THE EFFECTS OF THE CULTIVATED FILEDS SOIL CHEMISTRY OF THE LAKE NAGYSZÉKSÓS (HUNGARY)

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ABSTRACT

Nowadays natural watery habitats are imperilled because of human landscape-transformer processes and negative effects of climate change. Degradation time of them is 5-10 years while the regeneration time of them is 10-30 years (Szabó, 2004). Low rate of anthropogenic effects can lead to significant and fast changes in these places. In our work we examined the anthropogenic origin chemical effects in the area of Lake Nagyszéksós (Mórahalom, Hungary). On the base of the examinations we constructed soil- and water-chemical parameter maps (Nyilas et al., 2012). These maps are suitable for prove the contaminations which come from the agricultural cultivated fields for example. In this paper we show the results of the iterated examination of the north coast, one year after the first full examination of the area. We chose this coast because this was the one of the most contaminated fields in 2012. We found out, that in the last year the most contaminated zones show smaller nutrients-concentrations in this year. The causes of this are the next: (1) fast leaching, (2) fast use of nutrients in the spring vegetation period, (3) the new dose of ameliorators were not turned out. Consecutively the unapplied nutrients were measured in this year.

INTRODUCTION

Lake Nagyszéksós lies on Dorozsma-Majsa sand ridge region, Danube-Tisa middle-region, Hungarian Great Plain on the base of the new nomenclature (Kertész, 2003; Hajdú-Moharos & Hevesi, 1999). This is a characteristic warm and the largest sunshine contain field of the country with hot summers. The wind-chart is north-wester. The sand-blasts are often in the spring periods of the years. The waterlogged places are shown by large carbonate silty fields and saline fields. The water management and the salt balance conditions are formed by Széksóstó main channel significantly. The main channel was built for diverting of the spring inland water. The drying out of the area and the transformation of the vegetation were caused by one (Deák, 2006) and the quantity of the solute material rich waters was grown in the lake. The soil- and water chemistry of the lake is influenced by the intensive cultivation of the fields near the lake.

MATERIALS and METHODS

For getting to know soil- and water chemistry of Lake Nagyszéksós area, the samples were collected on 5th-6th of April in 2012. Every sampling point was appointed by EOV coordinates (297 water and 29 soil sampling points). Another 17 samples were collected to examine the changes from 9 points of the north coast of the lake in 10th of April in 2013. Soil samples were collected from genetical horizons. Chemical data were measured by Hungarian Standards from Lakanen-Erviö soil extracts. Electrical conductivity (EC) (MSZ EN 27888:1998; MSZ-08-0206-2:1978) and pH (MSZ 1484-22:2009; MSZ-08-0206-2:1978) were measured by potentiometric method. Nitrate (MSZ 1484-13:2009. (5.2.)) phosphate (MSZ 448 18:1977.(6.1.); MSZ 448-18:2009) and organic matter (OM) (MSZ 21470-52:1983) contents were determined by UV-VIS spectrophotometry. The carbonate was measured by Dean-method (ignition loss). Sodium-, potassium-, zinc- and copper-ion (MSZ 1484-3:2006. (6.); MSZ 20135:1999) concentration measurements were carried out by Young Lin AAS. Surfer 9 was used for evaluations.

RESULTS

The results of the 9 sampling points (A- and B-horizon) and the points of 2012 year (15A, 16A) are shown in the Table 1. The examined field shows characteristic alkaline land picture on the base of the pH. The pH of the samples diverge from each other in slight degree (pH 7.88+/-0.23) and they are less in the soil genetical A-horizon than the B-horizon. The EC is larger in the A-horizon than in the B-horizon (35-164 μS/cm) except 1. and 9. sampling points. In this last points with the less salt-content in the A-horizon show the leaching of the salts into the deeper horizons (43 és 30 μS/cm growing in the B-horizon). The difference is not so large, but it shows that the short dry period in the weather is enough to start the flow up of the salty solution in the soil capillars by the evaporation. The origin of the sodium is geological, the upflowing water takes it up to near the surface. The sodium is very mobile element because of this it shows the changes very fast in the water flowing. The starting of the water upflowing is come into view by this element first time in the dry periods.

The carbonates are accomulated in the surface horizon in badly-soluble calcium- and magnesium-carbonate and in easily-soluble sodium-carbonate forms. The measured values change between 3.6 and 12.0 %. The carbonates would come from the upflow soil-solutions or from the carbonate sand soils which are carried by wind. Close to the lake the carbonate-content is grown. The mean organic matter-content is 1-2 %, but it is decreased under 1 % close to the lake because of the slight humufication processes (low organic matter-clay aggregates). On the other part the wind can carry the easy organic materials from the surface because it is open, the close plant coverage is missed because of the cultivation. The organic matter content is increased in the 1. and 9. points (0.05 and 0,07 %). In this points the organic materials are not leaching down, the wind carries away them from the surface and/or the wind takes the sand to the surface to the top ot the humic-horizons. Same processes make the less carbonate-contents in the surface horizons in the 1., 7., 8. sampling points. Some places the cultivated fields are into the bed of the lake and the ploughing of the filed changes the natural soil horizons.

The place of the cultivated fields and the farms in the examined coast of the lake and the slope of the fields suggest that all of the nitrate is anthropogenic originally and it is leaching from the manure and the ameliorators. The large nitrate- and phosphate-content zones are near the cultivated fileds in all case. Consequently the intensive supply of the nutrients of the cultivated fileds determines the nitrate- and phosphate contents close to the lake. The potassium - same as the another main nutrients - flows from the higher places to the lower places of the coast. The potassium-flowing is revealed from the cultivated fileds to the lake. In every examined point the capillary upflowing is revealed by potassium. The potassium-concentration is higher in all A-horizon than the B-horizon, therefore the potassium - as easily leaching main-nutrient - was not migrated down into the soil profile.

The copper is presented with some mg/kg concentration in the soil solution. The mean concentrations of the zinc in the soils are 10-300 mg/kg. The concentrations of these elements are under the mean concentrations very much in the studied fileds, the copper-concentration is between 0.03-0.19 mg/kg, the zinc-concentration is between 0.02-0.04 mg/kg. The distribution-maps shows the similar behaviour of these elements in spite of the fact that the copper is bound for the organic matter, while the zinc is bound the aluminium- and iron-oxides. The stains of the high-concentrations were near the cultivated fileds, they have anthropogenic original (soil- and leave-manuring).

Sand layers were found at the soil sample collection (1., 8., 9.). In this sand layers the soil-solution and the rain water can flow free and because of this are the differences between the A- and B- horizons of the samples.

The values of every parameter are decreased in 2013. The EC, nitrate-, phosphate-, potassium-, zinc- and copper-concentration were 21, 15, 45, 29, 0,6, 1 % of the mean values of 2012 in the studied coast of the lake.

Table 1. Base soil chemical data of the samling area

Samples	pH*	EC	$CaCO_3$	OM	NO_3^-	PO_4^{3-}	K^+	Na^+	Zn^{2+}	Cu^{2+}
	-	(µS/cm)	(m/m%)				(mg/kg)			
1A	7.98	143	4.8	1.14	31.5	134.7	32.6	33.2	0.03	0.17
1B	8.06	186	6.3	1.63	37.6	128.0	24.3	45.1	0.03	0.16
2A	7.72	315	9.1	3.59	36.7	111.2	36.8	68.1	0.04	0.19
2B	8.16	151	7.3	0.94	15.4	77.5	12.3	65.5	0.02	0.04
3A	7.87	238	12.0	2.16	15.8	121.3	20.6	130.0	0.03	0.07
3B	8.01	177	9.5	1.48	14.3	74.1	18.4	76.6	0.02	0.05
4A	8.18	209	7.3	1.66	35.7	94.3	20.4	40.7	0.03	0.12
4B	8.25	159	6.6	1.26	31.9	98.8	18.6	40.4	0.02	0.08
5A	7.60	292	11.5	2.72	15.4	90.9	25.0	135.0	0.03	0.13
5B	7.83	225	8.5	1.11	8.2	67.3	12.5	58.6	0.02	0.03
6A	7.50	338	11.0	1.99	13.5	90.9	19.1	155.8	0.02	0.05
7A	7.51	171	3.6	1.18	43.1	128.0	100.4	17.2	0.03	0.07
7B	7.94	133	4.3	0.73	28.0	87.6	78.4	15.4	0.02	0.05
8A	7.90	147	3.8	0.65	20.0	87.6	30.2	19.9	0.04	0.04
8B	7.94	112	4.0	0.59	15.4	70.7	21.8	23.5	0.04	0.04
9A	7.71	103	4.0	0.89	12.9	87.6	30.3	20.1	0.03	0.06
9B	7.72	133	3.8	0.96	17.2	64.0	26.5	21.2	0.02	0.05
15A	7.39	894	13.7	0.95	162.1	221.6	105.5	390.8	5.18	7.52
16A	7.36	897	16.7	2.86	150.1	204.4	107.7	424.9	5.43	7.82

* pH in 1M potassium-chloride solution

CONCLUSIONS

- The effect of the evaporation and the upflow of the salty soil-solution are shown by EC and the sodium-concentration. The carbonate is accumulated because of this effect in the surface horizon. This accumulation is become stronger close to the bed of the lake.
- Sand layers were found in the soil profiles. The layers come from the neighbouring cultivated fields, they were carried by wind. The sand layers change the flow of the rain water and soil-solution so they influence the migration of the elements in the soil profile. The soils around the lake are disturbed sometimes by ploughing.
- The concentrarions of the main mutrients (nitrate. phosphate, potassium) are determined by the anthropogenic original nutrient inflow from the cultivated fields. This effect is made stonger by the slopes and the wind-chart on the studied part of the coast. The copper and zinc are micro-nutrients. The natural concentrations of them are under the mean concentrations of the soils because of this they are compensated by artificial fertilizers. The larger concentration patterns are near the cultivated fields.
- The values of the measured parameters showed large differences in the two consecutive years. The values of the parameters were decreased very much in the samples collected in 2013. The causes of this are the (1) fast leaching, (2) fast use of nutrients in the spring vegetation period, (3) the new dose of ameliorators were not turned out. Consecutively the unapplied nutrients were measured in this year.

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