Improving the Carbon Use Efficiency of Soil Microbial Communities: A Field Testing and Modelling Approach

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Terrestrial soils contain 2300 gigatonnes (GT) of carbon, most of which is processed by soil microbial communities that emit 60 GT of carbon each year. Thus, it is important that methods to improve the efficiency of these microbes are considered. In this experiment, the amendments biochar, humate, and kenaf fiber were added to soil for evaluation of carbon use efficiency (CUE) improvements. Sites were selected at a location characteristic of a Pinon Juniper Woodland and amendments, as well as mixtures of amendments, were added to the soil. Respiration measurements were performed using an infrared gas analyzer. Biomass and extracellular enzyme activity (EEA) data have been collected by chloroform fumigation and fluorescence detections respectively. Soil C:N ratio and organic matter data have also been collected. CUE is calculated using stoichiometric models. According to ANOVA, sample type and date had significant effects on soil respiration, with dramatically increased respiration the result of monsoonal rainfall towards the end of the test period. Respiration was increased or kept the same with the addition of amendments. According to a Tukey's HSD test result, all sample types had statistically similar respiration overall. Kenaf samples saw higher CUE and EEA values, suggesting improved soil microbial productivity. Humate samples had lower CUE and EEA values but respiration values closer to control, suggesting limited microbial growth but lower CO2 emissions. These results indicate the balance between increased microbial growth efficiency and reductions in respiration, an important consideration for future testing.

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