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ORGANIC MATTER-HUMUS AND NITROGEN CYCLE IN SOME SOILS FROM BANAT AREA

MATERIA ORGANICĂ DIN SOL – HUMUS ŞI CICLUL AZOTULUI ÎN SOLURILE BANATULUI

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Abstract: *Many studies on different soil types from Banat area have shown that soils may contain several tons of organic matter per hectare. Most of it can be only slowly degraded and metabolized by soil organism as a consequence of both its physical and chemical stabilization. There are three categories of microenviroments- free unprotected particles, particles occluded in an inorganic or organic microenvironment and adsorbed particles. Proportions of free particulate organic matter, humus and nitrate vary widely and are affected by land use, vegetation and soil type, climate, and other factors. For the main types of soils from Banat like Fluvisols, Chernozems, Phaeozems, Cambisols, Luvisols, Podzols, Vertisols, Gleysols, humus, nitrogen and nitrate. There are also discussed the impact of the nitrates of environment. The ecological impacts of nitrate on aquatic ecosystems can be serious so, it is important to minimize nitrate losses from agricultural soils as much as possible.*

Rezumat: *Numeroase studii efectuate pe diferite tipuri de sol, au relevant că solurile pot conține câteva tone de materie organică la hectar. Numeroase tipuri sunt degradate şi metabolizate de organismele din sol într-un ritm foarte lent, ca urmare a stabilității lor fizice şi chimice. Există trei categorii de microzone, cu particule libere neprotejate, particule separate într-o microzonă organică sau anorganică şi particule absorbite. Proporțiile particulelor de materie organică libere, de humus şi nitrați, variază în limite largi şi sunt afectate de modul de folosință, vegetație, climat, tipul de sol şi de alți factori. Pentru cele mai importante tipuri de sol din Banat, cum ar fi Aluviosolurile, Cernoziomurile, Faeoziomurile, Cambosolurile, Luviosolurile, Podzolurile, Vertosolurile, Perosolurile, Gleisolurile, Soloneţurile şi Erodosolurile sunt date conținuturile medii de materie organică, humus, azot şi nitrați. Sunt discutate şi impactul nitraților asupra mediului. Cum impactul nitraților asupra sistemelor acvatice poate fi serios, este importantă diminuarea cât mai accentuată a pierderilor de nitrați din solurile agricole.*

Key words: *organic matter, humus, nitrogen, nitrate, soil*
Cuvinte cheie: *materie organică, humus, azot, nitrați, sol*

INTRODUCTION

The term "Soil Organic Matter", refers to the total of all organic carbon-containing substances in soils. The major components of soil organic matter are humic substance, especially humic acids; other significant components are carbohydrates, proteinaceous materials, and lipids. The organic matter content of soils ranges from less than 1% in desert soils to close to 100% in organic soils. A typical agricultural soil may contain between 1 and 5% organic matter in the top 15 cm.

Soils may contain several tons of organic matter per hectare. Most of it can be only slowly degraded and metabolized by soil organisms as a consequence of both its physical and chemical stabilization. The dead plant material consists of lignocelluloses 5-30% lignin, and 2-15% protein. Minor components are phenols, sugars, amino acids and peptides, as well as numerous secondary metabolites. (6.11) It is thought that (HALDER, 6) the location of organic matter within the soil structural units has been demonstrated to control soil organic matter dynamics by physical or chemical mechanisms. Micro organisms are attached to clay particles and form macro and micro aggregates in which slow their biodegradation. Microbial access to substrates when located in small pores or sorbed on solid surfaces may be limited, because they are inaccessible to micro organisms and their enzymes, and are thereby protected from rapid decomposition. Within pores less than 8 nm, dissolved organic matter is inaccessible to exoenzymes (4,7) Organic compounds in sand-size fractions are turned over rather rapidly within several years, whereas organic matter associated with silt and clay particles show markedly higher turnover times, thus being involved in mid-and long- term dynamics.

Most of soil organic matter chemists partition the humic substances extract into the following three fractions: 1) Humic acid; 2) Fulvic acid; 3) Humin. Each of these fractions consists of hundreds of compounds which appear to be associated al molecular levels by mechanisms not yet well understood. The molecular formula of the HA is $C_{308}H_{328}C_{90}N_5$ and its elemental analysis is 66.8%C, 6.0%H, 26.0%O and 1.3%N. Almost 95% N soil is associated with soil organic matter. According to current estimates, about 75% of the total P in soils occurs in organically bound forms. It is estimated that more than 90% of the total S in most noncalcareous soils occurs in organic forms (5.8).

MATERIAL AND METHODS

The study is based on a few special research works executed in lots fertilized with tail waters from animal forms and on pedological mapping conducted in the period 2006-2008 in south-west of Romania.

RESULTS AND DISCUSSIONS

The surface water can be an important source of organic matter and nitrates for soils as a result of overflow rivers. From that reason it is important to know the content of nitrogen and nitrates.

Table 1

Analytical data-surface water

Seat	Index, mg N/l	Minimum	Maximum	Medium	Admissible values I
Bega, upstream Timisoara	NH_4	0,054	0,171	0,115	1
	NO_2	0,005	0,037	0,012	1
	NO_3	0,140	0,838	0,567	10
	N org.	0,003	1,761	0,537	-
	N tot.	0,540	1,960	1,232	0,3
Bega, Otelec, downstream Timisoara	NH_4	1,524	3,741	2,099	1
	NO_2	0,032	1,281	0,170	1
	NO_3	0,113	1,359	0,485	10
	N org.	0,003	1,398	0,287	-
	N tot.	1,800	4,520	3,040	0,3

Ground water is the source of drinking water for more than half of the Romania and in rural areas it represents more than 95% of the water used for domestic purposes. Nitrate-N concentrations in streams and groundwater are typically less than 2 mg l^{-1} but have been steadily increasing, but seldom up to 10 mg NO_3-N l^{-1}, which is the standard for drinking water.

The content of organic matter (C), humus, nitrogen and C/N ratio of the soil (average values of 10-20 soil profiles) are presented for three types relief forms: (1) high plain, (2) law plain and (3) mountain.

Table 2

Analytical data- groundwater ($mg.l^{-1}$)

Drilling	Organic substances	NH_4	NO_3	NO_2
Orţişoara F_1	0,92	0,35	2,95	0,003
Sânandrei F_1	2,00	0,03	2,30	0,250
Sânmihaiu R, F_1	22,0	1,30	0,64	0,650
II Foeni F_1	4,56	0,53	4,23	0,050
II Foeni F_1A	4,79	0,01	2,77	0,040
Toager F_1	4,64	4,15	0,31	0,040

Table 3

Analytical data-high plain, Sânandrei

Soil	Organic matter C%	Humus %	Nitrogen total, %	Ratio C/N
Chernozems	1,60	2,76	0,148	10,81
Phaeozems	2,00	3,41	0,168	11,90
Eutric Cambisols	1,75	3,01	0,136	12,87
Haplic Luvisols	1,67	2,88	0,154	10,84
Luvosols	1,40	2,41	0,123	11,38
Vertisols	1,78	3,08	0,143	12,45
Gleysols	2,16	3,72	0,250	8,64
Fluvisols	1,07	1,84	0,105	10,19
Solonetz	2,11	3,63	0,192	11,00

Table 4

Analytical data- low plain, Foeni

Soil	Organic matter C%	Humus %	Nitrogen total, %	Ratio C/N
Chernozems	2,03	3,49	0,171	11,86
Phaeozems	1,82	3,14	0,174	10,49
Eutric Cambisols	1,62	2,79	0,125	12,98
Vertisols	2,15	3,70	0,190	11,32
Gleysols	2,53	4,36	0,156	16,25
Fluvisols	2,13	3,66	0,128	16,62
Solonetz	2,96	5,09	0,159	18,61

Table 5

Analytical data- mountain, Muntele Mic

Soil and depth, cm	Organic matter C%	Humus %	Nitrogen total, %	Ratio C/N
Dystric Cambisols				
10-0	35,46	61,0	1,260	28,14
0-17	5,77	9,92	0,250	23,08
50-70	1,58	2,72	0,181	8,74
Entic Podzols				
8-0	25,13	43,22	0,689	36,47
0-18	8,71	14,99	0,513	16,98
18-36	4,43	7,62	0,441	10,04
36-51	2,81	4,83	0,218	12,88

In aerobic soils, in fact, the only stable forms of carbon are CO_2, HCO_3 and CO_3^{2-}; all soil organic matter is potentially susceptible to oxidation by O_2. While the persistence of humus in soils for years, even centuries, may seem to belie this statement, the redox reaction moves slowly but inexorably in the direction of equilibrium. The reduced forms of carbon in the soil organic matter provide the energy that drives the “engine” of chemical reduction under water- saturated conditions, like at Gleysols and Vertisols.

Organic N will be mineralized in soil in the absence of available inorganic soil N, although, as a general rule, N- containing compounds such as amino acids are not mineralized only to be subsequently resynthesized. When the C/N ratio of decomposing material exceeds approximately 20-25, net immobilization of inorganic N from soil occurs because there is insufficient N in the mineralizing material to sustain microbial biomass formation. This situation is in the case of Dystric Cambisols (ratio C/N 23,08-28,14) or in Entic Podzols (C/N-36,47). Soil micro organisms produce organic acids when they decompose plant litter that is rich in organic compounds but low in charge- balancing basic cations. In general, conifer litter tends to produce more organic acid than does leaf fall from deciduous woodlands. In contrast, when the C/N ratio is less than 20-25, such as in agricultural soils from high- and low plain, the N needs for microbial growth are met, and inorganic N is released into the soil environment. The decomposition of organic materials with very low C/N ratios (Chernozems, Phaeozems) can therefore cause inorganic N to accumulate briefly in excess of microbial and plant needs, with the potentially adverse effects of volatilization, runoff loss, 01 plant toxicity in the case of NH_4^+.

CONCLUSIONS

The C and N cycle in soil is dynamic and inherently leaky. Off-site losses of CO_2 and N gases, soluble ions and organic compounds are virtually impossible to eliminate completely. Nitrates and nitrites in ground water have been founded but the situation can be remediate through denitrification on increasingly larger scales to preserve groundwater quality and public health. In most environments the largest losses by nitrate leaching or surface runoff occur when crops are not actively growing or are not present at all. The measures include the following: (1) closed periods for N applications; (2) limits on quantities of N applied; (3) application controls; (4) slurry storage.

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