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CONSIDERATIONS REGARDING THE EVOLUTION OF CHERNOZEMS IN THE CARPATHO-DANUBIAN-PONTIC REGION UNDER AGRICULTURAL REGIME

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Abstract

Contemporary pedogenesis in the Carpathian-Danubian-Pontic region is determined by the evolution of natural pedogenetic factors (climate, geology, biology) in terms of increasing human impact on the overall system of factors ← soil. This means a new stage in the evolution of natural-anthropic soils that we propose to call anthropogenesis. The basic components of anthropogenesis are: 1. Anthropisation of the constitution and functioning processes of the soil as a body and physical system, especially the processes that are aggregate organization and settlement indices, 2. Modification of humus profile (organic matter) which is materialized into color changes, depth, content and composition of humus; 3. Transformation of the carbonates in the soil profile that is materialized into changes related to thickness, depth of accumulation, new formations of carbonates and the migration processes character, 4. Formation of the anthropical new horizon: arable, subarable, pedological metamorphosed 5. Modification in the structural organization of the pedologenetical layer that is evidenced in the shape deformation, the packaging and inter-aggregate organization, compactation, etc., 6. The transformation manner of how is placed the soil mass, reflected in the bulk density, porosity etc.

Key words: *agriculture regim, inter-aggregate organization, ecosystem, pedogenesis.*

INTRODUCTION

The anthropization problem on soil still remains unclear. The fact is that, as a result of industrial development, transport, energy and intensification of agriculture the human impact on the environment increases, that leads to the tehnogenesis of the natural background and therefore are affected the pedogenetic process, respectively ecosystems. As a consequence, the Carpathian-Danubian-Pontic region is facing with a number of serious environmental problems such as: reduction and accelerated degradation of water resources, degradation of soil biota, biodiversity loss and degradation of soil quality, etc.

The highest serious consequence is the biogeochemical flow modification of substances by reducing the bioproductive of the ecosystem function.

All of these in turn lead to the amplification of human intervention processes in the pedogenesis process. At the same time, the attempts to maintain agroecosystems bioproductivity by enhancing agricultural systems also lead to the increase of anthropogenesis levels in the pedogenesis process.

MATERIAL AND METHOD

The investigations refers to geographical area heaving clear borders whithin which the soil science natural laws regarding the genesis and evolution of the soil are realising. Departing from this statement, the evolution of agrosoils should be investigated only through „soi-environmental factors" system approach. In line with this methodological principle, the agro induced changes of soils are inherent and implies rational management of soil resources. The sustainability of soil resources can be assured when the mechanisms of soil evolution - the direction and the intensity of changes - are well known. The methodological support within the mentioned investigations is secured by the principle of actualism.

RESULTS AND DISCUSSIONS

The functional-genetical approach of the anthropic pedogenesis, as phenomenon is considered an integrating natural processes (tipogenetical zone) and tehno-anthropical process induced through the inclusion of soil in the agricultural use (Table 1). The contemporary processes of soil under anthropogenic regime are examined through the concepts, which are integration processes and organizational structure of the ecosystem soil functioning [1, 2, 3, 4, 5].

The anthropization processes of constitution and functioning of soil in his quality as a body and physical system, in special of the processes that determine the aggregate organization and settlement indices (Table 2).

Table 1. Contemporary evolutionary processes of soil

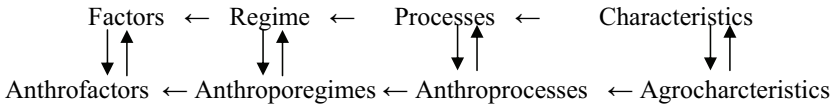
Natural			**Agrogene (pedo-morphological)**			**Degradation**	
Bioclimatic (conserva-tion)	Sin-evolution (process - regime)	Functional (reproduction)	Morto-turabtional	Regime - turabtional	Functional - turabtional	Abraded	Destructive
Formation and accumulation of humus Structuring Migration of carbonates	Elluviation Leaching Debasification Clay losses Substances differentiation	Decomposition-synthesis of organic substances Decomposition-synthesis of mineral substances Biological accumulation of substances	Stratification Compaction Destruction Stylization	Compactation Crimping Aridity Degradation of porous space Hydro-morphosis	Dehumification Depletion Exhausted Biodegradation	Erosion Deflation	Landslides Flooding Cover laying with pedolit

Table 2. Anthropogenesis elements for organization of aggregate in the typical chernozems moderate humiferous

The soil model used	**Depth, cm**	**Content of aggregates, %**			**Aggregate stability, %**		
		>10 mm	10- 0,25 mm	<0,25 mm	> 5 mm	5- 0,25 mm	<0,25 mm
Uncultivated, Celery	0-10	6.3	85.6	8.1	27.0	52.0	21.0
	10-20	8.7	84.0	7.3	21.0	59.6	19.4
	20-30	11.3	79.2	9.5	23.6	58.2	17.6
Cultivated, 53 years	0-10	13.9	73.6	12.5	7.4	53.0	39.6
	10-20	19.7	65.0	14.3	4.4	49.0	46.6
	20-30	31.7	58.2	10.1	11.8	41.9	46.3
	30-40	30.3	56.9	12.8	10.7	44.4	44.9
	40-50	17.8	69.8	12.4	10.9	52.0	37.1
Cultivated, 47 years	0-10	12.5	68.0	19.5	7.7	52.0	40.3
	10-20	19.4	68.5	12.1	6.1	47.0	46.9
	20-30	30.7	58.0	11.3	9.7	42.0	48.3
	30-40	30.3	56.9	12.8	10.3	41.5	48.2
	40-50	14.7	73.0	12.3	9.1	47.9	43.0

- Modification of humus profile (organic matter) which is materialized into color changes, depth, content and composition of humus
- Transformation of the carbonates in the soil profile that is materialized into changes related to thickness, depth of accumulation, new formations of carbonates and the migration processes character
- Formation of the anthropical new horizon: arable, subarable and pedological metamorphosed
- Modification in the structural organization of the pedologenetical layer that is evidenced in the shape deformation
- The transformation manner of how is placed the soil mass, reflected in the bulk density, porosity etc.

Starting from these, it should be complemented the new Dokuchaev triad "factors – processes - characteristics" with an identical formula "anthrofactors - agrogene processes - agrogene characteristics" and considering the previous publications, it is necessary to render the contemporary pedogenesis evolution through the relationship:



Regard as the contemporary pedogenesis interpretations are taken into consideration in all direct and indirect implications of the meaning that offer an integrated process of pedogenesis. In compliance with this formula, the anthropogenesis processes begins with the first soil impacts on the surface layer, accompanied by the disturbance of natural settlement that leads to the significant modifications in air-water regimes and hydrothermal fluid, as in biological reactions, air composition, etc. As a consequence, become operational coordinated processes by the mass modification that resulting as attenuation in the soil which leads to more or less to the natural characteristics and new characteristics.

Into this background, the integrated anthropogenesis includes several types of anthropogenesis:

- Anthropogenesis that is based on the agro-turbation on the elementary processes (anthropogenesis, agro-turbation), that is implying the movement and mixing of soil mass.
- Destructive anthropogenesis is the most common form that involve intensification of natural processes, fulvitization and dehumification of humus composition, disaggregation, restructuring and compaction; hydrological aridity and intensification of natural process.
- Abraded anthropogenesis, that is determined by the combining agro-pedogenetic processes against to the opposite of erosion.
- Sin-lithogenic anthropogenesis determined by the agro-pedogenesis processes and the accumulation of eroded material.
- Morphogenesis determined by the agro-pedogenesis processes of destruction and agrogen.

Of the latter, more important are physical degradation processes that change the composition of the soil profile morphology, even up to full replacement of natural features with new features anthropo-technogenic.

- Agro-irrigation-pedogenesis - is determined by the combining typo-genetic processes amended as a result of intervention of a new moisture regime and the destructive processes inherent to irrigation.
- Agro - tehnogenesis - includes agropedogenesis processes caused by tillage activities and processes derived from special agrotechnical measures taken in order to create a exploited agrogen layer.
- Agro-hydro-pedogenesis - include the agro-processes determined by pedogenesis and drainage works and soils with an excess of moisture.

In all cases agro-techno-pedogenesis leads to the formation of a layer in the upper segment of the agrogen profile that consists of arable and subarable horizon.

Depending on the processes taking place in the arable horizon, respectively, of its state, it can be (According to the processes which are realized within the arable horizon and respectively, of its state, it can be):

- agro-chernozem - chernozem retain basic traits;
- agro-ocric – humus content < 3 %, report Ah: Af <1.7;
- agro compacted - bulk density = 1.30-1.45 g/cm^3, total porosity 50-40%, resistance to penetration 20-30 kg/cm^2;
- agro-compact - bulk density >1.45 g/cm3, total porosity 30-40%, resistance to penetration from 30-40 kg/cm^2;
- agro-illuvial consolidated - bulk density > 1.55 g/cm3, total porosity < 30%, resistance to penetration > 40 kg/cm^2;
- agro – metamorphosed – aggregate content from 10-0.25 mm in 30 %, bulk density > 35 g/cm^3;
- agro-turbational - formed at the account of 2-3 genetic horizon. It is characterized with the ocric color inhomogeneous;

- Agro - abraded - is characteristic to highly eroded soil and is formed at the account of poorly humiferous horizon of profiles;
- agro-sin-lithogenic - formed at the result of mixing the initial ground material with the contribution through the process of diluvium.

A common characteristic of all arable horizons is partially caused by clays losing in the deflation in the period when the soil is unprotected. Sub arable horizon is distinguished by the high density, prismatic structure, and reduced total porosity. To a lesser extent is determined by processes such as bio-pedogenesis, the greater extent have the mechanical processes. Depending on the state subarable horizon, it may be: deformed and consolidated. Depending on the structure it can be: prismatic, polygonal, etc.

The research implies that the anthropogenesis is achieved by stages: in the first stage, pedogenesis processes arising predominantly and are involving the zonal tipogenetic process. There is found only slightly modified in the pedogenesis process and at beginning of the agrogen process. In the second stage under intensive processes caused by the degradation of organic systems and related dehumification processes are intensified (especially aggregation). The third stage involves maximal intensity of the physical degradation processes with agrogen layer formation.

Researches show that their conduct is needed for several decades. Basic processes in soils that are resulting under natural regime and processes which are performed are reversible.

Step four, involves the developing and simplifying of the agrozioms soil ecosystems (Fig. 1).

The evolution processes of chernozems under agricultural regime follow the hierarchy.

At ion-molecular level the tehno-anthtopic processes are materialized within the meaning and intensity of interphase processes (ion exchange, leaching (dilution) - soil solution concentration, migration and substances differentiation), but quantitative values are expressed in pH, cation exchange capacity, content substances etc. At elementary particle level, determining roles have the evolving processes of mineral colloids, organic and organo - mineral soil. The evolution of organic colloids is determined by the dehumification processes of soil plasma due to the significant decrease of the intensity of humification process, in line with intensification of the mineralization process of organic matter. Dehumification involves that removing of organic matter from the mineral particles surface, leading to their energy centers activation. Therefore is increasing the dispersion degree of hydrophilic fine mineral constituents. It occurs by increasing up to 2-3% clay content in the water and also in the internal soil specific area. At the same time, administration of fertilizer mobilizes acids condition about 0.4 -1.2 % that is contained by fine clay fraction composition which is comprised in the clay aggregate. Aridity of agrogen segment leads to fulvization of humus. Specified modifications are affecting the potential of soil structure - aggregation and create prerequisites for reorganization of soil structure. At micro-aggregates level the anthropization processes of pedogenesis are materialized in increasing partially the clay non-aggregation content. Therefore, there is highlighted a slight increase of the dispersion factor, and also the reduction of structuring factor. Aggregation indices, practically does not undergo any changes.

The structural-aggregate of soil state are affected by significantly change, which is materialized in the values of structural-aggregate parameter and mechanisms of structuring process. In anthropogenesis the evolution of structural-aggregate state is determined by the mechanical processes of rocks and scatter structure they are materialized in increasing the content of aggregates > 10 mm and for the most part <0.25 mm. In the composition of valuable agronomic aggregate fraction, the gaunt aggregates content is reduced, thereby increasing the share of rough aggregates along with the evolution of quantitative state and structural changes unit in the technical crop rotations that implies qualitative changes caused by compaction, predominantly, irreversible structural aggregates.

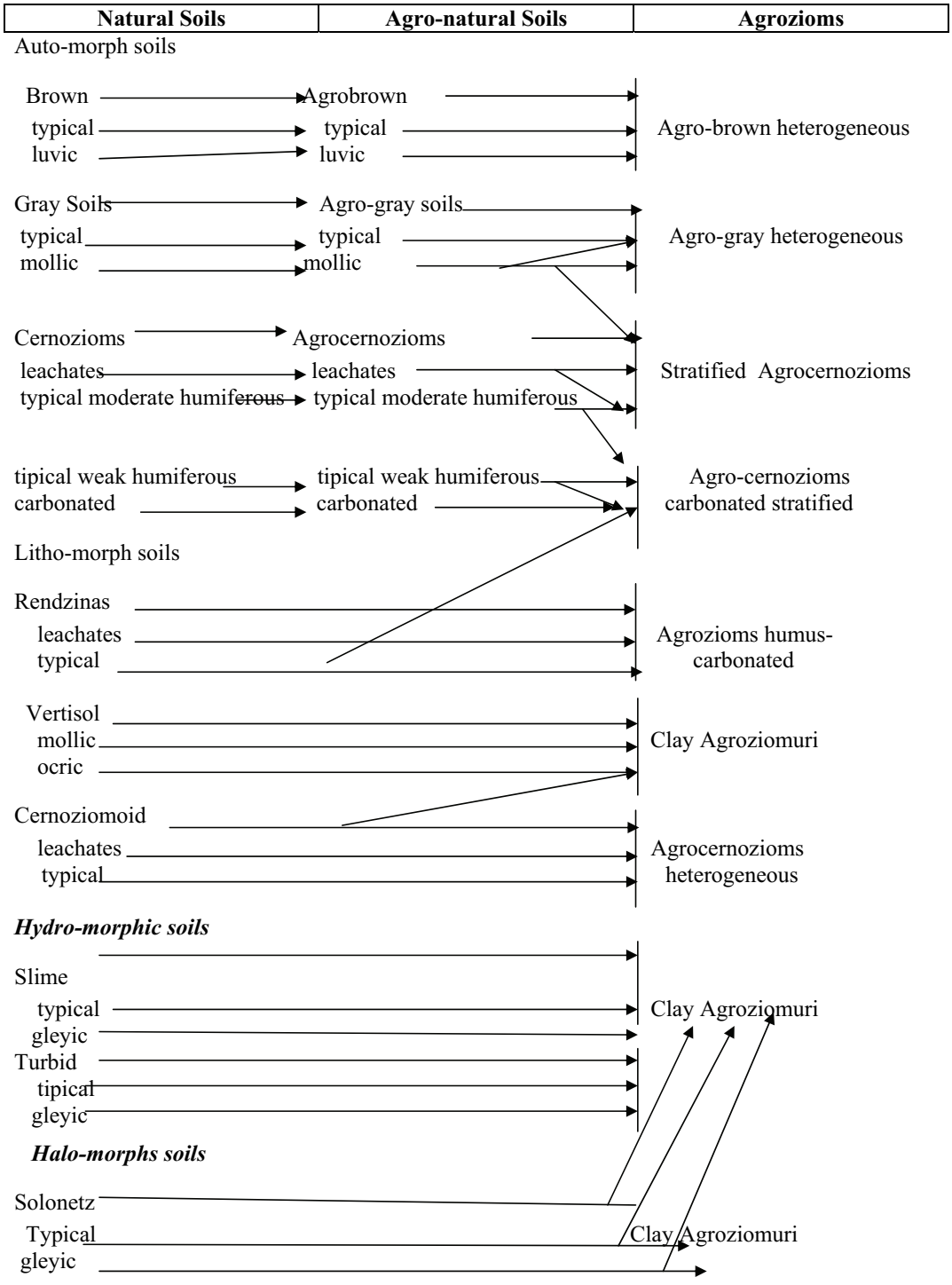


Fig. 1. Agrogene transformation scheme of the main types of soil

Aggregates with size > 10 and 10-7 mm are affected by compaction in small measure. Aggregates 7-5 mm are already affected by compaction. In the strongest manner are affected aggregates with sizes < 5 mm. Aggregate compaction is achieved at the expense of aggregate pore texture, due to reducing of their diameter and leads to the formation of pseudo - aggregate.

In the structuring mechanisms of soils under anthropogenic regime that increases considerably the role of physical-mechanical and physic-chemical processes are reduced by weight. The physical and mechanical processes are favored by cumulative aridity agrogen layer in the technical cropping, and also by contrast and hydrothermal regime character. In this context, an important role is given to structural aggregates cracking, leading both to the mechanical cohesion reduction and hydro – stabilities of aggregates.

Research at some long standing showed that the mineral fertilization causes disintegration of the soil mass The same research showed that the proportions of such a decomposition are so significant that organic fertilization (140t/ha of manure during the rotation of 7 cultures) is insufficient to compensate for its effects. The reduced effects of manure are also caused by low efficiency of organic fertilizer and also the background of ambience that is unfavorable for hydro-physical degradation caused by soil. Another important factor that influences the structure is under anthropogenic soil cultivation. Our research showed that early plowing vegetation provides structural condition - very good unit. This, however, remains in the ground a short time. Already, in June there is a clear tendency to reduce the content of agronomically valuable aggregates. At the end of vegetation valuable agronomic aggregates content is more than 15% lower than at the beginning of vegetation. In the deep loosening (40-50 cm) without turning furrow, shows the same trend but with much lower quantitative expression. In the minimal tillage systems, the structural unit status during the vegetation is changing much more and natural degradation processes are significantly reduced. The level of genetic horizon integrates changes from previous hierarchical level. Changes in the structural-aggregation state leads to the spatial distribution changing of solid constituents. Quantitative expression values of this redistribution are bulk density and pore space characteristics.

In the seasonal dynamics there is a steady reduction of the total porosity at the end of vegetation. Following the soil mass concentration, there takes place moisture pore diameter reduction and also their changes in the soil ecosystem functions. They are materializing in the pore volume moisture protective increased and conductors pore moisture reduction. Therefore, during the vegetation moisture deficit effect is amplified with adverse implications on the development of plants and crops. The changes that occur in the pore due to both regimes, that resulting as an intensive process of humus formation and mineralization of it. Share the latter are higher because the evolutionary trend is oriented in the sense of dehumification. The stratification of the tehno-agrogene profile affects the cellular space. In this connection is reduced the thickness of the plants root system of exploited layer. The specified changes involve significant changes in the soil ecosystem (Table 3).

CONCLUSIONS

Prolonged use of agricultural land involves a new phase of the development of soil cover in the Carpathian-Danubian-Pontic which characteristics is to simplify the soil ecosystem, convergence at higher taxonomic levels and divergence at lower levels.

Table 3. Indices of functionality of soils under technical crop rotation through physical degradation losing condition

Agro ecosystems Function	Processes that influence it	Specifications
Exploitation, conservation and water supply	Destruction Stratification	The degradation of porous space and reduction of water permeability by reduction of the quantity of water stored in the soil. Formation of surface spills that increase erosion. Reduction of capacity for water and water disposal capacity by plants.
Filtration	Compaction. Destruction Clogging. Significant dust rate pores Profile stratification	Disturbance in the continuity of the porous space. Reduction of hydraulic conductivity and leaching depth of the profile. Auto-pollution by nutrient soil, bio-products, etc. Geo and pedogenesis. Accumulation of toxic substances.
Gas exchange, renewal of soil air	Crustificarea Compaction Destruction Clogging Significantly dusty pores Profile stratification	Poor gas exchange. Reducing of the oxygen content and increasing of carbon dioxide content. Accumulation of iron and manganese, but also of gas (NH_3, H_2S, etc.) in the toxic quantities. Soil exhaustion.
Development environment of radicular system	Compaction Profile stratification	Limitation of radicular layer thickness. Increasing the vulnerability of plants to atmospheric drough.
Environment for plant growth	Compaction Destruction Profile stratification	Insufficient ensuring with water of plants, air and nutrition. Deficiencies of micronutrients.
Ecological niche	Compaction Clogging Significantly dusty pores	Disturbance hydrothermal regime. Biodiversity degradation of soil biota. The complete disappearance of some species organisms that is associated with steppe plants. Increasing mass saprophytic biota.
Environment degradation - transformation of substances and the formation of Biogeochemical cycles	Compaction Clogging Significantly dusty pores	Disturbance hydrothermal regimes, air-fluid, oxidation-reduction and biological. Modifications in the process of formation and accumulation of humus. Intensified humification.

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