

**RELATIONSHIP BETWEEN YEARLY SOIL SALINITY AND
GROUNDWATER DEPTH DYNAMISM AND CHEMICAL COMPOSITION AT
SIX MONITORING POINTS**

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Introduction

Sustainability, that is following a lifestyle which maintains the values of natural environment, but also satisfies the needs of the society is a requirement that we must adapt to. Among such needs the first most important ones are the good quality drinking water and food, which are not possible to obtain without good quality soil (Várallyay 2001). Among soil degradation forms, salinization is one of the most prevailing and most serious, which occurs in natural conditions and on intensively cropped areas as well. Because of the accumulation of soluble salts - mainly sodium salts - salt-affected soils have unfavourable physical and chemical properties, and low fertility. Prevention of human activity causing secondary salinization is a very important task, whereas conservation of the unique vegetation and fauna of naturally salt-affected areas is also necessary. Therefore we have to know the factors affecting the process of salt accumulation, and we have to follow-up the salinization stage of the soils with monitoring systems.

The aim of our work was to determine the importance of factors affecting soil salinization compared to each other. Therefore the temporal change of soil salinity at 3-3 soil sampling points was analysed, which represent contrasting situations in the study of Kovács et al. 2006.

Material and methods

We used salt and CaCO₃ content, pH and particle size data of the samples collected yearly from genetic soil horizons of the Hungarian Soil Information and Monitoring System (TIM) between 1992 and 2000 (Várallyay et al. 1995). Besides we knew the land use of the fields where the test hole was deepened. Out of the 70 sampled salt-affected soil profiles of the TIM, only six were selected for this study (Fig. 1.). According to the previous survey the yearly measured salt content decreased in the selected 3 soil sampling point (1-3) from Bács-Kiskun County (right-, west bank of river Tisza River) during the studied period, while the salt content of the 4-6 soil sampling points from Békés County (left-, east bank of river Tisza River) increased.

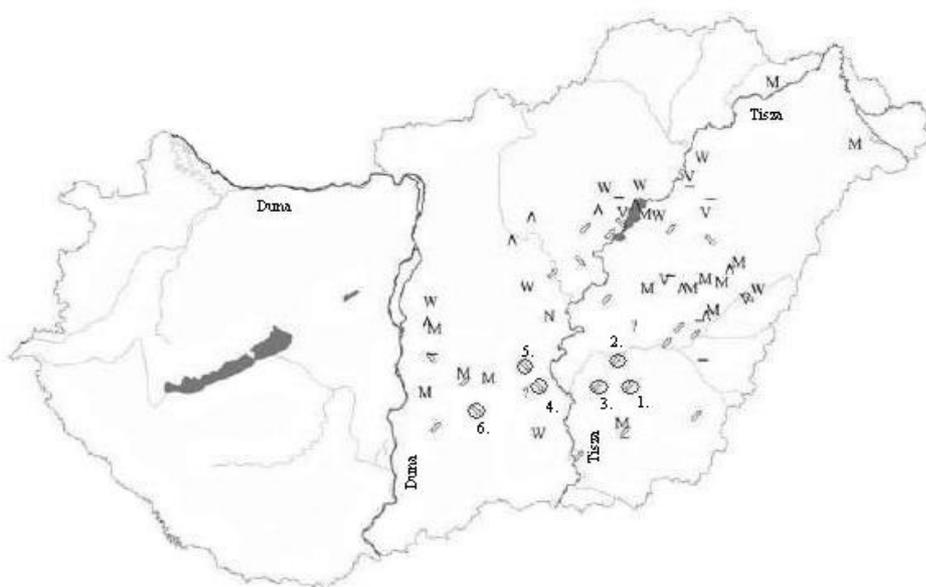


Figure 1. Distribution of the patterns of yearly soil salinity changes over the Great Hungarian Plain with the indication of selected sampling points for this study.

The yearly background meteorological and groundwater data were collected from published data of the Water Resources Research Centre (VITUKI) to accompany the monitored soil salinity data. The meteorological data were collected from the „mesoregions” (Somogyi et al., 1991), and we selected the closest groundwater observation wells to the monitoring points located in the same soil genetic polygon, to provide the background groundwater level data. The data of selected groundwater observation wells close to the monitoring points were incomplete in several cases, therefore we chose other two wells in the same elevation and not farther than 10 km from the wells with complete database, and we replaced missing data with linear regression. In addition, the groundwater chemical database originating from the boreholes deepened during the complex Geological Mapping of the Great Hungarian Plain was available. We used the chemical composition of the groundwater from the closest borehole to the monitoring points.

Our first task was to compile an optimum database for the statistical analysis from the data listed above. Soil salinity data (dependent data) used in our paper come from yearly samplings carried out in October. The background (independent) groundwater level and meteorological data were calculated as averages of months preceding the sampling. Since soil salinization is not an instantaneous process, we checked the effect of periods with differing lengths.

Results and discussions

We studied the importance of the following factors of salinization: meteorological data, groundwater level, the chemical composition of groundwater and the particle size of the soils.

The ANOVA of data from samples collected from the soil profiles located on the right and left bank of Tisza River showed statistically significant difference. Soils from Békés County are heavier, have up to 30 percent higher clay content and one unit lower pH value. The average of measured salt concentrations in the fifth genetic horizon of the soils from Bács-Kiskun County is about the twice of the average value measured in the same genetic horizon of the soils from Békés County. The ANOVA of groundwater chemical parameters collected from the boreholes deepened on the two banks of the river also showed statistically significant difference: in Békés County the salinity and sodicity was several times greater than in Bács-Kiskun County. The mean level of the three groundwater observation wells from Békés County is deeper than the level of the observation wells from Bács-Kiskun County. (Fig. 2.)

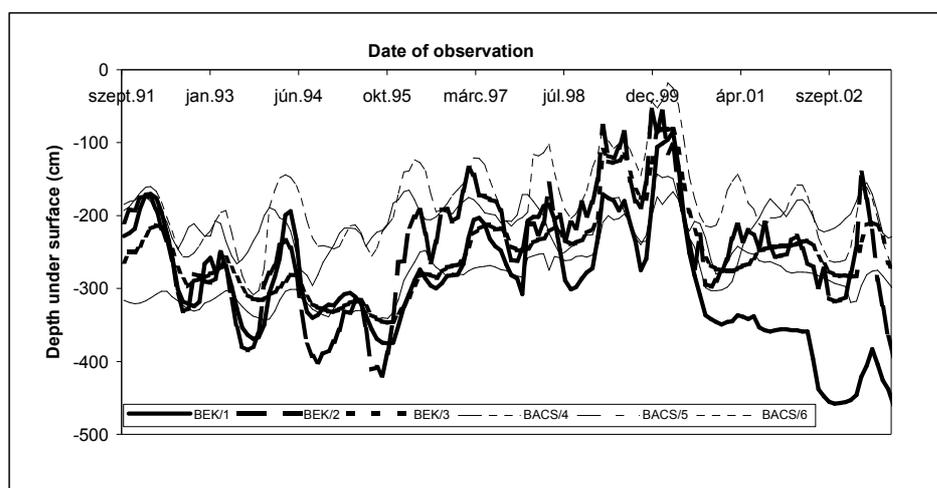


Figure 2. Change in groundwater level at the observation stations from 1992 to 2003

The following significant correlations were found between the soil salt concentrations from different soil horizons and the average values calculated from the monthly average background data for different periods preceding the yearly sampling. The salt concentration of the fifth soil horizon showed positive correlation at the 0.05 level with the current, the previous and the average values of the preceding 2 months groundwater depth, expressed as negative distance under the surface. The salt concentration of the third soil horizon also showed positive correlation at the 0.05 level with average groundwater depth calculated for every preceding period length.

Among the monitored soil properties, only pH and the salt concentration of soils from Békés County showed positive correlation with time. The soil properties of profiles from Bács-Kiskun County didn't showed correlation with time.

The multivariate regression analysis with the salt content of soils and the level and chemical composition of groundwater showed that, salt concentration could be predicted reliably from the values of groundwater depth, Ca^{2+} content, Na^+ and Mg^{2+} content, alkalinity and SAR value of groundwater.

Conclusions

From the Hungarian Soil Information and Monitoring System three-three yearly sampled soil profiles were selected, located either on the right (Bács-Kiskun County) or on the left (Békés County) bank of Tisza River in order to characterize the relationship between soil salinity and background variables.

The ANOVA of groundwater depth and chemical composition and data from samples collected yearly from genetic soil horizons between 1992 and 2000, showed statistically significant difference between the two areas. Soils from the left bank of the river are heavier, the pH value and the average of measured salt concentrations in the fifth genetic horizon are lower. The mean level of the groundwater in Békés County was deeper than the level in the observation wells located in Bács-Kiskun County.

The salt concentration of the fifth and third soil horizons showed positive correlation at the 0.05 level with the average groundwater depths calculated for different time period before soil sampling.

In contrast to the previous survey only the pH and the salt concentration of soils from Békés County showed correlation with time.

Multivariate regression analysis showed that, salt concentration could be reliably predicted with the depth and chemical composition of groundwater.

Acknowledgements

Authors acknowledge the support of HNSF grant T37731 and OM-4/015/2004 "NKFP" grant. Authors also thank Dr. L. Pásztor for all the help with GIS.

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