Department of Agriculture and Fisheries

Coastal/Hinterland Growers Solution Project

2019 PRACTICE CHANGE ON-FARM RESEARCH CASE STUDY

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

NORTHERN DECEMBER 2019

Impact of traffic systems on soil structure and tillage costs in Kingaroy

Overview

Growers in the Southern Burnett prioritised investigation of the economic benefit in reducing tillage passes and the potential impact on soil structure.

This work was initiated by grower interest in measuring the impact of tillage on soil structure. Growers were interested in developing some understanding of the impact of traffic on their soils, but more importantly how this influenced machinery running costs and their bottom line. In addition, growers believed that incorporating crushed basalt soil ameliorant had improved soil friability and reduced compaction and wanted to assess these observations.

A partnership was developed with University of Southern Queensland (USQ) Toowoomba, Faculty of Engineering, to investigate the effect of random traffic and controlled-traffic systems on implement drag and the subsequent influence on fuel cost.

Trial objectives

- To measure and observe the effects of random traffic and controlled-traffic passes on soil structure, incorporating reduced tillage.
- To measure draft force and assess its related impact on cost of operation.
- To measure the potential effects of crushed basalt soil ameliorant on soil friability.

To assess the effect of equipment traffic on draft force, measurements were taken behind the wheel of the tractor, off wheel, at the implement wheel and in the track of the sprayer at the end of season. The number of passes for the sprayer was three and the track of all equipment by the end of the season was seven passes. Measurements were conducted using a chisel tyne at 20 centimetres' working depth.

Methods

In collaboration with USQ Toowoomba, a modified tillage implement (chisel tyne) that measures drag force at 20cm soil depth (Figures 1 and 2) was used at three different sites. Three on-farm research sites were selected to represent the tillage practices in the area:

- 'Ellesmere' (controlled-traffic system) (Figure 3);
- 'Benair' (random-traffic system); and
- 'Barbelers' (controlled traffic plus reduced-tillage system).

At each site, measurements of draft force (newtons, kN) were conducted using a chisel tyne with a load cell attachment to a depth of 20cm at certain points; these points represent areas where compaction can occur due to equipment usage in farming systems. These points were:

- behind the wheel of the tractor;
- in the non-wheel area;
- behind the implement wheel; and
- in the spray track.

PHOTO: PETER WANT, QDAF

FIGURE 1: Assembling the load cells on the cultivator.

PHOTO: PETER WANT, QDAF

FIGURE 2: Tyne and load cell.

P Level 4 | 4 National Circuit, Barton ACT 2600 | PO Box 5367, Kingston ACT 2604
T +61 2 6166 4500 F +61 2 6166 4599 E grdc@grdc.com.au

Summary of results

The investigation studied the effects of controlled traffic, random traffic and reduced-traffic systems on draft force and soil structure. The preliminary results indicate the most critical observation is the comparison between random-traffic systems (represented by the aqua and orange columns in Figure 5) and the controlled-traffic systems (represented by the light green, red and dark green columns, that is, minimal traffic).

The results show a significant impact from traffic on soil structure, captured by the difference in draft force (the force required to pull the tyne through the soil at 20cm depth). The most significant observation made in Figure 5 was the impact of random traffic on compaction compared with controlled traffic, which transfers to significant savings in energy and time for controlled traffic.

Comparison of fuel use under different engine loads was calculated to assess cost differences between random traffic and controlled-traffic systems. This was calculated using the operating engine loads (140 horsepower tractor) and the draft force measurements between the combined traffic effects and the reduced-traffic effects. The work rate resulted in a $14 per hectare benefit under controlled-traffic systems. That is, where traffic was minimal, soil friability was better and therefore the time to till and associated fuel cost were reduced. However, as these results represent preliminary investigations, the team suggests that more detailed work is required. Additional resources are needed to continue investigations to improve soil and tillage knowledge and practice changes.

The effect of crushed rock ameliorant on draft force

An additional study measured the effect of crushed rock ameliorant on soil structure using draft force. Growers in the region believe that crushed rock ameliorant improves soil friability and as a result becomes easier to work. The results (Figure 6) indicate that the soil ameliorant has limited effect on draft force and therefore soil structure. However, the results also suggest that the cost of operations is greater in wheeled areas compared with non-wheeled areas. This suggests the practice of reduced tillage and/or controlled-traffic farming will reduce operating costs compared with conventional tillage. Therefore, the ameliorant rates did not counter the effects of random traffic.

Key messages

The study has demonstrated that:

- fuel cost in the controlled-traffic system was $19/ha compared with $33/ha in the random-traffic system;
- it costs 71 per cent more to cultivate a random-traffic system compared with a controlled-traffic system; and
- there are no significant differences in soil structure with the use of 0, 400 or 800kg/ha of crushed rock ameliorant.

PHOTO: PETER WANT, QDAF

FIGURE 3: Machine operating at the Ellesmere site.

FIGURE 5 The effect of different trafficking on draft force in the soil (average across all sites).

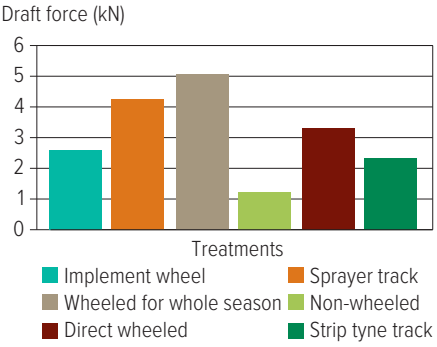
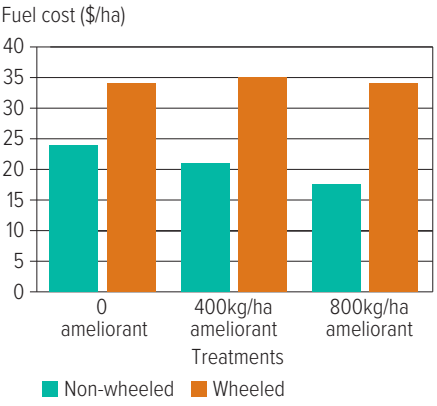


PHOTO: PETER WANT, QDAF

FIGURE 4: Spray track on the left, wheel track on the right.

FIGURE 6 The effect of crushed rock ameliorant on draft force and soil structure.



These experiments were conducted as on-farm studies based on current grower practice. The initial results appear to strongly support the benefits of controlled traffic and precision agricultural and implementing systems that reduce traffic on farming soils. They also highlight the need to continue with this work and develop locally driven activities that encourage collaboration between growers, extension officers, researchers and agribusiness.

PHOTO: PETER WANT, QDAF

FIGURE 7: The team.

ACKNOWLEDGEMENTS:

Nick Christodoulou and Peter Want, Queensland Department of Agriculture and Fisheries.

Produced by www.coretext.com.au