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Storage of Organic Carbon in Chemical Fractions in Acid Soil as Influenced by Different Liming

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Abstract : Soil organic carbon (SOC) is the key soil quality and ecological stability indicator, therefore, carbon accumulation in stable forms not only supports and increases the organic matter content in the soil, but also has a positive effect on the quality of soil and the whole ecosystem. Soil liming is one of the most common ways to improve the carbon sequestration in the soil. Determination of the optimum intensity and combinations of liming in order to ensure the optimal carbon quantitative and qualitative parameters is one of the most important tasks of this work. The field experiments were carried out at the Vezaiciai Branch of Lithuanian Research Centre for Agriculture and Forestry (LRCAF) during the 2011–2013 period. The effect of liming with different intensity (at a rate 0.5 every 7 years and 2.0 every 3-4 years) was investigated in the topsoil of acid moraine loam Bathygleyic Dystric Glossic Retisol. Chemical analyses were carried out at the Chemical Research Laboratory of Institute of Agriculture, LRCAF. Soil samples for chemical analyses were taken from the topsoil after harvesting. SOC was determined by the Tyurin method modified by Nikitin, measuring with spectrometer Cary 50 (VARIAN) at 590 nm wavelength using glucose standards. SOC fractional composition was determined by Ponomareva and Plotnikova version of classical Tyurin method. Dissolved organic carbon (DOC) was analyzed using an ion chromatograph SKALAR in water extract at soil-water ratio 1:5. Spectral properties (E4/E6 ratio) of humic acids were determined by measuring the absorbance of humic and fulvic acids solutions at 465 and 665 nm. Our study showed a negative statistically significant effect of periodical liming (at 0.5 and 2.0 liming rates) on SOC content in the soil. The content of SOC was 1.45% in the unlimed treatment, while in periodically limed at 2.0 liming rate every 3–4 years it was approximately by 0.18 percentage points lower. It was revealed that liming significantly decreased the DOC concentration in the soil. The lowest concentration of DOC (0.156 g kg-1) was established in the most intensively limed (2.0 liming rate every 3–4 years) treatment. Soil liming exerted an increase of all humic acids and fulvic acid bounded with calcium fractions content in the topsoil. Soil liming resulted in the accumulation of valuable humic acids. Due to the applied liming, the HR/FR ratio, indicating the quality of humus increased to 1.08 compared with that in unlimed soil (0.81). Intensive soil liming promoted the formation of humic acids in which groups of carboxylic and phenolic compounds predominated. These humic acids are characterized by a higher degree of condensation of aromatic compounds and in this way determine the intensive organic matter humification processes in the soil. The results of this research provide us with the clear information on the characteristics of SOC change, which could be very useful to guide the climate policy and sustainable soil management.

Keywords : acid soil, carbon sequestration, long–term liming, soil organic carbon
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