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Microbial community and soil properties modify microbial carbon use efficiency response to N and P addition

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Microbial carbon use efficiency (CUE) is critically important to global C cycling, because it embodies the control that heterotrophs exude on the huge terrestrial soil organic matter (SOM) pool. This ratio - defined here as the amount of C put towards biomass divided by the total amount of C taken up - is difficult to measure. A new technique using the incorporation of 18O labeled water into DNA as a measure of growth, rather than 13C labeled substrates, was used to measure CUE of two soils in response to stoichiometrically balanced and imbalanced fertilization. Globally, ecosystems experiencing atmospheric nitrogen (N) deposition have the potential to become phosphorus (P) limited. Assuming nutrient availability limits microbial growth, one would expect microbial CUE to increase with availability of mineral nutrients, such as N, although this might not occur if microbes are then P limited. To test these hypotheses, soils were collected from a Mediterranean oak-savanna underneath tree canopies and in adjacent open grassland areas, representing soils with relatively high and low SOM content, respectively. Average CUE under tree canopies was 0.48 compared to 0.33 in the open grassland. These soils also differed in their response to N, P, and N+P addition. CUE under tree canopies was not affected by any of the treatments, while the community in open grassland areas had lower CUE when N or P was added on their own, but was unaffected when N+P was added. These results indicate that while microbes in these soils were not nutrient limited, some microbial communities are sensitive to nutrient imbalance depending on soil properties.