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Waterstable chernozem structure degradation as a result of soil organic matter transformation: relation between hydrophobic and hydrophilic components

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Waterstability and mechanical strength of chernozem soils are well known. But the modern process of aggregate structure degradation accompanied by decrease of soil organic matter (SOM) content brings up the problem of physical mechanisms of these processes. The aim of this work was to investigate SOM content and transformation of its hydrophilic and hydrophobic components, in connection with structure evolution.

Samples and methods. Two variants of typical chernozem soil were investigated: (Var.I) - in natural steppe conditions (biosphere reserve, Kursk, Central Russia) with original structure, and (Var.II) – in experimental field conditions of long-term fallow land (since 1947, biosphere reserve, Kursk, Central Russia). The SOM content, content of its fulvic and humic acids were studied by method according to Tyurin. To investigate the hydrophilic and hydrophobic components SOM was isolated from the soil samples by 0.1M $Na_4P_2O_7$+0.1N NaOH, soil-solution ratio being 1:10. Mineral particles were eliminated from humus extract by centrifugation (8000 rpm; 15 min) and filtration through 0.45-μm membrane filter. Hydrophobic interaction chromatography was operated on Octyl-Sepharose CL-4B.

Results and conclusions. Because of hard agricultural treatments and low input of fresh plant residues in the soil content of water-stable aggregates (d$>$0.25 mm) in the upper layer (0-20 cm) changed from 64.5% (Var.I) down to 32.4% (Var.II). In the subsoil (40-50 cm) it changed from 66.9%(Var.I) down to 24.5% (Var.II). Infiltration capacity of Var.II was 120 times lower, than that of Var.I. In the upper layer organic carbon content decreased from 6.3% (Var.I) to 2.6% (Var.II), but it increased in the middle of chernozem profile from 1.7% (Var.I) to 2% (Var.II). The content of fulvic

acids in Var.II reduced by 22%, 46% in upper layer and subsoil, correspondingly, but the content of humic ones declined only by 4%, 26% as well. This is an unusual fact because structure degradation is usually connected with the decrease of humic acids content. But in this case, it seems the structure degradation to be associated with the absolute content of hydrophilic components: the content of hydrophilic components declined in upper layer and increased in the middle of the profile. We propose that hydrophobic components of SOM are more tolerant to microbiological and chemical degradation, also being more stable in upper layers of chernozem profile. The hydrophilic ones are less resistant and more mobile in the soil profile. So, it is possible to propose the next conceptual model of interrelation between structure degradation and SOM composition. During aggregate formation hydrophilic components of SOM bound hydrophilic parts of soil minerals. This is reflected in fact of increased soil hydrophobic properties, while hydrophilic properties of mineral particles are inactivated. Accumulation of stable hydrophobic components also causes growth of soil solid phase hydrophobicity and waterstability of soil aggregates. During the period of agricultural impact without any plant residues input the content of hydrophilic SOM components decreases, because these components are the most available for microbiological and chemical degradation. Total hydrophilic properties of solid phase being increased, may result in destabilisation of soil aggregates in water medium.