EVALUATION OF THE TECHNOLOGICAL POTENTIAL OF SOME OLD AUTOCHTHONOUS GRAPEVINE VARIETIES (*VITIS VINIFERA* L.) IN THE CURRENT CLIMATE CONDITIONS OF NORTHEASTERN ROMANIA

EVALUAREA POTENTIALULUI TEHNOLOGIC AL UNOR SOIURI AUTOHTONE VECHI DE VITA DE VIE (*VITIS VINIFERA* L.) ÎN CONDIŢIILE CLIMATICE ACTUALE DIN NORD-ESTUL ROMANIEI

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Abstract.

Old Romanian grapevine varieties are currently preserved in ampelographic collections or planted on very small areas. In the context of recent climate changes, technological characteristics of three old Romanian grapevine varieties (Vitis vinifera L.) for white wines (Rară Albă, Alb Românesc and Plăvaie) were evaluated in the climatic conditions of the northeastern Romania (Copou-Iasi wine-growing center) in two consecutive years (2023-2024). Ripening the grapes in the second part of September, the analyzed varieties produced medium - large grapes (140-220 g), leading to high yields (>19 t/ha), with good sugar accumulations (>185 g/L) and a balanced total acidity (>4.5 g/L as tartaric acid). Analyzed in relation to the current climate conditions, autochthonous varieties showed superior technological characteristics indicating their potential use of for the production of quality white wines in the northeastern area of Romania, also, providing important genetic material for future breeding programs.

Key words: climate change, grape yield, Romanian varieties, technological indices, white wine.

Rezumat.

Soiurile vechi de viță de vie românești sunt menținute în prezent în colecții ampelografice sau se regăsesc plantate pe suprafețe restrânse. În contextul schimbărilor climatice actuale, caracteristicile tehnologice a trei soiuri vechi românești de viță de vie (Vitis vinifera L.) pentru vinuri albe (Rară Albă, Alb Românesc și Plăvaie) au fost evaluate în condițiile climatice din nord-estul României (centrul viticol Copou-Iași), în doi ani consecutivi (2023-2024). Maturarea strugurilor a avut loc în a doua jumătate a lunii septembrie, soiurile analizate producând struguri mijlocii - mari (140-220 g), fiind obținute producții ridicate (>19 t/ha),

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cu acumulări bune de zaharuri (>185 g/L) și aciditate echilibrată (>4,5 g/L acid tartric). Analizate în raport cu condițiile climatice actuale, soiurile autohtone au prezentat caracteristici tehnologice superioare, care au indicat posibilitatea utilizării acestora pentru producerea de vinuri albe de calitate în zona de nord-est a României, de asemenea, oferind un material genetic valoros pentru viitoarele programe de ameliorare a viței de vie.

Cuvinte cheie: indici tehnologici, productivitate, schimbări climatice, soiuri românești, vinuri albe.

INTRODUCTION

Although initially cultivated on small areas, nowadays grapevine occupies a global surface area estimated to 7.2 mha, mainly in the temperate climate of the northern hemisphere [OIV, 2024]. Currently, Romania is one of the world's largest wine producers (4.4 mhL) and fifth-largest among European wine-producing countries [OIV, 2024]. In Romania, there are still growing varieties that date back to the Roman era, when Dacia was populated by Roman colonists who brought new varieties of grapevine, as well as new cultivation procedures and winemaking methods [Puşcă, 2006]. As the number of varieties increased, were selected and multiplied only those that met certain quality and yield conditions. Thus, some varieties disappeared or remained planted only in small areas, requiring a specific temperature regime to reach their biological potential and grape maturity.

Climate change is currently the greatest threat to the viticultural environment, but fortunately, various grapevine varieties managed to adapt to different climate conditions. As proof, today grapevine grows on six out of seven continents [Santos *et al*., 2020]. Recent studies revealed for the Copou-Iasi wine-growing area a significant increase in the average air temperature in the last 50 years, more pronounced in the last 10 years [Filimon *et al*., 2024]. In the last decade, days with extreme temperatures (>30 °C) have increased more than 3.5 times compared to the multiannual average. The rise in air temperature over the past 40 years has been strongly linked to earlier grape ripening and harvest dates for V. vinifera L. white cultivars. This study aims to assess the adaptation of older V. vinifera varieties to the changing climate in northeastern Romania, contributing to global efforts to mitigate the effects of climate change on grapevine cultivation and ensure sustainable vineyard management.

MATERIAL AND METHOD

The study has been carried out on three *Vitis vinifera* L. Romanian varieties for white wines: Rară albă, Alb românesc and Plăvaie, during the 2023 and 2024 growing seasons (Table 1). All varieties are growing in the Ampelographic collection of the Research and Development Station for Viticulture and Winemaking Iasi, Romania; Iasi vineyard, Copou-Iasi wine-growing center, NE of Romania (47°10’ N; 27°35’ E).

Table 1

Origin and pedigree of the studied autochthonous *V. vinifera* L. grapevine cultivars

Variety	Rară Albă	Alb Românesc	Plăvaie
VIVC no.*	9916	3267	9553
Pedigree	Schiras Dr. Houdbine × Chasselas Blanc	Unknown	Beala Debela × Iordan
Grape aspect			

*VIVC: Vitis International Variety Catalogue (www.vivc.de)

Grapevines were 30 years old, with planting distances of 2.2 m between rows and 1.2 m between plants (cca. 3700 plants/ha), grafted on the hybrid rootstock Kober 5 BB. Meteorological data were collected daily by means of a weather station located in the experimental plot, using an AgroExpert® software. Actual heliothermal index (IHr), hidrothermal coefficient (HC), bioclimatic index (Ibcv) and oenoclimate aptitude index (IAOe) were calculated according to the formulas presented by Zaldea *et al*. (2021). Total acidity (g/L as tartaric acid) and soluble solids (°Bx) were determined according to the OIV's Compendium of international methods (OIV, 2019). Gravimetric analyses were conducted using an EW-600 technical balance (Kern, Germany). The assessed technological indices were: grape composition index (berry weight/bunch weight ratio), berries index (number of berries in 100 g of grapes), berry composition index (pulp weight/skin weight + seed weight), yield index (grape must weight/skin weight + seed weight) and glucoacidimetric index (sugar/total acidity ratio). Relative productivity index (no. of grapes/total no. of shoots × medium grape weight) and absolute productivity index (no. of grapes/no. of fertile shoots × medium grape weight) were calculated. Phenological stages were evaluated according to the methodology proposed by Eichhorn and Lorenz (1977). The results were presented as a two-years average data (2023 and 2024), with standard deviation.

RESULTS AND DISCUSSIONS

The climate of the Copou-Iasi wine growing center is temperate continental, with large contrasts between seasons. In the two years of study, the average air temperature of the growing season was higher by about 1.5 to 3 °C compared to the multiannual average (Table 2). The sum of the active temperatures was up to 600 °C higher compared to the multiannual averages, indicating important changes in the thermal regime of the vineyard and higher favorability for varieties with longer vegetation period (increase bioactive period).

Table 2

The values of the main bioclimatic indices during the growing season (april-september) in the Copou-Iaşi wine-growing center (2023-2024)

Climatic elements	2023	2024	Multiannual average (1980-2010)
Average air temperature (°C)	18.7	20.35	17.20
The sum of positive temperatures (Σt°g; °C)	3427.0	3725.8	3168.4
The sum of active temperatures (Σt°a; °C)	3273.5	3669.7	3048.9
The sum of effective temperatures (Σt°u; °C)	1673.5	1909.7	1386.0
Average temperature of: July (°C)	23.0	25.0	21.0
August (°C)	24.6	24.4	20.3
September (°C)	19.9	19.1	15.6
Rainfall during vegetation period (mm)	349.3	400.2	398.1
No. of days with temperatures > 30°C	43	56	17.3
Length of bioactive period (days)	180	176	169.0
Actual heliothermal index (IHr)	2.43	2.88	2.0
Hidrothermal coefficient (HC)	1.07	1.09	1.3
Grapevine bioclimatic index (Ibcv)	8.30	7.86	7.1
Oenoclimate aptitude index (IAOe)	4592.0	5027.5	4106.1

Note: Σt°a - the sum of growing season average temperatures >10°C; Σt°u - the sum of differences between average daily temperatures >10°C and grapevine biological threshold (10 °C); HC = growing season precipitations / (the sum of active temperatures × 10); IHr = hours of real insolation in the growing season × Σt°u x 10^6; Ibcv = (real insolation × Σt°a)/ growing season precipitations × the number of days in the growing season with temperatures >10°C)/10; IAOe = real insolation + Σt°a – (average precipitations – 250).

Ibcv, recommended for the temperate climate, registered an upward trend, from 7.0 (1980-2010) to 8.3 (in 2023), indicating an increase in the humidity deficit, and, at the same time, an abundance of heliothermic resources in the vineyard. Also, the IHr and IAOe values revealed the possibility of producing quality red wines in the Copou-Iasi wine growing center. Moreover, in both years of study, the number of days with temperature >30 °C in the growing season was over 2.5-fold higher compared to the multiannual value. Under these conditions, the bud burst of the analysed varieties was initiated in the mid-April 2023 and earlier in 2024, under the influence of a higher sum of effective temperatures (Table 2).

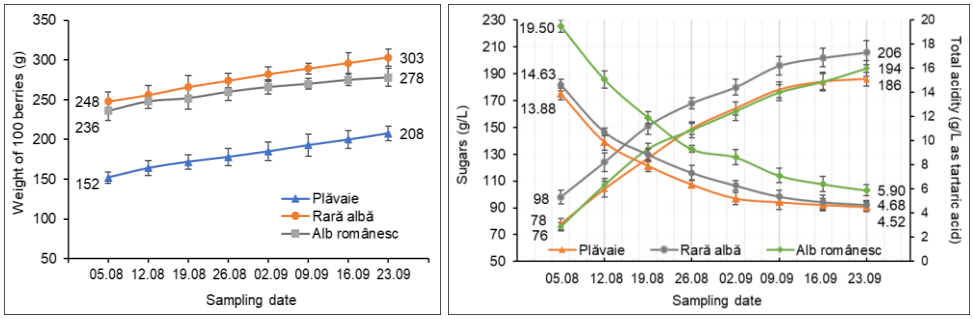
Table 2

The phenological spectrum of the autochthonous grapevine varieties

Variety / Year		Bud burst		Flowering		Veraison		Grape maturity	
		Date	Σt°u (°C)	Date	Σt°u (°C)	Date	Σt°u (°C)	Date	Σt°u (°C)
Plăvaie	2023	22.04	6.0	07.06	273.0	11.08	786.6	04.10	630.9
	2024	05.04	26.9	28.05	295.3	01.08	880.8	23.09	647.9
Rară albă	2023	25.04	13.3	08.06	276.6	08.08	745.1	02.10	650.3
	2024	07.04	34.9	28.05	287.3	29.07	844.2	25.09	705.9
Alb Românesc	2023	25.04	13.3	08.06	276.6	13.08	798.1	07.10	624.6
	2024	05.04	26.9	31.05	317.4	02.08	874.3	26.09	664.1

Note: Σt°u - the sum of temperatures >10°C.

In order to establish the optimal time to harvest, the evolution of the weight of 100 berries (Fig. 1 a), as well as the accumulation of sugars in parallel with the decreasing of total acidity (Fig. 1 b) was studied during the grapes maturation.



(a) (b)

Fig. 1. Grape ripening dynamics of the autochthonous grapevine varieties – weight of 100 berries (a) and sugars vs. total acidity (b)

Thus, at grape maturity, the Rară albă variety, together with the Alb românesc cv., showed the highest weight of 100 berries (>270 g) and the highest concentration of sugars in the must (>190 g/L). Total acidity remained balanced, with lower values in the grapes of the Rară albă and Plăvaie varieties (Table 3).

Table 3

The chemical composition of the grape must at harvest

Variety	Total sugars (g/L)	Total acidity (g/L tartaric acid)	pH	Sugar/acidity ratio	Alcoholic potential (% vol.)
Plăvaie	186±14	4.68±0.42	3.54±0.09	39.74	10.90±0.82
Rară albă	206±11	4.52±0.36	3.68±0.06	45.57	12.10±0.64
Alb românesc	194±6	5.90±0.45	3.32±0.04	32.88	11.40±0.35

Note: Values are presented as the mean of two years data with standard deviation (±).

The Alb românesc variety presented the highest weight of a grape (>230 g), in parallel with a smaller number of grapes per plant, ensuring, similar to Plăvaie variety, a high calculated yield per hectare (>24 t/ha) (Table 4).

Table 4

The production elements of the varieties studied

Variety	Average grape weight (g)	Productivity indices		No. of grapes per plant	Actual yield (kg/plant)	Calculated yield (t/ha)
		RPI	API			
Plăvaie	142±12	139	169	45±4	6.39±1.12	24.10
Rară Albă	178±21	146	221	29±6	5.16±0.96	19.50
Alb Românesc	234±34	218	288	28±7	6.55±1.26	24.84

Note: RPI - relative productivity index; API - absolute productivity index.

The berries of the Alb românesc and Plăvaie varieties had a thicker skin (6.8 % of the berry structure) (Table 5). The Rară albă variety showed the highest value of the composition index (15), closer to those of table grape varieties.

Table 5

Technological indices of grapes at harvest

Variety	Grape composition index	Berries index	Berry composition index	Berry structure			Grape yield index
				Skin (%)	Seeds (%)	Pulp (%)	
Plăvaie	12.78±1.02	49±3	9.04±0.96	6.73	3.22	90.05	3.54
Rară albă	14.61±1.21	32±2	15.03±1.04	4.95	1.29	93.76	3.16
Alb românesc	14.56±1.42	36±4	9.10±0.90	6.83	3.06	90.11	2.62

Note: Values are presented as the mean of two years data with standard deviation (±).

CONCLUSIONS

In relation to the current climatic conditions of the NE Romania, the studied old autochthonous *V. vinifera* L. varieties matured their white medium - large grapes in the second part of September, ensuring high grape yields (>19 t/ha), a good sugar accumulation and a balanced total acidity. Obtained values of the main technological indices indicate the potential use of these old varieties for the production of quality white wines in the Copou-Iaşi wine-growing center, especially of the Rară albă variety, also, providing important genetic material for future breeding programs.

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