



Quantitative analysis of the impact of three tillage systems on soil structure using X-ray tomography

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Soil structure is a dynamic property that can be altered by various structuring processes. Among other processes, there are soil tillage, soil organisms (e.g. earthworm bioturbation) and climate (e.g. freeze-thaw cycles). In cultivated fields, it is often acknowledged that soil tillage is a main structuring process, indeed in a very short time soil tillage can drastically altered soil structure. Despite this, the direct effect of tillage on soil structure through the mechanical action of tillage tools is seldom studied. Thus, this study aims at describing the effect of tillage tools used in three different tillage systems (ploughing, surface tillage and direct seedling). Their effect on soil structure is analysed by X-ray computed tomography (CT).

In our study, the ploughing and surface tillage systems consist in two tillage actions at different times: first the ploughing or the use of a tined tool and then the sowing combined with a rotary harrow. On the contrary, there is only one tillage action under the direct seedling system: the sowing. Soil columns were taken before and after each tillage action and then analysed by CT (spatial resolution of 0.3x0.3x0.1 mm). We first analysed the macroporosity and noticeably root and earthworm burrow paths. Algorithms developped in other studies to analyse earthworm burrows allowed us to measure the length, volume, continuity and branching rate of these paths.

First results show that there are very few paths in the tilled layer after ploughing and surface tillage. These paths are short, seldom connected to soil surface and mainly in dense aggregates suggesting that they can weakly improve soil water conductivity. Under direct seedling, we observed that there is a disturbed volume around the seed furrow that removed several paths but this impact is weaker than after the other tillage tools. Acquired knowledges will be used to build a model that accounts for the impact of tillage practices and earthworm bioturbation on soil structure.