

**STUDY OF FOOD CHAIN ELEMENT TRANSPORT ANALOGY:
SALINITY/SODICITY/ALKALINITY OF HUNGARIAN SOILS DURING A
DECADE AS SHOWN BY THE NATIONAL SOIL MONITORING NETWORK**

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Introduction

Food chain element transport is becoming more and more important worldwide. Although sodium is only marginally considered to be a major element in the food chain, the large experience collected on it provides useful background information for understanding transport of other similarly behaving soil constituents, such as cations, first of all ammonium. Soil salinization which is caused typically by sodium salts is one of the major degradation forms. Occurring in natural conditions and on intensively cropped areas as well, it is a remarkable process that affects some 5-10% of the total surface area of the continents.

To follow-up the tendencies of soil degradation processes, monitoring systems have been established in many countries. Soil salinization is a process that might be best characterized by soil monitoring networks, since salt concentration of soils can change rather fast.

Materials and methods

In this study we used the Hungarian soil monitoring system in order to decide what is the overall tendency of salinization in Hungary in recent years: is there an increase or decrease of soil salt concentration?

The first period of monitoring in the system was carried out between 1992 and 2000 by successive sampling of the genetic horizons of the soils. Out of the 1236 sampled soil profiles of the "Soil Protection Information and Monitoring system", only the salt-affected soils were selected for this study, making up between 55 and 70 profiles depending on the year.

Results and Discussion

For the less detailed study, the 19 national "county-level" administrative units were used to provide the yearly background meteorological (sum of precipitation, average, minimum and maximum temperature, irradiation) and groundwater depth data to accompany the monitored soil salinity data.

The study period was characterized by a small average rise of groundwater level all over the country. At a yearly time scale the following significant correlations were found between the soil salt concentration and the background variables of yearly precipitation, temperature, irradiation, groundwater depth: The salt concentration of the first, third and fourth soil horizons showed negative correlation at the 0.05 level with the groundwater depth of the previous year. The salt concentration of the first soil horizon showed positive correlation with the irradiation of the current year at the 0.05 level (Fig.1.a). The second soil horizon showed positive correlation with the irradiation of previous year at the 0.05 level (Fig1.b.).

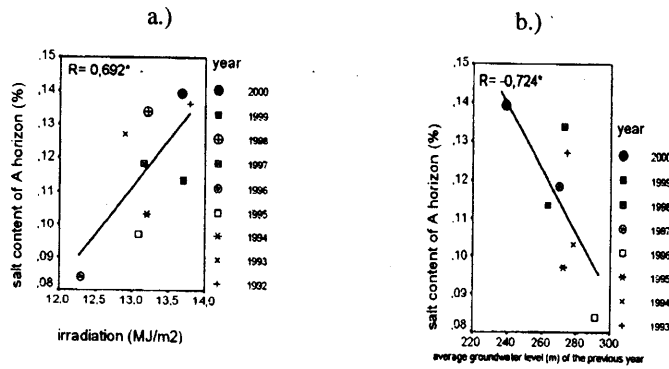


Figure 1. Scatterplot of average yearly measured soil salinity versus a.) yearly mean irradiation and b.) yearly mean groundwater level

Strongest response regarding soil salinity was shown by the second genetic horizon, which is either the second horizon of „1.SOLONCHAK”, or the "B" horizon of „2.SOLONCHAK-SOLONETZ”, „3.MEADOW SOLONETZ”, „4.MEADOW SOLONETZ TURNING INTO STEPPE FORMATION” „5.SOLOD” and „6.SOLONETZIC MEADOW” soils, where the maximum intensity of salt accumulation is found.

Based on the salinity, three groups were distinguished, the group of „SOLONCHAK”-type soils, including the first and second soil types, the group of „MEADOW SOLONETZ” soils, including the third type and the group of „SOLONETZIC” soils including types 4-6.

There were differences in the tendency of salinity between the groups, calculated by correlation analysis. Soils belonging to „SOLONCHAK” group showed a decrease of soil salinity by time in their second genetic soil horizon. In the group of „MEADOW SOLONETZ” there was no significant tendency shown by any soil depth. In the group of „SOLONETZIC” soils there was an increase in the soil salinity of the whole profile.

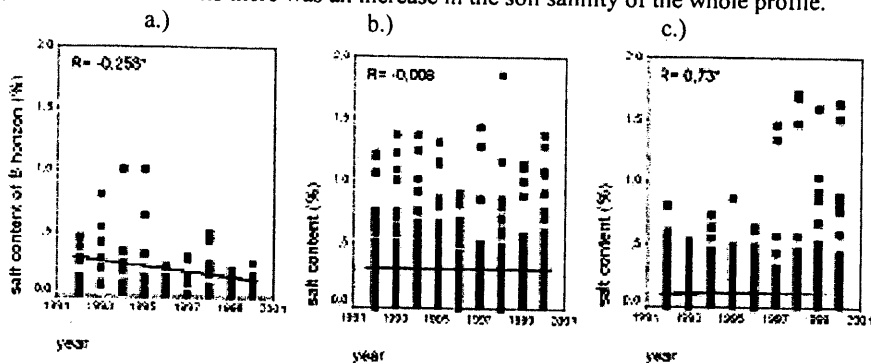


Figure 1. Changes of soil salinity in a.) Solonchak, b.) Solonetz, c.) Solonetzic soilgroup

These results indicate the strong atmospheric control over soil salinity (the groundwater depth is correlated to the precipitation of the previous year). There are no immediate effects, but rather retarded ones when the salinization is being related to yearly average and cumulative meteorological and groundwater data. Salinization is an active process, the most extreme salt-affected soils are becoming less saline, but the least salt-affected soils showed increasing salt concentration parallel to an increase in groundwater level.

For the detailed study the first task was the compilation of a database with the optimal support to the soil monitoring profiles. Optimization meant selection of those data that will provide most powerful interpretation to the temporal and spatial changes of soil salinity data. Since we have yearly collected soil salinity data (dependent data) from October it is not evident which background (independent) data of groundwater level and meteorological parameters are selected to enter the statistical analysis. "Which" means what frequency and for which time length should the data be selected and from which data collection station, since there are no meteorological stations at each soil monitoring point.

The optimization in time was done based on a detailed database available at Apaj (Tóth and Kuti, 2002). Through the use of correlation coefficient we checked which it the length of the preceding period that shows the closest correlation coefficient with the soil salt concentration. Based on October month and using monthly average meteorological data for the calculations the average values of the preceding 12 months (from October to September) showed the largest correlation coefficient (data not shown).

The optimization in space was done by visualizing the soil monitoring points and monitored groundwater wells on a GIS-based soil genetical map of Hungary at the scale of 1: 100 000. In the map the closest groundwater observation wells located in the same soil genetical polygon, in which the monitoring point was selected to provide the background temporal groundwater level data for the statistical calculations. From among the meteorological stations the selection was done on the basis of precipitation data, since these are the most variable parameters among the well documented ones. The yearly sums of precipitation collected between 1941 and 1971 at stations close to the soil monitoring points were analysed by ANOVA in order to compare at which level there are significant differences between the data. Based on the F values calculated from among three hierarchical spatial regionalization levels (see Somogyi et al., 1991), "mesoregions" showed outstandingly large F value, and this way this level was selected to provide the background data to be used as independent variables for meteorological data.

The first analyses with the data set showed that there was no significant trend in the salt content of the soils in the period 2000-2003 in either of the soil groups distinguished. Also there was a lack of correlation between the precipitation data and the salt content data from 0-30, 30-60 or 60-90 cm depth.

Conclusions

All information available about temporal and depth changes in easily soluble ions in the soil solution can be utilized when inferring on the transport of the elements of food chain. The results of the monitoring of soil salinity thus can facilitate the understanding of changes in cations occurring in soil solutions, such as ammonium.

The statistical analyses of any monitored data must be carefully planned in order to provide the optimal background data (independent data) from all those available to accompany the monitored soil data (dependent variable).

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