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Chernozems microbial community under anthropogenic impact (Russia)

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Chernozems is important natural resource, which in the last decade under intense influence as a result of plowing and urbanization. The parameters of soil microbial community functioning might be identify some soil deterioration under the impacts. Our research was focused on assessment of microbial community status in different soil layers of virgin steppe, bare fallow and urban ecosystems (Kursk region). In each ecosystem, we chose randomly 3-5 spatially distributed sites, where soil samples were collected by auguring up to 0.5 m depth (each layer 10 cm thickness) and up to 1.5 m depth (0-10, 10-50, 50-100, 100-150 cm layers), totally 127 samples. The bulk density was measured for these soil layers. In all soil samples the microbial biomass carbon content (Cmic) was analyzed by substrate-induced respiration (SIR) method and basal respiration (BR) was assessed by CO_2 rate production. The fungi-to-bacteria ratio (selective inhibition technique with antibiotics) was determined and portion of Cmic in soil organic carbon (Corg) content was calculated in topsoil (0-10 cm). The Corg (dichromate oxidation) and pHw (potentiometry) values were measured. The Cmic and BR profile pools were calculated using bulk density and thickness of studied layers.

The Cmic (0-10 cm) was varied from 84 to 1954 μg C g-1 soil, in steppe it was on average 3-4 times higher than those in bare fallow and urban. The BR rate was amounted from 0.20 to 1.57 μg CO_2-C g-1 soil h-1, however no significant difference between studied ecosystems was found. It was shown the relationship between Cmic, BR and Corg (the linear regression, R2=0.92 and 0.75, respectively, p<0.05). The Cmic / Corg ratio in steppe was on average 3.3%, it was significantly higher those bare fallow and urban (1.6 and 0.7%, respectively). The fungi-to-bacteria ratio was decreased along ecosystems row: virgin steppe>bare fallow>urban, and it was on average 6.0, 5.2 and 1.8, respectively. The Cmic profile pool (0.5 m) of steppe was reached up on average 206 g C m-2, and it was 2.0 and 2.5 times higher those bare fallow and urban, respectively. The BR profile pool (0.5 m) in steppe and bare fallow was reached up 5.9 and 5.8 g CO_2-C m-2 d-1, respectively, it was on average 2 times higher urban. The Cmic profile pool (1.5 m) in steppe was amounted to 372 g C m-2, and it was essentially higher those in bare fallow and urban (138 and 140 g C m-2, respectively). The BR profile pool (1.5 m) was also decreased along ecosystems row: steppe> fallow>urban, and it was on average 13.0, 8.0 and 5.6 g CO_2-C m-2 d-1, respectively.

Thus, we found a significant decreasing soil microbial biomass content, its portion in soil Corg, fungi content, and the Cmic and BR profile pools along Chernozems' ecosystems gradient from natural (virgin steppe) to anthropogenically transformed (bare fallow, urban). It might be illustrated some deterioration of soil microbial community functioning under plowing and urbanization.

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