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Colluvial soils as a carbon pool in different soil regions

Tereza Zádorová (1), Vít Penížek (1), Daniel Žížala (1,2)

(1) Czech University of Life Sciences Prague, Faculty of Agrobiology, Food and Natural Sciences, Department of Soil Science and Soil Protection, Kamýcká 129, Praha 6, Czech Republic (zadorova@af.czu.cz), (2) Research Institute for Soil and Water Conservation, Žabovřeská 250, 156 27 Praha 5 – Zbraslav, Czech Republic

Distribution and storage of soil organic matter are controlled by various environmental factors. In areas influenced by soil erosion, the soil organic carbon (SOC) pattern is characterized by both its removal in some parts and its storage in other parts of the landscape. Colluvial soils formed by accumulation of soil sediments represent such a carbon pool. SOC stock in colluvial soils was determined and related to terrain attributes on three agricultural plots (from 7 to 30 hectares) with different soil and geologic (Cambisol, Luvisol and Chernozem) character. The analysis was also focused on differences in SOC distribution in topsoil and subsoil. The study was based on a detailed network of soil borings and deep cores. SOC content was determined in each 25 cm in entire A horizon up to the depth of 5 m. SOC density determined in each point using SOC concentration, bulk density and A horizon thickness was statistically related to various terrain attributes derived from a detailed digital elevation model. Grid of SOC density was obtained by interpolating point measurements using the terrain attributes as accessory variables; the total SOC stock was then calculated by summing the grid cells. In Chernozem and Luvisol regions, SOC stock is strongly related to the terrain character when topographic wetness index and plan curvature were the most significantly related to the distribution of SOC density. In Cambisol region, low relationship between SOC distribution and terrain attributes was observed. Thickness of A horizon is variable in the three plots: its depth reaches up to 5 meters in Chernozem region while in Luvisol and Cambisol the maximum observed thickness was 1 meter. SOC density averages from the three plots are 7.63 kg.m-2 (Cambisol), 12.06 kg.m-2 (Luvisol) and 32.28 kg.m-2 (Chernozem). SOC stock in the topsoil (0-30 cm) represents 54.5 % in Cambisol region, 43.6 % in Luvisol region and only 19.3 % in Chernozem region from the total SOC stock. This finding shows an importance to include organic matter occurring under the plough layer into the total SOC stock calculations. SOC stock in colluvial soil showed significant differences at the three sites. In Chernozem region, a long-term erosion led to an intensive material redistribution and SOC concentrated in deep colluvial soil represents more than a half (56.9 %) of the total SOC stock at the study plot. By contrast, colluvial soil does not represent a large pool of organic carbon in Luvisol and Cambisol regions when they comprise 10.68 %, respectively 6.28 % of the total SOC stock at the study sites. Such a different distribution of material results mainly from distinct properties of the three soil units and their different vulnerability to soil erosion.

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