

SUBSTANCE REGIME PROCESSES DEPENDING ON MICRORELIEF IN A SALT AFFECTED NATURAL GRASSLAND

Lajos BLASKÓ - János TAMÁS - Róbert CZIMBALMOS

Introduction

In Hungary salinization is basically in correlation with the water balance of the soil (evaporation-type soil) and with the groundwater as the source of the salts.

From the point of view of soil protection the recognition of the harmful processes is of great importance. The negative water balance of the hydro-geologically closed Carpathian basin in the summer months resulted in the spread of salt affected soils, now covering 20% of the total area of arable lands (SZABOLCS, 1974; VÁRALLYAY, 1981). On heavy textured soils ZSIGRAI (2001) studied the movement of nitrate, while ZSEMBELI *et al.* examined the long-term effect of a water reservoir (Tisza Lake) on the spatial and time dynamics of salts. The morphological features of the soil surface considerably influence the main factors of the water balance (depth of groundwater, surface runoff, waterlogging, etc). Examining the visibly flat and even soil surfaces closely, it can be discovered that the micro relief is very varied, closed or semi-closed micro basins, valleys with different outlet features are surrounded by the higher parts (Fig. 1.).

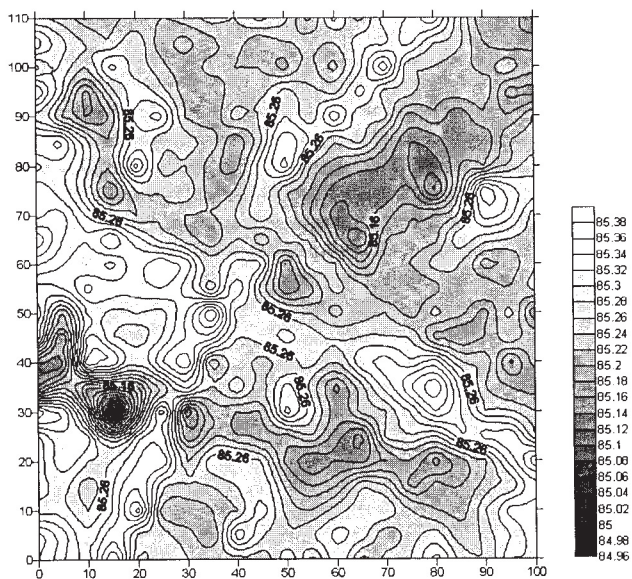


Fig. 1.: The contour map of the sampling area at Karcag

The water gathered on the soil surface can decrease the salt concentration of the root zone. On the base on the measurements done on a salt affected soil in the Hortobágy region, TÓTH *et al.* (2001) created a conceptional model on the correlation of salt accumulation and micro relief. According to this study, the highest degree of salt leaching occurs in the deepest, “meadow-like” soil parts, while salt accumulation is taking place in only one month of the year. Studying the salt affected soils of the area between river Duna and river Tisza, MILE *et al.* (2001) found the opposite: only the lower parts are involved in the salt accumulation process.

Methods

The dependence of salt accumulation from the relief was studied in the case of a meadow solonetz soil located at Karcag. The sampling area of 110x100 m was selected that represents all the three characteristic levels: the lower parts with high water inflow, the higher parts with high outflow and also the transitional situation between these two (Fig. 2.). The laboratory analysis of pH and EC was done according to RHOADES *et al.* (1999) from 1:2.5 soil-water suspensions. For the association measurements the type of the association, the dominant species, the cover rate, the height of the main species and the rate of bare spots were assessed. Several researchers like SZABOLCS (1954); VÁRALLYAY (1968); DARAB (1992); TÓTH and RAJKAI (1994) called the attention to the spatial variability of the salt affected soils in Hungary and determined the physical and chemical reasons of it. Utilising these experiences we evaluated the spatial correlations of salt content, plant cover and micro relief.

We tried to find out if leaching or accumulation is dominant in the salt affected soils of the Middle-Tisza region. Two sampling areas, 10 km from each other, were delimited, where the changes of salt- and sodium content and of the pasture can be monitored.

Results and discussion

Due to the variability of the relief, different spots are formed even on natural pastures, which have different features, like water input. The differences are the most developed in the early spring period. After snowmelt characteristic, spot-like water logging occurs: from the higher parts, due to the poor infiltration rate, the majority of the rainfall water can not penetrate into the soil, but runs off, then gathers in the deeper parts. From the point of view of salt regime this gathering could have two resultants theoretically: the running water carries the salts towards the deeper part and after its evaporation they accumulate, hence the deeper parts function as salt traps (MILE *et al.*, 2001); the other possible result is that the extra water leaches the salts into the deeper soil layers (TÓTH–KERTÉSZ 1993; TÓTH *et al.*, 2001).

According to the examinations done so far the leaching process is dominant in the deeper parts. One of the possible reasons of this is that the water flowing on the solonetzic surface can not solve the sodium of exchangeable form and hence can not transport towards the deeper parts, so on the surface of solonetz kind salt affected soils mainly water with low salt content flows. In Fig. 2. the characteristic pedological resultants of this phenomenon are shown in the cases of two sodic pastures around Karcag. From the upper parts the majority of the rainfall water runs off due to the limited infiltration, and a typical erosion, the so called 'padka' formations appear.

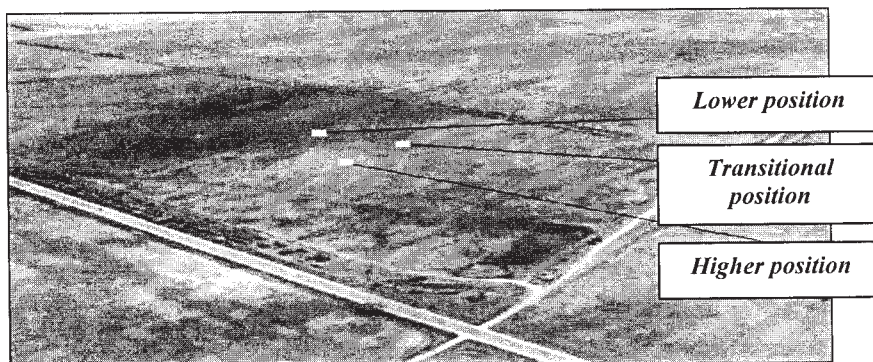


Fig. 2.: Location of soil profiles in the different relief positions of a salt affected pasture

The layer of salt- and exchangeable Na accumulation is quite deep even close to the soil surface. On the less eroded parts pastures with the dominant species of *Festuca pseudovina* can be found, these pastures can mainly be utilised for grazing sheep. From pedological point of view the lower parts are much more favourable. Due to the surplus water originating from run-on leaching is more expressed the high salt- and exchangeable Na content values can be detected only in the deeper layers. The characteristic grass species of the upper parts is *Alopecurus pratensis*. The bigger mass of the grasses and the limited decomposition result in increased organic matter accumulation, so meadow-like soils with deeper humus layer are formed here. Grazing is generally not possible on these wet, boggy areas. The profile of parts with higher position is salty even from the soil surface; the exchangeable Na content exceeds the threshold of salinization (Fig. 3.). In the profile of the lower position the salt content exceeds the threshold (0.1%) only under 40 cm.

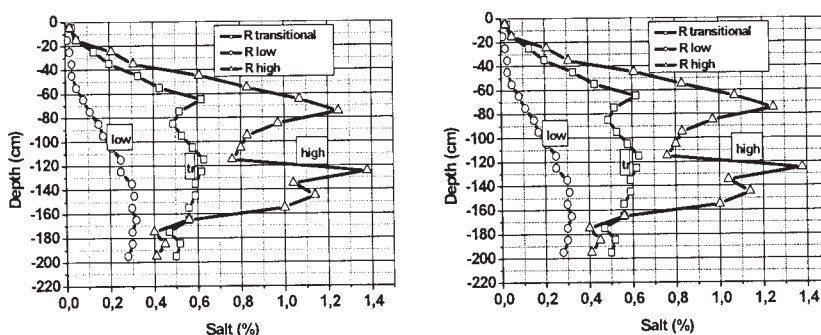


Fig. 3: Salt profiles of meadow solonetz soils with different relief positions

On the lower and at the same time wetter parts, under more favourable pedological conditions, grass species producing higher organic mass grow, while the organic matter production is lower on the higher and drier parts. Therefore the humus content of the soil is much higher on the lower parts than on the higher ones. The higher humus content improves the infiltration capacity of the soil, which reacts on the leaching process, so pedologically the deeper parts are much better.

Conclusions

Pedologically the deeper parts are much better. Due to the surplus water originating from run-on leaching is more expressed the high salt- and exchangeable Na content values can be detected only in the deeper layers. The characteristic grass species of the upper parts is *Alopecurus pratensis*. The bigger mass of the grasses and the limited decomposition result in increased organic matter accumulation, so meadow-like soils with deeper humus layer are formed here. Grazing is generally not possible on these wet, boggy areas, so harvesting the grass is a more rational utilisation of them or they can preferably be maintained as natural wetlands.

References

- Darab K. (1992): A szikesedés kémiája és fiziko-kémiája. Agrokémia és Talajtan, 41. pp. 103-126.
- Mile O. – Mészáros I. – Veres SZ. – Lakatos GY. (2001): A talajtulajdonságok térbeli változatossága és a növényzet közötti összefüggés a kiskunsági Péteri-tó melletti szikes területen. Agrokémia és Talajtan. 50. 427-438.p.
- Rhoades, J. D. – Chanduvi, F. – Lesch, S. (1999): Soil salinity assessment (Methods and interpretation of electrical conductivity management). FAO Irrigation and Drainage Paper, 57. pp. 29-36.
- Szabolcs I. (1954): Hortobágy talajai. Mezőgazdasági Kiadó, Budapest.
- Szabolcs I. (1974): Salt affected soils in Europe. Martinus Nijhoff - The Hague and Research Institute for Soil Science and Agricultural Chemistry of the Hungarian Academy of Science, Budapest.
- Tóth T. – Kertész M. (1993): Mapping the degradation of solonetic grassland, Agrokémia és Talajtan 42. 43-54.p.
- Tóth T. – Rajkai K. (1994): Soil and plant correlation in solonetz grassland. Soil Science. 157. pp. 253-262.
- Várallyay GY. (1968): Salt accumulation processes in the Hungarian Danube Valley. 9 th Intl. Congress of Soil Science. Transactions. pp. 371-380.
- Várallyay GY. (1981): Extreme moisture regime as the main limiting factor of the fertility of salt-affected soils. Agrokémia és Talajtan, 30. Suppl. pp. 73-96.
- Zsembeli J. – Blaskó L. – Juhász CS. (1996): A talajvízjárás és a sómozgás sorozatvizsgálata a Tisza-tó hidrológiai hatásterületén. Tisza-szabályozás 150. évfordulója és annak eredményei. Magyar Hidrológiai Társaság Kiadvány. Debrecen. 155-167.
- Zsigrai GY.: (2001): The Effect of Artificial Fertilization on Some Chemical Properties of The Soil and on The Yield of Maize in Long-Term Experiments. (In. Ed. LAZÁNYI, J.: Sustainable Agriculture and Rural Development. Vider Plus Bt., Debrecen. 91-117.)
- Kádár, I. (2004): Szennyvíziszap-adagok hatása a növény (*Triticum vulgare* L.)-talaj rendszer néhány mikrobiológiai és biokémiai tulajdonságára (Impact of sludge treatments on some microbiological and biochemical properties of plant (*Triticum vulgare* L.)-soil system. – in Hungarian). Agrokémia és Talajtan. 53. 3-4. 331-342 pp
- Svetková, K.; Henselová, M.; Morvová, M. (2005): Effects of a carbonization product as additive on the germination, growth and yield parameters of agricultural crops. Acta Agron. Hun. 53. (3). 241-250 pp
- Tanács, L., Matuz, J., Gerő, L., Petróczi, I.M. (2005): Effect of NPK Fertilizers and Fungicides on the Quality of Bread Wheat in Different Years. Cereal Res. Commun. 33 (2-3): 627-634 pp