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How do long-term different tillage treatments affect soil organic matter and nutrient cycling?

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Conventional tillage including ploughing after the harvest and/or for seedbed preparation aims to incorporate crop residues and weeds and to loosen, mix and aerate the soil. However, less beneficial effects like subsurface compaction and loss of soil organic matter (SOM) are reported to occur with intensive tillage. Thus, reduced and minimum tillage systems without ploughing are getting more popular in agriculture with the aim to contribute to soil quality and climate change mitigation. AGES runs a field experiment on a fine-sandy loamy Haplic Chernozem in Fuchsenbigl, Lower Austria, since 1988 to study the effects of different tillage systems on chemical, physical and microbial soil parameters as well as on crop parameters. The tillage treatments include “conventional tillage, CT” with a plough and a cultivator down to 30 cm soil depth, “reduced tillage, RT” with a cultivator down to 15 cm two to three times a year and “minimum tillage, MT” treated with a rotary driller once a year down to 5-8 cm soil depth. From 1998 to 2017 soil organic carbon (SOC) in 0-10 cm was highest in the MT plots compared to CT and RT, however, this fact was not always statistically verifiable. Average SOC stocks from 0-60 cm, measured in 2001, did not differ between the different treatments of the Fuchsenbigl tillage experiment. As nitrogen (N) is another major component of SOM, the enhancement of the SOC content may increase the potential for N losses. Total N (Nt) with different tillage treatments showed similar patterns in the temporal development as SOC, i.e. significantly higher Nt contents in 0-10 cm in MT plots compared to RT and CT, beginning only 10 years after the start of the experiment. No treatment effects in 20-30 cm soil depth could be shown. The long-term development of further parameters indicating especially nutrient cycling such as plant available P and K, potential N mineralisation, pH and cation exchange capacity (CEC) will also be presented. The results show that long-term field experiments are indispensable to quantify the effects of changes in arable soil management such as tillage with statistical certainty.