Summary

Thesis author:	Łukasz Borek, MSc
Thesis supervisors:	Prof. Krzysztof Ostrowski Andrzej Bogdał, PhD
Faculty:	Faculty of Environmental Engineering and Land Surveying
Department/Institute:	Department of Land Reclamation and Environmental Development
Granted title:	Doctor of agricultural sciences in the discipline of environmental protection and development
Thesis title:	The effect of subsoiling on certain physical and water properties of selected arable soils
Keywords:	subsoiling, physical and water properties of soil, water resources

Thesis summary:

The paper presents the effect of subsoiling on certain physical and water properties of selected arable soils. The relevant field studies and laboratory tests were carried out from April 2011 until April 2015 in Poland (the district of Racibórz and Kraków) and Slovakia (the district of Nitra). In the open pits in the field selected morphological features were identified. In the laboratory the following properties were determined: granulometric composition, solid phase density and bulk density, mass and volumetric moisture. That allowed to calculate porosity and the percentage of different phases in the soil. What was also determined was organic matter and soil reaction (pH). As far as water properties are concerned, in the field water permeability of the soil was measured, and in the laboratory – soil water potential, on the basis of which soil retention and water supplies were calculated. The object of the analysis were the results of examination of 18 soil pits: 9 before and 9 after subsoiling treatment, where 69 genetic horizons were separated. In terms of granulometric composition, the examined soils belong to a group of loam and silty, to subgroups of silty clay loam (SiCL), loam (L), sandy loam (SL), and silty clay (SiC) and silty loam (SiL). The results of the research were characterized using basic descriptive statistics and nonparametric tests, at the significance level $\alpha = 0.05$. The analyzes were carried out within the soil genetic levels of profiles – subjected to the influence of subsoiler, taking soil type as a criterion for the homogeneity of comparisons. The statistical significance of the effect of subsoiling on the change of soil bulk density and infiltration was evaluated. What was also determined was the significance of differences of distributions of general population of the properties tested in individual layers of the soil before and after subsoiling. Calculations were carried out of the statistical significance of the relationship between the granulometric composition and organic matter content and selected physical and water properties of the soils, as well as the relationship between the soil bulk density and physical and water properties of the soil in different variants.

The examined soils in terms of granulometric composition are not homogeneous in different genetic horizons. However, in the topsoil and subsoil, subjected to the influence of subsoiler in the facilities located in Poland, two types of soil dominate: silty loam and silty clay. The statistical interpretation of the results was carried out separately for the topsoil and subsoil, before and after subsoiling. The evaluation of the effectiveness of deep loosening of heavy soils showed a statistically significant decrease in the soil bulk density in both layers (topsoil and subsoil) and a statistically significant increase in the infiltration, but only in topsoil. In subsoil, subsoiling also increased

infiltration, but this increase was not statistically significant. Double subsoiling in the object of Koliňany (Slovakia) resulted in a total percolation of rainwater and reduced surface runoff.

A statistically significant relationship was found between physical and water properties of soil and the content of granulometric fractions and organic matter as well as soil bulk density. The results of the research show positive effects of subsoiling on the air-water relationship in the soil. In the majority of profiles an increase in percentage content of the gas phase in the first and second genetic levels of subsoiled soil was observed. The results confirmed that subsoiling increases the potential use of retention capacities of compacted and overdried soils and improves water effluent from the profiles with excessive humidity. Increasing water permeability of the surface layers of soil profiles also contributes to reducing surface runoff, preventing erosion. Subsoiling of compacted heavy arable soils is then justified, because in many cases of a lack or an excess of water it may prove to be enough to achieve optimal air-water relationship in the soil profile, without the need for costly drainage systems. This procedure should contribute to the rational management of water resources in the agricultural area, by mitigating the effects of drought and floods. The effectiveness of the subsoiling treatment of heavy and overly compacted soils should be confirmed by farmers obtaining satisfactory yields.