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Conservation tillage decreases soil erosion in organic farming

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Soil erosion causes severe impacts on terrestrial and fluvial ecosystems and is considered one of the major environmental problems of our time. It mainly occurs on agricultural land, but effects of different arable farming practices on soil erosion rates are still debated. In this context, the impact of conservation tillage practices on sediment loss in organic agriculture has rarely been tested in the field. Moreover, it is still unclear how conservation or no tillage under conventional conditions compares to tilled organic systems.

We studied interrill sediment loss during heavy rainfall events (60 mm h^{-1}) in a long-term replicated arable farming system and tillage experiment (FAST trial). Four different cropping systems were investigated: I) organic farming with intensive tillage, II) organic farming with reduced tillage, III) conventional farming with intensive tillage and IV) conventional farming with no tillage. Measurements were carried out with a rainfall simulator and micro-scale runoff plots in 2014 (fallow land after winter wheat) and 2017 (during maize growth). In addition to sediment delivery and runoff, soil aggregation, bulk soil density and soil organic carbon content were also investigated.

This study showed that organic farming decreased mean sediment delivery compared to conventional farming by 0.54 t ha^{-1} h^{-1} or 30 %. We could further demonstrate that reduced tillage in organic farming (0.73 t ha^{-1} h^{-1}) decreased sediment delivery by 61 % compared to intensively tilled organic plots (1.87 t ha^{-1} h^{-1}). Whereas intensively tilled conventional plots showed the highest sediment delivery (3.46 t ha^{-1} h^{-1}), the combination of conventional farming and no tillage showed lowest rates (0.24 t ha^{-1} h^{-1}). Soil erosion was much higher in June during maize growth (2.92 t ha^{-1} h^{-1}) than in August on fallow land after winter wheat (0.23 t ha^{-1} h^{-1}). Soil surface cover and soil organic matter were the best predictors for reduced sediment loss. Interestingly, it could be shown that living plant cover from weeds in reduced organic treatments protect soil surfaces better than plant residues in conventional, no-tillage plots. When soil cover was above 30 %, soil erosion rates were significantly lower.

In conclusion, this study enabled ranking four different arable cropping systems regarding soil erosion and proved that the application of reduced tillage further decreases sediment delivery in organic farming. Thus, it appears to be a major improvement for soil erosion control in organic farming systems.