

ECONOMIC EFFICIENCY OF SOILS FROM BANAT'S VINEYARDS

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Abstract

This paper presents a qualitative evaluation of soils from the main vineyards of Banat, generally recognized by its red wines. Strictly viewed from a qualitative point of view, the soils cultivated with grapevines fall into the medium or low fertility category. However, if certain requirements are met - exposition, slope, soil land climate conditions - these soils can ensure the necessary conditions for cultivating grapevines and obtaining high and good quality productions. The geological conditions in which the soils of this area have been formed and evolved - in Moldova-Nouă, on shale, quartz and calcite; in Buziaș, on carbonate clays; and Recaș and Tyrol, on poorly reddish and slightly carbonated clays and loams.

Key words: soil, vineyard, economic efficiency, fertility.

INTRODUCTION

According to the latest data presented by Business Microcredit IFN SA, in 2022, Romania ranked sixth in the EU in grapevine-cultivated areas, with about 190,000 ha, after Spain (almost 950,000 ha), France (over 800,000 ha) and Italy (almost 650,000 ha) (Antoce, 2017).

Romania has 37 vineyards, of which are 123 viticultural centers, plus 40 independent viticultural centers located outside the vineyards. The main wine regions of our country are: Moldova, Muntenia and Oltenia, Transylvania, Banat, Crișana and Maramureș, and Dobrogea (<https://businessmicrocredit.ro/romania-a-exportat-pestel-18-milioane-litri-de-vin-in-2019>).

Most soils in the vineyards are anthropic, poorly structured, with low humus content and reduced capillary porosity. On such lands, the appropriate execution and the optimal time for soil processing is very important (Dobrei et al., 2010; Contoman, 2011).

Literature (Fredrikson, 2011; Gaviglio, 2011) highlights the advantages and disadvantages of using the different soil maintenance systems in vineyards. Dobrei et al. (2005) studied, over the years, the influence of soil work on local varieties in the grapevine-growing areas of Recaș, Miniș, and Buziaș.

Best locations for a vineyard are those that have well-structured soils with optimum fertility and moisture which provides a favorable environment for vines root system development (Ohmart et al., 2011).

For winegrape production, soil quality can be considered as the soil's ability to support the production of a crop while minimising negative effects on the environment. Although the concept of soil quality has been developed in several papers as an indicator of sustainable land management (Pankhurst et al. 1995; Doran and Zeiss 2000; van Bruggen and Semenov 2000), there is no accepted measure of soil quality available to Australian viticulture.

The evolution of world viticulture in the future will depend on the current organization and on the historical, economic, cultural, scientific, social and religious influences that differ from one country to another (Fredrikson, 2011; Okros, 2015).

The culture of grapevine in Romania is part of the future of the world grapevine-growing, but with particularities imposed by the socio-economic conjuncture, the objectives pursued in the next and later stages, meant to make an outline for the viticulture of the beginning of the third millennium.

Teodorescu shows that, from a climate point of view, in the wine regions of Romania, the years with suitability for the quality of the wines are characterized by the low amount of precipitation during the active vegetation

period, especially since August, correlated with the lower proportion of the temperature degrees and the hours of sun (Mircov, 2021).

These climatic characteristics are also found in the areas under study, thus explaining the constant high quality of the wines (Mihuț et al., 2018).

The soil is the material support on which the grapevines develop. Its fertility features, as well as the relief, the altitude, and the exposition, determine its variability (Țărău et al., 2007). Grapevine is a plant that covers the most varied types of soil and has a very good adaptation capacity.

The physical properties of the soil indirectly have a strong influence on the growth and fruiting of plants, as the water and air regime, as well as the microbial life and the transformation of the nutrients in the soil, depend on them (Constantinescu et al., citation Drăgănescu, 2002).

MATERIALS AND METHODS

The studies were carried out in the main viticultural centers and vineyards in Banat: Moldova-Noua, Buziaș, Recaș, and Tyrol.

After identifying the main types of soil, the pedoclimatic potential was scrutinised and the economic efficiency of these soils for the grapevines was established.

The soils are of the rendzine, eutricambosol, preluvosol, luvosol, antrosol, and regosol type, along with soil associations.

In order to reach the proposed objectives, research methods specific to the soil science field were used: identification a description of the soil type, expeditious determinations in the field, laboratory analyses, processing of soil information, etc. (Mihuț, 2018).

RESULTS AND DISCUSSIONS

Banat's vineyards are located in the southwest part of Romania on the territory of Timiș and

Carăș Severin counties and include about 3,000 ha, with island-arranged plantations. These plantations are distributed in several viticultural centers, which have some uniformity of the soil an climate features and meet, to some extent, the conditions of a single vineyard. The climate is of sub-Mediterranean type, characterized by gentle winters, hot summers, and long autumns, which ensures a good maturation and even over-maturation of the grapes (Mihuț et al., 2018).

Rendzine soils (limestone soils), eutricambosols, preluvosols, luvosols, antrosols and regosols, along with soil associations, predominate. The main viticultural centers in this region are Moldova Nouă, Tyrol, Silagiu (Buziaș), Recaș, and Teremia. The viticultural centers of Moldova Nouă, Recaș, Buziaș, and Tyrol, whose area is 2,903 ha as shown in Figure 1 are not included in any grapevine region.

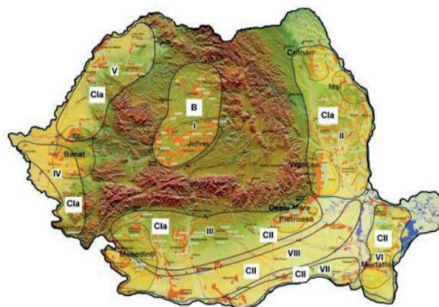


Figure 1. Classification of the grapevine regions in Romania

According to the data provided by the site www.timis.insse.ro, the western region of Romania comprises four counties (Arad, Carăș-Severin, Hunedoara, and Timiș), which, together, make up the Western region with 5,733 ha cultivated with grapevines: some of these vineyards are grafted and others are hybrid, as shown in Table 1.

Table 1. Area of fructifying vineyards in the Western region (ha) (after www.timis.insse.ro)

County	Fructifying vineyards		Grafted and indigenos vineyards		Hybrid vineyards	
	Total	Of which: mainly private property	Total	Of which: mainly private property	Total	Of which: mainly private property
Arad	2,524	2,524	2,104	2,104	420	420
Carăș-Severin	554	554	350	350	204	204
Hunedoara	11	5	6	-	5	5
Timiș	2,644	2,644	2,249	2,249	395	395
Total Western region	5,733	5,727	4,709	4,703	1,024	1,024

The largest areas occupied by fruit vines in this part of Romania (Western region) are occupied by the counties of Timiș, with 2,644 ha and Arad with 2,524 hectares, at the opposite pole is the county of Hunedoara, with only 11 ha and Caraș-Severin, with 554 ha. Of the total area, hybrid vines occupy very little, most of the vines are grafted and indigenous.

At the level of Timiș and Caraș-Severin counties, the situation is presented in Figure 2.

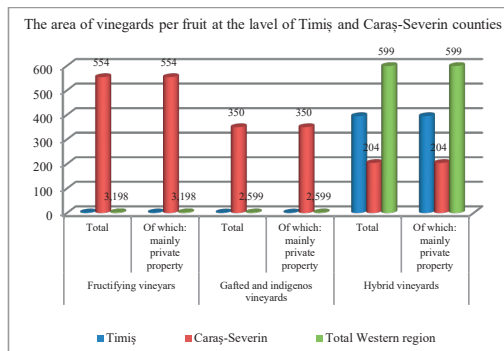


Figure 2. The area of vineyards per fruit at the level of Timiș and Caraș-Severin counties

The four vineyards and viticultural centers studied:

1. The Moldova-Nouă Viticultural Center occupies an area of 260 ha and is located in the hilly area of Banat, on slightly high hills of the Dognecea Mountains, at altitudes between 160-350 m; most of the grapevine plantations are located on plateaus with slopes of 9-20% and southern, south-western and southeastern exposition.

There, the following types of soils were identified: regosols, luvosols, and eutricambosols, the largest area (over 70%) being represented by regosols, which have a high content in skeleton (11.2-33.8), iron and microelements.

The soils in this viticultural center are very poorly supplied in humus and total nitrogen and very rich in total phosphorus and poor in potassium.

The water regime of the soil during the vegetation period differs from one type of soil to another, within wide limits, but does not affect the physiological functions of the grapevines. In dry years, however, there are certain varieties that suffer from the lack of

precipitation. On luvosols, the Cadarcă variety has great vigour, the foliar area and the length of the annual shoots increase with over 25% than on eutricambosols and with 45-62% more on regosols. It has also been observed that the weight and efficiency of the Cadarcă variety is higher on eutricambosols compared to regosols, but on regosols there is better quality and higher (8-21%) sugar content.

In this vineyard, the eutricambosols located on the slope, which have a high percentage of skeleton and an average texture, contribute to high quality red wines.

Regosols are soils formed and evolved on non- or low-consolidated parental materials. The physical features of the regosols are favorable, and chemical ones are restrictive, with a low natural fertility. They suit grapevines well, being classified 5th grade with 58 points, while luvosols have an average fertility, being classified in 6th grade with 49 points.

2. The Recaș Vineyard occupies an area of 1,589 ha; it is located mostly on slopes with southern exposition, at an altitude between 120-180 m (Figure 3). In this vineyard, three types of soil were identified: preluvosol, luvosol and eutricambosol.



Figure 3. Recaș Vineyard

Preluvosols were formed on clays and loams and occupy 30% of the total area of vineyard being characterized by the following features:

- The texture is medium (clayey-dusty and clayey) between 0-45 cm, and clayey-loamy in the horizons below 45 cm due to the increase of the illuviated loam content;
- The reaction of the soil is acid between 0-24 cm and low acidic between 24-115 cm;
- The humus content is 2.25% in the Ao

horizon and 2.13% in the transition horizon AB;

- The content in mobile phosphorus is medium;
- The content in the mobile potassium is small.

The suitability of this soil for grapevines is less favourable, it is classified 2nd with 40 points.

Luvosols occupy 40% of the territory; they are met on slopes of 10-12% and have the following features:

- The texture is clayey-dusty between 0-40 cm and clayey-loamy between 40-57 cm, with a textural differentiation index of 1.82;
- The reaction of the soil is medium acidic on the surface, strongly acidic (5.26) between 28-57 cm, and medium acidic (pH 6.60) below 58 cm;
- The content in humus is 2.09% in Ao and decreases to 1.40%;
- The content in phosphorus and mobile potassium is reduced.

Luvosols, although they have a low natural fertility for other crops, in terms of vines, this soil places them in class V with 53 points.

Eutricambosol occupies 30% of the area of the vineyard; it is a highly-levigated soil formed on carbonated clays and marls, it is found on slopes 20-30%, and it has the following features:

- The texture is clayey-dusty in the Ao and transitional AB horizons and deeper, in the Bv and BC horizons, it becomes clayey-medium-loamy;
- The reaction of the soil is low acidic (pH between 6.05 and 6.25);
- The content in humus is 2.43% between 0-22 cm and it reaches 1.37% between 22-41 cm;
- The content in mobile phosphorus is low;
- The content in mobile potassium is medium.

Regarding the suitability of this type of soil for grapevines, it falls into the group C or Suitable with 60 points.

These soils generally provide good conditions for cultivating and developing grapevines, with a porosity of 40-55% and a clay content between 14-35%. Groundwater is located at depths between 1.5-3 m and has a low chloride and phosphate content.

From a climatic point of view, the Recaș viticultural center is characterized by an average annual rainfall ranging from 650-

800 mm, and by average annual temperatures between 7.2-10.4°C. Annual aridity indices are between 35-45, and evapotranspiration is lower than the average rainfall. The water regimen is percolative, favouring debasification and the migration of the clay along the profile.

3. The Silagiu Viticultural Center (Buziaș) is located in the southeast of Timiș County in the Silagiului hills, at an altitude between 230-320 m. The soils identified there are represented by luvosols, preluvosols and anthrosols, predominantly being the anthrosols followed by luvosols.

Luvosols have evolved on clayey and loam deposits; on the surface, they have a medium texture (clayey-sandy, dusty-clayey dusty-loamy), with a high percentage of coarse sand and, along the profile, medium-fine (clayey-loamy) and fine (clayey-sandy). Total porosity has values of 45-50%, optimal values for the culture of grapevines. The soil reaction is low acidic to neutral or low alkaline with values that fall within optimal limits for cultivating grapevines (5.5-8.5). Humus content is reduced (1-2%) and it corresponds to the soils suitable for the cultivation of grape varieties for high quality wines. Groundwater is found at a depth of 10 m.

The climate is a moderate temperate continental one, with Mediterranean and Oceanic influences. The springs are early, short and quite warm, but there were also low temperatures in April and May because of a cold air front from north and northwest of Europe. Annual rainfall is between 700-800 mm, with a multiannual average value of 655 mm. The highest amounts of rainfall are in June and May.

These soils are classified 2nd and 3rd quality for grapevines culture.

The Silagiu Viticultural Center has, as a main direction of production, high quality white wines (Italian, Sauvignon, and Muscat Ottonel varieties predominate). However, high quality red wines from the varieties are also produced: Cabernet Sauvignon, Pinot Noir, Merlot, and Burgund.

4. The Tirol Viticultural Center, is located in the south-western part of Romania (Caraș-Severin county) in the grapevine area of

Banat's Hills, near the village of Tirol, west of Bocșa. This viticultural center occupies an area of 285 ha, on the Tyrolean Hills at an altitude between 140-180 m, on slopes whose inclination reaches up to 15%. The total area cultivated with vines within the commune of Doclin, to which the village of Tiroul also belongs, respectively this wine-growing center, is 327 hectares.

This viticultural center is located in a hilly area, the soils identified are districambosols and preluvosols, dominant in a proportion of over 80% are districambosols formed on clays. Districambosols are acidic soils, they have a pH between 5.6 and 5.8, a low humus content, with values between 1.03 and 1.88% at the depth of 0-20 cm, respectively between 0.55 and 0.75% at the depth 20-40 cm. They are poorly supplied in total nitrogen and assimilable potassium and moderately supplied in phosphorus. The soils that are located on the plateaus are very poor in humus and nutrients. Preluvosols, have a spread of 18%, have a humus content of 1.7-1.8%, the nitrogen content is 0.119, that in mobile phosphorus between 10.5-11.4 mg/100 g and that in assimilable potassium is between 9.6 and 12.0 mg/100 g soil.

Ground water is found at depths of more than 15 m.

Figure 4 shows the main chemical properties of the soils in the Tirol Viticultural Center (0-20 cm).

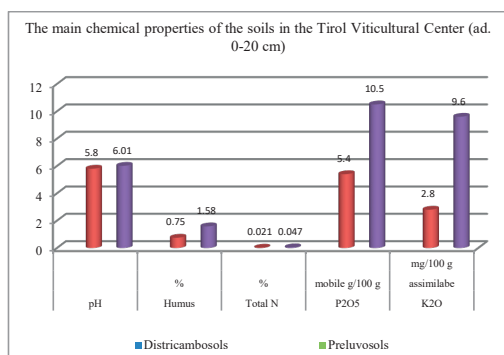


Figure 4. The main chemical properties of the soils in the Tirol Viticultural Center (0-20 cm)

The pedo-climatic conditions in this viticultural center are favorable for the cultivation of vines, the ones that cause problems are the late spring

frosts, which occur less often and during the vegetation period, the ones that have a high frequency are the late frosts (both those in spring and those in autumn), as well as the hail that in recent years has had an increasingly high frequency, which has led to a decrease in production and a decrease in the quality of the grapes. The most cultivated varieties are Fetească, Muscat, Merlot, Riesling and Sauvignon blanc.

CONCLUSIONS

The efficient use of the geographical and climate resources in this area, interwoven with the adoption of higher cultural and processing technologies to meet the demands of both domestic and foreign consumption are the priorities of modern viticulture in the Banat area.

Knowing the relationships between the plant and its development environment creates the possibility of expanding and optimizing the grapevine culture in various areas with appropriate natural conditions. The relationship between grapevines and climate factors determines the distribution of this culture in areas where it is possible.

The relief is of vital importance in determining the quality of the wine. The hilly relief increases the area of the land, and it is a barrier to the winds and the cold or hot currents. The slope also ensures the leakage of excess water, favouring the heating of the soil.

The four vineyards and viticultural centers belonging to Banat's vineyards represent an important and recognized grapevine-growing area due to its exceptional wines acknowledged both nationally and internationally (Recaș wines). Recaş wine center occupies the largest area cultivated with vines, 1589 ha.

The vineyards of Banat are represented by a series of soils, the most widespread are the luvosols that were identified in all 4 vineyards and viticultural centers and which are soils that lend themselves to this culture, followed by eutricambosols that were identified in the Moldova Nouă Viticultural Center and Recaş, regosols (Moldova Nouă), preluvosols in Recaş and Silagiu, districambosols in Tirol and antrosols in Silagiu. The soils from the Recaş Vineyard are the ones that lend themselves best

to this culture, followed by those from the Silagiu Viticultural Center.

We can thus state that this part of Romania, due to its soil and climate conditions, provides favourable and very favourable natural conditions for the culture of grapevines, especially of the varieties for high quality wines. The geographical location and infrastructure superior to the other grapevine areas of Romania have attracted many investors especially in recent years, which have contributed to the relaunch of the viticulture in this area. As a result of the investments made after 2000, numerous wine holdings appeared, which replaced the aging plantations with young plantations.

In most of the studied viticultural centers, however, there are a number of disadvantages regarding the efficiency of farms because of the exaggerated fragmentation of the property, especially in Silagiu-Buziaș, which prevents the formation of larger farms with an appropriate equipment in order to be able to practice high-performance technologies

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