CHARACTERIZATION OF THE PHYSICAL AND CHEMICAL INDICES OF PRELUVOSOLS FROM AREA OF SAGU LOCALITY, ARAD COUNTY

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Abstract: *This paper aims to obtain a fund of pedological and agrochemical information on the soil cover in Șagu commune, Arad County in terms of its properties: morphological, physical-mechanical, hydrophysical and chemical, in order to establish their quality in terms of productivity and data regarding the nature and intensity of the limiting factors and of the possible degradation phenomena, which should substantiate technically-scientifically the most adequate technological measures specific to each distinct piece of land from an ecological aspect.(D. DICU, R. BERTICI , I. GAICA ,2016)****.*** *The soil, as a means of production in agriculture and horticulture, has certain peculiarities, which distinguish it from other means of production. Thus, the soil is a natural means of production, which is formed and evolves on the land surface, over time and under the influence of environmental conditions. Also, unlike other means of production that wear out by use, the soil, if used rationally, not only does not reduce its fertility but, on the contrary, can increase it. In the case studies are presented the analysis and graphic interpretation of the analytical data obtained following the sampling of soil samples from Șagu commune, Arad County and their physico-chemical analysis. The soil is connected to the environment through a continuous flow of matter and energy. In its long evolution, under the action of natural and agricultural factors, the soil tends to a steady state, characterized by equalizing tendencies of imports and exports of energy and substances. The type of soil found within Sagu locality, Arad county is preluvosol, with two studied subtypes, vertical-stagnant and stagnant.* (DANIEL DORIN DICU, PAUL PÎRSAN, JELENA MARINKOVIC,2014)***.*** *The problems of raising the fertility of the soil must be seen both in terms of current requirements to increase agricultural production, improve the quality of primary production (and not only) and increase yields in agriculture, and their harmonious combination with the main parameters physico-chemical properties of the soil, with which they are in close interdependence. (KAREL IAROSLAV LAȚO, LUCIAN NIȚĂ, ALINA LAȚO, 2013)*

Keywords*: soil, preluvosol, ph, humus, degree of base saturation*

INTRODUCTION

Soil, as a means of production in agriculture and horticulture, has certain features that distinguish it from other means of production. Thus, soil is a means of natural production, which is formed and evolves at the surface of land, over time and under the influence of environmental conditions. Also, unlike other means of production that, by use, are worn out, soil, if used rationally, not only does not diminish its fertility but, on the contrary, it can increase it. (L. NIŢĂ, D. ŢĂRĂU, D. DICU, GH: ROGOBETE, GH. DAVID,2017,)

The fundamental soil property (providing conditions for plant growth) that naturally distinguishes it from the rock on which it was formed, is called fertility. The fertility of a soil depends directly on its physical and chemical properties. (ANIŞOARA DUMA, COPCEA, CASIANA MIHUŢ, L. NIŢĂ, 2014)

Fertility is a result of the stage of soil genesis and evolution, of its composition and properties, and of the physical and chemical processes that occur in the soil.

Agricultural practice shows that, indeed, the production capacity and, therefore, crops, may increase by certain measures such as the use of high-tech-made machines and tools, of fertilizers, of amendments and control substances, of irrigation, drainage, damming, prevention and control of erosion, improving human work and knowledge, applying the results obtained in scientific research, etc. (ANIȘOARA DUMA COPCEA , CASIANA MIHUȚ1, LUCIAN NIȚĂ1, 2015,)

Thus, soil as an open ecological system is related to the environment through a continuous flow of matter and energy. In its long-standing evolution, under the action of natural factors and agricultural practice, the soil tends to evolve to a stationary state, characterized by equalization of imports and exports of energy and substances trends. (LATO, A.NEACSU, A.; CRISTA, F. ; LATO, K.; RADULOV, I.; BERBECEA, A. ; NITA, L.;CORCHES, M. 2013)

MATERIALS AND METHODS

In order to achieve the proposed objectives of the study, soil science research methods were used such as soil mapping, morphological description, determinations in the field, laboratory analyses, soil information processing, etc.

Thus, within the perimeter investigated on the basis of recent data obtained by direct observation in the field and laboratory-processed, a number of 9 genetic soil types were identified. (ANIȘOARA DUMA-COPCEA, NICOLETA MATEOC-SÎRB, TEODOR MATEOC-SÎRB, CASIANA MIHUȚ, 2013)

Soil profiles are located in representative areas of the survey space so that the most representative types and subtypes of soil can be described. In the case of profiles, samples were harvested on soil genesis horizons both in natural (unchanged) and in modified settlements.

Soil sampling in a natural (unchanged) settlement for the characterization of certain physical and hydro-physical characteristics was made in known volume cylinders, at the momentary soil moisture and in cardboard boxes (specially made) for its micro-morphological characterization. (DUMA – COPCEA ANIȘOARA, MIHUȚ CASIANA, L. NIȚĂ,2014)

Soil sampling in a modified settlement for physical-chemical and partially biological characterization was made in bags on each genetic horizon. Also, to determine specific chemical indices, agrochemical soil samples (from the processed layer) were collected. The research ofeco-pedological conditions and morphological description of the investigated soil was made after the "Romanian soil taxonomy system" (1980) completed and/or modified by the "Methodology of the development of soil studies" (Vols. I, II, III) developed by I.C.P.A. Bucharest in 1987. (L. NIȚĂ, D. ȚĂRĂU, D. DICU, GH: ROGOBETE, GH. DAVID,2017)

Analyses and other measurements were carried out in the Timisoara Soil and Agrochemical Office Laboratories of the Banat’s University of Agricultural Sciences and Veterinary Medicine “King Michael I” from Timisoara, according to national norms and standards, approved by the Romanian Standardization Association (A.S.R.O.). The following analyses have been carried out (Table 1).

Table 1.

Analysis Type	Method
granulometric analysis (%)	Kacinscki method
apparent density (D.A. g/cm^3)	metal cylinder method
density (D. g/cm^3)	pycnometer method
hygroscopicity (CH%)	Mittscherlich method
pH (in H_2O)	potentiometric method
carbonates ($CaCo_3$ %)	Scheibler method
humus (%)	Walkley-Blanck method
available phosphorus (mobile) ppm	Egnér Riehm-Domingo method

accessible potassium (mobile) ppm	Egnér Riehm-Domingo method
exchange bases (S.B. me/100 g sol)	Kappen-Chiriţă method
exchangeable hydrogen (S.H. me/100 g soil)	N/K acetate percolation method
cation exchange capacity (T. me/100 g soil)	Bower method
exchangeable Na and K (me/100 g sol)	Schőllenberger-Cernescu method
exchangeable Ca and Mg (me/100 g sol)	Schőllenberger-Cernescu method
basic cations (Ca^{++}, Mg^{++}, Na^{+}, K^{+})	Schőllenberger-Dreibellis-Cernescu method
Anions (CO_3^{--}, $HCO_3^{-}SO_4^{--}$, Cl^{-})	electroconductibility method

RESULTS AND DISCUSSIONS

This paper presents the analysis and graphical interpretation of analytical data obtained from soil sampling in the commune of Şagu, Arad County, Romania, and their physical-chemical analysis according to the methods described in the previous chapter. (LOREDANA DARICIUC, I. GAICA, D. DICU 2016)

VERTIC-STAGNIC STAGNOGLEIED PRELUVOSOL LA/AL

Environment conditions

- Relief: hills
- Slope, exposition: 5.1-10% S/E
- Depth of groundwater: over 10.1 m
- Vegetation: Robur caesius, Echinochloa crus gali, Arthriplex patula, Setaria glauca, Xanthium spinosum, Convolvulus arvensis

Morphological features

Ap: 0-23 cm, medium clay, light brown with structure destroyed by soil works

Ah: 23-36 cm, medium clay, light brown with yellowish tinge, with destroyed structure, moist

AB W2: 36-55 cm, medium clay, brown with 6-15% rust spots, polyhedric, moist

BT_YW3: 55-85 cm, medium clay, brown with 6-30% rust spots, sliding faces, prismatic, moist

BT_YW3: 85-105 cm, medium clay, reddish yellow with 6-30% rust spots, sliding faces, prismatic, moist

BC: 105-135 cm, medium clay, rusty, bobovine, prismatic, moist

C: 135-197 cm, medium clay, rusty.

Soil taxonomy unit

Vertic-stagnic preluvosol with low stagnogleing, clay/clay on medium fine non-carbonate slope, poorly eroded by water.

El vs-st-w2-52/52 – 132/50 – E11 (Table 2)

Table 2.

Physical, hydro-physical and chemical properties of vertic-stagnic stagnogleied preluvosol AL/LA

Horizon	Ap	Ah	AB W2	Bty W3	Btyw3	BC	C
Depth (cm)	0-23	-36	-55	-85	-105	-135	-197
Fine sand (2,0-0,2 mm) %	0,9	1,1	1,2	1,0	1,4	1,3	2,2
Nisip fin (0,2-0,02 mm) %	35,3	33,5	30,4	30,1	30,2	28,6	30,2
Dust (0,02-0,002 mm) %	29,4	30,5	29,3	28,2	27,7	25,9	24,4
Clay 2 (< 0,002 mm) %	34,4	34,7	39,1	40,7	40,7	44,2	43,2
Physical clay (< 0,01 mm) %	48,3	49,5	54,2	55,2	55,6	56,6	55,1
TEXTURE	TT	TT	TT	TT	TT	TT	TT
Skeleton %							
Specific density (D g/cm^3)	2,65	2,70	2,75				
Apparent density (DA g/cm^3)	1,40	1,49	1,47				
Total porosity (PT %)	47,17	44,81	46,55				
Aeration porosity (PA %)	14,48	9,99	11,78				

Degree of settlement (GT %)	6,80	11,55	9,38				
Coef. de higroscopicitate (CH %)	8,06	8,13	9,16				
Coef. of hygroscopicity (CO %)	12,09	12,20	13,74				
Withering coefficient (CC %)	23,35	23,37	23,65				
Field capacity (CT %)	33,69	30,07	31,67				
Useful water capacity (CU %)	11,26	11,17	9,91				
Cover. Maximum yield (CCDmax %)	10,34	6,70	8,02				
pH in (H_2O)	6,13	6,17	6,38	6,57	6,55	6,94	6,98
Humus (%)	2,52	2,10	1,74				
Nitrogen index (IN)	1,86	1,54	1,45				
Humus reserve (t/ha)	157,63						
Mobile P (ppm)	26,8	23,6					
Recalculated mobile P (ppm)	26,71	23,43					
K mobile (ppm)	110	100					
Exchange bases (SB) me/100 g sol	18,28	17,26	21,76	22,58	23,40	22,37	25,03
Exchangeable hydrogen (SH me)	6,44	6,29	4,34	4,19	3,63	3,47	2,96
Total exchange capacity cationic T me/100 g sol	24,72	23,55	26,10	26,77	27,03	25,84	27,99
Degree of saturation in bases (V%)	73,94	73,29	83,37	84,34	86,57	86,57	89,42

VERTIC-STAGNIC PRELUVOSOL WITH LOW STAGNOGLEING LA/AL

As noted in Table 2, coarse sand values increase with the depth – from 0.9% in the Ap horizon to 2.2% in the C horizon.

Fine sand has values that decrease with the depth from 35.3% in the Ap horizon to 30.2% in the C horizon.

Dust has values ranging from 25.9% in BC horizon and 30.5% in Ah horizon.

Clay values increase with the depth from 34.4% in the Ap horizon to 44.2% in the BC horizon.

Soil texture is undifferentiated medium clay along the profile.

Soil density values increase with the depth from 2.65 g/cm^3 in the Ap horizon to 2.75 g/cm^3 in the ABW_2 horizon.

Apparent density has values between 1.4 g/cm^3 in the Ap horizon and 1.49 g/cm^3 in the Ah horizon, being medium. *(*POPA M.; LATO A.; CORCHES M.;RADULOV I.; BERBECEA A.; CRISTA F.; NITA L.; LATO KI;POPA D 2016*)*

Total porosity has values ranging from 47.17% in the Ap horizon and 44.81% in the Ah horizon, being medium.

Aeration porosity values decrease from 14.48% in the Ap horizon to 9.99% in the Ah horizon, being very low and low.

Wilting coefficient has values ranging from 12.09% in the Ap horizon and 13.74 in the ABW_2 horizon, being high.

Total capacity values decrease from 33.69% in the Ap horizon to 31.67% in the ABW_2 horizon, being high.

Soil pH has values that increase with the depth from 6.13 in the water horizon to 6.98 in the C horizon. Based on these values, the reaction of the soil ranges from poorly acidic to neutral.

Soil humus content decreases from 2.52% in the Ap horizon to 1.74% in the ABW_2 horizon, being low.

Base sum has values between 17.26 me/100 g soil in the Ah horizon and 25.03 me/100 g soil in the C horizon, being medium.

Hydrogen sum has values decreasing with the depth from 6.44 me/100 g soil in the Ap horizon to 2.96 me/100 g soil in the C horizon, being very low in the Ap horizon and extremely low in the C horizon.

Total cationic exchange rate values range between 23.55 me/100 g soil in the horizon ah and 27.99 me/100g soil in the horizon C being medium. (NITA SIMONA, NITA L., PANAITESCU LILIANA – 2015)

Base saturation level has values that increase with the depth of 73.29 in the Ah horizon to 89.42% in the C horizon, the soil being mesobasic at the surface and eubasic in depth.

STAGNIC PRELUVOSOL

Environmental conditions:

- Relief: hills, plane shape
- Soil appearance: normal
- Depth of groundwater: over 10 m
- Vegetation: Convolvulus arvensis, Xanthium spinosum, Robur caesius

Morphological features

Ap: 0-22 cm, greyish brown, structure destroyed by soil works, medium clay

AhW2: 22-35 cm, greyish brown with 10% rust spots, structure destroyed by soil works, dusty clay

A0W2: 35-53 cm, yellowish brown with 10% rust spots, small polyhedric, medium clay

ABW3: 53-68 cm, yellowish brown with 20% rust spots, small polyhedric, medium clay

Btw3: 68-88 cm, yellowish brown with 25% spots rust, rare bobovine, high polyhedric, medium clay

BT(y)W2: 88-123 cm, yellowish with 15% rusty and purple spots, sliding faces, large polyhedric, medium clay

BCW2: 123-150 cm, yellowish with 15% rusty and purple spots, high polyhedric, medium clay

Ck: 150-200 cm, yellowish rusty with purple spots, medium clay

Soil taxonomy unit

Stagnic preluvosol, low stagnogleied, baticalcaric, clay/clay, on eluvial solid medium fine carbonate materials.

E1 st-w2K5-52/52 – 121/50

Table 3.

Physical, hydro-physical and chemical properties of stagnic low stagnogleied preluvosol

Horizon	Ap	Ahw2	A0 w2	AB w3	Btw3	Bt(y)w2	BCw2	Ck
Depth (cm)	0-22	-35	-53	-68	-88	-123	-150	-200
Coarse sand (2.0-0.2 mm)%	1,8	2,0	1,2	1,7	0,9	1,8	2,8	1,3
Fine sand (0.2-0.02 mm)%	31,8	31,1	32,0	31,5	31,0	31,3	31,5	31,5
Dust (0.02-0.002 mm)%	32,3	34,2	27,7	25,2	27,7	23,6	22,4	24,0
Clay 2 (<0.002 mm)%	34,1	32,7	39,1	41,6	40,4	43,3	43,3	43,2
Physical clay (<0.01 mm)%	48,3	47,5	53,0	54,9	54,1	55,2	55,0	54,2
TEXTURE	TT	TP	TT	TT	TT	TT	TT	TT
Skeleton%								
Specific density (D g / cm3)	2,50	2,55	2,62	2,64	2,59			
Bulk density (DA g / cm3)	1,40	1,50	1,58	1,58	1,62			
Total porosity (PT%)	44,00	41,18	39,69	40,15	37,45			
Aeration porosity (PA%)	11,34	6,31	2,32	2,55	-0,99			
Degree of settlement (GT%)	12,97	18,18	22,74	22,46	27,41			
Coef. hygroscopicity (CH%)	7,99	7,67	9,16	9,74	9,46			
Withering coefficient (CO%)	11,99	11,50	13,74	14,61	14,19			

Field capacity (CC%)	23,33	23,25	23,65	23,80	23,73			
Total capacity (CT%)	31,43	27,45	25,12	25,41	23,12			
Useful water capacity (CU%)	11,34	11,75	9,91	9,19	9,54			
Cover. maximum yield (CCDmax%)	8,10	4,20	1,47	1,61	-0,61			
Hydraulic conductivity	1,80	1,0	0,5	0,48	0,40			
(K mm / hour)	5,96	6,11	6,33	6,51	6,58	6,56	6,75	7,62
pH in (H2O)								1,10
CaCO 3 (%)	3,57	2,50	1,48					
Humus (%)	3,07	1,91	1,22					
Nitrogen index (IN)	2,36	1,46	1,00					
C: N	193,79							
Humus reserve (t / ha)	26,8	36,4						
P mobile (ppm)	26,8	36,4						
Recalculated mobile P (ppm)	143	110						
Mobile K (ppm)	18,08	18,29	21,49	24,04	24,46	25,53	25,74	
Exchange bases (SB) me / 100 g soil	5,47	5,58	4,62	4,62	3,82	3,40	2,76	
Interchangeable hydrogen (SH me)	23,55	23,87	26,11	28,66	28,28	28,93	28,50	
Total exchange capacity	76,77	76,62	82,30	83,87	86,49	88,24	90,31	

STAGNIC LOW STAGNOGLEIED PRELUVOSOL

As noted in Table 3, coarse sand values range between 1.2 in the A_{OW2} horizon and 2.8% in the BCw2 horizon.

Fine sand has values between 31.0% in the B_{TW3} horizon and 31.8% in the Ap horizon.

Dust values range between 22.4 in the BC_{W2} horizon and 34.2% in the Ah $_{W2}$ horizon.

Clay has values ranging from 32.7% in the Ahw_2 horizon and 43.3% in the BCw_2 horizon.

Soil texture is undifferentiated medium clay.

Density values increase with depth from 2.5 g/cm^3 in the Ap horizon to 2.64 g/cm^3 in the ABw_3 horizon.

Apparent density has values between 1.4 g/cm^3 in the Ap horizon and 1.62 g/cm^3 in the Btw_3 horizon, being medium at the surface and high in depth.

Total porosity values decrease from 44% in the Ap horizon to 37.45% in the Btw_3 horizon, being medium at the surface and very low in depth.

Aeration porosity has values that decrease from 11.34% in the Ap horizon to 2.32 in the Aow_2 horizon, being low and extremely low.

Wilting coefficient has values ranging from 11.5% in the Ahw_2 horizon and 14.61% in the ABw_3 horizon, being medium and low. (NIȚĂ SIMONA, NIȚĂ LUCIAN DUMITRU ,MIHUȚ CASIANA, KOCIS ELISABETA, PANAITESCU LILIANA, LUNGU MARIUS, 2014)

Field capacity has values ranging from 23.25% in the Ahw_2 horizon and 23.8% in the ABw_3 horizon, being medium.

Total capacity has values that decrease with the depth from 31.43% in the Ap horizon to 23.12% in the Btw_3 horizon, being high at the surface and low in depth.

pH has values between 5.96 in the Ap horizon and 7.62 in the CK horizon, soil reaction being moderately acidified at the surface and low alkaline in depth.

Humus content decreases with the depth from 3.57% in the Ap horizon to 1.48% in the Aow_3 horizon, being medium at the surface and low in depth.

Base sum has values that increase with the depth from 18.08 me/100 g soil in the Ap horizon to 25.74 me/100 g soil in the BCw_2 horizon, being medium.

Exchangeable hydrogen has values between 5.58 me/100 g soil in the Ahw_2 horizon and 2.76 me/100 g soil in the BCw_2 horizon, being medium at the surface and very low in depth.

Total cation exchange capacity has values that increase with the depth from 23.55 me/199 g soil in the Ap horizon to 28.93 me/100 g soil in the Btw_2 horizon, being medium.

Base saturation level values increase with the depth from 76.62% in the Ahw_2 horizon to 90.31 in the BCw_2 horizon, being eubasic. (NIȚĂ SIMONA, NIȚĂ LUCIAN, PANAITESCU LILIANA, 2015)

CONCLUSIONS

1. Base sum has values between 17.26 me/100 g soil in the Ah horizon and 25.03 me/100 g soil in the C horizon, being medium.
2. Hydrogen sum has values that decrease with the depth from 6.44 me/100 g soil in the Ap horizon to 2.96 me/100 g soil in the C horizon, being very low in the Ap horizon and extremely low in the C horizon.
3. Total cation exchange values are between 23.55 me/100 g soil in the Ah horizon and 27.99 me/100 g soil in the C horizon, being medium.
4. Base sum has values that increase with the depth from 18.08 me/100 g soil in the Ap horizon to 25.74 me/100 g soil in the BCw_2 horizon, being medium.
5. Exchangeable hydrogen has values between 5.58 me/100 g soil in the Ahw_2 and 2.76 me/100 g soil in the BCw_2 horizon, being medium at the surface and very low in depth.
6. Total cation exchange capacity has values that increase with the depth from 23.55 me/199 g soil in the Ap horizon to 28.93 me/100 g soil in the Btw_2 horizon, being medium.Base saturation level values increase with the depth from 76.62% in the Ahw_2 horizon to 90.31% in the BCw_2 horizo

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