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Effects of elevated atmospherical CO2 concentration and nitrogen fertilisation on priming effects in soils

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It is expected that the biomass production and thus the input of organic carbon to the soil will increase in response to elevated CO¬2 concentrations in the atmosphere. It remains unclear whether this will lead to a long term increased carbon pool, because only little is known about the stability of the additional carbon inputs.
The soil samples were taken on an agricultural field at the experimental farm of the Federal Agricultural Research Centre (FAL) in Braunschweig, Germany. A Free-Air Carbon-dioxide Enrichment (FACE) system was installed here in May 2000. It consists of rings with 20 m diameter. Two rings were operated with CO2 enriched air (550 ppm), another two rings received ambient air (370 ppm). One half of each ring received the full amount of nitrogen fertiliser, the remainder received only half of this N-amount. The soil samples were taken after 6 years of operation and were incubated with 14C-labeled fructose and alanine for 21 days. Furthermore, combined additions with the respective substrate and ammonium nitrate or ammonium nitrate alone were conducted. The microbial biomass was determined after 2 and 21 days.
In the untreated controls the SOC mineralisation amounted to 0.59 to 0.68%. The addition of fructose, fructose+NH4NO3, alanine and alanine+NH4NO3 to the different soil samples increased SOC mineralization and thus caused priming effects of different extents. For NH4NO3 no priming effects occurred. The addition of fructose induced positive priming effects in all samples. The lowest priming effect was observed in the sample ambient CO2+50% N (+50%), either with fructose alone or in combination with NH4NO3. The addition of alanine caused similar priming effects in the ambient CO2+100% N and the elevated CO2+100% N samples (+92.4 and +95.6%, respectively). Again, the lowest priming effect was observed in the sample ambient CO2+50% N. The microbial biomass showed a clear increase in the substrate treated samples compared to the controls. The addition of NH4NO3 did not change the amount of Cmic.
The results show, that in no treatment SOC degradation was N-limited, but always limited by easily available energy substrates. On the other hand, N-fertilization had a stronger effect on the microbial response to alanine addition than the CO2-level. Only with low N-fertilization, soils under elevated CO2 are more substrate limited than under elevated CO2, indicating that biomass C-inputs are of different quality.