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Contribution of ants in modifying of soil acidity and particle size distribution

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Being a natural body, formed by the influence of biota on the upper layers of the Earth's crust, the soil is the most striking example of biogenic-abiogenic interactions in the biosphere. Invertebrates (especially ants that build soil nests) are important agents that change soil properties in well developed terrestrial ecosystems. Impact of soil microorganisms on soil properties is particularly described in numerous literature and concerns mainly chemical properties and general indicators of soil biological activity. Influence of ants (as representatives of the soil mesofauna) mostly appears as mechanical movement of soil particles and aggregates, and chemical effects caused by concentration of organic matter within the ant's nest. The aim of this research was to evaluate the effect of ants on physical and chemical soil attributes such as particle size distribution and soil acidity. The samples were taken from aerial parts of Lasius niger nests, selected on different elements of the relief (summit position, slope, terrace and floodplain) in the Arkhangelsk region (north of the European part of Russia) and compared with the specimens of the upper horizons of the reference soils. Particle size distribution was determined by laser diffraction method using laser diffraction particle size analyzer «Analysette 22 comfort» (FRITSCH, Germany). The acidity (pH) was determined by potentiometry in water suspension. Particle size distribution of the samples from the nests is more variable as compared to the control samples. For example, the content of 5-10 μm fraction ranges from 9% to 12% in reference soils, while in the anthill samples the variation is from 8% to 15%. Similarly, for 50-250 μm fraction – it ranges from 15% to 18% in reference soils, whereas in anthills - from 6% to 29%. The results of particle size analysis showed that the reference sample on the terrace has silty loam texture and nests soil L. niger are medium loam. The reference soil on the slope is characterized as medium loam, and ant's nest material has silty loam texture. The control samples of soil and ants nests on the summit position are similar and have medium loam texture. Generally we outline that the particle size distribution of anthill samples shows more variability. We assume that ants operate with small soil aggregates, in which fine fractions may link together coarser particles. pH measurements show that the reference soils have a strongly acidic reaction on the summit position (pH 4.6), slightly acidic on the slope (pH 5.5) and neutral on the terrace and on the floodplain (pH 7.2). While the material of the anthills tends to be slightly alkalinized on the summit (pH 4.8) and alkalinized on the slope (pH 7.2), but acidified to neutral on the floodplain and terrace (pH 6.4 and 5.7). Therefore, the ants form specific physico-chemical conditions that are different from the surrounding (native) soil, significantly increasing the complexity of soil cover structure. This is a clear example of ecosystem engineering functions of ants in nature. Increased complexity of soil pattern is the result of variations in pH and particle size distribution. Both cause the preconditions for the formation of new environmental niches and enhance biodiversity in natural ecosystems.