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THE INFLUENCE OF DIFFERENTIATED FERTILISATION ON THE SUGAR LEVEL IN THE MUST, FOR THE ALIGOTE AND FETEASCA ALBA VARIETIES, UNDER THE CONDITIONS OF THE IASI VINEYARD

Nicoleta Luminita PARASCHIV[1a], Mariana VOLF[1b *] and Elena Liliana CHELARIU[2]

Iasi University of Life Sciences, 3, Mihail Sadoveanu Alley, 700490, Iasi, Romania;
[1]Faculty of Agriculture;
[a]Department of Plant Science; e-mail: luminico2003@uaiasi.ro
[b]Department of Pedotechnics,
[2] Faculty of Horticulture, Department of Horticultural Technologies; e-mail: julia@uaiasi.ro

*Correspondence: marianavolf@gmail.com

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ABSTRACT. Wine soils from the country's main vineyards contain 0.05-0.25 g total N per 100 g soil, 0.9-20 mg P_2O_5/100 g soil and 6.5-36 mg K_2O/100 g soil. The amount of fertiliser that the plant will use - the degree of use - depends on the age of the stumps, the type of rootstock and the planned production. Acting as a factor for the intensification of production, mineral fertilisers, used as a complement to organic fertilisation, contribute not only to maintaining and increasing soil fertility but also to the quantitative and qualitative growth of production. Since the natural reserves of nutrients are limited, the application of natural and mineral fertilisers, scientifically based and differentiated according to the concrete pedoclimatic conditions, is of particular importance from an ecological and economic point of view. The research undertaken highlighted that the use of chemical fertilisers, in different dosages and ratios, favourably influenced the accumulation of sugar in the must for both varieties, with values that were between 178 g/L sugars for the Aligote variety and 170.7 g/L for Feteasca alba. The P-K relationship positively influenced the accumulation of sugars for both varieties, 177.4 g/L sugars for the Aligote variety and 171.3 g/L for Feteasca alba.

Keywords: chemical fertilisers; must; vines.

INTRODUCTION

Research from the specialized literature refers to the effects induced by the application of fertilizers and their most accurate sizing, to the establishment of the most appropriate ratios between N, P and K, in this sense developing mathematical models for agrochemical optimisation of the soil and the plant.

The vine extracts variable amounts of primary macroelements from the soil for its specific consumption (Khalil, 2020). They are translocated in the vegetative apparatus and influence a series of metabolic processes, with the final result being quantitative and qualitative production.

In general, the qualitative and quantitative differences in the primary metabolites of the grapevine are influenced by a multitude of factors, including temperature, pH, soil type and agricultural practises, specifically fertilisers, etc. (Cuadros-Inostroza *et al.*, 2016).

For the formation of the different components of the harvest, Davidescu and Davidescu (1992) cited optimal ratios as N:P:K: sugar – 0.3:1:1; acidity – 1.5:1:1.5; colour (pigments) – 0.3:1:1; vitamins – 3:1:1.5; flavor – 0.7:1:1.

Nitrogen nutrition of vines is one of the most widespread fertilisation practises in vineyards (Miliordos *et al.*, 2022). Nitrogen intensifies vegetative growth and berry development, but in excess, it favours fruiting and worsens a series of wine quality attributes, in conditions of P and K insufficiency (King *et al.*, 2014). In the last decades, it has been necessary to introduce alternative practises for the management of phosphorus-based fertilisers, especially to improve the availability of phosphorus forms in the soil and to reduce, as much as possible, the administration of phosphate fertiliser (Cao *et al.*, 2021). Phosphorus contributes to increasing the number of grapes per shoot, and potassium improves grapes in carbohydrates and shoots in starch (El Kersh *et al.*, 2022). Calcium gives the wine the characteristic bouquet, the richness in sugar and the frothiness, sulfur accelerates the ripening and iron increases the production and gives colour to the wine (Lăcătusu, 2006).

The study undertaken brings information about how different dosages and ratios of nutritional elements manage to influence the sugar content of the must in two varieties of wine specific to the studied area and in well-defined agro-eco-pedological conditions.

MATERIALS AND METHODS

The research was done in the Iasi vineyard, the Sorogari viticultural centre, on a plot of land occupied by vines of the Aligote and Feteasca alba varieties, belonging to a family association. The Sorogari wine centre is located (on the map at 47° 13' North, 27° 35' East) in the Depression of the Jijia-Bahlui rivers, in its southern part, which is part of the Iasi vineyard, along with other centres such as Copou, Bucium-Tomesti, Uricani and Comarna. In general, in this vineyard, ripening conditions are ensured for grapes from the ripening of the grapes takes place between September 1-15 (IV ages) and sometimes for those with late and very late ripening ages, a fact demonstrated by the value of the global heat balance, which stands for a multi-year period at the value of 3237.0 ^{o}C.

For wine grapes in Romania, the IV ripening period, also called the pre-normal period, meets a global thermal balance between 2600 and 3000 degrees Celsius. In the case of the analysed surface, this limit is slightly exceeded.

The Feteasca alba and Aligote varieties were chosen for this study due to their fairly wide adaptability to climate and soil conditions; the Iasi vineyard, of which the Sorogari wine centre is a part, is located at the northern limit of wine production in Romania (*Figure 1*).

The research area was 0.5 ha and is part of a larger pedological unit, that is fully occupied by vines.

The climatic changes that have taken place in the last decade have caused these values to widen their scope, with direct repercussions on the evolution of quantitative and qualitative production for this northeastern area of Romania (Zaldea, 2021).

For three years, simple fertilisers were used in various dosages and ratios, namely ammonium nitrate, concentrated superphosphate and 50 % potassium salt.

The optimal economic dose, called the full dose, was established based on the levels of nitrogen and phosphorus, potash supply of the soil (accessible forms) and the expected harvest.

a

b

Figure 1 - Position of the area under study (**a**. Iasi County; **b**. Aroneanu commune, where the Sorogari wine centre is located)

Two sets of dosages were used, half of the optimal dose - called the 0.5 dose level - and dosages one and a half times higher than the optimal dosages - called the 1.5 dose level, for each individual element. Thus, the 0.5 dose level consisted of 50 kg/ha N 25 kg/ha and 90 kg/ha K_2O; the level 1 dose consisted 100 kg/ha N, 50 kg/ha P_2O_5, 180 kg/ha K_2O; 1.5 dose level consisted 50 kg/ha N, 75 kg/ ha P_2O_5, 270 kg/ha K_2O.

The combination of fertilising elements was used to investigate how single elements or in binary or ternary combination induced the supply of sugars in grape must.

The soil under study was a mesocalcareous cambic chernozem (poorly leached or decarbonated), loamy-clay, developed on loessoid deposits, uncovered and unirrigated.

The determined chemical composition of the soil was: pH (H_2O): 6.9 - 7.4, neutral to moderately alkaline reaction; a nitrogen index (IN) with values of 3.38 - 3.48, placing the soil in the category of those with insurance medium in nitrogen; poor-medium in mobile phosphorus (< 108 ppm P-AL); and normal in mobile potassium (< 400 ppm K-AL).

The analysis methods and techniques for the soil samples were as follows:

- pH in aqueous extract, potentiometric method; SR EN 16192:2012, SR EN ISO 10523:2012.
- Humus content, Walkley-Black method, modified Gogoașa; STAS 7184/21-82, SR EN 16192:2012.
- $N-NO_3$ content, phenoldisulfonic acid method, colorimetric dosage; STAS 7184/7-87; SR ISO 14255:2000.
- P −AL content, Egner-Riehm-Domingo method, colorimetric dosage; STAS 7184/7-87; SR EN 16192:2012.
- K −AL content, Egner-Riehm-Domingo method, dosage by flame photometry, STAS 7184/7-87; SR EN 16192:2012.
- determination of sugar content in must samples – The method from the OIV Collection AS-311-02-GLUFRU.

RESULTS AND DISCUSSION

The use of chemical fertilisers in different dosages leads to a variation in the concentration of sugar in the must, for both varieties of grapes studied (*Table 1*, *Table 2*, *Figure 2*).

In the Aligote grape variety (*Table 1*), the average of the study years indicated different sugar concentration values for the three levels of the dosages of fertilisers used. The Level 0.5 dose led to the achievement of a sugar content of 173.5 g/L, a value superior to the control, not statistically guaranteed. The Level 1 dose of fertilisers, in optimal quantities, ensures a concentration of 175.9 g/L (distinctly significant value), and the use of fertilisers in maximum dosages (Level 1.5) ensures a concentration of 178.0 g/L sugar (very significant).

Table 1 - The influence of the dose on the sugar concentration (g/l) in the Aligote variety

Dose kg s.a./ha		Sugar (g/L)	% Compared to Control	Differences	Significance
0	control	171.7	100.00	control	
0.5	Dose	173.5	101.0	1.8	
1	Dose	175.9	102.4	4.2	xx
1.5	Dose	178.0	103.6	6.3	xxx
LDS	5 %	2.0			
LDS	1 %	2.9			
LDS	0.1 %	4.2			

x = significant endorsement; xx = distinctly meaningful; xxx = very significant

For the Fetească albă grape variety, the administration of fertilisers in increasing dosages ensures, for all three dosage levels, statistically guaranteed sugar concentration values (*Table 2*). The administration of fertilisers in minimum dosages (Level 0.5) leads to the achievement of a sugar concentration of 167.6 g/L, superior to the control by 1.3 g/L, a statistically significant value. At the level of applying the optimal dosages (Level 1), the concentration of sugar in the must increases compared to the previous version by 2.1 g/L, reaching 169.4 g/L (very significant). The maximum dosages administered (Level 1.5) achieved a sugar increase of 4.7 g/L compared to the unfertilised control, respectively, a concentration of 170.7 g/L sugar (very significant).

Table 2 - The influence of the dose on the sugar concentration (g/l) in the Feteasca alba variety

Dose kg s.a./ha		Sugar (g/L)	% Compared to Control	Differences	Significance
0	control	166.0	100.0	control	
0.5	Dose	167.6	100.9	1.3	x
1	Dose	169.4	102.0	3.4	xxx
1.5	Dose	170.7	102.8	4.7	xxx
LDS	5 %	1.5			
LDS	1 %	2.1			
LDS	0.1 %	3.1			

x = significant endorsement; xx = distinctly meaningful; xxx = very significant

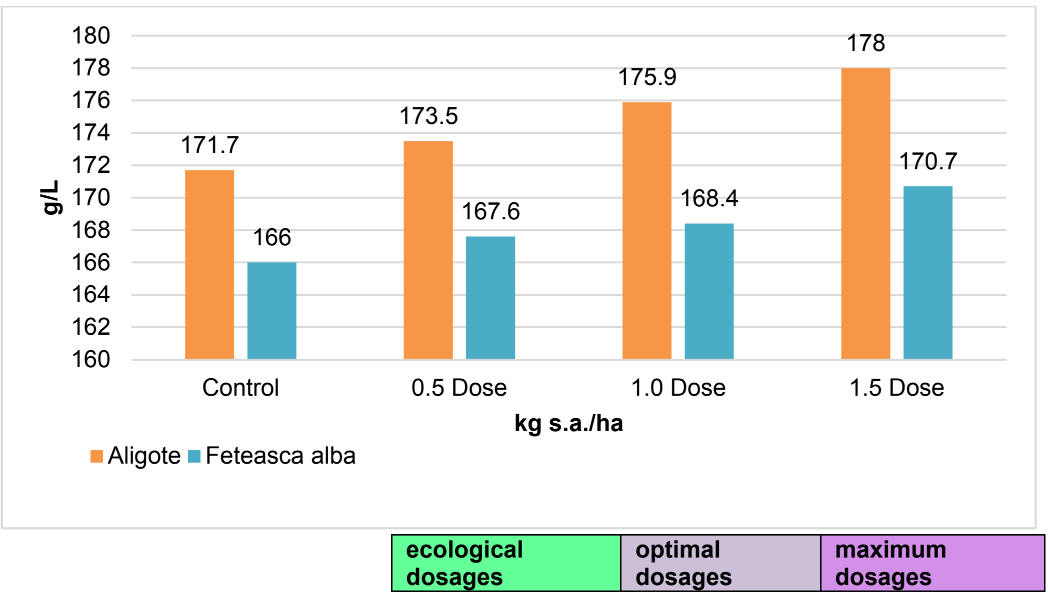

Figure 2 - The influence of the fertiliser dose on the concentration of sugar in the must (g/L) in the Aligote and Feteasca alba varieties

The concentration of sugar in must also varies with the fertilising elements applied unilaterally or in complex (*Figure 3*). It can be seen that for the Aligote variety (*Table 3*), the use of the PK binary complex achieves the highest sugar content, value of 177.4 g/L with an increase of 0.5 g/L, compared to the ternary complex fertilisation (NPK variant – control) with a sugar concentration of 176.9 g/L. The sugar contents decrease, compared to the control version fertilised in a ternary complex, in the following order: the unilateral application of phosphorus leads to a sugar concentration of 175.2 g/L and the fertilisation only with potassium to an accumulation of 174.3 g/L. The same assessment can be made in the case of the Fetească albă variety (*Table 4*). Fertilisation of the PK type leads to higher sugar accumulations than the control, namely a sugar concentration of 171.3 g/L, which was 0.8 g/L more than the NPK fertilisation variant (with 170.5 g/L). The sugar content decreases gradually. Unilateral administration of K achieves a sugar concentration of 167.9 g/L, and phosphorus administered alone leads to accumulations of 167.8 g/L. Binary combinations in which nitrogen participates lead to a decrease in sugar concentration (NK with 167.7 g/L and NP with 167.4 g/L).

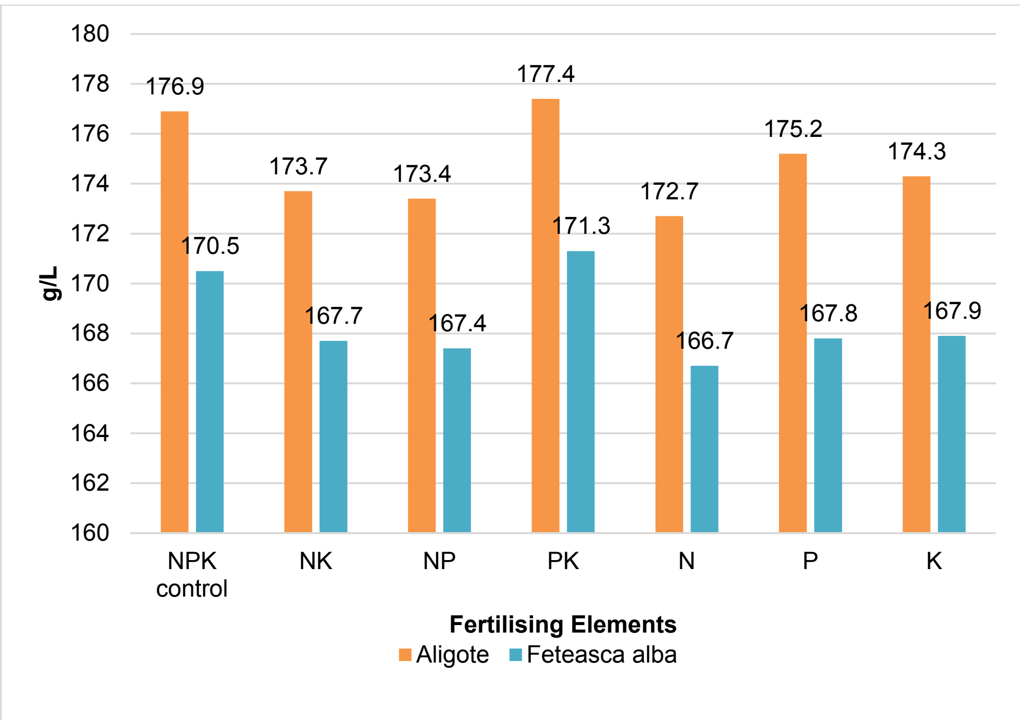

Figure 3 - The influence of the combination of fertilising elements on the concentration of sugar in the must in the Aligote and Feteasca alba varieties

Table 3 - The influence of the combination of nutrients on the sugar concentration (g/L) to the Aligote variety

Combination Nutritional Elements		Sugar (g/L)	% Compared to Control	Differences
NPK	control	176.9	100.00	control
NK		173.7	98.19	-3.2
NP		173.4	98.02	-3.5
PK		177.4	100.28	0.5
N		172.7	97.63	-4.2
P		175.2	99.04	-1.7
K		174.3	98.53	-2.6
LDS	5 %	1.0		
LDS	1 %	1.3		
LDS	0.1 %	1.7		

Table 4 - The influence of the combination of nutrients on the sugar concentration to the Feteasca alba variety

Combination Nutritional Elements		Sugar (g/L)	% Compared to Control	Differences
NPK	control	170.5	100.0	control
NK		167.7	98.36	-2.8
NP		167.4	98.18	-3.1
PK		171.3	100.47	0.8
N		166.7	97.77	-3.8
P		167.8	98.42	-2.7
K		167.9	98.48	-2.6
LDS	5 %	0.8		
LDS	1 %	1.1		
LDS	0.1 %	1.4		

CONCLUSIONS

The undertaken research brings information about the evolution of the sugar content in the must through the administration of dosages and reports of fertilising elements for two grape varieties, specific to the studied area and in well-defined agro-eco-pedological conditions.

The quality of the must, through the studied index, with regard to, he content in sugars, is also influenced by the dose of fertilisers used and by the fertilising element or the combination of fertilising elements.

The values of the content of sugars in must reach the specific level for both varieties. Sugar is controlled by the PK relationship, while the unilateral administration of fertilisers leads to decreases in this index.

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