Soil scientific investigation in Székesfehérvár

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Abstract – In our investigation the chemical and physical characteristics of different soil types have been analysed in Székesfehérvár and in its surroundings. In spring-summer 2011 we collected 288 samples on 144 points from two soil layers (in 0-10 and 10-20 cm depths). Based on our results it can be concluded, that the soils are mostly alkaline, and the calcium-carbonate content is high mainly in the city. The acidity and calcium-carbonate content of soils are determined fundamentally by the parent material and the calcareous deposited debris. Based on the particle size distribution and the Arany-type compactness analysis, most of the samples are loamy textured soils. The physical assortments show a heterogeneous picture in the city area, which refer to the soil types with different deposition. The upper soil layer is well supplied with nitrogen. It can be explained by the artificial fertilizer applied in this agricultural area and the human activity in the city region. The soil of the surrounding agricultural territory is in the most cases less humic. The possible reason of this is the intensive agricultural cultivation in this region. The agricultural area shows generally very high phosphorus values, which is probably resulted from the anthropogenic phosphorus fertilization. We detected the highest iron and manganese contents in the Csalai forest, which is situated in the northeast direction from the town. These high iron and manganese values refer to mineral origin. In both layers the highest copper values have been detected in the Máriavölgy street along the main road in suburban district. Salient zinc values have been found in Szárazrét (western part of the town), from the industrial area along the railway line, where an iron-foundry industry and an oil storage tank are located nearby. Furthermore, higher zinc values have been detected along the roads, which may originate from exhauster gas.

Keywords: Székesfehérvár / urban, suburban area, agricultural and forested area / upper and deeper soil layers/ chemical and physical soil properties

1. INTRODUCTION

Chemical and physical characteristics of soils have been analysed in Székesfehérvár and in the surrounding agricultural and forested areas. Our aim was to identify the main feedback effects between the town and its environment.

1.1 **Study area**

The town belongs to Fejér county and has more than 100.000 inhabitants. It is located at the meeting point of Sárrét and South-Mezőföld (Fieldland). The elevations are between 103 and 222 meters above sea level. The rocks are known for the Venetian Mountain's carbonic granite together with different paleozoic metamorphic formations. The climate of the city is warm and dry. The annual temperature mean is 10.2-10.4 °C, and annual precipitation sum is less than 540 mm. The most common winds are from the northwest with the average speed of 2.5-3 m/s. The most important watercourse is the Gaja stream, which is the eastern border of

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the city. Two big fish-ponds also belong to the town. The area is located in the transitional border zone of the mountainous and foreststeppe vegetation. The vegetation cover is significantly degraded or is mostly used by agriculture, which can be found near to the natural vegetation areas. There are 10 soil types in the investigated area, of which the productivity of meadow soils are the most favourable. The nature facilities are preferring the cultivation of field crops (DÖVÉNYI ed. 2011, FARKAS ed. 1997).

2. MATERIALS AND METHODS

In spring-summer 2011 we collected 288 samples on 144 points from two soil layers (in 0-10 and 10-20 cm depths) applying a random roaming method. We characterized the individual measurement points on site, determined the properties of the soil layers. Furthermore, we noted the GPS-coordinates of the point, the elevation above sea level, the date of the data collecting, the type of the urban area, the vegetation and land use types, as well as the origin of the soil. The following soil characteristics have been determined: the borderline between the two layers, the amount of humus, the structure, the compactness, the root system, the skeletal percent, the colour, the physical assortment, the separated element and the soil disturbance. In the laboratory the chemical analyses of the soil samples have been focused on the following properties and components: acidity (pH_{H2O}, pH_{KCl}), calcium-carbonate content, hydrolytic and exchange acidity, amount of exchangeable cation, humus content, total nitrogen content, ammonium-lactat-acetous acid (AL) solvent potassium and phosphorus content, KCl solvent magnesium and calcium content, the strength of ethylene-diamin-tetra-acetous (EDTA) and diethylene-triamin-penta-acetous (DTPA) measurements of manganese, copper, zinc and iron element, as well as the particle size distribution (BELLÉR 1997). The results of the field and laboratory investigations have been represented in a GIS system (Digiterra Map). The element value categories have been established based on BARANYAI et al. (1987), BELLÉR (1997), STEFANOVITS et al. (1999) and JUHÁSZ (ed., 2006).

3. RESULTS

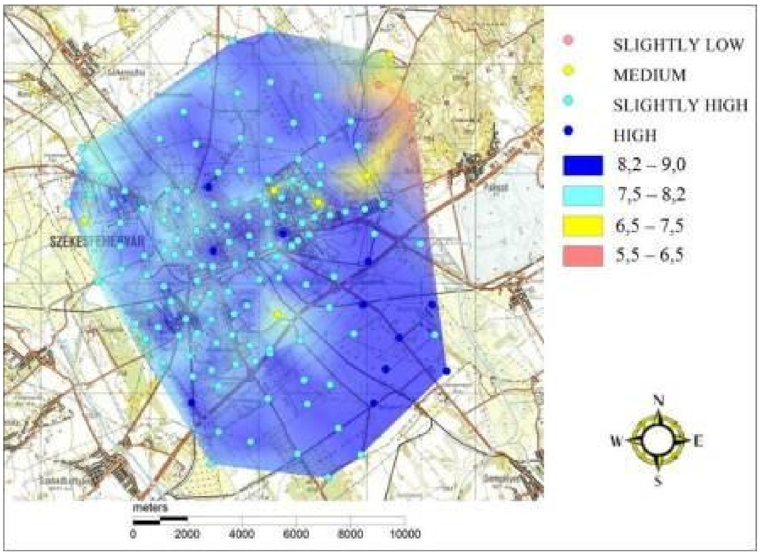

Figure 1. The soil pH (pH_{H_2O}) in the upper layer (in 0-10 cm depth)

Based on the results of the pH-measurements, 85% of the upper soil layer (0-10 cm depth) is slightly alkaline, 7% is neutral, another 7% is alkaline and 1% is slightly acidic (*Figure 1*). The deeper layers of the soil samples (79%) are showing slightly alkaline pH values. The calcium-carbonate content of the upper layers (*Figure 2*) is in 42% of the samples very high, in 49% high, in 9% medium, in 2% low and in 2% of the samples we do not detected any calcium-carbonate. The calcium carbonate content of the lower layer is similar to the upper layer. The acidity and calcium-carbonate content of the soil samples is basically determined by the parent material. In the city the soils are mostly alkaline, and the calcium-carbonate content is mainly very high. The reason of this (beside effect of parent material) can be the calcareous deposited debris.

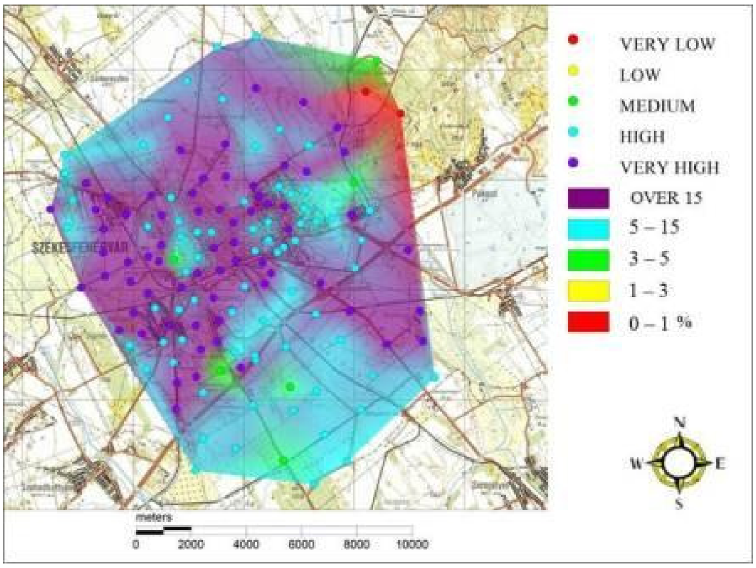

Figure 2. The calcium-carbonate ($CaCO_3$%) content in the upper soil layer (in 0-10 cm depth)

Based on the particle size distribution and the Arany-type compactness analysis, in the larger part of the samples the physical assortment of the upper soil layer is loam (31%), clayey loam (24%) and sandy loam (23%). In smaller rate there are clay (13%), weighty clay (6%) and sand (3%). In the deeper soil layer the distribution of the physical assortment is the following: loam 33%, sandy loam 26%, clayey loam 22%, sand 13%, clay 5% and rough sand 1%. The distribution of the physical assortments shows a heterogeneous picture in the city area, which refer to soil types with different deposition.

The results of the total nitrogen content analyses show that the upper soil layer is well supplied with nitrogen in 83%, medium supplied in 16% and slightly supplied in 1%. The lower layer is well supplied with nitrogen in 72%, medium supplied in 26%, slightly supplied in 1% and very little supplied in 1%. It can be explained by the artificial fertilizer applied in this agricultural area and the human activity in the city region. In 0-10 cm depth more than half of the samples belongs to the slightly humic category, one third of samples to the humic class. In 10-20 cm depth two-thirds of samples are in the slightly humic category, one fifth of samples in the humic class and one-eighth of samples in the poorly humic category. It is interesting to mention, that a significant part of the humic area is located inside the city. The soil of the surrounding agricultural area is in the most cases slightly humic. A possible reason for it is the intensive agricultural cultivation in this region.

The ammonium-lactat-acetous acid (AL) solvent potassium content measurements in the upper layer show the following results: in 28% of the samples is its value very high, in 20% high, in 16% good medium, in 19% moderately medium, in 13% low and in 3% very low. The potassium contents in the lower part of the soil samples are as follows: in 19% of the samples is very high, in 10% high, in 17% good medium, in 17% moderately medium, in 23% low and in 14% very low. In both soil layers we detected the highest potassium values in the Börgöndi street. According to the results of the AL solvent phosphorus measurements, two-thirds of the soil samples contained more than 36 mg phosphorus in 100g soil. We measured very low values for example the western part of the Velence-hills. In the agricultural area the phosphorus values are generally very high, which probably comes from the anthropogenic phosphorus fertilization. *Figure 3* shows the mean phosphorus content in the two soil layers.

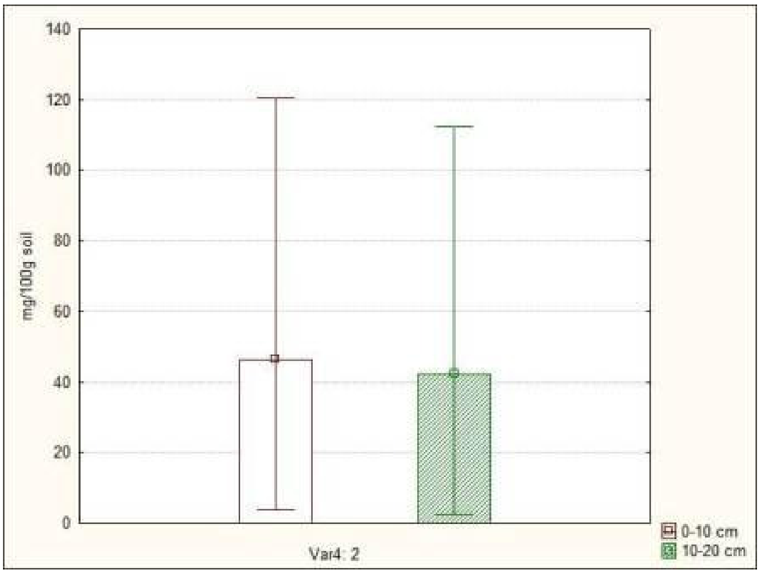

Figure 3. The mean P content in the two investigated soil layers. Error bars are representing the minimum and maximum values.

The KCl solvent magnesium content values are mainly between 0.1-0.4 g/kg in both layers. We detected the highest magnesium values in the Seregélyesi street in both soil layers (*Figure 4*). The KCl solvent magnesium content values are between 0.34 and 5.75 g/kg. The highest values were detected near to the Téglagyári- and Horgásztó.

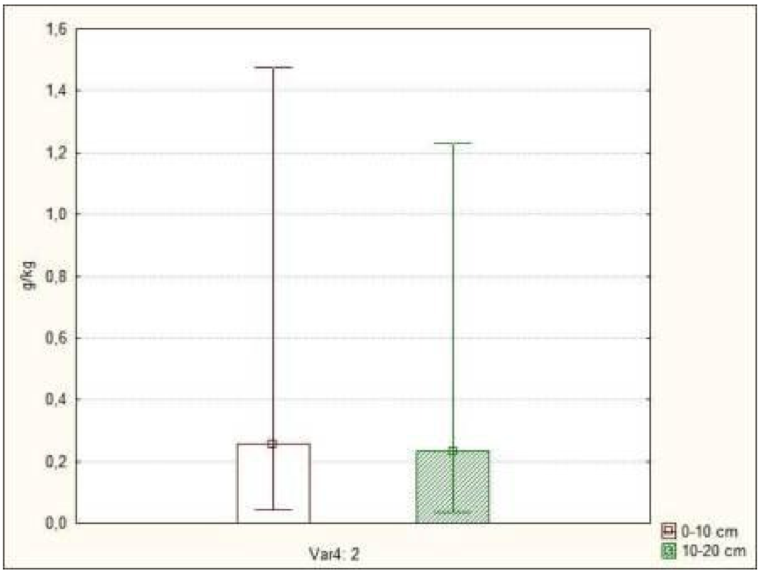

Figure 4. The mean Mg content in the two investigated soil layers. Error bars are representing the minimum and maximum values

The ethylene-diamin-tetra-acetous (EDTA) and diethylene-triamin-penta-acetous (DTPA) values were between 0.8 and 422.7 mg Fe/kg soil. The EDTA/DTPA solvent manganese contents are between 3.9 and 253.3 mg Mn/kg soil in both layers. We detected the highest iron and manganese contents in the Csalai forest, which is situated in the north-eastern

direction from the town. These high iron and manganese values refer to mineral origin and correspond to a slightly acidic forest soil. The EDTA/DTPA solvent copper values were between 0.51 and 174.02 mg Cu/kg soil. The highest copper values have been detected in the Máriavölgy street, along the main road in suburban district. The EDTA/DTPA solvent zinc values of soil samples varied between 0.42 and 311.22 mg Zn/kg soil (*Figure 5*).
Salient zinc values have been found in Szárazrét (western part of the town), from the industrial area along the railway line, where an iron-foundry industry and an oil storage tank are located nearby. Furthermore, higher zinc values have been detected along the roads, which may originate from exhauster gas.

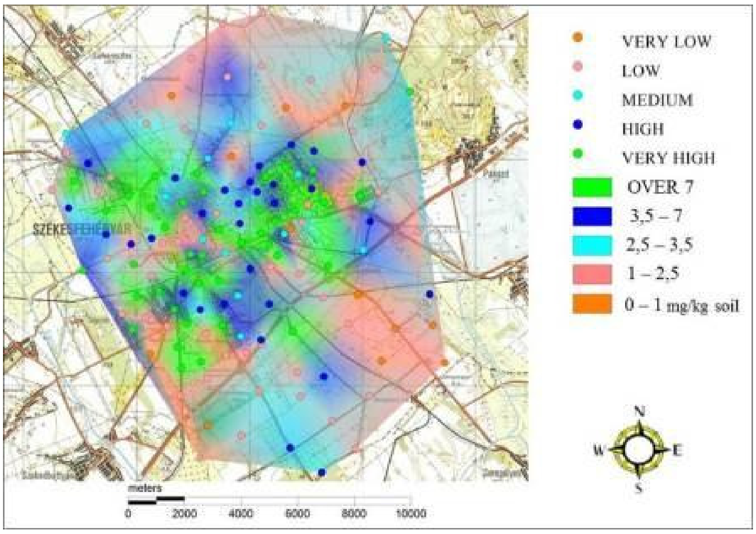

Figure 5. The zinc values (mg/kg soil) in the deeper soil layer (in 10-20 cm depth)

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