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Greenhouse gas emissions induced by tillage and fertilisation in an organic grass-clover ley

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Numerous research articles have proven advantages for soil quality and biodiversity in organic farming systems as compared to conventional. To integrate conservation tillage techniques in an organic management is a further instrument to improve soil health. However, its implementation is a challenging task. A question beyond deals with its climate impact. Regarding greenhouse gas emissions induced by reduced tillage under organic conditions, studies are still scarce. Within the TILMAN-ORG network (www.tilman-org.net), nitrous oxide and methane fluxes were thus monitored in a long-term tillage trial. This organic trial is situated in Frick, Switzerland (1000 mm, 8.9 ˚C) and compares the use of mouldboard ploughing (CT, 15 cm) with reduced tillage (RT, with skim plough (5 cm) and occasional chisel ploughing (15 cm)) since 2002. The trial is arranged in a strip-split-plot design on a heavy clay soil. In addition, cattle slurry only (SL) is compared with a slurry/manure compost treatment (MC) at a rate of 90 kg N/year. MC plots received one manure compost and two slurry batches, the latter applied with SL the same day but with half the amount. The overall management is in compliance with the EU organic farming regulation. Nitrous oxide (N_2O) and methane fluxes were determined from August 2012 to November 2013 in a grass-clover ley. We adjusted the closed chamber sampling method developed by Flessa et al. (1995) with eight replicates for each treatment. Gas and soil sampling took place weekly with additional measurements after fertiliser and tillage management. The gas samples were measured with an Agilent gas chromatograph 7890 (FID, ECD). Soil samples were analysed for mineralised nitrogen, dissolved organic carbon and gravimetric water content. Flux calculation included linear and non-linear regression calculated with the HMR-Model after Pedersen et al. (2010) and Fuss et al. (unpublished). N_2O fluxes calculated with the non-linear model were 10 % higher than calculated with the linear model only. First results showed that reduced tillage induced slightly higher cumulative N_2O emissions and less methane oxidation than the plough treatment for this 14 months period, but differences weren't significant. Fertilisation also didn't show significant differences which was surprising. After slurry application, N_2O pulse emissions went along with the amount of slurry applied to both fertiliser treatments and were thus higher in SL. In contrast, manure compost application induced no N_2O pulse emissions in MC. During ley destruction in October 2013 however, where the ley was tilled differently in RT and CT, N_2O emissions were higher in plots fertilised with manure compost.