



Effect of reduced tillage in organic farming on soil structure measured by non-destructive X-ray computed tomography in two long-term experimental field trials

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Reduction of tillage intensity by non-inversion and very superficial tillage techniques is expected to have effects on soil structure such as soil porosity and soil structure stratification. Our hypothesis was that, mainly due to earthworms' activity, soil macroporosity increases in the superficial soil layer with non-inversion and very superficial tillage compared to ploughing whereas, the opposite would be observable in the deeper soil layers. In the framework of the FERTILCROP project (<http://www.fertilcrop.net/fc-home-news.html>), we compared the effects of ploughing, non-inversion tillage and very superficial tillage techniques on soil structure in soil strata and more specifically on soil macropores using non-destructive X-ray computed tomography (CT) method. In 2016, after the growing season but before land preparation, we collected undisturbed soil columns (24 cm diameter to 30 cm soil depth) in two long-term experiments Thil (France) and Aesch (Switzerland). At each site a conventional tillage treatment (ploughing to 18-20 cm soil depth) was compared with reduced tillage intensity treatments (rotary and chisel tillage to 5-7 cm soil depth in Thil; chisel to 8 cm soil depth in Aesch). As a reference, we also sampled undisturbed grassland soil from a nearby area. Soil structure was analysed by X-ray CT with a resolution of 0.5 mm. The number of pores per m², total pore volume (%), and total pore length (cm per m²) were determined per soil pore class and per soil layer (1-6 cm and 10-15cm soil depth). Reduction of the tillage intensity (i.e. reduced tillage depth and non-inversion) resulted in an increased total length of all pore diameter size classes in the uppermost soil layer compared to ploughing, but especially of the pore diameter size classes <4mm². In general, pore diameters of <4mm² diameter are too small to be directly associated with earthworm activity, suggesting a rejection of the hypothesis. In addition, reduced tillage intensity in the Thil trial resulted in larger contrasts in pore numbers and volume between the upper and lower soil layers. In the Aesch trial on loess the effect was not statistically significant. Results obtained with X-ray CT confirm soil structure stratification obtained by reduced tillage intensity, previously shown with visual soil observations and penetration resistance measures in the same fields (Peigné et al., 2018).