EVALUATION OF THE IMPACT OF MAJOR CLIMATIC FACTORS ON THE AGROBIOLOGICAL AND TECHNOLOGICAL POTENTIAL OF TABLE GRAPE VARIETIES CULTIVATED IN THE COPOU IAȘI VITICULTURAL CENTER

EVALUAREA INFLUENȚEI PRINCIPALILOR FACTORI CLIMATICI ASUPRA POTENȚIALULUI AGROBIOLOGIC ȘI TEHNOLOGIC AL SOIURILOR PENTRU STRUGURI DE MASĂ CULTIVATE ÎN CENTRUL VITICOL COPOU IAȘI

NECHITA Ancuța[1], ZALDEA Gabi[1]*, ALEXANDRU Lulu Cătălin[1], FILIMON Roxana[1], FILIMON Răzvan[1],

*Corresponding author e-mail: gabizaldea@yahoo.com

Abstract.
The varied climatic conditions during the period 2015–2024 enabled the analysis of the performance of several table grape genotypes representative of the Iași vineyard, with regard to the cumulative effect of environmental stress factors on their agrobiological and technological traits. Under the influence of climatic factors whose levels have been altered by global warming, the studied varieties and clones (Gelu, Paula, Mara, Victoria, and Chasselas doré 20 Is) exhibited different responses, with their agrobiological and technological characteristics being affected both quantitatively and qualitatively. From the perspective of technological potential achieved in years with different climatic conditions (dry, normal, and rainy years), the results confirmed both the productive capacity and the climatic suitability of the Copou Iași viticultural center for the cultivation of table grape varieties.
Keywords: table grapes, variety, climatic suitability

Rezumat.
Condiţiile climatice variate din perioada 2015 - 2024, au permis analiza modului de comportare a unor genotipuri pentru struguri de masă, reprezentative pentru podgoria Iași, cu privire la efectul cumulativ al factorilor de mediu stresanţi, asupra însuşirilor agrobiologice şi tehnologice a acestora. Sub acţiunea factorilor climatici a căror nivel s-a modificat datorită încălzirii globale, soiurile și clonele studiate (Gelu, Paula, Mara, Victoria și Chasselas dore 20 Is) au reacționat diferit, însușirile agrobiologice și tehnologice fiind influențate atât cantitativ cât și calitativ. Din punct de vedere al potențialului tehnologic realizat în anii cu condiții climatice diferite (ani secetoși, normali și ploioși), rezultatele obținute au confirmat capacitatea productivă și favorabilitatea climatică a centrului viticol Copou Iași pentru cultivarea soiurilor pentru struguri

[1] Viticulture and Oenology Research and Development Station in Iasi, Romania

de masă.

Cuvinte cheie: struguri de masă, sortiment, favorabilitate climatică

INTRODUCTION

Table grape varieties have high requirements with respect to climatic factors, and their successful cultivation depends on identifying the most favorable ecological conditions capable of meeting their biological needs and highlighting their productive potential and economic efficiency [Olteanu *et. al*, 2002; Noa and Yishai, 2025].

In Romania, the effects of climate change have become increasingly evident over recent decades, through the growing incidence of late spring frosts and droughts, which exert a negative impact on vineyards by reducing both the qualitative and quantitative parameters of grape production. In this context, the continuous updating of knowledge regarding the climatic suitability of viticultural areas for table grape cultivation is essential [Damian *et al.*, 2022].

The cultivation of table grape varieties well adapted to the ecopedoclimatic conditions of a specific viticultural area represents a key factor in ensuring the sustainability of viticulture. The complex interactions between climatic factors and the genetic characteristics of the varieties determine grape quality [Bai *et al.*, 2022; Gashu *et al.*, 2020].

This study evaluates the influence of the main climatic factors recorded over the last ten years on the agrobiological and technological potential of representative table grape varieties cultivated in the Copou Iași viticultural center.

MATERIAL AND METHOD

The diverse climatic conditions recorded between 2015 and 2024 enabled the assessment of the performance of table grape genotypes (*Gelu*, *Paula*, *Mara*, *Victoria*, and *Chasselas doré* 20 Is), representative of the Iași vineyard, in relation to the cumulative effects of major climatic factors on their agrobiological and technological characteristics.

The ecological suitability of the Copou Iași Viticultural Center for table grape cultivation was determined using the evaluation system proposed by Irimia and Rotaru [2009], which considers the main ecological limiting factors for viticulture: mean annual temperature, mean July temperature, useful thermal balance, actual sunshine duration, total precipitation during the vegetation period, bioactive period duration, real heliothermal index, viticultural bioclimatic index, and oenoclimatic suitability index.

The study focused on assessing the agrobiological and technological potential through detailed observations and measurements of vegetation phenophases, fertility, productivity, growth vigor, and the quantitative and qualitative parameters of grape yield.

RESULTS AND DISCUSSIONS

The suitability classes of viticultural areas are determined based on the

influence of climatic factors on the accumulation of sugars, anthocyanins, aromatic compounds, and organic acids in grapes.

The values of the thermal regime and synthetic climatic indices (IHr, Ibcv, IAOe) recorded during the period 2015–2024 classify the Copou Iași Viticultural Center as belonging to suitability class I (very suitable), indicating an abundance of these resources and confirming the potential for cultivating table grape varieties (Table 1).

Table 1

Favorability classes and rating scores for the representative ecoclimatic factors in the viticultural area of the Iași vineyard [according to Irimia and Rotaru, 2009]

Ecoclimatic Factors	Average years 2015 - 2024	Favorability class	Climate rating
Mean annual temperature (°C)	11.4	I	10
Mean temperature in July (°C)	22.9	I	10
Useful thermal sum (Σt°u)	1642.2	I	10
Σ sunshine during the vegetation period (h)	1476.4	II	8
Σ precipitation during the vegetation period (mm)	333.6	I	10
Duration of the bioactive period (days	171	III	5
Real heliothermal index (IHr)	2.4	I	10
Bioclimatic index (Ibcv)	9.1	I	10
Oenoclimatic suitability index (IAOe)	4707.0	I	10

Based on the amount of precipitation recorded during the vegetation period, the studied area was also assigned to suitability class I with moderate values (250 – 390 mm), which allow for normal physiological processes and the production of high-quality grapes. Suitability class II was determined by the total number of actual sunshine hours, while class III was defined by the mean values of the bioactive period. During the period 2015–2024, the average annual temperature was 11.4°C, with an amplitude of 2.5°C determined by the difference between the maximum value of 12.6°C recorded in 2024 and the minimum value of 10.1°C recorded in 2021 (Figure 1)

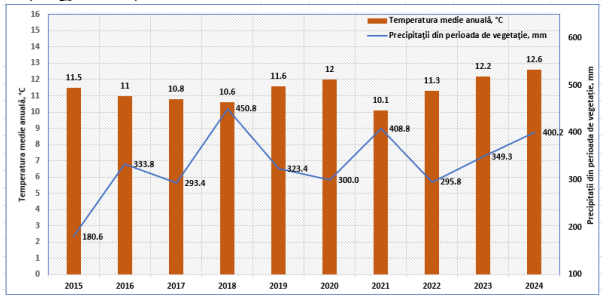

Fig. 1. Evolution of climatic factors recorded in the Copou Iași viticultural center

In the Copou Iași viticultural center, the multiannual average (1991 - 2020) of precipitation during the vegetation period (April - September) is 384.3 mm. In recent years, there has been a decline in precipitation levels and an increase in the frequency of drought years. The lowest amount of precipitation during the

vegetation period was recorded in 2015, with only 180.6 mm.

The observations conducted regarding the progression of the vegetation phenophases exhibited by the studied genotypes, in direct relation to climatic factors, highlight that these were conditioned by both the level and the action of climatic variables, as well as by the hereditary specificity of the cultivars.

During the study period, budburst occurred starting from the first decade of April (Table 2). The onset of flowering in the analyzed cultivars took place between the last decade of May and the last decade of June. Furthermore, it was observed that within the same cultivar, the flowering period may last between 6 and 12 days.

Table 2

The progression of vegetation phenophases in the Iași vineyard (2015 – 2024)

Variety name	Budburst	Flowering	Veraison	Ripening
Gelu	03.IV – 29.IV	26.V – 22.VI	09.VII – 06.VIII	15.VIII – 14.IX
Paula	05.IV – 29.IV	24.V – 19.VI	04.VII – 31.VII	10.VIII – 08.IX
Mara	05.IV – 28.IV	23.V – 18.VI	03.VIII – 20.VIII	12.IX – 08.X
Chasselas doré 20 Is	08.IV – 29.IV	26.V – 21.VI	24.VII – 14.VIII	12.IX – 30.IX
Victoria	09.IV – 29.IV	26.V – 22.VI	12.VII – 05.VIII	03.IX – 23.IX
Average years 2015 - 2024	**03.IV – 29.IV**	**23.V – 22.VI**	**03.VII – 20.VIII**	**10.VIII – 08.X**

Grape veraison occurred between July 3 and August 20, lasting between 5 and 19 days, depending on the cultivar and the year. In dry years, veraison began earlier—during the first ten days of July—and proceeded over a shorter period, whereas in wetter years it began in the first ten days of August. Stage of consumer maturity coincided with the harvest date and occurred in August for cultivars belonging to epochs II and III, and in September for those belonging to epochs IV and V. First grapes to reach consumer maturity were those of *Paula* cultivar, beginning on August 10th, followed approximately one week later by *Gelu* cultivar.

In order to assess the fruiting capacity of the cultivars, observations and measurements were conducted for each genotype regarding the total number of shoots per vine, the number of fertile shoots per vine, the number of inflorescences per vine, fertility expressed as the percentage of fertile shoots, as well as the absolute and relative fertility coefficients (Table 3).

Table 3

Average values of fertility and productivity elements (2015–2024)

Variety name	No. total shoots/ vine	No. fertile shoots/ vine	Fertile shoots %	No. inflores-cences	Fertility coefficient		Productivity indeces	
					relative	absolut	relative	absolut
Gelu	31	18	61	23	0.78	1.26	232	371
Paula	35	24	68	28	0.80	1.16	258	377
Mara	30	28	95	43	1.45	1.53	296	313
Chasselas doré 20 Is	44	35	79	46	1.04	1.33	158	200
Victoria	35	23	67	27	0.78	1.20	350	535

The total number of shoots per vine varied among cultivars, reflecting both their inherent biological characteristics and growth vigor. The proportion of fertile shoots exceeded that of sterile ones, indicating that all analyzed cultivars assimilated the ecological conditions of the ecosystem favorably.

The average number of inflorescences per vine differed from one cultivar to another, influenced by their genetic traits and the fruiting load left after pruning. The Mara cultivar and the Chasselas doré 20 Is clone stand out through a high number of inflorescences, indicating a superior production potential, with an average of 43 and 46 inflorescences per vine, respectively. The values of the fertility indicators, namely the absolute and relative fertility coefficients, varied among genotypes and were largely influenced by pedoclimatic factors and the quality of the applied agrotechnical practices. In general, the values of the absolute fertility coefficient were greater than one for all genotypes, ranging from 1.16 in the cultivar *Paula* to 1.53 in the cultivar *Mara.* The absolute and relative productivity indices also showed variation among genotypes, generally exhibiting higher values in the *Victoria* cultivar, a result attributable to its greater bunch weight. The growth vigor of table grape cultivars, evaluated based on the quantity of wood removed during pruning and the elongation of shoots, was influenced by climatic conditions, the crop load retained after pruning, and the hereditary characteristics specific to each cultivar (Table 4).

Table 4

The growth vigor of table grape cultivars grown in the Copou Iași viticultural center (average for the years 2015–2024)

Variety name	Total wood, kg/vine	Total wood, t/ha	Total shoot length per vine, m	Average shoot length per vine, cm
Gelu	0.665	2.517	37.7	128.1
Paula	0.608	2.303	43.3	124.4
Mara	0.408	1.546	29.9	100.6
Chasselas doré 20 Is	0.561	2.126	49.7	111.6
Victoria	0.645	2.441	44.0	120.4

Under identical ecoclimatic and agrotechnical conditions, the assessments indicated that the largest amounts of pruned wood were recorded in the highly vigorous cultivars *Gelu* (0.665 kg/vine) and *Victoria* (0.645 kg/vine), as well as in the moderately to highly vigorous cultivar *Paula* (0.608 kg/vine). The biometric measurements of the main shoots, taken at the onset of veraison when their intensive growth had ceased, confirmed the higher growth vigor of the *Gelu* variety, with an average main shoot length of 128.1 cm, followed by the *Paula* and *Victoria* varieties, with average lengths of 124.4 cm and 120.4 cm, respectively.

The assessment of technological characteristics indicated a good level of productivity in most of the genotypes examined, with yields reaching or exceeding their biological potential, depending on the climatic conditions of the viticultural year (Table 5). The average number of grape bunches per vine ranged from 15 bunches/vine for the *Victoria* cultivar to 29 bunches/vine for Mara. In terms of

bunch size, *Victoria* ranked first, with bunch weights between 386 and 519 g, followed by *Paula* and *Gelu*, with average weights of 314 g and 294 g, respectively. Under unfavorable climatic conditions, particularly in 2015, 2017, and 2022, bunches were smaller, which was also reflected in lower total yields.

Table 5

The production potential of the studied table grape genotypes

Years	Gelu			Paula			Mara			Chasselas dore 20 Is			Victoria		
	NG (no)	ABW (g)	Y (kg/ vine)	NG (no)	ABW (g)	Y (kg/ vine)	NG (no)	ABW (g)	Y (kg/ vine)	NG (no)	ABW (g)	Y (kg/ vine)	NG (no)	ABW (g)	Y (kg/ vine)
2015	16	298	4.77	9	298	2.68	23	148	3.4	20	134	2.68	10	421	4.21
2016	23	290	6.67	22	303	6.67	33	240	7.92	29	144	4.18	16	494	7.9
2017	16	319	5.1	20	316	6.32	26	125	3.25	31	134	4.15	15	451	6.77
2018	18	317	5.71	21	330	6.93	39	209	8.15	26	174	4.52	12	464	5.57
2019	22	330	7.26	19	328	6.23	21	244	5.12	25	152	3.8	14	478	6.69
2020	15	209	3.14	25	301	7.53	28	192	5.38	31	139	4.31	15	386	5.79
2021	26	323	8.4	21	345	7.25	34	256	8.7	26	174	4.52	18	412	7.42
2022	11	218	2.4	20	304	6.08	32	199	6.37	24	159	3.82	19	400	7.6
2023	24	323	7.75	21	297	6.24	29	205	5.95	30	161	4.83	18	463	8.33
2024	17	310	5.27	20	315	6.3	26	248	6.45	25	148	3.7	17	519	8.82
x̄	**19**	**294**	**5.65**	**20**	**314**	**6.22**	**29**	**207**	**6.07**	**27**	**152**	**4.05**	**15**	**449**	**6.91**

Note: NG (no) = number of grapes/vine;
ABW (g) = Average bunch weight;
Y (kg/vine) = yield, kg/vine

Regarding grape yield, the cultivars confirmed the productive potential observed during the pre-approval phase, achieving average yields ranging from 4.05 to 6.91 kg per vine.

CONCLUSIONS

The results obtained regarding the progression of veraison and grape ripening highlight the cultivars Paula and Gelu, which consistently retain their early ripening trait. This characteristic is important for completing and diversifying the varietal conveyor of table grape cultivars in the northeastern viticultural area of the country, a region that lacks a sufficient assortment to ensure fresh grape consumption over an extended period.

The specific climatic conditions during the 2015–2024 period positively influenced the physiological and metabolic processes, that determine fruiting capacity and shoot growth.

In terms of technological potential achieved under varying climatic conditions (drought, normal, and rainy years), the results confirmed both the productive capacity and the climatic suitability of the Copou Iași viticultural center for the cultivation of table grape varieties.

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