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Content and persistence of extracellular DNA in native soils

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The long-term persistence of soil extracellular DNA is questionable because of high potential activity of nucleases produced by soil microorganisms. By the other hand, the relative persistence of DNA-like biopolymers could be due to their adsorption on clay minerals and humus substances in soil. High-specific and ultra sensitive reagent PicoGreenTM (Molecular Probes) permits the quantitative assessment of microbial dsDNA in diluted soil extracts giving a good tool for tracing the DNA fate in soil. Our goal was to determine intracellular and extracellular DNA content in cambisol (loamy sand) and in chernozem (silty loam) soils and to investigate the possible adsorption and degradation of extracellular DNA in soil.

Optimized procedure of mechanical and enzymatic destruction of cell walls was used for direct extraction of microbial DNA with Tris-EDTA buffer (Blagodatskaya et al., 2003). Extracellular dsDNA was determined in distilled water and in Tris-EDTA extracts without enzymatic or mechanical treatments. DNA content was determined after addition of PicoGreen to diluted soil extracts. Degradation of extracellular DNA was traced during 24 h incubation of 2 μg lambda-phage DNA in soil. Possible DNA adsorption to soil matrix was determined by recovery of lambda -phage DNA added to autoclaved soil.

Extracellular dsDNA was absent in water extracts of both soils. The content of extracellular dsDNA extracted by Tris-EDTA buffer was 0.46 μg/g in chernozem and 1.59 μg/g in cambisol amounting 0.43 and 2.8% of total dsDNA content in these soils, respectively. 100% and 64.8% of added extracellular lambda -phage dsDNA was found in cambisol and chernozem soils, respectively, in 5 h after application. 39% and 73.5% of added DNA disappeared in cambisol and in chernozem, respectively, during 24 h incubation. Degradation rate of extracellular DNA depended on microbial biomass content, which was 2.5 times higher in chernozem as compared to cambisol. Maximum adsorption of DNA by soils was observed in cambisol and reached 2.7% of added amount. We speculate that probability of gene transfer could be rather high in soils, taking into account possible increase of extracellular DNA content after transient environmental events (i.e. drying – rewetting and freezing – thawing).