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The role of the organic layer for phosphorus nutrition of young beech trees (Fagus sylvatica L.) at two sites differing in soil Phosphorus availability

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The accumulation of an organic layer in forests is linked to the ratio between litterfall rates and decomposition rates with decomposition rates 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 source for Phosphorus (P) nutrition of forests on nutrient-poor soils. Our objective was to assess the importance of the organic layer to P nutrition of young beech trees at two sites differing in soil P availability. We established a mesocosm experiment including plants and soil from a Phosphorus depleted forest site on a Haplic Podzol in Lüss and a Phosphorus rich forest site on a Eutric Cambisol in Bad Brückenau either with or without the organic layer. After 1 year under outdoor conditions, we applied 33P to the pots. After 0h, 24h, 48h, 96h, 192h, 528h we destructively harvested the young beech trees (separated into leaves, branches, stems) and sampled the organic layer and mineral soil of the pots. In each soil horizon we measured concentrations of resin-extractable P, plant available P fractions and total P. We extracted the xylem sap of the whole 2-year-old trees by means of scholander pressure bomb. 33P activity was measured for every compartment in soil and plant. The applied 33P was recovered mainly in the organic layer in Lüss, whereas it was evenly distributed among organic and mineral horizons in pots of Bad Brückenau soil. Comparing pots with and without an organic layer, the specific 33P activity differed by 323% between pots with and without an organic layer present in the Lüss soil. For both sites, the presence of the organic layer increased 33P activity in xylem sap compared to the treatment without by 104% in Bad Brückenau and 700% in Lüss. Whereas the existence of an organic layer did not influence the total 33P activity in plant tissue in pots from the site Bad Brückenau over 528h, a strong increase of 155 kBq/g DM was recorded for the site Lüss. Therefore, the key role of the organic layer for plant P nutrition on a P depleted site like Lüss was reflected in the increased P uptake rates (xylem sap) and increased accumulation of P in plant tissue comparing the presence and absence of an organic layerIn conclusion, our results prove the more efficient cycling of P in the organic layers in Lüss as opposed to Bad Brückenau corroborating the hypothesized P recycling and P acquiring strategy in Lüss and Bad Brückenau, respectively.