The Effect of Different Tillage and Cover Crop on Soil Quality

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Introduction

The long term effects of management practices on soil properties provide valuable information in order to sustain soil quality and prevent soil degradation. Optimized use of cover crops can improve soil structure and carbon retention and thereby reduce the need for intensive tillage. We investigated soil friability, unsaturated hydraulic conductivity, penetration resistance, aggregate stability and evaluated visual properties of soils from a long-term field trial set up in 2007 at Foulum, Denmark.

Materials and Methods

Trial: Long-term tillage and rotation trial at Foulum, Denmark. Split plot design with tillage as main plot factor and cover crop as subplot factor.

Tillage treatments: Direct drilling (D), harrowing (H) to a depth of 8 cm and ploughing to a depth of 20 cm (P)

Cover crop treatments: planting Fodder radish as cover crop (+CC) or left without cover crop (-CC).

Assessing topsoil structural quality in field using a visual method, before (left) and after (right) breaking dawn sample(Ball et al. 2007)

determined aggregate size distribution after a drop shatter test for soil taken from 10-20 cm depth (Schjønning et al. 2002)

measuring unsaturated hydraulic conductivity at -4 hPa in field

Results and discussion

Visual evaluation

❑No significant different between tillage and cover crop treatments. A tendency for a better structural quality for P than for D (lower scores) ($p \sim 0.067$);

Drop shatter

❑Ploughing (P) had the least MWD (best friability) amongst other tillage treatments.

❑There was significant interaction between cover crop and tillage treatments, i.e., cover crop had a positive effect on direct drilling (D) .

Unsaturated hydraulic conductivity

❑The effect of treatments on unsaturated hydraulic conductivity of soil was not significant. However, there was a tendency to lower K_{unsat} for H and D than for P (51.3 cm day-1 for H, 58.2 for D and 94.7 for P).

Treatment effects on unsaturated hydraulic conductivity and Visual soil evaluation of soil quality. Numbers followed by identical letters are not significantly different (P=0.05).

Soil property	Tillage treatments			Cover crop treatments	
	D	H	P	+CC	-CC
$K_{unsat.}$ at -4 kpa, $cm.day^{-1}$	58.2^a	51.3^a	94.7^a	65.8^a	65.5^a
Visual evaluation scores	2.29^a	2.06^a	1.82^a	2.08^a	2.01^a

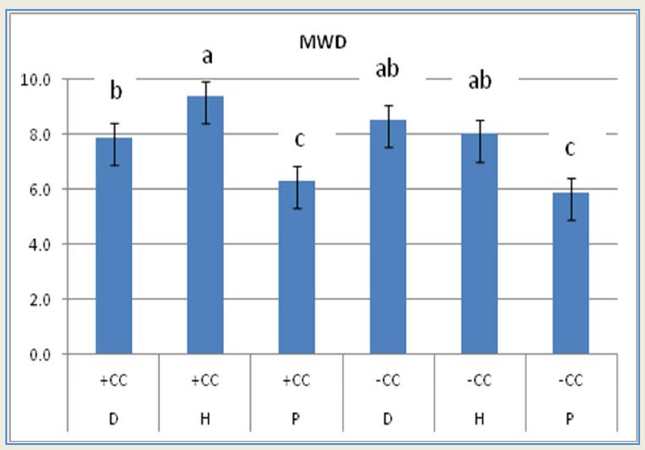

Figure: Effects of different management systems on the Mean Weight Diameter (MWD) determined from the size distribution of aggregates following a drop shatter test. Bars labelled by identical letters are not significantly different (P=0.05).

References:

1. Ball, B. C., Batey T. & Munkholm, L. J. . 2007. Field assessment of soil structural quality – a development of the Peerlkamp test. Soil Use and Management, December 2007, 23, 329–337
2. Schjønning, P., Elmholt, S., Munkholm, L.J. & Debosz, K. 2002. Soil quality aspects of humid sandy loams as influenced by organic and conventional long-term management. Agriculture, Ecosystems and Environment 88, 195-214.

Conclusions:

➢Ploughed soil (P) had the best friability (least MWD) amongst other tillage treatments

➢Cover crop had no significant effect on soil friability

➢Visual soil evaluation indicated the positive effect of ploughing (P) on soil structure

➢The unsaturated hydraulic conductivity was the lowest in harrowing treatment (H) compare to other tillage treatments