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Soil structure can be strongly damaged by compaction which derives from compressive forces of wheels and tillage machinery applied to soils under farming systems. Compaction process alters the spatial arrangement, size and shape of clods and aggregates. As a consequence, the soil bulk density and the soil strength increase and the soil functioning is severely disturbed with a reduction in permeability to air, water and heat which in turn affects environmental quality, root and shoot growth and consequently crop production. Compaction causes a restriction in root penetration and rooting depth, an increase in root diameter and a reduction in water and nutrient uptake.

However the responses in rooting stress and then in plant growth to compaction are controversial. They depend on the degree of compaction, its depth and persistence both laterally and vertically, on the texture of soils and their capacity to transfer water and more on weather conditions. Indeed, the crop production is strongly influenced by water stocks invested by roots. It was also observed that roots are preferentially confined to macropores as earthworm's galleries, voids, cracks, bypassing generally compacted clods with a clump effect in loose soil. For high rainfall intensity, it results in preferential water flow which may supply enough water to plants. In addition compaction damage is not irreversible. As a result of climate activity, soil cracking through wetting and drying, fauna activity, compacted clods may progressively break down with decreasing soil impedance and changing in water retention and flow.

Given the above mentioned debate, the objective of this study was to examine in space and time at high resolution the eventual changes in water content and soil structure of cropped soil as compared to bare soil after a prior compaction by in-field wheel traffic. Our study focused on the growing season of wheat crop. From in-field experiment, a precise time monitoring of water content and soil structure was analysed at the soil profile scale on a loamy-clay soil. The methods used to estimate both variables consisted in local soil sampling and visual morphological descriptions supplemented by Electrical Resistivity Tomographies (ERT), which have already been proven to be useful and efficient enough to describe soil water changes and the structural variability in soils.

Our results enhanced the relevant impact of compaction on water transfer and, therefore, on availability of water reserves for plants. Compacted zones created by wheel tracks and the tillage pan restricted root penetration and remained wetter than the loosen matrix. However these results depend on climatic events. As observed after rainfalls, reduced infiltration due to compaction was overcome by preferential flow pathways identified at borders of clods where roots were relatively clumped. In addition, the ploughpan was shown to be a restrictive layer for water flow. These combined effects modified in time water stocks in the rooting zone as well as the structural resilience of clods.