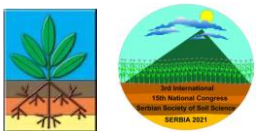

CARBON SATURATION POTENTIAL IN LONG-TERM WINTER WHEAT CROPPING SYSTEMS ON CHERNOZEM

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Abstract

Sequestration of atmospheric carbon (C) in soils is considered an important tool in CO_2 mitigation, therefore various management options for increasing soil organic carbon (SOC) have been discussed. Agricultural soils are characterized with high C sequestration potential, but promising management strategies are slowly accepted. Several studies showed that there is an upper limit of SOC storage that represents C saturation at a specific level where soil losing its ability to stabilize soil organic matter against microbial mineralization. Conversely, C saturation indicated historical loss of SOC. To evaluate C saturation data was acquired from the long-term experiment on a Haplic Chernozem at the Rimski Šančevi experimental station of the Institute of Field and Vegetable crops. Soil samples were collected from the winter wheat and adjacent land (control) for 0-20 cm and 20-40 cm depth under the following treatments: 4-year rotation with manure 40 t ha^{-1} (BØ); 4-year rotation, manure 40 t ha^{-1}+100 kg N ha^{-1} (B2); 4-year rotation 200 kg N ha^{-1} without crop residues (A4); 4-year rotation 200 kg N ha^{-1} +crop residues (C4); wheat monoculture + 100 kg N ha^{-1} (MO); 2-year rotation + 100 kg N ha^{-1} (D2); 3-year rotation + 100 kg N ha^{-1} (D3); unfertilized 2-year (N2); 3-year rotation (N3) and native vegetation (NV). The potential C saturation (C_{satpot}) of particles <20 µm was calculated using the equation of Hassink (1997). To calculate the C saturation deficit (C_{satdef}) measured C concentrations of the fine fraction were subtracted from the potential C saturation. The total amount of the C sequestration potential was calculated using the Weismeier et al. (2014) equation $C_{seq}=C_{satdef}$ x BD x depth x 10^{-2}. In the topsoil C_{satdef} was lower at the control and higher at unfertilized 3-year rotation. C sequestration in 0-20 cm soil depth was 2.78 kg m^{-2} being higher at D3 and lower at B2. In the 20-40 cm soil depth average C_{seq} was higher compared to topsoil (3.02 kg m^{-2}) indicating the higher potential for SOC storage and preservation. The ratio of bulk SOC in C_{satpot} averages at 61.48 % and 57.04% for the 0-20 cm and 20-40 cm, respectively. This showed the capacity of, approximately, 40% increase in SOC of Chernozem with using carbon smart agriculture systems in the future. Correspondingly, improvement in SOC would be more efficient in soil with lower SOC content. The obtained result could have implications in adopting "4 per Mille" (4p1000) strategy that suggested that an increase of 0.4% yr^{-1} in SOC stock.

Keywords: C saturation, C sequestration, climate change mitigation, Chernozem