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EVALUATION OF THE TECHNOLOGICAL POTENTIAL OF SOME VINE VARIETIES FOR WINE GRAPES UNDER CLIMATIC RISK CONDITIONS

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ABSTRACT

The research was carried out at Research and Development Station for Viticulture and Vinification Bujoru, Romania during 2020-2021. The main objective of the research is to evaluate the technological potential of three wine varieties and two vine clones for wine grapes under climate risk conditions. 'Bujoru', 'Blasius', 'Negru Aromat' varieties and 'Muscat Ottonel 49 Bj' and 'Şarbă 25/45'vine clones were analysed. Technological indicators were calculated based on the mechanical components of the grapes. The values of these indices complete the qualitative characteristics of the wine varieties. Due to the climatic risk, the varieties analysed did not reach their biological potential in any of the two years when this research has been carried.

INTRODUCTION

The vineyard plantations located in the South of Moldova region are increasingly affected by the climate changes that have occurred in the last period. The quantitative and qualitative decrease in grape harvests and the damage to the vines in the vineyard plantations as a result of the occurrence of early autumn frosts, excessive negative temperatures, late spring frosts and the pronounced drought during the growing season, cause important losses for the wine heritage. The climate risk expressed through drought is a meteorological phenomenon harmful to viticulture that directly affects the production of grapes and is characterized by the lack of precipitation, low relative humidity and high potential evapotranspiration (Domuţa et al. 2000). The temperature factor has a double role on water consumption. Firstly, temperature directly intensifies the transformation of water into vapor, and secondly it increases the ability to maintain water vapor in a state of saturation (Popescu & Bucur 1999). Drought and desertification, a consequence of rising temperatures and other anthropogenic reasons, have become the main causes currently affecting (and in the future) the level and quality of harvests, as well as the health of agriculture and the environment in general. The evolution of the climate will lead to rethinking the vineyard zoning of varieties depending on their adaptation to the new climatic conditions that will be recorded in the future. In this paper, it was analysed how grape production was affected during two years with climate risk (a dry year and a year with major rainfall events).

MATERIAL AND METHOD

In order to evaluate the technological potential of some vine varieties and vine clones for wine grapes under climatic risk conditions, the'Bujoru', 'Blasius', 'Negru Aromat' varieties and the 'Muscat Ottonel 49 Bj' and 'Sarba 25/45' clones were studied during the years 2020-2021. The years observed were different: the year 2020 was particularly dry and the year 2021 was characterised by extreme rainfall events (hail). Grape production was analysed from a quantitative and qualitative point of view. The analysis of the mechanical composition of the grapes at harvest was carried out in order to calculate the technological indices. The technological indices characterize the quality of the grapes and the technological efficiency. At harvest, the number of grains (normal, beaded, affected by rot), the weight of the rachis, the mass of the must, the volume of the must, the mass of the pomace and the number of grains/100 gram clusters were determined.

RESULTS AND DISCUSSIONS

The action of the climatic factors during the vegetation period, especially during the ripening period, correlated with the genetic specificity of the varieties leads to obtaining grapes of exceptional quality. To monitor the annual climate factors with a major impact on the vineyard plantations in the 'Dealu Bujorului' vineyard, the climate data from the RDSVV Bujoru weather station (AGROEXPERT System) were used. The agroclimatic monitoring was carried out by recording and processing the minimum, maximum and daily average values of the air temperature, the actual insolation, the amount of precipitation and the relative humidity of the air. Based on the recorded climate data, the climate risk factors were established number of days with critical values per month and the frequency of occurrence of the risk factor (%).

The vegetation period of 2020 began in April and May with a deficient thermal regime, continued with average monthly temperature values comparable to the multi-annual one, except for September when a thermal surplus of 1.9^0C was recorded. In 2021, the average air temperature is deficient, having lower values than the multi-annual one for the entire vegetation period (table 1). The maximum air temperature was 37^0C/July 2020 and 35.9^0C/July 2021. Both in 2020 and in 2021 in April, minimum negative temperatures of -7.3^0C (2020) and -4.8^0C(2021)were recorded.

In the year 2020, the month of April is particularly dry, being followed by months with monthly precipitation at the multi-annual level. The character of a dry year is given by the uneven distribution of precipitation and their torrential character. Torrential rains were recorded, surrounded by long periods without precipitation. In 2021, the months of April, May, July and September have a water deficit. On August 2, 2021, a severe rainfall event occurred, with hail measuring between 0.5÷3.0 cm (Table 2). The average hygroscopicity during the vegetation period of 2020 is deficient and during the vegetation period of 2021 it is surplus compared to the multi-year average. Hygroscopicity correlates with average air temperature and precipitation. Throughout the analysed period, the insolation is superior to the perennial.

Table 1

Air temperature during the growing season, ^{0}C (2020-2021)

Month	Normal	2020			2021		
		Monthly average	Abs. Maximum	Abs. Minimum	Monthly average	Abs. Maximum	Abs. Minimum
IV	11.9	10.5	26.0	-7.3	8.4	22.8	-4.8
V	17.9	15.2	31.6	4.0	15.5	29.3	2.1
VI	21.8	21.4	34.2	2.6	19.8	33.3	8.4
VII	24.4	23.3	37.0	9.9	23.5	35.9	11.0
VIII	23.5	23.4	35.9	10.4	21.9	35.2	9.3
IX	17.4	19.3	34.0	4.8	15.4	29.2	2.8
Average	19.3	18.8	37.0	-7.3	17.4	35.9	-4.8

Table 2

Rainfall regime, hygroscopicity and insolation during the vegetation period

Month	Rainfall (mm)			Hygroscopicity %			Insolation (hours)		
	Normal	2020	2021	Normal	2020	2021	Normal	2020	2021
IV	37.5	2.8	16.7	66.53	41.7	84.9	168.0	255.5	178.4
V	45.8	42.6	28.5	64.24	57.9	62.9	239.5	204.5	235.6
VI	69.7	79.3	149.0	64.67	61.1	71.9	243.8	254.5	272.7
VII	54.7	72.8	30.8	63.01	51.8	64.8	269.7	348.0	319.2
VIII	45.9	47.9	45.8	62.35	50.2	64.1	256.6	333.5	300.0
IX	42.3	44.0	7.0	68.02	56.5	61.0	177.6	256.4	236.4
v.p.	296.0	289.4	277.8	63.29	53.2	68.3	1355.2	1652.4	1542.3

The frequency of occurrence of the spring frost risk factor is maximum in March 2021 (48.39%). Drought, as a result of average air temperatures higher than 30^{0}C, has a maximum frequency of occurrence in July and August 2020 (67.7% and 74.2% respectively) and 64.52% in July 2021 (Table 3).

Table 3

The risk factors recorded during the vegetation period of 2020-2021

Risk factor	Month	Number of days with critical values/month		Frequency of occurrence of the risk factor(%)	
		2020	2021	2020	2021
Spring frost Min. temp. <-2^{o}C	III	3	15	9.7	48.39
	IV	4	5	13.3	16.66
Drought Abs. Max. temp.> 30^{o}C	VI	13	6	43.3	20.00
	VII	21	20	67.7	64.52
	VIII	23	11	74.2	35.48
	IX	9	0	30.0	0.00

Climatic conditions directly influence grape production and its quality (table 4). The grapes were harvested at full maturity. In 2020, the harvest was carried out in the first decade of September for the 'Bujoru' variety and the 'Muscat Ottonel 49 Bj' and 'Şarba 25/45' clones and in the second decade of September for the 'Blasius' and 'Negru Aromat' varieties. In 2021, the harvest was carried out on September 14 for the 'Bujoru' variety and on September 29 for the other varieties and clones. The

determinations regarding the accumulation of sugars in the must show that the varieties ‘Bujoru’, ‘Blasius’, ‘Negru Aromat’ and clone ‘Şarba 25/45’ have a high potential for accumulating sugars in the must, being valuable from this point of view. Under the conditions of a dry year, the production of grapes is maximum for the ‘Blasius’ variety (2.42 kg/bunch) and minimum for the ‘Negru Aromat’ variety (1.834 kg/bunch). The hail of 2021 greatly affected the production of grapes depending on the development of the leaf apparatus and the stage of the phenophase of vegetation on the varieties. The most affected was the ‘Şarba 25/45’ clone, with the lowest grape production (0.513 kg/bunch).The mechanical analysis of the grapes highlighted obvious differences from one variety to another, depending on their biological potential and the climatic conditions of the years studied (Filimon Roxana et. al.2021). In a dry year, the number of normal grape grains in a kilogram of grapes is maximum for the ‘Black Aromat’ variety and minimum for the Bujoru’variety‘ (Table 5). The hail affected the grapes, the number of normal grains is lower than in the dry year. Many grains were affected by hail and rot. The most sensitive variety to hail was the clone ‘Muscat Ottonel 49Bj’, with 414 grains affected by hail and rot out of a total of 839 grains/1 kg of grapes. Based on the values of the grain composition index, the grain index, the grape composition index and the harvest index, the technological characteristics of the analyzed varieties were evaluated (Table 6). The grain composition index shows values lower than 5 in a dry year, indicating a higher proportion of skin and seeds that negatively affected must production. In 2020, it was highlighted that the genotypes did not reach the parameters specific to the production direction in which they fall. In a normal year, this index had values higher than 8. The grain index provides information on the size and weight of the grains. In 2020, the highest values were recorded for the ‘Muscat Ottonel 40 Bj’ clone (112.5) due to the small grains. In 2021, the highest values of this index were recorded by the ‘Negru Aromat’ variety (112.5). In both analyzed years, the yield index has low values, between 1.32 (‘Negru Aromat’/2020, ‘Blasius’/2021) and 2.12 (‘Şarba’/2020, ‘Muscat Ottonel 49 Bj’/2021), due to the grains with a small percentage of pulp and high percentage of skin and seeds.

The contribution of the vegetative part to the achievement of grape production was appreciated through a series of indices that express the balance between the growth and fruiting processes, namely: Ravaz index, which best expresses the ratio between growth and fruiting, and the vegetative-productive balance index whose values give information on the influence of some agrotechnical measures (fruit load) on grape production (Alexandrescu I.C. et. al. 1994). Analysing the Ravaz index, whose optimal values are between 4 and 8, it was found that in 2020 there was an optimal balance between growth and fruiting in ‘Bujoru’ and ‘Blasius’varieties(Table 7).In 2021, the Ravaz index is maximum for the Bujoru variety against the background of the drought in 2020, which led to a reduced mass of the vegetative apparatus. The vegeto-productive balance index in 2020 indicates favourable conditions for the accumulation of sugars in the grape seeds and had variable values between 18.42÷23.13. In 2021, the minimum values of this index were 7.6 (‘Bujoru’) and maximum 11.9 (‘Muscat Ottonel 49 Bj’).

Table 4

The quality of the grapes at harvest 2020-2021

Physico-chemical characteristic/ Variety	Bujoru		Blasius		NegruAromat		Muscat Ottonel 49 Bj		Şarba 25/45	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Harvest time	09.09	14.09	17.09	29.09	17.09	29.09	09.09	29.09	09.09	29.09
Sugars,g/L	247	238	259	259	250	256	211	261	240	266
Acidity, g/L tartaric acid	5.25	6.36	7.34	6.96	5.43	4.04	3.89	4.12	4.42	6.67
Production (Kg/bunch)	1.886	1.47	2.42	1.971	1.834	0.926	2.194	1.449	2.036	0.513

Table 5

Physical-mechanical analysis of one kg the grapes at harvest 2020-2021

Mechanical analysis/ Variety	Bujoru		Blasius		NegruAromat		Muscat Ottonel 49 Bj		Şarba 25/45	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Number of grains,	655	548	741	720	1125	1131	856	839	757	895
- normal	581	348	689	287	1046	614	767	415	669	352
- shot berries (meiate)	74	6	52	46	79	126	89	10	88	161
-rot+hail	-	194	-	387	-	391	-	414	-	382
The mass of the grains, g	950	958	960	954	946	950	961	951	961	959
The weight of the cob, g	50	42	40	46	54	50	39	49	39	41
The mass of the juice, g	629	590	569	641	592	631	679	615	637	629
The volume of the juice, cm^3	419	526	301	587	370	560	428	552	419	573
The mass of the marc, g	321	368	391	313	354	319	282	336	324	330
No. grains / 100 g bunches	65.5	54.8	74.1	72.0	112.5	113.1	85.6	83.9	75.7	89.5

Table 6

Technological indices of the grapes at harvest 2020-2021

Index/variety	Bujoru		Blasius		NegruAromat		Muscat Ottonel 49 Bj		Şarba 25/45	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Index composition of the grain	4.06	19	4.09	24.0	1.73	17.5	1.83	24.6	2.05	24.6
Index grains	65.5	65.5	67.4	74.1	74.1	112.5	112.5	85.6	85.6	75.7
Yield index	1.70	1.70	1.54	1.32	1.32	1.45	1.45	2.12	2.12	1.75

Table 7

Vegeto-productive indices 2020-2021

Genotype	Ravaz index		Vegeto-productive balance index	
	2020	2021	2020	2021
Bujoru	4.43	12.14	18.42	7.6
Blasius	4.25	9.30	19.04	9.3
NegruAromat	3.82	7.78	20.07	11.4
Muscat Ottonel 49 Bj	3.32	7.43	23.13	11.9
Şarba 25/45	3.38	1.43	22.85	11.1

CONCLUSIONS

1. The production of grapes and its quality in the two analysed years was influenced by the action of climatic factors recorded in correlation with the genetic specificity of each variety. In both years when the research was conducted, the analysed genotypes did not reach their biological potential (Donici Alina et. al. 2014). The risk factors of 2020 and 2021 affected grape production both quantitatively and qualitatively. Low values of the mechanical properties of the grapes led to a low must yield.

2. In the conditions of a dry year, the production of grapes was maximum in the 'Blasius' variety (2.42 kg/bunch) and minimum in the 'Negru Aromat' variety (1.834 kg/bunch). The hail of 2021 greatly affected the production of grapes depending on the development of the leaf apparatus and the stage of the phenophase of vegetation on the varieties. The most affected was the 'Şarba' 25/45 clone, with the lowest grape production (0.513 kg/bunch).

3. The evaluation of the technological properties of the varieties and clones was done by calculating and interpreting some indices that express the technological, economic and commercial value of the genotypes. The yield index had low values, between 1.32 ('Negru Aromat'/2020, 'Blasius'/2021) and 2.12 ('Şarba'/2020, 'Muscat Ottonel 49 Bj'/2021), due to the grains with a small percentage of pulp and high percentage of skin and seeds.

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