CHARACTERIZATION OF SOILS IN PERIAM COMMUNE, TIMIȘ COUNTY, ROMANIA

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Abstract: *Agriculture has been around since ancient times and continues to be a vital area of human activity today. It remains the only source of food, an important supplier of raw materials for industry and also a significant market for its production. Agriculture is a branch of material production, in which, with the help of green plants and under the guiding action of man, takes place the transformation of the kinetic energy of the sun into potential energy - organic matter - the only form of energy accessible to humans and animals.(Okros, 2017). The development of agriculture is influenced by natural, technical and socio-economic factors Technical factors have an important role in increasing production, through mechanization, chemicalization, irrigation, etc. and the socio-economic ones through the capacity and the degree of training of the labor force and the entire economic context in which this branch of the economy develops.(Radulov, 2014) Among the natural factors, the climate has an essential role, it conditions the spread and structure of agricultural crops through the regime of temperature, humidity and light. The relief influences the distribution of crops by altitude, the exposure of the slopes, the inclination of the slopes. The genetic type of soil contributes through its main feature, fertility, to which is added the ability to drain and retain water. In this paper we want to present the characterization of soils in Periam commune, Timiș county.(Gaica, 2016). The soils encountered within the area are those of the chernozem type. Within this type of soil, several subtypes can be separated, among which wet groundwater chernozems predominate. (Niță, 2014) Due to the good physical, chemical and biological properties they have, chernozems have a high natural fertility. Grains, technical plants and fodder give very good yields on this type of soil. Gleiosoils appear in the lower areas due to the high level of groundwater rich in potassium. (Mihut 2014)*

Keywords: *agriculture, soil, factors, soil analysis*

INTRODUCTION

Agriculture appeared about 10,000 years ago, therefore it represents one of the oldest occupations of mankind. Gradually, people have settled on a certain area ceasing to be nomads and becoming plant cultivators and animal breeders.

Currently, 42% of the globe population is considered agricultural, making it by far the most widespread human occupation. Unfortunately, agricultural products count only as 4.4% of the gross world product. (FLORESCU, 2014)

Romania has nearly 15,000,000 ha of agricultural land, of which 9,300,000 arable land, 600,000 ha vineyards and orchards, over 4,800,000 natural meadows, most of the areas being highly fertility.

A branch with old traditions of Romanian agriculture is the culture of cereals: wheat, maize, barley, and, to a lesser extent, sorghum, rice, and oats. The main cereal regions in Romania are the Romanian Plain, the Western Plain, the Moldavian Plateau, the Dobrogea Plateau, the Transylvanian Depression and the Getic Plateau. (DRAGOESCU, 2019)

The main technical plants cultivated in Romania are sunflower (in the southeast part of the country), soybean, sugar beet, flax and hemp. In the colder areas (the Suceava Plateau, the Depression of the Oriental Carpathians, the northwest of the Transylvania Depression) and in the plains, potato is also cultivated. Vegetables and legumes for grains are grown especially in the surroundings of cities and in the meadows of rivers. (MANEA, 2009)

The Commune of Periam, Timis County, is located in the western part of the country, in the northwest part of the county, in the fertile Banat Plain. The agricultural area of the commune is 3,300 ha.

The plain is placed in the northern low Torontal Plain, on the first terrace on the left of the Mureş River, about 4 km from the current course of this river.

Geographically, the low plain of Torontal is part of the divagation or subsidence fields.

Among the forms and processes common here are strong meanders, floods with alluviations and divagations. All of this comes from the slope that is very low and the underlying process. The plain is crossed by Aranca and Galaţca, which are old courses of the Mureş River.

From a geomorphological point of view, the territory of Periam displays the general characters of all other loess plains in the Great Depression of Tisa River, the same large plane horizons, with slight irregular forms represented by isolated and very shallow depressions as a result of local setting. (LOZICI, 2013)

By its location in the western part of Banat, the Commune of Periam belongs to the moderate continental type with ocean and Mediterranean influences, the Sânnicolau-Mare topo-climate.

The annual frost-free interval is lower than in Timisoara, below 200 days. The annual number of tropical days (40) is higher than in the rest of the plain.

The average amount of atmospheric precipitation is lower than in the other two areas, 550 mm annually, and the number of rainy days less than 110 days/year. Also, the amount of precipitation fallen during the summer is less, 27%, and droughts are more common than in the rest of the plain. The number of days with snow layer is low, below 30 days. (MIRCOV, 2016)

Through the activity of pedological and soil maps, basic (geographic and descriptive) data for the inventory, classification and evaluation of soil resources are obtained. They make up scientific materials without which it would not be possible to plan the optimal use of land in agriculture and forestry, environmental protection and the substantiation of many other activities related to soil and land use. (David, 2018)

MATERIAL AND METHODS

1. Determination of physical properties

Soil texture- through the Cernikova method (the principle underlying the pipetting method is the sedimentation of particles into a liquid at different rates, depending on their size, according to Stokes' law).

The determination of the granulometric fractions in weight percentages was done using the following formulas:

Coarse sand (2 - 0.2 mm in diameter) % = $\frac{m_1\ x100}{m_0 xF}$

Fine sand (0.2-0.02 mm in diameter) % = $\frac{100xm_2}{m'}$

Dust (0.02 - 0.002 mm in diameter) % = $\frac{(m_2 - m_3)xVx100}{(Vxm_0)xF}$

Clay (diameter less than 0.002 mm) % = $\frac{m_3 x V x 100}{V x m_0 - d x F}$

Soil density (cm3) - using a pycnometer, using distilled water;
Soil density is calculated using the following formula:

$$D = \frac{M_2 - M}{M_1 + M_2 - M - M_3} \text{ x } d$$

Apparent density (cm3) -the formula by which we calculated the bulk density is as follows:

$$DA = \frac{M_1 - M_2}{V}$$

Total Porosity Pt (%) -was calculated using the following formula: $PT = \left(1 - \frac{DA}{D}\right) x 100$

Aerosis Porosity Pa (%). In order to determine it by calculation we used the values of some hydrophysical and physical indices: PA = PT - CC x DA
Setting and soil compaction (gt)

$$GT = \frac{PMN - PT}{PMN} x 100$$

PMN = 45 + 0,163 x A

2. Determination of chemical properties

Soil humus content (%) - by titrimetric methods, respectively Tiurin method;
The principle of the method is to oxidize the carbon in the humus with a solution of chromium anhydride or potassium dichromate in the presence of sulfuric acid.

The humus content of a soil sample was calculated using the following formula:

$$\text{Humus\%} = \frac{\text{(V1 V2) x f x 0,0005181 x 100}}{\text{m}} \text{ x K}$$

pH of the soil solution **-** according to the potentiometric method, in aqueous extract 1: 2.5;
Total nitrogen dosage - was done by Kjeldahl method (soil mineralization is done by boiling with concentrated sulfuric acid in the presence of catalyst);
Mobile phosphorus - determined by Egner-Rhiem-Domingo on a UV-VIS spectrophotometer;
Assimilable Potassium - extracted into ammonium lactate acetate and determined with atomic absorption spectrophotometer;
Total Cationic Exchange Capacity (T) - determined by the Bower method;
Degree Of Saturation In Bases (V%) **-** was calculated by the formula:

$$V = \frac{S_B}{S_B + S_H} X 100(\%)$$

RESULTS AND DISCUSSIONS

For the preparation of this paper, both field data and data taken over from OSPA Timisoara were used.

The main purpose is the assessment of the production capacity of the agricultural land in Periam, Timis County, Romania, for different agricultural crops and modes of use for their sustainable use.

This study is based on the selective assessment of the data in the literature on the fundamental, general and private aspects of the mapping and creditworthiness of agricultural land in Periam.

Below we will present the types of soil found on the area of the Commune of Periam. On this territory, the soils are of the chernozem type. Within this type of soil, several subtypes may be separated, including moist phreatic chernozems. Due to the physical, chemical and biological properties they have, chernozems have high natural fertility. This type of soil gives good productions in both cereals, technical and fodder plants. In depression areas, gleysols occur due to the high level of potassium rich water.

Chernozem

Chernozem is the most important soil thanks to the large areas it occupies and due to its natural fertility.

The soil profile is: Am - A/C - Cca.

Morphological features:

Am – displays a range of thicknesses of 0-33 cm, it is chestnut, the texture is clayey-sandy, the structure is glomerular, it is a compact, porous medium, with low effervescence;

A/C – displays thicknesses of 33-41 cm, it is chestnut, the texture is clayey-sandy, the structure is compact glomerular, it makes effervescence, it has carbon concretions, clear transition to:

CK – displays thicknesses of 41-100 cm, it is dark brown, the texture is clayey-sandy, it is low-structured, it makes effervescence.

Table 1 presents the physical and chemical properties of the chernozem.

Table 1

Physical and chemical properties of chernozem

Horanzions	Am	AC	Cca
Depths (cm)	0-33	33-41	41-100
Sand (2,0-0,2mm %)	4,4	4,2	4,0
Sand (0,2-0.02 mm%)	60,3	65,6	65,0
Dust (0,02-0,002 mm%)	14,4	13,9	14,5
Clay 2 (sub 0,002 mm %)	20,9	16,3	16,5
TEXTURE	**LN**	**SM**	**SM**
pH in H2O	7,34	7,65	8,04
Carbonates(CaCO3)	0,56	2,43	4,66
Humus (%)	2,07	1,02	1,02
P mobile (ppm)	15,6	13,2	12,4
K assimilable (ppm)	122	74	56
Degree of saturation in bases (V%)	100	100	100

The coarse sand has oscillatory values, namely: 4.4 in the Am horizon, 4.2 in the A/C horizon, and its value decreases to the base of the profile, i.e., 4.0% in the Cca horizon.

The fine sand exhibits values of 60.3 in the Am horizon, which increases in the A/C horizon to 65.6 and 65.0% Cca. The dust has increased value in the Am horizon, namely, 14.4 of which decreases in the A/C horizon to 13.9.

Clay has high values in the Am horizon, 20.9 times higher than A/C where it drops to 16.3, being slightly higher in the Cca horizon of 16.5%.

The texture is of the clayey-sandy type.

Soil reaction (pH) is slightly alkaline with values in the Am horizon of 7.34, in the A/C horizon increasing to 7.65, and at the base of the profile, in the Cca horizon, reaching 8.04.

Calcium carbonate ($CaCO_3$) contained in this type of soil is very low, with values in the Am horizon of 0.56, in the A/C horizon with values of 2.43 and in the Cca horizon of 4.66%. Humus content is medium with values between 2.07 and 1.02%. The humus reserve is 318.19 t/ha.

The content of (P) is low in the Am horizon with a value of 15.6 decreasing in the horizon A/C to 13.2 and in the Cca horizon to 12.4 ppm.

Potassium content (K) is medium to low, having the following values: in the AM horizon 122 ppm, in the A/C horizon 74 ppm, and in the Cca horizon 56 ppm.

(V%) has a value of 100 throughout the profile, so this is an eubasic soil.

Typical Batigleic Chernozem

Morphological features:

Atk – 0-5 cm, average clay, blackish, moderate effervescence.

Amk – 5-50 cm, medium clayey, blackish brown, with whitish spots towards the base, with well-developed structure, small and medium glomerular

A/Ccaac – 50-75 cm, medium clayey, dark brown - dark grey, with dense whitish spots, medium moderately developed structure, high – very high porosity, well aerated.

Ccaac1g2 – 75-140 cm, medium clayey, grayish-yellowish towards the base, yellowish-rusty with purplish spots, unstructured, effervescent, low settled, contains calcium carbonate concretions of $CaCO_3$ and soluble salts.

C/GO3 - 140-165 cm, medium clayey, yellowish-rusty with purplish spots, lacking structure, effervescent, low settled, contains $CaCO_3$ concretions and soluble salts.

C/GO4 - 165-200 cm, medium clayey, yellowish-rusty with purplish spots, contains $CaCO_3$ concretions and soluble salts, effervescent.

Taxonomic soil unit: typical batigleic chernozem, moist phreatic, moderate hipposodium between 50-100 cm, low carbonate, deep on medium loessoid matter, medium clayey/medium clayey.

Table 2 presents the physical and chemical properties of typical batigleic chernozem.

Table 2

Physical and chemical properties of typical batigleic chernozem

HORIZONS	Aț	Amki	Amk2	A/Ccaac	Ccaacig	C/G03	C/ G04
Depths (cm)	0-5	5-18	18-50	50-75	75-140	140-165	165-200
Sand (2,0-0,2 mm)%	0.3	0,4	0,3	0,2	0.3	0,3	0,5
Sand (0,02-0,02 mm)%	46,7	48,0	45,8	45,3	43,6	48,6	39,3
Dust (0,02-0,002 mm)%	22,7	22,9	23,8	23,5	25,7	26,2	23,2

Clay 2 (sub 0,002 mm)%	30,3	28,7	30,1	31,0	30,4	24,9	32,0
Clay (sub 0,01 mm)%	40,4	38,1	40,5	40,7	41,3	37,7	46,5
TEXTURE	**LL**	**LL**	**LL**	**LL**	**LL**	**LL**	**LL**
Density (D g/cm^3)	2,53	2,55	2,53				
(DA g/cm^3)	1,1	1,35	1,24	1,14			
Hygroscopicity coefficient (CH %)	6,40	5,99	6,19	7,26			
pH (in H2 O)	7,92	8,01	8,32	8,46	8,62	8,59	8,51
Carbonates(CaCO3%)	3,15	3,31	5,55	17,4	22,4	21,7	20,4
Humus (%)	3,82	3,53	2,92				
P mobile (ppm)	71	72					
K mobile (ppm)	66	62					
Na (me la 100 g sol)				0,91	1,53		
Na exchangeable (% din T)				2,68	2,89		
(T me/100 g sol)				33,94	22,19		
Cl(me/100 g sol)				0,40	0,45		
SO4$^{'2}$(me/100 g sol)				0,32	0,25		
CO3H (me/100 g sol)				0,35	0,91		
CO3 $^{2-}$(me/100 g sol)				0,07	0,10		
Ca^{2+} (me/100 g sol)				0,65	0,53		
Mg^{2+} (me/100 g sol)				0,50	0,77		
Na^{+} (me/100 g sol)				0,28	0,65		
K $^{+}$ (me/100 g sol)				0,013	0,103		
Na in extraction at saturation (me/l).				1,19	2,18		

The coarse sand values are subunit, oscillating, between 0.2% in the A/Ccaac horizon and 0.5% in the C/G04 horizon. Fine sand is comprised of high values between 39.3% C/GO4 and 48.6% in the C/GO3 horizon. The dust exhibits values between 22.7% in the Atk horizon and 26.2% in the C/GO3 horizon. The argyle fraction has values oscillating between 24.9% in the C/GO3 horizon and 32.0% in the CGO4 horizon.

The value of the apparent density (AD) is extremely low in the Atk surface horizon with a very low value of 1.10 g/cm3 in the range 18-75 cm, and low in the Amk2 horizon with 1.35 g/cm3.

The soil reaction is low to moderate alkaline with values between 7.92 in the Atk horizon and 8.62 in the Ccaac1g2 horizon.

Up to the depth of 50 cm, the soil is low to moderately carbonated with values between 3.15% and 5.55% CaCO3, after this depth becoming heavily carbonated with values between 17.4% and 22.4% CaCO3.

The medium texture and glomerular structure ensure good aeration and good water and air permeability, good useful water retention capacity and lower resistance to soil works, which gives it the highest agro-productive potential. Being located, however, in a low and unequally distributed precipitation area, it needs primarily irrigation.

To maintain and restore the fertility of this soil, organic and mineral fertilising is required.

Chernic gleysol

Morphological features:

Ap - 0-25 cm, medium argylous clay, brown-black (10YR 2/2), moist, grainy, moderately plastic, moderately adhesive, show rare roots and small pores.

Am - 25-40 cm, medium argylous clay, black brown (10YR 2/2), moist.

A/CGo3 - 40-60 cm, medium argylous clay, brown-black (10YR 2/2), with grey-olive spots (5Y 5/2), moist, medium-sized polyhedric structure, well-developed total small porosity, moderate plastic, moderately adhesive.

CGo4 - 60-80 cm, medium clay, grey clay (2,5Y 3/2), with olive (5Y 5/2), moist, medium, well-developed subangular polyhedral structure, well-developed low porosity, moderately plastic, moderately adhesive.

CGr5 - 80-150 cm, medium clay, olive (5Y 5/2), 70% with light olive grey (2,5Y 3/2), moist, medium-sized subangular polyhedral structure, well-developed low porosity, moderately plastic, moderately adhesive.

Taxonomic unit: chernic gleysol, poor carbonate on medium fine, medium argyle/clay-medium clay.

Table 3 presents the physical and chemical properties of the chernic gleysol.

Table 3

Physical and chemical properties of the chernic gleysol

HORIZONS	**AP**	**AmGo4**	**A/CGr5**	**CGr5**	**CGr5**
Depths (cm)	0-25	25-40	40-60	60-80	80-150
Coarse sand (2.O-0.2 mm)%	0,2	0,5	0,5	0,5	0,5
Fine sand (0.2-0.02 mm)%	36,7	36,0	34,6	32,7	44,7
Dust (0.02-0.002 mm)%	26,0	27,0	24,8	28,5	22,6
Clay 2 (sub 0.002 mm)%	36,7	36,5	40,1	28,3	32,2
Physical clay (sub 0.01mm)%	52,9	51,6	53,0	50,9	45,4
TEXTURE	**TT**	**TT**	**TT**	**TT**	**LL**
Density (DA g/cm^3)		1,39	1,49	1,53	
Total porosity (PT %)		49	45	43	

Hygroscopicity coefficient (CH %)		7,46	8,80	7,80	
Wilting coefficient (CO %)		11,2	12,8	11,5	
Field capacity (CC %)		23,7	22,8	21,3	
Useful water capacity (CU %)		12,5	9,9	9,8	
pH in (HO)	8,05	8,05	8,10	8,00	8,15
Carbonates(CaCO3%)	0,16	0,16	0,16	0,16	0,16
Humus (%)	3,35	3,78	3,32		
P mobile (ppm)	30,5	24,8	4,8		
K mobile (ppm)	249	266	178		
Cation exchange capacity (T m.e./100 g sol)	35,0	35,0	38,0	36,9	31,5
Na exchangeable (%din T)	0,86	1,71	1,58	0,81	0,63
Degree of saturation in bases (V%)	100	100	100	100	100

The coarse sand shows small variations from one horizon to another, with low values ranging from 0.2-0.5%. The better represented fine sand has values that oscillate from 32.7% in CGo4 and 44.7% in CGr5. Dust has percentage variations across the profile between 22.6% and 28.6%. The clay fraction has the same fluctuating values but decreasing to the depth, from 36.7-40.1% in the upper horizons to 28.3% in the CGo4 horizon.

Apparent density oscillates within the range 1.39 g/cm3 in Am and 1.53 g/cm3 in CGo4.

Total porosity has low values ranging from 43% in the CGo4 horizon and 49% in the Am horizon. Soil reaction is low alkaline all along the entire profile, i.e., between 8.0 and 8.15. Carbonates are present from the first horizon in small quantities, 0.16%, over the entire profile.

Humus content is relatively large in the Am horizon, 3.78, but decreases in the A/CGo3 horizon to 3.32%. These humus content values include soil in moderate humiferic soil. The large intakes of plant debris and their biodegradation and mineralization conditions favour increased humus accumulations in the upper horizons and a high humus reserve within the range of 0-50 cm. The presence of calcium carbonate on the surface causes a low alkaline reaction, a large cationic exchange capacity with values between 31.5 and 38.0 m.e./100 g soil and a saturation degree in maximum bases. The use of chernic gleysol for agricultural crops is limited by excess moisture. Given that these soils are included in the agricultural circuit, they have a medium to low fertility, and their use as meadows and haymaking fields, where they are found in superior qualitative conditions.

Soil production capacity for their sustainable use

Table 4

Soil suitability in Periam, Timis County, for wheat, barley, grain maize and sunflower

No. crt.	Soil type	Wheat		Barley		Corn		Sunflower	
		Rating note	Fertility class	Rating note	Fertility class	Rating note	Fertility class	Rating note	Fertility class
1.	Chernozem	90	II	90	II	90	II	90	II
2.	Typical batigleic chernozem	80	III	80	III	80	III	80	III
3.	Chernic gleysol	46	VI	46	VI	45	VI	48	VI
4.	Typical gleiosol	39	VII	43	VI	44	VI	48	VI

Table 5

Soil suitability in Periam, Timis County, for pastures and haymaking fields

No. crt.	Soil type	Pastures		Haymaking fields	
		Rating note	Fertility class	Rating note	Fertility class
1.	Chernozem	90	II	90	II
2.	Typical batigleic chernozem	80	III	80	III
3.	Chernic gleysol	65	IV	56	V
4.	Typical gleiosol	47	VI	41	VI

Table 6

Soil suitability in Periam, Timis County, for apricot and peach

No. crt.	Soil type	Apricot		Peach	
		Rating note	Fertility class	Rating note	Fertility class
1.	Chernozem	80	III	70	IV
2.	Typical batigleic chernozem	80	III	80	III
3.	Chernic gleysol	14	IX	14	IX
4.	Typical gleiosol	12	IX	12	IX

CONCLUSIONS

The soils encountered in the studied perimeter, are of the chernozem type. Within this type of soil, several subtypes may be distinguished, including moist phreatic chernozems. Due to the physical, chemical and biological properties they have, chernozems have a high natural fertility. This type of soil gives good productions in both cereals, technical, and fodder plants.

Chernozems are soils with physical and chemical properties, and with the highest agro-productive potential.

Very good crops are obtained at cereals. Good results are obtained in fruit trees.

In order to increase the fertility of these soils, it is recommended to take the following measures:

- works leading to the accumulation and maintenance of water in the soil (proper soil water supply);
- application of organic fertilizers and fertilization with NPK;
- avoidance of monoculture and practice of crop rotation;
- irrigations in the case of sugar beet, maize, etc.

Gleysols, because to groundwater oscillations, negatively influence physicochemical indices and fertility, cultivated plants hardly supporting the alternation of excess or lack of moisture.

Gleysols evolved on more permeable rocks with good drainage are more productive, being covered with medium grade meadows or forests.

Following amelioration, wheat, maize, barley, and sunflower can be cultivated.

Gleysols are not recommended for the cultivation of fruit trees, because of the groundwater that is shallow.

In order to increase the natural fertility of these soils, it is recommended to take the following measures:

- organic and mineral fertilization;
- applying limestone amendments.

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