

Soil physical effects of sugar beet harvest and slurry spreading on regularly managed fields

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Introduction

During the last decades the average weight of agricultural machinery has increased. At present, large wheel loads characterize machines such as self-propelled combine harvesters. Simultaneously, wide tires enabling low inflation pressure kept constant the mean ground pressure. This alleviated topsoil stress, while subsoil stress depends more on axle load than on contact pressure. Several studies confirmed that heavy machinery can lead to considerable compaction in the subsoil. In many studies, however, wheeling conditions differed from actual field traffic with respect to type of machines, tires, number and speed of passes, etc.

The objective of this study was to investigate the effect of sugar beet harvest and slurry spreading with present-day machines characterized by high axle loads on soil physical properties.

Materials and Methods

Sites and Management

- 11 conventionally managed fields with a long term history of annual mouldboard ploughing to 20–30 cm depth in autumn (plough pan!!)
- Site 1 was subsoiled to 40 cm depth and site 3 was left unploughed one year before starting the investigation

Machine characteristics

- Machine passes took place in course of normal field operations of beet harvest (self propelled 6-row combine harvester, 45 Mg total mass) and slurry spreading (self propelled slurry spreader, 30 Mg total mass)
- Both machines were equipped with wide tires (80-105 cm) and with the rear wheels running offset from the front wheels

Soil sampling and measurements

- Sampling before/after wheeling from topsoil/subsoil, 25–30 replicates each, cores taken in a grid scheme with alternating sampling positions
- Measurement of pore size distribution and air permeability (pF 1.8)

Results

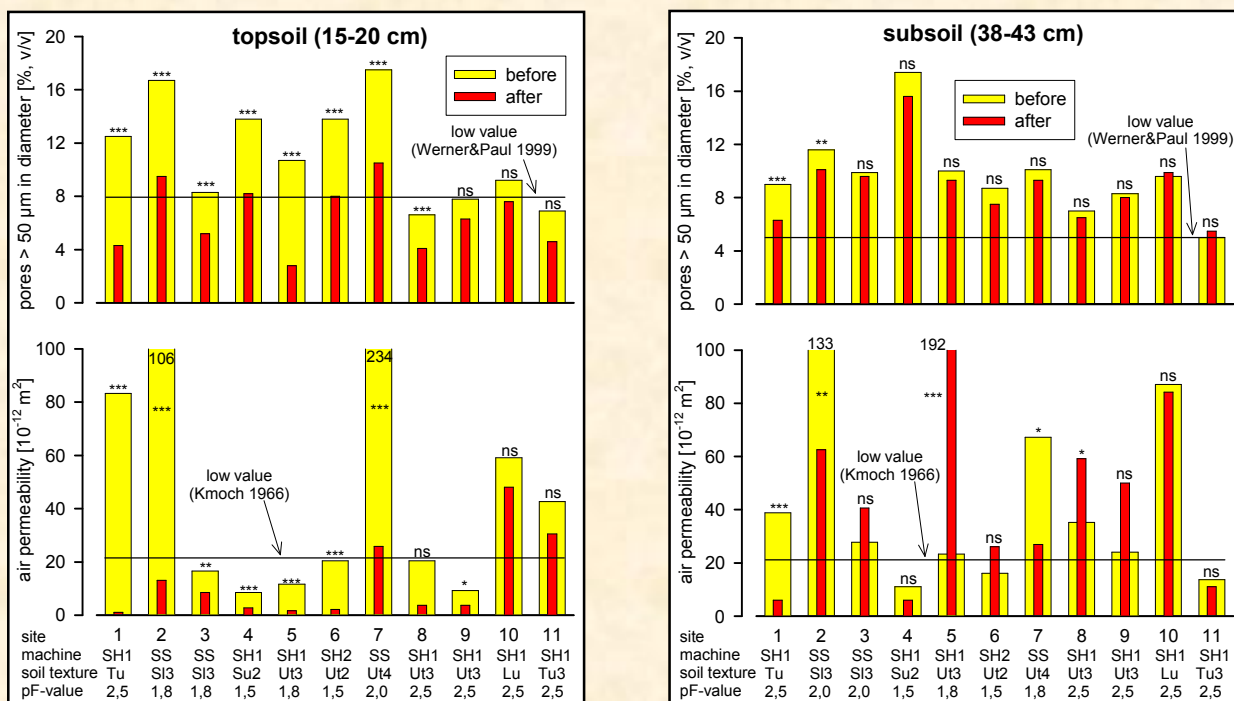


Fig. 1: Median values of air capacity (pores > 50 µm in diameter) and air permeability at pF 1.8 (field capacity) in topsoil (left) and subsoil (right) as affected by sugar beet harvest (SH1, SH2) and slurry spreading (SS). *, **, *** = significance of changes due to the machine pass as indicated by Mann-Whitney-U test, ns = not significant; pF-value at time of passing.

- **Topsoil:** At most sites, a pass by the sugar beet harvester and the slurry spreader significantly decreased air-filled porosity and air permeability (Fig. 1, left).
- **Subsoil:** The subsoil showed no changes or only minor signs of compaction (Fig. 1, right). Only at site 1, which had been subsoiled one year before wheeling, severe signs of compaction (i.e. air filled porosity and air permeability) were detected.

Conclusions

- Present-day heavy agricultural equipment does not necessarily lead to severe subsoil compaction. Even if the soil is wet, the effect of a single pass on soil properties seems to be slight.
- However, these slight changes may add up with repeated passes of heavy machines over years.
- Especially soils with little potential for self-restoration as well as deeply fissured soils with an unstable subsoil structure are in serious danger of becoming compacted.

The risk of soil structure degradation due to heavy farm machinery needs to be reduced by:
wide tires, low inflation pressure, radial instead of bias-ply carcass, offset wheels, conservation tillage