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Impact of different tillage practises on greenhouse gas emissions in an organic farming system

Philipp Koal (1), Rolf Schilling (1), Georg Gerl (2), Karin Pritsch (1), and Jean Charles Munch (1)

(1) Helmholtz Zentrum Muenchen-Institute of Soil Ecology, D-85758 Neuherberg, Germany (philipp.koal@helmholtz-muenchen.de), (2) Research Farm Scheyern, Prielhof, D-85298 Scheyern, Germany (georg.gerl@helmholtz-muenchen.de)

In order to achieve a reduction of greenhouse gas emissions, management practises need to be adapted by implementing sustainable land use. Organic farming with minimum or reduced tillage practises are applied as an alternative to conventional tillage systems. The aims of these practises are the prevention of soil erosion by improving the soil structure, the decrease of the energy consumption for tillage and the improvement of the CO_2 balance of a farm. The conducted field experiment examines and compares greenhouse gas budgets of different tillage practises (minimum tillage vs. conventional tillage) of an organic farming system. Furthermore, the analysis of the alterable biological, physical and chemical soil properties enables a link between the impact of different management systems on greenhouse gas emissions and the monitored cycle of matter, especially the nitrogen cycle.

Measurements were carried out on long-term field trials at the Research Farm Scheyern located in a Tertiary hilly landscape approximately 40 km north of Munich (South Germany). The long-term field trials of the organic farming system were started in 1992. Since then, parcels in a field (each around 0,2 to 0,4 ha) with a particular interior plot set-up have been conducted. So the 20 years impacts of different tillage practises on soil properties including trace gases were examined.

Fluxes of CH4, N2O and CO_2 are monitored since 2012 for the organic farming system trial using an automated system which consists of chambers (per point: 4 chambers, each covering 0,4 m^2 area) with a motor-driven lid, an automated gas sampling unit, an on-line gas chromatographic analysis system, and a control and data logging unit (Flessa et al. 2002). Each chamber is sampled 3 to 4 times in 24 hours.

The main outcomes are the analysis of temporal and spatial dynamics of greenhouse gas fluxes as influenced by management practise events (fertilisation and tillage) and weather effects (drying-rewetting, freezing-thawing, intense rainfall and dry periods) and the creation of an impact study comparing the minimum tillage system with the conventional tillage system. Physical, chemical and biological soil properties (i.a. texture, mineral nitrogen and soil organic carbon) were monitored to aggregate the parameters and processes influencing the greenhouse gas fluxes. Moreover, to understand processes leading the greenhouse gas emissions, additional experiments under laboratory conditions (e.g. soil potential for trace gas formation) are included. Furthermore, in comparison with a similar long-term field experiment under a conventional management for over 20 years more relevant data are ascertained to assess and calculate the global warming potential of different management and tillage systems.