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THE MODERN TECHNOLOGIES AND DEVELOPMENT PROSPECTS OF THE VITICULTURE INDUSTRY IN THE ATU GAGAUZIA

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Abstract. The article aims to understand and address the challenges within viticulture, focusing on investigating the reasons behind the low efficiency of utilizing viticultural production potential amid contemporary challenges. The research explores new approaches to ensure the sustainability of viticulture, examining the potential applications of innovative cultivation technologies to enhance the quality and yield of grapes. The article presents effective solutions aimed at fostering the sustainable development of viticulture within the unpredictable conditions of agricultural production.

Key words: Cabernet Sauvignon, Clone R5, Development, Growth, Productivity, Vines.

Резюме. Статья нацелена на понимание и разрешение проблем виноградарства, сфокусированных на исследовании причин низкой эффективности использования производственного потенциала виноградарства в условиях современных вызовов. Исследования рассматривают новые подходы к обеспечению устойчивости виноградарства, изучают возможности применения инновационных технологий возделывания для улучшения качества и урожайности винограда. В статье предложены эффективные решения, способствующие устойчивому развитию виноградарства в нестабильных условиях сельскохозяйственного производства.

Ключевые слова: Каберне-Совиньон, Клон R5, Развитие, Рост, Продуктивность, Кусты.

The development of viticulture and winemaking in ATU Gagauzia is determined by favorable soil and climatic conditions in this region, which is a key factor in shaping the potential for creating a modern and competitive industry [1]. The adoption of the Program for the Recovery and Development of Viticulture and Winemaking at both the national level of the Republic of Moldova and within the framework of the Autonomy underscores the importance and priority of this sector [2, 3].

The main goal of the regional program is to establish modern viticulture capable of producing high-quality grapes that meet market demand and exhibit high economic efficiency. One of the key objectives currently is to increase the area of vineyards planted with high-quality saplings of enhanced biological value and to implement new methods in vineyard arrangements. This aims to rejuvenate and enhance agricultural practices to ensure higher quality and productivity of grapes. Agricultural producers are directing efforts towards modernization and development, facilitating the reorientation of viticulture towards more productive and efficient cultivation methods. The utilization of new cultivation techniques and clones adapted to the region's climatic conditions is

fostering the creation of a sustainable and competitive winemaking industry. The implementation of these new methods and technologies not only contributes to increasing the production of high-quality grapes but also enhances resource efficiency, improves resilience to environmental challenges, and creates favourable conditions for the development of the winemaking sector [4]. This, in turn, ensures the stable development of agriculture, enhances the economic prosperity of the region, and strengthens its position in domestic and global markets.

Increasing the efficiency of grape production is a challenge that has engaged numerous scientists, and the outcomes of their research play a pivotal role in addressing this issue [5].

However, despite the potential of viticulture, existing issues within the industry stem from a range of objective and subjective factors. Financial crises in viticulture and winemaking have limited the development opportunities within this sector, failing to match its potential. Many grape-growing enterprises have faced financial difficulties and have been compelled to revise their strategies, replacing viticulture with less costly sectors. This has led to a reduction in vineyard areas within agricultural enterprises [6]. It's crucial to pay attention to these challenges and issues, as well as the solutions proposed by researchers, to find ways to enhance the efficiency of viticulture. Analyzing the current situation and taking steps to ensure the sustainability of this crucial agricultural sector is essential.

In this article, we aim to contribute to the understanding and resolution of viticulture issues. Our research focuses on identifying the reasons behind the low efficiency in utilizing viticulture's production potential amidst modern challenges. We explore new approaches to ensuring the sustainability of viticulture and winemaking, investigating the possibilities of applying innovative technologies to enhance grape quality and yield. Our studies are aimed at identifying optimal strategies to overcome the financial and economic challenges faced by this industry. We strive to offer practical solutions and recommendations that foster increased efficiency in viticulture, maintaining its competitiveness and strengthening market positions.

Our goal is not only to pinpoint the problems faced by grape growers but also to propose specific, realistic, and effective solutions to support sustainable viticulture development in the variable conditions of agriculture.

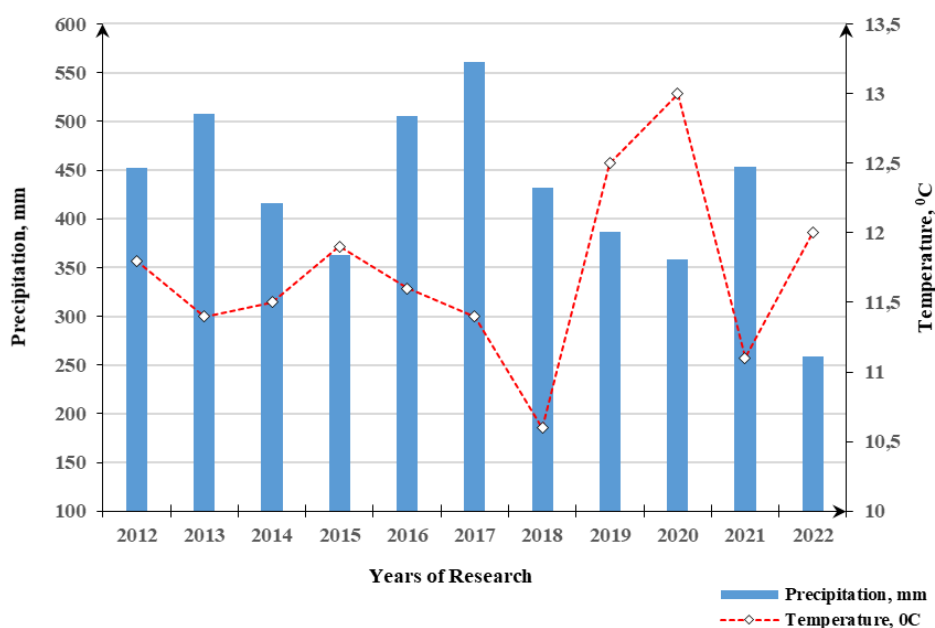


Figure 1. Meteorological Conditions in the Ceadr-Lunga District, Autonomous Territorial Unit of Gagauzia, Throughout the Research Years.

(according to the data from the meteorological station in the city of Ceadîr-Lunga)

The analysis of meteorological data from 2012 to 2022 revealed unstable levels of precipitation and average annual temperatures during the examined period. For instance, the amount of annual precipitation fluctuates widely, ranging from 258 mm to 560.4 mm. The most favourable year in terms of precipitation was 2017. Average annual temperature values varied between 10.6°C and 13.0°C. It was found that in 2020, an increase in average annual temperatures (13.0°C) was accompanied by a decrease in precipitation to 357.8 mm, negatively affecting the growth and development processes of grapevines. This impacted the 2020 harvest and subsequent formation of embryonic flower clusters for 2021. In 2022, a similar trend is observed: average annual temperature indicators rise to 12.0°C, while the amount of precipitation decreases to 258.9 mm.

An analysis of meteorological conditions in the Autonomous Territorial Unit of Gagauzia in recent years reveals that their variability and instability significantly impact grape cultivation processes. Fluctuations in temperature and precipitation negatively affect grapevines, thereby impacting their yield. These unpredictable weather factors pose a significant challenge for agronomists and researchers, highlighting the necessity of developing more resilient grape-growing methods that account for the variability of meteorological conditions and their impact on plants.

Intensification of the grape-growing industry implies the systematic improvement of technologies, processing methods, and production organization, along with the implementation of productive varieties and cutting-edge scientific developments [7]. Achieving these goals became possible due to the strict adherence by grape-growing enterprises to production technology recommendations.

Effective grape cultivation relies heavily on the careful selection of grape varieties and clones. This selection significantly impacts the final quality and quantity of grape and wine production. This process demands not only extensive knowledge about various grape varieties and their characteristics but also an understanding of market demands and changing climatic conditions. The selection of suitable grape varieties and clones helps optimize yields, ensures consistent product quality, and fosters the sustainable development of the grapevine industry. Continuous analysis and adaptation of the grape assortment are crucial strategic steps for successful and long-term operations in this field.

According to the analysis of the Grape and Wine Registry of the Republic of Moldova [8], it has been determined that in the ATU Gagauzia, 54 varieties of grapes are cultivated, comprising 30 technical and 24 table grape varieties. This diverse range of grape varieties stands as a pivotal asset for the development of viticulture and winemaking in the region. It provides an opportunity for further exploration and utilization of various characteristics of these varieties, thereby contributing to enhancing the quality of produced grape-based products and enriching the diversity of wines available in the market.

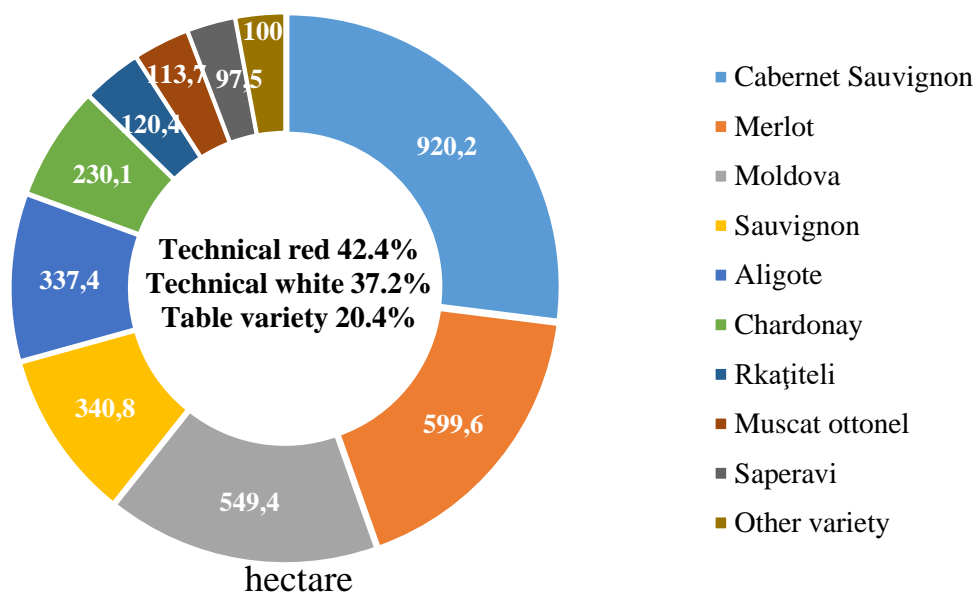


Figure 2. Grape Varieties cultivated in ATU Gagauzia.

(according to the analysis of data from the Grape and Wine Registry of the Republic of Moldova [8]).

The Autonomous Territorial Unit of Gagauzia encompasses 4,562.8 hectares of productive grape plantations. The predominant portion, constituting 79.6% of this area, comprises technical grape varieties, of which 42.4% are technical red and 37.2% are technical white grapes. In contrast, table grape varieties occupy 20.4% (Figure 2). The primary red technical grape cultivars include Cabernet Sauvignon, Merlot, and Saperavi. Among the white technical grape varieties is Sauvignon, followed by Aligote and Chardonnay. Moldova stands as the most prominent variety among table grapes, trailed by Rannii Magaracea and Alb de Suruceni.

At the vineyards in ATU Gagauzia, the adoption of modern grapevine care methods is increasingly observed. This encompasses mechanized processes like machine pruning, shoot thinning, soil cultivation, and harvesting. These innovations not only alleviate physical strain on workers but also enhance the efficiency and accuracy of these procedures. The implementation of modern methods reduces the reliance on manual labour, ultimately cutting down on costs in grape cultivation and winemaking. This facilitates an increase in production and positively influences the development of the industry in the region.

Due to the dominant presence of the Cabernet Sauvignon variety in the vineyards of the Autonomous Territorial Unit of Gagauzia, we have chosen it for conducting an analysis of grapevine growth, development, and productivity in the context of agroecological factors specific to this autonomous region. This choice will enable us to gain a deeper understanding of how this variety adapts to the region's conditions and which aspects of its cultivation can be optimized to enhance crop yield and quality. The research was conducted on the introduced clone R5 of the Cabernet Sauvignon variety of Italian selection, which was imported to the Republic of Moldova in 1999.

Table 1. The Growth, Development, and Yield Parameters of the Clone R5 Cabernet Sauvignon onto Kober 5BB in the Agroecological Conditions of the ATU Gagauzia. SC «Tomai-Vinex» SA.

Years of Research	Parameters			
	Number of Shoots, pcs./vine	Volume of One-year Growth dm ³ /vine	Leaf Area m ² /vine	Fruit yield per vine, kg/vine
2015	40.4±0.34 c	2.72±0.02 d	12.4±0.23 d	4.37±0.09 c
2016	41.0±0.31 c	2.99±0.02 c	15.0±0.15 c	5.39±0.07 b
2017	44.2±0.26 a	4.47±0.03 a	19.9±0.11 a	6.11±0.09 a
2018	43.1±0.20 b	3.49±0.03 b	18.3±0.13 b	5.94±0.14 a
2019	41.2±0.19 c	2.73±0.03 d	12.3±0.23 d	4.47±0.08 c
2020	31.5±0.25 e	0.51±0.01 f	6.1±0.07 f	1.82±0.08 e
2021	37.5±0.20 d	1.13±0.02 e	9.5±0.08 e	3.42±0.10 d
Mean ± SE	39.8±0.48	2.58±0.15	13.4±0.54	4.50±0.17
f-Value	278.26	2934.96	962.5	260.24
p-Value	<0.001	<0.001	<0.001	<0.001

**The effects over the years of the research were determined by conducting a one-way analysis of variance (ANOVA). Differences between the mean values of the years were evaluated according to the Tukey's posthoc test (HSD). Values are expressed as mean ± standard deviation (n=10). Values marked with different letters significantly differ.*

The number of shoots varied throughout the research period (Table 1). We found that during the study period, an average of 39.8 ± 0.48 shoots formed per vine of the Clone R5 Cabernet Sauvignon. The highest average number of shoots was observed in 2017 (44.2 ± 0.26), while the lowest was in 2020 (31.5 ± 0.25). Statistically significant differences in the number of shoots among the years of the study were detected (f-Value = 278.26, p-Value <0.001).

It has been established that the R5 clone of Cabernet Sauvignon, grafted onto the BxR Kober 5BB under the conditions of SC «Tomai-Vinex» SA, develops an Average Volume of One-year Growth of 2.58 ± 0.15 dm³/vine over the years of the study. The highest results were recorded in 2017, reaching 4.47 ± 0.03 dm³/vine. Significant differences in these parameters have been observed across the years of the study (f-Value = 2934.96, p-Value <0.001).

The average Leaf Area reaches 13.4 ± 0.54 m²/vine, representing a high parameter that contributes to high yields and sugar accumulation in grape berries. This high Leaf Area plays a crucial role in the photosynthesis process, determining carbohydrate production and sugar accumulation in the berries. The increased Leaf Area ensures more efficient sunlight absorption, promoting the formation of higher-quality grape yields [9]. Additionally, this may enhance resilience to various stress conditions, which is crucial for ensuring quality grape harvests in fluctuating weather conditions. It's noted that this indicator also varies across the study years and is significantly reduced in the year 2020, potentially due to decreased precipitation.

Yield is the final metric denoting the effectiveness of cultivating crops, representing the quantity of produce generated within a specific timeframe. It stands as a pivotal measure in assessing agricultural process efficiency, depicting the outcome of efforts put into each grapevine.

Yield is closely tied to various factors, such as meteorological conditions, soil types, cultivation methods, maintenance practices, fertilization, and technological approaches. Yield outcomes not only mirror production success but also its resilience to fluctuating grape-growing conditions. It has been established that the average yield of the R5 clone Cabernet Sauvignon, under the conditions of SC «Tomai-Vinex» SA, amounts to 4.50 ± 0.17 kg per vine. Growth and development parameters of the Shoots, the One-year Growth, and the Leaf Area, which vary depending on meteorological conditions during the research period, directly influence the grapevine yield. The high yields observed in 2017 and 2018 correspond to periods with more favourable weather conditions, likely contributing to optimal plant growth and development. In 2020, during less favourable weather conditions, the yield significantly decreased, confirming the impact of weather conditions on grapevine productivity (f-Value = 260.24, p-Value <0.001).

CONCLUSION

The results of the conducted research give grounds to draw the following conclusions:

1. The meteorological conditions during the years of research in the ATU Gagauzia were variable. More favorable in 2017-2018 and less favorable in 2019-2020. Unfavorable conditions were linked to a sharp decrease in precipitation and high temperatures during the growing season.
2. It has been established that the varying meteorological conditions across the years of the study significantly influence the growth, development, and productivity processes of the R5 clone of Cabernet Sauvignon grapevines, under the conditions of the SC «Tomai-Vinex» SA enterprise.
3. In favourable meteorological years, the vineyards of the R5 Cabernet Sauvignon clone grafted onto the BxR Kober 5BB rootstock, are characterized by the following indicators: the development of 44.2 ± 0.26 shoots per vine, a Volume One-year Growth of 4.47 ± 0.03 dm³/vine, a Leaf Surface Area reaching 19.9 ± 0.11 m²/vine, and a Yield of 6.11 ± 0.09 kg per vine. In unfavorable years, these indicators decrease by 1.4 to 3.3 times.
4. The technology for cultivating the R5 clone of Cabernet Sauvignon in ATU Gagauzia, exemplified by the SC «Tomai-Vinex» SA company, is at a high level of agricultural practices. The utilization of mechanized technological operations, innovative methods in growth management, and vine care contribute to improving production quality and increasing vineyard yield at the enterprise.

REFERENCES

1. CARA, S. *Viticulture Industry of ATU Gagauzia and its Development in Modern Conditions*. BAHÇE. Journal of Atatürk Central Horticultural Research Institute. Yalova, Turkey, Vol: 49 Special Ed.: 1, 2020, ISSN 1300-8943, p.287-291.
2. *The Program for the Restoration and Development of Viticulture and Winemaking in the Years 2002-2020/ HG nr. 1313 / 07.10.2002*. În: Monitorul Oficial al Republicii Moldova, [online], 142 / 17.10.2002, art. 1448) [citat 17. 03. 2020]. Disponibil: https://www.legis.md/cautare/getResults?doc_id=27089&lang=ro
3. *The Viticulture Development Program of the ATU Gagauzia for the period of 2008-2020*. Agricultural Complex of ATU Gagauzia, 2007, p.35.

4. CARA, S. *Innovative elements in the grape cultivation technology in the conditions of the ATU Gagauzia*. International Scientific and Practical Conference “Science. Education. Culture. CSU, Journal, Volume I, Comrat, 2023, pp. 321-326. ISBN 978-9975-83-255-7.
5. CARA, S. *Growth and productivity of vineyards depending on planting material quality*. Monograph. Comrat State University, A&V Poligraf SRL, 2021. ISBN 978-9975-83-165-9, Comrat, Republic of Moldova, 194 p.
6. PARMACLI, D., CARA, S. *Analysis of the State of Grape Cultivation in ATU Gagauzia*. Vector European. Revistă științifico-practică Nr. 2/2021. Chișinău 2021, p.113-125. ISSN 2345-1106 E-ISSN 2587-358X. <https://doi.org/10.52507/2345-1106.2021-2>
7. CARA, S. *Analysis of the Development of the Viticulture Industry in ATU Gagauzia*. London International Conferences. UKEY Consulting and Publishing, London, United Kingdom. ISBN: 9798747509795, 2021, p. 85-88.
8. Vine and Wine Register Republic of Moldova - <https://rvv.gov.md/publicpart/overview.jsf>.
9. CARA, S. *Development of the leaf surface the clone R5 Cabernet Sauvignon variety in the Southern region the Republic of Moldova*. 5th International Agriculture Congress. UTAK 2022, [online]. Proceeding Book, 2022, p.125-131. ISBN: 978-605-80128-8-2.

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