Optimising drilling methods in conservation tillage systems in a wheat - oilseed rape rotation in UK

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1. Aim and objectives

Aim: To determine the effect of commercially available conservation tillage systems in the UK on the agronomic, environmental and economic performance of a winter wheat (WW) and oilseed rape (OSR) rotation.

Objectives: to determine the performance of the tillage systems in terms of their effects on: crop growth and yield, soil condition, and, profitability

2. Methods

A field experiment, with five tillage systems established across two fields (Snagsborough and Top Furze) at Lamport (Table 1).

The systems were:
- the default farm system of a Sumo Trio in OSR and with a drill for WW
- three strip tillage systems: Claydon Hynrid, Mzuri Pro Til 3, and Sumo DTS
- zero-tillage system: Vaderstad Seed Hawk used in OSR (replaced by Horsch ST in 2014-15) and Vaderstad Rapid used in WW

Table 1. Crops (and planting dates) for each cropping season

Field	Snagsborough	Top Furze
Soil type	Clay loam	Clay
2013-14	Oilseed rape (5 Sept)	Wheat (23 Sept)
2014-15	Wheat (29 Sept)	Oilseed rape (28 Aug)
2015-16	Oilseed rape (10 Sept)	Wheat (15 Oct)

The field research has been supported by the use of Cranfield University's soil bin facility in order to examine the effect of the tillage implements (Fig. 1) on horizontal draft and degree of soil disturbance

3. Results

Figure 1. Diagrams showing configuration of implements

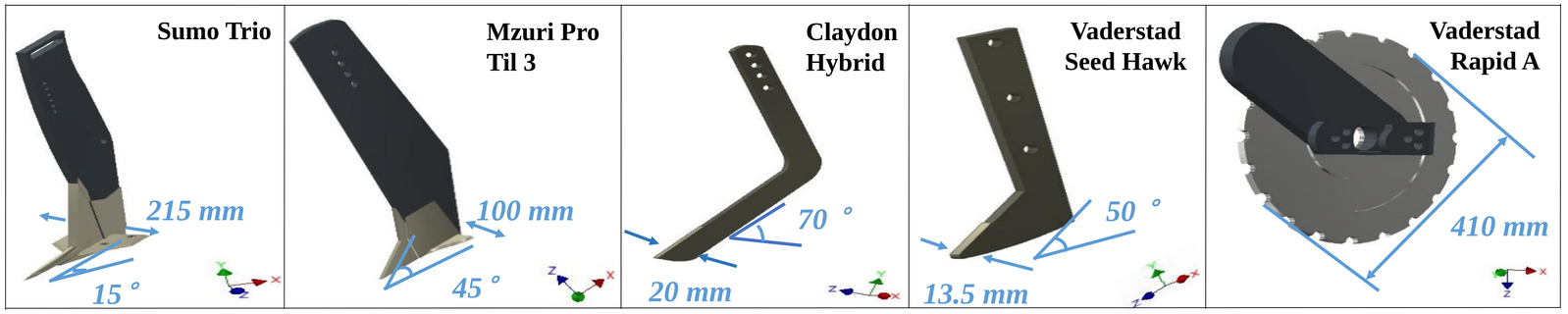

Table 2. Working depth, area of disturbance and horizontal draft of the main tine or disc in each tillage system

Implements used in soil bin	Sumo Trio	Mzuri	Claydon	V. Seed Hawk	V. Rapid
Working depth (mm)	200	150	150	25	25
Cross-section of disturbed soil (cm^2)	507	205	162	14	8.5
Horizontal draft (kN)	2.28	1.6	2	0.18	0.1

Table 3. Yields measured in 13-14, estimated cultivation costs (based on estimated depreciation, fuel and labour), predicted net margin, and measured earthworms

Treatments used in the field	Sumo Trio	Mzuri	Sumo DTS	Claydon	V. Seed Hawk	V. Rapid
WW yield (13-14) (t/ha)	9.7 a	10.7 a	9.9 a	9.9 a	-	10.7 a
OSR yield (13-14) (t/ha)	4.7 a	4.8 a	4.8 a	4.4 a	4.5 a	-
Cultivation cost in OSR* (£/ha)	19	19	21	11	16	-
WW net margin** (£/ha)	639	763	714	725	-	766
OSR net margin** (£/ha)	713	749	746	653	674	-
Earthworms (m^{-2}) in WW	115 b	84 b	131 b	62 b	-	228 a
Earthworms (m^{-2}) in OSR	134 a	160 a	165 a	165 a	147 a	-

*Cultivation cost in wheat was the same, apart from the two pass farm system (31 £/ha)
** Net Margin = Gross margin minus machinery, labour and fuel costs
Means with the same letter are not significantly different and apply to rows

4. Conclusions

- Horizontal draft increased with working depth and soil texture
- Draft requirements reduced with low rake angles. Cross section of disturbed soil increased with winged tines
- No significant effect ($p>0.05$) of systems on yield in first two years
- Differences in predicted net margin of ± £96/ha in wheat and ± £127/ha in OSR, were based on obtained machinery prices and measured yields in 2013-14
- Predicted net margin in wheat (2013-14) was lowest for the 2 pass farm system (Sumo Trio + seed drill)
- There is some evidence that i) soil biology has improved in shallow working systems in terms of earthworms populations and ii) soil structure has improved over time for all systems (data not shown)

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