Geophysical Research Abstracts
Vol. 16, EGU2014-10215, 2014
EGU General Assembly 2014

How do soil physical conditions for crop growth vary over time under established contrasting tillage regimes?

Paul Hallett (1), Ron Stobart (2), Tracy Valentine (3), Timothy George (3), Nathan Morris (2), Adrian Newton (3), and Blair McKenzie (3)

(1) University of Aberdeen, Institute of Biological and Environmental Sciences, Aberdeen, United Kingdom (paul.hallett@abdn.ac.uk), (2) NIAB TAG, Morley Business Centre, Morley, Wymondham, Norfolk, NR18 9DF, UK, (3) The James Hutton Institute, Dundee, DD2 5DA, UK

When plant breeders develop modern cereal varieties for the sustainable intensification of agriculture, insufficient thought is given to the impact of tillage on soil physical conditions for crop production. In earlier work, we demonstrated that barley varieties that perform best in ploughed soil (the approach traditionally used for breeding trials) were not the same as those performing best under shallow non-inversion or zero-tillage. We also found that the Quantitative Trait Loci (QTL) associated with improved phosphorus uptake, and hence useful for marker assisted breeding, were not robust between different tillage regimes.

The impact of the soil environment had greater impact than the genetics in GxE interactions. It is obvious that soil tillage should be considered when breeding the next generation of crops. Tillage may also have important impacts on carbon storage, but we found that despite greater soil carbon at shallow depths under non-inversion tillage, the carbon stored throughout the soil profile was not affected by tillage.
Studies on soil tillage impacts to crop productivity and soil quality are often performed in one season, on single sites that have had insufficient time to develop. Our current research explores multiple sites, on different soils, with temporal measurements of soil physical conditions under contrasting tillage regimes. We use the oldest established contemporary tillage experiments in the United Kingdom, with all sites sharing ploughed and shallow (7cm) non-inversion tillage treatments. In eastern Scotland (Mid Pilmore), the site also has zero tillage and deep ploughing (40 cm) treatments, and was established 11 years ago. In east England there are two sites, both also having a deep non-inversion tillage treatment, and they were established 6 (New Farm Systems) and 8 (STAR) years ago. We measure a range of crop and soil properties at sowing, one month after sowing and post-harvest, including rapid lab based assays that allow high-throughput. Samples are taken over the rooting zone in the topsoil, plough pan and subsoil.

The first year's dataset from this comprehensive project will be presented. Early data identified plough pans under shallow non-inversion tillage that will limit root growth at all sites. Aggregate stabilities vary as expected, with plough soils at shallow depth being less stable than non-inversion tillage, but greater stability in plough soils at greater depth due to incorporated organic matter. Very rapidly following cultivation, the seedbeds coalesce, resulting in a more challenging physical environment for crop growth. We are exploring the mechanisms in soil structure temporal dynamics in greater detail, including the resilience of seedbeds to structural degradation through natural weathering and the action of plants. These profound differences in soil conditions will impact the root ideotype of crops for these different conditions. This has implications for the way in which breeding and genotype selection is performed in the future. Ultimately, we aim to identify crop varieties suited to local soil conditions and management, possibly with root traits that boost yields and soil physical quality.