Section Editor:
Brett Masters
Rural Solutions SA, Port Lincoln

Soils

Trafficking a heavy Minnipa soil does not hurt crop production but beware on deep sands

RESEARCH

Nigel Wilhelm[1], Peter Fisher[2], Chris Bluett[3] and Rebecca Mitchell[2]

[1]SARDI, Minnipa Agricultural Centre; [2]Agriculture Victoria, Bendigo; [3]Australian Controlled Traffic Farming Association

Location:
Minnipa Agricultural Centre, paddock S3
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2018 Total: 244 mm
2018 GSR: 186 mm
Paddock History
2018: Scepter wheat
2017: Volga vetch
2016: Fathom barley
2015: Scepter wheat
2014: Medic pasture
Soil Type
Calcareous red sandy loam
Plot Size
50 m x 3 m x 4 reps

Key messages

- **Over the last four years, trafficking at any level has not decreased crop production on a heavy Minnipa soil so moving to controlled traffic farming on this soil type is not likely to increase crop production due to less trafficking in the paddock.**
- **Trafficking on a deep sand (trial at Loxton in the northern mallee) has substantially reduced crop production for at least 4 years so CTF may have additional benefits on deep sands, especially if ripping is used to correct existing compaction.**
- **Similar to many previous trials, ripping has not benefited production on the heavy Minnipa soil.**

Why do the trial?

Adoption of Controlled Traffic Farming (CTF) in the low rainfall zone (LRZ) of the Southern Region is very low. The GRDC-funded project 'Application of controlled traffic in the low rainfall zone' has been evaluating whether or not this scepticism is justified. To help LRZ growers answer the questions and uncertainties they face when thinking about CTF adoption, the project is conducting research on five sites (R sites) across dominant soil types and agro-ecological zones in the Southern Region LRZ. These trials focus on the impact of trafficking (by heavy vehicles) on crop production and soil condition as well as monitoring how quickly LRZ soils will "self-repair" if heavy trafficking is stopped. Issues of implementing CTF and managing permanent wheel tracks are being addressed in other components of the project.

This article summarises the first four years of crop performance after trafficking was imposed on a red calcareous sandy loam at Minnipa Agricultural Centre (a detailed summary of 2015, 2016 and 2017 results can be found in the 2015, 2016 and 2017 Eyre Peninsula Farming Systems Summaries, respectively). Three other trials similar in design and monitoring have also been implemented across the LRZ - on a deep sand at Loxton (SA), a brown loam near Swan Hill (Vic) and on a deep red earth at Lake Cargelligo (NSW). All these trials except Swan Hill (land ownership has changed) have been maintained for at least the five years of the project. A new trial was set up in 2018 to investigate the role of CTF on a deep sand which has been ameliorated with deep ripping.

How was it done?

The original research trials were designed and implemented to be the same at all four sites. Each trial consists of 5 treatments replicated 4 times:

1. Control (no heavy vehicle trafficking).
2. One pass of a 20 tonne vehicle prior to seeding when soil was dry.
3. One pass of a 20 tonne vehicle prior to seeding when soil was wet.
4. Three passes of a 20 tonne vehicle prior to seeding when soil was wet.
5. Deep ripping (to loosen any historical trafficking).

These passes were implemented in 2015 with 50% overlap of the load bearing wheels to ensure even coverage and were not re-imposed in subsequent years.

The trafficking treatments simulate the effect of compaction caused by trafficking of heavy vehicles, with three passes when the soil is moist as an extreme (soil is always softer when wet so compacts more for the same vehicle weight). A deep ripping treatment was included because we cannot be sure if there is still compaction from previous trafficking in our control areas and the ripping was designed to disrupt any of this historical compaction. Trials were located on farms with soils typical for their district and where wheel track patterns for the previous five years (at least) were the same and were identifiable. The trials are being seeded and managed with the farmers' equipment.

At Minnipa, trafficking treatments were imposed in April 2015, the wet passes and deep ripping following 30 mm of rainfall. Scepter wheat was grown in 2015, Fathom barley in 2016 and Volga vetch in 2017. In 2018, Scepter wheat was sown @ 75 kg/ha on 25 May with 70 kg/ha of Granulock Z (11:22 1% Zn).

Crop performance was monitored at establishment, biomass at several times during the season and at maturity (grain yield, quality and biomass). Grain harvest was conducted by hand to avoid trafficking from a header on treated plots.

What happened?

Emergence of wheat was slow in 2018 due to later seeding and drying conditions in the seed bed, but reasonable plant numbers were finally achieved in all treatments (Table 1). Unlike previous years, seeding depth was consistent across all treatments in 2018. Crop growth was very poor until August when more substantial rains really lifted crop growth and grain yields were surprisingly good (Table 1). Crop performance was similar for all treatments throughout the season.

Vetch hay production in 2017 after trafficking of any type was similar to the control although production after both wet trafficking treatments was better than after ripping (Table 1). Grain yields were very poor (average of 350 kg/ha for the trial) and similar for all treatments.

Trafficking on wet soil substantially increased the yield of barley in 2016. Ripping and trafficking on dry soil resulted in grain yields similar to the control.

Grain yields of wheat in 2015 were similar for all treatments, except for ripping which was lower (mostly due to low plant numbers and substantially deeper seeding).

Table 1 Performance of Scepter wheat in 2018 after trafficking and ripping at Minnipa in 2015

	Establishment (plants/m^2)	Depth of seeding (mm)	Dry weight of shoots at tillering (t/ha)	Flowering biomass (t/ha)	Grain yield (t/ha)
Control	135	35	0.18	3.64	2.32
Single trafficking on dry soil	130	31	0.22	3.96	2.38
Single trafficking on wet soil	111	36	0.15	3.34	2.13
Multi trafficking on wet soil	118	39	0.14	3.09	2.19
Ripping	140	31	0.21	3.39	2.14
LSD (P=0.05)	*ns*	*ns*	*ns*	*ns*	*ns*

What does this mean?

We have imposed three increasing levels of trafficking in all four research sites to investigate the sensitivity of crop production to compaction caused by heavy vehicles in typical LRZ situations. The ripping treatment is an attempt to remove any compaction already existing in our control areas due to historical traffic.

On this heavy Minnipa soil after four crops, trafficking has not caused any production losses, if anything there has been an increase in production. This suggests that anybody moving into CTF on this type of soil will not see any improvements in crop productivity in the short term. We have no information about longer term effects. Loosening up the soil by ripping has not resulted in any production increases either, a result which has been seen many times with ripping on this type of soil.

On deep sands however, where responses to deep ripping are common and often substantial, CTF is a complementary strategy which should not only increase and prolong the benefits from deep ripping operations but also avoid trafficking issues with deeply loosened and fragile sands. At our Loxton site, crop yields have been severely depressed every year by repeated trafficking on damp soil. The yield decreases have often been more than 50% and in 2018, barley yields were also depressed by a single trafficking pass on damp soil in 2015.

Of the other three trials, the two on lighter soils (typical of mallee environments) are also showing that little crop production is being lost with all but the most extreme trafficking treatment. However, on the heavy and deep red soil of southern NSW, crop production was severely depressed by any trafficking in the first year but in the very wet year of 2016, production was similar across all treatments. Freshly imposed multiple trafficking in 2018 also depressed wheat yields, but the 2015 treatments had no impact. These results suggest that the effect of trafficking on crop production on this deep red soil can be severe but short lived.

The benefits of improved traction and better fuel efficiency from driving on permanent traffic lanes are there, but again with smaller gains than in other zones because trafficability is less of an issue in the LRZ and the traffic lanes are likely to be seeded, reducing the benefits of permanent wheel tracks.

The often poor performance of crops after multiple heavy vehicle passes on wet sandy soils indicates that while most of our cropping paddocks are probably already quite compacted, the current generation of very heavy machinery has the potential to further increase damage into the future on sandy soils. The catch is that physical interventions with operations such as deep ripping will be necessary to fully realise the benefits of non-compacted sands.

Acknowledgements

Thanks to MAC farm staff for the implementation and management of the research site and to Ian Richter, Brett Hay and Naomi Scholz for undertaking the monitoring of crop performance and soil condition. GRDC is the major funder of this project, which is managed by the Australian Controlled Traffic Farming Assocation.