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Original Article

Research Concerning the Ratio Between Organic Carbon and Clay Content in Representative Soils from Transylvania (Natural Soils)

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Abstract

The current study fits the present approaches related to diversifying and perfecting the soil fertility control and monitoring methods in order to effectively increase the vegetal yield for the surface unit and to achieve durable soil fertility. The approach of this study was developed through research related to perfecting the evolution of organic components in the soil method, due to their importance in the soil fertility, in the thermodynamic equilibrium of soil's component phases and in designing rational fertilizing management measures. The results obtained in the current research exhibit the ratio between organic carbon and clay content in different soils that are representative for Transylvania region, natural soils, which have the tendency of diminishing the organic carbon contents manifested at high and excessive representing domains for clay.

Keywords: humus, organic carbon, clay.

1. Introduction

The processes that include the non-humic and humic substances that have a decisive character in the soil humic balance are extremely complex, some having cumulative effects, some destructive effects, but it is of high importance that they have a specific character for the ecosystem during the anthropic interventions, on the short term but especially on the medium and long term and they may also have important effects.

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Knowledge of these processes that include the organic matter in the soil can form the base of a management and some strategies concerning the protection and increase of soil fertility. Humification or microbiological synthesis of the humus is an essential process that permanently takes place on the long term and leads to the formation of humus in the soil on a microbiological way, from plant debris of cultivated crops, from microorganisms and organisms that populate the soil and from organic fertilized resources embedded in the soil. The humus synthesis process may be influenced by the mass of organic remains, by the dosage of organic fertilizers applied, by the C/N ratio of all these organic matters engaged in the process and also by other trophic and technologic factors. The shift of the organogenic elements (C, N, S, P, O, H) in humic substances depends on the C/N ratio of the materials that are subject to humification and it is related to the microbiological activity in the soil (as population biodiversity and the efficiency of their activity) [2].

2. Material and Method

The research in this study was conducted on representative soils in Transylvania – natural soils having the characteristics for the pedogenetic conditions in which they were formed. In this context, concerning the content of organic carbon and clay, on different pedogenetic horizons, the following types of soil were studied:

-Distric skeletal litosol, with the following horizon sequence: At - ARp – Rp

-Stagnic moderately eroded luvisol, with the following horizon sequence: At - El – EBw – Btw

-Limestone molic gleyic aluvisol, with the following horizon sequence: At – Am – ACGo – CkGor

-Argic phaeozem, with the following horizon sequence: Am – Bt– Cca.

The analysis on soil were conducted complying with the methodology recommended by ICPA (1981, 1987), for agrochemistry and pedology laboratories. The determination of the total content of carbon and humus in the soil was carried out using the wet oxidation and titrimetric dosage method (Walkly-Black variant, modified by Gogoașă) and for determining the total organic carbon content in the soil we used dosage through dry combustion according to STAS SR ISO 10694 : 1998.

3. Results and Discussions

The results obtained assess the multiple possibilities that circumscribe to the general goal of studying the analytical alternatives of characterization and interpretation of the organic component in the soil useful for agrochemical and pedological studies conducted on agricultural and horticultural productive surfaces. Methods used took into consideration the traditional analytical procedures (determining organic carbon through wet digestion, humus, C/N ratio) and also the modern approaches that implement new procedures (in the case of organic carbon through dry digestion with the evaluations that follow this methodology) pursuing the promotion of these analytical procedures in the current soil study activity.

The agrochemical obtained values fit in the soil class and type limits, with essential modifications between them as pedologic determination but also with the influence of their use and of the technologies applied (table 1).

The dependence and variability of organic carbon contents (wet digestion and dry digestion) towards clay representation in soils is ordered following a polynomial curve ($a+bx+cx^2$ type) for 0-20 cm and 20-40 cm depths in which the essential processes of bioaccumulation (humification – mineralization) and those of formation and migration of clay are activated (fig.1, fig.2).

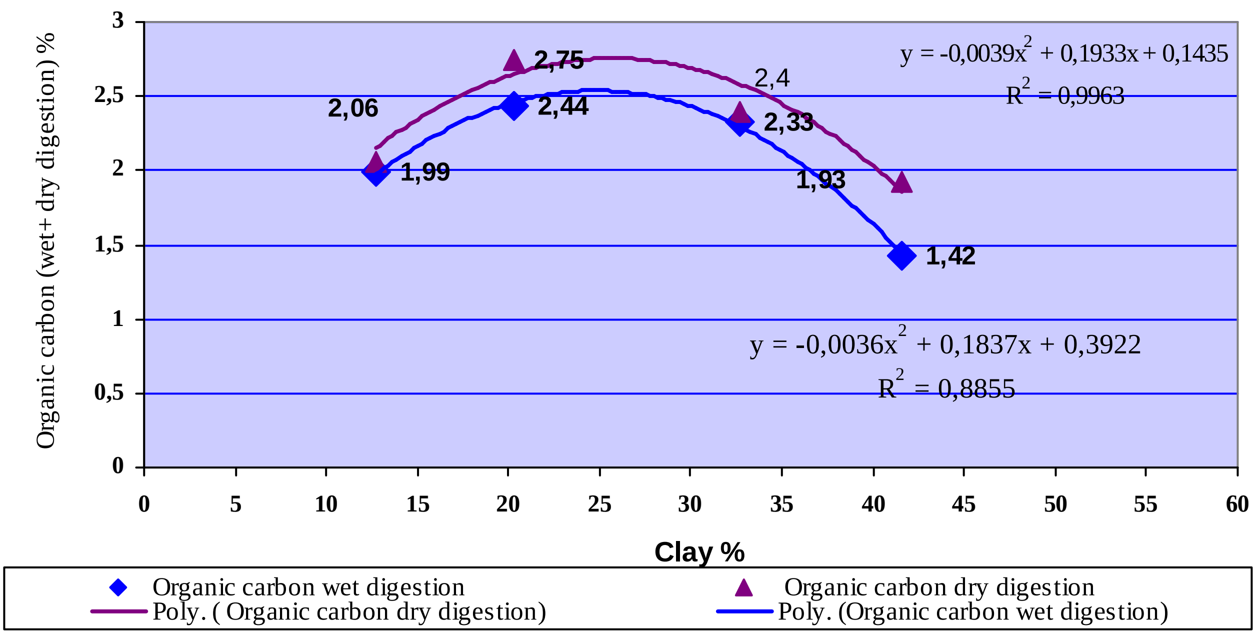

Figure 1. Dependence of C-organic content (by digestion wet + dry digestion) to clay content in soils (0-20 cm)

Table 1. Agrochemical indicators of organic C regime and total-N in representative soils of Transylvania

A. Distric skeletal litosol

Agrochemical indicators	Soil horizons ARp (7 - 19 cm)	Rp (19 - 43cm)
Humus %	3.44	0.20
N_t %	0.225	0.095
C-org.(wet digestion)%	1.99	1.85
C-org.(dry digestion)%	2.06	1.61
C/N (wet digestion)	8.84	19.47
C/N (dry digestion)	9.16	16.95
Clay%	12.72	11.18
pH	5.22	5.28
I_N	1.85	1.08

B. Stagnic moderately eroded luvisol

Agrochemical indicators	Soil horizons		
	El (8 - 27 cm)	EBw (27 - 48 cm)	Btw (48 - 74 cm)
Humus %	4.02	3.36	1.74
N_t %	0.192	0.163	0.093
C-org.(wet digestion)%	2.33	1.94	1.01
C-org.(dry digestion)%	2.40	1.06	0.76
C/N (wet digestion)	12.14	11.90	10.86
C/N (dry digestion)	11.14	6.50	8.17
Clay%	32.72	46.77	61.90
pH	5.58	5.39	5.42
I_N	2.60	2.15	1.10

C. Limestine molic gleyic aluvisol

Agrochemical indicators	Soil horizons		
	Am (10 - 36cm)	ACGo (36 - 61cm)	CkGor (61 - 94 cm)
Humus %	4.02	2.22	0.98
N_t %	0.192	0.112	0.059
C-org.(wet digestion)%	2.44	1.28	0.56
C-org.(dry digestion)%	2.75	1.07	0.77
C/N (wet digestion)	12.71	11.43	9.49
C/N (dry digestion)	14.32	9.55	13.05
Clay%	20.31	20.90	19.90
pH	8.15	8.55	8.74
I_N	3.82	2.11	0.93

D. Argic phaeozem

Agrochemical indicators	Soil horizons		
	Am(40-60 cm)	Bt (60-160 cm)	Cca(160-180 cm)
Humus %	2.46	1.88	0.70
N_t %	0.133	0.124	0.050
C-org.(wet digestion)%	1.42	1.09	0.41
C-org.(dry digestion)%	1.93	0.97	0.56
C/N (wet digestion)	10.68	8.79	8.20
C/N (dry digestion)	14.51	7.82	11.20
Clay %	41.60	48.00	38.20
pH	5.24	5.51	6.80
I_N	2.41	1.84	0.69

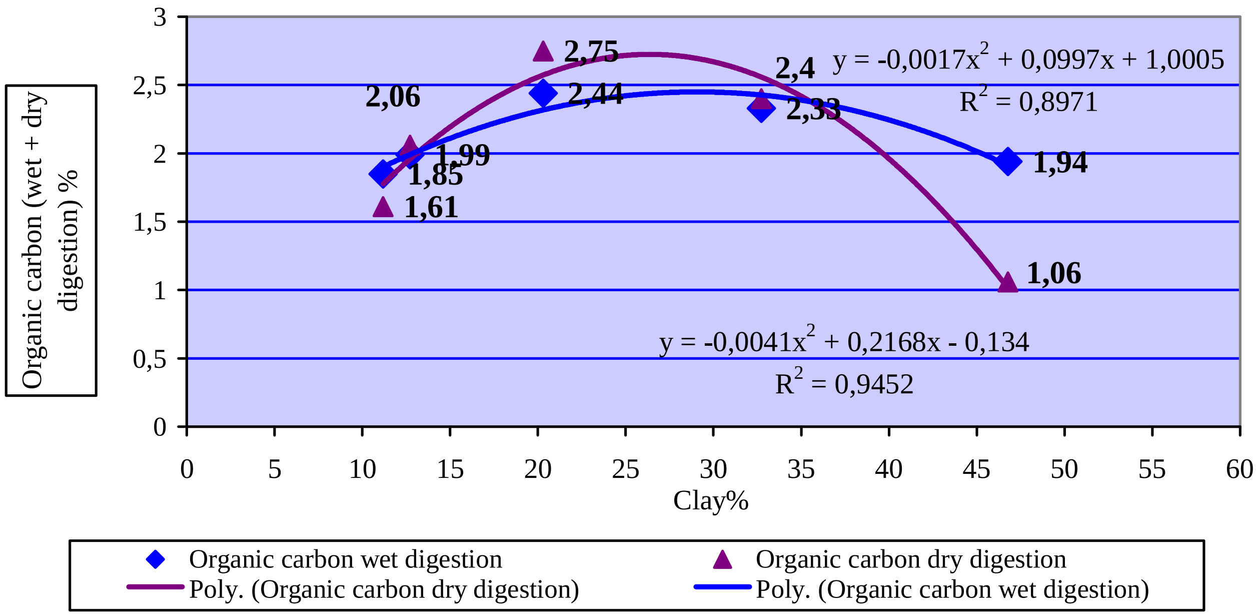

Figure 2. Dependence of C-organic content (by digestion wet + dry digestion) to clay content in soils (20-40 cm)

The polynomial curve inflections that represent the dependence of organic carbon contents towards clay contents in soils occur at a representation of clay that is higher than 25% after which it is systematically manifested a significant reduction of the organic carbon contents (below 2.5%) and a depreciation of the fundamental processes which imply the regime and balance of these organic components in soils. Natural and anthropic compaction processes prove to have negative effects in the quantitative and qualitative evolution of organic carbon and humus in soil. These negative effects occur at once with the reduction of organic carbon and humus content in the soil profile and are systematically consistent with the increase and accumulation of clay in the medium and deep horizons of the soil.

4. Conclusions

The research conducted on natural soils, having variable contents in organic components and being in a natural state determined the achievement of some results together with some analytical and practical conclusions:

The results are comparable at determinations through both digestion methods, but it is obvious from the absolute values and the values of dependency between the methods coefficients that dry digestion (in O_2 flow) is more active and efficient as an oxidizing action than wet digestion.

The organic carbon contents determined both through wet digestion and dry digestion significantly correlate with clay contents in soils, but only at 1 - 20 cm and 20 - 40 cm depths, this relationship being achieved according to a polynomial equation, $y = a + bx + cx^2$ type, with tendencies manifested at natural soil for diminishing the organic carbon contents for high and excessive areas of clay representation (for contents > than 20-25% clay). For soils in natural state, organic carbon content determined through dry digestion correlates significantly distinct with organic carbon content determined through wet digestion. The values of organic carbon determined through dry digestion are systematically higher than the ones of organic carbon determined through wet digestion, noticing that for a value of 0.8903% of organic carbon determined through wet digestion, the value of organic carbon determined through dry digestion increases on average by 0.1123%.

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