

PRINCIPLE AMELIORATIVE SOLUTIONS FOR ADOPTION OF DEGRADED TERRAINS AND THEIR TRANSFORMATION INTO SPECIFIC WINE TERROIR

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Abstract

In terms of its geomorphology, the area outlines the southern border of the Upper Thracian Plain. The whole area of the studied objects belongs to the erosion part, and the accumulation is partly manifested only in some lower forms of the micro relief. The morphological peculiarities of the terrain – soil texture and physical properties of the soil, content of total and alkaline earth carbonates, the content of active calcium, humus, water-soluble salts, the indicators characterize the harmful acidity and the content of nutrient macro elements were studied.

The presence of gley spots and nodules warrants predicting unfavorable water and air regime at strong compaction of the subsoil horizons. The texture coefficient 1,83 was a restriction on the suitability of the soil for vineyards. The established pH was a major restriction for the growth of the vine, especially in the period from planting to fruitage

The presented work was an attempt to systematize the complex study on the suitability of one complicated in terms of the erosion conditions terrain in regard to its suitability for transformation into wine terroir.

Key words: degraded terrains, wine terroir, erosion

1. INTRODUCTION

The most important factors, defining the concept of "terroir" for a great wine are soil and climate. The climate allows the vine to adapt to the given location and under specific conditions (Falcetti M., 1994).

One of the most important forms for determination of the climatic conditions are agro-climatic resources of the territory (Wilson J., 1998).

The variety of soil conditions in Bulgaria is large and in terms of opportunities for wine viticulture in the recent years was formed specific areas for production of quality wines, which according to the methodology for determination of areas for their production should cover certain requirements regarding to the location of the vineyards (Mihalev Trendafilov, 2005). In this sense, the location determines the specificity, and the specificity is due to the advantages and disadvantages of the region, including its soils.

The main soil degradation processes in the described areas are the massive in recent years erosion of the terrains and the soil acidity.

2. MATERIAL AND METHODS

In terms of climate, the studied objects, located in the land of Rogozinovo vilage belong to the Continental-Mediterranean climatic region.

The soil samples were taken from the terrain with a soil probe, as sample points were located within the field in a square grid, regardless of the borders of the different soil types of the terrain (BDS ISO 10381-2:2002). Samples were taken in three depths 0-25; 25-50 and 50-75 cm.

After standard preparation, soil samples were analyzed to establish the indicators: soil texture with fotosedimentograf (Trendafilov and Popova, 2007), pH - potentiometric in aqueous extract (Arinushkina, 1970), content of total and alkaline earth carbonates – gas metrically by Scheibler method (Arinushkina, 1970), activate calcium precipitable with $(\text{NH}_4)_2\text{C}_2\text{O}_4$ – Druinnot-Gallet

(NO1085/NFX31-106), humus content by Turin method (Trendafilov and Popova, 2007), water-soluble salts (BDS ISO 11265:2002), content of easily absorbable iron, total nitrogen in the soil (BDS ISO 11261: 2002), phosphorus and potassium mobile forms (GOST 26209-91/01.07.93).

3. RESULTS AND DISCUSSION

In the peripheral and especially in the southern parts of the terrain was found rocks, and the soil was a complex of Rankers and Lithosols. These places are marked on sketch 1: 10000 (Figure 1).

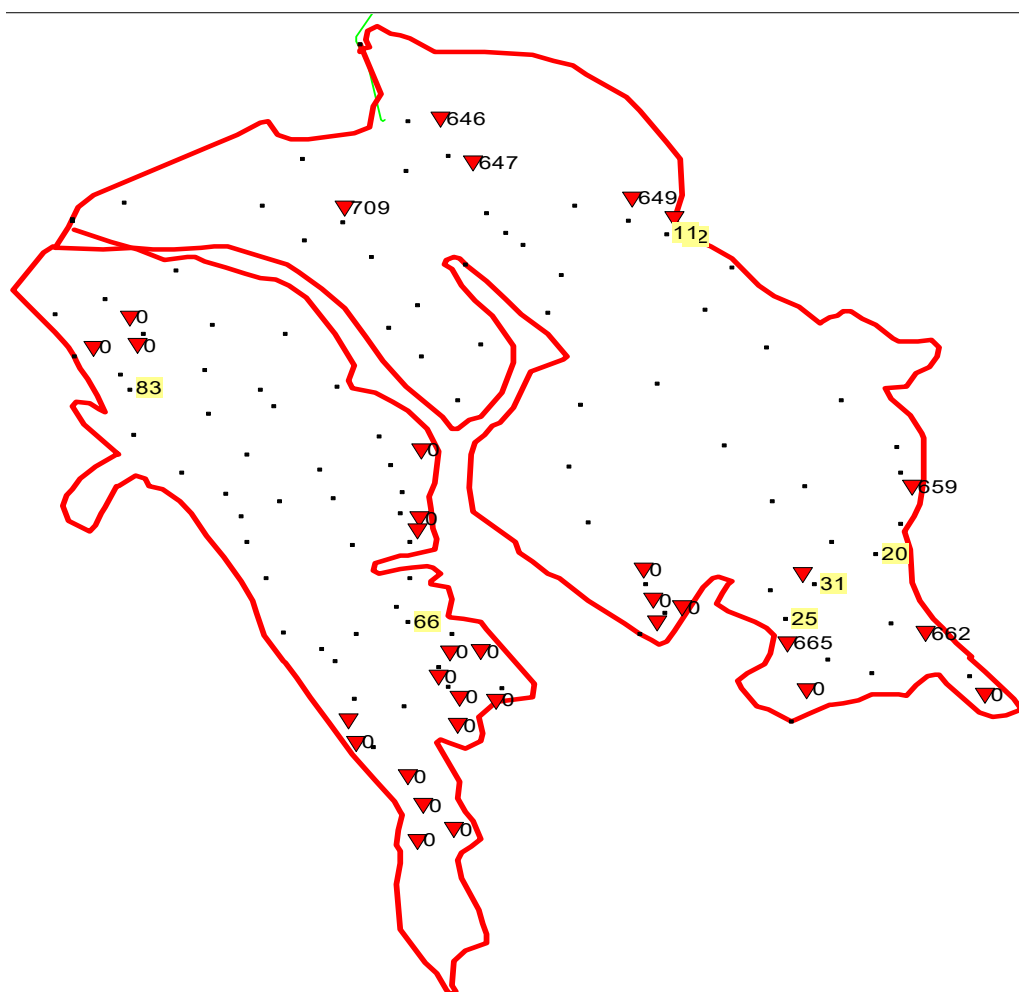


Figure 1. Sketch M 1:10000 with an indication of rocks and places occupied by complexes of Rankers and Lithosols

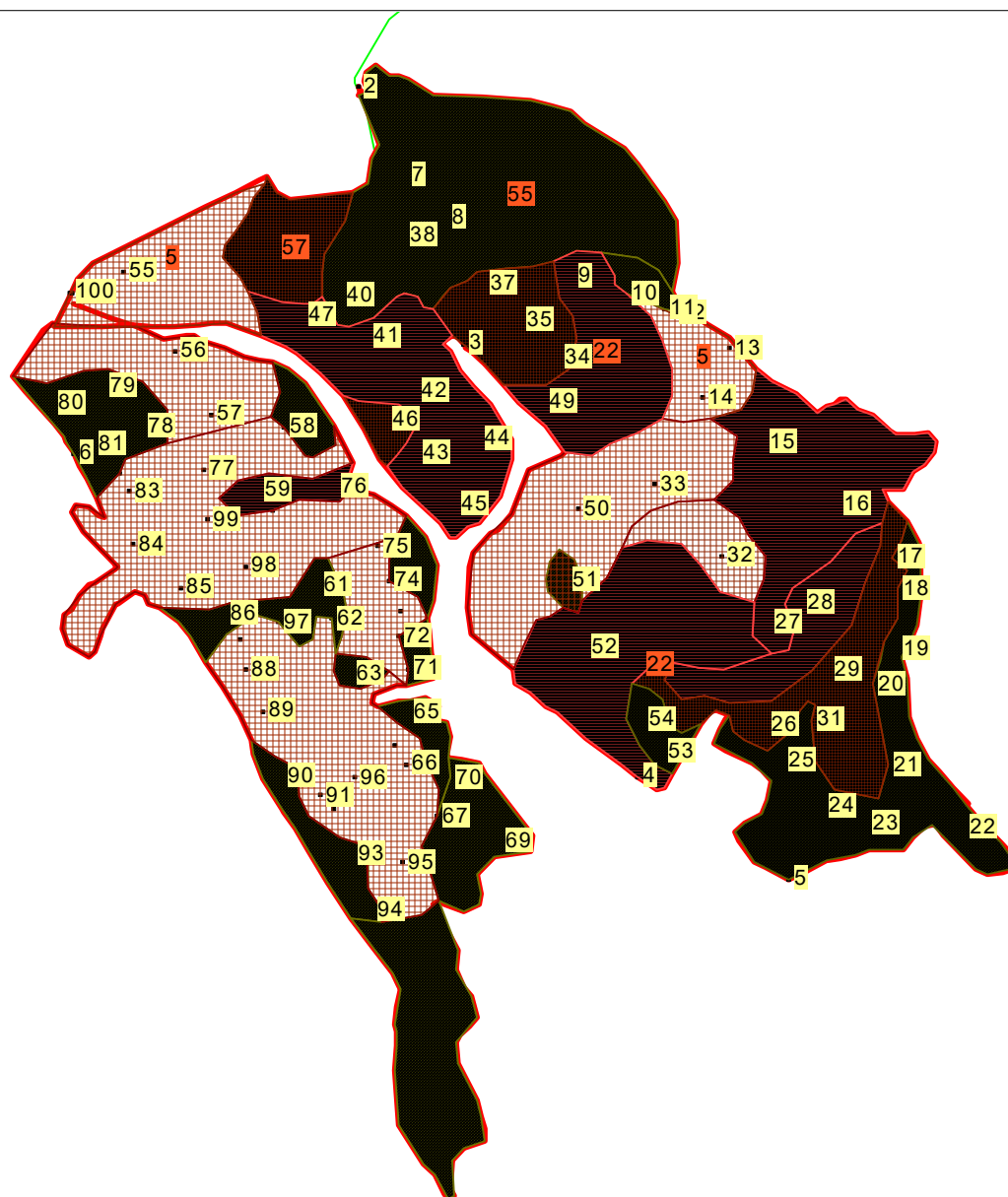


Figure 2. Soil Map M 1/10000 object Rogozinovo

Table 1. Legend of the soil map M 1/10000 object Rogozinovo

Number of soil diversity	Symbol	FAO
22		Chromic luvisols
57		Eutric regosols
54		Rankers

Chromic luvisols

Soil texture and physical properties of the soil

The average content of physical clay at a depth of 0 to 75 cm was 35,9% and increased by the depth of the profile. In the top soil horizons, the soil texture was sandy clay loam (Table 2). In the subsoil

horizons soil, the soil texture was sandy clay to a depth of 25-50 cm and sandy clay loam to a depth of 50-75 cm. The established values of physical clay shown, that the soil texture was not a restriction on the suitability of the soil for growth of vines.

Table 2. Average values of the physical indicators of Chromic luvisols by depths

Indicators	Depth (cm)		
	0-25	25-50	50-75
<i>Physical clay (%)</i>	27,1	49,5	31,8
<i>Particles <0,001mm(%)</i>	6,9	6,7	6,7
<i>Specific density g/cm3</i>	2,69	2,71	2,71
<i>Bulk density at saturation</i>	1,43	1,48	1,5
<i>Porosity %</i>	46,83	45,22	44,64

Soil pH

The average value of the pH (H₂O), established for the entire investigated object was 5,66 with a confidence interval of 5,42 to 5,91. The indicator pH in the top soil horizon had an average value of 5,2 with a confidence interval of 4,85 to 5,63. The soil reaction in the top soil horizon was acidic. In the depth of the soil, pH values increased slightly. The reaction of the subsoil horizons, however, was also defined as acidic.

The established in the analysis pH, was a major limitation for the growth of the vine, especially in the period from planting to fruitage. To prevent the adverse effect of the established soil acidity, when growing vine plantation, the soil needs to be neutralized by the application of chemical amelioration (liming) and planting vines on resistant pad.

Content of total carbonates

The soil did not contain carbonates at all sampling points.

Content of active Ca²⁺

The average content of active calcium for the area, occupied by Chromic luvisols was 0,48% and varies within the confidence interval of 0,39 to 0,58%. The maximum value of active Ca²⁺, established within the studied soil difference was 0,78%. The average content of the active calcium for the top soil horizons was 0,57% (Figure 3). The content of active Ca²⁺, basically decreased by the depth of the profile. The established values diversity of the indicator was insignificant, and as a quantity, the values were in the range of analytical error. The content of active calcium in the soil did not limit the choice of the pad for planting.

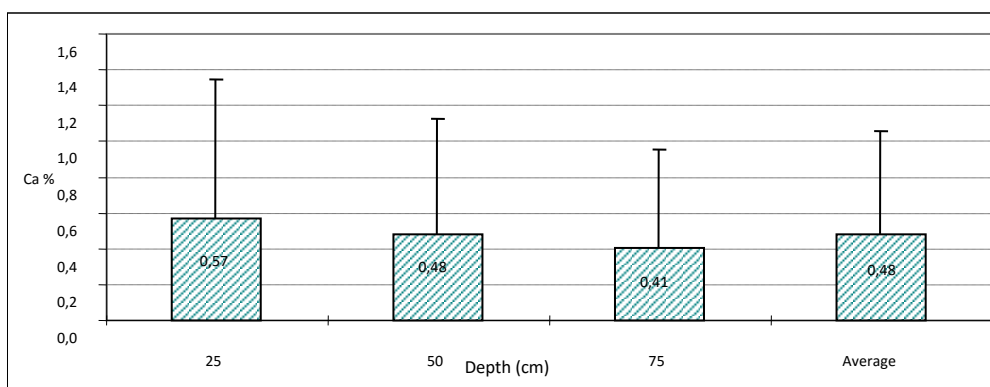


Figure 3. Content of active Ca^{2+} and distribution in the soil profile

Humus content

The humus content of the top soil horizon of Chromic luvisols was 1,26% and assessed as low. The humus content decreased to 0,58% at a depth of 25-50cm, and to 0,34% at a depth of 50-75 cm (Figure 4). The corresponding to the humus, the content of total nitrogen in the soil was average 0,07% in the top soil horizon; 0,03% of a depth 25-50 cm, and average 0,05% for the trenching soil layer. Total nitrogen stock in layer 0-50cm was 4 t/ha. About 72% of this stock was found in the top soil 25 cm of the profile.

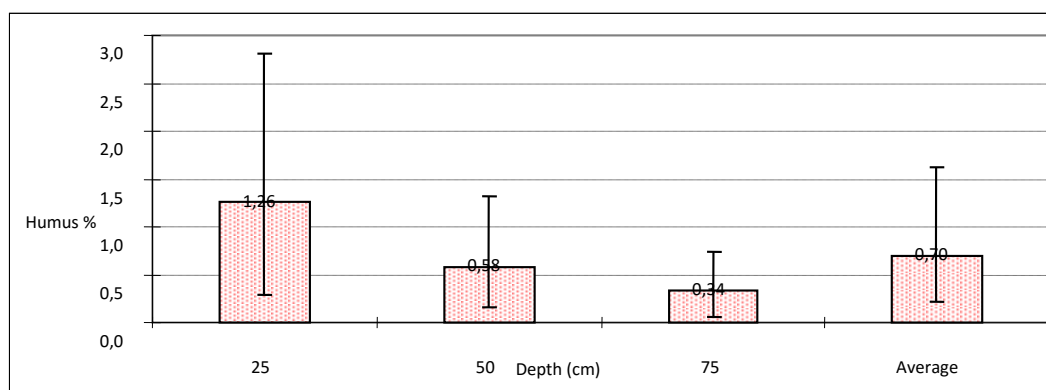


Figure 4. Average humus content (%) in the soil profile depth of Chromic luvisols

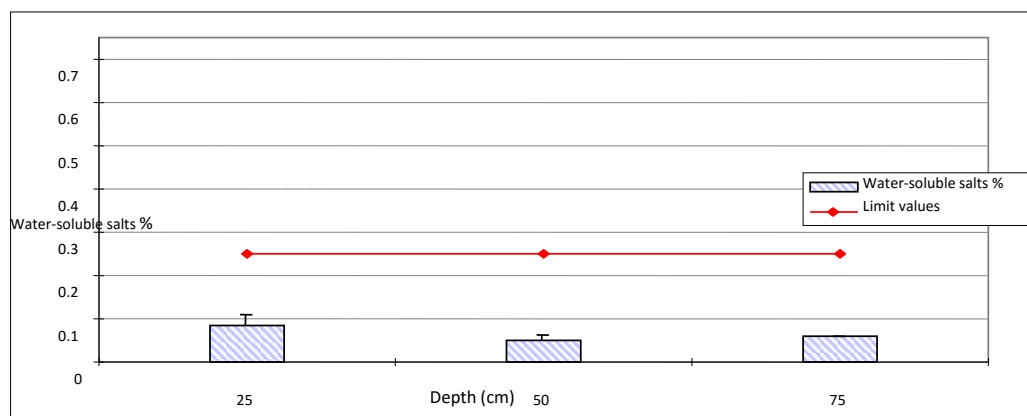


Figure 5. Contents of water-soluble salts and distribution of the salts on the profile of Chromic luvisols

Content of water-soluble salts

The content of water-soluble salts in the soil was very low and did not exceed the limit of harmfulness (0,25%) and was not a restriction for the growth of the vine. The data for the average content of water-soluble salts and their distribution in the profile are presented in Figure 5.

Content of nutrient macro elements

The content of assimilable ammonium and nitrate nitrogen in the soil and content of assimilable phosphorus and potassium is shown in Table 3. The soil was poorly stocked with phosphorus and relatively well with assimilable potassium.

Table 3. Content of nutrients macro elements in the top soil horizon

Indicators	Total
<i>Content of N in the soil (mg/kg)</i>	36,4
<i>Content of P in the soil (mg/100g)</i>	2,74
<i>Content of K in the soil (mg/100g)</i>	30,00

Exchangeable acidity and degree of saturation of the soil with bases

Table 4. Content of easily mobile exchangeable Al^{+++} , H^+ , Mn^{++} , Ca^{++} u Mg^{++} in extract with 1m KCl and degree of saturation of the permanent sorption positions in the soil with easily mobile exchangeable bases

Sample	Depth (cm)	pH (H ₂ O)	pH (KCl)	Al+H (meq)	Mn (meq)	Ca+Mg (meq)	V ₃ %
648	0-25	5,1	3,9	0,39	0,08	7,48	94
	25-50	6,1			0,13		
656	0-25	4,7	3,6	1,41	0,08	6,65	82
	25-50	5,5			0,14		
657	0-25	5,8	3,7	0,6	0,11	2,44	78
	25-50	4,9			0,21		
667	0-25	5,6			0,1		
	25-50	5,9			0,17		
710	0-25	5	3,7	1,04	0,06	9,83	90
	25-50	6,1	3,7	0,95	0,12	9,19	90

Eutric regosols

Soil texture and physical properties of the soil

The average content of physical clay at a depth of 0 to 75 cm was 29,9% and decreased by the depth of the profile. In the top soil horizons, the soil texture was sandy clay (Table 5). In the subsoil horizons soil, the soil texture was sandy clay to a depth of 25-50 cm and sandy loam to a depth of 50-75 cm. The established values of physical clay shown, that the soil texture was not a restriction on the suitability of the soil for growth of vines. The texture coefficient had a value of 0,80 and was not a restriction on the suitability of the soil for vineyards.

Table 5. Average values of the physical indicators of Eutric regosols by depths

Indicators	Depth (cm)		
	0-25	25-50	50-75
<i>Physical clay (%)</i>	36,9	35,2	14,4
<i>Particles <0,001mm(%)</i>	4,3	3,4	2,1
<i>Specific density g/cm³</i>	2,7	2,71	2,71
<i>Bulk density at saturation</i>	1,45	1,49	1,5
<i>Porosity %</i>	46,37	44,99	44,66

Soil pH

The average value of the pH (H₂O), found for the entire studied object was 5,21 with a confidence interval of 4,99 to 5,43. The indicator pH in the top soil horizon had an average value of 5,2 with a confidence interval of 4,92 to 5,52. The soil reaction in the top soil horizon was acidic. In the depth of the soil, pH values decreased. The reaction of the subsoil horizons, however, was also defined as acidic.

The established in the analysis pH, was a restriction for the growth of the vine, similar to Chromic luvisols. It should provide the same type of ameliorative work as at Chromic luvisols.

Content of total carbonates - The soil did not contain carbonates.

Content of active Ca²⁺

The average content of active calcium for the area, occupied by Eutric regosols was 0,43% and varies within the confidence interval of 0,31 to 0,55%. The maximum value of active Ca²⁺, found within the studied soil difference was 0,76%. The average content of the active calcium for the top soil horizons was 0,48% (Figure 6). The content of active Ca²⁺, basically decreased by the depth of the profile. The established values diversity of the indicator was low. The content of active calcium in the soil was insignificantly and within of analytical error.

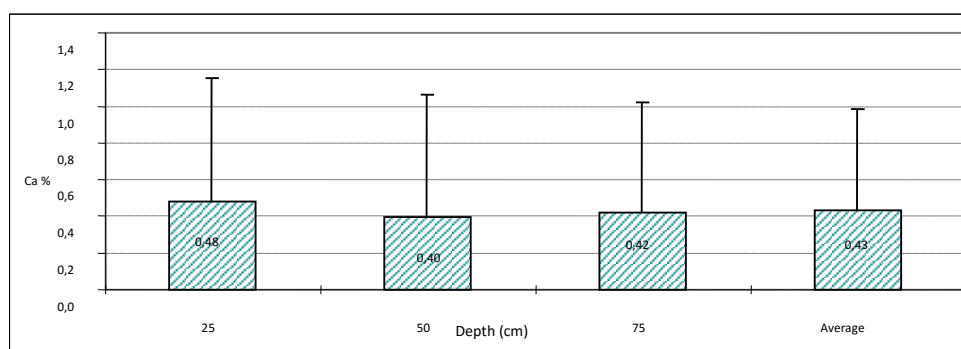


Figure 6. Content of active Ca²⁺ and distribution in the soil profile

Humus content

The humus content of the top soil horizon of Eutric regosols was 1,06% and assessed as low. The humus content decreased to 0,48% at a depth of 25-50cm, and to 0,34% at a depth of 50-75 cm (Figure 7). The corresponding to the humus, the content of total nitrogen in the soil was average 0,06% in the top soil horizon; 0,03% of a depth 25-50 cm, and average 0,05% for the trenching soil layer. Total

nitrogen stock in layer 0-50cm was 3 t/ha. About 68% of this stock was found in the top soil 25 cm of the profile.

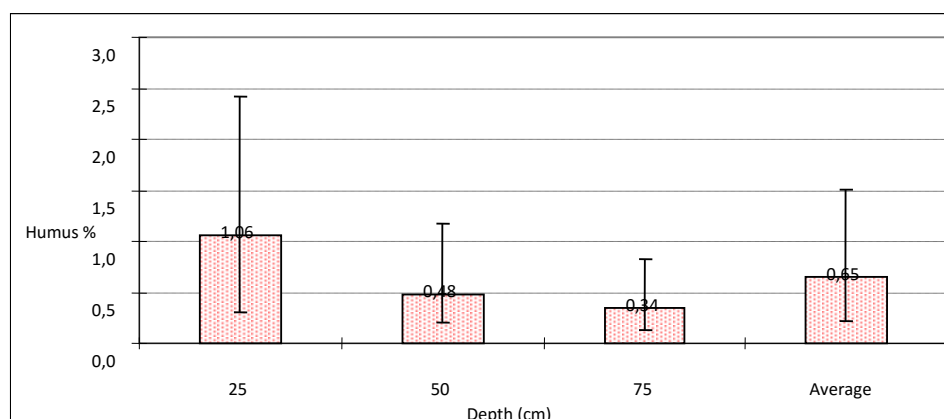


Figure 7. Average humus content (%) in the soil profile depth of Eutric regosols

Content of water-soluble salts

The content of water-soluble salts in the soil was very low and did not exceed the limit of harmfulness (0,25%) and was not a restriction for the growth of the vine. The data for the average content of water-soluble salts and their distribution in the profile are presented in Figure 8.

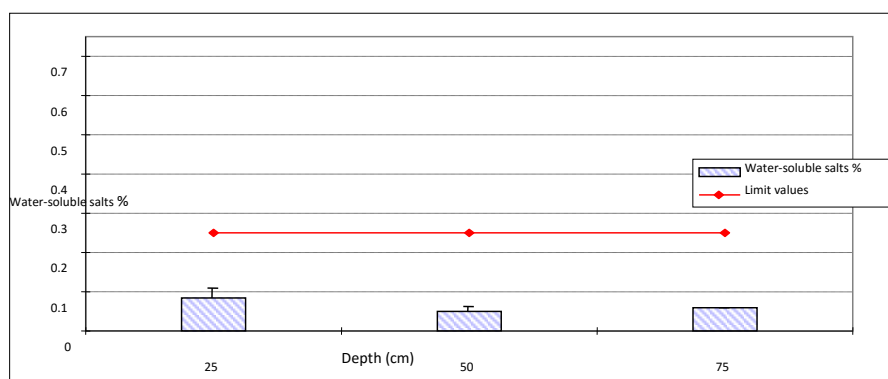


Figure 8. Contents of water-soluble salts and distribution of the salts on the profile of Eutric regosols

Content of nutrient macro elements

The content of assimilable ammonium and nitrate nitrogen in the soil and content of assimilable phosphorus and potassium is shown in Table 6. The soil was poorly stocked with phosphorus and potassium.

Table 6. Content of nutrients macro elements in the top soil horizon

Indicators	Total
<i>Content of N in the soil (mg/kg)</i>	23,5
<i>Content of P in the soil (mg/100g)</i>	6,34
<i>Content of K in the soil (mg/100g)</i>	16

Exchangeable acidity and degree of saturation of the soil with bases

Table 7. Content of easily mobile exchangeable Al^{+++} , H^+ , Mn^{++} , Ca^{++} u Mg^{++} in extract with 1m KCl and degree of saturation of the permanent sorption positions in the soil with easily mobile exchangeable bases

Sample	Depth (cm)	pH (H2O)	pH (KCl)	Al+H (meq)	Mn (meq)	Ca+Mg (meq)	V ₃ %
655	0-25	4,9	3,65	1,02	0,1	8,14	88
	25-50	5,7					
658	0-25	4,8	3,7	0,73	0,05	4,6	86
	25-50	4,8	3,6	0,94	0,08	4,75	82
671	0-25	5,4	4,6	0,05	0,09	1,11	89
	25-50	4,8	3,4	2,06	0,08	3,72	63
673	0-25	5,5					
	25-50	5	4,2	0,13	0,17	3,63	92
726	0-25	5,5					
	25-50	6,25					

4. CONCLUSION

In the high parts of the studied objects were established areas with shallow and strongly skeleton profile. Considering the conditions of the natural water balance of the territory, it is appropriate the growth of the vines in the terrains of Eutric regosols to cover areas, where the depth of the soil profile is not less than 50 cm. In land occupied by deep soils - Chromic luvisols, needs trenching performance. In the part of the terrain, occupied by the shallow and highly eroded Eutric regosols needs deep ameliorative loosening, without turning the top soil layer.

The presence of gley spots and nodules of Chromic luvisols warrants to predict unfavorable water and air regime with strong compaction of the subsoil horizons, which will occur after the fruit-bearing of the plantation. There is a process of accumulation of clay in the subsoil horizons of the profile, which requires pre sowing treatment system, designed to reduce the density of the clay accumulation horizon and to increase its aeration degree.

In order to neutralize the established soil acidity and to prevent greater acidification of the soil in the cultivation of the vine plantation need to perform liming of the sections with acidification and the planting of the vines on sustainable pad.

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