ASPECTS REGARDING THE VARIABILITY OF SOME PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS IN THE BĂNDOIU AREA, THE GREAT BRĂILA ISLAND

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Abstract

The current status of Great Brăila Island is the result of an extensive activity of damming/draining/land reclamation of the Brăila Swamp with the aim to be used in agriculture. The final areas obtained from this complex activity preserve the specific variability of the flood areas. In order to be used in agricultural purposes, they need crop technologies which capitalize the physical and chemical soil properties.

In order to highlight this variability, physical and chemical analysis on soil samples have been done. The analyzes highlighted the following: the soil texture is uniform (clayey and clay-loamy); the indicators characterizing the structural soil state indicate a good structural aggregation; soil reaction is weakly alkaline on the profile for the entire area; humus content varies from low to medium; the total nitrogen content varies from low to high (the vast majority of samples having medium contents); available phosphorus content varies from high to very high; available potassium content ranges from medium to very high; the total content of soluble salts indicates non-saline soils, while the total cation exchange capacity has medium and high values.

The statistical analysis of the studied indicators indicates a coefficient of variation with values between 1.99% for the soil reaction and 53.17% for the structural instability index. Detailed analysis of these coefficients indicate a higher variability for the easily exchangeable indicators (such as nutrient supply) and a lower variability for stable elements (total cation exchange capacity, soil texture and soil reaction, being dependent on parent material).

The results of the study highlights a relative homogeneity of the area, the indicators varying inside the same class of values, allowing the application of homogenous agricultural technologies on the study area.

***Key words**: soil, soil analysis, soil indicators, variability*

INTRODUCTION

The current status of Great Brăila Island is the result of an extensive activity of damming/draining/land reclamation of the Brăila Swamp with the aim to be used in agriculture. The final areas obtained from this complex activity preserve the specific variability of the flood areas. In order to be used in agricultural purposes, they need crop technologies which capitalize the physical and chemical soil properties.

The dammed floodplains with complex exploitation activities (agricultural, forestry, fisheries, tourism), taking into account the needs of conservation and spread of the natural specific biodiversity and environmental conservation solutions, ensure the effective exploitation of these territories (Vișinescu and Bularda, 2008). Changes in the natural order within the Great Brăila Island ecosystem or anthropic intervention to obtain agricultural productions produce changes in the soil's tendency to create some balances in agreement with the other environmental components. The soil in areas that have undergone such transformations can be used sustainably, without disturbing these balances, through a good knowledge of its characteristics and properties, of the intimate mechanisms that act in full interdependence with the other components of the ecosystem (Piciu, 1999). The areas in the dammed floodplain have specific characteristics requiring the application of efficient hydrotechnical exploitation and an ameliorative agricultural system. The floodplain soils highlight local degradation processes: waterlogging on limited areas (8 - 10%), degradation of chemical properties (salinity, alkalization) (3 - 4%), that could be avoided by applying an ameliorative agricultural system (Vişinescu and Bularda, 2007; 2014). The careful monitoring of the soil evolution in the dammed floodplains used in agriculture allows the adjustment of the anthropic intervention taking into account both the soil and other environmental resources protection and economically efficient yields. The variability of some soil indicators regarding the soil trophic state in the dammed floodplains can create difficulties in applying agricultural technologies (choosing the crop rotation, soil tillages, fertilization system).

The aim of the paper is to highlight the variability of some soil physical and agrochemical properties at the level of a Land Parcel Identification System in the Great Brăila Island, and to emphasize, once more, the importance of knowledging soil resources for the application of appropriate technologies to obtain adequate crop yields.

MATERIALS AND METHODS

The study area is located in the south-western part of the Great Brăila Island, in Băndoiu farm (fig. 1), climatically characterized by average annual precipitation of 447 mm, average annual temperatures of 10.9°C, potential evapotranspiration – 705 mm, climatic water deficit – 258 mm. The soil cover in the studied area is represented by gleic and molic calcareous Alluviosols (Florea and Munteanu, 2012).

The soil samples have been picked from from 26 physical blocks of Băndoiu farm, Great Brăila Island, at three depths: 0 - 20, 40 - 60 and 80 - 100 cm, one sample for each 50 ha.

The main soil properties analyzed are pH (SR 7184-13:2001), organic C content (Walkley-Black method modified by Gogoasa, STAS 7184/21-82), NPK content (Kjeldahl method STAS 7184/2-85 standard, Egnèr-Riehm-Domingo method).

The total content of water-soluble salts was conductometrically measured.

To assess the particle size distribution, the pipette method and the wet sieving method were used, while structural

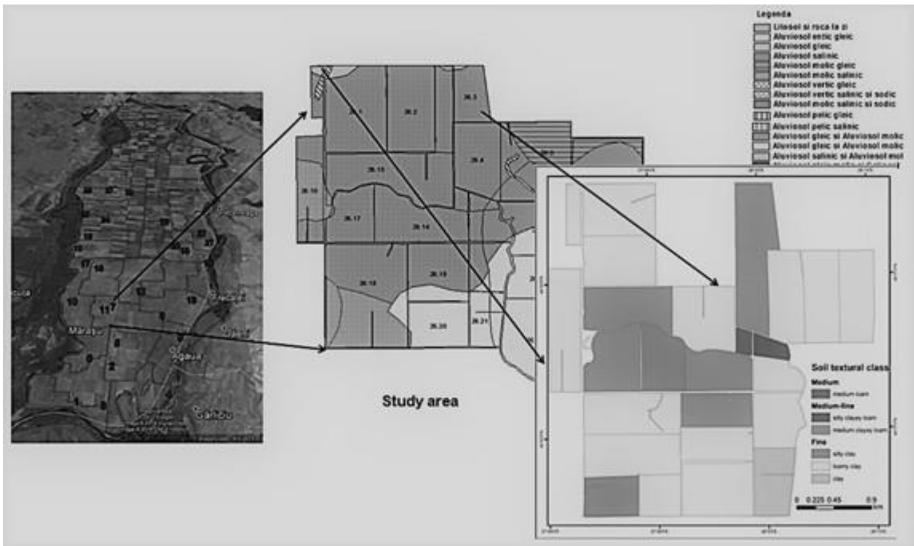

Figure 1. Study area

stability indices were determined using the Hènin-Feodoroff method. All analytical methods are standardized, in the STAS or ISO system (MESP, 1987; Dumitru et al., 2009; Dumitru and Manea, 2011). The indicators distribution maps (cartograms) have been developed using Arc Map 10.7.1, and statistical parameters were calculated in Microsoft Excel.

RESULTS AND DISCUSSIONS

The Great Brăila Island was the subject of extensive research studies on the soil cover (Munteanu et al., 1961; Piciu, 1994; Piciu, 1999; Dumitru et al., 2021). The literature data (Piciu, 1999) emphasize the textural variability of the solification deposits in the Great Brăila Island, both vertically (on the soil profile) and horizontally. The texture in topsoil varies according the landforms and locally topography. The soil genetic, physical and chemical properties are taken over from the deposits on which the soils were formed. The soil texture directly influences the slowing down or acceleration of the development of some pedogetic processes, the speed and degree of mineralization of organic matter, the processes of eluviations, circulation of ground- and surface waters, which translates into different states of soil drainage, influencing their morphology.

In the study area, the soil texture is predominantly loamy clay and clay loam in the first 20 centimeters; predominantly loamy (40 - 60 cm), and it varies from sandy to clayey, mainly the loamy one with its combinations (80 - 100 cm), a fact that underlines the above mentioned.

The indices characterizing the structural soil state are largely influenced by the soil texture, organic matter content and human action. The analytical data obtained on the analyzed soil samples indicate the decreasing of the number of hydrostable aggregates with depth. The number of structural microaggregates also decreases with depth. The index of structural instability has higher values in depth and lower values in topsoil.

The statistical indicators that emphasize both the horizontally and vertically variability of the analyzed indicators are presented in the tables 1 (a 0 - 20 cm, b 40 - 60 cm, c 80 - 100 cm).

Table 1. The horizontally and vertically variability of soil indicators

(a) 0 – 20 cm

	pH	**Humus content**	**Nt**	**P_{AL}**	**K_{AL}**	**TCSS**	**T-NH_4**	**AH**	**D**	**IS**
		(%)		**(mg/kg)**		**(mg/100 g)**		**(%g/g)**		
n	26	26	26	26	26	26	26.0	26	26	26
x min	7.49	3.08	0.109	37	167	7	24.0	7	6	0.16
x max	8.14	5.72	0.482	167	406	172	42.9	39	21	1.60
$\bar{x}$	7.81	4.29	0.236	76	286	67	35.4	24	13	0.68
σ	0.16	0.82	0.073	26.07	69.61	25.70	4.7	9	4	0.36
x_g	7.81	4.21	0.226	72	278	62	35.0	21	13	0.60
c.v. (%)	1.99	19.05	30.91	34.25	24.31	38.21	13.2	40.08	27.71	53.17
Me	7.83	4.38	0.234	72	282	65	35.5	24	13	0.58
Mo	7.68	3.43	0.222	72	282	89	35.6	26	14	0.58

(b) 40 – 60 cm

	pH	**Humus content**	**Nt**	**P_{AL}**	**K_{AL}**	**TCSS (mg/100 g)**	**AH**	**D**	**IS**
		(%)		**(mg/kg)**			**(%g/g)**		
n	26	26	26	26	26	26	26	26	26
x min	7.16	0.65	0.024	5	32	44	2	5	0.28
x max	8.38	3.79	0.238	33	179	181	47	18	7.83
$\bar{x}$	7.92	1.71	0.108	18	98	77	15	10	1.30
σ	0.27	0.90	0.059	7.35	44.75	30.83	11	3	1.55
x_g	7.92	1.48	0.091	16	88	73	11	10	0.88
c.v. (%)	3.38	52.78	54.58	41.28	45.52	40.15	70.42	31.58	118.96
Me	7.91	1.72	0.108	19	93	67	13	10	0.67
Mo	7.91	1.00	0.047	21	49	62	4	9	

(c) 80 – 100 cm

	pH	**Humus content**	**Nt**	**P_{AL}**	**K_{AL}**	**TCSS (mg/100 g)**	**AH**	**D**	**IS**
		(%)		**(mg/kg)**			**(%g/g)**		
n	26	26	26	26	26	26			
x min	7.66	0.36	0.004	5	13	49	26	26	26
x max	8.41	3.08	0.197	26	182	273	2	4	0.42
$\bar{x}$	7.99	0.86	0.050	12	63	151	37	16	6.26
σ	0.20	0.75	0.046	5.36	43.72	72.39	6	9	2.73
x_g	7.98	0.68	0.035	10	52	134	8	3	1.74
c.v. (%)	2.48	87.28	93.04	46.16	69.60	47.99	4	8	2.12
Me	7.98	0.62	0.038	11	52	147	131.96	35.19	63.54
Mo	8.08	0.62	0.029	8	48	80	3	8	2.53

The soil reaction is weakly alkaline both in the first 20 centimeters (7.49 - 8.14) and the entire soil profile (7.16 - 8.41); the coefficient of variation has the value 1.99% for the first 20 centimeters, 3.38% for the depth 40 - 60 cm, respectively 2.48% for 80 - 100 cm. The parent material rich in calcium carbonate as well as the climatic conditions gave these soils a weak alkaline character.

The humus content varies from low (3.08%) to medium (5.72%) in the first 20 cm and from extremely low (0.36%) to low (3.79%), in depth (fig. 2); the coefficients of variation have the values: 19.05% (the first 20 cm), 52.78% (40 - 60 cm) and 87.28% (80 - 100 cm).

This situation emphasizes that, in general, the humus content in the dammed floodplain varies depending on the landforms, increasing from the beams to the depressed areas, due to different bioaccumulation conditions existing along the soil evolution in the Great Brăila Island.

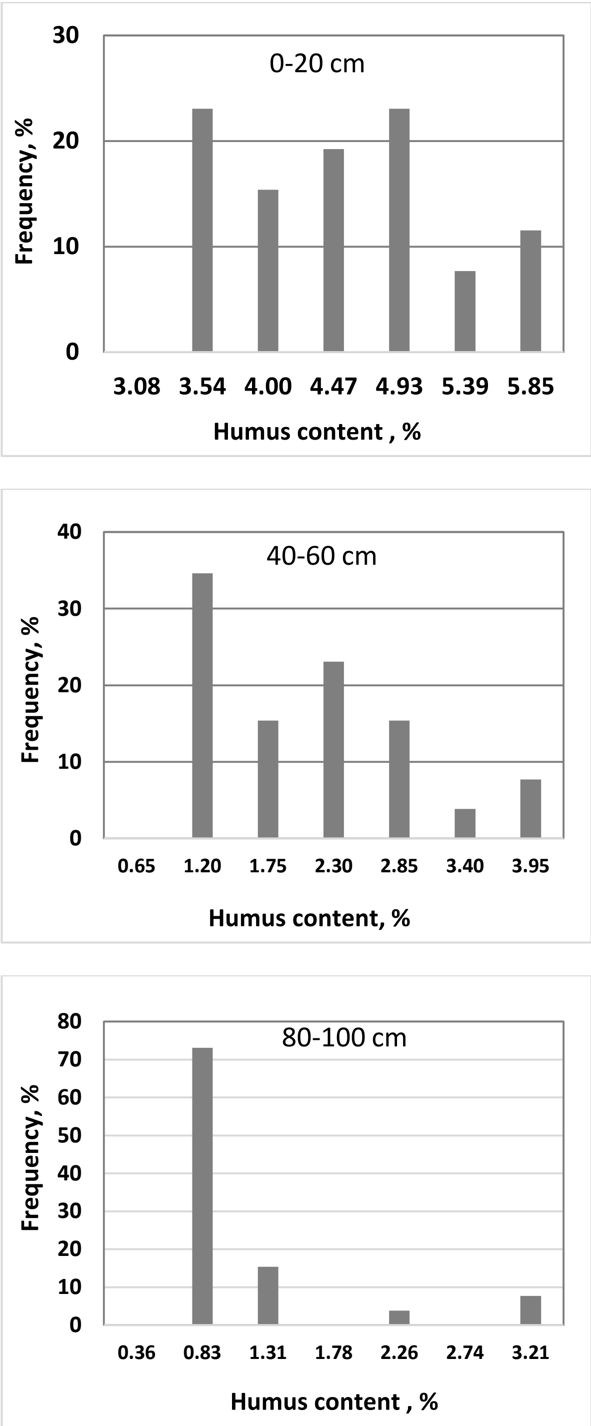

Figure 2. The frequency of soil humus content at different depths

The total nitrogen content (Nt) varies from low (0.109%) to high (0.482%), the vast majority of samples having medium contents in the first 20 cm; from very low (0.024%) to medium (0.238%) for depth 40 - 60 cm and from very low (0.004%) to medium (0.197%) for depth 40 - 60 cm; the coefficients of variation have the values 30.91% (0 - 20 cm), 54.58% (40 - 60 cm), respectively 93.04% (80 - 100 cm). Large variation in total N supply levels is influenced by the quality of decomposed organic matter (poorer or richer in total N content) due to the bioaccumulation conditions.

Available phosphorus content (P_{AL}) varies from high (37 mg/kg) to very high (167 mg/kg) in the first 20 centimeters and from very low (4.5 mg/kg) to medium (33 mg/kg) for the soil depth; the coefficients of variation have the values 34.25% (0 - 20 cm), 41.28% (40 - 60 cm) and 46.16% (80 - 100 cm).

Available potassium content (K_{AL}) ranges from medium (167 mg/kg) to very high (406 mg/kg) in the first 20 cm and from extremely low (13 mg/kg) to medium (182 mg/kg) for the soil depth; the coefficients of variation have the value 24.31% (0 - 20 cm), 45.52% (40 - 60 cm), respectively 69.60% (80 - 100 cm).

The nutrients supply (total N, available P and K) in topsoil (the plowed layer) is not only given by the soil intrinsic contents, but it is also influenced by the systematic administration of significant amounts of mineral fertilizers. One can notice an important decrease in the (N and P) contents with depth, and an increase of the coefficient of variation, the constant fertilization of the topsoil leading to a relative uniformity of these contents.

The total content of soluble salts indicates non-saline soils in the first 20 centimeters, with values between 7 - 85 mg/100 g, while for the next layers (40 - 60 cm and 80 - 100 cm, respectively), the values vary between 44 and 273 mg/100 g, from non-saline to slightly saline characteristics; the coefficient of variation has the value 38.21% (0 - 20 cm), 40.15% (40 - 60 cm) and 47.99% (80 - 100 cm).

The total cation exchange capacity ($T\text{-}NH_4$) has medium (24 me/100 g soil) and high (43 me/100 g soil) values, and the coefficient of variation has a value of 13.25% for the top soil.

CONCLUSIONS

The statistical analysis indicates a coefficient of variation of 1.99% for the soil reaction and 53.17% for the structural instability index.

Detailed analysis of these coefficients indicate a higher variability for the easily exchangeable indicators (e.g. nutrient supply) and a lower variability for stable elements (e.g. total cation exchange capacity, soil texture and soil reaction), which dependent on parent material.

The lower variability of the stable indicators recommends the application of homogenous agricultural technologies on the study area.

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