CHARACTERISTICS OF SOIL IN RELATION TO GRAPEVINE NUTRITION

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ABSTRACT - Characteristics of soil in relation to grapevine nutrition
The studies and research on which the present paper is based aimed at assessing the soil in the grapevine plantation of the Didactic Station in Timisoara as a nutrition environment for grapevine whose goal was to supply a fertilisation variant that ensures nutrient bio-availability and optimal nutrition to the plants. Taking into account the biology of the grapevine, we can say that soil is, on grapevine plantations, of great interest for nutrition due to the large edaphic volume distributed over two soil horizons: 0-20 cm and 20-40 cm. This is why we have characterised the soil over the two levels of interest in water and nutrient supply for grapevine plants. The soil on the grapevine plantation can be characterised as a heterogeneous nutrition environment if we take into account the two levels of supply of nutrients. Nutrients have different physical-chemical features due to the factors and conditions that impact them. The horizon 0-20 cm has a higher content in organic matter; it is worked, aerated, more oxygenated, and more subjected to more significant chemical and reaction changes as a result of applying organic and mineral fertilisers. From the point of view of the reaction, the studied soil can be characterised as a neuter reaction medium over the horizon 0-20 cm (pH = 6.85) and as low acidic over the horizon 20-40 cm (pH = 6.30). Humus content (H) is 1.85% over the horizon 0-20 cm and 1.70% over the horizon 20-40 cm. Total nitrogen content N_t is 1.141% and 1.30%, respectively. Mobile phosphorus supply is 28.55 ppm over the upper horizon and 23.41 ppm over the horizon 20-40 cm. Available potassium ranges between 155.05 ppm over the upper horizon 0-20 cm and 141.2 ppm over the horizon 20-40 cm. The value of the nutrition environment pH is neuter to low acidic which results in a relatively good macro-element bio-availability. As for phosphorus, there is the possibility of lower-mobility calcium phosphate development, but fertilisation makes possible a proper nutrition. Soil supply in nutrients and organic matter ensures a proper nutrition environment.

Keywords: soil, nutrition environment, soil fertility, soil – plant relationship, grapevine

INTRODUCTION

Soil as a nutrition environment for grapevine should be analysed at two levels or depths (0-20 cm and 20-40 cm) because of the developed root system that explores and supplies water and nutrients to the plants from a larger volume of soil.
Therefore, soil characterisation as a nutrition environment for grapevine should be done over the two horizons through the prism of specific agro-chemical indices such as pH, humus content, Nt, mobile P, and assailable K.
Grapevine nutrition state depends largely on the way the soil ensures the necessary nutrient requirements and their bio-availability correlated with other vegetation and technological factors (EPSTEIN & BLOOM, 2005, GRECU V., 2006).
The amounts of nutrients that grapevine consumes are determined by such factors as genetic, soil and climate, and technological ones. Depending on these factors, grapevine consumes annually the following amounts of nutrients: 92-154 kg N, 21-45 kg P_2O_5, and 91-129 kg K_2O per ha (CONDEI 1987).
Besides these basic macro-elements, grapevine also consumes the following: 100-160

kg CaO, 10-15 kg MgO, 1-2 kg Fe, 80-150 g B, 80-240 g Mn, 60-120 g Cu, 100-120 g Zn, and 2-3 g Mo per ha (ŢÂRDEA et DEJEU 1995, ŢÂRDEA et CHIVU 2004).
Nutrient consumption also differs depending on the grapevine cultivars (DOBREI et al. 2010), as follows:
- wine grapevine cultivars have higher consumption levels, i.e. 210-267 kg NPK/ha, particularly in high-quality wines. Of the total consumption of nutrients, N represents 40-52%, P represents 14-17%, and K represents 34-41%;
- table grapevine cultivars have lower consumptions, i.e. only 129-234 kg NPK/ha, with the lowest consumption in extra-early and early maturation cultivars and with the highest consumption in late maturation cultivars. Of the total consumption of nutrients, N represents 50-54%, P represents 15%, and K represents 30-36% (CONDEI, 1974).
As for the specific consumption of nutrients in kg/t of grapes, it reaches 4.9 kg N, 0.5 kg P, and 2.6 kg K in table grape cultivars, 6.0-14.8 kg N, 1.0-3.7 kg P, and 3.8-15.2 kg K in wine grape cultivars (IONESCU & IONESCU, 1985 quoted DOBREI et al. 2005).
Another factor that impacts macro- and micro-elements consumption in grapevines is the rootstock. Rootstock grapevines have the capacity to absorb nutrients selectively with differences from one type of rootstock to another (ŢARDEA ET CHIVU 2004).
Upon fertilisation, one should take into account the mobility of the elements in the fertilisers. Less mobile elements (P, K) should be administered before the consumption requirements of the grapevine through incorporation in the soil, close to the roots or outside the roots with quick efficacy and with high valorisation coefficient.
On grapevine areas that are homogeneous from the point of view of soil and climate conditions, grapevine has almost the same nutrient consumptions year after year, thus easing their monitoring and assessment based on nutrient balance. Starting from all this and taking into account the soil reserve, one can establish guiding rates for grapevine plantations.

MATERIAL AND METHOD

Research aimed at investigating the soil as a nutrition environment depending on grapevine nutrient requirements.
We studied agro-chemical parameters of importance for the soil in the nutrition of grapevine: pH, H, N_{total}, P_{mobile}, $K_{assailable}$, the measurements being made through current laboratory methods (colorimetry, atomic absorption spectrophotometry). Researches were conducted in 2009-2010, vine plantation was in the seventh year of production.
The study of the soil and of the relationship between the soil and the plants, i.e. grapevine, allows the assessment of the nutrient balance and of the nutrient requirements per vegetation pheno-phases and per nutrition phases.
The grapevine cultivars cultivated at the Didactic Station in Timisoara are wine cultivars, i.e. Muscat Ottonel, Burgund, and Silvania. The Didactic Station and the Fruit-tree and Grapevine Centre are in the Banat Plain, a plain with specific features.

RESULTS AND DISCUSSION

Soil as a nutrition environment has certain features in relation to grapevine. We differentiated 2 levels (horizons) of water and nutrient supply over 0-20 and 20-40 in correlation with the specific feature of the grapevine root system. As a consequence, we

also made measurements of the agro-chemical indices presented above and the characterisation of the soil at two levels. The values obtained are presented in Table 1 and in *Figures 1 and 2*.

Table 1. Value of soil agro-chemical parameters on the grapevine plantation of the Didactic Station in Timisoara

Depth (cm)	Agro-chemical parameters				
	pH	Humus (%)	Nt (%)	P_{mobile} (ppm)	$K_{assailable}$ (ppm)
0-20	6.85	1.85	1.141	28.55	155.00
20-40	6.30	1.70	1.130	27.00	140.00

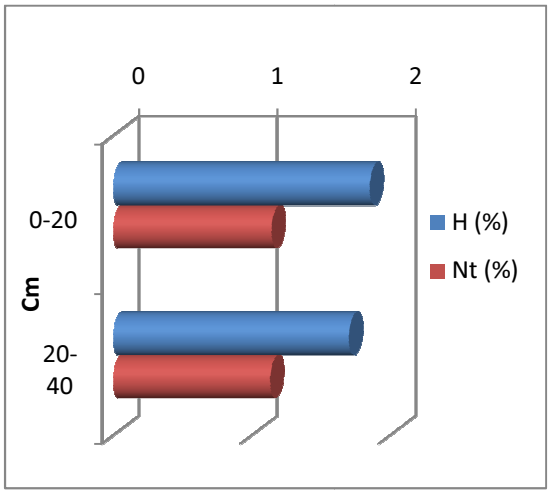

Fig. 1. Humus and total nitrogen contents (%).

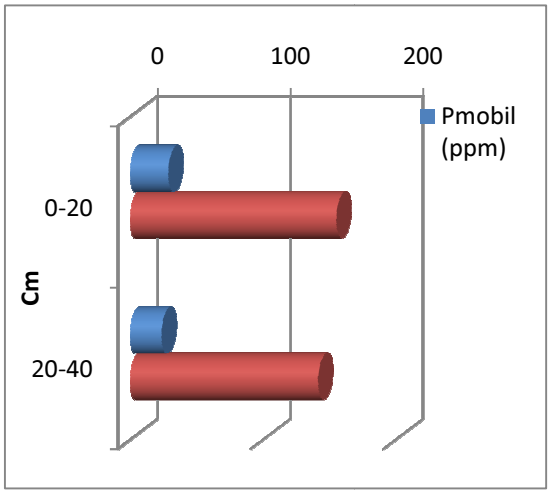

Fig. 2. Mobile phosphorus and assailable potassium supplies (ppm)

The grapevine cultivars cultivated at the Didactic Station are wine cultivars (Muscat Ottonel, Burgund, and Silvania) whose nutrition requirements range as follows: 6.0-14.8 kg N, 1.0-3.7 kg P, and 3.8-15.2 kg K as reference values.
Taking into account the normative limits concerning the necessary nutrients in grapevine cultivars and the soil supply in nutrients, we estimate that their bio-availability is medium in nitrogen and phosphorus and good in potassium.
Nutrition specificity in grapevine is given by the plant's biology. Thus, there are three different periods of consumption: a critical period, during the pheno-phase of bud opening; a period of maximum consumption, during the pheno-phase of blooming; and a period of decreased consumption, during the pheno-phase of grape maturation and reserve accumulation in the stems (*Figure 3*.).
Well knowing the specific nutrient requirements and consumption of grapevine and correlating them with its vegetation periods allow a proper guidance of nutrition through a fertilisation system differentiated for each nutrient depending on soil and climate conditions, estimated yields, plant requirements, and period or pheno-phase of maximum consumption.

Applying fertilisers depending on sequential (physiological and technological) requirements on the grapevine plantation we studied ensures a more efficient and economic use of fertilisers and a diminution of the pollution hazards, and allows the development of a sustainable exploitation.
To do so, we developed a fertilisation plan to ensure nutrients gradually, to ensure the bio-availability of nutrients in correlation with the vegetation pheno-phases, and to ensure a proper nutrition for the plantation (*Figure .4*).

	Critical period of consumption	Maximum consumption period	Low consumption period
Vegetation phases and nutrition requirements in grapevine	Bud opening	Blooming start	Grape ripening
			
	Lack of, excess of, or imbalance between nutrients has a negative impact on the entire vegetation period	Nutrients are assimilated at a higher rate and in larger amounts	Nutrient consumption decreases gradually and ceases during this period

Fig. 3. Nutrient requirements in grapevine

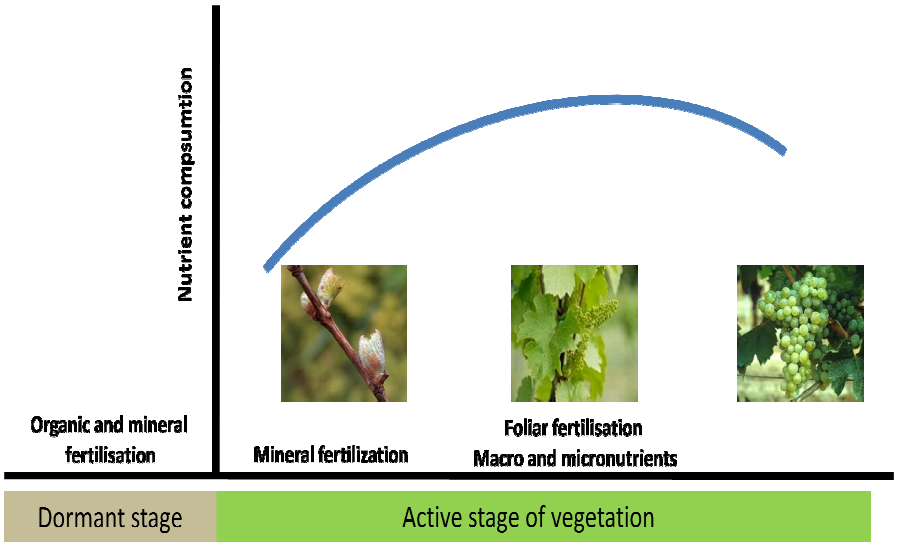

Fig. 4. Fertilisation diagramme of the research field

Given the supply of soil minerals and nutritional requirements of the vines have established the plantation system of fertilization. Organic fertilizer at 20 t / ha provide

100 kg N, 50 kg P_2O_5 si 120 kg K_2O. Availability is different in time, 20-25% in the first year for nitrogen, 30-40% for phosphorus and 60% for potassium. Fertilization with complex fertilizers provides the necessary macro-nutrients in the first period. Microelements are provided in foliar fertilization during the growing season.

CONCLUSIONS

As far as grapevine plantation soil is concerned, it is a differentiated nutrition environment that supplies water and nutrients over two horizons with different features from the point of view of their bio-availability.
Soil reaction is low acidic over the horizon 20-40 cm, and neuter over the horizon 0-20 cm, which supports the development of calcium phosphates and the low bio-availability of the soil phosphorus in amounts of 23-28.55 ppm P. Nitrogen and potassium are present in good amounts.
Grapevine necessary nutrients are ensured by a system of fertilisation correlated with the level of supply in the soil and by the pheno-phases of vegetation to ensure optimal nutrition.

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