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# Effects of liming and tillage on meso- and macropore networks derived from X-ray tomography images

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Soil structure influences water infiltration, aeration and root growth and, thereby, also the conditions for sustainable crop production. Our objective was to quantify the effects of different soil management methods, with a focus on liming, on the topsoil structure of clay soils in Sweden. We sampled 32 intact soil columns (18 cm high, 12.7 cm diameter) from an experimental field with four treatments: conventional tillage (CT), conventional tillage followed by liming (CTL), reduced tillage (RT) and unfertilized fallow (UF). The samples were taken in autumn after harvest, seven years after CaO was applied to the CTL plots. We also sampled in total 72 smaller columns (6 cm high, 6 cm diameter) from the same experiment and from two additional liming experiments where a mixture of Ca(OH)2 and $CaCO_3$ had been applied three years prior to sampling. All columns were analysed using X-ray tomography. One soil aggregate (diameter approximately 5 mm) were isolated from each small column and analysed with the same method. Despite a relatively large number of replicates per treatment for the large columns, there were no significant differences between any of the investigated macropore network properties related to tilled treatments. It is possible that the effects of liming on soil structure was limited to a few years, which means that any effect would have diminished by the time of sampling. The UF treatment, in contrast, exhibited more vertically oriented macropores, which were also better connected compared to the other treatments. This confirms previous findings that tillage may disrupt the vertical continuity of macropore clusters. Liming had generally reduced total imaged porosity for pores >100 $\mu$m) for the smaller columns resulting in less connected pore networks. Liming had no significant effects on the pore networks (pores>11 $\mu$m) of the aggregates.