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Day and Night Variability of CO_2 Fluxes and Priming Effects under zea Mays Measured in High Resolution

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Plant induced increase of soil organic matter turnover rates contribute to carbon emissions in agricultural land use systems. In order to better understand these rhizosphere priming effects, we conducted an experiment which enabled us to monitor CO_2 fluxes under Zea mays plants in high resolution. The experiment was conducted in a climate chamber where the plants were grown in tightly sealed boxes for 40 days and CO_2 efflux from soil was measured twice a day. Continuous 13C-CO_2 label was used to allow differentiation between plant- and soil-derived CO_2.This enabled us to monitor root respiration and soil organic matter turnover in the early stages of plant growth and to highlight changes in soil CO_2 emissions and priming effects between day and night. The measurements were conducted with a PICARRO G2131-I [U+F064][U+F031][U+F033]C high-precision isotopic CO_2 Analyzer (PICARRO INC.) utilizing an automated valve system governed by a CR1000 data logger (Campbell Scientific). After harvest roots and shoots were analyzed for 13C content. Microbial biomass, root length density and enzymatic activities in soil were measured and linked to soil organic matter turnover rates. Results show an increased soil CO_2 efflux at day time periods and an overall increase with increasing plant biomass. No difference in chloroform fumigation extractable microbial biomass has been found but a strong negative priming effect was measured in the short experimental period, suggesting that the microbes shifted to the utilization of plant exudates without actual microbial growth triggered by the new labile C input. This is coherent with the observed shift in enzyme kinetics. With this experimental setup we show that measurement of priming effects in high resolution can be achieved.