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# Rhizospheric soil-microbial biomass C, N, and P stoichiometry and function across global agroecosystems

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Rhizospheric C, N, and P stoichiometry embodies the dynamic equilibrium between nutrient release through mineralization and the retention of elements during organic matter turnover. Yet, global quantitative assessments of how rhizospheric processes reshape soil and microbial elemental ratios across agricultural ecosystems remain scarce. To address this, we conducted a synthesis of 1,683 data points collected from 122 peer-reviewed studies worldwide. The meta-analysis revealed that rhizospheric processes significantly increased soil C:N, C:P, and N:P ratios by 5.1%, 5.9%, and 3.4%, respectively, relative to bulk soil. In contrast, microbial biomass C:P and N:P ratios decreased by 15.1% and 12.4% under rhizospheric conditions. Importantly, no significant overall effect of the rhizosphere was detected for microbial biomass C:N ratios. The enhancement of soil C:N ratio was most evident under humid climates and mildly acidic soils (pH 5.5–6.5). Conversely, reductions in microbial biomass C:N ratios were less apparent in humid environments with higher ammonium-N availability. Vegetable systems and the rapid growth phase of crops enhanced rhizospheric soil C:N by approximately 8.8% and 4.3%, respectively, whereas microbial C:N declined by 23.3% and 6.3%. Additionally, organic fertilizer raised the soil C:N ratio by about 8.9%, whereas nitrogen fertilization reduced it by roughly 6.0% ($P < 0.05$), however, neither treatment significantly affected the microbial biomass C:N ratio. Among environmental variables, soil organic carbon and ammonium-N emerged as primary drivers of stoichiometric variation for soil and microbial C:N ratio, explaining 30.6% and 24.1% of total variability, respectively. Overall, this study reveals that rhizospheric effects substantially alter soil C:N ratios, while microbial C:N ratios remain comparatively stable and show no significant association with soil C:N responses, suggesting differential regulation of carbon–nitrogen stoichiometry in soil and microbial pools