Soil-derived greenhouse gas emissions as influenced by farming management

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Agricultural practices contribute considerably to emissions of greenhouse gases. So far, knowledge on the impact of organic compared to non-organic farming on soil-derived nitrous oxide (N_2O) and methane (CH_4) emissions is rather limited. Meta-studies studies show, that organically managed soils emit less N_2O and take up more CH_4 than those under non-organic management. This in contrast of that what has been found in the laboratory with soil material from the DOK trial. When subjected to the same water-filled pore space (90%) and N fertilization level (40 kg N ha^{-1}), BIOORG showed a higher N2O production potential than CONMIN. This can be related to the higher soil C content and higher microbial activity in BIORG than in CONMIN soil. Production of N_2 was similar in BIOORG and CONMIN and significantly lower in NOFERT, most likely due to significantly decreased pH inhibiting N_2O reduction. This caused the greatest $N_2O/(N_2O + N_2)$ ratios in NOFERT (0.88 ± 0.02) followed by BIOORG (0.79 ± 0.01) and CONMIN (0.68 ± 0.02) ($p < 0.001$).
Furthermore, we investigated N_2O and CH_4 fluxes with manual chambers during 571 days in a grass-clover– silage maize – green manure cropping sequence in the field, making use of the contrasting farming systems of the DOK trial. We compared two organic farming systems – BIODYN and BIOORG with the two non-organic systems CONMIN and CONFYM – all reflecting Swiss farming practices–together with the unfertilised control NOFERT. We observed a 40.2% reduction of N2O emissions per hectare for organic compared to non-organic systems. In contrast to current knowledge, yield-scaled cumulated N2O emissions under silage maize were similar between organic and non-organic systems. Cumulated on area scale we recorded under silage maize a modest CH_4 uptake for BIODYN and CONMIN and high CH_4 emissions for CONFYM. We found that, in addition to N input, quality properties such as pH, soil organic carbon and microbial biomass significantly affected N2O emissions. This study showed that organic farming systems can be a viable measure contributing to greenhouse gas mitigation in the agricultural sector.