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THE ACIDITY IN THE MUST OF THE FETEASCĂ ALBĂ VARIETY, IN RELATION TO FERTILIZATION AND THE CONTENT OF MACROELEMENTS IN THE PLANT

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Abstract

The research focused on the analysis of the impact of these macroelements, used in different doses and ratios, on the accumulations in the plant and on the production quality, respectively on the varied acidity of Feteasca albă must. The analysed Feteasca albă variety is one of the predominant varieties of the Sorogari wine-growing center, belonging to the Iasi vineyard. The soils of the area under study are part of the group of anthropogenic soils, such as cambic cherno-zones, forest ash and regosols, with uneven fertility. Values of the content in the plant of 2.12% N, 0.183% P, 0.883 K as well as acidity values of 5.27 g/l H2SO4, by applying fertilizers in the minimum necessary doses, certify that they can be at the level statistical assurances It can be stated that the use of doses of fertilizers according to the criterion of sufficiency, in the analysed agro-eco-pedological context, ensures that the optimal experimental doses, optimal contents in the plant of macronutrients and implicitly, the nutrition environment is protected from pollution.

Key words*: foliar diagnosis, level of sufficiency, nutritional balance.*

INTRODUCTION

Primary macroelements are essential for the nutrition of cultivated plants and, when they are in optimal quantities, they compete in obtaining the expected harvests, of a high level and of a superior quality. Their presence in the soil and their translocation in plants, through root or extra-root absorption processes, make possible the development of numerous and complex chemical, biochemical and physiological processes, which lead to a sustained metabolic activity. Any nutritional imbalance has its causality in a dysfunction of these processes, induced in turn, primarily by the nutritional environment - the soil - but also by a series of other factors, with equal importance, such as the climate, the anthropic factor, etc. Fertilization in different doses and ratios of fertilizers improves the yield but also the quality of crops, establishing important correlations in the soil-plant relationship (Habibur et al., 2021).

In relation to the expected production and the variety, the vine has a nitrogen, phosphorus and potassium consumption per ton of grapes that oscillates between 6-15 kg N, 1-3.7 kg P_2O_{55}, 3.8 and 15 kg $K_{22}O$ (Davidescu & Davidescu, 1992). The need for such quantities resides in the role of these elements in the general metabolism of this plant. The plastic role of nitrogen is well known, in the composition of biological membranes, through structural and enzymatic proteins, which also intervene in transport (Mengel, 1987).

Among its multiple functions, phosphorus is highlighted by its fundamental role in the storage and transmission of genetic information. Phosphorus has implications in energy metabolism and photosynthesis, in different phenophases of plant growth. (Yan et al., 2021). A balanced nutrition in phosphorus increases the resistance of plants to drought and frost, shortens certain stages of vegetation in organogenesis, but also compensates, through rebalancing, the excess of nitrogen.

Potassium is the most important cation in the life of plants, its functions being multiple such as: cell division, growth of meristematic tissues, absorption of nutrients, synthesis and activation of enzymes, role in photosynthesis, in carbohydrate and protein metabolism

(Hassanein et al., 2021). In the cellular structure of plants, approximately 10-20% of total potassium is found in chloroplasts and another 10-20% in the cytoplasm (Marschner, 1993).

The study undertaken refers to the content and variation of these essential elements in the plant material, in the vine, in relation to the administration of fertilizers, in different doses and ratios, precisely to stimulate these processes, which tend to be reflected in the quantity but also quality of grape production. The central goal of the research is to bring information about the use of small doses of fertilizers applied on the criterion of sufficiency, protecting the environmental and nutritional environment, possible to use to obtain the organoleptic properties specific to obtaining wines of superior quality, with designation of origin.

MATERIALS AND METHODS

The research took place in three consecutive years, in a vineyard, belonging to the Sorogari viticultural center in the Iasi vineyard. This territory, which currently belongs to a family association, falls geographically in the Jijia-Bahlui depression, being located in its southern part.

In general, in this vineyard, ripening conditions are ensured for grapes from the I-V ripening periods and sometimes for those with late and very late ripening, a fact demonstrated by the value of the global heat balance, which stands for a multi-year period at the value of 3237.0°C.

The soil present in the area of the experimental polygon is a mesocalcareous cambic chernozem (weakly leached or decarbonated), loamy-clay, developed on loessoid deposits, uncovered, unirrigated. The determined agrochemical properties of the soil unit studied were: pH (H_2O): 6.9-7.5, neutral to slightly alkaline reaction, medium humus content (2.4-2.5% H), a low to medium content in nitrates (1.9-3.9 mg NO_3/100 g soil), low content in mobile phosphorus (20.8-52.8 ppm P-AL); good supply status in mobile potassium (260-301 ppm K-AL). The content of 17.0 me % Ca^{2+}, indicates a high fertility. Among the exchangeable cations, the content of 2.06-2.88 me % Mg^{2+} places the soil in a medium fertility class. Boron is at the lower limit of a medium insurance (0.4-0.5 ppm B), copper at values > 25 ppm indicates an excess supply of the soil, mobile zinc at high levels respectively 1.8-2.0 ppm Zn.

The biological material used was the Feteasca Alba vine variety, grafted on the Kober 5 BB rootstock, derived by clonal selection from the population of Berlandieri X Riparia Teleky 5 A.

During the experimentation two factors were implemented and analysed independently such as **dose levels** and **fertilizer combinations** as a result of the combination of fertilizing elements (Table 1).

Table 1. Factors implemented during the experimentation

Factor 1 - Dose levels			
Dose levels	**N, kg/ha**	**P, kg/ha**	**K, kg/ha**
D1 - level 0.5	50	25	90
D2 - level 1.0	100	50	180
D3 - level 1.5	150	75	270
Factor 2 - Fertilizer combinations			
Fertilizer combinations	**N**	**P**	**K**
Control	N	P	K
T1	N	-	K
T2	N	P	-
T3	-	P	K
T4	N	-	-
T5	-	P	-
T6	-	-	K

The 0.5 dose level represents the minimum administered doses, respectively the state of sufficiency, the 1 dose level is represented by optimal dose and the 1.5 dose level being studied in research, to track the agronomic and economic efficiency of the maximum doses.

The combination of fertilizing elements was introduced for the study of the singular or combined effect, on the aspects addressed, since the relationships of antagonism and synergism between the essential elements on the one hand and between them and the rest of the elements in the soil solution and at the level of the various vegetative organs are already known.

For the analysis of plant samples, methods currently used in foliar diagnosis were used:

- dosing of total nitrogen, mineralization option with sulfuric acid, distillation and titration of ammonia with H_2SO_{44}; SR ISO 11261:2000

- total phosphorus dosage - wet mineralization, with ammonium molybdate and reduction with stannous chloride, colorimetric dosage SR EN 16192:2012
- dosing of total potassium, by mineralization with a mixture of sulfuric acid and perchloric acid and dosing by flame photometry. STAS 7184/7-87

The harvesting of leaves, for the foliar diagnosis, was done in the flowering phenophase.

The chemical analyzes of the must consisted in determining the total acidity, by titration with a 0.1 n NaOH solution ; SR EN 16192:2012

RESULTS AND DISCUSSIONS

The analysis of the total nitrogen content in the leaves (Table 2), reveals its values from 2.12 to - D1 to 2.22% to D3, values statistically different from significant to very significant and included in supply levels from weak at optimum.

Table 2. The influence of the fertilizer dose on the evolution of Nt (%) in the leaves of Feteasca albă variety

Dose level		N_t (%)	% increase	Differences
Control	0	2.05	100.0	-
D1	0.5	2.12	103.5	0.07*
D2	1	2.17	105.9	0.12**
D3	1.5	2.22	108.1	0.16***
***LSD**	5 %	0.06		
****LSD**	1 %	0.10		
*****LSD**	0.1%	0.14		

LSD - least significant difference

The Nt values in the leaves in relation to the combination of fertilizing elements (Table 3), oscillate from the NPK variant (control), where optimal values of 2.27% and only 2.06% are recorded for fertilizing exclusively with phosphorus or potassium (T5 and T6). As expected, the binary fertilized variants containing nitrogen, NK (T1) and NP (T2), obtained similarly results as control.

At flowering (Table 4), the 0.5 dose level (D1) ensures in the leaves a total phosphorus value of 0.183% Pt, higher than the control by 0.014% Pt (statistically significant), very close to the optimal content for this phenophase (0,19-0.25% Pt) but below the level of using the optimal doses (D2).

Table 3. The influence of the fertilizer combinations on the evolution of Nt (%) in leaves of Feteasca albă variety

Fertilizer combinations		N_t (%)	% increase	Differences
Control	NPK	2.27	100.0	-
T1	NK	2.20	96.7	-0.07
T2	NP	2.19	96.5	-0.07
T3	PK	2.06	90.6	-0.21
T4	N	2.15	94.9	-0.11
T5	P	2.06	90.5	-0.21
T6	K	2.06	90.7	-0.21
***LSD**	5 %	0.05		
****LSD**	1 %	0.07		
*****LSD**	0.1 %	0.09		

LSD - least significant difference

Table 4. The influence of the fertilizer dose on the evolution of Pt (%) in the leaves of Feteasca albă variety

Dose level		P_t (%)	% increase	Differences
Control	0	0.169	100.0	-
D1	0.5	0.183	108.6	0.014*
D2	1	0.196	116.2	0.027**
D3	1.5	0.210	124.6	0.041***
*LSD	5 %	0.014		
**LSD	1 %	0.020		
***LSD	0.1 %	0.030		

LSD - least significant difference

The fertilizing elements in different combinations achieve optimal insurance with Pt. (Table 5). Thus, the control variant in ternary combination (NPK) achieves 0.273% Pt (optimal for this phenophase), followed by the variants in binary complex NP (T2) with 0.259% Pt, PK (T3) with 0.258% Pt and the P variant (T5) with 0.254% Pt.

Table 5. The influence of the fertilizer combinations on the evolution of Pt (%) in leaves of Feteasca albă variety

Fertilizer combinations		P_t (%)	% increase	Differences
Control	NPK	0.273	100.0	Mt
T1	NK	0.225	82.6	-0.047
T2	NP	0.259	94.8	-0.014
T3	PK	0.258	94.5	0.015
T4	N	0.226	82.9	-0.046
T5	P	0.254	93.1	-0.018
T6	K	0.225	82.6	-0.047
*LSD	5 %	0.105		
**LSD	1 %	0.139		
***LSD	0.1 %	0.181		

LSD - least significant difference

The research undertaken for the dosages of total potassium in the leaves (Table 6) highlighted that for dosage levels of fertilizers D1 and D2, the values recorded were below optimal, respectively values below 0.9% Kt. The D3 level was slightly above the optimum, respectively 0.909% Kt, being statistically significant.

Table 6. The influence of the fertilizer dose on the evolution of Kt (%) in the leaves of Feteasc albă variety

Dose (kg s.a./ha)		Kt (%)	% increase	Differences
Control	0	0.876	100.0	Mt
D1	0.5	0.883	100.9	0.007
D2	1	0.886	101.2	0.010
D3	1.5	0.909	103.8	0.033
*LSD	5 %	0.028		
**LSD	1 %	0.040		
***LSD	0.1 %	0.060		

LSD - least significant difference

The method of combining the fertilizing elements (Table 7) brings the Kt content values around the optimal values for the NK (T1) and K (T6) variants with 0.900% Kt.

Table 7. The influence of the fertilizer combinations on the evolution of Kt (%) in leaves of Feteasc albă variety

Type of fertilizer		Kt (%)	% increase	Differences
Control	NPK	0.914	100.0	Mt
T1	NK	0.900	98.4	-0.013
T2	NP	0.870	95.2	-0.043
T3	PK	0.899	98.3	-0.015
T4	N	0.870	95.1	-0.044
T5	P	0.868	94.9	-0.046
T6	K	0.900	98.4	-0.013
*LSD	5 %	0.017		
**LSD	1 %	0.023		
***LSD	0.1 %	0.029		

LSD - least significant difference

In Table 8, it can be noted the lower value of the total acidity in the must, in the case of administration of fertilizers in minimum doses compared to the use of optimal and maximum doses.

The administration of 0.5 doses of fertilizers, D1, contributes to obtaining a concentration of 5.27 g/L H_2SO_4, (distinctly significant), a value lower than that of the level of 1 dose, D2 (5.33 g/L H_2SO_4) and 1.5 doses, D3 (5.36 g/l H_2SO_4), both provided very significantly (Table 8).

Table 8. The influence of the fertilizer dose on the total titratable acidity (g/L H_2SO_4) in musts of Feteasc albă

Dose level		Acid. (g/L)	% increase	Differences
Control	0	5.22	100.0	Mt
D1	0.5	5.27	101.0	0.054**
D2	1	5.33	102.0	0.109***
D3	1.5	5.36	102.7	0.144***
*LSD	5 %	0.036		
**LSD	1 %	0.052		
***LSD	0.1 %	0.077		

LSD - least significant difference

With the administration of fertilizers in combination NK (T1), the total acidity in the must rises to the value of 5.44 g/L H_2SO_4 (by 0.107 g/L H_2SO_4 more than the control version, fertilized with NPK), statistically very significantly ensured. At the opposite pole, the option of using phosphorus and potassium unilaterally, lowers the total acidity to the level of 5.23 and 5.24g/L H_2SO_4, respectively (Table 9).

Table 9. The influence of the fertilizer combinations on the total titratable acidity (g/l H_2SO_4) in musts of Feteasc albă

Type of fertilizer		Acidity (g/L)	% increase	Differences
Control	NPK	5.33	100.0	Mt
T1	NK	5.44	102.0	0.107***
T2	NP	5.26	98.67	-0.071
T3	PK	5.25	98.54	-0.078
T4	N	5.32	99.83	-0.009
T5	P	5.23	98.20	-0.096
T6	K	5.24	98.41	-0.085
* LSD	5 %	0.040		
**LSD	1 %	0.053		
***LSD	0.1 %	0.069		

LSD - least significant difference

CONCLUSIONS

Foliar diagnosis, as a research method, plays an important and powerful role in the control of mineral impurities and in its adjustment, depending on the production directions. For the Feteasc albă variety, located in a northern border area, fertilization with macroelements influences its state of insurance, in direct

relation with the production quality, respectively with the acidity in the must.

Corollary to the research undertaken, it can be stated that along with the optimal doses of fertilizers, the minimum doses tend to ensure the life of the vine with macroelements, at sometimes optimal levels, statistically significant or not, as well as the acidity in the must, which induces the idea of their use, for protection of the nutrition environment.

Nitrogen, phosphorus and potassium influence the acidity in the must, with values that are specific to the variety. The NPK and NK fertilization relationship ensures acidity values, statistically confirmed and which reinforce in the studied area, the direction of use of this variety as being for quality wines with designation of origin and quality levels.

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