Geophysical Research Abstracts
Vol. 14, EGU2012-4054, 2012
EGU General Assembly 2012

Effects of tillage on contents of organic carbon, nitrogen, water-stable aggregates and light fraction for four different long-term trials

R. Andruschkewitsch (1), D. Geisseler (1), H. -J. Koch (2), and B. Ludwig (1)

(1) University of Kassel, Organic Agricultural Sciences, Environmental Chemistry, Germany (andruschkewitsch@uni-kassel.de), (2) Institute of Sugar Beet Research, Göttingen, Germany

Despite increasing interest in tillage techniques as a factor affecting organic carbon (Corg) dynamics and stabilization mechanisms little is known about the underlying processes. Our objectives were (i) to quantify the impact of different tillage treatments on the amount and distribution of of labile Corg pools, on the water-stable macro-aggregate (>250 μm) contents and on organic carbon (Corg) storage and (ii) to quantify the ability of soils under different tillage treatments, light fraction (LF) inputs and clay contents in macro-aggregate formation.
Therefore four long-term tillage trials on loess soil in Germany with regular conventional tillage (CT, to 30 cm), mulch tillage (MT, to 10 cm), and no-tillage (NT) treatments. Samples were taken in 0-5 cm, 5-25 cm and 25-40 cm depth after 18-25 years of different tillage treatments and investigated on free and occluded LF (fLF and oLF, respectively) and on macro-aggregate contents. Furthermore an incubation experiment for the quantifcation of macro-aggregate formation was conducted. Macro-aggregates in soils from CT and NT treatments (0-5 and 5-25 cm soil depth) were destroyed and different amounts of light fraction (LF) and clay were applied.
The four long-term tillage trials, differing in texture and climatic conditions, revealed consistent results in Corg storage among each other. Based on the equivalent soil mass approach (CT: 0-40, MT: 0-38, NT: 0-36 cm) the Corg stocks in the sampled profile were significantly higher for the MT treatment than for the CT and NT treatments. Significantly lower Corg, fLF, oLF, and macro-aggregate contents for the soils under CT treatment in comparison with the soils under NT and MT treatments were restricted on the top 5 cm. The correlation of the macro-aggregate content against the fLF and oLF contents suggested that the macro-aggregate content is influenced to a lesser extent directly by the physical impact of the different tillage treatments but by the contents of available biomass, presumably due to the higher biomass input via higher crop yields under CT and MT and the vertical distribution of the residue input by tillage.
Stepwise multiple linear regression analysis of the incubation experiment suggested that the Corg content was the driving factor of macro-aggregate formation. Microbial parameters like microbial activity, metabolic quotient, microbial carbon (Cmic)/Corg ratio and ergosterol/Cmic ratio were only of minor relevance for macro-aggregate formation. Differences in clay content revealed no clear effects on macro-aggregate formation, probably due to missing alterations of soil water content and therefore missing swelling or shrinkage of the soil. However, at early stages of the incubation the microbial activity was the main factor of macro-aggregate formation and on the long term the effect of saprotrophic fungi was increasing.
The results of the incubation experiment are in line with findings of the field experiment, leading to the conclusion that the amount of available biomass has higher effects on macro-aggregate content and formation than the physical effect of the different tillage treatments.