Gluco-acidometric index
			kg/vine	kg/ha			
'Galbenă de Odobești'	20.2	177.7	3.59	13.590	210	5.26	39.9
'Cruciuliță'	24.4	181.6	4.43	16.770	202	5.62	35.9
'Pârciu'	13.6	166.3	2.26	85.600	219	4.16	52.6
'Gordin'	22.4	190.0	4.26	16.130	190	5.10	37.3
Average - control	20.1	178.9	3.64	13.762	205.3	5.04	41.4



Figure 4. 'Pârciu' variety - phenological aspects

In contrast, for the total acidity of the must, lower values were recorded compared to those specified in the specialized literature for these varieties, this being between 4.16 g/L tartaric acid for 'Pârciu' variety and 5.62 g/L tartaric acid for 'Cruciuliță' variety, with intermediate values for 'Galbenă de Odobești' variety (5.26 g/L

tartaric acid) and 'Gordin' variety (5.10 g/L tartaric acid). The values recorded for the sugar content and total acidity of the must determined higher values of the glucoacidimetric index, whose ranging between 35.9 for 'Cruciuliță' variety and 52.6 for 'Pârciu' variety.



Figure 5. 'Gordin' variety - phenological aspects

The statistical interpretation of the experimental data obtained for the main technological characteristics of the studied varieties compared to the average values - control, was performed by applying the Student test in Microsoft Excel (TTEST).

Regarding grape production/vine, the P probability values obtained through the Student test show that 'Pârciu' (P = 0.002211) and 'Cruciuliță' (P = 0.042744) varieties present

statistical differences compared to the control variant - the average (Table 8).

And the P probability values obtained through the Student test for the acidity indicator show that the varieties 'Pârciu' (P = 0.001505) and 'Cruciuliță' (P = 0.010836) present statistical differences compared to the control variant - the average.

Table 8. Student's t-test probability value (P) for establishing statistical difference from control

Ancestral grape variety	Student's t-test probability value (P) P critical <0.05		
	Grape production	Sugar content of the must	Total acidity
'Galbenă de Odobești'	0.887285	0.560830	0.185383
'Cruciuliță'	0.042744	0.709985	0.010836
'Pârciu'	0.002756	0.061367	0.001505
'Gordin'	0.061057	0.066501	0.441804

The 'Pârciu' variety shows significant negative statistical differences, and the 'Cruciuliță' variety shows positive statistical differences. The P probability values obtained through the Student test for the sugar content in the juice show that the studied varieties do not present statistical differences compared to the control variant - the average ($P > P_{critic}$).

Table 9. Analysis of the physicochemical composition of 100 berrys (Odobești, 2024)

Ancestral grape variety	Weight (g)	Volume (cm ³)	No. of seeds	Seeds weight (g)	Skin weight (g)	Flesh weight (g)
'Galbenă de Odobești'	172	162	151	5.76	11.45	154.89
'Cruciuliță'	126	115	214	5.27	6.51	114.22
'Pârciu'	137	120	165	4.94	10.73	121.33
'Gordin'	154	145	174	6.56	5.13	142.31

The analysis of the values obtained for the main technological indices shows that, with the exception of 'Galbenă de Odobești' variety, the grape structure index recorded values below 30, indicating that the grapes are not well formed, with a low yield in normally developed berries (Table 10).

Table 10. Technological indices of grapes at harvest (Odobești, 2024)

Ancestral grape variety	Grape composition index	Berrys index	Berry composition index	Yield index
'Galbenă de Odobești'	31.9	55.1	9.1	4.4
'Cruciuliță'	21.4	80.3	9.7	4.2
'Pârciu'	26.7	66.7	7.7	3.2
'Gordin'	27.8	62.8	12.2	3.5

The values obtain for the berry composition index (55.1-80.3), highlight the fact that the studied varieties have reached the specific parameters of the production direction in which

Analysis of the physicochemical composition of 100 berrys. The average weight of 100 berrys recorded values that varied between 126 g for 'Cruciuliță' variety and 172 g for 'Galbenă de Odobești' variety, with intermediate values for 'Pârciu' (137 g) and 'Gordin' (154 g) varieties, lower by 25 to 31% compared to the values specified in the specialized literature (Table 9). Of the average weight of 100 berrys, the weight of the flesh represented between 88.3% for 'Pârciu' variety and 92.2% for 'Gordin' variety, and the weight of the skin represented between 3.3% for 'Gordin' variety and 8.0% for 'Pârciu' variety. The number of seeds contained in 100 berrys varied between 151 in 'Galbenă de Odobești' variety and 214 in 'Cruciuliță' variety, and the average seed weight recorded values between 4.94 g in 'Pârciu' variety and 6.56 g in 'Gordin' variety.

they fall, and the yield index presented values specific to wine grape.

CONCLUSIONS

From a climatic point of view, the 2024 wine year in the Odobești vineyard was an extremely dry one with a profoundly excessive thermal regime and a deficient precipitation regime, accumulated over the last 5-6 years.

In the conditions of the 2024 wine year, the ancestral romanian varieties 'Gordin', 'Cruciuliță' and 'Galbenă de Odobești' showed high fertility (over 85%), and 'Pârciu' variety showed medium fertility (63%), confirming the data from the specialized literature.

Under the conditions of the 2024 wine year, the average grape mass recorded values lower than those recorded in the specialized literature for these varieties in the Odobești vineyard, ranging between 166.3 g for 'Pârciu' variety and 190.0 g for 'Gordin' variety.

The production of grapes per vine varied between 2.26 kg for 'Pârciu' variety and 4.43 kg for 'Cruciuliță' variety, lower values compared to those specified in the R.S.R. Ampelography for these varieties.

The dry climate recorded in the Odobești wine-growing area during grape ripening determined the accumulation of higher amounts of sugars in the berries (190-219 g/L) in conditions of decreased values for the total acidity of the must (4.16-5.62 g/L tartaric) compared to data in the literature.

The statistical interpretation of the experimental data for the main technological characteristics of the studied varieties compared to the average values - control, shows statistical differences for grape production and total acidity in the must in the case of 'Cruciuliță' and 'Pîrciu' varieties.

The average weight of 100 berries recorded values lower by 25 to 31% compared to the values specified in the Ampelography of R.S.R., of which the pulp weight represented between 88.3-92.2%, the skin mass between 3.3-8.0%, and the seed mass between 3.7- 4.5%.

Taking into account the extremely dry climatic conditions in the Odobești wine-growing area, it is necessary to continue research on the evaluation of the agrobiological and technological potential of these ancestral Romanian varieties, in order to obtain conclusive data on their agrobiological and technological value in order to capitalize on them in the context of climate change.

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