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AGROBIOLOGICAL CHARACTERISTICS OF SOME AUTOCHTHONOUS TABLE GRAPE VARIETIES UNDER THERMOHYDRIC STRESS IN SOUTHERN ROMANIA

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Abstract

In this study, we followed the physiological characteristics of three local table grape varieties, under conditions of thermal and hydric stress, which have an essential role in their transpiration and implicitly drought resistance. The varieties 'Augusta', 'Victoria' and 'Xenia' were studied, in the phenophases of flowering, berry growth, veraison and ripening. The content of chlorophyll and carotenoid pigments was generally sub-unitary, compared to the values reported for grapevines (1.05-1.58 mg 100 g^{-1} FW). Regarding the number of stomata, the most were determined in the 'Augusta' variety (123 stomata/mm^2), followed by 'Xenia' (98 stomata/mm^2) and 'Victoria' (88 stomata/mm^2). The photosynthesis rate recorded maximum values in the flowering phenophase in the 'Augusta' (16.14 µmols CO_2 $m^{-2}s^{-1}$) and 'Xenia' varieties (12.37 µmols CO_2 $m^{-2}s^{-1}$), possibly also due to a high requirement for photoassimilates. In the 'Victoria' variety, the highest value was reached at veraison (11.19 µmols CO_2 $m^{-2}s^{-1}$). As a result, the recorded productions were diminished, without affecting the quality of the grapes.

***Key words**: table grape varieties, physiology, thermohydric stress.*

INTRODUCTION

The complexity of the Romanian geographic landscape creates favorable ecoclimates for the cultivation of wine grape varieties, but also of table varieties - more demanding in terms of heliothermal and hydric conditions. Moreover, the current climatic warming favors this production direction.

In the past, the most favorable areas for table grapes varieties were those situated in the southern half of the country (Oşlobeanu et al., 1980; 1991). In the latest decades, as a result of climatic warming, the cultivation of these varieties, with different maturation periods, has also developed in the northern part of the country (Rotaru et al., 2011; Filimon et al., 2016).

Grapes, apart from wine production, are highly appreciated for fresh consumption; in addition to a significant nutritional value, table grapes also have therapeutic actions, with beneficial effects on the human body.

The quality of table grapes must be appreciated from the point of view of both the consumer, the producer and the trader (Bucur, 2024).

The consumer is interested in the organoleptic quality of grapes. It is based on the overall consideration of olfactory (aroma), gustatory (flavor, acidity, sugar content), tactile (pulp consistency), visual factors (color, size, freshness etc.).

For the producer, the cultivation of table grapes is a profitable activity. The producer is interested in the maximum value of the goods he puts on the market, so the concept of quality must take into account both the consumer and the trader. Using valuable varieties, well placed in the field and properly cared for, the productions obtained are much higher compared to wine varieties. Production costs are recovered in a shorter time for table grapes than for wine grapes, therefore the rotation of financial means takes place faster.

For the trader, quality is assessed by homogeneity, the size of the grapes and berries, the external appearance, resistance to transportation and storage etc.

In the last 50 years, as a result of research work carried out in our country, numerous new table grape varieties have been approved and introduced for propagation, as well as valuable clones, appreciated not only in the country but also abroad (Indreaș & Vișan, 2000). These include 'Augusta', 'Victoria' and 'Xenia', which present a series of characteristics appreciated by the modern consumer, producer and trader.

The present study was carried out in the ampelographic collection of the Faculty of Horticulture in Bucharest (a region located in the Romanian Plain, characterized by a fairly high effective temperature), to examine the agrobiological characteristics of some Romanian table grape varieties, in an attempt to determine their behavior and adaptation in semi-arid climatic conditions. Thus, we can rationally choose and apply certain technological links (pruning, green operations, solar protection, irrigation, fertilization etc.), compatible with high quality (Dobrei et al., 2023; Stănuș et al., 2024).

Climate change (global warming, different distribution of precipitation during the growing season, with increased water stress during grape ripening, greater frequency of extreme weather events etc.) produces physiological and biochemical changes in the growth and fruiting of the vine, influencing grape production and especially its quality. Heat waves cause an acceleration of the development of phenophases, especially grape ripening, with large accumulations of sugars, with a sharp degradation of acidity, increased pH values and the development of atypical aromatic compounds.

MATERIALS AND METHODS

The biological material used and the study site

On carried out the study within the framework of the Faculty of Horticulture, located in the southern part of Romania, at the University of Agronomic Sciences and Veterinary Medicine of Bucharest (N Lat.: 44° 47' 07"; E Long.: 26° 07' 28"; alt. 87 m).

The grapevine cultivars analized in this study in year 2024, all of them for table, were with green yellow berry skin color ('Augusta', 'Victoria' and 'Xenia'); the biological material subjected to the study is presented in Figure 1.

'Augusta'
Genitors - *Italia x Regina viilor*
VIVC no - 14781

'Victoria'
Genitors - *Cardinal x Afuz Ali*
VIVC no - 13031

'Xenia'
Genitors - *Bicane x Muscat de Hamburg*
VIVC no - 13274

Figure 1. Grape varieties studied

'Augusta' - table grape variety obtained at Nicolae Bălcescu Agronomic Institute Bucharest, by Neagu Marin and Georgescu Mihai, homologated in 1984. The variety complements the assortment of early maturing table grape varieties, being appreciated for its earliness, production, taste qualities, berry size, low number of seeds etc. (Georgescu et al., 1986).

'Victoria' - table grape variety obtained at the Drăgășani Viticulture and Winemaking Research Station, by Lepădatu Victoria and Condei Gheorghe, homologated in 1978. Is one of the most valuable Romanian table grape varieties, being cultivated in other wine-

growing countries such as Italy, France, Spain, Portugal, Greece, China, South Africa, Australia etc. (Glăman et al., 2018).

'Xenia' - table grape variety obtained at the Greaca Viticulture and Winemaking Research Station, by Gorodea Grigore and Lumînare Zamfirița, homologated in 1983. The variety completes the varietal conveyor of late table varieties, for fresh consumption and winter storage.

Varieties are planted at a spaced by 2.2 m (inter-row) and 1.2 m (intra-row), with a density of 3787 plant·ha^{-1}, rows direction N-S, in a trellis system in a Guyot pruning type semi-tall.

No irrigation was performed in the vineyard during the vegetation season when the determinations were made and phytosanitary treatments against to control diseases and pests have been applied in accordance with local standard practice. Soil management provides for natural ground cover.

Climatic conditions

For this study, there were used weather data recorded at Bucharest-Baneasa meteorological station for the year 2024, as compared to multi-annual values (1991-2020). Monthly average temperatures were used to calculate a set of bioclimatic indices commonly used in viticulture.

Parameters determined

Analysis of the phenological spectrum

The recording of the development of the vegetation phenophases (budburst, flowering, veraison, harvesting maturity) will be based on the specifications made in the OIV Descriptor List - second edition (2009), according to BBCH (**B**ioligische **B**undesansalt und **Ch**emische Industrie). Data were recorded at which 50% of buds, flowers, grapes reached the respective phenological stages (BBCH 008 - budburst; BBCH 605 - flowering; BBCH 801 - veraison and BBCH 809 - berries ripe for harvest).

Quantification of Photosynthetic Pigments

The determinations on the variation of chlorophyll and carotenoids content pigments were carried out at the beginning of flowering, berry growth, veraison and in the phenophase of grape ripening.

Analytical determinations were performed using a UV-vis spectrophotometer, at wavelengths: 663, 646 and 470 nm, using as a solvent acetone 80% (Lichtenthaler, 1987). Results were expressed as mg 100 g^{-1} FW fresh mass.

Determination of leaf moisture

In parallel with the determination of the content of photosynthetic pigments in the leaves, the moisture content (%) of the leaves was also determined, by drying for minimum of 4 hours in an oven, at a temperature of 105±2C (until constant mass).

Stomatal density measurement

Stomata density (SD) in leaves has been analysed on mature healthy, in July 2024, during the berries growth phase (the size of a pea), by the method of stomatal impression described everywhere in specialized works.

A thin layer of nail polish was applied on the abaxial leaf side, on an area of about 2 cm^2. After solvent evaporation (about 20 minutes later), the transparent stomatal impression of the leaf epidermis was taken with the help of a sheet of transparent shells and placed on a microscopic slide, which was labelled with the name of the sample. The observations were made with the optical microscope. SD was counted and expressed as number per mm^2.

Leaves gas exchange parameters

Photosynthesis rate (A - µmols CO_2 m^{-2}s^{-1}) and transpiration rate (E - mmol H_2O m^{-2}s^{-1}) have been measured *in-situ*, for leaves situated at the middle third of the shoot (nodes 4-7), in the morning, between 09:00 and 11:00, in the flowering phenophase, berries growth (pea size) and at the beginning of the ripening, using the portable infrared gas analyser (LCPro-SD-ADC BioScientific Ltd, Hoddesdon, UK).

Quantitative and qualitative parameters at harvesting

At harvesting determinations were made on quantitative (grape weight - grams, weight of 100 berries – grams) and qualitative parameters (sugar content - ºBrix, titratable acidity - g/L tartaric acid, pH, ºBrix/acidity ratio, polyphenolic potential). Sugar concentration in grapes was measured by using an Atago digital refractometer. The results were expresed in ºBrix. Titratable acidity was determined by titrating with 0.1 N NaOH using an Pellet digital biurette, and expresed as g/L tartaric acid; while polyphenolic potential of the harvest were assessed according to ITV method.

Statistical analysis

Data were processed using Microsoft Excel (version 2010) and are shown as average values ± Standard Deviation (SD).

The analysis of variance (ANOVA) was performed. Then, the post hoc Duncan Multiple Range Test (DMRT) by using IBM SPSS Statistics software was carried out to determine where there were statistically significant differences. Statistically significant differences have been considered at the value of $p \leq 0.05$.

Different lowercase letters denote significant differences when comparing cultivars within the same phenophase. Different uppercase letters denote significant differences when comparing a cultivar, taking into account the phenophase in which the respective indicator was determined.

RESULTS AND DISCUSSIONS

Climatic conditions

In the year 2024, higher temperatures were recorded, compared to the multiannual average, both in terms of average temperature and annual maximum temperature (Table 1). The growing season in 2024 was drier, and summer rainfall (VI-VIII) was lower than usual. Heat waves, assessed based on the number of days with maximum temperatures above 30ºC and 35ºC (the heatwave threshold), have experienced an upward trend in the last two years in the southern part of the country and beyond. Due to intense solar radiation and extreme temperature values during the grape ripening period, sunburn was recorded in grapes on the western side of the rows oriented in the N-S direction.

The hydrothermal coefficient recorded on a low value (0.64), which indicates a dry area, where the cultivation of table grape varieties becomes economical only under irrigated conditions, with moderate irrigation also necessary for wine varieties. The Huglin Index (HI) has increased to very high values, both in terms of the multiannual average (HI = 3163) and in the year 2024 (HI = 4138). The increase in the Huglin Index indicates the evolution of the local climate towards a very warm climate (HI+3), which is now typical of regions such as Malaga (Spain) or Marsalla (Italy) (Irimia & Patriche, 2019). The values of the Winkler index and Cool night index were also higher as compared to the multiannual average. These climatic conditions have led to changes in the development of the phenophases, the grapes yield and its quality.

Table 1. The main climatic indicators of the year 2024 compared to the multiannual average (1991-2020)

Climatic indicator	Multiannual average (1991-2020)	2024
Average annual temperature, ºC	10.98	14.70
Average temperature in the growing season, ºC (IV-X)	17.46	20.62
Average temperature in summer, ºC (VI-VIII)	22.15	26.30
Average annual minimum temperature, ºC	5.24	7.70
Average annual maximum temperature, ºC	17.6	21.10
Number of hot days (T_{max} > 30°C)	46	52
Number of very hot days (T_{max} > 35°C)	10	38
Annual total precipitation, mm	633	583
Total precipitation in the growing season (IV-X), mm	430	339
Total precipitation in summer (VI-VIII), mm	193	180
Hydrothermal coefficient (HC)	1.1	0.75
Huglin index (HI, Huglin, 1978)	3163	4138
Winkler index (WI, Winkler, 1974)	1762	2273
De Martonne Aridity Index (IDM, year)	30.3	23.6
Cool night index (CI, Tonietto and Carbonneau, 2004)	10.64	13.5

Analysis of the phenological spectrum

In a rational viticulture, in search of an optimal organoleptic quality, the climatic factors involved are more complex; and the climatic parameters taken into account are, in general, temperature, insolation and precipitation. In order to characterize the genetic resources in grapevine, it is important to record the main phenophases correlated with these parameters, especially with the thermal ones. Knowing the moment when these phenophases occur in different varieties is necessary not only for the understanding of the vineyard physiology, the application of pesticides, fertilizers, irrigation at the right time, the correct execution of the green aplication, but also for their influence on yield and quality attributes (Bucur & Dejeu, 2018).

Table 2 shows the average data of the four main phenological stages (budburst, flowering, veraison and berries ripe for harvest); climatic factors from the year 2024 directly influencing the onset and their development. Thus, the beginning of the phenophases varied depending on the average daily air temperatures, the useful heat balance (UHB) being calculated.

Budburst occurred 10-20 days earlier in year 2024 (April 5-10) for 'Augusta' and 'Victoria' varieties, respectively with 10-15 days earlier for 'Xenia' variety, compared to literature data (April 15-25) (Bucur & Dejeu, 2018; Glăman et al., 2018).

The flowering took place earlier in the 'Augusta' and 'Xenia' varieties (May 25), and with about 5 days later to the variety 'Victoria' (May 31).

The beginning of berry ripening (veraison) took place on the 22 July in the 'Augusta' and 'Victoria' varieties, and later in 'Xenia' (August 5-7).

Grape ripening took place on August 5 for the 'Augusta' variety, followed by the 'Victoria' variety. The 'Victoria', appreciated for its early ripening and commercial value of the grapes, reached organoleptic maturity on August 12, knowing that this variety ripens starting from the 2nd-3rd decade of August in the wine-growing areas of Romania (Lepădatu & Condei, 1986; Olteanu et al., 2002; Stroe, 2016; 2021).

This variety makes good use of its early full ripening, having an advance of at least one week compared to other cultivation areas in our country, in the ecoclimatic conditions of southwestern Romania (Plenița vineyard) (Cichi et al., 2023).

The greatest variation in grape ripening was recorded for 'Xenia'. Under the temperate-continental climate of Romania, grape ripening for this cultivar, takes place between September 15-20, and in the south of the country somewhat earlier, on August 26-28.

It should be noted that under the climatic conditions of the year 2024, 'Xenia' reached organoleptic maturity on August 12, 15-28 days earlier than other growing areas in the country.

Table 2. The phenological spectrum of the studied varieties
(ampelographic collection of USAMV of Bucharest, 2024)

Variety	Budburst (50%)		Flowering (50%)		Veraison (50%)		Harvest	
	Date	UHB* (ºC)	Date	UHB* (ºC)	Date	UHB* (ºC)	Date	UHB* (ºC)
'Augusta'	05.04	18.5	25.05	239.5	22.07	866	05.08	224
'Victoria'	10.04	41.0	31.05	260.5	22.07	813	12.08	305
'Xenia'	05.04	18.5	25.05	239.5	05.08	1074	12.08	133

*useful heat balance

Quantification of photosynthetic pigments and determination of leaf moisture

Photosynthetic pigments make up the receptor antennae and reaction centers of the two photosynthetic systems and participate in the process of photosynthesis. The chlorophyll a/b ratio is maximal at the beginning of the vegetation period, reaching up to 3/1 and decreases during grape ripening, while the chlorophyll/carotenoid ratio can register values of 4/1 (Filimon et al., 2016).

Assimilating pigments have an important role in plant growth, in the oxidation-reduction and fruiting processes, the variation of these parameters being an indicator of stress or damage to the leaf apparatus (Ghiur et al., 2022).

As can be seen in Table 3, chlorophyll *a* reached the highest value in the flowering phenophase in the ‘Augusta’ variety (101.0 mg 100 g^{-1} FW), and in the phenophases of berry growth, veraison and harvest it recorded the highest values in the ‘Xenia’ variety (97.91 mg 100 g^{-1} FW, 115.25 mg 100 g^{-1} FW, and 116.06 mg 100 g^{-1} FW, respectively).

Chlorophyll *b* recorded high values in the flowering and berry growth phenophases in the ‘Augusta’ variety (60.56 mg 100 g^{-1} FW, respectively 59.30 mg 100 g^{-1} FW), and in the veraison and ripening phenophases the highest value was taken over by the ‘Xenia’ variety (76.22 mg 100 g^{-1} FW, respectively 79.55 mg 100 g^{-1} FW).

Carotenoids had the highest values in the flowering (26.34 mg 100 g^{-1} FW), veraison (26.51 mg 100 g^{-1} FW) and ripening (25.83 mg 100 g^{-1} FW) phenophases in the ‘Victoria’ variety, and in the berry growth phenophase in the ‘Xenia’ variety (26.35 mg 100 g^{-1} FW).

After determining the content of photosynthetic pigments, *the humidity of the leaves* of the studied grape varieties was also determined. According to the data in Table 3, the humidity recorded the highest values at flowering (in the third decade of May), for the varieties ‘Augusta’ (73.11%) and ‘Xenia’ (72.43%), followed by a gradual decrease in July and August. For the variety ‘Victoria’ the humidity recorded the highest value during the period of berry growth (73.03%).

Table 3. Assimilatory pigments contents and leaf moisture of the studied varieties

Variety	Chl *a* (mg 100 g^{-1} FW)	Chl *b* (mg 100 g^{-1} FW)	Carotenoids (mg 100 g^{-1} FW)	Moisture content of the leaf (%)
		Flowering		
‘Augusta’	101.00 ± 0.86aB	60.56 ± 8.83aAB	25.82 ± 1.58aA	73.11 ± 3.11A
‘Victoria’	89.85 ± 8.71bB	34.26 ± 10.39bB	26.34 ± 2.01aA	71.95 ± 2.24A
‘Xenia’	82.32 ± 1.79bC	28.30 ± 4.82bC	23.11 ± 2.11aAB	72.43 ± 0.41A
		Berry growth		
‘Augusta’	97.59 ± 0.61aB	59.30 ± 5.17aAB	23.37 ± 0.53cB	69.29 ± 1.55B
‘Victoria’	97.62 ± 1.95aAB	52.05 ± 6.84aA	25.35 ± 0.47bA	73.03 ± 0.85A
‘Xenia’	97.91 ± 2.74aB	48.28 ± 3.55aB	26.35 ± 0.09aA	70.43 ± 2.58A
		Veraison		
‘Augusta’	100.46 ± 1.63bB	50.57 ± 5.45bB	26.20 ± 1.27aA	65.88 ± 3.09BC
‘Victoria’	102.83 ± 1.86bA	55.60 ± 5.14bA	26.51 ± 0.69aA	58.70 ± 14.58A
‘Xenia’	115.25 ± 4.54aA	76.22 ± 10.15aA	21.99 ± 3.22bBC	63.48 ± 0.69B
		Grape ripening		
‘Augusta’	108.92 ± 7.24abA	66.25 ± 6.33abA	20.59 ± 0.89aC	64.06 ± 1.45C
‘Victoria’	101.86 ± 2.90bA	53.09 ± 7.90bA	25.83 ± 1.30aA	66.83 ± 0.73A
‘Xenia’	116.06 ± 3.68aA	79.55 ± 7.05aA	18.82 ± 0.98aC	59.90 ± 1.01C

Legend: Data are shown as mean value ± Standard Deviation (N = 3). The significant differences ($P < 0.05$) between variants are indicated by different letters in the row: different lowercase letters denote significant differences when comparing cultivars within the same phenophase; different uppercase letters denote significant differences when comparing a cultivar, taking into account the phenophase in which the respective indicator was determined.

Stomatal density measurement

Stomata are the main route of water removal from plants, through the process of transpiration, but also the place where carbon dioxide enters, which is a raw material in the photosynthesis process. These tissues called stomata are found on epidermal surfaces of all plant organs which contact with air.

From the data presented in Table 4, it can be seen that there are no significant differences in the number of stomata in the three varieties studied.

Table 4. Determination of the number of stomata

Variety	Number of stomata/mm^2
‘Augusta’	123.33 ± 8.50a
‘Victoria’	97.67 ± 32.02a
‘Xenia’	88.00 ± 1.41a

In grapevines, the leaf surface varies depending on the grape variety, the ecological conditions in the growing area, fertilizers used, the irrigation regime, and grapevines have quite large leaf surfaces (Odabasioglu & Gursoz, 2019).

Leaves gas exchange parameters

▪ *Analyzing the intensity of the photosynthesis process* during the different phenophases (Table 5) it is found that the intensity of this process varied between 7.92 and 16.14 µmol CO_2 $m^{-2}s^{-1}$ in the flowering phase (May 31), between 5.82 and 8.19 µmol CO_2 $m^{-2}s^{-1}$ in the berry growth phenophase (June 26) and between 3.27 and 11.19 µmol CO_2 $m^{-2}s^{-1}$ in the ripening phase (July 22, August 05).

▪ *Analyzing the intensity of the transpiration process* during different phenophases (Table 5), it was found that the intensity of this process varied between 4.77 and 9.42 mmol H_2O $m^{-2}s^{-1}$ in the flowering phase (May 31), between 5.04 and 9.42 mmol H_2O $m^{-2}s^{-1}$ in the berry growth phenophase (June 26) and between 1.68 and 9.39 mmol H_2O $m^{-2}s^{-1}$ in the ripening phase (July 22, August 05).

It can be noted that in the flowering phenophase there are significant differences between the three varieties, while in the berry growth phenophase the differences recorded are statistically insignificant. The beginning of berry ripening (veraison), statistically significantly lower values were recorded for 'Xenia'.

For each variety studied physiological parameters evolved differently.

For the variety 'Augusta' the intensity of photosynthesis peaked in the flowering phenophase, possibly also due to a high requirement for photoassimilates, then showed a marked decrease in the berry growth phenophase and then the process showed a slight increase. *The transpiration intensity* peaked at the berry growth phenophase (5.04 mmol H_2O $m^{-2}s^{-1}$).

In 'Victoria' we note that the intensity of photosynthesis increased progressively from flowering to beginning of berry ripening (veraison), when it reached its maximum value (11.19 µmol CO_2 $m^{-2}s^{-1}$). *Transpiration intensity* was high in all three phenotypes, with no marked differences between phenotypes.

In 'Xenia', the maximum values of photosynthesis rate were recorded at flowering (12.37 µmol CO_2 $m^{-2}s^{-1}$), when water use efficiency had the highest values, then gradually decreased, reaching 3.27 µmol CO_2 $m^{-2}s^{-1}$ at the fallow stage. *The intensity of the transpiration process* was also highest at flowering (5.72 mmol H_2O $m^{-2}s^{-1}$), and then gradually decreased, reaching its lowest value in the veraison phenophase (1.68 mmol H_2O $m^{-2}s^{-1}$).

Table 5. The main physiological parameters recorded of the studied varieties, Bucharest 2024

Variety	Flowering	Berry growth	Veraison
A - Net photosynthesis (µmol CO_2 $m^{-2}s^{-1}$)			
‘Augusta’	16.14 ± 2.71aA	5.82 ± 0.59aB	8.73 ± 2.19aB
‘Victoria’	7.92 ± 0.23bB	8.19 ± 1.80aB	11.19 ± 1.72aA
‘Xenia’	12.37 ± 1.77cA	7.35 ± 0.86aB	3.27 ± 1.03bC
E - Transpiration rate (mmol H_2O $m^{-2}s^{-1}$)			
‘Augusta’	4.77 ± 1.53bA	5.04 ± 1.51bA	3.64 ± 1.73bA
‘Victoria’	9.42 ± 3.27aA	9.42 ± 0.57aA	9.39 ± 0.28aA
‘Xenia’	5.72 ± 0.60abA	4.16 ± 1.46bA	1.68 ± 0.68bB

Legend: Data are shown as mean value ± Standard Deviation (N = 3). The significant differences ($P < 0.05$) between variants are indicated by different letters in the row: different lowercase letters denote significant differences when comparing cultivars within the same phenophase; different uppercase letters denote significant differences when comparing a cultivar, taking into account the phenophase in which the respective indicator was determined.

Our obtained data are in a great measure consistent with those of Williams & Biscay (1991), who found that the intensity of the photosynthetic process ranged from 13.8 µmol µmol CO_2 $m^{-2}s^{-1}$ in August to 7.5 µmol µmol CO_2 $m^{-2}s^{-1}$ in September. Also, Botos-Balo et al. (1992), found that leaves of *Vitis vinifera* plants have an average net photosynthesis intensity of 11.6 µmol CO_2 $m^{-2}s^{-1}$, and Lasko et al. (2000), state that it varies between 16 and 18 µmol CO_2 $m^{-2}s^{-1}$. Determinations carried out by Burzo et al. (2001) on 28 grapevine varieties revealed that the intensity of photosynthesis ranged from 5.26 µmol CO_2 $m^{-2}s^{-1}$ in the variety 'Kiș Miș white', 10.44 µmol CO_2 $m^{-2}s^{-1}$ in the variety 'Victoria' and 12.08 µmol CO_2

$m^{-2}s^{-1}$ in the variety 'Rkatițeli', under similar temperature conditions (34-36ºC) and light intensity of 1.820-1.870 moli/m^2/s.

Villalobos-Gonzalez et al. (2022), found during the vegetation period, photosynthesis intensity values ranging between 4.68 and 12.02 μmol CO_2 $m^{-2}s^{-1}$ under the conditions of a year with a rainfall deficit, in the varieties 'Chardonnay', 'Carménère', 'Sauvignon Blanc' and 'Cabernet Sauvignon', which are stomatal sensitive.

The determinations carried out by Bucur et al. (2024) indicated that the intensity of this process varies between 3.88 and 13.3 μmol CO_2 $m^{-2}s^{-1}$, in the case of applying treatments with kaolin and zeolite in concentrations of 3 and 5% to the 'Fetească regală' variety, intended to mitigate the effects of summer thermohydric stress.

Quantitative and qualitative parameters at harvesting

Table 6 presents the main quantitative and qualitative parameters at harvesting time of the studied varieties. The average grape weight data represent the average of three replicates, each one for three representative grapes, according to the methodology established under COST Action FA 1003.

The quality of the grapes, indicated by the average weight of the berries, the sugar content, titratable acidity and ºBrix/acid ratio (proportion), reflected both the specific genetic character of each individual genotype and the influence of climatic factors on these elements.

The analyzed varieties were characterized by medium-large grapes, with an average weight between 544 g ('Victoria'), 315 g ('Augusta') and 253 g ('Xenia') (Table 6), the current value of 'Xenia' cultivar being close to that reported by Irimia et al. (2009).

The weight of 100 berries, was specific to each genotype, ranging from 380 g for the grapes of 'Xenia' variety, 564 g for the 'Augusta' to 681 g for 'Victoria'. Table grape varieties are usually harvested at a lower sugar content, compared to wine varieties. According to The International Organisation of Vine and Wine (OIV), resolution VITI 1/2008, grapes with a Brix degree equal to or above 16 shall be considered riped (OIV, 2008). For white/pink table grape varieties, grapes with a Brix degree under 16 must have a minimum sugar (expressed in g/L) / acid (expressed in g/L of tartaric acid) of 20/1 proportion, in order to be considered riped.

In the EU, the minimum refractometric index shall be above of 12 ºBrix for the varieties 'Alphonse Lavallée', 'Cardinal' and 'Victoria', 13 ºBrix for all other seeded varieties, and 14 ºBrix for all seedless varieties. In adition, all varieties must have satisfactory sugar/acidity proportion levels.

In the climatic conditions of the year 2024, the studied varieties showed average to high sugar concentrations (16.9 ºBrix 'Victoria' variety, 19.3 ºBrix 'Xenia' and 19.6 ºBrix 'Augusta'). 'Xenia' variety grapes showed the lowest total acidity of the must (3.68 $g.L^{-1}$ tartaric acid), while 'Victoria' variety presented a low sugar-acidity ratio, due to higher acidity of grapes.

ºBrix/acid ratio can be used as predictor for the table grapes consummer acceptability, better for the sensory attribute as compared to the ºBrix or acidity values (Jayasena & Cameron, 2008; Irimia, 2012).

The total polyphenolic index determined by the ITV method (extraction of crushed berries with 0.1% HCl and 95% ethanol) showed values between 14.48 and 46.26, the highest value being obtained for the 'Xenia' variety grapes.

Table 6. Grapes quantitative and qualitative parameters at harvesting time of the studied varieties, Bucharest 2024

Variety	**Grape weight (g)**	**Weight of 100 berries (g)**	**Sugar content (ºBrix)**	**Titratable acidity ($g.L^{-1}$ tartaric acid)**	**pH**	**ºBrix / acidity ratio**	**The polyphenolic potential of grapes**	
							DO 280 nm	**Polyphenolic index**
'Augusta'	315	564	19.6	3.90	2.7	50.2	0.073	21.918
'Victoria'	544	681	16.9	3.86	2.9	43.7	0.048	14.484
'Xenia'	253	380	19.3	3.68	3.9	52.4	0.154	46.259

CONCLUSIONS

Analyzing climate data from 2024, compared to the multi-year average (1991-2020), climate warming is evident, both in terms of average temperature, precipitation, but especially heat waves felt by the number of days with maximum temperatures above 30°C, respectively 35°C, but also by the time when these temperatures occurred (in April there were days with temperatures above 30°C). Thus, the budburst phenophase started very early (05.04.2024 - 10.04.2024) in all the varieties studied. The other phenophases were also 7-10 days early. It should be noted that under the climatic conditions of the year 2024, 'Xenia' reached organoleptic maturity on August 12, 15-28 days earlier than other growing areas in the country.

The study of new varieties revealed a great phenological plasticity, the development of phenophases being dependent not only on the genetic factor, but also on the environmental conditions, mainly by the evolution of the temperatures that are constantly increasing. From a physiological point of view, considering the specific characteristics of the three varieties and the variability of the results obtained from this study, it is not possible to draw a clear conclusion on the superiority of one or the other in terms of photosynthetic yield and even less so in terms of transpiration rate.

The sugar content of the three table varieties ('Augusta', 'Victoria' and 'Xenia') was high, but together with the lower acidity resulted in a balanced gluco-acidimetric index.

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REFERENCES

Botos-Balo, B., Varadi, G., Pölös, E., & Happ, I. (1992). Effect of shading on the photosynthetic apparatus of Chardonney vine leaves. *Symp. Int. di Fisiol. della Vite*, Torino, 555-558.

Bucur, G.M. (2024). *Viticultură.* Iași, RO: "Ion Ionescu de la Brad" Publishing House.

Bucur, G.M., Delian, E., Stroe, M.V., Marian, I., & Pîrcălabu, L. (2024). Research on increasing the adaptation capacity of grapevine to climate change - treatments with kaolin and zeolites. *Scientific Papers, Series B, Horticulture. LXVIII*(1), 264-271.

Bucur, G.M., & Dejeu, L. (2018). Research on phenotyping and eno-carpological traits of twenty-three new romanian table grape varieties (*Vitis vinifera* L.). *Conference Proceedings Sciendo, 1*(1), 268-275.

Burzo, I., Dobrescu A., & Dejeu, L. (2001). Research concerning the variation intensity of photosinthetic process, respiratuon and transpiration at 28 grape vine soils. *Analele Ştiinţifice ale Universităţii Al. I. Cuza, Iaşi, Secţiunea II, Biologie vegetală, XLVII,* 69-74.

Cichi, D.D., Căpruciu, R., Gheorghiu, N., & Stoica, F. (2023). Agrobiological and technological characteristics of table grapes varieties, grown in the temperatecontinental climate from southwestern Romania. *Scientific Papers, Series B, Horticulture. LXVII*(1), 269-276.

COST FA1003 Action, 2010. "East-West Collaboration for Grapevine Diversity Exploration and Mobilization of Adaptive Traits for Breeding". Retrieved 2024 February from http://users. unimi. it/grapenet/.

Dobrei, A., Nistor, E., Scedei, D., & Dobrei, A.G. (2023). Local microclimates and climate changes influence on cultivation techniques, grapevine production and quality. *23rd International Multidisciplinary Scientific GeoConference, 23*(4.1).

Stănuș, (Rujoiu) M., Dobrei, A.G., Nistor, E., Cristea, T., Tâc, (Faur) A.I., & Dobrei, A. (2024). The local grapevine varieties - a source of typicity, authenticity, and adaptability, within the framework of sustainable viticultural technologies. *Scientific Papers. Series B, Horticulture, LXVIII(*2), 361-370.

Filimon, R.V., Damian, D., Filimon, R., & Rotaru, L. (2016). Assessment of consumer preferences on table grapes of new *Vitis vinifera* L. cultivars. *Cercetări Agronomice în Moldova, XLIX 3*(167), 97-110.

Filimon, R.V., Rotaru, L., & Filimon, R. (2016). Quantitative investigation of leaf photosynthetic pigments during annual biological cycle of *Vitis vinifera* L. table grape cultivars. *South African Journal for Enology and Viticulture, 37*(1), 1-14.

Georgescu, M., Georgescu, M., & Indreaș, A. (1986). Completarea conveierului varietal cu noul soi de struguri pentru masă - Augusta. *Producţia vegetală - Horticultura. Nr. 1*/1986.

Ghiur, A.D., Rotaru, L., Filimon, V.R., Zaldea, G., Nechita, A., & Damian, D. (2022). The study of photosynthetic pigments content at some vine for table grapes under the influence of biostimulant substances application. *Lucrări ştiinţifice. Seria Horticultură, USV Iaşi, 65*(2), 55-62.

Glăman, Gh., Dejeu, L., Brîndușe, E., Șerdinescu, A., Ion M. (2018). *Ampelografia României, vol. IX.* Bucharest, RO: Ceres Publishing House.

Indreaş, A., Vişan, L. (2000). *Principalele soiuri de struguri de masă cultivate în România.* Bucharest, RO: Ceres Publishing House.

Irimia, L.M., Patriche, C.V. (2019). *Potenţialul viticol al podgoriilor şi evoluţia acestuia în contextul* *schimbării climatice.* Iași, RO: „Ion Ionescu de la Brad” Publishing House.

Irimia, L.M. (2012). *Biologia, ecologia şi fiziologia viţei-de-vie.* Iași, RO: „Ion Ionescu de la Brad” Publishing House.

Irimia, N., Dejeu, L., & Matei, P.M. (2009). Research concerning the behaviour of some new table grape cultivars in Huşi Vineyard. *Lucrări ştiinţifice USAMV Bucureşti, Seria B, LIII,* 564-568.

Jayasena, V., & Cameron, I. (2008). ºBrix / acid ratio as a predictor of consumer acceptability of Crimson Seedless table grapes. *Journal of Food Quality, 301,* 736-750.

Lakso, A.N., Dunst, R.M., Denning, S.S., & Krishnaswami, M. (2000). Pruning and environmental factors affecting the carbon balance of Concord grapevines. *6th Int. Symp. Grapevine Physiology and Biotechnology, Heraklion,* 52

Lacombe, T., Boursiquot, J.M., Laucou, V., Di Vecchi-Staraz, M., Peros, J.P., & This P. (2013). Large-scale parentage analysis in an extended set of grapevine cultivars (*Vitis vinifera* L.). *Theoretical Applied Genetics, 126* (2), 401-414.

Lepădatu, V., & Condei Gh. (1986). Contribuții la studiul genetic, agrobiologic și tehnologic al soiurilor Victoria și Azur recent omologate. În *Stațiunea de Cercetare și Producție viti-vinicolă Drăgășani - La 50 de ani de activitate științifică în slujba viticulturii și vinificației,* 137-142.

Lorenz, D.H., Eichhorn, K.W., Bleiholder, H., Klose, R., Meier, U., & Weber E. (1994). Phänologische Entwick-lungsstadien der Weinrebe (*Vitis vinifera* L. ssp. *vinifera*). *Vitic. Enol. Sci. 49,* 66-70.

Odabasioglu, M.I., & Gursoz, S. (2019). Leaf and stomatal caracteristics of grape varieties (*Vitis vinifera* L.) cultivated under semi-arid climat conditions. *Fresenius Environmental Bulletin, 28*(11A), 8501-8510.

Olteanu, I., Cichi, D.D., Costea, D.C., Mărăcineanu, C.L. (2002). *Viticultură specială – zonare, ampelografie, tehnologii specifice*. Craiova, RO: Universitaria Publishing House.

Oşlobeanu, M., Oprean, M., Alexandrescu, I., Georgescu, M., Baniţă, P., Jianu, L. (1980). *Viticultură generală şi specială. Ecologia viţei-de-vie.* Bucharest, RO: Pedagogical Publishing House,

Oşlobeanu, M., Macici, M., Georgescu, M., Stoian, V. (1991). *Zonarea soiurilor de viţă-de-vie în România*. Bucharest, RO: Ceres Publishing House.

OIV, 2009. Descriptor List for Grape Varieties and *Vitis* species (2nd edition). Retrieved 2024 December 20 from http://oiv.int.

OIV Resolution VITI 1/2008. OIV standard on minimum maturity requirements for table grapes. Retrieved 2024 December 20 from http://www.oiv.int/public/medias/369/viti-2008-1-en.pdf.

Rotaru, L., Mustea, M., & Nechita, B. (2011). La valeur agrobiologique et technologique du nouvelles creations pour raisins de table dans le vignoble de Iaşi. *Lucrări Ştiinţifice, Universitatea de Ştiinţe Agricole şi Medicină Veterinară "Ion Ionescu de la Brad" Iaşi, Seria Horticultură 54*(1), 481-486.

Stroe, M.V. (2016). Knowledge of quality performance of some table grape varieties grown and obtained in the experimental field from UASVM Bucharest. *Scientific Papers, Series B, Horticulture 60,* 103-108**.**

Stroe, M.V. (2021). Genetic diversity the viticultural germplasm fund of Romania - news accessions. *Scientific Papers. Series B. Horticulture, 65*(1), 350-359.

Villalobos-Gonzalez, L., Alarcon, N., Bastias, R., Perez, C., Sanz, R., Pena-Neira, A., & Pastenes, C. (2022). Photoprotection is achieved by photorespiration and modification of the leaf incident light, and their extent is modulated by the stomatal sensitivity to water deficit in grapevines. *Plants, 11*(8, Art. 1050) 23 pp.

Vitis International Variety Catalogue, 2012. Retrieved 2024 March 03 from http://www.vivc.de./

Williams, L.E., & Biscay P.J. (1991). Partitioning of Dry Weight, Nitrogen, and Potassium in Cabernet Sauvignon Grapevines From Anthesis Until Harvest. *Am. J. Enol. Vitic., 42,* 113-117