Results from recent traffic systems research and the implications for future work

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In the 1970's Soane showed that approximately 95% of a field growing spring barley was covered by wheel marks during the establishment operations. Recent data revealed that resulting from the Random Traffic Farming (RTF) practices some 85%, 65% and 45% of the field was randomly tracked for conventional tillage, minimum tillage and direct drilling/no-till respectively. This suggests that much could be gained from improved traffic systems. The potential advantages through avoiding compaction are: a. improved crop yields, b. reduced tillage and crop establishment draught forces/energy, and c. improved soil conditions and infiltration of rainfall/irrigation water.

Yield improvements of 7% to 35% have been reported for a range of crops in a number of international studies into Controlled Traffic Farming (CTF) systems. This data is very promising, however, not all of the results were from replicated experiments. In order to overcome these issues randomised-replicated studies were initiated by Cranfield University and The Arable Group (TAG) in the UK in 2007 and 2009, the Slovak University of Agriculture in 2010 and Harper Adams University, Shropshire, UK in 2011.

The replicated field plot studies by Cranfield University - TAG showed 15.5% and 16.4% improvement in yield where all traffic was removed from the field plots in the crop establishment operation for the two depths of tillage respectively and a 12% and 5.5% improvement where the machinery operations were confined to a rubber-tracked vehicle. More detailed studies in Bedfordshire showed significant differences for wheat grown on a clay soil but none were found on a sandy loam.

In the Slovak University of Agriculture study a 16ha field was managed using 6m wide CTF systems with three 33m wide compacted (RTF) zones crossing the direction of the CTF traffic. The yield for three cropping seasons shows the CTF - No Traffic treatment to have advantages over the RTF - Multiple Pass treatment for all crops/seasons. With the spring barley showing the greatest difference (50%), followed by maize (32.5%) and winter wheat (10%).

In order to determine if tillage systems have an effect upon the traffic management Harper Adams University established a long-term (10 year) experiment in 2011. A sandy loam field was chosen for this study, which was drained and the deep compaction ameliorated. Three traffic management systems were combined with three tillage treatments in a 3 x 3 factorial design with 4 blocks, namely:

1. Random conventional pressure traffic farming (RTF) with 1.2 and 1.5 bar inflation pressure in the front and rear tyres respectively.
2. Random lower ground pressure farming (LGP) with 0.7 bar inflation pressure in both the front and rear tractor tyres and
3. Controlled traffic farming systems (CTF).

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1. Deep tillage (250mm).
2. Shallow tillage (100mm) and
3. Zero (No-till) tillage.

Crop establishment in the first year of the treatment (2012) was difficult due to the wet autumn; however, the experimental grand mean wheat yield of 7.54t/ha was typical for the UK. The major problem was the poor establishment, growth and yield in the traffic lanes of the zero tilled plots of all traffic systems. The severity of this is shown by the analysis of very small hand harvested samples from the Controlled Traffic Farming plots, where the yield in the traffic lanes of the Zero tillage plots was only 4.33t/ha.

Plot widths of 4m were chosen for operational reasons; hence the trafficked area of the CTF plots was high at 30% of the total area. As many CTF farmers are attempting to reduce this, the yields for 15% traffic lane areas were estimated from hand-harvested measurements of the trafficked and non-trafficked zones.

The CTF/Shallow tillage treatment (for the 30% traffic lane area) showed a significant ($p<0.10$) 15% (1.1t/ha) increase in yield, over RTF/Deep tillage (effectively conventional farming practice) and similarly the LGP/Shallow tillage treatment showed a significant ($p<0.10$) 9% (0.64t/ha) increase. The estimated data show that reducing the trafficked area to 15% increases the CTF/Shallow tillage yield to 19% (1.39t/ha) over the RTF/Deep tillage treatment.

The poor performance of the Zero tillage treatments should be treated with caution at this stage for the following reasons; a. the yield is often lower in early years of conversion to Zero tillage and will usually increase with time as soil structure improves; b. it is the poor yield in the traffic lanes that effected performance, as the yield in the non-trafficked zone of the Zero tillage plots was estimated at 8.15t/ha (with the hand harvested data showing a yield of 10.51t/ha) and c. alternative “no-till” drills may have been better suited to the conditions.

These results, although only based upon one year's data, show trends similar to those found in earlier research; they provide further evidence (albeit at a 10% probability level) that is logical and one on which farmers would be confident to make management decisions.

The results lead to the following implications for further research and development:

1. Ensure a robust experimental design and adequate replication for field experiments.
2. Understand the underlying soil variation and attempt to correct before experimental work starts.
3. Evaluate the soil conditions that provide optimal crop development.
4. Investigate the benefits of wheel mark eradicator tines especially with Zero/No-Till practices to improve the management of wheel ways.
5. Further improve the equipment for fully integrated mechanisation systems.
6. Consider the use of lower tyre inflation pressure options.
7. Additional work is needed for grass and forage production.

The above evidence shows that with sufficient ingenuity by farmers and their equipment suppliers to match operating and wheel track widths, the appropriate traffic management systems should improve crop yield, reduce energy consumption and improve infiltration rates (which will reduce runoff, erosion and flooding). These together will improve agronomic, economic and environmental sustainability of agriculture. Controlled Traffic Farming and Zero/No - Tillage should ultimately be good companions if we can improve crop performance in the traffic lanes. Low ground pressure alternatives may well be the option that best suits some farming enterprises and should not be discounted as viable traffic management methods.

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