

Effect of phosphorus and carbon addition on gross nitrogen mineralization, microbial respiration and N₂O emission in a grassland soil

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Soil microbes are frequently limited by carbon (C), but also have a high phosphorus (P) requirement (e.g., the microbial C:P ratio is often smaller than the C:P ratio of the substrate they live on). However, little is known about the effect of P availability relative to the availability of C on microbial activity in soil. Here we assessed the effect of P availability with and without addition of a labile C substrate (glucose) on microbial respiration, gross N mineralization and nitrous oxide (N₂O) emission in a grassland soil. Gross rates of N mineralization were measured during a 48 hr incubation experiment using a ¹⁵N isotope pool dilution technique after treating the soil with ¹⁵N labelled NH₄⁺ (1 mg ¹⁵N kg⁻¹ soil) with and without P (20 mg kg⁻¹ soil) and/or C (500 mg kg⁻¹ soil). In a separate incubation experiment the rate of carbon dioxide (CO₂) and N₂O emission were measured after 0, 1, 2, 5 and 13 days of incubation after treating the soil with the same kind of treatments. Addition of P did not show any effect on gross N mineralization, microbial respiration and N₂O emission. However, C addition significantly increased both CO₂ and N₂O emission. After 48 hrs of incubation, C addition also increased both microbial biomass C, N and soil ¹⁵N recovery, but had no effect on gross N mineralization. The increased availability of C substrates may have increased soil microbial growth including nitrifiers and/or denitrifiers which ultimately increased microbial respiration and N₂O emission. The observations suggest that, microbial growth and activities including nitrification and/or denitrification are more dependent on the availability of readily available C substrates than on P in the grassland soil.