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Soil aggregate stability within the morphologically diverse area

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This study evaluates the effect of soil erosion on properties of topsoil especially on soil aggregate stability. Study was performed on morphologically diverse study site (6 ha area) in loess region of Southern Moravia, Czech Republic. The region has been under uninterrupted agricultural use since the middle of the Holocene. Haplic Chernozem is an original dominant soil unit in the area, nowadays progressively transformed into different soil units along with intensive soil erosion. There are eroded phases of Chernozem, Regosol (the steepest and heavily eroded parts of the study area), colluvial Chernozem and Colluvial soil (base slope).

Sampling spots were selected in order to represent diverse soil units and morphological units. Soil samples were taken from the topsoil, carefully transported to the laboratory and consequently air dried. Following soil properties were measured: pH_KCl, pH_CaCl2, soil organic matter content (SOM), carbonate content (CO_3), content of iron and manganese (in ammonium oxalate extract, Fe_o and Mn_o, and dithionite–citrate extract, Fe_d and Mn_d), and stability of soil aggregates using two different methods. The indexes of water stable aggregates (WSA) were determined using the procedure presented by Nimmo and Perkins (2002). The three methods proposed by Le Bissonnais (1996) were also used to study various destruction mechanisms. The fast wetting test (KV1) was applied to study aggregate slaking due to the compression of the entrapped air (mechanism similar to the WSA test). The slow wetting test (KV2) was used to evaluate aggregate disintegration caused by the micro cracking due to the different swelling, and physico-chemical dispersion due to the osmotic stress. The shaking after prewetting test (KV3) was utilized to study the mechanical aggregate breakdown. Terrain attributes were evaluated from digital terrain model.

In general the lowest soil aggregate stability was observed on steep slopes, which were highly impacted by soil erosion. The highest aggregate stability was measured on soils sampled at relatively flat upper parts, which were only slightly influenced by erosion processes. Higher stability was also obtained on base slope, where the sedimentation of previously eroded soil material occurred. Following correlations were obtained between different test results: R=0.911 for WSA and KV1, R=0.481 for WSA and KV2, R=0.700 for WSA and KV3. The statistical significant correlation was found between WSA index and SOM (R=0.403), WSA and pH_CaCl2 (R=-0.360), WSA and Mn_d (R=0.408), WSA and Mn_o (R=0.355), KV1 and SOM (R=-0.377), KV1 and pH_CaCl2 (R=0.352), KV2 and CO_3 (R=0.379), KV3 and pH_CaCl2 (R=0.376). We also found statistical significant correlation between WSA index and two terrain attributes (plan curvature R=-0.490, and total curvature R=-0.501).

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