



Biochemical quality of plant residues and soil pH control on microbial metabolism and CUE in the soil

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The ratio of carbon (C) that is allocated into microbial growth to assimilated organic C is known as microbial carbon use efficiency (CUE). CUE is influenced by environmental factors such as soil pH and quality of organic substrate, which is decomposed by microorganisms. The interlinked effect of organic residues of complex biochemical quality and soil pH on microbial CUE in the soil ecosystem remains elusive. Therefore, we designed a microcosm experiment with high (pH_{CaCl}=4.35, S1) and medium (pH_{CaCl}=5.04, S2) acidic soils using plant residues of different biochemical quality as a substrate for soil microbes. Subsamples of each soil type (40 g) were mixed with 0.4g of plant residues of low (R1) and high (R2) biochemical quality. Applied residues of *Calliandra calothyrsus* differed in polyphenol (63.4 and 46.2 g kg⁻¹) and lignin content (97 and 68 g kg⁻¹) for R1 and R2, respectively. Soil samples with three replicates per treatment were collected after 7, 15, 30, 45 and 60 days of incubation. We estimated evolved CO₂, microbial biomass carbon and selected C cycling enzymatic activities (β -D Glucosidase, β -D Xylanase and β -D cellobiohydrolase). CUE and metabolic quotient (qCO₂) were calculated using data on biomass and CO₂ increments. Microbial biomass C, respiration activity and enzymatic activities were lower in the more acidic soils than in soils with higher pH. Plant residues of low biochemical quality (cf. high quality) were decomposed by lower microbial biomass, but with higher respiration and enzymatic activity. CUE in soil with low quality plant residues was lower than in soil amended with residues of higher quality, while the reverse was true for qCO₂. The effect of soil acidity on microbial CUE was significant only in soils amended with residues of high quality: in this case CUE was higher in less acidic soil. A significant (P<0.001) interaction between soil acidity and biochemical quality of residues was noted for the effects on microbial biomass C, respiration, selected enzymatic activities and CUE. High quality residues applied to the less acidic soils in all cases led to higher microbial biomass C but lower respiration activity and lower β -D Glucosidase activity in comparison to the effect of low quality residues applied to the same soil. However, in more acidic soils, the residue quality effect was not significant for microbial biomass C, while higher respiration and β -D Xylanase activity were recorded in soil amended with low quality residues. We found that the residue quality effect on CUE was reduced in the more acidic soil as compared to soil with medium acidity. However, the reverse was true on qCO₂. We conclude that not only the effect of individual factors (residue quality, soil pH), but also the interaction effect between these factors on microbial biomass C, respiration and enzymatic activities was paramount to better understand the changes in CUE of soil microbes.

Key words: Biochemical quality, soil pH, microbial metabolism, CUE (carbon use efficiency)