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Biomass and number of gene copies of fungi in the polar urban soils, Murmansk, Russia

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The anthropogenic impact on soil microbiota in polar climate remains overlooked and the comparison between microbiota in urban and natural soils in polar regions are highly interesting. Fungi are the key components of soil microbiota, responsible for improtant functions and ecsystem services and highly senstive to direct (e.g., pollution) and indirect (e.g., urban heat island) anthropogenic effects. Urban soils of Murmanks (68.967 N, 33.083 E) – the biggest polar city in the world – were studied in comparison to Podzols of the natural forest-tundra area. Soil fungi in urban and natural soils were analyzed by luminescence microscopy and PCR real time.

The fungal biomass in the upper horizon of Technosol varied from 0.50 to 0.75 mg/g of soil, which was 1.5-2 times less than in Podzol. Different profile distribution of fungal biomass was shown for urban and natural soils. In natural Podzol, the highest fungal biomass was observed in the upper organic O horizon, then decreased in the topsoil mineral elluvial E horizon, and then slightly increased in the subsoil mineral illuvial Bs horizon. In urban soils, the second maximum of number of fungi in the soil profile was not found. The biomass of fungi decreased exponentially in the soil profile.

The number of ITS ribosomal gene copies of fungi in the topsoil organic horizon of natural Podzol reached 10^{10}gene copies/g of soil. In urban soils, there was a decrease in their number by 6 or more times. The number of fungal gene copies decreased sharply down the soil profile in both urban and natural soils. So, if the number of fungi in topsoil horizons was about 10^{8}-10^{10} gene copies /g of soil, in subsoil horizons it was 10^{6}-10^{7} gene copies/g of soil. First of all, this may be due to the mycorrhizal mycobiota, which has the largest extent of mycelium in the topsoil horizons of soil. In forest soil, the number of gene copies in horizon E was 37 times less than in the topsoil horizon; in urban soil, the content of gene copies in the subsoil BC horizon is 10 times less than in the topsoil horizon.

The proportion of fungal mycelium varied from 28 to 80%. A minimum of mycelium was found in the subsoil horizons, while the topsoil horizons were abundant with fungal hyphae, the length of which in them reached more than 160 m/g of soil. The maximum amount of mycelium (581.72 m/g

of soil) was observed in natural Podzol. The number of single-celled fungal propagules (spores and yeasts) was 10^4-10^5 cells/g of soil. Most of the propagules are represented by small-sized forms (2-3 microns), the proportion of which increased from the topsoil horizons (68-93%) to the deep ones (up to 100%). This trend was observed for both urban and background soils. Large propagules with a diameter of 5-7 microns were found exclusively in the topsoil horizons, and their number is no more than 10^3 cells/g of soil.

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