An investigation into the effect of traffic and tillage on soil properties and crop yields

Emily K. Smith[1]*, Kristof, K.[1,2], Misiewicz, P.A.[1], Chaney, K.[1], White D.W.[1] and Godwin, R.J[1]

[1]Harper Adams University College, Newport, Shropshire, TF10 8NB, UK
[2]Slovak University of Agriculture, Trieda A. Hlinku 2, 949 76, Nitra, Slovakia
*Corresponding author: Emily K. Smith, Crop and Environment Sciences, Harper Adams University College, Newport, Shropshire, TF10 8NB, UK; esmith@harper-adams.ac.uk

Agricultural production systems are increasingly characterised by extensive in-field trafficking of larger and heavier field machinery. The random nature of trafficking, covering 80-90% of the field area, that is characteristic of commercial practice inevitably leads to negative impacts on soil, water and crop characteristics as a result of degraded soil structures, impeded root development and water infiltration, yield losses and water pollution. Remedial action requires energy, time and cost. The future development of a sustainable agricultural sector needs to balance an increase in demand whilst protecting the environment. Emerging technologies and engineering solutions have stimulated a recent shift towards reduced tillage methods and coupled with the development of traffic management systems, aided by Precision Agriculture (PA), aim to reduce the severity of compaction on cropped areas whilst improving efficiency and sustainability. Controlled Traffic Farming (CTF) emanates from Australia and the United States of America where all field traffic travels on permanent wheel-ways, significantly reducing total area trafficked to c. 30% depending on working widths used. Low Ground Pressure (LGP) systems can facilitate random trafficking and are often used to access fields during wet conditions whilst minimising the negative effects of field traffic.

A multidisciplinary long-term project was established at Harper Adams University College (UK) in October 2011 to investigate the interaction between traffic and tillage on soil, crop and energy responses in a randomised and replicated study to determine the effects of Random Traffic Farming, Controlled Traffic Farming and Low Ground Pressure with conventional, minimum and zero tillage. The aim of this study is to develop an integrated mechanisation system to optimise soil and water resources, crop growth and yields and system performance and economics in commercial agricultural practice.

The first year of this research considered the uniformity of the proposed study site on Large Marsh field (8.5 ha.), Harper Adams University College (52°46.7899'N, 002°25.5236'W). The field was assessed in terms of soil type and structure, water infiltration, crop growth and yield using in-field and remote sensing techniques following a process of normalisation against which the treatments of the subsequent plot trials can be assessed. The research site (4 ha.) uniformly yielded 4.5 tonnes per hectare of winter wheat (*Triticumaestivum*var. *Duxford*) at harvest 2012 based on measurements from a combine yield monitoring system and plot yield weights. A tracked Cat Challenger MT765C with a 4m Vaderstad TopDown was used on cultivated plots. Second winter wheat (*Triticumaestivum*var. *Duxford*) was drilled to establish treatments (n=9) in November 2012 using a Vaderstad Rapid. Treatments are randomly allocated on plots (n=36) arranged in 4 blocks and will be evaluated based on soil and crop properties, systems performance and economics in a standard crop rotation. This study will also consider the system performance of treatments at a farm scale on a range of soil and crop types to allow for the development and assessment of optimum system and implement design for tillage and traffic management in crop production.