Assessment of depth-dependent microbial carbon use efficiency in long-term fertilized paddy soil using an 18O-H2O approach

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Abstract

Microbial biomass (MB) production and turnover strongly affect soil organic carbon (SOC) accumulation. Microbial carbon use efficiency (CUE) and MB turnover in paddy soil were determined using a novel substrate-independent H218O labeling approach and the effect of long-term fertilization with mineral (NPK) or combined (NPK+OM (manure)) amendments in 0-10, 10-20, and 20-30 cm depths were investigated. Long-term fertilization increased microbial C uptake, CUE, and growth rates, and all indexes were the highest in the NPK+OM treatment. The CUE ranged between 0.07 and 0.23 and showed variable behavior with depth: it reduced in the control treatment, indicating that more C was allocated to energy production than biomass growth, and increased in fertilized soils, showing the shift of C usage for biomass growth. The highest CUE was observed at 20-30 cm in NPK and NPK+OM and indicated that microorganisms overcome the nutrient deficiency in deep soil layers by keeping high C uptake rates at a constant CUE. MBC turnover was more rapid in NPK (10-70 d) and NPK+OM (40-65 d) compared to control (80 d) and intensified with the depth. These findings highlight that under long-term fertilization MB turnover can be controlled by CUE. These shifts in the strategies of microorganisms functioning can explain the accumulation of SOC in heavily fertilized paddy soils.

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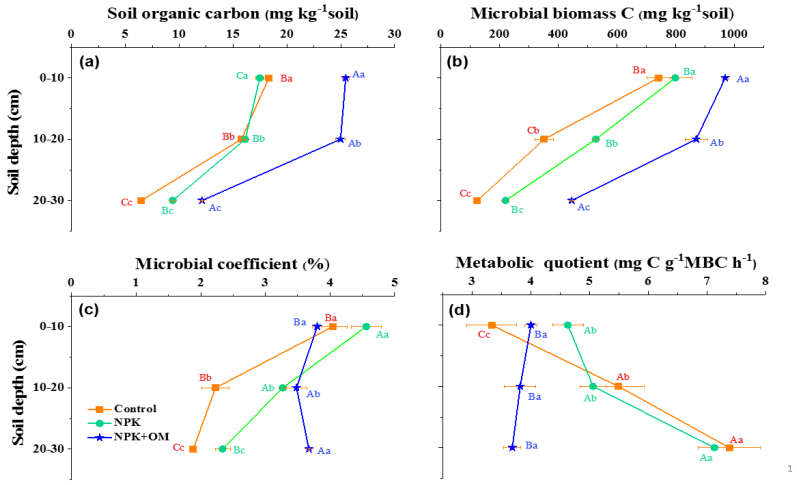

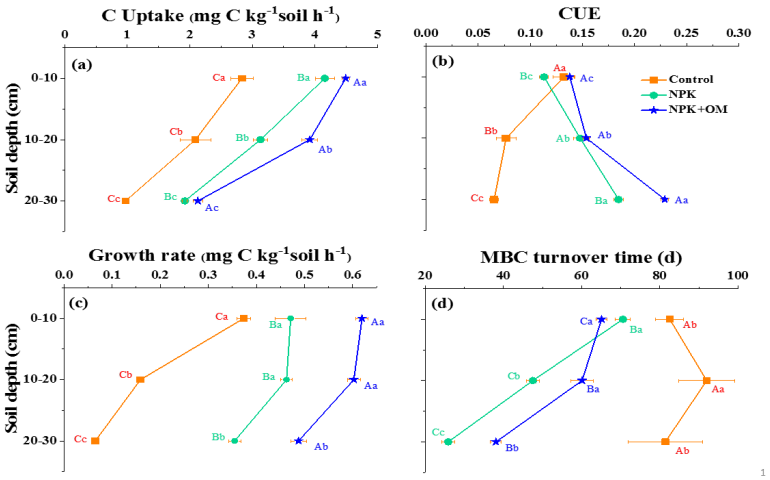

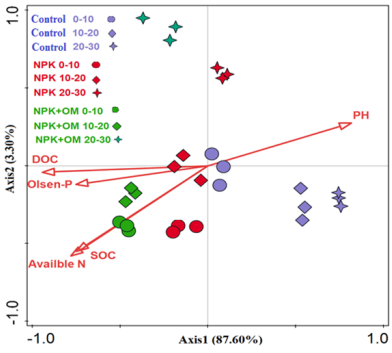

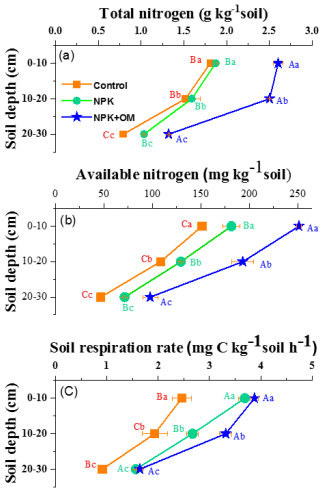

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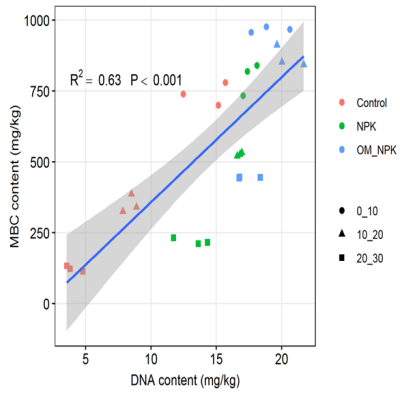

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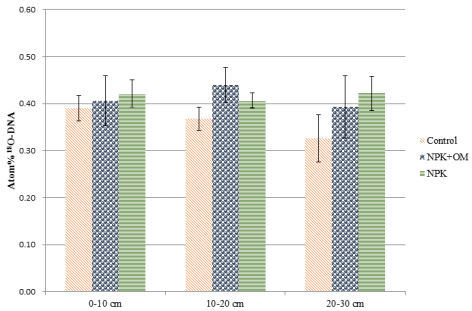

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