MORPHOLOGICAL, CHEMICAL, PHYSICAL AND HYDROPHYSICAL CHARACTERISTICS OF SOILS: DEFINING ELEMENTS IN ESTABLISHMENT OF MEASURES FOR SUSTAINABLE UTILIZATION OF AGRICULTURAL LANDS IN TIMIŞ COUNTY

ÎNSUŞIRILE MORFOLOGICE, CHIMICE, FIZICE ŞI HIDROFIZICE ALE SOLURILOR – ELEMENTE DEFINITORII ÎN STABILIREA MĂSURILOR DE UTILIZARE SUSTENABILĂ A TERENURILOR AGRICOLE DIN JUDEŢUL TIMIŞ

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Abstract: *Between the morphological, chemical, physical and hydrophysical characteristics of soils which directly influence the composition and life medium of phytocoenosis and which have a determinant role in establishment of measures for sustainable utilization of soils, used in present by the pedological school from our country, we mention: gleysation, stagnogleysation, reaction, humus reserve and the content of main nutrients (N, P, K), texture, porosity, low edaphic volume etc. Agricultural technological systems have major effects on the main characteristics of soil, as was observed within the researches made in the stationary experiments on long term or different physical models. The approached problematic is referring to 869.665 ha, 702.398 ha being represented by agricultural lands.*

Rezumat: *Dintre însuşirile morfologice, chimice, fizice şi hidrofizice care influenţează în mod direct compoziţia şi mediul de viaţă al fitocenozelor şi care au un rol determinant în stabilirea măsurilor de utilizare sustenabilă a solurilor, utilizate în prezent de şcoala pedologică din ţara noastră, menţionăm: gleizarea, stagnogleizarea, reacţia, rezerva de humus şi conţinutul în principalii nutrienţi (N, P, K), textura, porozitatea, volumul edafic redus etc. La rândul lor, sistemele tehnologice agricole au efecte majore asupra principalelor însuşiri ale solului, aşa cum s-a constatat prin cercetările efectuate în experienţele staţionare de lungă durată ori pe diferite modele fizice. Problematica abordată se referă la o suprafaţă de 869.665 ha, din care 702.398 ha terenuri agricole.*

Key words: *environment, ecology, limiting, land evolution, area, morphological, sustainability.*
Cuvinte cheie: *mediu, ecologie, limitativ, evoluţie teren, zonă, morfologic, durabilitate.*

INTRODUCTION

Cognition of morphological, physical, chemical and hydrophysical characteristics of soils present a special theoretical and practical importance. Theoretical because it offers to specialist the possibility to interpret the phenomena that took place or take place in the soil and to predict the evolution of these phenomena; practical importance because warn the practitioner about measures that must take in order to find those most adequate for the sustainable utilization of soils.

Starting from these motives, the authors try to present in this paper a few aspects referring to quality state of soils and the evolution of the main factors that concur to its realization, basing on data collected from scientific researches developed in the course of many years, as well as impressive volume of data stored in the OSPA Archive, information that was complete with data from the monitoring system of ICPA Bucharest.

MATERIAL AND METHODS

The approached problematic is referring to a surface by 869.665 ha, 702.398 ha being represented by agricultural lands. The researching of ecopedological conditions, ordering and processing of data were made in conformity with the Methodology for Elaboration of Pedological Studies, developed by ICPA Bucharest in 1987 and the Romanian System of Soils Taxonomy (SRTS-2003).

RESULTS AND DISCUSSIONS

Placed in the western part of Romania, between co-ordinates 20°16` (Beba Veche) and 22°23` (Poieni) eastern longitude, respectively 45°11` (Lăţunaş) and 46°11` (Cenad) northern latitude, the Timiş County has a surface by 869.665 ha (3.6 % from the national territory), holding the first place in the country. The relief of Timiş County is characterized by a large diversity of forms, generally connected by the geneses and evolution in time of the entire Carpathian-Danubian relief, distinguishing three different sectors:

- Eastern sector, the highest, formed by northern ramification of Mountains Poiana Ruscă;
- Central sector, formed by hills and alluvial plains;
- Western sector, the lowest as altitude, formed by low plains of subsidence and divagation.

The territory is crossed from east to south-west by the rivers Bega and Timiş with their affluents: Beregsău, Timişoara, Pogăniş, Bârzava etc. In the north of territory, Aranca, an old course of the Mureş River, follows its flow.

Macroclimatic particularities of the studied territory are determined by its geographic position in the European continent, position with a specific circulation of different type of air masses, circulation that is imprinted either by action centres with dynamic origin (Azores anticyclone and subtropical anticyclone), or by centres of thermal seasonal action (Siberian anticyclone, Asiatic or Mediterranean depression). Timiş County is placed at the interface between air masses with a distinct maritime character and western origin and continental masses with eastern origin, and in the same time are present the invasion of warm air masses with southern origin which cross the Mediterranean Sea. The influence degree of these air masses on clime from Timiş County determines in this zone a temperate clime, moderate continental, with subtropical influences more or less accentuated in certain geographic areas.

Phytogeographically, the researched area belongs to the central-European geobotanic province, strongly influenced by the neighbourhood of the south-European geobotanic province. The phytocenological researches developed within the studied space more then half of century (Coste et al., 1997) pointed out the existence of a vegetal carpet very rich, represented by over 400 vegetal associations.

Thus, the relief particularities and pedoclimatic conditions permitted to arable lands to hold 75.49 % from the agricultural surface, respectively 60.97 % from the surface of Timiş County (869.665 ha, table 1), being represented within the relief by he following percents: 55.30 % in the low plains and river meadows, 34.70 % in the high plains and terraces, 8.70 % in the hills and 1.30 % in the mountains.

Terrains with meadows occupy 18.23 %, as following: 28.90 % in the low plains and river meadows (including micro-meadows), 18.50 % in the high plains, 27.80 % in the hills and 24.80 % in the mountains.

Terrains with vineyards and orchards represent only 1.94 % from the agricultural surface of the county.

The forestry fond is represented by terrains that totalize a surface by 109.017 ha, respectively 12.53 % from the agricultural surface of the county, as following: 16.80 % in the

Table 1

Percentage of use categories within the main relief forms

Relief forms	Arable (ha)	%	Pastures and hay fields (ha)	%	Vineyards and orchards (ha)	%	Agricultural lands (ha)	%	Forests (ha)	%	Others	%
River meadows and low plains	293.290	55.3	45.819	28.9	246	1.8	339.274	48.3	18.315	16.9	480	8.2
High plains and terraces	183.985	34.7	29.331	18.5	1309	9.6	214.625	30.6	10.029	9.2	21.028	49.8
Hills and terraces	46.129	8.7	44.075	27.8	11.225	82.3	101.429	14.4	64.102	58.8	15.620	86.8
Mountains and depressions	6892	1.3	39.319	24.9	859	6.3	47.070	6.7	16.575	15.2	8802	15.1
TOTAL	530.215	100	158.544	100	13.639	100	702.398	100	109.017	100	58.250	100
%	-	61.0	-	18.2	-	1.6	-	80.8	-	-	-	6.7
%	-	75.5	-	23.6	-	1.9	-	100	-	-	-	-

river meadows and low plains, 9.20 % in the high plains, 58.80 % in the hills and 15.20 % in the mountains.

As an effect of interaction between pedogenetic factors was a numerous population of soils with specific characteristics in a continuous evolution. Thus, according to Romanian System of Soils Taxonomy (SRTS-2003) were identified 11 classes, 21 types with 107 subtypes, 300 soil units with numerous detailed categories, which are very distinct by their properties, productive capacity and measures for maintaining and increasing fertility (table 2).

Table 2

The main types and associations of soils from Timiş County

Nr.	SRTS-2003	FAO/UNESCO 1998	Agricultural lands		Forestry found	
			ha	%	ha	%
1	Litosol	Leptosol	9834	1.40	44	0,04
2	Regosol	Regosol	22477	3.20	44	0,04
3	Psamosol	Arenosol	211	0.03	-	-
4	Auviosol	Fluviosol	29150	4.15	4328	3,97
	Protisoluri		61672	8.78	4416	4,05
5	Cernoziom	Chernozem	186979	26.62	-	-
6	Faeoziom	Phaeozem	24724	3.52	-	-
7	Rendzine	Rendzinic Leptosol	141	0.02	-	-
	Cernisoluri		211844	30.16	-	-
8	Eutricambosol	Eutric Cambisol	88784	12.64	34700	31,83
9	Districambosol	Distric Cambisol	210	0.03	11708	10,74
	Cambisoluri		88994	12.67	46408	42,57
10	Preluvosol	Haplic luvisol	85000	12.10	7489	6,87
11	Luvosol	Luvisol	76561	10.90	49712	45,60
12	Planosol	Planosol	4214	0.60	-	-
	Luvisol		165775	23.60	57201	52,47
13	Vertosol	Vertisol	71223	10.14	218	0,20
14	Pelosol	-	341	0.05	-	-
	Pelisoluri		71564	10.19	218	0,20
15	Gleiosol	Gleysol	43127	6.14	447	0,41
16	Stagnosol	Stagnic Luvisol	7375	1.05	327	0,30
	Hidrisoluri		50502	7.19	774	0,71
17	Solonet	Solonetz	42495	6.05	-	-
18	Salsodisol	-	42495	6.05	-	-
19	Erodosol	-	5619	0.80	-	-
20	Antrosol	Anthrosol	3933	0.56	-	-
	Antrosoluri		9552	1.36	-	-
TOTAL			702398	100	109017	100

The gleysation state, resultant of the hydric regime of soils influenced by phreatic water, is taken into account in the case of differentiation in gleyc types, subtypes, and varieties of soil, resulting different favourability of soils for the spontaneous or cultivated plants and different pedoameliorative and cultural measures. Reported to gleysation intensity and to depth where it appears, were defined gleysation classes. In conformity with these classes, in the researched space we found the following situation: excessive gleysation – 6.41 %; very strong gleysation – 6.30 %; strong gleysation – 21.20 %; moderate gleysation – 19.50 %; low gleysation – 17.50 %; wet 3.40 %; ungleyed – 25.69 %.

The stagnogleysation state, resultant of the hydric stagnant regime, is represented in the researched space by the next classes: excessive stagnogleysation – 0.30 %; very strong stagnogleysation – 1.05 %; strong stagnogleysation – 21.50 %; moderate stagnogleysation –

15.50 %; low stagnogleysation – 13.10 %; stagnogleysation in deepness - 3.40 %; un stagnogleysation – 45.05 %.

The reaction of soil expresses in large measure the development of the main biochemical processes from soil and the real condition of growth and development of cultivated plants or those from natural biocoenosis. In the studied area exist the following situation: lands with pH under 5.0 = 0.38 %; lands with pH between 5.1-5.8 = 21.20 %; lands with pH between 5.81-6.80 = 42.10 %; lands with pH between 6.81-7.20 = 8.20 %; lands with pH between 7.21-8.40 = 19.50 %; lands with pH over 8.40, excessive alkaline = 8.62 %.

The content in humus, respectively in organic matter, defines the fertility state of soils that differs both in accordance with climatic conditions and the entire complex of pedogenetic factors. In the researched area, the situation is: under 1 % (extremely low) = 0.5 %; between 1.1 – 2.0 % (very low) = 10.5 %; between 2.1 – 3.0 % (low) = 48.0 %; between 3.1 – 4.0 (middle) = 35.0 %; over 4.0 (large) = 6.0 %.

The nitrogen index, used in defining of the essential chemical characteristics of soil, respectively the quality state of soil, present within the researched area values closed to the humus content: under 1 % (very low supply) – 1.5 %; between 1.1-2.0 (low supply) – 29.5 %; between 2.1 – 4.0 (middle) – 6.60 %; between 4.1 – 6.0 (good supply) – 3.0 %.

The content of soil in phosphorous (P_2O_5) and potassium (K_2O) present different situations. Regarding the supply of soil in mobile phosphorous, this element is in dependence with varying disposition of parental materials, respectively with the phosphorus content of these materials.

Basing on agrochemical mapping, were observed a very large proportion of soils with a deficit supply in mobile phosphorous (64.0), under the level 30-35 ppm P_{AL} which is considered the limit value for satisfying the requires of culture plants, so they need a big quantity of fertilizers with phosphorous. Thus, within the studied space there is the following situation: under 8.0 ppm (very low) – 8.0 %; between 8.1-18.0 ppm (low) – 20 %; 18.1-36.0 ppm (middle) – 33.0 %; between 36.1-72.0 (good) – 25.0 %; over 72.0 ppm – 14.0 %.

The supply in potassium represents values which show that this element is in a better concentration than phosphorous. From data result that 44 % from terrains have a very good supply (over 200.1 ppm), 36 % have a good supply (values between 132.1 – 200.0 ppm), 19 % have a middle supply (values between 66.0 - 132.0 ppm), and only 1% have a low supply.

This fact is due in great measure to the pedogeneses processes, because the soils from studied area were formed preponderantly on parental materials with considerable content in potassium and with increased value of basic cations. Thus, the large majority of soils from the subsidence plain and alluvial plain present a good and very good supply. Not the same thing could be said about soils from the hilly areas where were identified, even from the first agrochemical mapping, significant surfaces occupied by soils low supplied. The placement in these areas (Pietroasa, Dumbrava, Sudriaş) of some experimental fields by OSPA Timişoara, demonstrated the efficiency of potassium fertilizers that were applied here.

Soil texture, as physical parameter with big stability, presents within the studied area a large variability, both in the contact section where soils with brutish texture (NL and LN) represent 9 %, soils with middle texture (LL, LP) – 21 %, and those with fine and very fine texture – 70 % (TT – 43 %; AL – 27 &), and in worked layer (Ap) or the first 20 cm, where soils with brutish texture represent 8 %, those with middle texture – 39 %, and those with fine and very fine texture – 53 %. The most fertile soils, the chernozems, destined to agricultural cultures, situated in the western part of the county, have in the soil profile a homogenous texture, middle and middle to fine. The soils less fertile with increased content in clay and/or with unbalanced texture are, as a rule, destined to pastures or, in the last time, are uncultivated.

The content of clay oscillates in large limits, between 4-12 % (psamosoils and psamic subtypes) and 40-70 % (vertosoils, pelosoils, and vertic or pellic subtypes). The increased content in clay, over 35 %, constitutes for the arable terrains a limitative factor regarding their suitability for conservative systems for soil tillage, especially if the soil has a low permeability and a increased compactness.

The content of dust is comprised in a large interval, between 14-38 %, the most increased values being in the alluvial horizon of luvisoils. The big quantity of dust (over 25 %), associated with an large content of sand and a low content of organic matter lead to increasing of risk to structure destroying and crust formation.

Special problems appear as well in the case of soils with textural differentiation on soil profile, which usually appears at 40-50 cm depth, so that current agricultural workings must be adapted in conformity with texture of the upper part of soil profile.

Porosity presents within the researched space a big variability, from porous soils to soils with very low porosity. Soils with low and very low porosity hold 82 % from the surface of researched area, fact that constitute a serious problem regarding the suitability of these surfaces for the conservatives systems for soil tillage. The increasing of compactness is a consequence of technological system used in the last ten-year periods.

CONCLUSIONS

Sustainable utilization, as well as soils degradations is concepts that still have only theoretical value, the conceptual understanding depending on "users" which can see the immediate on long term effects.

Soil, the main natural resource of the agricultural system that use conservative measures for its workings, is in the same time a limitative resource more complex than air and water, representing in the same time the essential base of life.

The studies that were made in the territory are fated to offer us a general view on the main morphological, chemical, physical and hydrophysical characteristics of soils, at a certain moment, and especially to distinguish their importance in defining of conservative measures for soil tillage.

Results obtained in the territory are in consonance with those obtained in the experimental fields, in researches regarding the consequences of secondary compactness and these results showed, one more time, which is necessary that soils have certain compactness according to cultivated plant.

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