

Soil microbial phosphorus limitation constrains carbon use efficiency in subtropical forests

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Abstract: Microbial carbon use efficiency (CUE) is a vital ecosystem trait that determines soils' ability to accumulate C, yet the response of CUE to land use conversion and the relevant regulatory mechanisms remain poorly understood, leading to large uncertainties in developing strategies to mitigate C losses. We investigated how legacies of land use (cropland and forest) intensity and climate affect the microbial CUE along a subtropical climate gradient in southwest China. Our findings showed that microbial utilization of organic C for biomass production and C losses through respiration varied proportionally between land-use types, resulting in the same CUE values. Microbial CUE increased in wetter and warmer climates in cropland rather than forest soils, indicating that intensive land use management increased the sensitivity of microbial C transformation to climate change. We also found that microbial CUE was limited by phosphorus (P) availability in forest soils and was enhanced after P addition. Collectively, our work suggests that land use conversion does not alter microbial CUE, and highlights the importance of P limitation to restoring forests and predicting their C sinks. Such inferences deserve attention under potentially increasing P limitation induced by enhanced N deposition and warming.