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Soils compaction in low plain

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Abstract: The research of compaction phenomenon is a problem of particular interest to soil science and protection and soil improvement.

In the first part of the paper is presented some generalities concerning the natural geomorphological, geological, hydrological and hydrogeological, climatic and vegetation, and work continues with the presentation of indices that influence and even produce the phenomenon of compaction. Finally some conclusions are given the degree of compaction of the soils in the Low Plain.

Detailed knowledge of the productive each homogeneous ecological area both in terms of current characteristics and their production capacity and in terms of real possibilities to increase these capacities, is a prerequisite for improving the quality of agricultural land and safety quality of life. Due to the execution agricultural work with heavy machinery, increasing the number of passes with machinery and other equipment, as well as perform basic work of inadequate soil humidity conditions led to worsening phenomenon of compaction.

Keywords: soil, compaction, bulk density, degree of compaction, porosity.

1. INTRODUCTION

Soil compaction is the process by which there is an increase in bulk density than normal and sharp decline in total porosity of the soil.

Soil compaction is due to the influence of natural factors (natural compaction) and anthropogenic (artificial compaction).

Natural compaction processes are determined by pedogenesis processes (argilization) and is specific to the Luvisols (Haplic Luvisols, Luvisols, Haplic Planosols) where very strong compaction appears to the B argic horizon or due to heavy traffic with cars and animals on those lands.

Compaction phenomenon is greatly influenced by the granulometric composition of soils, by stability structural aggregates and by the content of organic matter of the soil.

Depending on the depth, the compaction can be:

- a *surface compaction*, when the plough is effectuated annually at the same depth (20cm) leading to formation of a compacting layer, with high bulk density so called “plowpan”. Following the basic work of the soil at the same depth are formed stocky layer at the bottom of layer ploughing. This layer noted by Ap, characterized the type A horizons of intensively cultivated soils.
- a *naturally compaction*, under 50 cm depth.

2. MATERIALS AND METHODS

In order to solve this study I consider both, natural compaction (in the case of Luvisols) and on the anthropogenic compaction (produced by agricultural works and land reclamation, transportation).

There have considered all clay soils (fine textured soils that have a clay content of over 33%) in 13 pedological studies conducted by OSPA Timisoara in Timis County (over 500 soil profiles).

The main physical and chemical characteristics have been determined with respect the national standard (A.S.Ro).

Analyzes of particle size fractions, density, bulk density, humus, Na^+ (% of T) and Al_{mobile} were placed on the computer, generating a spreadsheet.

With these data were then drawn graphs which show the degree of soil compaction and scarification emergencies and some correlations between these indices.

3. RESULTS AND DISCUSSIONS

Eight major soil degradation processes confronting the European Union are: erosion, organic matter decline, contamination, salinisation, compaction, loss of soil biodiversity, withdrawal from agricultural use, landslides and floods.

To combat soil compaction will track the use of appropriate agro-technical measures and reduce the number of passes of farm machinery on the soil surface where soils have high moisture content. Compaction can be removed mechanically by working on the compact layer depth.

$$GC = \frac{DA}{DA_{max}} \cdot 100$$

where: GC - the degree of compactness in %; DA - bulk density of the soil at a time (g/cm^3); DA_{max} - maximum soil bulk density (g/cm^3).

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In addition to particle size, defining the texture, and the manner of their association, the structure, physical behavior of the soil depends on settlement loose or tight particle and structural elements.

This characteristic is specific to any porous body in which the particulate components having different sizes and shapes, are packed in different ways. Packing is done in a way that between solid particles (including within the structural elements) remain Goals (pores) of different sizes and shapes.

Status settlement (compaction) is expressed by various indicators, among which the density, bulk density, porosity and compaction.

The size of these indicators is under the influence of the structure formation processes and the anthropic compaction, as well as the presence and proportion in the soil of components for the solid part.

- ***Soil density***:

$$D = \frac{M}{V_s}$$

where: D – soil density (g/cm^3); M - mass of dry soil (g); V_s - solids particles volume of the soil (cm^3).

In practice may be accepted for the superior horizons values of most soil density from 2.65 to 2.68 g/cm^3, and the lower horizons values from 2.70 to 2.72 g/cm^3. Organic and organo-mineral materials, in relation to the content of the organic material, the density will be smaller values. It follows that the upper horizons of grassland soils from wetland, greenhouse soils heavily organic fertilized, density values can be 2.50 to 2.60 g/cm^3.

- ***Bulk density*** is the ratio of the mass of the total volume of the soil and is therefore a characteristic of the soil in its entirety, plus a solid part voids (pores) of solid particles:

$$DA = \frac{M}{V_t} = \frac{M}{V_s + V_p}$$

where: DA – bulk density (g/cm^3); M- soil mass (g); V_t - total volume of the soil (cm^3); V_s - solids particles volume of the soil (cm^3); V_p – pores volume (cm^3).

Bulk density is relatively independent characteristic, knowledge of which provides physical characterization of soil elements independent, which in some cases can only be deduced from other attributes. In other words, most of the soil belonging to a genetically type, with a certain texture, with particular chemical properties, can have very different bulk density values.

On the contrary, many of the other physical properties of the soil depends, in addition to texture and some chemical properties, by the bulk density. For physical characterization of a soil, the texture and bulk density are characteristics basic, strictly necessary which must known through direct determinations. On this general background bulk density values tend to be slightly lower with increasing clay content and, at the same clay content, somewhat higher as the texture is less balanced be respectively with increasing dust content or especially the coarse sand.

Bulk density is one of the main indicators of the settlement (compaction) of the soil. Higher Bulk density means lower water holding capacity, permeability, the aeration and increased soil mechanical resistance opposed to works, especially the penetration of roots.

Such connection elements concerning bulk density and some of the essential characteristics of production capacity of the soil can not be correctly interpreted only in conjunction with other soil properties, especially with the texture. Same values of bulk density can be favorable on a sandy soil, but totally adverse to a clay soil.

- ***Porosity*** - total pore volume expressed as a percentage of unit volume.

$$PT = \frac{V_p}{V_t} \cdot 100 = \frac{V_p}{V_s + V_p} \cdot 100$$

where: PT – total porosity; V_t - total volume of the soil (cm^3); V_s - solids particles volume of the soil (cm^3); V_p – pores volume (cm^3).

Total porosity values depend on the same factors that determine the values of density and bulk density. In mineral soils, where the density is very less variable, total porosity will depend only on the bulk density.

Total porosity values increase with increasing organic matter content. They are of the order of 60-70% in organomineral soils and can reach over 80% in peat or in soils with amorphous silicate materials. High values indicate a high water retention capacity, high permeability and good aeration.

- ***The degree of compaction*** (GT)

$$GT = \frac{PMT - PT}{PMT} \cdot 100$$

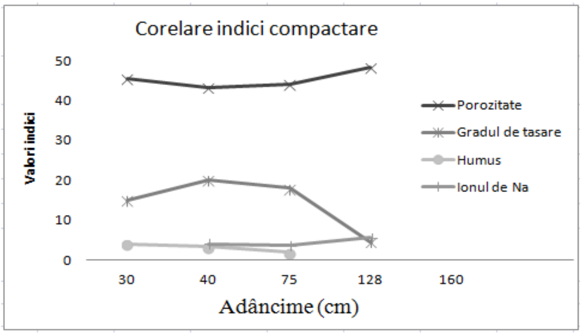
where: GT - the degree of compaction (%); PMN - required minimum porosity; PT – total porosity; A - the clay content of less than 0.002 mm.

The degree of compaction can be determined in a simplified manner on the basis of a diagram. The degree of compaction was used directly in practice to establish the need for works by loosening excessively compacted soil.

It is considered that such works are necessary emergency first grade soil compaction greater than 18%, in the second emergency degree of compaction in the range of 11 to 18% and in the third emergency if the indicator value is between 1 and 10%.

By soil compaction means the process by which its bulk density increases above normal (1.19 to 1.34 g/cm^3) and total porosity falls below normal (47-60%). In terms of the degree of compaction for poor soils and poorly compacted loose it falls between -9 and 10.

These values were chosen taking into account that fine textured soils were chosen from clay loam and from total porosity and bulk density tables were retained only those values that correspond to these textures and soil is considered poorly compacted.



The graph has been drawn for a soil to the low plain area.

Soil profile is to the cadastral territory of Dudeştii Vechi.

From the graph it is observed as the degree of compaction increases depth of 40 cm, and the total porosity is reduced, that is a change, a rearrangement of solid particles of the soil so that between them there is less air. In following table lists the dates on which the graph was drawn.

Table 1 Pellic-salic-sodic Vertisols – analytical data

Soil	Pellic-salic-sodic Vertisols VSac-sc-gc					
Depth (cm)	**30**	**40**	**75**	**128**	**160**	**210**
A(<0,002 mm)	52.6	56.1	53.6	33.7	31.4	15.6
D(g/cm^3)	2.68	2.68	2.7	2.72		
DA(g/cm^3)	1.46	1.52	1.51	1.41		
PT(%v/v)	45.52	43.28	44.07	48.16		
GT(%v/v)	15.03	20.06	17.98	4.62		
Humus	3.92	3.28	1.92			
Na$^+$ (%)	4.1	3.65	5.6			

It is observed from the table that about 40 cm depth soil is compacted if it is the degree of compaction.

Total porosity achieves this lowest value 43.28%.

One of the reasons that led to this compaction could be high clay content correlated with soil works.

For a better understanding of the phenomenon Further present analytical data of some soil profiles the studied area.

Table 2 Analytical data [6]

Vertic-gleyic Chernozems CZvs-gc					
Depth (cm)	A (<0,002 mm)	D (g/cm^3)	DA (g/cm^3)	PT (%v/v)	GT (%v/v)
-7	39.1	2.68	1.46	46.52	11.39
-33	44.1	2.68	1.33	50.37	3.48
-50	40.2	2.68	1.46	45.52	11.70
-68	43.1	2.7	1.42	47.41	8.88
-100	33.7	2.72	1.46	46.32	8.26
-160	32.3				
-200	29				
Hyposodic Chernozems CZac					
Depth (cm)	A (<0,002 mm)	D (g/cm^3)	DA (g/cm^3)	PT (%v/v)	GT (%v/v)
-20	45.1	2.68	1.25	53.36	-1.92
-35	44.8	2.68	1.55	42.16	19.38
-57	36.5	2.68	1.53	42.91	15.78
-71	24.6	2.7	1.41	47.78	2.51
-100	19.2	2.72	1.4	48.53	-0.83
-150	11.4				
-170	10.8				
-190	17.7				
Sodic-salic Gleysols GCac-sc					
Depth (cm)	A (<0,002 mm)	D (g/cm^3)	DA (g/cm^3)	PT (%v/v)	GT (%v/v)
-30	34.3	2.68	1.26	52.99	-4.73
-38	34.7	2.68	1.39	48.13	4.98
-51	33.8	2.68	1.38	48.51	3.96
-120	46.1	2.68	1.49	44.40	15.45
-150	36.3				
-200	34.5				
Vertic-sodic Solonchaks SCvs-ac					
Depth (cm)	A (<0,002 mm)	D (g/cm^3)	DA (g/cm^3)	PT (%v/v)	GT (%v/v)
-7	43.3	2.68	1.38	48.51	6.82
-35	50.9	2.68	1.53	42.91	19.49
-70	50.7	2.68	1.52	43.28	18.74
-90	49.5	2.7	1.5	44.44	16.25
-125	40.2				
-160	46.4				
-200	53.2				
Vertic-salic Solonetz SNvs-sc					
Depth (cm)	A (<0,002 mm)	D (g/cm^3)	DA (g/cm^3)	PT (%v/v)	GT (%v/v)
-24	45.5	2.68	1.38	48.51	7.46
-57	43.1	2.68	1.41	47.39	8.91
-90	52.9	2.7	1.48	45.19	15.73
-125	44.4				
-150	44.5				
-180	40				
Pellic-gleyic Vertisols VSgc					
Depth (cm)	A (<0,002 mm)	D (g/cm^3)	DA (g/cm^3)	PT (%v/v)	GT (%v/v)
-15	57.3	2.68	1.39	48.13	11.42
-27	58.5	2.68	1.54	42.54	22.00
-51	55.6	2.68	1.52	43.28	19.94
-71	45	2.7	1.46	45.93	12.25
-90	30.9	2.72	1.39	48.90	2.28
-143	19.9				
-180	19.3				
Pellic-stagnic-salic Vertisols VSst-sc					
Depth (cm)	A (<0,002 mm)	D (g/cm^3)	DA (g/cm^3)	PT (%v/v)	GT (%v/v)
-23	48.3	2.68	1.36	49.25	6.85
-50	48.6	2.68	1.46	45.52	13.98
-77	47.2	2.7	1.45	46.30	12.14
-100	45.4	2.72	1.43	47.43	9.49
-130	38.1				
-155	3.2				
-200	4.2				
Pellic-stagnic-sodic Vertisols					

VSst-ac					
Depth (cm)	A (<0,002 mm)	D (g/cm^3)	DA (g/cm^3)	PT (%v/v)	GT (%v/v)
-16	45	2.68	1.18	55.97	-6.95
-33	46.5	2.68	1.27	52.61	-0.06
-48	52.6	2.68	1.4	47.76	10.85
-68	44	2.7	1.48	45.19	13.39
-85	13.4	2.72	1.18	56.62	-19.99
-125	2.6				
-200	3.4				
Pellic-sa;ic-sodic Vertisols VSac-sc-gc					
Depth (cm)	A (<0,002 mm)	D (g/cm^3)	DA (g/cm^3)	PT (%v/v)	GT (%v/v)
-11	60.9	2.68	1.38	48.51	11.69
-27	66.5	2.68	1.51	43.66	21.82
-58	63.4	2.68	1.49	44.40	19.75
-78	62.5	2.7	1.49	44.81	18.80
-102	42	2.72	1.4	48.53	6.40
-120	39.6				
Mollic-sodic Fluvisols ASmo-ac-gc					
Depth (cm)	A (<0,002 mm)	D (g/cm^3)	DA (g/cm^3)	PT (%v/v)	GT (%v/v)
-22	42.4	2.68	1.41	47.39	8.71
-41	43.8	2.68	1.48	44.78	14.12
-63	35.6	2.7	1.36	49.63	2.31
-82	28.8	2.72	1.21	55.51	-11.71
-120	24.8				

Based on these analytical data was mapped soil compaction and urgency to scarification.

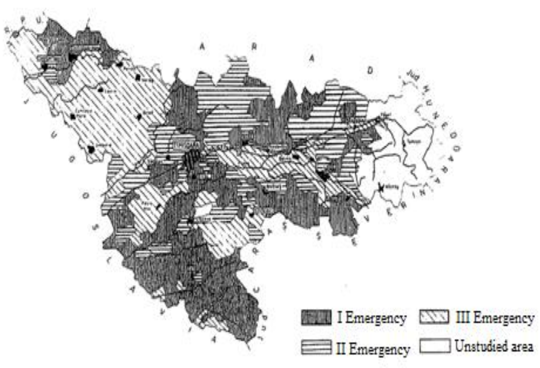


Figure 1 Soil compaction and urgency of scarification [4]

4. CONCLUSIONS

Compaction is one of the limiting factors of agricultural production is included in the category of pollutants and affecting large areas of agricultural land in Timis County.

Soil compaction is one of the most important factors of human influence on soil physical properties with immediate effect on the management of farms and the environment.

Soil compaction affects soil water dynamics, erosion, soil carbon and nitrogen cycle energy requirements and efficiency of farming, washing pesticides, soil biology and crop formation.

Soil changes induced the compaction can lead to soil degradation, pollution of surface or groundwater, also causing increased consumption of exhaustible natural resources such as oil and mineral fertilizers.

In Romania, most soils are compacted, medium and heavy texture (clay content varies between 30-50%), bad drainage, and often with a layer of impermeable soil. The climate ranges from sub-humid to the dry area with an annual rainfall between 400-600 mm and 600-700 mm potential evapotranspiration values.

In Timis county soils, over wide areas, require scarification work.

Over wide areas, in low plain, urgency to scarification is even grade I.

Once a need for soil remediation is recognized, the best available technology is selected according to the nature related to the physical and chemical characteristics of the soil and a cost – benefit analysis.

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