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The influence of geological setting and land use on the physical and chemical properties of the soil at the Fruška gora Mountain

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Abstract: Soil erosion is a problem that affects the landscape at different scales and represents a serious challenge for land management and soil conservation in both natural forests and meadows. The aim of this study was to determine how the parent material and land use affect the physical and chemical properties of the soil in the area of the Fruška gora Mountain. The soils were developed on five bedrock types: serpentinite, marl, trachyte, shale, loess and two land use types: forest and meadow. Twenty-three forest soil and 24 meadow soil from a depth of 0-20 cm were sampled from the Fruska gora Mt. Following properties were determined: pH, electrical conductivity, oxidation-reduction potential, content of organic carbon, sodium adsorption ratio, aggregate size and stability. There is no statistically significant difference in pH, Eh, EC, and SAR values between the analyzed forest and meadow soils, but there is a statistically significant difference in the content of C_{org}. It can be conculded that both the parent matrial, and to a slightly less extent, land use have a great influence on physico-chemical properties of the soil.

Keywords: soil characteristics, bedrock, forest, meadow, environmental change

INTRODUCTION

Physical and chemical properties of soils are important for decision makers to choose the best land use practise on the local level.[1] This is especially important in the context of soil protection. Applying forest management practices that maintain forests with a closed canopy can help prevent soils erosion processes. However, the resistance to erosion of forest soils can dramatically change in the conditions of climate changes, with increasing occurrences of outbreaks of pests and pathogens, forestfires, *etc.*[2]

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Similar to forests, meadow soils are also subjected to climate change impacts such as increased temperatures and changing precipitation patterns. Dryer and hotter conditions may result in loss of valuable habitat, but also in the encroachment of new species, and a greater risk of wildfire. Increased drought frequency could also cause major changes in vegetation cover. Vegetation shifts will impact ecosystems and species, and changes in species composition and plant productivity may also impact the human communities that rely on agricultural production in these regions. Losses of vegetative cover coupled with increases in precipitation intensity and climate-induced reductions in soil aggregate stability will dramatically increase potential erosion rates.[3]

Forest soils, especially those under native forests, differ from soils of other land use systems in terms of their infrequent (but sometimes major) disturbance, and high organic matter content which may increase the capacity to buffer the effects of climate change. Some of the effect of climate change on soils in such forests may be slow but cumulative, and would require special and sensitive parameters to detect any change in terms of soil health. Any alteration to either the quantity or the quality of soil organic matter under climate change is probably the most important factor affecting soil health under forests. This is because organic matter exerts strong controls on the physical,chemical and biological properties affecting soil "fertility".[3] Mountain soils are generally shallow and their fertility is often concentrated in the uppermost layers. Therefore, soil erosion is a key problem that affects the landscape at different scales and represents a serious challenge for land management and soil conservation.[4]

Soil structure is important for soil stability and land degradation and depends on geological settings and land use practices. Physical and chemical features determine soil erodibility, but less is known how their interactions alter erodibility.[5] Soil texture, the content of organic carbon, pH value, electrical conductivity, and total water-soluble cations clearly differentiate forest soils by the type of bedrock and were proven to be explanatory variables.[6]

Physico-chemical characteristics can be directly or indirectly influenced by soil aggregate stability which can be used as a soil degradation indicator.[7] Aggregate stability is the ability of aggregates to resist stresses causing their disintegration such as tillage, swelling and shrinking of clay minerals, raindrop impact, *etc*. Land use has a significant impact on aggregate stability, and forest soils generally have better structure than meadow soils.[8]

Forest soils contain more carbon per unit area than meadow or arable land.[9] Increased organic carbon content in forest soils is associated with type of vegetation.

Besides land use, bedrock is essential for soil quality; however, its impact on soil degradation is not sufficiently understood. Soil degradation in changed environmental conditions depends largely on the bedrock, which was until recently considered of subordinate significance compared to climate and pedological characteristics. Bedrock has a significant role in vegetation growth through regulation of soil physico-chemical properties, and it can alter the response of vegetation to climate properties.[11]

Considering the heterogeneous nature of soils, more information is needed for a better understanding of the effect of both land use and geological settings. The aim of this study is to determine how the parent material and land use affect the physical and chemical properties of the soil in the area of the Fruška gora Mt.

EXPERIMENTAL

The Fruška gora Mt. is located in the south of the Pannonian Plain and stretches between the Danube and the Sava River. On the south and west, it is framed by the loess plains of Srem. This mountain range has a length of 75 km, and a maximum width of about 15 km. With the highest peak (Crveni Čot) of 539 m, Fruška gora belongs to low mountains. The geological diversity, together with the specific microclimate, contributed to the development of a large number of different species of plants and animals that live there, so in 1960 Fruška Gora Mt. was declared a national park.

Geological composition of the Fruška Gora Mt. is heterogeneous and consists of various types of rocks of different ages. The central part of the mountain has peaks with an average height of 440 to 460 m above sea level and mainly consists of serpentinites, while the western part is flat with an average height of about 200 m above sea level built of limestone. The eastern part is at a lower altitude and consists of sedimentary rocks, mainly loess.

Total of 47 soil samples from the Fruška gora Mt. (Fig. 1) were analyzed for determining the difference between land use and geological settings. Twenty-three samples of forest soil and 24 samples of meadow land were analyzed. The soils used in this study were developed on five bedrock types: serpentinite (Se), marl (M), trachyte (T), shale (Sh), loess (L) and two land use types forest (F) and meadow (M). Figure 1 shows sampling locations with the indicated badrock type and land use: MM - marl meadow (9 samples), MF - marl forest (6 samples), SeF - serpentinite forest (6 samples), SeM - serpentinite meadow (9 samples), ShF - shale forest (6 samples), TF - trachyte forest (5 samples), LM - loess meadow (6 samples).

All samples were taken from the depth of 0 - 20 cm. Samples cleaned of plant residues were dried for seven days in laboratory conditions at room temperature, and then representative samples were selected using the chessboard method.

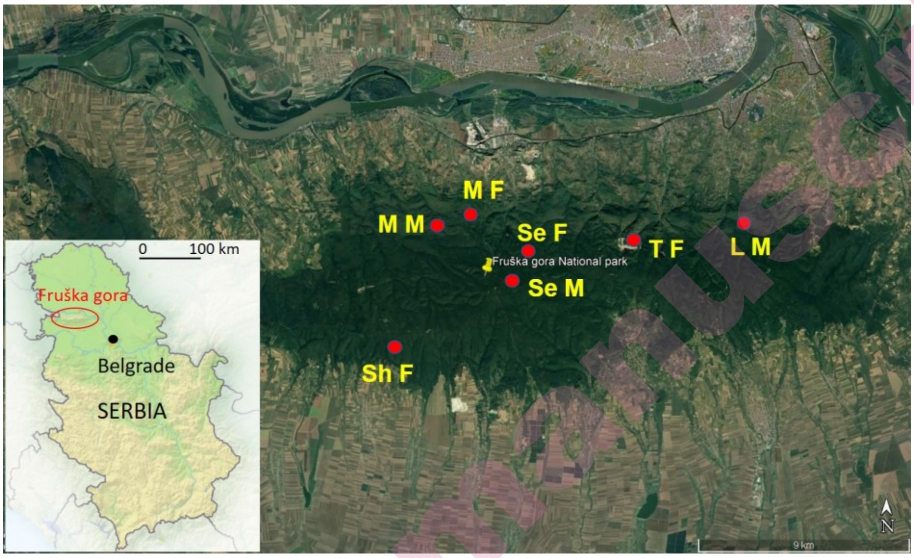

Fig. 1. Map of Serbia and Fruška gora Mt. with marked sampling locations. MM - marl meadow, MF - marl forest, SeF - serpentinite forest, SeM - serpentinite meadow, ShF - shale forest, TF - trachyte forest, LM - loess meadow.

For the purposes of this paper, determination of soil aggregate size and aggregate stability, content of organic carbon (C_{org}), pH value, redox potential (Eh), determination of electrical conductivity (EC) and available ions concentration (Na^+, K^+, Ca^{2+}, Mg^{2+}) were conducted. Sodium adsorption ratio (SAR), as an index of soil disperisvity, was calculated from the concentration of available ions.

Aggregate size analysis was done according to a standard sieving procedure using a set of sieve sizes ranging from 16 mm to 1 mm (16, 8, 4, 2 and 1 mm).

Stability of soil agregates was determined by sieving previously air-dried soil through a sieve of 4 mm and 2 mm pore size to obtain fraction of 2 - 4 mm size aggregates. Five grams of these agregates were weighed and gently placed into a 250 cm^3 beaker containing 50 cm^3 of distilled water. At the moment of descent, the stopwatch was turned on. After 10 minutes, the water was sucked out with a pipette, and the soil was dried. The dried soil was sieved on a 2 mm sieve. The content of stable aggregates was obtained from the differences between the initial weight of the soil aggrregates and the portion that remained on the sieve.

Elemental analysis was performed in order to determine the content of organic carbon (C_{org}) in the tested samples. Measurements were performed on a Vario EL III instrument, CHNOS Elemental Analyzer, Elementar Analysen systeme GmbH.

Determination of the pH value of the soil was obtained using a pH meter AD 1000 pH / mV & Temperature Meter (Adwa), which was previously calibrated with buffer solutions from the set of instruments, pH values 4, 7, 9. The redox potential was determined potentiometrically, using a Pt electrode, and a calomel electrode as a reference, on the HI 9321 Microprocessor pH meter (HANNA Instruments) and soil electrical conductivity was determined using a Cond-330i conductivity meter (WTW). For all three measurments the soil was prepared in the same way. Five grams of representative sample was added to 25 cm^3 of distilled water, and the suspension was placed on a shaker for 30 min, after which the sample was centrifuged.

Determination of available Na^+, K^+, Ca^{2+} and Mg^{2+} ions in soil was done by Inductively coupled plasma optical emission spectrometry (ICP-OES) method, analytical method used for the qualitative and quantitative determination of elements. The ICP-OES instrument used for this analysis was the Thermo Scientific iCAP 6500 Duo ICP (Thermo Fisher Scientific, Cambridge, UK). The parameters of the source at which the measurements were performed were: RF generator power: 1150 W, axial gas flow rate: 0.5 L / min, nebulizer gas flow rate: 0.5 L / min, cooling gas flow rate: 12 L / min.

The dispersivity index Sodium adsorption ratio (SAR), where all concentrations are in milliequivalents per liter, was calculated using the equation[12]:

$$SAR = \frac{[Na^+]}{\sqrt{\frac{[Ca^{2+}]+[Mg^{2+}]}{2}}} \quad (1)$$

Statistical t-Test was used to analyze the existence of possible differences in soil properties according to the land use. The least significant difference (LSD) one-way analysis of variance (ANOVA) test was used in the context of the analysis of variance between bedrock types with the F-ratio suggesting rejection of the null hypothesis when the difference between the population means is significant. For interpretation of parameter results, principal component analysis (PCA) and correlation coefficients were calculated using the SPSS Statistics 20 package.

RESULTS AND DISCUSSION

Soil samples of five types of bedrock and two types of land use from the Fruška gora Mt. were analyzed with the aim to determine the possible differences in their physico-chemical properties.

The soil aggregate size analysis was conducted with the purpose of determining the most represented aggregate size class. On average, meadow soils have a larger portion of soil aggregates in the class < 2 mm, with a total of 38.77 % compared to 23.87 % of forest soils, and vice versa, the content of 16 - 8 mm and 8 - 4 mm aggregates are higher in the forest soils. The dominant aggregate size for most soils is 8 - 4 mm, except for loess meadow and trachyte forest with the 4 - 2 mm aggregate size being dominant (TABLE I). The highest content of 16 - 8 mm and 8 - 4 mm aggregates is found in marl forest soils, followed by the shale forest. Highest portion of smallest aggregates have loess meadow and serpentinite meadow soils.

TABLE I. Distribution of soil aggregate size, %

Bedrock and land use type		> 16 mm	16 – 8 mm	8 – 4 mm	4 – 2 mm	2 – 1 mm	< 1 mm
LM	AVG	0.00	8.9	20.59	27.03	19.5	23.98
	SD	0.00	11.32	9.67	3.82	6.27	11.36
SeM	AVG	0.00	6.51	28.58	25.57	21.9	17.44
	SD	0.00	4.92	6.37	3.77	3.5	5.57

MM	AVG	0.00	5.27	35.13	24.54	18.7	16.36
	SD	0.00	6.34	7.53	2.11	4.11	6.51
SeF	AVG	2.58	9.14	33.45	24.21	19.09	14.11
	SD	6.31	7.57	5.76	4.9	5.33	5.04
MF	AVG	0.41	36.92	43.95	12.31	4.73	1.68
	SD	1.01	18.65	13.4	6.89	3.96	1.23
TF	AVG	0.00	2.56	23.67	30.84	28.52	14.42
	SD	0.00	3.63	2.41	2.92	6.3	2.65
ShF	AVG	0.50	16.01	38.55	23.05	12.03	9.86
	SD	1.22	8.11	7.05	4.17	3.64	3.82

LM - loess meadow; SeM - serpentinite meadow; MM - marl meadow; SeF - serpentinite forest; MF - marl forest; TF - trachyte forest; ShF - shale forest; AVG - average; SD - standard deviation.

Stability of soil aggregates was investigated for all forest and meadow soil samples

On average, it was found that forest soils have lower average aggregate stability (51.04 %) than meadow soil (60.05 %) (Fig. 2). However, meadow soils have a smaller range of stable aggregates than the forest soils. The content of stable aggregates, regarding geological settings and the land use type is decreasing in the following order: LM > TF > MF > ShF > SeM > SeF (Fig. 2). The ratio of stable : unstable aggregate is lowest for SeF soils (0.24) and highest for LM (2.30).

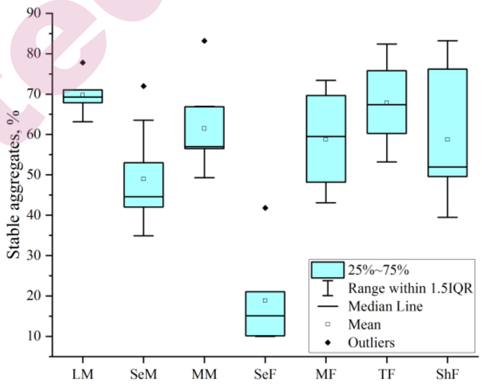

Fig. 2. Content of soil stable aggregates. LM - loess meadow; SeM - serpentinite meadow; MM - marl meadow; SeF - serpentinite forest; MF - marl forest; TF trachyte forest; ShF - shale forest

Since the stability of soil aggregates was tested on 4 - 2 mm size, the analysis of variance (ANOVA) was performed to determine the possible existence of differences between this soil aggregates size depending on: the bedrock type, land use type, and depending on both of these factors simultaneously.

Statistically significant difference ($p < 0.05$) among bedrock type was found between aggregate size of 4 - 2 mm sampled over shale and trachytes, loess and marls, serpentinites and marls, serpentinites and trachytes, as well as among aggregates of marls and trachytes soils. No significant difference ($p > 0.05$) was found between aggregates size of 4 - 2 mm among solely meadow soils, while, on the contrary, a significant difference ($p < 0.05$) was found between forest soils on serpentinites and marls, serpentinites and trachytes, as well as among marls and trachytes. ANOVA performed for both of these factors for all soil samples showed that significant difference ($p < 0.05$) exists between aggregates size of 4 - 2 mm of ShF and MF, ShF and TF, LM and SeF, LM and MF, SeM and MF, SeM and TF, MM and MF, MM and TF, SeF and MF, SeF and TF, MF and TF.

The content of organic carbon (C_{org}) was measured in all soil samples, indicating that forest soil covers the range of 1.75 to 6.08 %, while in meadow soil is in the range of 1.06 to 1.98 % (Fig 3). The average value of C_{org} is statistically different ($p < 0.05$) between two types of soil, with 2.97 % for forest soils and 1.48 % for meadow soils. The obtained results show that C_{org} depends on the land use. According to the ANOVA there is a statistically significant difference ($p < 0.05$) in C_{org} in soils on different bedrock types. The organic carbon content decreases in the following order: TF > MF > ShF > SeF > LM > SeM > MF. In comparison with the land use, a smaller impact was established. Thus MF and MM soils have a statistically significant difference ($p < 0.05$) in C_{org}, which can be related to the influence of land use.

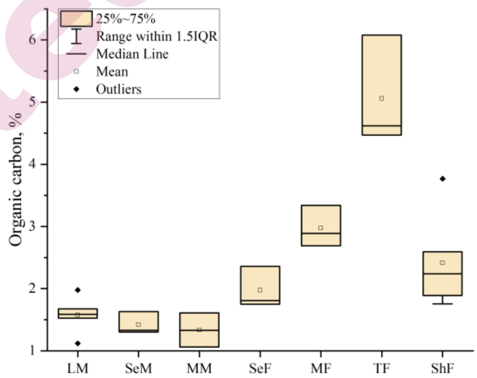

Fig. 3. Organic carbon content in Fruska gora soils.
LM - loess meadow; SeM - serpentinite meadow; MM - marl meadow; SeF - serpentinite forest; MF - marl forest; TF trachyte forest; ShF - shale forest

Electrical conductivity (EC), redox potential (Eh) and pH of all soil samples were measured with the aim to determine the physico-chemical properties of soils of different bedrock and land use type.

The pH value of forest soils varies in the range of 6.15 to 7.13 classifying them weakly acidic to neutral soils, while the pH of meadow soil varies in the range of 5.77 to 7.29 classifying them moderately acidic to neutral soil. Mean values and standard deviations of analyzed parameters are presented in TABLE II. Electrical conductivity measured in forest soils vary in the range from 76.8 to 333 μS cm^{-3}, and in meadow soil from 61.2 to 294 μS cm^{-3}, while the redox potential of forest soils varies in the range from 444.4 to 575.8 mV, and meadow soil similarly from 452.8 to 559.7 mV.

TABLE II. Physico-chemical properties of soils

parameter		ShF	SeF	MF	TF	LM	SeM	MM
pH	Mean	6.77	6.79	6.85	6.7	6.9	6.27	6.82
	SD	0.21	0.38	0.22	0.28	0.28	0.37	0.34
Eh (mV)								
EC (μS cm^{-3})	Mean	191.53	130.58	197.85	282.4	259.83	89.97	233.39
	SD	80.68	42.23	58.58	36.41	21.04	14	37.91
SAR	Mean	0.04	0.12	0.08	0.08	0.02	0.21	0.07
	SD	0.01	0.06	0.03	0.00	0.01	0.02	0.04

SD - standard deviation; ShF - shale forest; SeF - serpentinite forest; MF - marl forest; TF - trachyte forest; LM - loess meadow; SeM - serpentinite meadow; MM - marl meadow.

The difference in soil pH values on different bedrock type was tested by one-factor analysis of variance, and it was found that there is a statistically significant difference ($p < 0.05$) between individual soil groups (TABLE III). Post hoc Fisher's test of the least significant difference (LSD) showed that statistically significant deviations in pH values exist in the following soil pairs: serpentinites - marl and serpentinites - loess ($\Delta = 0.42 > \text{LSD} = 0.33$). ANOVA conducted on analyzed parameters showed there is no statistically significant difference ($p > 0.05$) between pH in forest and meadow soils which can imply that the land use does not significantly affect the soil pH value. Furthermore, Fisher's LSD test proved that statistically significant differences ($p < 0.05$) exist in the following soil pairs: SeF - SeM; SeM - MF; SeM - MM; SeM - TF; SeM - SeM; SeM - ShF (Δ = 0.63 - 0. 43> LSD = 0.35 - 0.30).

TABLE III. One-factor analysis of variance of physico-chemical properties of soils

Parameter	F factor	Significance
pH	2.71	0.04
Eh (mV)	4.95	0.00
EC (μS cm^{-3})	22.23	0.00
SAR	0.51	0.73

ANOVA analysis showed that there is a statistically significant difference ($p < 0.05$) in the values of oxidation-reduction potential between soils of different bedrock. Fisher's post hoc LSD test determined the existence of a statistically significant difference ($p < 0.05$) in Eh values in the following soil pairs: serpentinites - marl; serpentinite - trachyte; serpentinites - trachyte; trachyte - shale; trachyte - shale ($\Delta = 37.1 - 27.12 > LSD = 28.16 - 16.98$). The result of the t-Test shows that there is no statistically significant difference ($p > 0.05$) in the values of oxidation-reduction potential between forest and meadow land.

The ANOVA method was used to examine the differences in the values of the oxidation-reduction potential of the soil, taking into account the land use and the bedrock. The Fisher's LSD test determined the existence of a statistically significant difference ($p < 0.05$) in the following soil pairs: SeF - SeM; SeM - MF; SeM - MM; SeM - TF; SeM - SeM; TF - ShF; MF - ShF ($\Delta = 26.67 - 47.77 > LSD = 21.10 - 27.11$).

The result of the t-Test shows that there is no statistically significant difference ($p > 0.05$) in the values of electrical conductivity between forest and meadow soil. The LSD test determined the existence of statistically significant differences ($p < 0.05$) between the following soil pairs: serpentinites – marl; serpentinites – trachytes; serpentinites – loess; serpentinites - shale; marl – trachytes; trachytes – shale; loess – shale ($\Delta = 176.19 - 63.22 > LSD = 56.52 -34.08$). The ANOVA was conducted to examine the values of electrical conductivity of the soil. Taking into account the land use and the bedrock type there was a statistically significant difference ($p < 0.05$) between the tested samples. Fisher's LSD test the existence of a statistically significant difference ($p < 0.05$) in the following soil pairs was determined: SeF - MF; SeF - MM; SeF - TF; SeF - LM; SeF - ShF; SeM -MF; SeM - MM; SeM - TF; SeM - LM; SeM - ShF; MF - TF; MF - LM; TF - ShF; LM - ShF ($\Delta = 192.43 - 60.95 > LSD = 51.89 - 47.37$). The obtained results show that there are large deviations depending on the parent matrial. The biggest difference comes from serpentinite, both forest and meadow, and this shows a strong influence of the geological substratum on the examined parameter.

In results obtained depending on the bedrock statistically significant difference ($p < 0.05$) was found between the pH value of soil sampled over loess and serpentinites, and serpentinites and marls. Significant differences ($p < 0.05$) in Eh values exist between soil sampled over shale and loess, shale and trachyte, loess and serpentinite, serpentinite and marl, and serpentinites and trachytes. In EC values significant differences ($p < 0.05$) exist between soils sampled over shale and loess, shale and serpentinites, shale and trachytes, loess and serpentinites, serpentinites and marls, serpentinites and trachytes, and marls and trachytes.

ANOVA performed to determine the possible existence of differences between pH, Eh, EC within the same land use (meadows or forests) over different geological substrates showed certain differences. For meadow soil samples, differences were found in case of pH values of soil sampled over shale and serpentinites, loess and serpentinites, and marls and serpentinites. In the case of Eh values of soil sampled, differences over shale and loess, shale and marl, loess and serpentinites, and serpentinites and marls were found, while analyzing EC values, differences were observed between shale and loess, shale and serpentinites, loess and serpentinite, and serpentinites and marls. For forest soil samples, differences were found for EC values of soil sampled over serpentinites and marls, serpentinites and trachytes, and marls and trachytes. At pH, Eh of forest soil samples there are no significant differences in the 95 % confidence interval.

The average values of the sodium adsorption ratio (SAR) of forest and meadow soil are presented in TABLE II. The high concentration of sodium ions in the soil causes the replacement of calcium and magnesium ions, which leads to the dispersion of soil particles and the adhesion of particle aggregates. This process is unfavorable for the soil, because hard soils, which are very poorly permeable to water, are formed and thus become unfavorable for the growth and development of plants. The results show that the SAR values of forest soil vary in the range from 0.03 to 0.19 mmol / l, while in meadow soil they are in the range from 0.02 to 0.64 mmol / l. The mean SAR value is 0.08 mmol / l for forest soils and 0.11 mmol / l for meadow soils. The result of the t-Test showed that there was no statistically significant difference ($p > 0.05$) in SAR values between forest and meadow soil. ANOVA showed that there is a statistically significant difference ($p < 0.05$) in SAR values between soils of different bedrock between the following soil pairs: serpentinites - marl; serpentinites - loess; serpentinites - shales ($\Delta = 0.147 - 0.098 > LSD = 0.091 - 0.069$).

The ANOVA was also used to examine the SAR values of the soil, taking into account both the land and the bedrock. Results showed that there is a statistically significant difference ($p < 0.05$) between the examined samples. LSD test determined the existence of a statistically significant difference in the following soil pairs: SeM - MF; SeM - MM; SeM - TF; SeM - ShF ($\Delta = 0.184 - 0.125 > LSD = 0.103 - 0.087$). The greatest differences come from serpentinite, from the SeM that has the highest SAR value. In general, in all tested soil samples, the SAR value is not high, which implies that these soils do not have a high tendency towards dispersion.

The above results show that the characteristics of the soil in the examined area of the Fruška gora Mt. largely depend on the geological settings, except in the case of organic carbon content, where the greatest impact is land use. The pH has statistically significant positive correlation with Eh, EC and SAR, and Eh with EC (TABLE IV). Content of organic carbon is not in correlation with any of the tested parameters, while content of stable aggregates is correlated with EC (TABLE IV).

TABLE IV. Correlations between physico-chemical properties of soils

		pH	Eh (mV)	EC (μS cm^{-3})	SAR	C_{org}	stable aggregates (%)
pH	PC	1	-0.47	0.49	-0.38	-0.08	0.16
	Sig.		0.00	0.00	0.01	0.70	0.28
Eh (mV)	PC		1	-0.57	0.20	-0.15	-0.09
	Sig.			0.00	0.17	0.46	0.56
EC (μS cm^{-3})	PC			1	-0.21	0.31	0.62
	Sig.				0.16	0.12	0.00
SAR	PC				1	-0.05	0.07
	Sig.					0.80	0.62
C_{org}	PC					1	0.24
	Sig.						0.22
Stable aggregates (%)	PC						1
	Sig.						0.00

PC – Pearson Correlation, Sig. – Significance

The relationship between EC and SAR following the Rengasamy et al. (1984)[12] domains indicate that the soil samples are potentially dispersive. This means that in the case of land use change, deforestation of tillage, the erosion processes could be expected.

The percentage of variance for the first component is 30.7 % which had large positive Eigen values for concentrations of pH, EC, stable aggregates %, and negative for SAR, Na^+ and Eh. The percentage of variance of the second component explained 24.5 % of variance and it had large positive eigenvector for Ca^{2+}, Mg^{2+}, K^+ (Fig. 4). The ShF and TF soils are grouped as soils with most stable aggregates, and serpentinite soils, both with meadow and forest land use, are most dispersive, grouped around SAR.

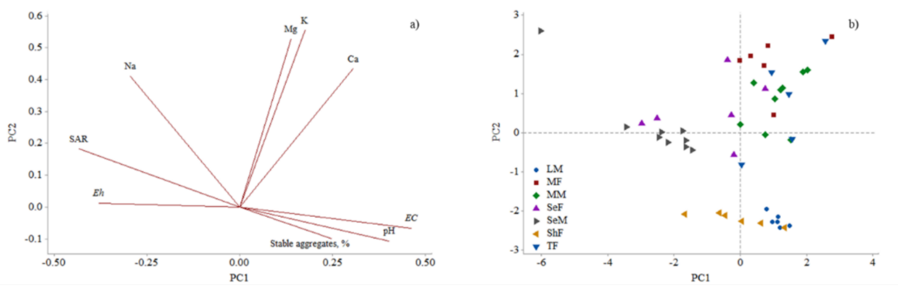

Fig. 4. Principal Component Analysis of Fruška gora soils: a) loading plot b) score plot.

The physical and chemical properties of the soil in the examined area of Fruška gora Mt. depend on the bedrock type and land use. Statistical analyses have shown that the bedrock has a strong influence on a larger number of analyzed soil parameters. Evidence of this are the differences in pH and Eh values for meadow and forest serpentinite soils. However, at the same time, no statistically significant difference was found in these parameters between meadow and forest soil on marl.

CONCLUSION

For the purposes of this paper, 47 soil samples (23 forest and 24 meadow samples) were analyzed with the aim to determine the impact of land use and geological background on the physical and chemical properties of the soil in the areas of Fruška gora Mountain.

Based on the obtained results it can be seen that forest soils belong to slightly acidic to neutral and meadow soils to slightly acidic to neutral. This data, together with values of Eh, EC, SAR and C_{org}, confirms the good soil quality in the study area.

No statistically significant difference in pH, Eh, EC, and SAR values exists between the analyzed forest and meadow soils, except for the content of C_{org}, implying that the land use does not have a great influence on pH, Eh, EC and SAR values, but that the content of C_{org} largely depends on soil vegetation.

Various parent material affects measured parameters in a different way. Results indicate that serpentinite soil differ from the other bedrock type soils. Statistical tests which took into account the bedrock and land use, showed that for all parameters, except for the content of organic carbon, serpentinite soils, primarily meadow serpentinite soils, are most vulnearable to land use, and possible climate changes.

It can be concluded that both, parent matrial, and to a slightly less extent, land use have a great influence on physico-chemical properties of the soil.

Of all parent material types, serpentine soils proved to be most sensitive to dispersion and possible soil erosion processes due to land use change. Also, differences in soil properties between land use types are most prominent for serpentinite soils, while at the same time, the parameters do not show statistically significant differences between meadow and forest soil on marl. This finding should be taken into account in forest management practices especially in the predicted climate change conditions.

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И З В О Д
УТИЦАЈ ГЕОЛОШКЕ ПОДЛОГЕ И НАЧИНА КОРИШЋЕЊА ТЕРЕНА НА ФИЗИЧКО-ХЕМИЈСКА СВОЈСТВА ЗЕМЉИШТА ФРУШКЕ ГОРЕ

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Ерозија земљишта је проблем који утиче на пределе у различитим размерама и представља озбиљан изазов за управљање земљиштем и очување земљишта како у природним шумама тако и на ливадама. Циљ овог истраживања био је да се утврди како матична стена и начин коришћење земљишта утичу на физичко-хемијске особине земљишта на подручју Фрушке горе. Земљишта су развијена на пет типова стена: серпентинит, лапорац, трахит, шкриљац, лес, као и на два начина коришћења терена: шума и ливада. Са Фрушке горе узоркована су 23 шумска земљишта и 24 ливадска земљишта са дубине од 0-20 цм. Одређена су следећа својства: pH, електрична проводљивост (EC), оксидо-редокс потенцијал (Eh), садржај органског угљеника (C_{org}), однос адсорпције натријума (SAR), величина агрегата и стабилност. Не постоји статистички значајна разлика у вредностима pH, Eh, EC и SAR између анализираних шумских и ливадских земљишта, али постоји статистички значајна разлика у садржају C_{org}. Може се закључити да на физичко-хемијске особине земљишта велики утицај имају изворни материјал и у нешто мањој мери начин коришћење земљишта.

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