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STUDIES REGARDING THE PHYSICAL AND CHEMICAL TRAITS OF SOME SOILS IN THE MURES REGION

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Abstract

Disintegration, alteration and bioaccumulation are processes which lead to soil formation; soil quality results from the complex interactions among its composing elements and may be linked to the interventions caused by the introduction of more or less toxic compounds into the soil. The accumulation of toxic products results from different industrial activities deployed in some areas. That is why it is necessary to have a sustained surveillance activity of the soil characteristics in order to control and protect human and environment safety. The present study shows that some potentially polluting activities (chemical plants, wood processing units) deployed in certain areas (Târnăveni, Jabenița) influence soil properties to various extents.

Keywords: sol, sampling, soil texture, soil density, granulometric fractions, conductivity, organic matter.

1. Theoretical considerations

In time, under the action of the atmospheric agents, hydrosphere and biosphere, the superior part of the land cover, minerals and primary rocks were subjected to processes of disintegration (grinding) and alteration (chemical modification). Consequent to these processes, the primary, compact rocks were transformed in secondary, light rocks formed of sand particles, dust or finer particles. Simultaneously, simple chemical substances such as salts, oxides and hydroxides were formed, as well as complex compounds argillaceous minerals [2], [3], [11], [13]. Disintegration and alteration, transport and the deposit of resulted products led not only to the formation of new compounds, but also to land cover modeling, the displacement of the higher and lower part material and relief differentiation [15], [18]. Water from rain falls, once reaching the surface of the cover formed of massive, compact rocks, can only enter through fissures and cracks, therefore it cannot accumulate. Consequently, massive rocks do not present water and air capacities [3], [19]. But, consequent to the above-mentioned processes, the newly-formed light rock presents water and air capacity due to porosity. The water from rainfalls reaches the surface of the land cover formed of light rocks and is retained in the pores, thus forming water reserves for plants [7], [17], [20].

The primary rocks do not contain nutritious substances in simple forms which should be accessible to plants. The disintegrated, altered rocks contain different salts formed on the basis of primary minerals; thus, they can ensure, at a certain extent, some nutritious substances for plants [3], [9], [10].

Due to disintegration and alteration, the upper part of the land cover provides minimal conditions including water, air and mineral nutritious substances which allow the installation of plants and microorganisms. After their life cycle is over, they turn into organic waste which, under the action of microorganisms, are decomposed into mineral substances and in also in humus, a soil-specific organic component [1], [11]. The process, known as bioaccumulation, repeats on a yearly basis, causing a retention and also an accumulation of nutritious substances in the upper part of the land cover, under the form of organic substances [19], [17] .

Due to bioaccumulation, disintegration and to the retention or migration of products resulted from these processes, the upper part of the land cover turns into *soil* – a natural body with specific structure and characteristics. The structure and characteristics of soils greatly depend on their hydrous state, of the climate conditions from different geographical areas and of the soil content of macroelements and microelements [4], [7], [8].

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2. Material and determination method

The present study intends to highlight the importance and the necessity of implementing programs to monitor soil quality in different areas. We took soil samples from the Jabeniț a and Târnăveni (Mureș area), in 2013 (table 1). Soil sampling is a particularly important stage in the process of physical and chemical analysis of the studied samples, because they needed to be representative and could not introduce modifications in the soil composition and quality, because of faulty technologies or incorrect conditions of material preparations [12].

We collected seven soil samples, at an air temperature of 19-23^{0}C, according to the area and sampling time. The individual samples were taken by means of a soil sampling drill, in order to perform physical and chemical tests.

Table 1. Tested soil samples

Soil sample	Soil sample region	Soil sample land category [22]	Distance from a polluting source (mill saw-Ideciu, former plant Bicapa-Târnăveni)
P1	Jabeniț a	Farmland (A)	1000
P2		Orchards (L)	500
P3		Farmland (A) (vegetable garden)	200
P4		Pasture(P)	100
P5	Târnăveni	Orchard (L)	500
P6		Farmland (A) (vegetable garden)	1000
P7		Farmland (A)	700

The purpose of the study is to assess soil quality by determining physical and chemical properties of the soil samples.

The determinations were performed at the Pedological and Agro-chemical Studies Office Mures (granulometric test, humus content) and in the environment laboratory of the “Petru Maior” University in Targu Mures (soil texture, humidity, real density, pH, conductivity).

2.1. Granulometric test and texture

Soil texture is given by the percentage content with which granulometric fractions with a diameter smaller than 2 mm (argil, loam or dust and sand) participates in the definition of a soil sample. [14], [21]. The particles whose dimensions are within certain limits (according to the Romanian Soil Taxonomy System – SRTS 2012) (table 2), [23] have specific properties, forming a category of particles, groups or granulometric fractions. The more advanced the grinding level, the greater the surface and the number of particles. Based on the granulometric structure it is possible to determine the proportion of soil which is formed of the primary particles of the solid silica phase of soil, classified on size categories [21].

The granulometric composition is determined on air-dried samples which have been homogenized and sieved at the size of 0,2 mm (figure1). The material smaller than 0,2 mm is known as fine soil [14], [23].

Fig. 1. Sieves with a diameter of 0,2 mm

Table 2: Values of the granulometric fractions stipulated by SRTS 2012[22]

Granulometric test			Soil type
Sand	**Dust**	**Argil**	
23-52	15-32	33-45	Average argillaceous soil
8-54	<32	46-60	Argillacelous loamy
$\leq$47	33-79	21-32	Dusty argillaceous

2.2. Real soil density

The real soil density is also called specific mass and represents the mass of the volume unit of the soil solid phase, or the mass of an absolutely dried soil sample weighed by its volume.[14], [19]. The real density was determined by using the pycnometric method, consisting of finding the dislocated volume of a soil sample whose mass is known with known mass, in the pycnometer volume. [14], [19]. The real density provides information regarding soil texture and its humus content (table 3). In most mineral soils, the average density of particles is approximately 2.6-2.7 g/cm^3. It must be noted that the presence of organic material in the soil lowers the density value. Thus, in the higher horizons of pasture soils in humid areas, the soils of highly fertilized areas using organic materials have density values of 2,50-2,60 g/cm^3, while in the peaty soils these values drop below these limits, reaching, in extreme cases, values of 1,80-2,00 g/cm^3 [14], [15].

2.3. Soil humidity

Soil is not uniform in time and space in terms of its water content. The information regarding humidity determines soil behavior in processing, the force required to drive various machines, the optimal time for different activities and their quality [14], [15]. The method of the drying stove consists of the evaporation of the water in the soil sample, at a temperature of 105^{0}C.

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2.4. Determination of the humus content in the soil – Oxidation method and titrimetric dosage method (Walkeley and Black, version Gogoaşă)

The humus is the main reservoir of nutritious substances in the soil, which, by means of water, provides plants with the nutritious elements they require to grow and develop. Humus is strongly related to soil fertility, influencing its physical, chemical and biological properties [1], [6]. In our study, we used Walkley–Black method in Gogoaşă's version. The method is largely used, as it involves insignificant errors. The method is based on carbon oxidation (the main constituent of humus) using excessive anhydride dichromate, in the presence of sulphuric acid. Oxidation is accelerated by the heat produced by diluting a volume of normal $K_2Cr_2O_7$ solution with two volumes of concentrated H_2SO_4 and heating the sample for 20 minutes at a temperature of 100°C. The information regarding humus content (in the 0-30 cm layer) is presented in table 3.

Table3: Humus content [5], [23]

Assessment-Loamy and argillaceous structure	Humus content (%)	Assessment-Loamy and argillaceous structure	Humus content (%)
Extremely weak	≤0,5	Good	4,1-8,0
Very weak	0,6-1,0	Very good	8,1-15,0
Weak	1,1-2,0	Excessive	15,1-35,0
Average	2,1-4,0	Organic soils	>35

2.5. pH test

For the pH test we used a Hanna HI 113 digital pH-meter (figure 2**).** When interpreting the results of the soil reaction one should take into account the value limits and the pH interval names, which are not unitary in the specialized literature. When interpreting pH values, one should take into account the fact that during a year, the soil reaction presents oscillations of up to one pH unit, according to climate conditions (rainfalls, temperature etc.) and to the intensity of biological activity in the soil. The assessment is made according to the following values [22]:

pH	<3,5	4,5	5,5	6,5	7,2	8,5	>8,5
characterization	Extremely acid	Highly acid	acid	weakly acid	neutral	alkaline	Strongly alkaline

Fig. 2. Hanna HI 113 digital pH-meter

3. Results and interpretations

The results obtained after the granulometric test are presented in tables 4 and 5.

Table 4: Values obtained after the granulometric test and soil sample texture

Sample	Granulometric test					Texture
	sand (%)		dust(%)		Argil (%)	
	Coarse	Fine	I	II		
P1	29,3	25,6	8,2	13,3	23,5	Sandy-argillaceous
P2	14,0	25,8	8,4	14,5	37,4	argillaceous, sandy
P3	22,8	22,7	7,6	10,8	35,9	argillaceous, sandy
P4	20,5	36,3	6,2	11,3	25,6	Sandy-argillaceous
P5	9,0	16,5	18,0	12,4	44,0	Loamy-argillaceous
P6	14,6	14,3	6,5	16,1	48,4	argillaceous
P7	8,8	40,7	7,5	14,0	28,9	argillaceous, loamy

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One may note that there is a proportion of granulometric fractions which determine an average (loamy- argillaceous) to fine (argillaceous) texture on soil samples taken from the Tarnaveni area, from soils entering the agricultural cycle.

Table 5: Determination results (density, humidity, humus content, pH)

Analyzed sample	Real density (g/cm^3)	Humidity (%)	Humus content (%)	pH(pH units)
P1	2,33	39,51	5,18	8,03
P2	2,45	31,18	4,39	8,04
P3	2,03	36,97	5,55	8,21
P4	2,29	29,44	5,38	7,66
P5	2,25	26,41	3,50	7,81
P6	2,32	29,46	4,03	7,63
P7	2,27	29,95	2,81	7,68

The density registered values within the interval 2,03 g/cm^3 in sample 3(characterizing a soil with decomposing organic matter) and 2,45 g/cm^3 in sample 2 (organically fertilized soil). Humidity registered value oscillations, according to the ratio between the sand and argil fractions, as well as the humus presence in the soil. The soil samples analyzed in the study have a good humus content (according to the assessment in table 3) with the exception of sample 7, with an average humus content, (2,81%). The pH analysis shows that soils registered values indicating the neutral to alkaline character of the tested samples, values which are higher than the ones which are agreed by most cultivated plants.

4. Conclusions

- Real density is a relatively constant feature in time, which depends on the texture and humus content [13] and influences soil humidity [22].

- When interpreting the pH values, one must take into account the fact that throughout the year, the soil reaction presents oscillations of up to one pH unit, according to climate conditions and to the intensity of the biological activity from the soil which is influenced, at its turn, by activities performed in the area.

- A pH from neutral to alkaline is less supportive of the soil biological activity, lowers substance solubility influencing plant growth, especially in an area with activities which led to the increase of heavy metal concentration in the soil.

- The influence of argillaceous minerals over some physical traits, which determine the dynamics of some pollutants in the soil makes argil (which is found in all soil samples, to different extents) a determining factor in the horizontal and vertical spread and distribution of potential pollutants. Due to its content and mineral composition, argil can become a means of transport or a barrier to some pollutants.

- The theoretical and practical results of the present study can be used as didactic material with engineering students, both in specialized practical activities (labs) and as an authentic input material for the acquisition of specialized terminology [16].

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