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EVOLUTION OF HYDRO-PHYSICAL PROPERTIES OF A ALBIC LUVISOL FROM DUMBRAVA, TIMIS COUNTY

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Abstract: *Research goal is to accumulate scientific data on development of components of agricultural land productivity, necessary to support of an methodology of their quality evaluation through a complex firm approach to physical and geographical conditions from Banat Plain. Research on the main physical and chemical characteristics of soil have been taken by many scientists, in the country and abroad, since the beginning of last century and the German classification system was designed mainly based on soil texture in the so-called phase of its evolution. The objectives and activities fall within the current agricultural research and agricultural practice, on international and national level, for the study of the importance of hydro-physical characteristics of the edaphic coating in substantiation of tillage systems. As part of the soil, clay plays a role in the relations established between certain physical and chemical properties of soil and between them and the activities of organisms that inhabit it. The physical and chemical properties of soil samples (texture, pH, content of humus and N,P,K), were analyzed in USAMVB-OSPA Timisoara Research Laboratory, after national norms and standards approved by the Standards Association from Romania (ASRO). The research of the ecopedologic conditions was made according to "The methodology of elaborating of pedological studies", vol. I, II and III elaborated by the ICPA Bucharest in 1987, completed with specific elements from the Romanian System of Taxonomy of Soils (SRSTS-2012). Knowledge of these features of the soil have of special theoretical and practical importance. Theoretical, it provides to specialist the possibility to interpret the phenomena that occur in soil and to predict soil evolution in particular and the environment in general, in terms of present and future health, and practical because warns the physician as what measures should be taken to bring the soil in optimal conditions for growth and development of plants cultivated or wild. Importance, originality and timeliness of work is the need to protect the edaphic layer and environmental protection by: The accumulation of scientific data necessary to support technologies of conservative tillage and sustainable management of soil and water resources, Implementation of conservative tillage and sustainale management of physical, geographical and edaphic conditions from Banat Plain.*

Keywords: *properties, soil, moisture, reserve, albic,*

INTRODUCTION

Knowledge of natural conditions and ecological features of the proposed zoning of land for various utilities and some cultures have great social and economic importance both for large and for small farm producers.

In this context, the major directions of the Romanian school of Pedology (CANARACHE AND TEACI, 1980, CÂRSTEA, 1995 , TEACI 1995,MUNTEANU 2000) on the unitary research of land to meet the needs of sustainable agriculture and environmental protection, will have to solve in order to connect to the European system, in full accordance and harmony earth following specific functions such as: environmental, economic, technical, social and legal functions.

Based on these considerations, the authors try to present in this paper, based on data extracted from scientific research topics and an impressive volume of data collected from the archive OSPA Timisoara, some aspects of soil quality status and evolution of the main factors that contribute to its realization.

MATERIAL AND METHODS

The research ison the line of sustainable agriculture system and aims to highlight the main objective the quantitative and qualitative changes occurring in the agricultural eco-system in application to wheat and corn.

The experiences are placed on a Luvisol-stagnic albic medium clay / clay loam, in the experimental field of OSPA Timisoara field, representative for of Făget Depression.

The research of the ecopedologic conditions was made according to "The methodology of elaborating of pedological studies", vol. I, II and III elaborated by the ICPA Bucharest in 1987, completed with specific elements from the Romanian System of Taxonomy of Soils (SRTS-2012).

To achieve objectives, the research were oriented towards both observations and measurements made in the field and experimental validation of these findings by laboratory analysis.

RESULTS AND DISCUSSION

The teritory of Dumbrava is located in the depression between the Zarand mountains and Poiana Rusca mountains, at the limit of the passage between Lipova Plateau and Western Plain piedmont.

From genetical point of view, the studyed area is characterized by an accumulative relief piedmont consists of Pliocene fluvial deposits.

The morphogenetic processes are determined mainly by the action of existing hydrographic network and present the appearance generated a hilly terrain with altitudes values ranging from 135 to 308 m (ROGOBETE AND ŢĂRĂU 1997).

Overall, the landscape presents a general rise from northeast to southwest. In cross section, the relief descends from north to south through terraces of different generations.

Framed between Poiana Rusca and Zarand mountains, wide depression postechtonic-Mures depression has evolved under the influence of Pannonian area, the geology of the region is closely related to the sinking of the area into the lower Tortonian.

The foundation of the area consists of Mesozoic crystalline fractions of mountainous areas, border formations contributed to filling the Pannonian basin from east to west to occupying successively tortoniene deposits, Pleistocene and Quaternary then.

It followed the ransformation of fillings piedmont plain fluvial accumulation, helping to shape the hydrographic relief.

Dumbrava territory is part of Bega catchment, river which crosses the territory. Bega flow is permanent, but inconsistent (with peaks in spring and late summer minimum).

From climate perspective Lugoj-Faget area is characterized by an annual average air temperatures of 10.4 ° C and an amount of rainfall (annual average) to 672.00 mm (Table 1).

The average amount of precipitation would provide favorable conditions for most crops if they have a corresponding distribution on months or vegetation phenophases.

Tne rainfall in summer and the winter have the same ratio value between those stations, but the differences were more pronounced in summer to the cold, the most pronounced differences were recorded in the spring and in early summer , in the rainy months when cyclone activity is higher.

Table 1

Monthly and annual average rainfall at Faget station (mm)

Agricultural year	Month												Annual
	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	
10-11	25,4	25,9	39,5	68,3	30,5	40,7	22,7	31,1	51,8	37,6	122,1	7,0	502,6
11-12	15,9	23,7	0,0	38,6	73.8	55.9	11.7	72.2	70.3	28.5	84.6	29.0	504,2
Normal	55,3	49,2	52,3	61,6	61,7	40,1	43,0	62,8	68,6	87,9	59,3	61,3	703,1
Difference													
10-11	-29,9	-23,3	-12,8	+ 6,7	-31,2	+ 0,6	-20,3	-31,7	-16,8	-50,3	+62,8	-54,3	-200,5
11-12	-39,4	-25,5	-52,3	-23,0	+12.1	+15,8	-31,2	+9,4	+1,7	-59,4	+25,3	-32,3	-198,9

To assess the impact of weather conditions on land productivity, the data were recorded in both stationary fot significance compared with rainfall (reference limits in relation to the requirements of agriculture (tab. 2) using data from the Agroclimatic Resources of Timis county (Berbecel, 1979).

Table 2

The significance of rainfall
(the reference limits range with the agriculture requirements)

Interval	Semnification of rainfall quantityes				
	Very dry	Dry	Satisfactory	Optimal	Excedentary
September-octomber	Under 40	41-60	61-80	81-150	Over 150
November-march	Under 100	101-150	151-200	201-300	Over 300
April	Under 20	21-30	31-40	41-70	Over 70
May-july	Under 100	101-150	151-200	201-300	Over 300
Annual	Under 350	351-450	451-600	601-700	Over 700

The analysis of rainfall data from the 2011-2012 crop year, that in his anamblul was a dry year (tab. 3).

Table 3

The significance of rainfall
range with the agriculture requirements at Dumbrava

Agricol year	Characteristic intervals									
	IX-X	Semnif.	XI-III	Semnif.	IV	Semnif.	V-VII	Semnif.	Anual	Semnif.
10-11	51,3	Dry	194,2	Satisfactory	31,1	Satisfactory	211,5	Optimal	502,6	Satisfactory
11-12	39,6	Very dry	180,0	Satisfactory	72,2	Excedentary	212,4	Optimal	504,2	Satisfactory

In close conjunction with various geomorphological factors that determine the existence of varied landscape units, those geo-lithological leading to a great diversity of parental material and the climate or the hydrological and the various human interventions, resulted in a large population of soils with specific characteristics (related or completely different from each other) evolving, but prevailing are Albic luvisols in different degrees of stagnogleyzation.

The experiences are on a albic-stagnic luvisol, silty loamy / loamy clay with profile type: Ap- Atp -Ea – Bt - Btz – BCy - Czy (tab.4) in the experimental field of OSPA Timisoara.

Pedogenesis processes are specific of soils in the deciduous forest, with macro and grain structure in a relatively small thickness in Ao horizon (15-20cm), with a significant migration of clay and iron hydroxides and the formation of a El or Ea horizon, over a horizon

Bt (argic) to excessively strong textural difference under woody vegetation represented by Quercineae (thermophilic) mixed with deciduous trees.

Table 4

Physical, hydro-physical and chemical properties of the Albic-stagnic Luvisol, strongly stagno-gleyed, silty loamy / loamy clay, on fine eluvial material

Indices	Depth (cm)								
	0-18	-28	-40	-54	-70	-92	-110	-143	-196
Horizonts	Apw_2	Atp w_3	Ea w_4	EB w_4	Bt w_5	Bt z w_5	BCy w_3	CBy w_2	Czy
Coarse sand (2.0 – 0.2 mm)	6,2	7,0	4,7	1,8	1,1	1,5	1,3	1,7	1,0
Fine sand (0.2 – 0.02)	27,3	28,4	25,3	21,2	18,9	27,4	18,5	19,9	20,1
Silt (I + II) (0.02-0.002 mm)	39,8	38,2	37,5	32,1	20,7	15,7	29,5	28,1	27,8
Coloidal clay (sub 0.002)	26,7	26,4	32,5	44,9	59,3	55,4	50,7	50,3	51,1
Phisical clay (praf II +arg col)	45,5	44,6	50,2	59,8	70,0	67,0	64,9	63,4	64,0
TEXTURE	LP	LP	LP	TT	AL	AL	AL	AL	AL
Specific Density (Ds)	2,69	2,69	2,70	2,72	2,72				
Aparent density (Da)	1,55	1,70	1,54	1,59	1,59				
Total phorosity (Pt)	45,00	37,00	43,00	42,00	42,00				
Aeration phorosity (Pa)	17,10	1,30	10,66	8,61	0,66				
Degree of compaction (GT)%	7,00	25,00	11,00	20,00	24,00				
Higroscopical coefficient(CH)	4,76	6,20	6,20	6,20	10,00	10,00	10,00		
Fadind coefficient (CO)	7,13	9,30	9,30	9,30	15,00	15,00	15,00		
Field capacity (CC)	18,00	21,00	21,00	21,00	26,00	26,00	26,00		
Utile water capacity (CU)	10,87	11,70	11,70	11,70	11,00	11,00	11,00		
Total capacity (CT)	29,04	21,77	27,93	26,42	26,42				
pH in water	5,79	5,26	4,76	4,77	5,22	5,60	6,45	6,75	6,78
Carbonates ($CaCO_3$)	0,00	0,00	0,00	0,00	0,00	0.00	0,00	0,00	0,00
Saturation in base degree (V)	48,09	29,86	30,13	39,45	52,37	67,77	85,65	90,96	90,96
Humus	2,09	1,98	1,30	0,70					
Nitrogen index (IN)	1,01	0,59	0,39	0,28					
Humus reserve (50 cm)	58,32	33,66	18,48	11,13	**111,36**				
P mobile	10,68	15,35	7,31	3,18	3,00	1,40	2,00	3,30	3,30
K mobile	45,00	43,00	31,00	82,00	81,20	111,60	81,20	56,60	56,60

According to WRB-SR, 1998, luvisols are soils whose essential features are textural differentiation (the presence of argic diagnostic horizon), high ability of clay to cationic change, base saturation >50% and low saturation of aluminum (ŢĂRĂU ET ALL. 2002).

Argic horizon may color from brown to reddish brown depending on the nature of iron compounds resulting from pedogenesis processes.

Regarding the main physical and hydro-physical characteristics of the analyzed soil, it has a silty loamy texture in upper horizons (Ap-Atp-Ea) located in the first 50 cm of the profile, a clay loamy texture in transition horizon (EB) of about 14 cm and loamy clay in whole soil profile, in the range 54-196 cm (tab.4).

Granulometric composition is characterized by the clay content that increases from 26.4% (in Atp) to 59.3% (Bt) and then gradually decreases on soil profile.

Bulk density (g/cm^3) have very high values throughout the soil profile, except the processed layer (Ap) in the range 0-18 cm that showing high values.

Total porosity (PT%) show medium values in processed layer (Ap) or 0-18 cm, very low between 18-28 cm and low between 28-70 cm and aeration porosity (PA%) medium values in processed layer (Ap), very small between 28-54 cm and extremely low in Atp (18-28 cm), respectively Bt (54-70 cm).

From chemical characteristics that influence the composition and the way of life of phyto-coenosis and have an important role on soil fertility, are important: soil reaction, the reserve of humus and nutrients insurance, etc. status (DUMITRU ET ALL. 2000).

The analyzed soil have a moderately acid reaction (pH) in the range 0-28 cm, strongly acid between 28 and 54 cm, moderately acidic between 54-92 cm and weakly acidic between 92-196 cm, respectively at the base of soil profile.

Nitrogen index (IN) has medium values in 0-33 cm layer and low values on depth. Humus reserve (t/ha) in 0-50 cm layer is low (111.36).

Nutrient supply status indicates a small mobile phosphorus content (ppm) in the surface horizon of 0-28 cm, very little between 28-40 cm and extremely low between 40-196 cm, a very low content of mobile potassium (ppm) between 0-40cm and small between 40-196 cm, whereas nitrogen index (NI) record low values.

Regarding the evolution of soil moisture, the observations (through soil sampling and laboratory determinations) in the two cultures have highlighted a number of issues on how to achieve the ecological functions of soil in agro-ecosystems, namely those related to main features embedded in the concept of eco-pedologic profile.

Knowing these features of agro-ecosystems in terms of air and hydro resource have a great theoretical and practical importance. Theoretical, it provides to the specialist the possibility to interpret the phenomena that occur in the soil-plant-technology relations and predict breakneck development, and practical as practitioner warns the measures to be undertaken to bring the soil under optimal conditions

Based on measurements taken, namely momentary humidity (U%) and density (g/cm3 DA) was calculated reserve of water (W mm), on profile depth on intervals respectively: 0-10 cm, 0-25 cm, 0-50 cm, and the intervals 0-100 cm, 0-125 cm and 50-100 cm, both in wheat (tab.5.) and maize (tab. 6). By comparing the values thus obtained with values of field capacity (CC mm) can be determined accurately the excedent or deficit of soil moisture and then how to bring optimum soil moisture values.

Could be found that soil water reserve (W mm) comparing with field capacity values (CC mm) have, in almost all cases, values below those of field capacity, which is due largely low quantities of rainfall in the 2010-2011 crop year, when he was a deficit of 200.5 mm and in particular the conditions of the agricultural year 2011-2012 when, in the first 4 months, was recorded a deficit of 140.2 mm (tab.5).

Table 5

Soil water reserve (mm) compared with field capacity values-CC (mm)

Location/Date		Interval 0-10 cm			Interval 0-25 cm			Interval 0-50 cm		
		Water reserve (mm)	CC (mm)	Difference (mm)	Water reserve (mm)	CC (mm)	Difference (mm)	Water reserve (mm)	CC (mm)	Difference (mm)
Dumbrava (Weath)	23.10.2011	18,59	27,54	-8,95	43,71	73,53	-29,82	78,75	162,58	-83,83
	14.11.2011	15,68	27,54	-11,86	36,70	73,53	-36,83	71,74	162,58	-90,84
	16.12.2011	39,34	27,54	+11,80	67,33	73,53	-6,20	108,05	162,58	-54,53
	18.01.2012	40.70	27.54	+13.16	90.41	73.53	+16.88	153.36	162.58	-9.22
	20.03.2012	40.71	27.54	+13.17	88.63	73.53	+15.10	181.38	162.58	+18.80
	29.03.2012	28,78	27,54	+1,24	74,24	73,53	+0,71	-	-	-
	27.04.2012	35,02	27,54	-7.48	84,89	73,53	+11.36	161.16	162,58	-1.42
	11.05.2012	17.78	27,54	-9.76	46.40	73,53	-27.13	92.98	162,58	-69.60
	28.05.2012	35.96	27,54	+8.42	84.78	73,53	+11.25	137.83	162,58	-24.72
	25.06.2012	9.72	27,54	-17.82	25.09	73,53	-48.44	66.26	162,58	-96.32
	02.07.2012	7.24	27,54	-20.30	23.31	73,53	-50.22	56.33	162,58	-106.25
	18.07.2012	3.21	27,54	-24.33	16.94	73,53	-56.59	60.57	162,58	-102.01
	22.08.2012	8.40	27,54	-19.14	21.74	73,53	-51.79	47.26	162,58	-115.32
	19.09.2012	11.95	27,54	-15.59	26.38	73,53	-47.15	76.56	162,58	-86.02

Table 5

Soil water reserve (mm) compared with field capacity values-CC (mm)-continuation

Location/Date		Interval 0-100 cm			Interval 0-125 cm			Interval 50-100 cm		
		Water reserve (mm)	CC (mm)	Difference (mm)	Water reserve (mm)	CC (mm)	Difference (mm)	Water reserve (mm)	CC (mm)	Difference (mm)
Dumbrava (Weath)	23.10.2011	246.62	366.03	-119.41	348.46	470.03	-121.57	167.87	203.45	-35.58
	14.11.2011	236.84	366.03	-129.19	326.68	470.03	-143.35	162.7	203.45	-40.75
	16.12.2011	271.84	366.03	-94.19	359.8	470.03	-110.23	163.79	203.45	-39.66
	18.01.2012	309.84	366.03	-56.19	396.85	470.03	-73.18	156.48	203.45	-46.97
	20.03.2012	384.40	366.03	+18.37	482.12	470.03	+12.09	203.02	203.45	-0.43
	27.04.2012	359.45	366.03	-6.58	452.93	470.03	-17.10	198.29	203.45	-5.16
	11.05.2012	285.60	366.03	-80.43	379.20	470.03	-90.83	192.62	203.45	-10.83
	28.05.2012	302.88	366.03	-63.15	377.08	470.03	-92.95	165.05	203.45	-38.40
	25.06.2012	232.72	366.03	-133.31	315.88	470.03	-154.15	166.46	203.45	-36.99
	02.07.2012	185.07	366.03	-180.96	284.71	470.03	-185.32	128.74	203.45	-74.71
	18.07.2012	224.40	366.03	-141.63	307.08	470.03	-162.95	163.83	203.45	-39.62
	22.08.2012	195.04	366.03	-170.99	276.68	470.03	-193.35	147.78	203.45	-55.67
	19.09.2012	243.95	366.03	-122.08	319.43	470.03	-150.60	167.39	203.45	-36.06

Situations where soil water reserve (W mm) recorded positive values to the values reported of field capacity (CC mm) were extremely rare and short-lived, manifesting only in the winter at wheat (Table 5) and maize (tab. 6), except that the wheat they were recorded only in the upper third of the soil profile.

Regarding the yields obtained from the two cultures, they were statistically assured, noting that, in the 2011-2012 agricultural year, the climatic conditions have negatively influenced the soil moisture regime and especially the production obtained from corn and lower high at wheat.

Table 6

Soil water reserve (mm) compared with field capacity values-CC (mm)

Location/Date		Interval 0-10 cm			Interval 0-25 cm			Interval 0-50 cm		
		Water reserve (mm)	CC (mm)	Difference (mm)	Water reserve (mm)	CC (mm)	Difference (mm)	Water reserve (mm)	CC (mm)	Difference (mm)
Dumbrava plowing	23.10.2011	19,25	27,54	-8,29	45,17	73,53	-28,36	80,47	162,58	-82,11
	14.11.2011	21,22	27,54	-6,32	50,26	73,53	-23,27	114,03	162,58	-48,55
	16.12.2011	40,81	27,54	+13,27	85,57	73,53	+28,00	151,95	162,58	-10,63
	18.01.2012	38.57	27,54	+11,03	87,08	73,53	+13,55	166.95	162.58	+4.37
	20.03.2012	41,59	27.54	+14.05	99,87	73,53	+26.34	181,.56	162.58	+18.98
	29.03.2012	28,75	27,54	-12,10	72,02	73,53	-1,51	-	-	-
Maize	27.04.2012	30.39	27,54	+2.85	80.43	73,53	+6.90	160.54	162,58	-2.04
	11.05.2012	22.49	27,54	-5.05	61.89	73,53	-11.64	135.29	162,58	-27.29
	28.05.2012	34.09	27,54	+5.05	81.09	73,53	+7.56	155.24	162,58	-7.34
	25.06.2012	17.72	27.54	-9.82	44.94	73,53	-28.59	108.17	162,58	-54.41
	02.07.2012	21.18	27,54	-6.36	47.92	73,53	-25.61	112.41	162,58	-50.17
	18.07.2012	6.46	27,54	-21.08	21.69	73,53	-51.84	68.27	162,58	-94.31
	22.08.2012	10.07	27,54	-17.47	23.12	73,53	-50.41	54.80	162.58	-107.78
	19.09.2012	12.74	27,54	-14.80	29.25	73,53	-44.28	56.07	162.58	-106.51

Table 6

Soil water reserve (mm) compared with field capacity values-CC (mm)-continuation

Location/Date		Interval 0-100 cm			Interval 0-125 cm			Interval 50-100 cm		
		Water reserve (mm)	CC (mm)	Difference (mm)	Water reserve (mm)	CC (mm)	Difference (mm)	Water reserve (mm)	CC (mm)	Difference (mm)
Dumbrava (plowing)	23.10.2011	329.48	366.03	-36.55	415.22	470.03	-54.81	188.45	203.45	-15.00
	14.11.2011	331.78	366.03	-34.25	424.86	470.03	-45.17	217.75	203.45	+14.30
	16.12.2011	377.19	366.03	+11.16	476.15	470.03	+6.12	225.24	203.45	+21.79
	18.01.2012	406.05	366.03	+40.02	515.25	470.03	+45.22	239.1	203.45	+35.65
	20.03.2012	410.99	366.03	+44.96	514.42	470.03	+44.39	229.43	203.45	+25.98
Maize	27.04.2012	388.46	366.03	-22.43	488.02	470.03	+17.99	227.92	203.45	+24.47
	11.05.2012	354.72	366.03	-11.31	452.36	470.03	-17.67	219.43	203.45	+15.98
	28.05.2012	345.50	366.03	-20.53	432.02	470.03	-38.01	190.26	203.45	-13.19
	25.06.2012	320.86	366.03	-45.17	412.22	470.03	-57.81	212.69	203.45	+9.24
	02.07.2012	357.78	366.03	-8.25	469.70	470.03	-0.33	245.37	203.45	+41.92
	18.07.2012	245.70	366.03	-120.33	338.50	470.03	-131.53	177.43	203.45	-26.02
	22.08.2012	-	366.03	-	-	470.03	-	-	203.45	-
	19.09.2012	201.07	366.03	-164.96	263.31	470.03	-206.72	145.00	203.45	-58.45

CONCLUSIONS

Periodic measurements of soil moisture from researched area concerns the field, at both nationally and globally level, in the context of climate change from last decades.

Based on measurements taken, namely momentary humidity (U%) and density (g/cm^3 DA) was calculated reserve of water (W mm) depth profile intervals, respectively: 0-10 cm, 0-25 cm, 0-50 cm, and the intervals 0-100 cm, 0-125 cm and 50-100 cm. Values thus obtained could be compared with values of field capacity (CC mm), so can be determined accurately the surplus or deficit of soil moisture and how to bring optimum soil moisture values.

Regarding the evolution of soil moisture, the observations (through soil sampling and laboratory determinations) in the two cultures have highlighted a number of issues on how to achieve the ecological functions of soil in agro-ecosystems, namely those related to main features embedded in the concept of eco-pedologic profile.

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