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INFLUENCE OF VARIETY ON THE GRAPE QUALITY OF STANUSHINA CULTIVAR

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ABSTRACT

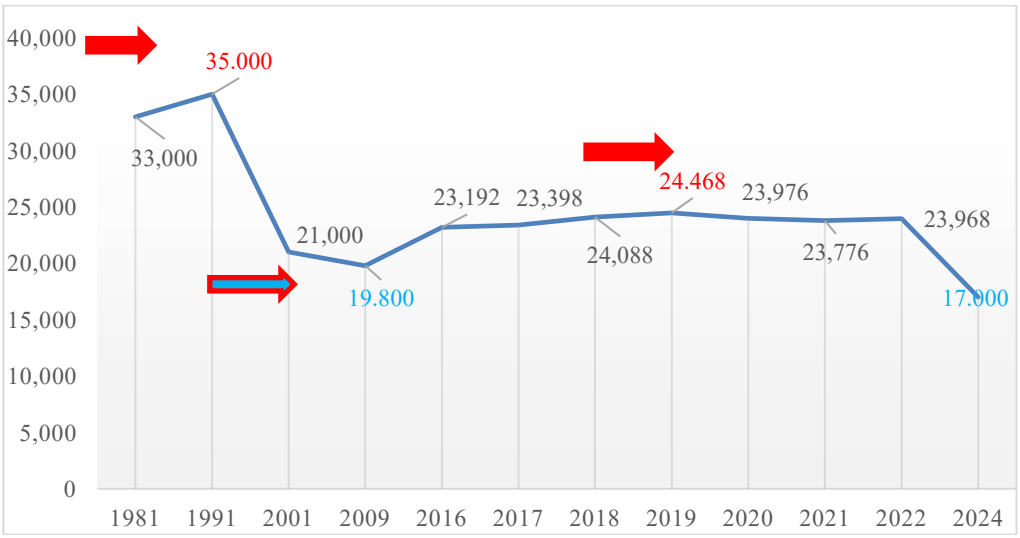
The Tikveš wine-growing region is the largest area for grape and wine production in the Republic of North Macedonia and is also the region with the highest concentration of the only native grape variety – Stanushina. This indigenous variety has been cultivated since ancient times in the Tikveš region and belongs to the ecological-geographical group of Black Sea varieties, subgroup *Balkanica*. Out of approximately 300 hectares of vineyards planted with Stanushina, more than 250 hectares are located in the Tikveš region. In other wine regions, this variety is very rare and typically found only as individual vines. Stanushina exists in several biotypes (varieties), with the following identified: black, pink (sura), and reulava Stanushina. The Black Stanushina variety is characterized by a dark blue skin coloration. The pink variant exhibits pink skin pigmentation, whereas the Sura variant is distinguished by looser cluster structure, with the presence of unfertilized or underdeveloped berries within the cluster (millerandage). This study presents a comparative analysis of two identified Stanushina varieties at two different micro-locations: the black variety was studied at the "Bela Češhma" site near the village of Resava, and the pink variety at "CrvenoBrdo," near the village of Begnište. Both sites use the vertical trellis (espalier) training system. The objective of this research is to determine the differences between the two varieties in terms of average bunch weight, yield, fertility, and overall grape quality. The comparative analysis showed us a higher shoot yield coefficient and shoot fertility coefficient in the pink variety (Sura), and a higher average bunch mass in the black Stanushina (variety).

Keywords: Stanushina, varieties, fertility, yield, grape quality

INTRODUCTION

The cultivation of grapevines, as well as the production of grapes and wine on the territory of the Republic of North Macedonia, has a long-standing centuries-old tradition. Numerous artifacts, records, and legends serve as evidence that grapevine cultivation in this region developed in parallel with the evolution of humankind and was often a fundamental means of livelihood for many families. (Ministry of Agriculture, Forestry and Water Economy – Strategy for Viticulture and Winemaking for the Period 2024–2033, 2024). The development of viticulture in the Republic of North Macedonia can be divided into two periods: the period before the appearance of phylloxera and the period after its occurrence. In the first period, vines were grown on their own roots, using low-trained systems and without supporting structures. During this time, the most common grape varieties included Stanushina, Beglerka, Ohrid White, Ohrid Black, Lisichina, Plovdina, and others. (Bozhinović, 2010). After the appearance of phylloxera and the destruction of the vineyards, the renewal of viticulture began. Initially, vineyards were replanted on the same areas that

had been cultivated before the outbreak of phylloxera. The use of grafted rootstocks was introduced, vines were grown using low-trained systems with dense planting spacing, and mechanized cultivation was not yet possible. (Bozhinović, 2010). Significant progress was achieved after the Second World War - a period marked by the introduction of more modern cultivation systems, the use of supporting trellis constructions, and changes in the range of grape varieties. During this period, the area under vineyards continuously increased, reaching over 30,000 hectares by the end of the 20th century. (Bozhinović, 2010). Historically, from a modest 14,000 hectares in the 1970s, the vineyard area expanded to a record 35,000 hectares in 1991. According to data from the State Statistical Office (SSO), the total vineyard area in the Republic of North Macedonia remained stable during the period from 2000 to 2023, averaging around 23,000 hectares. However, in 2024, a significant decline was recorded, with the vineyard area decreasing to 17,000 hectares. (Ministry of Agriculture, Forestry and Water Economy – Strategy for Viticulture and Winemaking for the Period 2024–2033, 2024).



Graph 1. Vineyard area in hectares (1980–2024)

Indigenous grape varieties represent the historical and cultural heritage of a country, as well as its natural wealth. They originate from a specific region or territory and continue to exist and be cultivated primarily or exclusively in the area from which they originate (Program for the Protection of Biological Diversity in Agriculture, 2011–2017). They reflect the place, culture, history, and local traditions, shaping the individuality and uniqueness of the region. For this reason, the interest in indigenous grape varieties is continuously increasing and has become a global trend (Program for the Protection of Biological Diversity in Agriculture, 2011–2017). Italy is currently the leading country in terms of the number of indigenous grape varieties, with a total of 350. In recent years, Portugal has positioned itself as a pioneer and leader in the propagation and preservation of biodiversity in viticulture. Considering territorial size, Portugal ranks first with 250 varieties, or approximately 2.7 indigenous varieties per square kilometer, followed by Italy with 1 variety, France with 0.4, and Spain with 0.3 varieties per square kilometer (Martins, A., 2023). The Tikveš wine-growing region accounts for the largest share of grape and wine production in the Republic of North Macedonia and is also the region where the country's only native grape variety, *Stanushina*, is most widely cultivated. (Bozhinović, 1998).

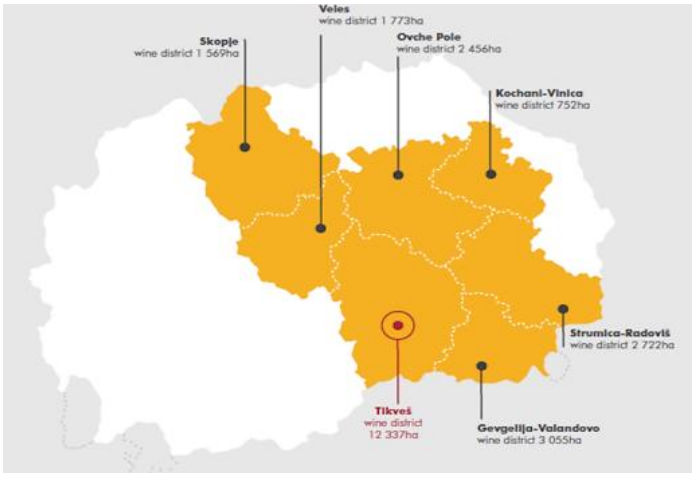


Figure 1. Tikveš wine region

Stanushina is the only domestic indigenous grape variety originating from the Tikveš wine region, where it has been cultivated since ancient times. After the phylloxera outbreak, it was replaced by other, higher-quality varieties. Today, covers an area of around 300 hectares, mainly within the Tikveš region, while in other wine regions it can be found only as individual vines. (Bozhinović, 1998). The variety belongs to the ecological–geographical group of Black Sea grape varieties, subgroup *balkanica*. It is characterized by good productivity and is considered a high-yielding variety. It thrives particularly well on poor, dry, and calcareous soils and demonstrates strong drought resistance.

Table 1. Vineyard area of the Stanushina variety in the Tikveš wine region

Location	Kavadarci	Begnište	Resava	Disan	Drenovo	Vataša	Dabnište	Raec	Debrište	Brušani	Fariš	Negotino	Sirkovo	Marena	Glišik	Conor	Demir	Šivec	Kamen Do	Total
ha	46.5	42.3	37.8	26.4	25.4	13.8	9.5	8.5	7.3	6.9	6.2	5.6	3.4	3.3	2.4	1.8	1.0	0.6	0.4	249.1

It is also resistant to common grapevine diseases (downy mildew, powdery mildew, gray rot) and to low temperatures (tolerating down to -19°C) (Bozhinović, 2010). The native *Stanushina* variety should remain part of the Tikveš wine region's assortment, primarily in dry, poor, and limestone soils. It is a variety that makes the most rational use of low-quality terrain and is among the most drought-resistant grape types. For this reason, it remains most widespread in the areas around the city of Kavadarci, with 46.47 ha, followed by the villages of Begnište with 42.34 ha, Resava with 37.80 ha, Disan with 26.4 ha, and Drenovo with 25.43 ha (Beleski, 2022). *Stanushina* is a domestic indigenous variety that exists in several biotypes (varieties). There are three known variants: Black, Pink (or "Sura"), and "Reulava" Stanushina (Beleski, 1999). The varietys is characterized by:

1. The black variety
   - Uniform berry coloration within the bunch
   - Good technological characteristics
   - Strong enological potential
   - Higher sugar content
   - Most widespread type

Figure 2. Black Variety

2. Pink ("Sura") variety
   - Uneven berry coloration
   - Greenish and pinkish berries dominate
   - High yields
   - Lower enological potential
   - Higher acidity

Figure 3. Pink variety

3. "Reulava" (Infertile) Stanushina
   - Not fertilized
   - Defects in the fruit
   - No production value

Figure 4. "Reulava" (Infertile) Stanushina

MATERIALS AND METHODS

The objective of our research was to determine the differences between the two *Stanushina* varieties in terms of average cluster weight, yield, productivity, and grape quality. The comparative analysis showed a higher coefficient of shoot fertility and productivity, as well as higher total acidity in the must of the pink ("Sura") variety, whereas the black *Stanushina* variety demonstrated a higher average cluster weight and a higher sugar content in the must. In our study, a comparative analysis was carried out between two identified (determined) varieties located in two different micro-locations. The first site is situated at the micro-location "Bela Češhma," near the village of Resava, close to Lake Tikveš, at an altitude of 300 meters, covering a total area of 0.7 hectares. The vineyard was established in 1995, and the black variety was studied there.

Figure 5. Micro-location Bela Češhma, Village of Resava (Black Variety)

Figure 6. Micro-location Crveno Brdo, Village of Begnište (Pink Variety)

The second site is located at the micro-location "Crveno Brdo," near the village of Begnište, at an altitude of 400 meters, covering an area of 0.3 hectares. This vineyard was established in 1992, and the pink variety was examined there. Both micro-locations employ the trellis (espalier) training system for grapevine cultivation.
The following parameters were examined:
- Percentage of developed/undeveloped buds on shoots

- Percentage of fertile shoots
- Coefficient of bud fertility
- Coefficient of shoot fertility
- Coefficient of shoot productivity
- Yield
- Technological characteristics (cluster weight, sugar content, and total acidity in the must for both varieties)

The results was descriptively processed, determined the median as the middle number to confirm the average, statistical deviation and the coefficient of variation. Also, through analysis of variance and the LSD test, was determined significance at the level of 0.5.

RESULTS AND DISCUSSION

The percentage of undeveloped buds on shoots in the black *Stanushina* variety was 25.7%, while in Variant 2 (the pink variety), it was 18.2%. The obtained results for the percentage of undeveloped buds on shoots in both varieties fall within the general varietal characteristics of *Stanushina*. However, in Variant 1 (the black variety), the percentage of undeveloped buds on shoots was 7.5% higher compared to the pink variety.

Table 1. Percentage of developed/undeveloped buds on shoots

	Bud		I	II	III	IV	V	VI	$\bar{x}$	Media	STDE	VC	LS
Variant 1	Developed	%	72	81	72	91	63	55	74	77	15.81	21.2	7.2
	Undeveloped		25	18	21	4	36	50	25.7				
Variant 2	Developed	%	72	81	95	91	81	63	82	84	10.85	13.2	
	Undeveloped		29	17	5	10	15	33	18.2				

* *Shoot* = young vine shoot formed from a bud during the vegetation period * *Bud* = dormant eye (node),
* *Variant 1* = black variety, * *Variant 2* = pink variety

Median shows an increasing tendency of the average in both variants, by three units in variant 1 and two in variant 2. Also, in terms of the percentage of developed/undeveloped buds on shoots, variant 2 shows a statistically significant difference compared to variant 1.

Table 2. Percentage of native shoots

Bud	I	II	III	IV	V	VI	$\bar{x}$	Median	STDEV	VC	LSD
Variant 1	77	88	95	96	83	100	89.8	91.5	8.8	9.7	3.7
Variant 2	84	94	90	94	100	92.4	92.4	93.2	5.3	5.7	

* *Shoot* = young vine shoot formed from a bud during the vegetation period * *Bud* = dormant eye (node),
* *Variant 1* = black variety, * *Variant 2* = pink variety

In Table 2, the percentage of fertile shoots for both *Stanushina* varieties is presented. For Variant 1 (the black variety), it amounted to 89.8%, while for Variant 2 (the pink

variety), it was 92.4%. The obtained results for both varieties are within the expected varietal characteristics. Nevertheless, Variant 2 (the pink variety) showed a higher percentage of fertile shoots by approximately 2.6% compared to the black variety. The median shows an increasing tendency of the average in variants, bigger in variant 1, but without significant differences between variants.

Table 3. Coefficient of bud fertility

Bud	I	II	III	IV	V	VI	$\bar{x}$	Median	STDEV	VC	LSD
Variant 1	0.71	0.96	1.18	1.68	1.08	1.00	1.10	1.04	0.32	29.41	0.20
Variant 2	1.00	1.26	1.40	1.65	1.30	1.28	1.32	1.29	0.21	16.07	

* *Shoot* = young vine shoot formed from a bud during the vegetation period * *Bud* = dormant eye (node),
* *Variant 1* = black variety, * *Variant 2* = pink variety

Variant 2 the pink variety, has a higher coefficient of bud fertility (1.32), in relation to variant 1 (1.04) and difference from 0.22% (Table 3). The median as the middle number of the series shows decreasing tendency of the average in both variants, lower in variant 1 comparing with variant 2. Additionally, bud fertility in the variant 2 shows a significant difference compared to variant 1, in the determination of the coefficient.

Table 4. Coefficient of shoot fertility

Bud	I	II	III	IV	V	VI	$\bar{x}$	Median	STDEV	VC	LSD
Variant 1	1.00	1.24	1.50	1.74	1.60	1.45	1.42	1.48	0.26	18.63	0.08
Variant 2	0.74	1.52	1.47	1.83	2.00	1.48	1.51	1.50	0.43	28.75	

* *Shoot* = young vine shoot formed from a bud during the vegetation period * *Bud* = dormant eye (node),
* *Variant 1* = black variety, * *Variant 2* = pink variety

The same like previous parameter, variant 2 has a higher (1.51) average coefficient of shoot fertility, compare to variant 1 (1.42). The median shows insignificant decreasing tendency of the average in variant 1, and increasing in variant 2, but without statistically significant difference between variants. The coefficient of shoot productivity for both varieties is shown in Table 5. For the black variety, it amounted to 1.64%, while for the pink variety, it was 1.74%.

Table 5. Coefficient of shoot productivity

Bud	I	II	III	IV	V	VI	$\bar{x}$	Median	STDEV	VC	LSD
Variant 1	1.23	1.35	1.57	1.81	1.87	2.00	1.64	1.69	0.31	18.68	0.10
Variant 2	1.36	1.64	1.64	1.94	2.17	1.66	1.74	1.65	0.28	16.21	

* *Shoot* = young vine shoot formed from a bud during the vegetation period * *Bud* = dormant eye (node),
* *Variant 1* = black variety, * *Variant 2* = pink variety

The middle number of the series for coefficient of shoot productivity shows an increasing tendency of the average in variant 1, but decreasing in for almost one units (1.65) in variant 2, with is significant reduction from average. For this parameter between the two variants has not been determined statistically significant differences (Table 5). Average cluster weight for both varieties presented in the Table 6. obtained results in black variety from 196 g and 179 g in the pink variety and weight differences by 17 grams.

Table 6. Average bunch weight

	1	2	3	4	5	6	7	8	9	10	11	$\bar{x}$	Median	STDEV	VC	LSD
Variant 1	210	190	188	195	205	211	200	190	185	185	199	196	195.0	9.5	4.9	16.3
Variant 2	205	184	170	165	185	174	191	170	177	168	181	179	177.0	11.8	6.6	

* Grape= fruit of the grapevine composed of several grains **Variant1*=black variety, * *Variant 2* = pink variety

The median did not show a significant decrease from the obtained mean values in the variants, i.e. a value of 1 g in variant 1 and a decrease of 2 g in variant 2. The LSD test at the 0.05 level showed a statistically significant difference in the values in variant 2 compared to variant 1. The sugar content and total acidity in both variants were determined through basic physicochemical analyses (Table 7). On average, 178.5 g/L sugar in must was determined for both variants. Higher values of 181 g/L was determined in variant 1 or 1.4% higher than variant 2 in relation to the average.

Table 7. Percentage of sugar content and total acidity in the must of the two *Stanushina* varieties

		Sugar in must (g/L)	Total acidity (g/L)
Variant 1 (Black variety)		181	6.2
Variant 2 (Pink variety)		176	6.7
$\bar{x}$		178.5	6.45
% of $\bar{x}$	Variant 1 (Black variety)	1.4	-3.9
	Variant 2 (Pink variety)	-1.4	3.9

**Must* = unfermented juice from crushed grapes

The average total acidity for both variants are 6,45 g/l, higher was determinating in the pink variety 6.7 g/l, and for the 3,9% lower in black variety. The obtained values for sugar content and total acidity are in consistent with the technological and oenological characteristics of varieties.

CONCLUSIONS

The influence of the variety on the quality of the two Stanushina varieties, in addition to the varietal characteristics, production-technological and enological properties, can also be determined based on several parameters that were of interest in this research. Results for percentage of developed/undeveloped buds on shoots, shows 82 % in variant 2 and statistically significant difference compared to variant 1 (74%). In determination of the bud fertility coefficient, variant 2 shows a significant difference of 1.32 compared to variant 1. Results for percentage of native shoots, coefficient of shoot fertility and productivity has not been determined by statistically significant differences between the two variants. Average bunch weight of 196g in variant 1 showed a statistically significant difference in the values in compared to variant 2. Sugar content in variant 1 is for 1.4% higher than variant 2, and higher total acidity was exterminating in the pink variety for the 3,9% in relation to the average. We recommend the selection and establishment of mother plantations for the propagation of the variety, especially the black variety, which would increase the area and preserve the indigenous Stanushina variety.

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