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Influence of crop rotation and tillage intensity on soil physical properties and functions

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Soil tillage intensity can vary concerning tillage depth, frequency, power input into the soil and degree of soil turn-over. Conventional tillage systems where a plough is regularly used to turn over the soil can be differentiated from reduced tillage systems without ploughing but with loosening the upper soil and no tillage systems. Between conventional tillage and no tillage is a wide range of more or less reduced tillage systems.
In our case the different tillage intensities are not induced by different agricultural machinery or techniques, but result from varying crop rotations with more or less perennial crops and therefore lower or higher tillage frequency. Our experimental area constitutes of quite unstructured substrates, partly heavily compacted. The development of a functioning soil structure and accumulation of nutrients and organic matter are of high importance. Three different crop rotations induce varying tillage intensities and frequencies. The first crop rotation (Alfalfa monoculture) has only experienced seed bed preparation once and subsequently is wheeled once a year to cut and chaff the biomass. The second crop rotation contains perennial and annual crops and has therefore been tilled more often, while the third crop rotation consists only of annual crops with annual seedbed preparation.
Our results show that reduced tillage intensity/frequency combined with the intense root growth of Alfalfa creates the most favourable soil physical state of the substrate compared to increased tillage and lower root growth intensity of the other crop rotations. Soil tillage disturbs soil structure development, especially when the substrate is mechanically unstable as in our case. For such problematic locations it is recommendable to reduce tillage intensity and/or frequency to allow the development of soil structure enhanced by root growth and thereby the accumulation of organic matter and nutrients within the rooting zone.