EVALUATION OF SUSTAINABLE SOIL MANAGEMENT AND COVER CROP PRACTICES

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Introduction

There is increasing 'on farm' interest in the use of cover crops to improve productivity and resilience of farming systems, and also for their capacity to provide wider environmental benefit. These goals are very much in keeping with Sustainable Intensification (SI) aspirations. While the term SI can be subjective, the Sustainable Intensification research Platform (SIP) suggests that key SI objectives in an agricultural context may be expressed as '*managing farmland to increase farm output and competitiveness, whilst protecting the countryside and enhancing environment and social benefits'* (www.siplatform.org.uk). The SIP initiative is a highly collaborative platform, working with stakeholders to explore risks and opportunities associated with the practical delivery of SI across a range of perspectives and scales. At a farm level SIP study farms at Morley (Norfolk) and Loddington (Leicestershire) are examining further the impacts of cover crops on aspects of soils, environment and production at a range of scales.

Materials and Methods

Cover crop research at Morley (sandy loam soil) builds on the New Farming Systems (NFS) programme (initiated in 2007). This examines tillage system (plough, inversion to *c*. 20 cm depth; deep non-inversion, *c*. 20 cm depth; and shallow non-inversion, *c*. 10 cm) and brassica cover crop (radish, *Raphinus sativus*) interactions in large, fully replicated plots using farm scale equipment. Rotations alternate between winter wheat and spring sown combinable crops, and rotations are differentiated further by the presence/absence of an autumn cover before spring crops (for details see Stobart *et al*., 2014; Morris *et al*., 2014). Highly complementary research at Loddington (clay loam soil) is evaluating cover crops at a farm level, using large scale field strip studies, where a range of autumn sown cover crops are compared to farm standard approaches (over winter stubble or autumn cultivation), followed by a spring oat crop established by direct drilling.

Results and Discussion

The interaction of brassica cover crop use and primary tillage method on the yield of other crops in the rotation can be gauged though the NFS data presented in Figure 1. Positive yield responses from the use of a cover crop are represented as values above the zero line and negative responses as values below. Findings suggest an interaction between cover crop yield response and tillage practice; with brassica cover crop use in conjunction with shallow non-inversion tillage more likely to give a positive yield response in this study. Interestingly the only appreciable negative value in the shallow non-inversion tillage system was in 2014, where oilseed rape followed repeated use of a brassica cover crop; this is discussed further in Stobart & Morris (2014). Findings from the field scale evaluation at Loddington demonstrated both improvements in soil structure (lower VESS score, Guimarães *et al*. (2011)) and in the yield of a spring oat crop following the use of cover crops compared to an overwinter stubble area (Table 1). While it should be noted soil structure following cover crop use was similar to that achieved with an autumn soil cultivation, the yield response in the following crop tended to be greater where an over winter cover crop had been used. The mean oat yield response associated with cover crop use (*cf*. stubble) was *c*. 0.5 t ha-1 (worth *c*. £60/€70 ha-1).

Table 1. VESS Score and follow crop yield (spring oats t/ha) in farm field strips following different cover crop and farm practice treatments at Loddington, 2015

Treatment/ Cover Crop	Overwinter Stubble	Autumn Cultivation	Radish + Oats	Radish	Radish + Tillage Radish	Rye + Vetch
VESS Score	3.03	2.61	2.49	2.54	2.55	2.35
Follow Crop Yield	6.26	6.57	6.77	7.26	6.66	6.36

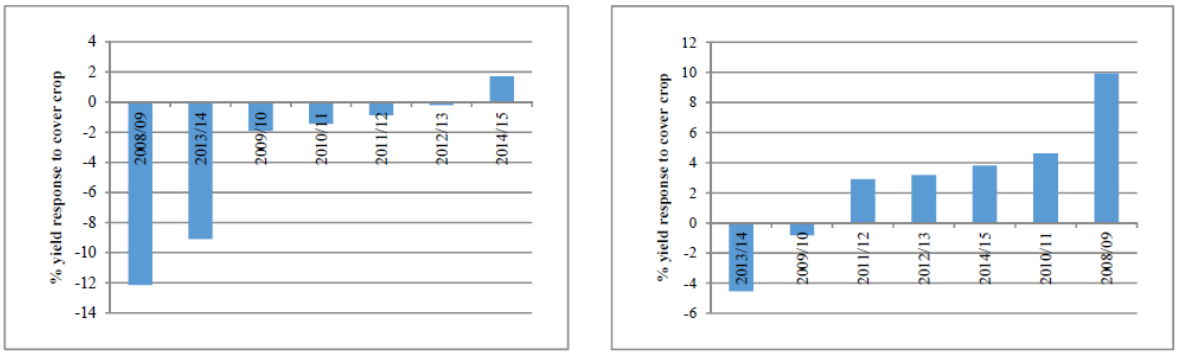

Figure 1. The effect of tillage and brassica cover crop (before spring sown break crops in the rotation) on crop yield (t ha-1). Figure 1a (plough based systems) and 1b (shallow non-inversion tillage); positive values are a benefit from rotational cover crop use. Crops in specific harvest years were: 2009 (spring oilseed rape), 2011 (spring beans), 2013 (spring barley), 2014 (winter oilseed rape) and 2010, 2012 and 2015 (winter wheat).

Conclusions

Collectively these findings demonstrate both the potential for positive yield and financial responses associated with cover crop use in arable systems, but equally that system interactions (e.g. tillage approach and crop rotation) will impact on performance.

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References

Guimarães M.L. – Ball B.C. – Tormena C.A.: 2011. Improvement in the visual evaluation of soil structure. *Soil Use and Management*, **27**: 395–403.

Morris N.L. – Stobart R.M. – Orson J.H: 2014. An appraisal of research, best practice and communication approaches for the management of soil structure. *Felix Cobbold Trust review*.

Stobart R. – Hallett P.D. – George T.S. – Morris N.L. – Newton A.C. – Valentine T.A. – McKenzie B.M.: 2014. Platforms to test and demonstrate sustainable soil management: integration of major UK field experiments. *Aspects of Applied Biology* **127**: *Precision Decisions for Profitable Cropping*, pp. 233–240.

Stobart R. – Morris N.L.: 2015. The impact of repeated brassica cover crops use on system performance and oilseed rape yield. *Aspects of Applied Biology* **129**: *Getting the Most out of Cover Crops*, pp. 51–56.