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The Quality of Grapes of the Moldova Variety According to the Foliar Fertilization System in the Phenophase of the Berry Growth

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RESEARCH ARTICLE

Abstract

The fertilization of the vineyards is an important and sometimes decisive technological process in the production technology of table grapes. Knowing the nutritional needs of the grapevine in different phenophases ensures obtaining homogeneous, quantitative and qualitative harvests, but also increases the plants' resistance to adverse environmental conditions. The aim consists in the analysis of the quality indices of the Moldova table grape variety, following the application of Ca treatments, in the phenophase of berry growth. In the research, different variants of application of treatments with Ca (Calcinite) were studied, with 1-4 treatments, in different periods. Observations, measurements and determinations were carried out in the field, as well as chemical laboratory analyzes according to the methods approved in viticulture. The growth of the berries on the vine begins a few days after flowering and lasts until the grapes enter the field. Following the study, a positive influence of calcium treatments on grain firmness was observed in the variants with the highest number of foliar applications. The use of individual or combined calcium fertilization of the Moldova variety in the production conditions with 1-4 post-fertilization treatments, depending on the conditions of the year, positively influenced the quality of the harvest.

Keywords: grapes, fertilization, Moldova, quality, phenophase, variety

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INTRODUCTION

The viticulture and wine sector has a significant influence on the national economy of the Republic of Moldova. This is due to favorable environmental conditions for the cultivation of vines, adaptability to climate change, but also centuries-old traditions and accumulated experience. An important area of the viticulture and wine complex is the table grape production sector. (Nicolaescu and Cazac, 2012). During the last years, the consumption of fresh grapes is increasing, due to their taste and healing properties, but also the increasing trend towards a healthy diet. (Nicolaescu and Cazac, 2012). The main factors that influence the growth and harmonious development of the vines, but also the obtaining of quality harvests, are: the biological characteristics of the variety and the rootstock, the pedoclimatic conditions and, last but not least, the technological peculiarities of cultivation (planting scheme, the canopy management, fertilization, irrigation, phytosanitary protection). (Reynier, 2012). Currently, in order to obtain high-quality, homogeneous harvests but also to increase the productivity of vineyards, foliar treatments with micronutrients are widely applied in grapevine cultivation technology. Through foliar fertilization, the elements needed by the plant are delivered directly to the leaves, flowers or berries, with the aim of complementing the basic fertilization, offering greater efficiency.

Foliar absorption of nutrients is influenced by several factors: relative air humidity, moderately high temperatures, photosynthetic radiation. It was also found that young leaves are more penetrable than fully developed leaves. (Moreno, 2009)

During the growing season, the nutrient requirement of the vine differs from one growing phase to another. Knowledge of the agro-technological requirements for vine cultivation, as well as the implementation of modern technologies, ensure the achievement of quantitative and qualitative stability.

The rational use of fertilizers ensures the obtaining of superior, relatively stable grape yields, without decreasing quality or resistance to diseases and pests, frost and drought. Balanced mineral nutrition, along with favorable climatic factors, causes an increased accumulation of sugars, anthocyanins and aromatic substances in grapes (Bucur, 2011).

Correct fertilization of vines is a crucial component of technology that can have a significant impact on quality and on quantity of grape harvests. Rational use of fertilizers contributes to the development of a healthy plantation with good yields and with quality production. (Oslobeanu et al, 1980).

The application of calcium treatments during the vegetation period of the grapes is very important, because calcium is part of cell walls, vacuoles and is fundamental for the activity of cell membranes. At the same time, it increases the mechanical resistance of plant tissues and participates in the activation of many enzymes, the accumulation of carbohydrates and the development of the rachis. (Colapietra, 2023).

The aim consists in the analysis of the quality indices of the Moldova table grape variety, following the application of Ca treatments, in the phenophase of berry growth.

The research was carried out in the Codru or Centru wine region, Pascani village, Criuleni district, Republic of Moldova.

This region is characterized by favorable pedoclimatic conditions for the cultivation of table grapes.

MATERIALS AND METHODS

The vineyard was established in 2006, with the Moldova variety. The training system of the vines is the bilateral horizontal cordon, the two-plane vertical trellis. Planting distances are 3x1,5 m, the pruning system is cane system. The variety was grafted on Berlandieri x Riparia SO4. The number of buds left after pruning were 32. The experiences were carried out in the years 2013-2015, 2022. Observations and analyzes were carried out in accordance with approved and recommended methods for viticulture.

In the research, different variants of application of treatments with Ca (Calcinite) were studied, with 1-4 treatments, in different periods. The 1-st treatment was applied 7-10 days after flowering, the 2-nd 14-18 days after the 1-st treatment, the 3-rd treatment 14-18 days after the 2-nd treatment and the 4-th treatment 14-18 days after the 3-rd treatment. For the 1-st and 2-nd treatment we used 3,6 kg/ha Ca, for the 3-rd and 4-th treatment we used 7,2 kg/ha Ca. The treatments were effectuated with manual pump.

Observations, measurements and determinations were carried out in the field, as well as chemical laboratory according to the methods approved in viticulture. The sugar concentration in grapes was effectuated according to method OIV-MA-AS2-02: "Evaluation by refractometry of the sugar concentration in grape musts, concentrated grape musts and rectified concentrated grape musts". Determination of titratable acidity was effectuated according to method OIV-MA-AS313-01: „Total acidity".

Table 1. The scheme of calcium treatments

Variants	The frequency and term of the treatments			
	1	2	3	4
V-1	1	x	x	x
V-2	1	2	x	x
V-3	1	2	3	x
V-4	1	2	3	4
V-5	x	2	x	x
V-6	x	2	3	x
V-7	x	2	3	4
V-8	x	x	3	4
V-9	x	x	3	4
V-10	x	x	x	4
Control (M)	x	x	x	x

RESULTS AND DISCUSSIONS

The growth of the berries on the vine begins a few days after flowering and lasts until the grapes enter the vineyards (Perstniov et al, 2000). Following the study, a positive influence of calcium treatments on grain firmness was observed in the variants with the highest number of foliar applications.

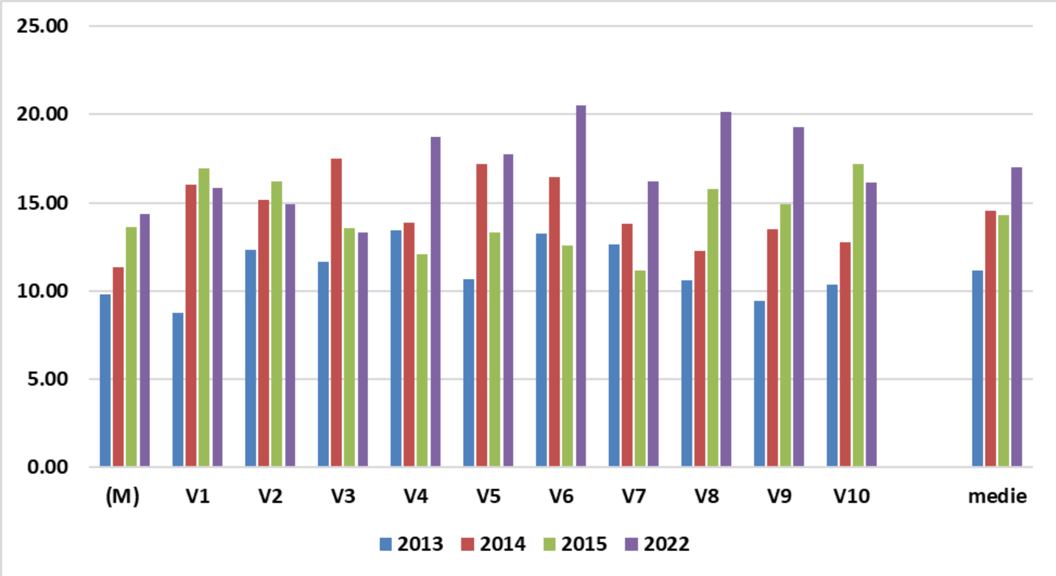

Figure 1. The yield calculated on average per vine (kg/vine) averaged over variants in years of experience. Source: Data obtained experimentally and processed by the author

Based on the experimental data for the year 2013, Figure 1, it can be seen that the calculated harvest per vine on the experimental variants was within the limits of 8.72 - 13.45 kg/vine, the average value being 11.17 kg/vine. In 2014, the calculated harvest per vine on the experimental variants was within the limits of 11.34 - 17.49 kg/vine, the average value being 14.52 kg/vine. In 2015, the calculated harvest per vine on the experimental variants was within the limits of 11.16 - 17.22 kg/vine, the average value being 14.29 kg/vine. In the year 2022, the calculated harvest per vine on the experimental variants was within the limits of 13.28 - 20.49 kg/vine, the average value being 17.01 kg/vine.

Based on the dispersion analysis data, the DL value is found, at the 5% (or 0.95) significance level it is 3.11, at the 1% (or 0.99) significance level it is 4 .19, at the 0.1% (or .999) significance level is 5.55. Error of difference (Sd) being ±1.522. The coefficient of variation (V) – 15.1046, and the precision of experience (Sx%) - 7.5523%.

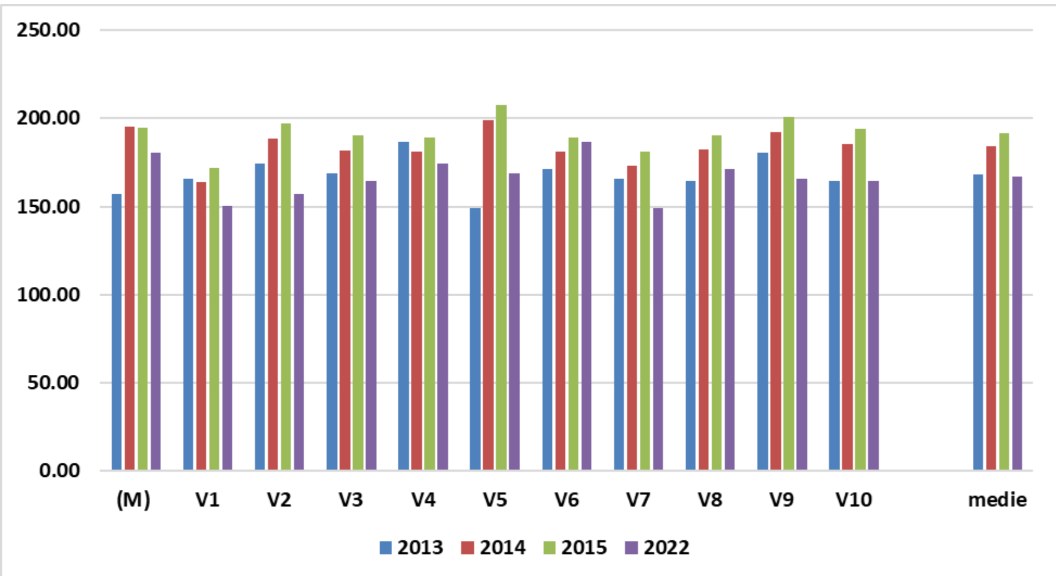

Figure 2. Sugar content (g/dm^3) averaged over the years of experience

Source: Data obtained experimentally and processed by the author

Based on the experimental data for 2013, Figure 2, it can be seen that the sugar content in the berries on the experimental variants was within the limits of 149.21 - 186.76 g/dm^3, the average value being 168.05 g/dm^3. In 2014, the sugar content in berries on the experimental variants was within the limits of 164.13 - 198.74 g/dm^3, the average value being 183.95 g/dm^3. In 2015, the sugar content in berries on the experimental variants was within the limits of 171.58 - 207.77 g/dm^3, the average value being 191.44 g/dm^3. In 2022, the sugar content in berries on the experimental variants was within the limits of 149.21 - 186.76 g/dm^3, the average value being 166.64 g/dm^3.

Based on the dispersion analysis data, the DL value is found, at the 5% (or 0.95) significance level it is 13.17, at the 1% (or 0.99) significance level it is 17 .74, at the 0.1% (or .999) significance level is 23.51. The error of difference (Sd) being ±6.4492. The coefficient of variation (V) - 5.1378, and the precision of experience (Sx%) - 2.5689%.

For the sugar content in berries based on the correlation and regression analysis on the whole experience, it is found that the coefficient of determination is 0.5335, or with a level of influence of the factors in size of 53.35%. The linear regression equation obtained the form:

$$Y=-247{,}41+(0{,}17)X_1+(0{,}15)X_2+(-2{,}45)X_3+(0{,}98)X_4+(0)X_5+(2{,}01)X_6+(0)X_7.$$

* The sum of useful temperatures (X_1), the amount of precipitation (X_2), the number of treatments (X_3), the amount of Ca (X_4), the average temperature of the months of June (X_5), July (X_6) and August (X_7).

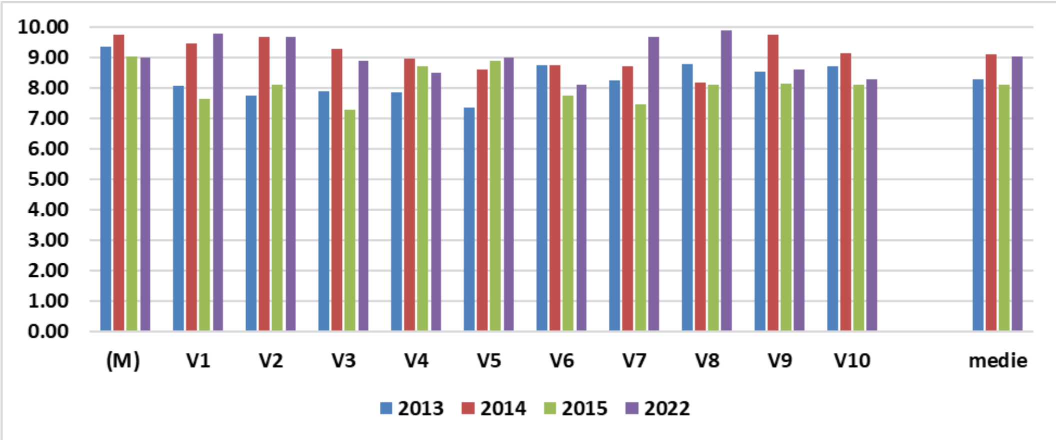

Figure 3. Titratable acidity content (g/dm^3) averaged over the years of experience.
Source: Data obtained experimentally and processed by the author

Based on the experimental data for 2013, Figure 3, it can be seen that the content of titratable acidity in the berries on the experimental variants was within the limits of 7.36 - 9.36 g/dm3, the average value being 8.30 g/dm3. In 2014, the content of titratable acidity in berries on the experimental variants was within the limits of 8.18 - 9.75 g/dm3, the average value being 9.12 g/dm3. In 2015, the content of titratable acidity in berries on the experimental variants was within the limits of 7.29 - 9.04 g/dm3, the average value being 8.11 g/dm3. In 2022, the content of titratable acidity in berries on the experimental variants was within the limits of 8.10 - 9.90 g/dm3, the average value being 9.04 g/dm3.

Based on the dispersion analysis data, the DL value is found, at the 5% (or 0.95) significance level it is 0.86, at the 1% (or 0.99) significance level it is 1 .16, at the 0.1% (or .999) significance level is 1.54. Error of difference (Sd) being ±0.4221. The coefficient of variation (V) - 6.9008, and the precision of experience (Sx%) - 3.4504%.
Based on the correlation and regression analysis of the content of titratable acidity in the berries over the entire experience, it is found that the coefficient of determination is 0.4382, or with a level of influence of the factors in size of 43.82%. The linear regression equation obtained the form:

$$Y=10{,}55+(-0{,}01)X_1+(0)X_2+(-0{,}18)X_3+(0{,}01)X_4+(0)X_5+(0{,}45)X_6+(0)X_7.$$

* The sum of useful temperatures (X_1), the amount of precipitation (X_2), the number of treatments (X_3), the amount of Ca (X_4), the average temperature of the months of June (X_5), July (X_6) and August (X_7).

Based on the experimental data for 2013, Figure 4, it can be seen that the GAI value on the experimental variants was within the limits of 16.81 - 23.79, the average value being 20.34. In 2014, the GAI on the experimental variants was within the limits of 17.31 - 23.08, the average value being 20.22. In 2015, the GAI on the experimental variants was within the limits of 21.55 - 26.09, the average value being 23.65. In 2022, the GAI on the experimental variants was within the limits of 15.33 - 23.06, the average value being 18.56.

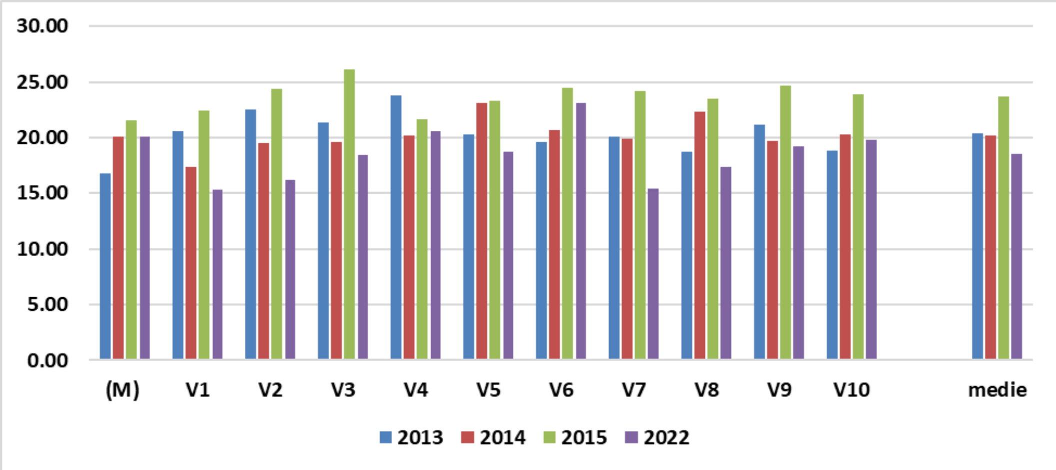

Figure 4. The value of the Gluco-Acidometer Index (GAI) averaged over the years of experience.
Source: Data obtained experimentally and processed by the author

Based on the dispersion analysis data, the DL value is found, at the 5% (or 0.95) significance level it is 2.63, at the 1% (or 0.99) significance level it is 3 .54, at the 0.1% (or .999) significance level is 4.7. The error of difference (Sd) being ±1.2884. The coefficient of variation (V) - 8.8064, and the precision of experience (Sx%) - 4.4032%.
Based on the correlation and regression analysis of the GAI, on the whole experience it is found that the coefficient of determination is 0.5564, or with a level of influence of the factors in size of 55.64%. The linear regression equation obtained the form:

$$Y=-33,21+(0,04)X_1+(0,01)X_2+(0,25)X_3+(0,04)X_4+(0)X_5+(-0,79)X_6+(0)X_7.$$

* The sum of useful temperatures (X_1), the amount of precipitation (X_2), the number of treatments (X_3), the amount of Ca (X_4), the average temperature of the months of June (X_5), July (X_6) and August (X_7).

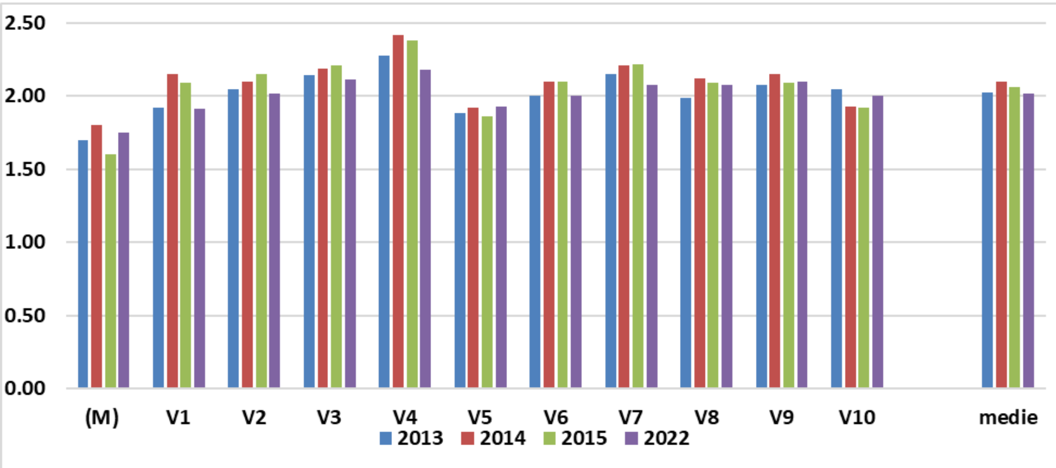

Figure 5. The firmness of the berry, depending on foliar fertilization with calcium.
Source: Data obtained experimentally and processed by the author

Based on the experimental data for 2013, Figure 5, it can be seen that the firmness of the berries on the experimental variants was within the limits of 1.70 - 2.28, the average value being 2.02. In 2014, the firmness of the berries on the experimental variants was within the limits of 1.80 - 2.42, the average value being 2.09. In 2015, the firmness of the berries on the experimental variants was within the limits of 1.60 - 2.38, the average value being 2.06. In 2022, the firmness of the berries on the experimental variants was within the limits of 1.75 - 2.18, the average value being 2.01.

Based on the dispersion analysis data, the DL value is found, at the 5% (or 0.95) significance level it is 0.09, at the 1% (or 0.99) significance level it is 0 .12, at the 0.1% (or .999) significance level is .16. Error of difference (Sd) being ±0.0437. The coefficient of variation (V) - 3.0136, and the precision of experience (Sx%) - 1.5068%.

The level of significance as a result of the dispersion analysis, states that all the analyzed variants were ranked in the "Very significant positive difference" category.

CONCLUSIONS

The use of individual or combined calcium fertilization of the Moldova variety in the production conditions with 1-4 post-fertilization treatments, depending on the conditions of the year, positively influenced the quality of the harvest. Berries firmness representing crushing resistance was directly influenced by Ca treatments. The variants where the summary content of Ca is higher registered the highest firmness, variant V4 when where applied four treatments during the vegetation period. The high firmness was also obtained for variant V3 with three treatments applied at 7-10 days after flowering and for variant V7 with also three treatments. All these variants registering highly significant positive difference.

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Conflicts of Interest

As the sole author of the article, I declare that based on the materials reflected in this article there is no conflict of interest with other persons or entities.

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