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Significant Influence of Land Use Type on Earthworm Communities but Not on Soil Microbial Respiration in Selected Soils of Hungary

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Abstract : Following the 1992 Earth Summit in Rio de Janeiro, soil biodiversity has been recognized globally as a crucial player in guaranteeing the functioning of soil and a provider of several ecosystem services essential for human well-being. The microbial fraction of the soil is a vital component of soil fertility as soil microbes play key roles in soil aggregate formation, nutrient cycling, humification, and degradation of pollutants. Soil fauna, such as earthworms, have huge impacts on soil organic matter dynamics, nutrient cycling, and infiltration and distribution of water in the soil. Currently, land-use change has been a global concern as evidence accumulates that it adversely affects soil biodiversity and the associated ecosystem goods and services. In this study, we examined the patterns of soil microbial respiration (SMR) and earthworm (abundance, biomass, and species richness) across three land-use types (grassland, arable land, and forest) in Hungary. The objectives were i) to investigate whether there is a significant difference in SMR and earthworm (abundance, biomass, and species richness) among land-use types. ii) to determine the key soil properties that best predict the variation in SMR and earthworm communities. Soil samples, to a depth of 25 cm, were collected from the surrounding areas of seven soil profiles. For physicochemical parameters, soil organic matter (SOM), pH, $CaCO_3$, E_4/E_6, available nitrogen (NH_4^+-N and NO_3^--N), potassium (K_2O), phosphorus (P_2O_5), exchangeable Ca^{2+}, Mg^{2+}, soil moisture content (MC) and bulk density were measured. The analysis of SMR was determined by basal respiration method, and the extraction of earthworms was carried out by hand sorting method as described by ISO guideline. The results showed that there was no statistically significant difference among land-use types in SMR ($p > 0.05$). However, the highest SMR was observed in grassland soils (11.77 $mgCO_2$ $50g^{-1}$ soil 10 $days^{-1}$) and lowest in forest soils (8.61 $mgCO_2$ $50g^{-1}$ soil 10 $days^{-1}$). SMR had strong positive correlations with exchangeable Ca^{2+} ($r = 0.80$), MC ($r = 0.72$), and exchangeable Mg^{2+}($r = 0.69$). We found a pronounced variation in SMR among soil texture classes ($p < 0.001$), where the highest value in silty clay loam soils and the lowest in sandy soils. This study provides evidence that agricultural activities can negatively influence earthworm communities, in which the arable land had significantly lower earthworm communities compared to forest and grassland respectively. Overall, in our study, land use type had minimal effects on SMR whereas, earthworm communities were profoundly influenced by land-use type particularly agricultural activities related to tillage. Exchangeable Ca^{2+}, MC, and texture were found to be the key drivers of the variation in SMR.

Keywords : earthworm community, land use, soil biodiversity, soil microbial respiration, soil property
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