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Conference Abstract

On the presence and detectability of polyphosphates in soil microbial biomass

Petr Čapek‡, Adéla Tupá‡

‡ Department of Ecosystem Biology, Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic

Corresponding author: Petr Čapek (petacapek@gmail.com)

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Abstract

Polyphosphates (PolyP), i.e. phosphate polymers, are commonly found in pure cultures of various microorganisms. Although they have been the subject of intensive microbiological research in the past, they have never been directly studied in species-rich soil microbial communities. So far, there are only few studies indirectly suggesting that soil microorganisms build up PolyP as a storage for phosphorus (P), and use them when soil P availability decreases. We attempted to provide direct evidence for PolyP presence in soil microorganisms, and test if the PolyP can be detected in the soil microbial biomass P pool applying the standard chloroform-fumigation extraction method. Twelve different soil samples were collected along the gradient of forest recovery after the bark beetle outbreak in the catchments of two adjacent glacier lakes (Plešné and Čertovo, Bohemian forest, Czech Republic). The presence of PolyP in the samples was assessed by staining in a manipulative experiment designed to deplete any PolyP present. Carbon (C), nitrogen (N), and P in the microbial biomass were estimated by the chloroform-fumigation extraction method and soil slurries of fresh samples stained by the Neisser method. The soils were then mixed with sterile sand and supplemented with growth medium without P. The rate of growth of microbial biomass was estimated from oxygen consumption during one week incubation at dark. After one week, the microbial biomass C, N, and the P were estimated again and samples stained. The combination of the incubation experiment and staining proved that the soil microorganisms in the collected samples contained PolyP and that PolyP were used to achieve maximum growth rate under P-limited conditions. The C to N to P ratio increased significantly over one week of incubation reflecting the changing PolyP

content. To further confirm that the fumigation extraction method is sensitive to PolyP content, manufactured PolyP was added to all soils at different steps of the fumigation extraction method, and its recovery was estimated. Recovery ranged from 80 to 100%. Abiotic depolymerisation at acidic conditions required for the correct quantification of P-PO_4 using molybdenum-blue method was very likely responsible for half of the recovery, the remaining being enzymatic depolymerisation. We conclude that PolyP are ubiquitous in soils and affect microbial biomass P estimation. The high recovery rate of PolyP around 90% implies that presence of PolyP can cause a significant overestimation of the microbial biomass P when typical correction factor 0.4 is used.

Keywords

Soil microbial biomass, microbial biomass composition, microbially-explicit model, conversion factors

Presenting author

Petr Čapek

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Conflicts of interest

The authors have declared that no competing interests exist.