Performance of UK organic spring wheat and contrasting soil tillage: yield and economic impact

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Introduction

There is concern that intensive conventional tillage has deleterious effects on soil structure and quality [1]. In contrast, non-inversion tillage covers a range of soil management practices that are reported to minimise the disruption of the soil structure; substantially save time with seedbed preparation; increased soil organic matter and reduced operation costs [2].

Aim

To investigate tillage effects on weed pressure, crop performance, gross margin and benefit cost ratio under organic management systems

Experimental design & tillage treatments

The study was conducted from Mar 2012 to Aug 2013 at the Royal Agricultural University's organic Harnhill Manor Farm (NGR SP 075 006), UK. The experiment was a randomized complete block design replicated six times for 2012, but three times for 2013. Each block of was divided into three tillage treatment plots of 30 × 100 m^2. Treatments included :

- CT - mouldboard plough + power harrow combination
- LRNiT – 2 passes of ST bars attached Simba X-press + Vaderstad Rapid- A system disc combination seed drill
- HRNiT - 1pass of ST bars attached Simba X-press + Eco-dyn integrated seed drill

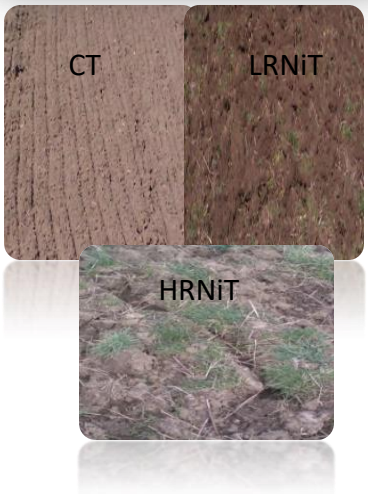
For 2012, spring wheat cv. Paragon was drilled on 14 Mar 2012. After the harvest on 22 Aug 2012, the field was left with soil cover over the winter, and the tillage process was repeated and spring wheat drilled on 10 Apr 2013 and harvesting on 27 Aug 2013

Results

Table 1. Yield and economic analysis of spring wheat under contrasting tillage

	Plant (counts m^{-2})	Grain yield (t ha^{-1})	Price (£ t^{-1})	Variable cost (£ ha^{-1})	Total cost of production (£ ha^{-1})	Gross return (£ ha^{-1})	Benefit to cost ratio	Weed DM (t ha^{-1})
2012								
CT	277a	3.52a	283.89	138	336	858a	3.01a	0.34b
LRNiT	214b	2.96b	276.94	134	332	686b	2.51b	0.64b
HRNIT	170c	2.11c	279.03	108	306	482c	1.97c	1.94a
SED	18.66*	0.15*	3.82 ns	-	-	45.8*	0.15*	0.39*
2013								
CT	235a	3.10a	282.5	138	336	736a	2.61a	1.88b
LRNiT	178b	2.22b	283.9	134	332	497b	1.91b	2.46b
HRNIT	115c	1.33c	283.9	108	306	268c	1.26c	3.57a
SED	10.15*	0.23*	4.32 ns	-	-	78.5*	0.22*	0.36*

*Values followed by the same letter do not differ significantly (*p <0.05)*



Discussion & Conclusion

In both seasons, CT produced the most favourable seedbed conditions for crop establishment. This indicates that as the intensity of soil tillage is reduced with increase in surface soil cover, the seedbed conditions tend to become coarser with larger soil clods and less uniform affecting seed-soil contact or drill performance, resulting in lower crop establishment [3].

In both seasons, more tilled seedbed had significantly lower weed DM than less tilled seedbed such as HRNiT, reinforcing the findings summarised by [2].

Maximum crop yield was always obtained when crop establishment was highest and weed infestation was lowest

Non-inversion tillage although, incurred lower production/variable costs, substantial reduction in yield resulted in significantly lower gross margin, compared to CT . Benefit cost ratio was also significantly lower with non-inversion tillage, implying that the production values with non-inversion tillage have not rewarded with lower production costs.

Under organic systems, with respect to crop emergence, weed prevalence and wheat productivity, the best results were achieved with CT.

References

1. Pittelkow *et al.* (2015). Productivity limits and potentials of the principles of conservation agriculture. Nature 517: 365-368.

2. Cooper *et al.* (2016). Shallow non-inversion tillage in organic farming maintains crop yields and increases soil C stocks: a meta-analysis. Agron Sustain Dev. 36:22

3. Vijaya Bhaskar AV *et al.* (2014). Soil cultivation influences on organic spring wheat performance in contrasting weather. Agronomic decision making in an uncertain climate, Asp Appl Biol. 125: 11-19.