Effect of ploughing under a loess soil after several years of conservation tillage on sugar beet yield and quality

S. Pacyna, N. Stockfisch, O. Tomanová, H.-J. Koch

Institute of Sugar Beet Research, Holtenser Landstraße 77, D-37079 Göttingen

Institute of Sugar Beet Research

Introduction

Conservation tillage systems can substitute mouldboard ploughing and gain more and more in importance for agricultural soil cultivation. The well known advantages of conservation tillage are increased soil aggregate stability, reduced erodibility, prevention of plough soles as well as reduced costs of crop management. However, shallow-mixing conservation tillage may also enhance soil strength in the lower layer of the formerly ploughed horizon. Soil compaction can impede sugar beet growth more severely than growth of cereals and rapeseed.

This poster presents the effect of a single ploughing operation which was conducted after several years of conservation tillage to alleviate the detrimental influence of a compacted soil layer on sugar beet growth.

Experimental design

In 1992 the experimental site was divided into three fields to grow sugar beet, winter wheat and winter barley in a rotation having each crop in one of the fields every year. Following winter barley, white mustard was grown as a catch crop. The site is characterised by loess soil (clayey silt) and temperate climate.

On each field two tillage systems were conducted (randomised block design, 4 replicates): continuous ploughing (30 cm; CP) and continuous shallow-mixing conservation tillage (≤10 cm, CCT). After several years half of the conservation tillage plots was treated by a single ploughing operation (30 cm, SP) between harvest of winter barley and sowing of mustard. SP was performed on field 1, field 3 and field 2 in 1998, 1999 and 2000, respectively.

Results

- Beet yield (Fig. 1A) was significantly higher after CP compared to SP and CCT treatments.
- White sugar yield (Fig. 1B) was significantly increased by CP treatment compared to CCT, whereas yield of SP was intermediate and not significantly different from the other treatments.
- Fanging of beetroots (Fig. 1C) and crown height (Fig. 1D) were significantly increased after CCT compared to CP and SP treatments.

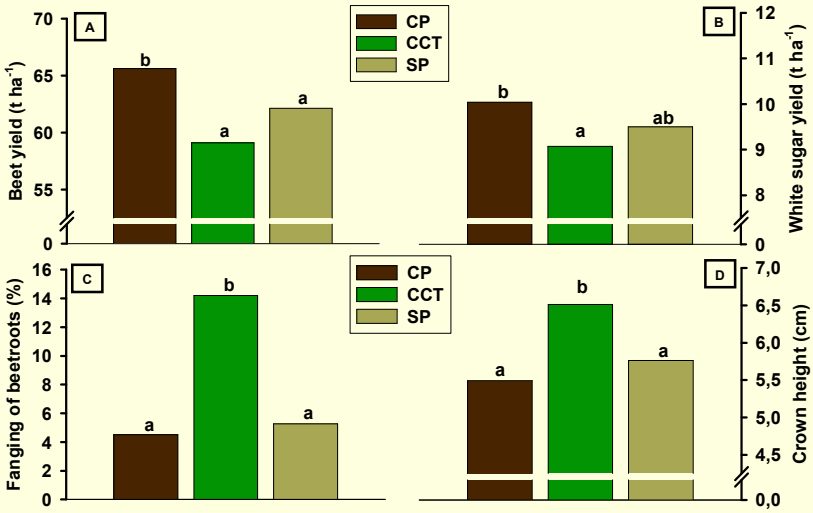

Fig. 1: Influence of tillage (CP, CCT and SP) on beet yield (A), white sugar yield (B), fanging of beetroots (C) and crown height (D). N-fertilisation 110 kg N ha^{-1}. Average of fields 1 to 3. Different letters indicate significant differences between tillage systems (Tukey`s test, p≤0,05).

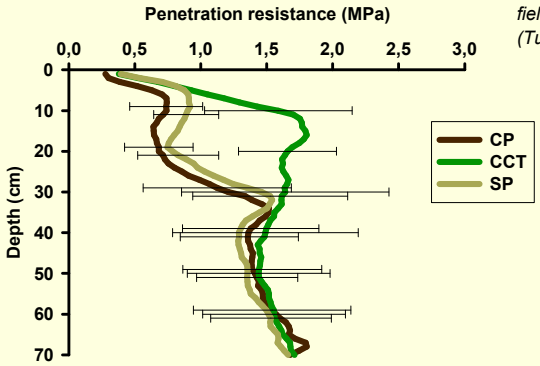

Fig. 2: Influence of tillage (CP, CCT and SP) on penetration resistance. Measurements conducted at field capacity in spring. Average of fields 1 to 3. Bars indicate ±1 standard deviation.

- Down to 70 cm, penetration resistance (Fig. 2) was very similar in CP and SP treatments. CCT, however, revealed a substantial increase in penetration resistance compared to CP and SP in 6 to 33 cm soil depth. In the subsoil no differences between treatments occurred.

Conclusions

➡ *A single ploughing operation can ameliorate topsoil compaction caused by several years of shallow-mixing conservation tillage. This may decrease fanging of beetroots but may not restore sugar beet yield completely.*