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The ^{13}C-^{12}C ratio as a tool to study soil microbial metabolism

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Microbial mineralization of soil organic matter is estimated by the rate of CO_2 evolution and O_2 uptake. The ratio between the two estimates is defined as the microbial respiratory quotient (RQ). The addition of readily available substrate to soil may induce the activation of soil organic matter mineralization which is defined as positive priming effect (PE) and can be calculated using stable carbon isotope characteristics. We studied here a beech forest soil. The glucose addition of 50 μg C-glucose g^{-1} soil that was corresponding to the estimated two-week C input under field conditions significantly stimulated respiration for 1 day only. The 10told higher rate of 500 μg C-glucose g^{-1} soil increased respiration for 1 week and the highest rate of 2000 μg C-glucose g^{-1} soil which corresponds to the rate for the microbial biomass method by substrate-induced respiration (SIR) induced more than four-week stimulated respiration. When the respiration rates have returned to the control level, the carbon isotope characteristic of the CO_2 evolved indicated that the CO_2 evolved still derived from glucose metabolites. With increasing glucose rate, both priming effect and the soil respiratory quotient values increased simultaneously. The maximal RQ values were 1.60, 1.40 and 1.05 induced by addition at 2000, 500 and 50 μg C-glucose g^{-1} soil respectively. The short-time PE over 9 hours showed about 62 % for both the 2000 and 500 μg C-glucose g^{-1} soil and about 18 % for 50 μg C-glucose g^{-1} soil. The long-term PE during 4 weeks gave 120, 50 and 0 % for 2000, 500 and 50 μg C-glucose g^{-1}

soil respectively. The SIR was used for the estimation of growing (r-strategists) and non-growing (K-strategists) microorganisms. The respiration rate obtained immediately after the addition of substrate was about $(r + K) = 2.4 \pm 0.2$, where $r = 0.6 \pm 0.2$ and $K = 1.8 \pm 0.3$. In conclusion, the addition of glucose to the forest soil activated soil organic matter mineralization accompanied by high RQ and PE values and the PE was initially induced by K-strategist.