Geophysical Research Abstracts
Vol. 21, EGU2019-299-1, 2019
EGU General Assembly 2019

The effects of traction and repeated wheeling to the protection of soil structure against compaction

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In spite of decades of research, soil compaction is still a growing problem. This is due to the ever-increasing size of agricultural machinery in a search of optimization of field operations. Recent research developments indicated that traction rather than the number of wheels passing in the same track might control the risk and the degree of deformation of the soil structure. The aim of this study was to investigate the effects of activating the offset steering on traction and its consequences to soil mechanical properties (compressibility and shear strength) and pore system distortion in comparison to the effects of repeated passes. This study was performed using a tractor pulling a trailer equipped with offset steering, that enabled to change from a (standard) configuration with two wheel tracks to six wheel tracks (two for the tractor and four for the trailer). Traction was quantified through the pulling force. In situ vertical and horizontal soil stress were measured at 0.4 m depth in an undisturbed soil profile with load cells beneath rolling tyres. The contact stress distribution was assessed using a battery of load cells installed just below the soil surface. Minimally disturbed soil cores were sampled at 0.15 and 0.4 m depth for determination of mechanical properties, dry bulk density, total porosity, efficient air-filled porosity, and air permeability to assess the degree of deformation of soil structure for the different treatments. For a given speed and a given slippage, the pulling force was larger with activated offset steering than when driving in the standard configuration. The pulling force also increased with the load for a given speed and slippage. With increasing pulling force for a given speed and given slippage, horizontal stresses increased. Air permeability at 0.15 m was the lowest beneath the centre of the tractor tracks with offset steering and a high load on the implement. More than three passes of one passive implement wheel were needed to approach similar increase in bulk density and decrease of air permeability at 0.15 m as resulted from a single pass of the tractor. These preliminary results consequently indicate that wheels with traction induced more pore distortion than multiple passive wheels.