Traffic-induced soil compaction – Experimental field measurements during harvest

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Background

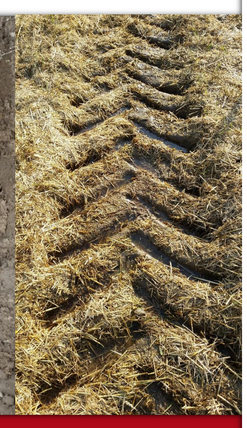
In recent decades, sizes and weights of agricultural machinery increased significantly. Especially under wet conditions, high wheel loads cause major concern regarding the risk of soil compaction, which is an essential factor responsible for soil physical degradation. To understand traffic-induced soil compaction processes, it is necessary to investigate soil as well as agricultural machine parameters.

Aim of study and experimental design

- Measuring and collecting soil and agricultural machine parameters, which are important to assess field traffic-induced soil compaction
- Study took place within the scope of the project SOILAssist
- Study site is located in Adenstedt in southern Lower Saxony, Germany and soil type is a stagnic Luvisol
- Wheeling experiments with agricultural machinery from the harvest chain with different wheel loads were carried out
- Soil pressure and soil deformation were measured in situ using a multi-channel measuring device
- Soil sampling of undisturbed soil cores before and after wheeling to investigate changes in soil structure and functionality.







Soil parameters

Field measurements

- Soil pressure and soil deformation in different soil depth (20, 35 and 50 cm) evoked by field traffic of agricultural machinery
- Penetration resistance (penetrometer)
- Soil sampling (undisturbed soil cores) before and after wheeling at various depths (20, 35, 50 cm) in different plots in the field
- Number of earthworm channels

Laboratory measurements

- Analysis of undisturbed soil cores to identify changes in soil structure and functionality
- Dry bulk density, particle density, soil moisture
- Pore size distribution, water retention characteristics (pF)
- Air capacity, (usable) field capacity, plant available soil water, permanent wilting point, saturated water conductivity

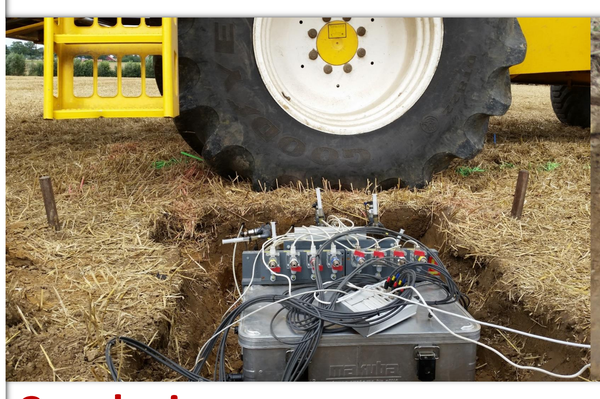
Agricultural machine parameters

Wheeling effects

- Wheeling experiments with agricultural machines will be carried out in different plots in the field in typical crop rotations
- Soil pressure and soil deformation will be measured at various depths (20, 35, 50 cm) using a multi-channel measuring device
    - Modified hydrostatic hose → soil deformation
    - Bolling probes → soil pressure

Machine parameters

- On-site weighing of machinery with portable scales
    - Total weight and wheel load
- Contact area of the tires
- Tire dimensions
- Tire inflation pressure
- Track depth





Conclusion

To link soil parameters with machine parameters, and thus, to understand the development of harmful soil compaction, it is necessary to collect information from the agricultural machines of the harvest chains, such as the wheel load, track depth, tire inflation pressure, and contact area, which is required to determine the important contact area pressure. The connection with changes in soil parameters before and after wheeling enables tracking the propagation of soil pressure and soil deformation from the soil-tire interface to deeper soil layers.

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