

# Influence of conservation tillage and direct drilling on soil physical properties and sugar beet yield

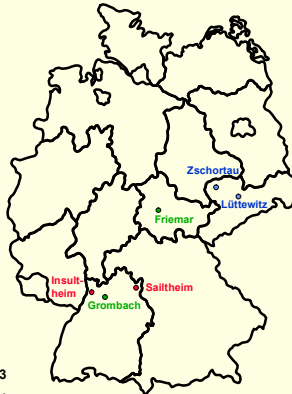
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## Introduction

Developments in the EU CAP, especially the introduction of cross compliance regulations made conservation tillage systems increasingly popular in recent years. Reduced tillage intensity enables high crop yields and, simultaneously, low production costs compared to ploughing. In contrast, direct drilling of sugar beet may result in substantially lower white sugar yields (WSY). For this study it was hypothesized that the yield decrease observed with direct drilling is caused by soil structure degradation.

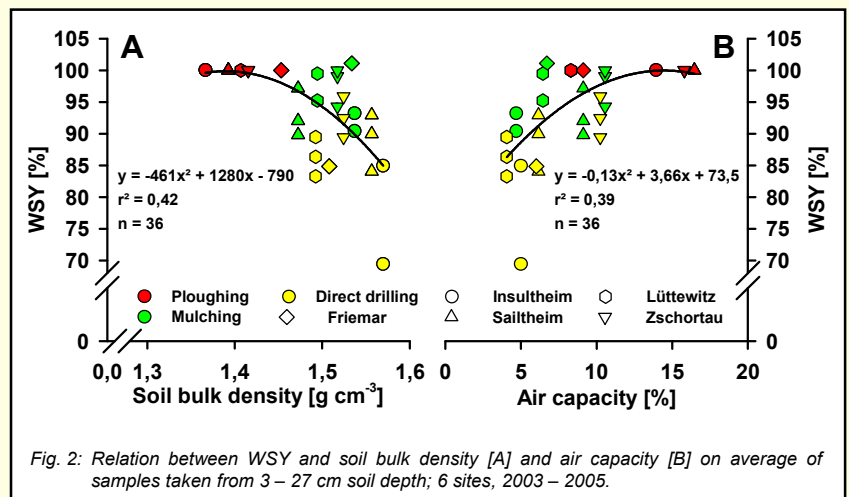
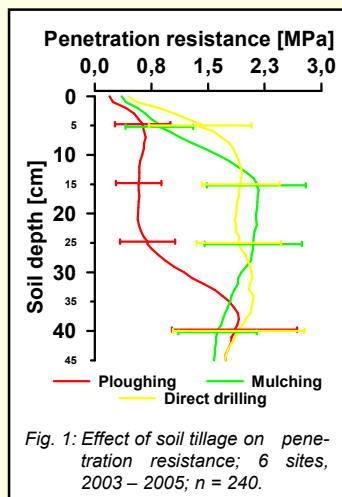


- experimental sites 2003
- experimental sites 2004
- experimental sites 2005

## Materials and Methods

- Large-scale field comparisons of tillage treatments (2.5 - 10 ha each) since 1992
- Tillage treatments:
  - Ploughing: Annual mouldboard ploughing, 30 cm deep
  - Mulching: Shallow mixing, 10 cm deep
  - Direct drilling: No tillage (except seedbed preparation for sugar beet, 2 cm deep)
- Crop rotation: Sugar beet, winter wheat, winter wheat, followed by white mustard catch crop; Residues remained in the field
- Penetration resistance (40 replicates per plot) was recorded and undisturbed soil cores (24 - 30 replicates per plot) were taken after sowing sugar beet from 3 - 7 cm, 13 - 18 cm, 23 - 27 cm and 38 - 43 cm depth
- Soil bulk density, total pore volume and pneumatic conductivity was determined
- Small plots (4 replicates per tillage treatment, each 10,35 m<sup>2</sup>) were established close to the soil sampling pits to measure white sugar yield

## Results



### Reducing tillage intensity

- increased penetration resistance (Fig. 1) and soil bulk density (Fig. 2 A) in the topsoil.
- decreased air capacity (Fig. 2 B) and pneumatic conductivity (not shown) in the topsoil.

WSY was correlated to soil physical parameters with  $r^2$  values ranging from 0,03 to 0,46 (Table 1). In the upper soil layers the relation was closer than in the lower horizons.

Table 1: Relation between soil physical parameters and WSY; 6 sites 2003 - 2005.

Soil depth [cm]	Soil bulk density	Air capacity	Pneumatic conductivity
3 - 7	$r^2 = 0,46^{***}$ $y = -380x^2 + 1006x - 565$	$r^2 = 0,35$	$r^2 = 0,24$
13 - 18	$r^2 = 0,28$	$r^2 = 0,35$	$r^2 = 0,16$
23 - 27	$r^2 = 0,22$	$r^2 = 0,12$	$r^2 = 0,12$
38 - 43	$r^2 = 0,07$	$r^2 = 0,03$	$r^2 = 0,07$
3 - 27	$r^2 = 0,42$	$r^2 = 0,39$	$r^2 = 0,14$

## Conclusions

- ➔ Extreme reduction of tillage intensity such as direct drilling may result in a structure degradation in the topsoil having the potential to decrease sugar beet yield.