SADRŽAJ

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CHARACTERISTICS OF ORGANIC MATTER OF THE A-C STAGE IN OAK COMMUNITIES OF DELIBLATO SANDY DESERT

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The work explores the impact of various oak communities on quantity, dynamics and the composition of humus, as well as evolution of soil within the A-C stage on Deliblato sandy desert. It displays results of research of physical and chemical soil properties, also the group-fraction composition of humus on the sites of Devojački bunar and Natural reserve - Crni Vrh in the following communities of oak:

1. *Querco-Tilietum* tomentosae subas. quercetosum pubescentis (Stjepanovič-Veseličič, L. 1953) - forest of Vergilius Oak and Silver Lime.

2. *Querco-Tilietum* tomentosae subas. convallarietosum (Stjepanovič-Veseličič, L. 1953) - forest of English Oak and Silver Lime.

3. *Orno-.Quercetum cerris-Virgilianae* (Jov. et Vuk. 1977) synonim *Querco-Tilietum tomentosae subas. quercetosum pubescentis* (Stjepanovič-Veseličič, L. 1953) - forest of Vergilius Oak and Turkey Oak.

Key words: organic matter, humus, oak community, evolution, soil fractions

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INTRODUCTION

Elaborate study and cartographic survey of the soil of Deliblato sandy desert has been accomplished by PAVIĆEVIĆ, N. and STANKOVIĆ, P. (1963). ANTIĆ, M. *et al.* (1969) were dealing with the question of genesis. NEJGEBAUER, V. *et al.* (1972) have, within paedological exploration of Vojvodina, also analyzed the soils of Deliblato sandy deserts. Study of impact of conifer stage on evolution of soil of Deliblato was subject of research of BUNUŠEVAC, T. and ANTIĆ, M. (1951) and KNEŽEVIĆ, M. (1994).

Data on results of research on organic matter and its role in evolution of soil morphology of Deliblato sandy desert cannot be found from our paedological literature. Exploration of these problems was initiated bearing in mind these facts (KOŠANIN, O. 2001).

In this paper researches the caracteristics of organic matter of soil in A-C stage in communitis of oak, however, researches the role quantity, content and dynamics of humus and their influence on level of soil development on the Deliblato sandy desert.

OBJECT OF THE STYDY AND METHOD

The research was carried out on four sites in Deliblato sandy desert, among various distinctly differentiated oak communities, lined in succession.

1. Communities of Silver Lime, English Oak, Vergilius Oak and Common Smoketree (*Querco-Tilietum tomentosae subas. convallarietosum* (Stjepanovič-Veseličič, L. 1953) on regosol. The site of Natural reserve-Crni Vrh, altitude 182m, northern exposure, base of dune.

2. Communities of Silver Lime, English Oak, Vergilius Oak, without Common Smoketree (*Querco-Tilietum tomentosae subas. convallarietosum* (Stjepanovič-Veseličič, L. 1953) on chernozem on carbonate aeolian sand-carbonate (shallow). The site of Natural reserve-Crni Vrh, altitude 182m, northern exposure, slope 5-8°(slope of dune).

3. Communities of Silver Lime and Vergilius Oak (*Querco-Tilietum tomentosae subas. quercetosum pubescentis* (Stjepanovič-Veseličič, L. 1953) on chernozem on carbonate aeolian sand-carbonate (medium depth). The site of Devojački bunar, altitude 187m, north-northeastern exposure, slope 20°.

4. Communities of Turkey Oak and Vergilius Oak (*Orno-Quercetum cerris-Virgillianae* (Jov. et Vuk. 1977) on chernozem on carbonate aeolian sand- carbonate (medium depth). The site of Devojački bunar, altitude 186m, northeastern exposure, slope 15°.

Field and laboratory study was executed by methods usual in Pedology. The studies of basic physical and chemical properties of soil were executed by standard methods adopted by the Yugoslav Society of Soil Sciences (Metode za istraživanje fizičkih svojstava zemljišta, 1997; Hemijske metode ispitivanja zemljišta, knjiga 1, 1966). Group-fraction composition of humus was determined by the method of PONOMAREVA, V. V.(1957), after ŠKORIĆ, A. and RACZ, Z. (1966).

With regards to the inseparable relation between soil and vegetation, the field study used phytocenologic records by the Braun-Blanquet Method.

STUDY RESULTS AND DISCUSSION

Conditions for soil formation on the studied sites are approximately the same. Therefore, the major role and impact on development degree of soil structures in the sand of Deliblato sandy desert is that of organic matter, that is, humus, by its qualitative and quantitative indices. The biotization of Deliblato sandy desert initiates a lasting process of soil formation on sand and of stabilizing of the complex eco-system of Deliblato sandy desert. Forest vegetation is of manifold benefit for the process. On one side, it has an active effect on the soil through its organic residue, finally through humus. On the other, forest trees binds the sand by its underground part – the root, and alleviates the stand extremes by its crown.

Based on the results of field and laboratory soil analyses, it was determined that the studied soils belong to the humus - accumulative class. The morphological structure of soil on the Deliblato sands is O - A - C or O - A - AC - C. Only in one of the studied soils was of the undeveloped class, with profile composition type Oh - (A) - C, where formation of the humus-accumulating horizon was only at its very beginning.

As regards texture, majority of the soil structures were of loam-sand mechanical composition, with only one case of the sand-loam type (table 1). Contents of hygroscopic water was established as directly dependant on humus contents in the soil.

Reactions of the studied soils were neutral or mildly alkaline (table 2). Total adsorption capacity of the studied soils of Deliblato sandy desert is rathe high, and is in direct correlation to the humus contents and that of colloid clay. Adsorptive complex of soil of Deliblato sandy desert is characterized by high adsorption capacity by the alkaline cathiones, as well as high alkaline saturation of the soil (V>95.74%).

Basic property of the studied soils is their carbonate degree, at the same time indicator of degree of soil evolution. Correlation was established between the humus and carbonate contents. More precisely, evolution of soils of Deliblato sandy desert was followed by increase in humus contents and simultaneous carbonate washing from surface out to deeper soil layers.

Characteristic forest type of accumulation and arrangement of organic matter in the soil was recorded in the studied soil structures (PONOMAREVA, V. V., PLOTNIKOVA, T. A. 1975). It is characterized by high contents of humus at the surface profile area (10-15cm). At the point of crossover from the quoted surface layer to lower soil layer the humus contents sharply decreases, while, further, with depth increase, the contents gradually decreases (fig. 1).

Values within the ratio between carbon and nitrogen range between 5.5 and 15.8. Rapid mineralizing is recorded in community of Vergilius Oak and Silver Lime (pedologic profile 1). The Lime residue easily disintegrates, and enriches the soil by humus and nitrogen. Given the abundance of Lime in this community, as well as presence of capillary condensing, the conditions are favourable for rapid mineralizing. In the surface part of humus – accumulating soil horizon, in profiles 6 and 9, a certain imbalance is recorded between humifying and mineralizing. The cause of this phenomenon is predominance of organic matter of oak origin. The ratio C:N points to the mull-form of humus.

The total quantity of nitrogen is conditioned by the contents of humus matters in the ground. The nitrogen contents decreases or remains below detectable level. In the surface part of the A horizon of all profiles the nitrogen contents can be considered as satisfactory. With soil genesis the humus quantity also increases, as does the nitrogen quantity.

The maximum quantity of available phosphorous was detected at the soil profile 1, in carbonate – medium depth chernozem. Studied soils are medium supplied by contents of available phosphorous. As for the contents of available potassium, studied soils of Deliblato sandy deserts are medium to well-supplied.

In group fraction humus contents of the studied soil of the Deliblato sandy desert (table 3), the most frequent is the undiluted residue, that is, humin. Surface parts of humus - accumulative horizon display lower degree of humus solubility in relation to deeper parts of the profile (fig. 1).

High content of the humic acid can be regarded as a highly important property of the studied soil of the Deliblato sandy desert, especially fractions bound for Calcium. The content of fraction 2 of humic acids increases with depth, in all soil profiles. This increase is directly related to the contents and transfer of carbonate within profile. The acids transfer within the soil in form of colloid gels, to form highest quantities of Ca-humate at the point of highest concentration of Calcium iones (KOŠANIN, O. 2001). Surface parts in all the studied soils contain lower quantities of this fraction. Contents of the fraction 1 of humin acids is low and decreases with depth in all profiles. Domination of humin acids, especially fraction 2, is considsered a very important property of the soil of Deliblato sandy desert. Based on this property, the studied soil structures were isolated in classification as chernozem.

Group fraction content of humus of the studied soils of Deliblato sandy desert is characterized by law content of fulvic acid. Fraction 2, analogue to fraction 2 of humin acids, is leading among the fulvic acids. Contents of fraction 1 of the fulvic acids is low, and decreases with depth. Content of free, mobile and aggressive fraction 1a of the fulvic acids is also low, and increases with depth in all soil profiles. This fraction very quickly migrates to deeper soil layers, where its increased content can serve as indication of higher soil development.

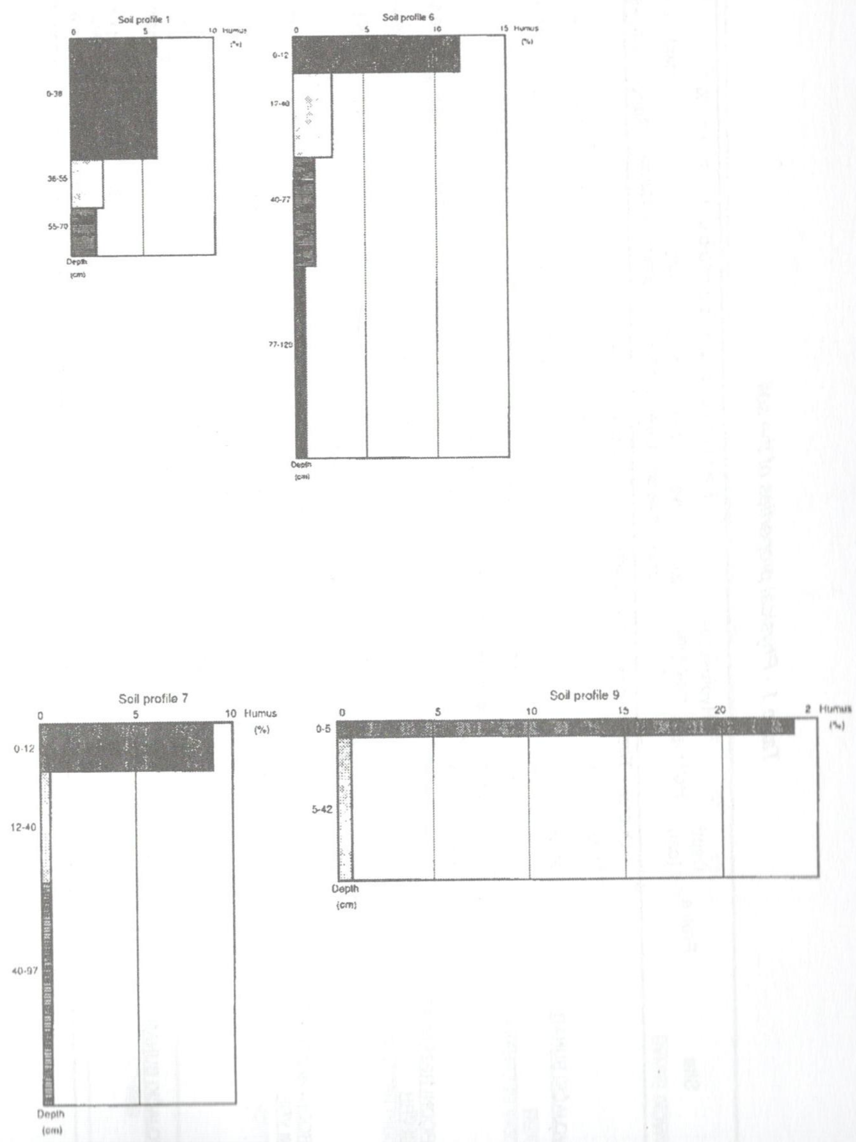


Fig 1 - Content and ordering of humus on depth soil on the Deliblato sands

Table 1 - Physical properties of the soil

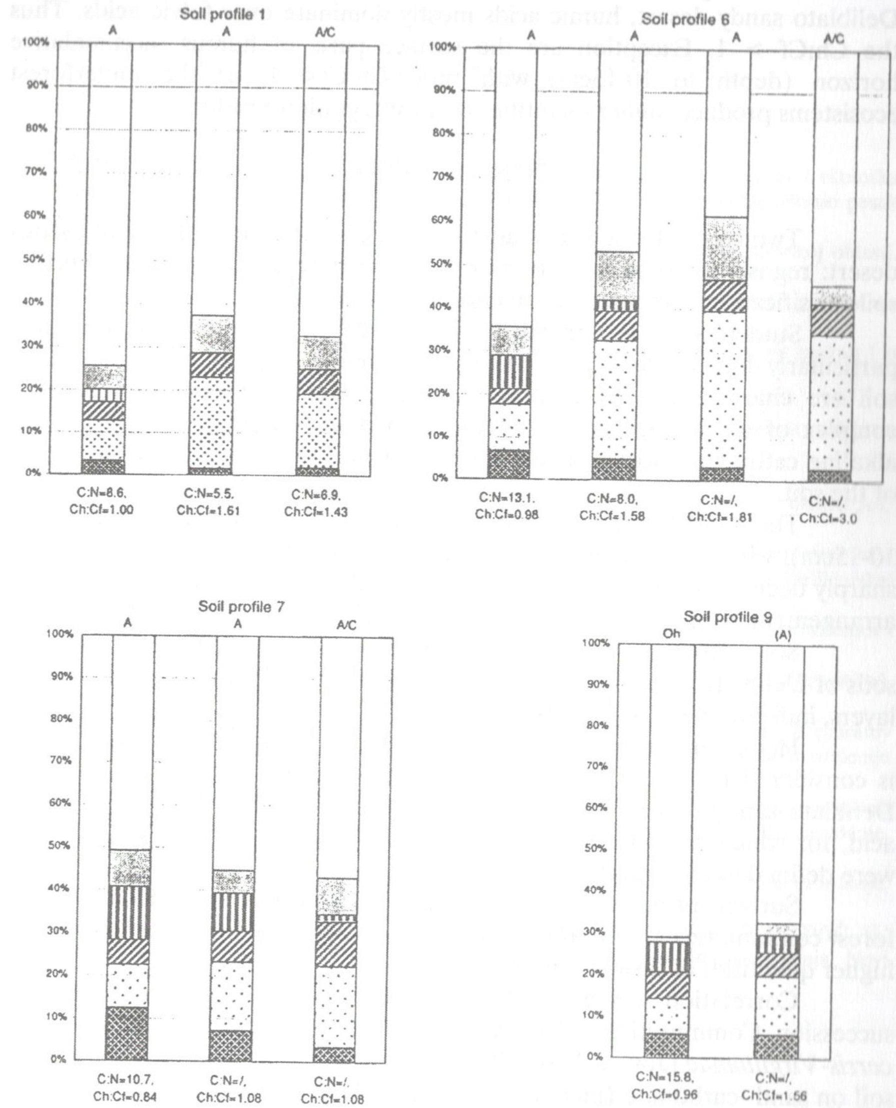
Site	Profile	Depth (cm)	Horizon	Hygroscopic moisture (%)	Particle size composition in % 2.0-0.2mm	0.2-0.06mm	0.06-0.02mm	0.02-0.006mm	0.006-0.002mm	< 0.002mm	Total Sand	Total clay+silt
Querco - Tilietum tomentosae subass. quercetosum pubescentis												
DEVOJAČKI BUNAR	1	0-38	A	2.17	-	75.90	9.40	7.70	3.60	3.40	85.3	14.7
		38-55	A	1.29	-	78.00	6.50	6.30	5.10	4.10	84.5	15.5
		55-70	A/C	1.10	-	79.70	4.80	6.30	3.40	5.80	84.5	15.5
Querco - Tilietum tomentosae subass. convallarietosum												
PRIRODNI REZERVAT - CRNI VRH	7	0-12	A	2.86	-	79.50	10.00	5.20	0.50	4.80	89.5	10.5
		12-40	A	0.54	-	90.20	4.80	3.00	1.00	1.00	95.0	5.0
		40-97	A/C	0.58	0.13	88.77	5.60	3.00	1.00	1.50	94.5	5.5
Querco - Tilietum tomentosae subass. convallarietosum												
PRIRODNI REZERVAT - CRNI VRH	9	0-5	Oh	7.46	0.30	64.80	15.30	9.20	2.20	8.20	80.4	19.6
		5-42	(A)	0.54	0.08	89.62	5.40	2.60	0.30	2.00	95.1	4.9
Orno - Quercetum cerris - virgilianae												
DEVOJAČKI BUNAR	6	0-12	A	3.42	-	82.10	4.60	8.10	1.30	3.90	86.7	13.3
		12-40	A	1.57	-	81.90	4.90	7.70	2.50	3.00	86.8	13.2
		40-77	A	1.30	-	83.30	5.30	5.60	3.00	2.80	88.6	11.4
		77-120	A/C	1.03	-	88.50	2.10	4.40	1.90	3.10	90.6	9.4

Table 2 - Chemical properties of the soil

Site	Profile	Depth (cm)	Horizon	pH H_2O	pH KCl	Y1 ccm n/10 NaOH	Adsorptive complex (T-S) ekv. mmola H/100g soil	S	T	V (%)	Humus (%)	C (%)	N (%)	C/N	Readily available P_2O_5 in mg/100g	K_2O	$CaCO_3$ (%)
Querco - Tilietum tomentosae subass. quercetosum pubescentis																	
DEVOJAČKI BUNAR	1	0-38	A	7.80	7.16	1.30	0.85	90.60	91.45	99.07	5.93	3.44	0.40	8.6	6.90	19.60	-
		38-55	A	8.31	7.61	-	-	-	-	-	2.17	1.26	0.23	5.5	6.80	6.40	4.80
		55-70	A/C	8.48	7.82	-	-	-	-	-	1.79	1.04	0.15	6.9	5.40	5.80	6.75
Querco - Tilietum tomentosae subass. convallarietosum																	
PRIRODNI REZERVAT - CRNI VRH	7	0-12	A	7.36	6.80	-	-	-	-	-	8.89	5.16	0.48	10.7	3.70	19.70	4.20
		12-40	A	8.35	7.70	-	-	-	-	-	0.96	0.56	-	-	1.40	5.50	11.80
		40-97	A/C	8.45	7.88	-	-	-	-	-	1.00	0.58	-	-	1.40	3.80	8.85
Querco - Tilietum tomentosae subass. convallarietosum																	
PRIRODNI REZERVAT - CRNI VRH	9	0-5	Oh	7.56	6.81	3.65	2.37	97.60	99.97	97.63	23.71	13.75	0.87	15.8	4.65	30.50	1.90
		5-42	(A)	8.30	7.57	-	-	-	-	-	1.23	0.71	-	-	1.10	6.00	12.20
Orno - Quercetum cerris - virgilianae																	
DEVOJAČKI BUNAR	6	0-12	A	7.18	6.62	3.82	2.48	55.80	58.28	95.74	11.77	6.83	0.52	13.1	3.80	21.00	-
		12-40	A	7.90	7.30	0.96	0.62	54.80	55.42	98.88	2.75	1.60	0.20	8.0	2.70	8.50	-
		40-77	A	8.17	8.57	-	-	-	-	-	1.56	0.96	-	-	2.40	6.20	2.35
		77-120	A/C	8.30	7.70	-	-	-	-	-	1.20	0.70	-	-	1.40	6.40	2.35

Table 3 - Group fraction of humus

Site	Profile	Depth (cm)	Horizon	Complete content in the soil: C(%)	N(%)	C/N	Humic acid Fraction 1	Humic acid Fraction 2	Humic acid Sum	Fulvic acid Fraction 1a	Fulvic acid Fraction 1	Fulvic acid Fraction 2	Fulvic acid Sum	Sum of set aparated fraction (%)	Humin	Ch/Cf	Level of humification
Querco - Tilietum tomentosae subass. quercetosum pubescentis																	
DEVOJAČKI BUNAR	1	0-38	A	3.44 / 100	0.40	8.6	0.11 / 3.20	0.33 / 9.59	0.44 / 12.79	0.15 / 4.36	0.10 / 2.91	0.19 / 5.52	0.44 / 12.79	0.88 / 25.58	2.56 / 74.42	1.00	0.26
		38-55	A	1.26 / 100	0.23	5.5	0.02 / 1.59	0.27 / 21.43	0.29 / 23.02	0.07 / 5.56	0.00 / 0.00	0.11 / 8.73	0.18 / 14.29	0.47 / 37.30	0.79 / 62.70	1.61	0.37
		55-70	A/C	1.04 / 100	0.15	6.9	0.02 / 1.92	0.18 / 17.31	0.20 / 19.23	0.06 / 5.77	0.00 / 0.00	0.08 / 7.69	0.14 / 13.46	0.34 / 32.69	0.70 / 67.31	1.43	0.33
Querco - Tilietum tomentosae subass. convallarietosum																	
PRIRODNI REZERVAT - CRNI VRH	7	0-12	A	5.16 / 100	0.48	10.7	0.64 / 12.40	0.52 / 10.08	1.16 / 22.48	0.30 / 5.81	0.64 / 12.40	0.44 / 8.53	1.38 / 26.74	2.54 / 49.77	2.62 / 50.78	0.84	0.49
		12-40	A	0.56 / 100	-	-	0.04 / 7.14	0.09 / 16.07	0.13 / 23.21	0.04 / 7.14	0.05 / 8.93	0.03 / 5.36	0.12 / 21.43	0.25 / 44.64	0.31 / 55.36	1.08	0.45
		40-97	A/C	0.58 / 100	-	-	0.02 / 3.45	0.11 / 18.97	0.13 / 22.41	0.06 / 10.34	0.01 / 1.72	0.05 / 8.62	0.12 / 20.69	0.25 / 43.10	0.33 / 56.90	1.08	0.43
Querco - Tilietum tomentosae subass. convallarietosum																	
PRIRODNI REZERVAT - CRNI VRH	9	0-5	Oh	13.75 / 100	0.87	15.8	0.79 / 5.75	1.16 / 8.44	1.96 / 14.25	0.89 / 6.47	0.98 / 7.13	0.17 / 1.24	2.01 / 14.84	4.00 / 29.09	9.75 / 70.91	0.96	0.29
		5-42	(A)	0.71 / 100	-	-	0.04 / 5.63	0.10 / 14.09	0.14 / 19.72	0.04 / 5.63	0.03 / 4.23	0.02 / 2.82	0.09 / 12.68	0.23 / 32.39	0.48 / 67.61	1.56	0.32
Orno - Quercetum cerris - virgilianae																	
DEVOJAČKI BUNAR	6	0-12	A	6.83 / 100	0.52	13.1	0.46 / 6.73	0.75 / 10.98	1.21 / 17.72	0.24 / 3.51	0.53 / 7.76	0.46 / 6.74	1.23 / 18.01	2.44 / 35.73	4.39 / 64.28	0.98	0.36
		12-40	A	1.60 / 100	0.20	8.0	0.08 / 5.00	0.44 / 27.50	0.52 / 32.50	0.11 / 6.88	0.04 / 2.50	0.18 / 11.25	0.33 / 20.63	0.85 / 53.13	0.75 / 46.88	1.58	0.53
		40-77	A	0.96 / 100	-	-	0.03 / 3.13	0.35 / 36.46	0.38 / 39.58	0.07 / 7.29	0.00 / 0.00	0.14 / 14.58	0.21 / 21.88	0.59 / 61.46	0.37 / 38.54	1.81	0.62
		77-120	A/C	0.70 / 100	-	-	0.02 / 2.86	0.22 / 31.43	0.24 / 34.29	0.05 / 7.14	0.00 / 0.00	0.03 / 4.29	0.08 / 11.43	0.32 / 45.71	0.38 / 54.29	3.00	0.46



Note:

- Humin
- Fraction 2 fulvic acid
- Fraction 1 fulvic acid
- Fraction 1a fulvic acid
- Fraction 2 humic acid
- Fraction 1 humic acid

In the group fraction contents of humus of the studied soils of Deliblato sandy desert, humic acids mostly dominate over fulvic acids. Thus the Ch:Cf > 1. Exception are the surface parts of humus -accumalative horizon (depth to 10-15cm) with ratio Ch:Cf< 1, as the underforest ecosistems produce higher quantities of disintegration residue.

CONCLUSIONS

Two types of soil were studied in oak communities of Deliblato sandy desert: regosol on sand and chernozem on carbonate aeolian sand. Further soil classification made distinction between varieties and forms.

Studed soils are mostly characterized by loam-sand texture and particularly high content of the fine sand fraction. Chemical properties of the soil are characterized by neutral or mildly alkaline reactions. Adsorptive complex of studied soil of Deliblato sandy desert is characterized by high alkaline cathione adsorption capacity, and high degree of alkaline saturation of the soil.

The humus content is high in the surface part of the A horizon (depth 10-15cm), where very high values are reached (11.77%). The humus content sharply decreases with depth. This is the so called forest type of contents and arrangement of humus (PONOMAREVA, V.V., PLOTNIKOVA, T.A. 1975).

Soil carbonate content is a very important property of the studied soils of Deliblato sandy desert, the wash-out of which, from surface to deeper layers, indicates also the soil evolution.

High content of humic acids in the group fraction contents of humus is considered to be the basic property of the studied soil characteristics of Deliblato sandy desert. Particuylarly important is the content of gray humic acid, for which reason the studied soil structures of Deliblato sandy desert were defined as chernozem.

Surface parts of humus-accumulative horizon (depth to 15 cm) in forest communities are in ratio Ch:Cf < 1, as underforest ecosistems produce higher quantities of disintegration residue.

Correlation was established between soil evolution and vegetation succession. Communities of Turkey Oak and Vergilius Oak (*Orno-Quercetum cerris-Virgillianae* (Jov. et Vuk. 1977), where the most developed chernozem soil on sand -carbonate (medium depth) was determined, were established as final stage in development of forest vegetation.

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KARAKTERISTIKE ORGANSKE MATERIJE ZEMLJIŠTA A-C STADIJE U HRASTOVIM ZAJEDNICAMA NA DELIBLATSKOJ PEŠČARI

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Izvod

Na Deliblatskoj peščari u hrtastovim zajednicama proučena su dva tipa zemljišta: sirozem na pesku i černozem na karbonatnom eolskom pesku. Dalja klasifikacija izvršena je na varijetete i forme.

Proučena zemljišta uglavnom karakteriše ilovasto-peskovit mehanički sastav i posebno visok sadržaj frakcije sitnog peska. Hemijske osobine zemljišta karakteriše neutralna ili slabo alkalna reakcija. Adsorptivni kompleks se odlikuje visokim kapacitetom adsorpcije za bazne katjone kao i visokim stepenom zasićenosti zemljišta bazama, što je inače odlika zemljišta aridnih regiona.

Sadržaj humusa je visok u površinskom delu A horizonta (10-15cm dubine) gde dostiže veoma visoke vrednosti (11.77%). Sa dubinom sadžaj humusa se oštro smanjuje. To je takozvani šumski tip sadržaja i rasporeda humusa.

Karbonatnost je veoma važno svojstvo proučavanih zemljišta Deliblatske peščare, sa čijim ispiranjem, iz površinskih u dublje slojeve, teče i evolucija zemljišta.

Osnovnim svojstvom proučavanih karakteristika organske materije zemljišta smatra se visok sadržaj huminskih kiselina u grupno-frakcionom sastavu humusa. Posebno je značajan visok sadržaj frakcije sivih huminskih kiselina, zbog čega su proučene zemljišne tvorevine definisane kao černozem.

Površinski delovi humusno akumulativnog horizonta (do 15cm dubine) u šumskim zajednicama, imaju odnos Ch:Cf<1, jer se pod šumom produkuje veća količina kiselih produkata razlaganja.

Utvrđeno je postojanje veze između evolucije zemljišta i sukcesije vegetacije. Kao završna stadija u razvoju šumske vegetacije izdvojena je zajednica *Orno-Quercetum cerris-virgilianae* (Jov. et Vuk. 1977), pod kojom je utvrđeno i najrazvijenije zemljište černozem na pesku-karbonatni (srednje duboki).

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AGROPHYSICAL CHARACTERISTICS OF LEACHED SOIL (LUVISOL) FROM THE AREA OF MOUNTAIN MASSIF RADOČELO

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The subject of this paper is a number of the most important agrophysical properties of two profiles of (not severely) leached soil, over a deep volcano tufaceous deposition, from the altitudes around 1300 m, recently ploughed, for a long time under meadows (and before that covered with beech and spruce forest) from the mountain massif Radočelo, where very high yields of good quality potatoes (up to 40 tha^{-1}) are achieved with the application of advanced agrotechnical measures. On the basis of conducted field and laboratory investigations it has been found that the analysed leached soil shows rather favourable agrophysical characteristics for normal development of the grown crops.

Key words: leached soil (luvisol), physical and water-aeration properties, differential porosity

INTRODUCTION

Agrophysical characteristics of soil are very important for solving many theoretical and practical problems in pedology, agriculture and meliorations. Absence and lack of experimental data on these characteristics make either difficult or impossible both the implementation of scientific measures for the increase of productivity of grown crops, especially on actual agricultural fields, and quantitative evaluation of the physical state of rhizospheric soil layer. Special role belongs to physical characteristics under such conditions as: process of structure aggregate degradation and compression of arable and subarable horizons,

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