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STUDIES ON THE BIOLOGICAL AND PRODUCTIVE POTENTIAL OF SOME TABLE GRAPE CULTIVARS GROWN IN THE PEDOCLIMATIC CONDITIONS OF SOUTHERN OLTENIA

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Abstract

The researches carried out followed the potential of some vine cultivars with table grapes, from the point of view of biology and the grape production of the cultivars, from the ampelographic collection of the Research – Development Station for Plant Culture on Sands Dabuleni. During the three years of the study, the vine cultivars with table grapes cultivars budded between April 12 and May 10, the 'Victoria' and 'Prima Cl. 1022' cultivars budded between the earliest, and the latest 'Moldova' cultivar.

The point of view of the average production of grapes, in the analyzed period the cultivars 'Prima Cl. 1022' stood out, 17389 kg/ha with a difference from the witness of 2809 kg/ha and 'Perla de Zala' 15527 kg/ha with a difference from the witness of 947 kg/ha, both statistically uninsured. The values of the content in total sugars, at harvest maturity, fluctuated from one cultivar to another but also from one year to another. From this point of view, the first place was the 'Perla de Zala' cultivar with an average amount of total sugars of 207 g/l and a difference compared to the witness of 73 g/l, statistically assured as significant. In the period 2020-2022, the table grape vine cultivars analyzed behaved differently depending on the climatic conditions of the crop year.

Key words: table grapes, phenological stages, fruit, productivity, evaluation climatic conditions.

INTRODUCTION

Grapevine (*Vitis vinifera L.*) is one of the most cultivated crops in the world, with approximately 75 million tons of grapes produced each year: of these, 45% are used for fresh consumption, fresh derivatives (eg juice) or, alternatively, raisins (FAO-OIV, 2016).

Along with production capacity and resistance to diseases and pests, the quality of grapes, mainly represented by their organoleptic characteristics, remains one of the most important improvement objectives for grapevines (Sestraș et al., 2008).

The viticultural potential is determined by the interaction of all the ecological factors that interact in the vineyard: relief, climate and soil (Irimia et al., 2014).

All these factors determine the quality of the crop through the influence they have on the composition of the grapes: temperature influences the content in sugar, anthocyanins and malic acid (Kliewer and Lider, 1970; Buttrose et al., 1971; Coombe, 1987); the thermal amplitude between day and night influences the content of anthocyanins and aromatic substances (Kliewer and Torres, 1972; Tomana et al., 1979); precipitation can affect the incidence/severity of vine disease and berry ripening (Tregoat et al., 2002); solar radiation influences the content of anthocyanins, sugar and malic acid (Buttrose, 1970; Kliewer, 1977; Crippen and Morrison, 1986; Dokoozlian and Kliewer, 1996).

Due to global climate change, it is necessary to evaluate the response of vine plants to possible changes in agroclimatic, growing conditions in order to more efficiently use the resources of a certain region and to increase the yield and quality of crops (Kovalyshyna et al., 2020a).

Climatic elements such as temperature, precipitation, humidity, radiation, and wind affect grapevine phenology, berry development, yield, and berry quality (Jones and Davis 2000; Caprio and Quamme 2002; Fraga et al., 2012). Climatic indices have particularly important roles in determining the viticultural potential of geographical regions in the world (Jones et al. 2010; Kenny and Shao 1992).

The temperature summation index is one of the most used climate indices in viticulture and this index explains the energy aspect of the climate, taking into account the temperature above 10 °C during the growing season (Fregoni and Pezzutto 2000; Kök and Çelik 2003). During the life cycle, the vine develops in parallel with the growth processes.

At a certain age, depending on the cultivar, it forms its reproductive organs, flowers and fruits.

This qualitative leap corresponds to physiological maturity and is the result of a whole series of physiological and biochemical transformations that take place at the level of cells (Aurel Popa, 2019.

MATERIALS AND METHODS

The study was carried out on four table grape cultivars ('Victoria', 'Prima Cl. 1022', 'Perla de Zala', 'Moldova'), from the ampelographic collection of the Research – Development Station for Plant Culture on Sands Dăbuleni.

The witness cultivar was 'Victoria', because it is the most widespread table grape vine cultivar in the area of sandy soils in south-west of Oltenia.

The ampelographic collection was founded in 2010. The planting density was 3787 stumps/hectare, which resulted from planting distances of 2.2/1.2 m.

The experiment was established on a sandy soil with a nitrogen content between 0.02-0.03% values that indicate a very low soil supply state; extractable phosphorus showed values between 74.42 ppm and 85.56 ppm, values that characterize the soil as being well supplied in phosphorus; exchangeable potassium was between 36.26 ppm and 46.93 ppm, the established values characterize the soil with a low supply state; organic carbon presented values in the range of 0.24% - 0.74%, the state of the soil's supply of organic matter being reduced, a fact characteristic of sandy soils.

The study carried out consisted of observations and experimental determinations regarding the phenology of the buds of the shoots, the production of grapes and its quality (weight of 100 berries, content of total sugars and total titratable acidity).

Observations and determinations were made regarding the phenological stages: beginning of bud burst (07 BBCH), beginning of ripening (81 BBCH) and berries ripe for harvest (89 BBCH), production and quality of grapes. The phenological observations (beginning of bud burst (07 BBCH), beginning of ripening (81 BBCH) and berries ripe for harvest (89 BBCH) consisted of the visual observation and notation every day of the beginning of each phenophase, for each cultivar. Production determinations were made by weighing the grapes in 4 replicates, for each cultivar. For quality determinations, samples were taken from the harvested plants and analyzed in the laboratory: the weight of 100 grains was determined gravimetrically; the content in sugars was determined with the refractometer; the titratable acidity at harvest was determined by the titrimetric method.

RESULTS AND DISCUSSIONS

From the analysis of the main climatic elements carried out in the period 2020-2022, it is found that the temperature values expressed through the heat balances fell within the limits presented in the specialized literature, so the global heat balance recorded 3682 °C, the active heat balance recorded 3601 °C and the useful heat balance recorded 1888 °C. In the period 2020-2022, relatively favorable conditions for grapevine culture were manifested (table 1).

The minimum temperature, between -9.4 and -10.6 in the period 2020-2022, was favorable for the wintering of the vines in optimal conditions.

The average temperature during the analyzed period was between 12.5-13.6 °C, the lowest average temperature was recorded in 2021, and the highest average temperature was recorded in 2020.

The maximum temperature recorded values between 37.3 °C in 2020 and 41.6 °C in 2022.

From the point of view of annual precipitation, the amount of precipitation in the period 2020-2022 was around 500 mm, in 2020 550.4 mm were recorded, and in 2021, 544.6 mm. During the vegetation period (April-September), the highest amount of precipitation was recorded in 2020 with 310.4 mm, and the lowest amount of precipitation was recorded in 2021, which was 173.6 mm.

In 2022, the rainfall recorded during the vegetation period, in a small amount (300.2 mm), but over a large number of days (62), caused the appearance of the main vine diseases, *Plamopara viticola* and *Uncinula necator* since phenophase of grain growth, requiring a large number of treatments.

Pouget (1965), stated that the active temperature for beginning of bud burst is 13 °C for early cultivars and 10 °C for late cultivars. Further research by Pouget (1988) stated that beginning of bud burst occurs only if the characteristic beginning of bud burst temperature is maintained for 3 to 8 consecutive days.

Table 1. The main climate elements from the period 2020-2022

Climatic elements	**The year**			**Average (2020-2022)**
	2020	**2021**	**2022**	
Global heat balance	3757	3596	3693	3682
Active heat balance	3725	3471	3607	3601
Useful heat balance	1945	1811	1907	1888
Medium temperature (°C)	13,6	12,5	12,7	12,9
Minimum temperature (°C)	-9,4	-10,6	-10,2	-10,6/2021
Maximum temperature (°C)	37,3	41,2	41,6	41,6/2022
Multiannual average temperature (1956-2022) °C	11,46	11,46	11,48	11,47
Multiannual average precipitation (1956-2022) mm	560,98	562,08	560,06	561,04
Annual precipitation (mm)	550,4	544,6	547,2	547,4
Precipitation during the growing season (mm)	310,4	173,6	300,2	261,4
Number of days with rain	102	114	111	109
Number of days with maximum temperatures > 30°C	79	68	79	75

The triggering of flowering is conditioned by the sum of the degrees of active temperature that must be accumulated by the vine, from entering the vegetation until flowering. If the biological degree is considered to be 10 °C, then the early cultivars need approx. 310 °C active temperature, and the late ones of approx. 380 °C active temperature (Aurel Popa, 2019). During the analyzed period, beginning of bud burst in table grape varieties was triggered at temperatures between 11.5-18.2 °C. The useful temperature recorded from beginning of bud burst to flowering recorded values between 252.1-294.3 °C. To reach maturity, the grapes needed useful temperatures between 333.4-718.4 °C, different depending on the cultivar and climatic conditions.

The useful heat balance during the vegetation period recorded values between 1059.5-1762.3 °C, and the active heat balance recorded values between 2078.4-3450.6 °C, different depending on the ripening period of each cultivar (table 2). Not all buds start vegetatively at the same time. First of all, they started in the vegetation buds, which are the most morphologically evolved and which also have a greater number of inflorescences (Bucur G. M., 2011).

In the analyzed period, table grape vine cultivars beginning of bud burst 12.04-10.05, the 'Victoria' and 'Prima Cl. 1022' cultivars beginning of bud burst the earliest, and the latest 'Moldova' cultivar.

The fallow beginning of ripening took place during the month of July, opened with the 'Prima Cl. 1022' cultivar (July 2) and ending with 'Moldova' cultivar (July 23).

The grape harvest took place between July and October, the 'Victoria' and 'Prima Cl 1022' cultivars could be harvested at the earliest (table 3).

During the analyzed period for table grape cultivars, the beginning of bud burst phenophase took place over a period of 12-16 days, flowering took between 7-12 days, and 23-66 days were recorded from the bush to ripening.

The minimum duration from beginning of bud burst to the full maturity of the grapes was recorded for the 'Prima Cl.1022' cultivar (98 days), and the maximum for the 'Moldova' cultivar (176 days) (fig.2).

The differences in the non-beginning of bud burst percentage of buds bursting from one year to another are due both to the environmental conditions of the year in which the buds were formed and which influenced their evolution, but also to those of the year in which they enter vegetation. As a rule, in cool springs, budding is delayed, uneven, the percentage of unopened buds being higher than in warm springs, with sufficient moisture in the soil and air, when budding occurs faster and the percentage of unopened buds decreases (Bucur G. M., 2011).

In the period 2020-2022, the average production of grapes for table grape cultivars was between 12034 kg/ha for the 'Moldova' cultivar and 17389 kg/ha for the 'Prima Cl. 1022' cultivar, with a difference from the witness of 2809 kg/ha, not statistically assured (fig. 1).

In each of the three years of study, the highest production was registered with the 'Prima Cl. 1022' cultivar (table 4).

Quality analyzes consisted of determinations of weight of 100 berries, total sugar content, and total titratable acidity at harvest.

In the 2020-2022 period, the weight 100 berries recorded values between 320 g for the 'Perla de Zala' cultivar, which is statistically significant in the negative sense, and 689 g for the 'Victoria' cultivar witness. The content of sugars recorded values between 134 g/l in the 'Victoria' cultivar and 207 g/l in the 'Perla de Zala' cultivar, with a difference from the witness of 73 g/l, statistically assured as significant (table 5).

A high content of sugars was also recorded in the 'Moldova' cultivar 192 g/l, statistically assured as significant. Titratable acidity at harvest expressed in g/l H_2SO_4 recorded values between 3.77 g/l for the 'Victoria' cultivar and 5.79 g/l for the 'Prima Cl. 1022' cultivar, with a difference from witness of 2.01 g/l, statistically assured as significant.

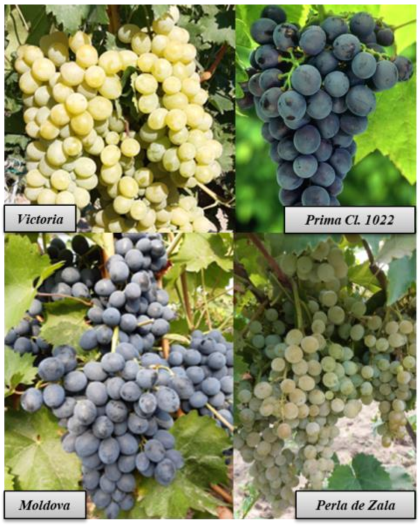

Figure 1. Table grapes

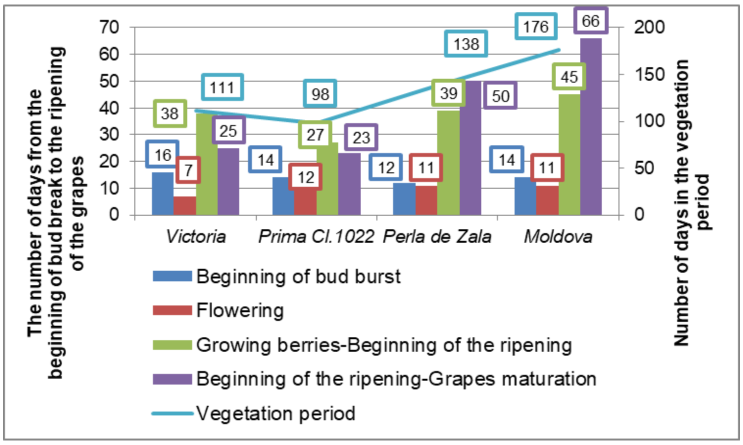

Figure 2. The duration of each phenophase at table grape cultivars during 2020-2022

Table 2. The useful thermal balance for each phenophase (°C), in the period 2020-2022

Cultivar	The beginning of bud burst	The beginning of bud burst - Flowering	Flowering - Beginning of ripening	Beginning of ripening - Berries ripe for harvest	Useful heat balance in vegetation period	Active heat balance in vegetation period
	Limitation °C	Σ ºt useful	Σ ºt useful	Σ ºt useful	Σ ºt useful	Σ ºt active
'Victoria'	13,4-18,2	294,3	600,6	384,2	1212,6	2425,5
'Prima Cl.1022'	13,4-18,2	252,1	474,0	333,4	1059,5	2078,4
'Perla de Zala'	11,5-14,8	275,3	637,8	712,5	1565,3	2987,6
'Moldova'	13,9-18,2	282,6	764,4	718,4	1762,3	3450,6

Table 3. The main phenological observations of some table grape vine cultivars in the period 2020-2022

Cultivar	The beginning of bud burst	Flowering	Growth the berries	Beginning of ripening	Berries ripe for harvest
'Victoria'	12.04-10.05	27.05-16.06	04-16.06	11-22.07	01-16.08
'Prima Cl.1022'	12.04-10.05	23.05-13.06	03-14.06	02-10.07	25-29.07
'Perla de Zala'	16.04-07.05	20.05-13.06	02-13.06	12-27.07	29.08-09.09
'Moldova'	18.04-10.05	28.05-14.06	06-18.06	23-28.07	20.09-19.10

Table 4. Grape production (kg/ha) of some table grape vine cultivars in the period 2020-2022

Cultivar	Average production (kg/ha)	Relative production (kg/ha)	The difference compared to the control (kg/ha)	Signification
'Victoria'	14580	100	Mt.	
'Prima Cl.1022'	17389	65	2809	-
'Perla de Zala'	15527	47	947	-
'Moldova'	12034	67	-2546	-
LSD 5%=5088 LSD 1%=7704 LSD 0.1%=12377				

Table 5. Grape quality in some vine cultivars with table grapes in the period 2020-2022

Soiul	Weight of 100 berries		Total sugar content		Total titratable acidity H_2SO_4	
	(g)	The difference compared to the control (g)	(g/l)	The difference compared to the control (g/l)	(g/l)	The difference compared to the control (g/l)
'Victoria'	689	Mt.	134	Mt.	3,77	Mt.
'Prima Cl.1022'	447	-241°	147	13	5,79	2,01*
'Perla de Zala'	320	-369°°	207	73*	4,78	1,01
'Moldova'	458	-230°	192	58*	4,06	0,3
	LSD 5%	166	LSD 5%	53	LSD 5%	1,4
	LSD 1%	252	LSD 1%	80	LSD 1%	2,2
	LSD 0.1%	405	LSD 0.1%	129	LSD 0.1%	3,5

CONCLUSIONS

The climatic conditions recorded in 2020-2022 were favorable for the development of metabolism in the vines throughout the growing season

From the point of view of the outburst of the phenophases of vegetation, the 'Prima Cl. 1022' and 'Victoria' cultivares stood out due to their early maturity, which beginning of bud burst 7 days earlier than the 'Moldova' cultivar.

The 4 vine cultivars with table grapes recorded a vegetation period between 98-176 days, the standing out 'Victoria' and 'Prima Cl. 1022' cultivars, which reached maturity in July-August.

From the point of view of production, the 'Prima Cl. 1022' cultivar stood out (17389 kg/ha), and from the point of view of the content in total sugars at harvest, the cultivars 'Perla de Zala' (207 g/l) and 'Moldova' (192 g/l) stood out.

The table grape cultivars studied in the period 2020-2022 are recommended to be cultivated in sandy soil conditions because they find favorable conditions (Σ °t global 3596-3757) and offer staggered ripening, from July to October.

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