INTERACTIONS BETWEEN SOIL STRUCTURE 
AND EXCESS WATER FORMATION ON CHERNOZOEM SOILS

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Introduction

The main natural resource of Hungary is soil therefore its protection is a fundamental obligation for the state and the farmers too. The frequency of the weather extremes has increased due to the global climate change which takes effect also on the soil properties. The Hungarian agriculture was stricken with drought in the 1990’s, whereas inland excess water has caused damages in the previous decade. According to multi-variable correlation tests, pedological parameters influence on the formation of extra water besides hydrogeomorphological, geological or relief factors. But not only the soil parameters can take effect on the formation of excess water; but also excess water can modify the soil parameters – causing appearance of hydrodynamic characteristics or physical degradation (crusts) leading to loss of multifunctionality of soils. The value of the soil depends how many functions the soil has in the same time. Soil can integrate, accumulate the effects of other natural resources. But due to the inland excess water store function and biosphere function of the soil are limited.

Purposes

• to identify the properties of chernozem soil which influence the formation of inland excess water

• to estimate the effects of excess water on soil structure

Materials and methods

With a Multitemporal analysis of Landsat TM-ETM images (04/2000, 06/2006 and 07/2010), the study area covered (Fig. 1) was defined (located on the South Hungarian Great Plain). In the process of appraising the study field, agrotopographic and keyplag soils, regional hydraulic regimes by Aimali and inland excess water frequency maps by Pálfalvi were considered (Fig. 1).

In July, 2011 soil samples were collected along a 709 meters long catena at each 50 meters from the depth of 0-5 cm, 10-15 cm and 20-25 cm to compare the partial size distribution and agronomic structure of soils covered temporarily by excess water and without it.

Applied laboratory methods

• Hungarian State
• Agronomic structure (aggregate-size distribution) with dry sieving – 9 classes of structural aggregates were separated (>20, 20-10, 10-5, 5-3.15, 3.15-2, 2-1, 1-0.5, 0.5-0.25 and <0.25 mm); mean weight diameter (MWD) was calculated from the mean size of aggregate-fractions according to ratio of weight of aggregate-fractions.

Penetration resistance and relative moisture of soils were determined at the depth of 60 cm in definite points (n=117) of a 25x25 meters grid on the 4 hectare by inland excess water par. (Fig. 2) in order to create a multilayer-map from the soil compaction data.

Conclusions

The researches on our study field have proven that partial size distribution and texture are the most influential factors out of the soil parameters taking effect on formation of inland excess water.

The partial size distribution of the examined soil samples affected by excess water can be characterized with high proportion of clay fraction, thus their texture is clay silty loam. The inland excess water results in a peculiar dynamics of wetting-drying which might lead to aggregation degradation over the agrophic structure of soil. Mostly coarse aggregates (2-5 mm) are typical of the aggregate size distribution of samples of excess water patches – the MWD values are above 13 mm which indicates the degradation of soil structure and hereby the loss of multifunctionality.

In our study site, soil compaction is also responsible for formation of inland excess water. Both on the area covered and not covered by excess water soil compaction was measured by 3T System hand penetrometer in a depth of 55-45 cm.

In our further research, relations and functionality between soil relative moisture content, penetration resistance and bulk density will be carried out to compare the penetration resistance values of areas with different relative moisture content.

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Figure 1. Study field with inland excess water patches and the apportion points

Figure 2. Sketch of sampling points in a 3D grid of 25x25x25 cm

Figure 3. Partial size distribution of upper soil samples

Figure 4. Soil samples in a 3D grid of 25x25x25 cm

Figure 5. Crusts on clayey soil

Figure 6. Aggregate-size distribution by dry sieving

Figure 7. Mean weight diameter of soil aggregate

Figure 8. Sampling and excess water pattern

Figure 9. Vertical profiles of soils