ANNALS OF THE UNIVERSITY OF CRAIOVA

Series: ✔*Biology*
✔*Horticulture*
✔*Food products processing technology*
✔*Environmental engineering*

Vol. XXX (LXVI) - 2025

DETERMINATION OF THE FOOD NEED OF THE VINE AND THE BALANCING OF MACROMOLECULAR SUBSTANCES AND THE INFLUENCE OF SOME FACTORS ON THE ABSORPTION OF MACROMOLECULAR ELEMENTS IN THE PRODUCTION OF GRAFTING ROPES

Truşcă Ion Bogdan[1,2], Gorjan Sergiu-Ștefan[1], Popescu Raluca Iuliana[1]
[1] Research and Development Station for Viticulture and Vinification Drăgășani, Blvd. Regele Ferdinand, no. 64, Zip Code: 245700, Drăgășani, Vâlcea, Romania
[1,2] The Doctoral School of Engineering and Management of Vegetal and Animal Resources, USAMV University, Bd. Mărăşti , nr. 59, Sector 1, Bucharest, Romania
* *Correspondance author. E-mail: truscaionbogdan@yahoo.com*

Keywords: *production, fertilization, soils, vine, plant*

ABSTRACT

The vine uses different amounts of substances in the nutrition process every year, the extraction process being varied depending on various factors: the requirements of the graft variety, the absorption capacity of the rootstock variety, climatic factors, the morphological characteristics of the soil.
The study conducted at the Research and Development Station for Viticulture and Vinification (RDSVV) Drăgășani aimed to investigate the influence of certain factors on the absorption of macroelements from the soil by the vine and certain requirements of the graft variety, the absorption capacity of the rootstock variety, the natural fertility of the soil, the use of various fertilizers.

INTRODUCTION

Deficiencies in these nutrients will result in poor growth and can even lead to the drying of the plant (Mihalache and Ilie, 2016). At the same time, the farmer will need to understand that an excess of nutrients is as harmful as their lack. Improperly dosed can affect plants, sometimes with effects that are difficult to remedy (Bramlage et al., 1980). The vine can adapt to a wide range of soil types and, if the soil depth, texture and water conditions are favorable, it will survive and produce good marketable crops on soils with poor fertility (Guș, 1998). The vine needs well-drained soil. Plants grow better in soils with a pH between 6 and 7. In soils with a high pH (above 7.5) phosphorus deficiencies may occur, as well as other micronutrients, such as iron. If the soil is deep enough, grass can be placed between the rows to prevent erosion and weeds (Borlan et al., 1990). Site Selection: Local microclimates play an important role in the feasibility of planting grapes in a particular location (Mihalache, 2006). The most important feature is cool air and drainage. Other factors to consider when selecting a site are: availability of full sunlight and lack of strong winds and heavy hail (Borlan and Hera, 1984). Grapevines typically

require a warm, dry climate, meaning warm days, cool nights, and low humidity (Burzo et al., 1999). These generally produce higher quality grapes.

MATERIAL AND METHODS

The action of the graft and rootstock varieties and the interaction between these soil nutrients were monitored in 2023-2024, on three grape cultivars, Negru de Drăgășani, Alutus, Crâmpoșie Aromată. In the two years of experimentation, nitrogen, phosphorus and potassium in the leaves were determined, and mineral forms in the roots, shoots, petiole were also analyzed. The leaves were used for the analysis, during the vegetation period, the biological material to be analyzed can consist of any organ or tissue of the grapevine. The most accessible part is the leaf. The sample must contain young and mature leaves (max. 10 leaves) if it comes from a hub.

Leaf tissue analysis will also confirm most visible deficiency symptoms, reveal hidden deficiencies where visual plant symptoms are not yet present, and show excessive concentrations of nutrients that may cause deficiencies of other nutrients - e.g. excess K causes an imbalance of calcium or magnesium. Fresh, whole leaves free from dust or dirt, disease and pest traces are taken for analysis. The practice consists of collecting a random sample of leaves in the morning, before the day gets hot, taking the youngest fully developed or expanded leaves of the same cultivar. Wood weight, shoot weight, leaf weight were determined in the field for the specified varieties. The nutrient content of the vine organs was experimentally determined in percentages, and the overall nutrition, nutritional balance and the various ratios between the absorbed elements were also calculated.

The absorption rate is given by comparing the amounts of mineral substances absorbed between 2 consecutive determinations, which in turn come from multiplying the dry weight of each organ by its centesimal content in elements.

The global consumption of nutrients relative to the biological unit (organ or hub) during the vegetation period or at its different phenophases was calculated by summing the amounts of minerals absorbed (with positive values between the analysis intervals).

Climate and soil conditions. The climatically similar years 2023-2024 are characterized by the following elements presented in Table 1 and Table 2.

Table 1

Thermal regime during the period November 2022-October 2023

Year	Month	Average temperature (°C)	Temperature Minimium average (°C)	Temperature maxim average (°C)
2022	XI	6.4	2.4	15.0
2022	XII	3.0	1.2	6.0
2023	I	4.9	1.8	7.9
2023	II	3.9	-1.7	9.6
2023	III	8.2	2.4	14.1
2023	IV	10.9	5.6	16.3
2023	V	16.3	10.7	21.9
2023	VI	20.2	14.6	25.7

2023	VII	23.8	16.7	30.9
2023	VIII	24.2	17.8	30.6
2023	IX	21.3	14.4	28.2
2023	X	15.3	8.9	21.6

Table 2

Thermal regime during the period November 2023-October 2024

Year	Month	Average temperature (°C)	Temperature minimium average (°C)	Temperature maxim average (°C)
2023	XI	8.2	4.3	12.1
2023	XII	4.7	1	8.3
2024	I	1.4	-3.3	6.1
2024	II	8.5	2.8	14.2
2024	III	9.3	4.4	14.3
2024	IV	15.1	8.6	21.7
2024	V	17.1	11.7	22.5
2024	VI	25.4	18.3	32.4
2024	VII	28.0	20.4	35.6
2024	VIII	27.5	20.2	34.8
2024	IX	20.4	14.1	26.8
2024	X	13.6	6.7	20.5

RESULTS AND DISCUSSION

In order to interpret the data regarding the absorption of nutrients from the soil, the climatic indices were determined (Table 3). Starting from the principle of equal importance during the vegetation period of heat, humidity and light for the development of metabolic processes in the vine. Vegetative growth - intense growth of shoots positively correlating with the increased values of the climatic indices corresponding to the months of June-August (Weather Station, 2024).

Table 3

Climatic indices during the vegetative growth period

Month	Air temperature					Hygroscopicity (U%)	No. of days with T>30°C	Sunshine duration (hours)
	T med (°C)	T min (°C)		T max (°C)				
		average	absolute	average	absolute			
july	28	20.4	15.0	35.6	42.0	54.0	9	317.0
august	27.5	20.2	16.0	34.8	40.0	59.0	1	259.0
september	20.4	14.1	7.0	26.8	35.0	48.0	0	212.0
Average	25.3	18.2	12.7	32.4	39.0	53.7	10.0	788.0

The dry matter reported for each organ has a specific course, while in shoots and fruiting organs (inflorescences) the dry matter increases continuously until reaching full maturity, in leaves it increases at a sustained rate until maturity, after which it is reduced and maintained at a constant level.

In perennial organs (roots, wood) the highest amount of dry matter is in autumn and spring, with a decrease during the flowering period.

Table 4

The amount of substances in the multiannual organs

Organ analyzed	Fresh substance (%)	Dry substance (%)	Mineral substance (%)
Root	19.01	24.0	27.02
Old Wood	5.9	8.6	10.09
New Wood	22.8	7.9	5.9
Shoots	22.1	26.9	20.09
Leaves	23.5	19.01	27.9
Inflorescences	25.6	13.9	6.9

The nitrogen content in the vine organs decreases from spring, highest was found in the leaves, followed by the bunches and then the shoots, and among the multiannual organs in the roots.

The phosphorus content in the annual organs follows the same path as nitrogen. The highest percentage of P_2O_5 was found in the leaves and then the shoots, and among the multiannual organs in the roots.

The potassium content decreases towards the end of the vegetation in the leaves and the branches, while in the other organs of the vine it increases until the ripeness of the multiannual organs in the roots.
new and old wood.

The calcium content in the annual organs generally follows a reverse course than that of nitrogen and phosphorus. The highest percentage of Ca was found in the leaves and multiannual organs.

The magnesium content follows a different course in the organs of the vine. As with calcium, the highest percentage of Mg was found in leaves and perennial organs.

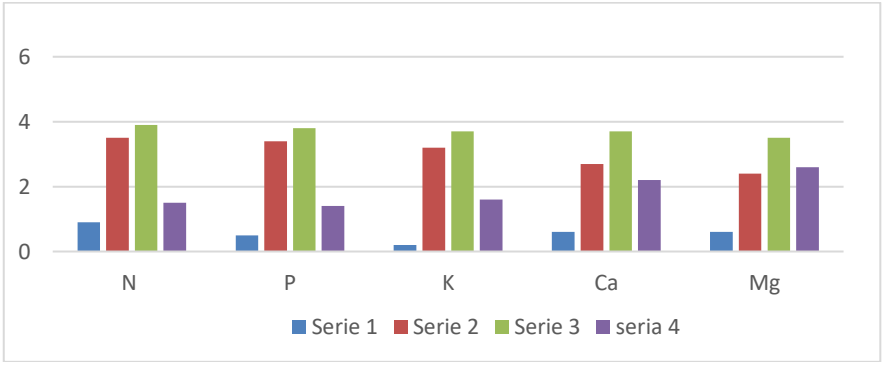

Figure 1. Global nutrition and nutritional balance achieved by different organs of the grapevine at the most important phenophases

Table 5

NPK content in grape cultivars

Grape cultivar	Organ analyzed	Element researched			Global nutrition	Dietary balance		
		NO_3 (%)	P_2O_5 (%)	K_2O (%)	(%)	NO_3 (%)	P_2O_5 (%)	K_2O (%)
Negru de Drăgășani	root	0.010	0.29	0.34	0.80	10.8	48.3	42.5
	shoot	0.15	0.34	1.09	1.50	7.9	22.5	70.0
	petiole	0.30	0.21	1.21	1.78	19.0	14.9	66.3
Alutus	root	0.09	0.27	0.32	0.78	11.0	37.9	51.9
	shoot	0.14	0.33	1.06	1.48	10.1	21.2	69.2
	petiole	0.28	0.19	1.17	1.75	22.5	14.9	63.4
Crâmpoșie Aromată	root	0.010	0.29	0.36	0.81	11.0	48.4	42.8
	shoot	0.16	0.35	1.10	1.52	7.9	22.6	70.9
	petiole	0.30	0.22	1.23	1.80	19.1	15.01	66.5

It is found that compared to the total NPK content of the leaf blade, the nutrition is dominant in the case of mineral forms of K_2O and P_2O5. Regarding the global nutrition with NO_3, P_2O_5, K_2O it increases in the order: root, shoot, petiole. The ratio between NPK is very different from one organ to another. P_2O_5 predominates in the root, K_2O in the shoot and petiole NO_3 although it is found in small quantities is better represented in the petiole.

Some differences are also found between the varieties in terms of global nutrition with mineral NPK and the content in each of them (Tables 6, 7 and 8).

Table 6

Variation in nutrient content of different organs of the Negru de Drăgășani cultivar

Organ analyzed	C (%)		N (%)		P_2O_5 (%)		K_2O (%)		CaO (%)		MgO (%)	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
Root	35.90	35.95	1.32	1.33	0.178	0.175	0.35	0.36	1.74	1.75	2.68	2.70
Old wood	37.16	37.17	0.89	0.90	0.249	0.250	0.21	0.22	1.71	1.72	1.07	1.08
New wood	39.12	39.10	0.78	0.81	0.131	0.131	0.17	0.18	1.72	1.71	2.76	2.77
Shoots	38.60	38.61	0.98	0.91	0.107	0.107	0.17	0.17	1.73	1.73	1.34	1.36
Tendrils	35.90	35.90	0.98	0.95	0.287	0.290	1.00	1.01	1.57	1.57	2.71	2.70
Leaves	40.19	41.20	2.66	2.67	0.351	0.351	0.21	0.21	1.62	1.63	2.31	2.32
Blade	38.69	38.71	1.89	1.90	0.191	0.192	0.46	0.45	3.49	3.48	2.25	2.25
Petiole	32.49	33.2	1.62	1.60	0.320	0.320	0.57	0.58	3.01	2.98	3.10	3.09

Table 7

Variation in nutrient content of different organs of the Alutus cultivar

Organ analyzed	C (%)		N (%)		P_2O_5 (%)		K_2O (%)		CaO (%)		MgO (%)	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
Root	35.92	35.89	1.33	1.30	0.176	0.170	0.32	0.35	1.75	1.76	2.69	2.71
Old wood	37.18	37.20	0.90	0.91	0.250	0.248	0.20	0.23	1.72	1.72	1.10	1.09
New wood	39.17	39.12	0.78	0.82	0.132	0.133	0.18	0.18	1.72	1.72	2.87	2.78
Shoots	38.62	38.62	0.99	0.92	0.108	0.109	0.18	0.18	1.73	1.74	1.42	1.34
Tendrils	36.01	36.03	0.98	0.93	0.208	0.291	1.01	1.02	1.60	1.60	2.32	2.71
Leaves	40.21	40.21	2.56	2.60	0.289	0.352	0.22	0.21	1.62	3.49	2.28	2.24
Blade	38.70	38.71	1.87	1.91	0.189	0.190	0.47	0.46	3.50	3.99	2.24	2.23
Petiole	32.57	35.54	1.63	1.61	0.300	0.321	0.52	0.58	3.09	2.94	3.12	3.07

Table 8

Variation in nutrient content of different organs of the Crâmpoșie Aromată cultivar

Organ analyzed	C (%)		N (%)		P_2O_5 (%)		K_2O (%)		CaO (%)		MgO (%)	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
Root	35.90	35.88	1.30	1.31	1.171	1.170	0.35	0.32	1.75	1.76	2.65	2.70
Old wood	37.16	37.18	0.87	0.92	0.252	0.250	0.21	0.20	0.21	1.78	2.66	2.71
New wood	39.12	39.10	0.75	0.80	0.130	0.131	0.17	0.17	0.17	0.17	0.18	0.18
Shoots	38.60	38.60	0.87	0.90	0.109	0.107	0.17	0.17	0.17	0.17	0.18	0.18
Tendrils	35.90	36.01	0.94	0.91	0.288	0.290	1.00	1.00	1.00	1.01	1.02	1.01
Leaves	40.19	40.22	2.48	2.59	0.188	0.351	0.21	0.21	0.20	0.21	0.22	0.23
Blade	38.69	38.72	1.88	1.92	0.188	0.192	0.46	0.45	0.45	0.46	0.47	0.48
Petiole	32.49	35.56	1.61	1.62	0.289	0.320	0.57	0.49	0.48	0.50	0.49	0.49

Regarding the nutrient content of the various organs or their components, it is clear from the table that the leaf (blade + petiole) is the organ with the highest content in most elements (C, N, P and Ca), which is why it is the object of analysis of most studies. The average content of the leaves in nutrients, the overall nutrition and the nutritional balance achieved during the vegetation period of the main Vitis vinifera grape cultivars spread in the Drăgăşani vineyard are presented. It is found that there are differences between the varieties both in terms of the content of the leaves in nutrients, as well as in terms of the overall nutrition with NPK and the nutritional balance achieved, as is natural, differentiations in vigor, fruiting, quality.

The specificity of each grape cultivar in the absorption of nutrients naturally determines differences in vigor, quality, resistance to bad weather, resistance to diseases and pests, etc. it also constitutes the basis for the development of fertilization systems differentiated from grape cultivar to grape cultivar, taking into account at the same time the absorption capacity of the rootstock used.

The favorable effect of fertilizers is easier to notice when the mineral forms of NPK in the petiole are followed. It is felt faster for N and K (still at time 1) and later for P (time II).

Among the fertilizers applied alone, those with potassium achieved, depending on the degree of solubilization of the fertilizers, an increase in the dose of fertilizer applied to the soil and the quantity of nutrients in the leaves, a better overall nutrition. There is no proportionality between the influence of different fertilizers on the growth, fruiting, fruiting and maturation of the wood.

CONCLUSIONS

Similar to the variation of total NPK in leaves, the content of petioles in mobile forms decreases as the vine progresses in vegetation.

The nutritional needs of the vine differ from grape cultivar to grape cultivar, being influenced by the specificity of the requirements of the graft grape cultivar, the absorption capacity of the rootstock, the vigor of the hubs, the size of the production and its quality.

This fact must be taken into account when applying fertilizers in viticulture in a differentiated manner.

The percentage content of mineral elements and their dynamics during vegetation is specific to each organ of the vine.

ACKNOWLEDGEMENTS

This work was supported by the ADER Project 6.3.12 "Reconsideration of some old autochthonous grape cultivars with valuable agrobiological and technological characteristics and potential for adaptation to climate change ", Phase 3/2025.

REFERENCES

Borlan, Z., Hera C., 1984. Agrochemical optimization of the soil-plant system, Ed. Academiei RSR, Bucharest.

Borlan, Z., Hera, C., Bunescu O., 1990. Agrochemistry of phosphorus. Current aspects of practical scientific interest, Ed. Ceres, Bucharest.

Bramlage, W.I. et al., 1980. The influence of mineral nutrition on the quality and storage performance of pomefruitsgrowth in North America in Mineral nutrition of fruit trees. Ed.by Butterworths, London, Boston pp. 29-39.

Burzo, I. et al., 1999. Physiology of cultivated plants. Editorial-Printing Enterprise Science, Chisinau.

Guş, P. et al. (1998). Agrotehnica, Ed. Risoprint, Cluj-Napoca.

Mihalache, M., 2006 – Pedology – genesis, properties and taxonomy of soils. Ceres Publishing House, Bucharest.

Mihalache, M., Ilie, L., 2009 – Pedology-Soils of Romania, Dominor Publishing House, Bucharest.

* Weather Station, (2023-2024), I.N.M.H. Drăgăşani.