MODIFICATIONS OF THE CHEMICAL PROPERTIES OF SOILS IN THE ARANCA SURFACE-DRAINAGE SYSTEM (TIMIŞ COUNTY)

MODIFICĂRILE PROPRIETĂȚILOR CHIMICE ALE SOLURILOR DIN SISTEMUL DE DESECARE ARANCA (JUDEȚUL TIMIŞ)

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Abstract: *The paper deals with the modifications of the chemical properties of the soils in a surface-drainage system. The soil samples were collected at an interval of 20 years, in 1975 and 1995, from four 100-cm deep soil profiles. The values obtained for the pH, the humus, the $CaCO_3$, the exchangeable Na, the soluble salts and the Cl^-, SO_4^{2-} and CO_3^{2-} anions have been compared.*

Rezumat:*Lucrarea prezintă modificarile proprietatilor chimice ale solurilor dintr-un sistem de desecare. Probele de sol au fost recoltate la un interval de 20 de ani, in 1975 si 1995, din 4 profile de sol,pe adancimea de 100 cm comparandu-se valorile obtinute pentru pH, humus, carbonat de calciu, Na schimbabil , saruri solubile si anionii de Cl^-, SO_4^{2-}, CO_3^{2-}.*

Key words**:** *surface-drainage system, chemical properties, soils.*
Cuvinte cheie: *system de drenaj, proprietăți chimice, soluri*

INTRODUCTION

After the Second World War, due to the pedoclimatic conditions specific to the western part of Romania as well as to the absence of land improvement works, the productive potential of most of the soils in Timiş County has decreased. This was due not only to the moisture excess in the low and high plain areas during the autumn-spring periods and to the moisture deficit during summer, but also to the erosion process of the soil in the hilly areas.

Of all these, the moisture excess has damaged the crops the most due to its spread area and frequency.

Taking into account the causes that led to the moisture excess of the lands in the low plain of the western part of Romania, surface and sub-surface drainage works as well as impounding works were taken into consideration. These works were a part of 26 systems, the Aranca system being the largest.

The Aranca surface-drainage system was set up in 1954 was extended in 1960 and 1975, reaching today approximately 85,000 ha. It is situated in the extreme western Romania, being bordered on the north by the Romanian-Hungarian border and the Mureş River's eastern dyke, on the south and south-west, by the Romanian-Yugoslavian border, and on the east and south-east, by Aranca's compartment II.

In order to observe the modifications of the chemical properties of the soils in the Aranca surface-drainage system, we have started from the chemical analyses of 4 soil profiles that were carried out in 1975. In 1995, soil samples from the same profiles were collected.

MATERIALS AND METHODS

In order to observe the chemical modifications that take place in soils, the main chemical properties of the soils have been analysed : the pH, the $CaCO_3$ content, the humus content, the soluble salts content and the Cl^-, SO_4^{2-}, CO_3^{2-} ions content. The exchangeable Na in me/100g, the exchangeable Na in % T and the total capacity of cationic exchange , T, have

also been determined. The 1975 data have been taken from the OSPA archives while the 1995 data were determined in the pedological lab of the faculty.

The determining methods of the chemical properties of soils were the ones recommended by the "Chemical Analyses Methods of Soils", elaborated by ASAS-ICPA Bucharest.

RESULTS AND DISSCUSIONS

The analytical data for the alkalised gley soil are presented in Table 1.

Table 1

Analytical data for the alkalised gley soil (Sânnicolau Mare)

Characteristics \ Depth(cm)		1975				1995			
		0-25	25-50	50-75	75-100	0-25	25-50	50-75	75-100
Coarse sand	%	2.0	1.0	1.0	1.0	1.7	2.3	1.1	1.0
Fine sand	%	12.9	5.6	24.6	21.8	25.5	36.4	35.4	43.1
Dust	%	15.3	23.2	10.6	33.6	28.5	15.0	17.4	17.2
Clay	%	69.9	70.2	63.8	53.6	44.3	46.3	46.1	38.7
Texture		A	A	A	AL	LA	AL	AL	LA
pH		7.20	8.15	8.45	8.35	7.16	7.72	8.74	8.77
$CaCO_3$	%	-	0.16	0.26	1.00	-	0.16	2.38	4.17
Humus	%	2.36	1.66	-	-	3.12	3.27	-	-
Exchangeable Na	me/100g	-	-	8.00	10.50	-	-	8.19	6.68
Exchangeable Na	% T	-	-	16.50	18.90	-	-	14.26	10.69
Exchange capacity T	me/100 g	-	-	48.80	55.60	-	-	57.40	54.40
Soluble salts	g/100g	-	-	2.548	0.588	-	-	0.097	0.119
Cl^-	me/100g	-	-	0.507	1.492	-	-	0.400	0.400
SO_4^{2-}	me/100g	-	-	0.591	0.510	-	-	0.380	0.360
CO_3^{2-}	me/100g	-	-	0.033	0.100	-	-	0.070	0.120

The comparison of the analytical data carried out in 1975 and in 1995 has shown that the pH remains unchanged on the soil profile, varying from neuter to slightly and moderate alkaline.

The low humus content remains unchanged. As far as the $CaCO_3$ is concerned, an increase in the horizons below 50 cm has been observed.

Na^+, Cl^-, SO_4^{2-} and CO_3^{2-} ions content remains unchanged while the soluble salts content decreases from medium to very low in the 50-75 horizon. A slight decrease in alkalisation (from strong to moderate) and in salinisation (from slightly salinised to non-salinised) has also been observed.

The comparison of the analytical data of salinised alkali soil (table 2) - from 1975 to 1995 has shown an insignificant variation in the pH. In 1995, through the first 88 cm, the pH is slightly alkaline-moderate alkaline, while from 88 to 108 cm, it increases to strong alkaline.

The $CaCO_3$ and humus content shows an insignificant variation on the soil profile in 1995 as opposed to the one in 1975. Nevertheless, the Na^+, Cl^- and PSA ions content decreases very much in 1995 as opposed to 1975, and the soil changes from moderate salinised chlorinated ($Cl^-/SO_4^{2-} \geq 1$) to non-salinised.

The soluble soils content remains very low throughout the years.

Profile of Table 3 shows a variation of the pH from slightly moderate alkaline in 1975 to neuter slightly acid in 1995. In 1995, the $CaCO_3$ is observed only in the inferior part of the profile as opposed to 1975, when it can be observed through all the profile.

The humus and the Na^+, Cl^-, SO_4^{2-} and CO_3^{2-} ions show an insignificant variation. The ratio Cl^- / SO_4^{2-} is ≤ 1 to 68 cm, thus the salinisation is sulphatic, then the ratio changes into ≥ 1 and the salinisation becomes chlorinated.

Soluble salts, being very low, vary little, not only in 1975, but also in 1995.

Table 2

Analytical data for the salinised alkali soil (Sânnicolau Mare)

Depth (cm) / Characteristics		1975					1995				
		5-15	15-35	35-70	70-88	88-108	5-15	15-35	35-70	70-88	88-108
Coarse sand	%	2.0	1.0	0.5	1.0	0.5	1.5	1.4	0.4	0.4	0.3
Fine sand	%	22.8	13.8	0.5	16.7	19.3	37.9	32.4	27.9	29.0	31.7
Dust	%	27.2	23.7	21.6	24.3	30.6	21.9	24.0	23.0	24.1	30.2
Clay	%	48.0	61.5	77.4	58.0	49.6	38.7	42.2	48.7	46.5	37.8
Texture		AL	A	A	AL	AL	LA	LA	AL	AL	LA
pH		7.35	7.90	8.15	8.58	9.05	6.61	7.31	8.42	8.24	9.24
$CaCO_3$	%	0.16	0.16	0.16	2.10	19.3	-	0.10	0.25	6.80	20.60
Humus	%	5.15	2.73	1.52	-	-	3.72	2.91	2.34	-	-
Exchangeable Na	me/100g	12.75	31.66	45.57	45.62	32.76	-	-	14.58	18.82	15.16
Exchangeable Na	% T	27.00	53.10	72.20	82.90	85.40	-	-	22.64	28.47	37.10
Exchange capacity T	me/100 g	47.50	59.60	64.00	55.00	38.40	-	-	66.40	66.10	40.90
Soluble salts	g/100g	0.147	0.361	0.709	0.667	0.601	-	-	0.228	0.559	0.216
Cl^-	me/100g	2.563	5.859	11.35	10.30	8.704	-	-	0.700	0.900	0.550
SO_4^{2-}	me/100g	0.326	1.653	2.510	2.979	2.000	-	-	2.900	12.00	2.090
CO_3^{2-}	me/100g	-	-	-	0.400	0.966	-	-	0.070	0.110	0.200

Table 3

Analytical data for the salinised alkali soil and chernozem soil (Sânnicolau Mare)

Depth (cm) / Characteristics		1975					1995				
		0-30	30-50	50-68	68-97	97-127	0-30	30-50	50-68	68-97	97-127
Coarse sand	%	2.0	2.0	3.0	2.0	2.0	3.8	3.4	2.7	1.7	1.7
Fine sand	%	7.7	10.4	14.6	9.8	12.8	41.8	31.7	30.9	21.6	23.8
Dust	%	22.3	17.4	15.0	21.5	32.0	16.0	17.9	20.0	22.7	18.3
Clay	%	68.0	70.2	67.4	66.7	53.2	38.4	47.0	46.4	54.0	56.2
Texture		A	A	A	A	AL	LA	AL	AL	AL	AL
pH		7.65	8.10	8.25	8.45	8.90	7.13	6.91	6.84	7.22	7.52
$CaCO_3$	%	0.16	0.16	1.20	1.20	1.36	-	-	-	0.10	0.16
Humus	%	4.30	3.70	3.10	2.30	-	2.99	3.12	2.15	1.05	-
Exchangeable Na	me/100g	-	16.66	19.90	18.95	15.95	-	16.00	17.25	15.35	12.25
Exchangeable Na	% T	-	34.10	40.80	41.70	41.50	-	31.20	35.17	36.20	34.25
Exchange capacity T	me/100 g	-	48.80	48.80	45.50	38.40	-	31.40	32.50	33.00	30.00
Soluble salts	g/100g	-	0.320	0.521	0.468	0.222	-	-	0.429	0.396	0.112
Cl^-	me/100g	-	0.366	2.929	4.507	2.676	-	0.311	2.502	4.205	2.232
SO_4^{2-}	me/100g	-	3.306	3.224	2.693	0.938	-	2.960	2.745	2.117	0.825
CO_3^{2-}	me/100g	-	0.023	0.033	0.100	0.166	-	-	0.032	0.112	0.175

As far as the salinised alkali soil is concerned, the pH has been observed to vary from slightly-moderate alkaline in 1975 to moderate-strong alkaline in 1995, starting from the very surface of the land.

The $CaCO_3$ content shows insignificant variations through the whole soil profile. The same is true for the humus content which is stable, having medium values.

While the Na^+ cation content increases with the depth (48-100 cm), the Cl^- anion and sulphates content decreases very much through the whole soil profile. The ratio Cl^-/SO_4^{2-} remains ≥ 1 which means a chlorinated salinisation except through 60-100 cm, when it changes into sulphatic in 1995.

In 1995, as in 1975, the soluble salts content remains very low through the whole profile.

Table 4

Analytical data for the salinised alkali soil (Sannicolau Mare)

Characteristics \ Depth (cm)		1975					1995				
		0-14	14-28	28-48	48-60	60-100	0-14	14-28	28-48	48-60	60-100
Coarse sand	%	0.5	0.5	0.5	0.5	0.5	0.1	0.1	0.1	0.1	0.1
Fine sand	%	22.2	28.0	22.7	23.9	21.3	28.9	30.5	29.2	30.3	25.5
Dust	%	31.9	29.8	29.5	32.2	29.7	29.5	27.1	27.7	29.1	30.3
Clay	%	45.4	41.7	47.3	43.4	48.5	41.5	42.3	43.0	40.5	44.1
Texture		AL	LA	AL	LA	AL	LA	LA	LA	LA	LA
pH		7.85	8.25	8.25	8.25	8.80	8.40	9.09	9.33	9.48	9.43
$CaCO_3$	%	0.16	0.16	0.58	8.70	13.40	0.33	0.42	2.04	8.93	14.80
Humus	%	5.75	4.60	3.20	2.48	-	3.35	3.27	2.99	2.42	-
Exchangeable Na	me/100g	4.80	10.20	11.20	11.40	9.72	1.96	6.34	10.90	12.59	11.36
Exchangeable Na	% T	10.30	20.80	21.50	29.40	15.50	3.52	11.65	20.37	28.18	28.98
Exchange capacity T	me/100 g	46.50	49.00	52.20	38.80	64.00	55.70	54.40	53.50	50.00	39.20
Soluble salts	g/100g	0.509	0.548	1.203	1.190	0.610	0.064	0.090	0.114	0.120	0.221
Cl^-	me/100g	9.859	9.014	17.183	14.08	4.788	0.30	0.50	0.45	0.40	0.50
SO_4^{2-}	me/100g	2.448	2.857	8.163	8.571	4.612	0.27	0.23	0.37	0.33	0.99
CO_3^{2-}	me/100g	-	-	-	0.200	0.500	0.01	0.12	0.16	0.19	0.38

CONCLUSIONS

Following the comparison of the four profiles (Table 1- alkalised gley soil, Table 2 and Table 4 – salinised alkali soil, table- chernozem complex + salinised alkali soil) analyses carried out in 1975 and 1995, insignificant modifications of the soils properties have been observed. A decrease in salinisation and alkalisation has been noticed. These results seem to contradict the fact that, starting from 1998, the climate in the western Romania has been more arid which would mean a concentration in the soil solution.

This contradiction can be explained by the prior observations concerning the ground water tables which state that these have lowered considerably due to the use of the surface-drainage system as well as to the aridisation of the climate after 1998. Therefore, during 1965-1980, due to the intense use of the land improvement works, the ground water tables lowered considerably, reaching 2-3 m depth.

During 1980-1995, due to an arid climate, the ground water tables lowered with other 1-2 metres. The additional water supply that was provided by the ground water diminished continuously, which led to the need of additional water supply from irrigations in some areas.

Since 1995, a scarce rainfall regime has been noticed, leading thus to the continuous lowering of the ground water table.

This could account for the lack of sodium and salts supply in the ground water table.

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