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Titel
The role of the organic layer for phosphorus nutrition of young beech trees (Fagus sylvatica L.) revealed by multi-isotopic labelling (P-33; H_2O-18) at two sites differing in soil phosphorus availability

Abstract
The accumulation of an organic layer in forests is linked to the ratio between litterfall and decomposition rates, the latter being decelerated due to acidification and associated nutrient depletion with proceeding ecosystem development. Nevertheless, the nutrient pool in the organic layer might still represent an important interim storage and source for phosphorus (P) nutrition of forests on nutrient-poor soils. Due to the retention of P in soil e.g., by sorption to sesquioxides, P-poor ecosystems tend to show P recycling by organic matter decomposition. Our objective was to assess the importance of the organic layer to P nutrition of young beech trees. We established a mesocosm experiment including plants and soil from two forest sites differing in P availability. In half of all pots comprising both sites, the organic layer was present while the organic layer was lacking in the other half. We applied P-33 and H_2O-18 to the pots. After 0h, 24h, 48h, 96h and 192h we destructively harvested the young beech trees, sampled the organic layer and mineral soil. P-33 activity was measured for every compartment in soil and plant (xylem, leaves, branches, stems) whereas ?O-18 values in phosphate(?O-18_P) were assessed for soil only. For both sites, ?O-18_P values in resin-extractable P in soil were close to those expected if isotope fractionation during intracellular pyrophosphate storage and subsequent release takes place. Therefore, ?O-18_P values indicate that bioavailable P in both soils has been cycled through microorganisms. However, the absence of an organic layer at the P-poor site resulted in a considerable shift of ?O-18_P values from those to be expected if P has been cycled through microorganisms. For both sites, the presence of the organic layer increased P-33 activity in xylem sap compared to the treatment without (104% P-poor site, 700% P-rich site). The total P-33 activity in plant tissue in pots from the P-rich site was not affected by the presence or absence of an organic layer after 192h, whereas a strong increase of 155 kBq/g DM was recorded for the P-poor site if an organic layer was present. Therefore, the key role of the organic layer for plant P nutrition on a P-depleted site was highlighted by our multi-isotopic labelling approach. In conclusion, our results suggest that P mobilization strategies differ among sites i.e., a P recycling vs. a P acquiring strategy.