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Higher taxonomic diversity of protists, fungi and bacteria, but lower functional diversity in soils of agricultural ecosystems compared to a deciduous forest

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Microbial taxonomic diversity is considered as one of the crucial factors responsible for the sustainable functioning of soil systems. However, it is still unclear to what extent microbial taxonomic diversity reflects its functional diversity. In this study, we compared taxonomic and functional diversity of the soil microbiome in a few natural and agricultural ecosystems.
Soil samples were collected three times (April, July, and October) from grassland, deciduous forest, and three agricultural ecosystems (no fertilizers, NPK, cattle manure). We applied high-throughput sequencing on the Illumina MiSeq platform using a combination of multiple DNA metabarcoding markers and characterized soil prokaryotic (16S rRNA gene: bacteria and archaea) and eukaryotic (ITS2 to target fungi; 18S rRNA gene to target protists) communities. Community-level physiological profiles of the soil microbiomes were analyzed using Biolog Ecoplates to assess functional diversity of heterotrophic microorganisms.
All five soils differed significantly from each other in the taxonomic composition of the bacteriome, the mycobiome, and the protistome. The forest soil microbiome was characterized by the higher relative abundances of Verrucomicrobia, Agaricomycetes, Apicomplexa, and Mesomycetozoa. Proteobacteria, Acidobacteria, Sordariomyces, Cercozoa, and Ochrophyta were the dominant taxa in the agricultural soils. Surprisingly, taxonomic diversity of the bacteriome, the mycobiome, and the protistome in forest soil was significantly lower compared to the agricultural soils (except the NPK treatment). Differences in microbial physiological profiles between distinct ecosystems were much lower than those in taxonomic diversity. The forest soil microbiome was characterized by the highest physiological activity and plasticity, especially for amines and phenolic compounds. Our findings suggest that lower microbial taxonomic diversity does not necessarily result in lower functional diversity of the soil microbiome.

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