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Research on the Physico-Chemical Properties of Soils Locality Dobrosloveni, Olt County for Sustainable Agriculture

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Abstract

The studied territory located in the central-western part of Olt County, belongs to the Caracal Plain and extremely little in the Leu-Rotunda Field in the SW part, both as divisions of the Romanati Plain.

Locality presents a predominant relief of plain low altitude that is characterized by alluvio-proluvial plains moderately fragmented with local terraces, covered with loess-like deposit but relief of saucer.

The soil cover of the territory under study is the direct reflection of all environmental factors, each having a role in the pedogenetic processes. Climate, as a pedogenetic factor, acted by its components, namely: temperature, precipitation, evapotranspiration, global radiation.

Forest steppe vegetation was the supply of organic matter and biomass, because the hydrological regime is deficient, but especially the lithological substrate (loess-like complex) to steer solification to types characteristic of the cernisols class.

Under the influence of environmental factors and pedogenetic processes within the locality Dobrosloveni it formed a wide range of soils, namely: protisols, cernisols, luvisols and hydrisols.

Keywords: Soil resources, Pedogenetic factors, Physico-chemical characteristics, Sustainable agriculture, Ameliorative work

1. Introduction

Locality Dobrosloveni is among the regions nature and diversity of natural territorial complex components ensures optimum user to obtain agricultural production and income, the more they are exploited effectively, economically and environmentally existing technologies. A productive agriculture is essential prerequisite for sustainable development of agriculture with multiple objectives, improve livelihoods, with preserving and protecting the natural resource base. All this is not possible without special research, extensive and often lengthy.

Locality Dobrosloveni is located in Olt County, in the central-western part of the Caracal Plain, but also in the SW part of the Leu-Rotunda Field, where there are large interfluve with numerous saucer (Cotet, 1976).

Withen the territory studied is presented formation, development, soils distribution, physical and geographical conditions, main physico-chemical properties of the soils, as well as agro-pedoameliorative works.

Closely related to formation, development and distribution of soils in the territory, was intended at the outset how the appearance of each factor of the complex territorial analyzing on all the structure, dynamics and function of each of them, as their role directly or indirectly in the soils genesis.

Thus, they were taken into account the physical and chemical properties of the soils in the pedological ensemble, depending on the physical-geographical factors and recovery productive potential for sustainable agriculture.

2. Materials and Methods

Elementary basic unit of content in soils research from within Locality Dobrosloveni was the soil profile, thus allowing the study of morphological characteristics of the soils. As a result, soils were classified based on intrinsic properties, namely the soil profile, taking into account horizons and diagnostic characters.

In the territory taken in study was applied the ICPA methodology which included a rich land and laboratory, which consisted in exploration the ground cover in large and medium scale, using soil profiles in a network of points with respect to the geological, geomorphologic composition of planning, its hydrography, hydrology and hydrogeology. Also played an important role in vegetation, relief and human activity.

To characterize the physical and chemical were collected numerous soil samples unmodified and modified settlement on which were performed the determinations in the laboratory.

In modified settings, soil samples of 20 cm thickness were taken in bags, for the chemical characterization to be carried. In natural (unchanged) settings, soil samples were taken using a metal cylinder of known volume (200 cm^3) to characterize the physical features, as well as the momentary soil moisture.

The following methods have been used for the physical features:

Determination of particle size fractions (granulometry):

- pipette method fraction ≤ 0. 002 mm;

- wet sieving method for fractions 0.002 to 0.2 mm and dried fractions > 0.2 mm. The results are expressed as a percentage of the remaining material after the pretreatment.

For the **textural classes and subclasses**, we used the Romanian system, according to the Methodology developed for soil studies, ICPA, 1987.

The chemical characteristics were determined using the following methods:

pH: potentiometrically, with glass and calomel combined electrode, in aqueous suspension, at the ratio of ½, 5.

Humus: wet oxidation (Walkley-Black method, modified) and results expressed in percentage.

Total nitrogen (Nt): Kjeldahl method, decomposition of H_2SO_4 at 350°C, catalysts: potassium sulphate and copper sulphate.

Available phosphorus (mobile): Egner-Riehm-Domingod method and colorimetric dosed with blue molybdenum, according to Murphy-Riley method (ascorbic acid reduction).

Available potassium (mobile): extraction according to Egner-Riehm-Domingo method and dosing by flame photometry.

Map making materials were used following map: Romanian soil map, scale 1:200.000, sheet Slatina. Thus, those maps were scanned, then the images were vectorized. He data were then processed using ArcMap. For each map, the computer result in a "polygon layer" mapping each polygon representing a territorial unit. Cartographic data validation was done by overlapping polygons layer the source data. Each territorial mapping unit, were entered as attributes: soil genetic unit, the surface texture, the parent material, pedogenetic processes and the relief.

3. Results and Discussion

Geomorphologically the area under study overlaps a relief with a general slight slope from north to south and also to the floodplains of the great rivers. Most of the region is occupied by the floodplain area and the lower terrace levels of the Olt River, communes in places with those of tributaries. In the researched sector we are located within the Caracal Plain and very little in the Leu-Rotunda Field (Posea et al., 2005).

The Olt Valley stands out with a extremely wide floodplain accompanied by its lower terraces connectable to those of the lower rivers as a taxonomic rank. The Olt Riverbed represents the level of evolution of the hydrographic elements in the area due to its local basic level, especially after the construction of nearby lakes, which largely covered the meanders and previous depletions. The river floodplain has the appearance of a true aisle with a width of up to 2-3 km arranged mainly on the right side, and on the left it is fragmentarily delimited by the forehead of the lower terrace (Figure 1).

The lithology of surface deposits is closely related to and corresponds to levantine and quaternary formations.

Levantine represented by clays, marls, sands and gravels appears at base of slopes of Teslui Valley.

Quaternary forms the most extensive superficial bedspread and quite varied in terms of genetic and lithologic in which are distinguished the following lithologic complexes:

Loess-like complex occupies the area located on the higher forms of relief (Caracal Plain and the Leu-Rotunda Field) and comprises wind loess, dusty and sandy, as well as deluvial sandy clays, which in many sectors are difficult to separate (Figure 2).

Alluvial complex appears in the floodplain Teslui River and consists of deposits of gravel, mass boulders, sands and has variable thicknesses in report to the transport power of the Teslui River. The thickness of deposits Olt floodplain reach 10-12 m.

Surface leaks are generally oriented by the relief configuration.

Figure 1. Olt floodplain in Dobrosloveni

Figure 2. Loess-like deposits in Caracal Plain

Teslui Valley, a right tributary of the Olt River, it is dominated by a minor riverbed with strong meandering, with wide floodplain sectors of up to 500 m and with two obvious terrace levels. The higher terrace has 10-15 m relative altitude, and the lowest of 7-8 m, with a fragmentary distribution due to the meandering of the river (Figure 3).

Figure 3. Teslui Valley in Dobrosloveni

Locally flows and the Potopin (left tributary of the Teslui) with extremely low flow and with a large fluctuation during the year that gathers its waters from an area of 48 km^2 with a length of 20 km and Frasinet right tributary of Teslui which has a basin area of 84 km^2 and a length of 19 km (Ujvari, 1972).

Groundwater canvases have depths of 0-2 m in the floodplain area, and on the terrace the depth of groundwater is more than 10 m, practically not influencing the soil profile.

On the territory of the locality Dobrosloveni the climate is of temperate-continental type with a more arid hue due to the waves of dry air from the east, which cause harsh winters and dry summers.

The average annual temperature is 10.6°C at the Caracal Station; the lowest monthly average air temperature was recorded in January, -0.2°C, and the highest 22.4 °C in July.

Regarding the precipitation, we can say that they also have the same continental influence as the air temperature, they are predominantly in the form of rains, but unevenly distributed.

Thus, the average annual rainfall amounts at the Caracal Station have a value of 522 mm.

Within the tree-covered space, woody elements consisting of *Quercus pedunculiflora*, *Acer tataricum*, *Q. cerris*, *Q. frainetto*, *Fraxinus excelsior*, *Ulmus minor*. The shrub floor is dominated by *Crataegus pentagyna*, *Cornus sanguinea*, *Cornus mas*.

On the lands that have not been subjected to agricultural crops, we find elements of

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spontaneous flora, among which *Festuca valesiaca*, *Agropyron cristatum*, *Poa bulbosa*, *Artemisia austriaca*, *Cynodon dactylon*, *Stipa lessingiana*, *Stipa capillata*, *Trifolium pratense*, *Medicago falcata*, *Melilotus officinalis*, *Carex praecox*, *Crysopogon grullus*, (Stănilă, 2006) (Figure 4).

Figure 4. Grassy vegetation with clumps of woody vegetation to the south-east of Dobrosloveni

Depending on the conditions and factors that contributed to the formation of the soils, within the territory under investigation the following soils have been identified at class level: protisols, cernisols, luvisols and hydrisols (Ispas & Stănilă, 2015) (Figure 5).

Protisols class comprises the youngest soils, at an early stage of development, formed as a result of repeated sediment deposition, represented by eutric aluviosols.

Eutric aluviosols appear widespread in the major riverbed of Teslui, Frasinet and Potopin, in the floodplain area under the influence of water by the action of transport and deposition of fluvial materials, with ground water located between 2-3 m.

Presents a profile of type *Ao-AC-C*$_1$*-C*$_2$*-CGox* well developed. The texture is loamy in the surface horizon (26.2% clay) and clay loam on the profile (34.6-44.6% clay) (Table 1).

The soil reaction is weakly-moderately alkaline (pH=7.6-8.6). The humus content is small in the surface horizon (1.5 %). In terms of nutrient supply, there are soils low in total nitrogen

(0.100-0.131%) and medium supplied with phosphorus and potassium (P mobile–20-30 ppm; K mobile -140-200 ppm) (Table 2).

Due to the favorable water and trophic regime, eutric aluviosols fall into the category of soils with good fertility.

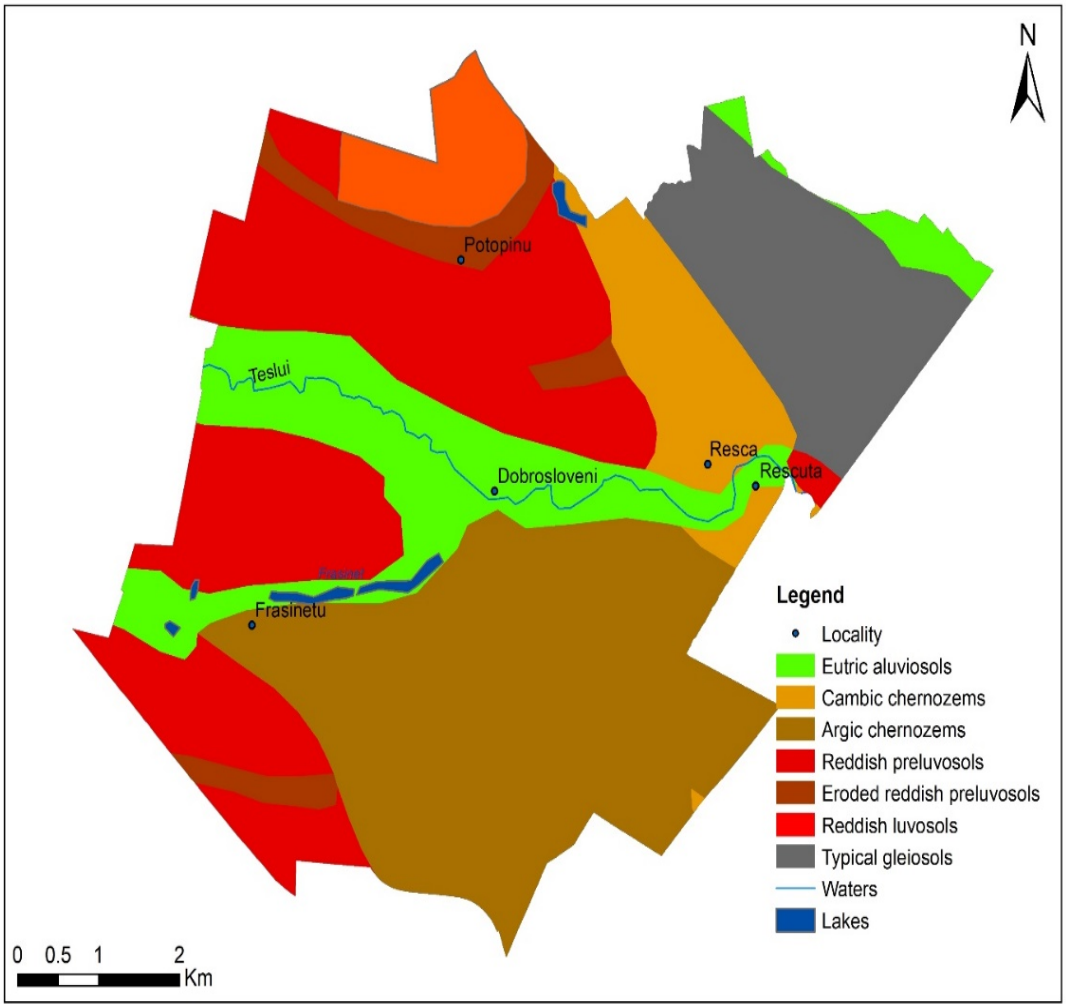

Figure 5. Soils Map of Dobrosloveni

Table 1. Granulometric composition of eutric aluviosols

Horizon	**Depth (cm)**	**Granulometry**			
		< 0.002 mm	**0.002-0.02 mm**	**0.02-0.2 mm**	**0.2-2.0 mm**
Ao	0-32	26.2	14.7	54.8	4.3
AC	33-50	34.6	15.9	46.4	3.1
C_1	51-75	36.7	6.0	53.9	3.4
C_2	76-95	38.4	6.2	53.0	2.4
CGox	96-150	44.6	20.9	30.3	4.2

Table 2. Chemical properties of eutric aluviosols

Horizon	Depth (cm)	pH (H_2O)	Humus %	Total Nitrogen %	Mobile P (ppm)	Mobile K (ppm)
Ao	0-32	7.6	1.5	0.131	30	200
AC	33-50	7.8	1.3	0.103	25	175
C_1	51-75	8.1	1.2	0.100	20	140
C_2	76-95	8.5	-	-	-	-
CGox	96-150	8.6	-	-	-	-

They can be grown with various crop plants and legumes. Frequently they are used as pastures and meadows and less often as floodplain forests.

Cernisols are represented in the researched territory by cambic chernozems and argic chernozems.

Characteristic for cernisols is the obvious accumulation of organic matter (relatively saturated in bases) at the top of the soil profile, having a diagnostic horizon of type Am, continued with the transition horizon (AB, AC, Bv), having colors of Am horizon, at least at the top (on a minimum 10-15 cm) and at least on the faces of structural agregates (SRTS, 2012).

Cambic chernozems were formed under the conditions of a plain relief, with a relatively flat surface, on parental materials consisting of loess-like deposits, with groundwater depth above 10 m. Presents a profile of type *Am-Bv_1-Bv_2-C* well developed. The texture is loamy in the surface horizon Am (34.3% clay) and becomes clay loam on the profile (36.6-42.0% clay) (Table 3), and the soil reaction is moderately acidic in horizon Am (pH=5.6) and becomes weakly alkaline at the level of the C horizon (pH=7.4). The humus content has values between 1.8-3.2%. The nutrient supply is low-medium with total nitrogen (0.145-0.178%), high with phosphorus (P mobile-25-42 ppm) and very high with potassium (K mobile-360-440 ppm).

Table 3. Physical and chemical properties of cambic chernozems

Horizon	Depth (cm)	Clay <0.002 mm	pH (H_2O)	Humus %	Total Nitrogen %	Mobile P (ppm)	Mobile K (ppm)
Am	0-37	34.3	5.6	3.2	0.178	42	440
Bv_1	38-70	36.6	6.7	2.6	0.168	39	415
Bv_2	71-98	40.4	7.2	2.3	0.153	30	385
C	99-135	42.0	7.4	1.8	0.145	25	360

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Cambic chernozems are soils with high fertility due to favorable physical and chemical characteristics, being cultivated with wheat, barley, corn, sunflower, as well as in fruit growing and viticulture with good production results.

Argic chernozems were formed under the conditions a plain relief on quasi-horizontal surfaces (predominantly between 1-2%), with bumps between 10-20 cm, on loess-like deposits, the depth of groundwater between 7-8 m.

Presents a profile of type *Am -Bt*$_1$*-Bt*$_2$*-C* well developed. The texture is loamy in the surface horizon Am (28.0% clay) and becomes clay loam on the profile (35.0-39.3% clay), and the soil reaction is weakly acidic in the surface horizon (pH=6.5). The humus content has values between 1.7-3.0%, and soil supply with total nitrogen is very small (0.074-0.098%). The supply of the soil with mobile phosphorus and mobile potassium is high (P mobile-45-54 ppm; K mobile-248-260 ppm) (Table 4).

Argic chernozems fall into the category of soils with medium to good fertility, being cultivated with cereals, technical plants and leguminous plants. Of the fruit trees, good results give the cherry, cherry tree, apple, plum and walnut.

Luvisols are represented in the analyzed territory by reddish preluvosols, eroded reddish preluvosols and reddish luvosols.

Table 4. Physical and chemical properties of argic chernozems

Horizon	Depth (cm)	Clay <0.002 mm	pH (H_2O)	Humus %	Total Nitrogen %	Mobile P (ppm)	Mobile K (ppm)
Am	0-45	28.0	6.5	3.0	0.098	54	260
Bt_1	46-60	39.3	6.8	2.7	0.088	49	256
Bt_2	61-95	35.0	7.0	2.0	0.074	45	248
C	96-130	37.0	7.5	1.7	-	-	-

Reddish preluvosols appear spread within a flat relief, relatively drained, on loess-like deposits, with a reddish tint due to a somewhat higher content of unhydrated iron oxides, influencing the color of the soil, with the depth of the ground water between 7-8 m.

Presents a profile of type *Ao-Bt*$_1$*-Bt*$_2$*-C* deeply developed. The texture is medium clay loam in the surface horizon (37.0% clay) and becomes loamy-clayey on the profile (44.4-50.0% clay). The soil reaction is moderately acidic-neutral (pH=5.1-7.2).

The humus content is small in the surface horizon (1.8 %) and decreases on the profile. In terms of nutrient supply, the total nitrogen content of these soils is small (0.056-0.102%), while mobile phosphorus and mobile potassium appear in medium quantities (P mobile -14-25 ppm; K mobile-160-200 ppm) (Table 5).

Table 5. Physical and chemical properties of reddish preluvosols

Horizon	Depth (cm)	Clay <0.002 mm	pH (H_2O)	Humus %	Total Nitrogen %	Mobile P (ppm)	Mobile K (ppm)
Ao	0-20	37.0	5.1	1.8	0.102	25	200
Bt_1	21-70	44.4	6.0	1.4	0.087	20	182
Bt_2	71-98	49.2	7.0	0.9	0.080	18	173
C	99-135	50.0	7.2	0.7	0.056	14	160

Reddish preluvosols are used for agricultural, fruit-growing and forestry purposes. With good results, are grown with wheat, corn, sunflower and fodder plants.

Eroded reddish preluvosols were formed on the slopes of the valleys of the studied territory, such as Teslui, Frasinet and Potopin in sectors with weakly-moderately inclined slopes, on mostly uncultivated land, with the depth of the groundwater >10 m.

Presents a profile of type *Ao-AB-Bt_1-Bt_2-C* poorly developed. The texture is medium clay loam in the surface horizon (44.6% clay) and becomes loamy-clayey on the profile (46.8-54.7% clay). The soil reaction is moderately acidic-neutral (pH=6.3-7.1).

The humus content is small in the surface horizon (1.7 %) and decreases on the profile. In terms of nutrient supply, the total nitrogen content of these soils is small (0.134-0.152%), while mobile phosphorus and mobile potassium appear in medium quantities (P mobile -12-20 ppm; K mobile-150-190 ppm) (Table 6).

Reddish luvosols are spread over poorly drained surfaces with frequent bumps, on clay terrace deposits, with ground water at over 5 m. Presents a profile of type *Ao-Elv-Bt-C* poorly developed.

Table 6. Physical and chemical properties of eroded reddish preluvosols

Horizon	Depth (cm)	Clay < 0.002 mm	pH (H_2O)	Humus %	Total Nitrogen %	Mobile P (ppm)	Mobile K (ppm)
Ao	0-20	44.6	6.30	1.7	0.152	20	190
AB	21-26	39.0	6.40	1.5	0.146	18	182
Bt_1	27-32	47.6	6.75	1.3	0.134	15	174
Bt_2	33-82	54.7	7.00	-	-	12	150
C	83-110	46.8	7.10	-	-	-	-

The clay content of these soils varies between 29-31% in the Ao horizon and between 25-27% at the Elv horizon level, and the soil reaction is weakly acidic in the Ao and Elv horizons (pH=6.5-6.6) and neutral in the Bt horizon (pH=6.9-7.0). The humus content is small in the surface horizon (1.3%). The level of nutrient supply of these soils is inadequate. Thus, the total nitrogen content does not exceed 0.082%, mobile phosphorus is between 15-18 ppm and mobile potassium does not exceed 125 ppm.

Reddish luvosols show low fertility. This is due to the reduced ability to provide plants with nutrients, as well as the argilization of the argic horizon (Bt), which causes water stagnation in the soil and at the surface of the soil, improper aeration conditions for the development of crop plants. For the most part these soils are cultivated with wheat, maize and fodder plants with poor production results.

Hydrisols are formed as a result of prolonged excess moisture, with the appearance of gleyic properties (Gr) or intense stagnic (W), starting from the first 50 cm. They are represented within the territory studied by *typical gleiosols*.

These soils were formed under the conditions of a floodplain relief represented by micro-depression zones, on parental materials consisting of fluvial deposits, with a groundwater depth of 1-1.5 m. Presents a profile of type $Ao\text{-}AGox\text{-}Gr_1\text{-}Gr_2\text{-}Gr_3$ well developed.

The texture clay loam (27,9-36,5%) on the profile, and the soil reaction is from moderate to strongly acidic (pH =4,9-5,7). The humus content is small (2.6%) in the surface horizon and decreases on the profile and the supply of soil with total nitrogen is medium on profile (0.178-0.160) (Table 7).

Table 7. Physical and chemical properties of typical gleiosols

Horizon	**Depth (cm)**	**Clay < 0.002 mm**	**pH (H_2O)**	**Humus %**	**Total Nitrogen %**
Ao	0-15	31.1	4.9	2.6	0.178
AGox	20-30	29.4	5.3	2.1	0.170
Gr_1	31-45	27.9	5.5	1.3	0.160
Gr_2	46-90	36.5	5.7	0.3	-
G_3	91-125	30.5	5.1	-	-

Due to the excess of moisture that causes an aerohydric regime unfavorable to the development of cultivated plants and valuable grasses, as well as due to the low level of decomposition and mineralization processes of organic substances, these soils have a very poor natural fertility.

4. Conclusions

The investigated territory is located in the central-western part of Olt County, which from a geomorphological point of view belongs to the Caracal Plain, as well as the Leu-Rotunda Field in the SW part.

The limiting factors of agricultural production are the results of the elements of natural setting, namely the conditions of relief and parental materials, climate, ground water, as well as vegetation.

The elimination of the negative effects of some restrictive factors requires the application of several measures and pedoameliorative and hydroameliorative works. They can be made both singularly and combined with each other. The order of their execution is recommended to be:

- deep loosening works to create an appropriate aerohydric regime in the case of soils with clay loam-clay texture (argic chernozems, reddish preluvosols, reddish luvosols and typical gleiosols);
- organic and mineral fertilization works in the case of soils with a varied texture, from the soil classes: protisols, cernisols, luvisols and hydrisols;
- surface drainage works to combat and prevent excess moisture in the case of soils with groundwater located at low depth (eutric aluviosols and typical gleiosols);
- works to prevent soil erosion in the case of those located on slopes (eroded reddish preluvosols).

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