Tillage and undersowing effects on organic wheat yield components and yield

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Introduction

Previous research has shown that long-term and frequent conventional tillage can affect soil environment leading to poor crop yields. In contrast, non-inversion tillage has many benefits which include reduced energy usage; faster land preparation and improved soil aggregation. However, most organic farmers hesitate to adopt non-inversion tillage due to greater weed competition and potential lower crop yields (Vakali *et al.*, 2011). In organic farming, nitrogen input be provided through cereal-legume intercropping. Bi-cropping can utilises biologically-fixed N_2 and can also provides greater competitiveness against weeds. However, the performance of organic bi-cropping is highly variable and crop yields are often reduced compared to monoculture cereal (Jones, 1992).

Aim

To investigate the effects of conventional tillage (CT) against low residue non-inversion tillage (LRNiT) and high residue non-inversion tillage (HRNiT) and also undersowing with either black medic (BM) or white clover (WC) against non-undersown (N_{us}) on the performance of organic winter and spring wheat

Experimental design, tillage & undersowing treatments

The study was conducted from Oct 2010 to Aug 2012 at the Royal Agricultural University's Harnhill Manor farm (NGR SP 075 006) near Cirencester, UK. Experiment was arranged in a randomized complete block design with cultivation treatments (CT, LRNiT and HRNiT) as main plots (30 x 100m) replicated in six separate blocks. In 2010/11 cropping year, winter wheat cv. Claire; 410 seeds m^{-2} was planted on 5 Nov 2010. In 14 Apr 2011, the main plots was split into 3 subplots (30 x 33.3m) and undersown either with WC, BM or N_{us}. After the harvest on 25 Aug 2011, the field was left with soil cover and the experiment was repeated with spring wheat cv. Paragon; 420 seeds m^{-2} planted on 14 Mar 2012, undersowing on 10 Apr 2012 and harvested on 22 Aug 2012.

Results

Tillage & undersowing effects on organic winter & spring wheat

		Plant heights (cm)	Ears (m^{-2})	Grain yield (t ha^{-1})	Legume DM (t ha^{-1})	Weed DM (t ha^{-1})
2010//11 Winter wheat	CT	73.03a	589 a	7.00a	0.055a	0.207a
	LRNiT	71.70a	561 a	6.58a	0.135b	0.272a
	HRNiT	68.43b	410 b	5.53b	0.264c	0.640b
	SED	0.525	66.77	0.317	0.0356	0.128
	P	**	*	**	***	*
2012 spring wheat	CT	81.76a	345a	3.52a	0.250a	0.337a
	LRNiT	78.06b	269b	2.96b	0.643b	0.644a
	HRNiT	74.18c	212c	2.11c	0.793b	1.938b
	SED	1.63	19.61	0.152	0.087	0.385
	P	**	***	***	***	**
	BM	76.10a	256a	2.57a	0.602b	1.221b
	N_{us}	79.76b	294b	3.13b	0.364a	0.923ab
	WC	78.13ab	276b	2.89ab	0.720b	0.775a
	SED	1.39	9.61	0.162	0.105	0.165
	P	*	*	*	**	*

Any two mean within columns not sharing common letters differs significantly. *** significance $p < 0.001$, ** significance $P<0.01$, * significance $p<0.05$, ^{ns} non-significant

Discussion

- For 2010/11, CT & LRNiT gave greater plant heights and ears than HRNiT due to better seedbed quality and reduced weed burden. Conversely, for 2012 CT produced taller plants and higher ears than LRNiT or HRNiT. 2012 cropping period experienced higher precipitation that resulted in cooler and wetter soil environments. Since non-inversion tillage often have greater variability in seedbed than CT, this might have caused slower plant growth and shorter plant heights
- Greater plant heights and higher ears resulted in higher grain yields under CT & LRNiT than HRNiT for 2010/11. Conversely, for 2012, tillage treatments that affected yield components also affected grain yields, with CT being significantly higher than other treatments.
- For 2010/11 there was no effect of undersowing detected due to limited growth in response to dry weather.
- For 2012, increased precipitation favoured higher DM yield of legumes. Undersowing BM did not suppress or may even have stimulated the weeds resulting in greater weed DM. This caused greater competitiveness and lowering of yield significantly compared to N_{us}. Conversely, undersowing WC did not show any significant reduction in yield compared to N_{us} due to their strong competitiveness with weeds and less negative influence on the main crop.

Conclusion

An alternative to CT could be LRNiT for winter wheat. Conversely, for the shorter season spring wheat CT seems the best option. Among undersowing, WC proved to be more suitable in spring wheat

References

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