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Phosphorus addition can trigger strong priming of soil organic matter decomposition

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Atmospheric dust and nitrogen deposition may alter phosphorus (P) availability in soils. Understanding how P affects decomposition of soil organic matter (OM) is important to unravel relationships between P and carbon (C) cycles. To examine P priming effect on decomposition of OM, we added P at three levels on a basis of organic C content (0.0156%, 0.0625% and 0.25% of organic-C contents) to four types of OM (leaf litter, wood litter, organic and mineral soils collected from a subtropical forest) in a microcosm experiment over a 3-day period. We detected P priming effect on decomposition of all four types of OM and the magnitude of this priming effect varied with both OM types and P addition levels. Efflux of CO_2 from decomposing leaf litter was decreased by 18.4% with the low-level P addition but increased by 11.9% in the intermediate-level P addition treatments. High-level P addition did not change CO_2 efflux from decomposing leaf-litter. For the wood OM, the low-level P addition reduced CO_2 efflux by 10.2%, intermediate-level P addition had no effect, but high-level P addition increased CO_2 efflux by 17.0%. Positive P priming effect on CO_2 efflux occurred in both organic and mineral soils at all three-level P additions and the magnitude of this priming effect increased with P addition levels. The high-level P addition treatment increased CO_2 effluxes by 66.3% in the organic soil and by 25.4% in the mineral soil. We conclude that increase in P availability may trigger strong priming effect on CO_2 efflux in forest soils, consequently produce C-climate feedbacks.

Keywords: Priming effect, available phosphorus, plant litter, soil organic matter