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Rhizosphere effect on phosphorus availability in forest soils at different altitudes.

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Phosphorus (P) is an essential nutrient for plants but it is one of the least available mineral nutrients, and can substantially limit plant growth. Although plants are able to respond to the P shortage, the global warming might modify the soil-plant-microorganisms system and reduce P availability. We evaluated the rhizosphere effect of beech (Fagus sylvatica L.) in forest soils of the Apennines mountains (central Italy) at two altitudes (800 and 1000 m) and along 1° of latitudinal gradient, using latitude and altitude as proxies for temperature change. Specifically, we tested if 1) soil organic C, total N, and organic and available P decrease with increasing latitude and altitude, and 2) the rhizosphere effect on P availability becomes more pronounced when potential nutrient limitations are more severe, as it happens with increasing latitude and altitude. The results suggested that the small latitudinal gradient has no effect on soil properties. Conversely, significant changes occurred between 800 and 1000 m a.s.l., as the soils at higher altitude showed greater TOC, organic and available P contents, and alkaline mono-phosphatases activity than the soils at 800 m a.s.l. Compared to the soils at lower altitude, a marked rhizosphere effect was found at 1000 m a.s.l., and it was mainly attributed to the release of labile organics through rhizodeposition processes. These labile organic compounds were considered able to induce a "priming effect" that fostered the mineralization of the soil organic matter. The enhanced organic carbon cycling, in turn, likely promoted the mineralization of the organic P forms. This was supported by the smaller proportion of orthophosphate monoesters found in the P pool of the rhizosphere than in that of the soil far from the roots, with a consequent increase of the amount of available P. Hence, we speculate that at high altitude the energy supplied by the plants through rhizodeposition to the rhizosphere heterotrophic microbial community promotes the rhizospheric biochemical processes and, in particular, P cycling.