CONTROLLED TRAFFIC FARMING

Key points

- Controlled traffic farming (CTF) limits compaction zones to permanent wheel tracks.
- Each farm is unique and there may be more sensible changes to management practices to capture economic and environmental benefits more easily.
- The future integration of new cropping technologies (e.g. CTF, raised beds, precision agriculture) to create a more comprehensive system will allow growers to simplify the number of choices with which they are faced.

Background

It is estimated that up to 13M ha (70%) of Western Australia's agricultural soils have moderate to high susceptibility to subsurface compaction (DAFWA, 2006). Subsurface compaction is caused by compression from agricultural machinery traffic with the compacted layer forming between 10 and 40 cm (Davies, 2007).

Compaction results in decreased pore space around the root zone of the plant, creating an environment high in density and strength. Less pore space reduces soil water holding capacity, and water that is available to plants is held more tightly in the smaller pores (Hamza and Penny, 2005). Therefore the plant has to exert more energy to extract water rather than using that energy for producing yield. Low soil porosity can also be detrimental to soil biological activity. There are limited options for ameliorating subsurface compaction apart from physical tillage of the compacted zone. However, management practices can be implemented to reduce or avoid subsurface compaction.

Limit soil compaction to zones

Reducing the amount of trafficking on agricultural soils will reduce soil compaction. This can be achieved by limiting trafficking by agricultural machinery to designated areas, rather than across a whole paddock. Traffic is confined to the least amount of permanent wheel tracks possible—limiting compaction to zones, whilst the rest of the seedbed remains undisturbed (figure 1). This system is known as controlled traffic farming (CTF).

The best way to implement CTF is to develop a unique system that fits the landholders own farm and circumstances. For example, contour seeding can utilise a single marker arm with matching machinery widths and wheels tracks, whilst paddocks can also be worked up and back (again with matching machinery widths and wheel tracks) utilising auto-steer where available and considering options such as raised beds on low country. It is the right system for the landholder if it fits their economic conditions and farming style. For more technical details see Webb *et al.* (2004).

Figure 1: *A crop being harvested with the chaser bin driving on permanent wheel tracks. (Photo by Paul Blackwell, DAFWA).*

Benefits of controlled traffic farming

More precise operations and segregation of the paddock into different zones (traffic lanes, row, inter-row, 'soil type') allow the farm and regional environment to benefit from:

- Lower energy requirements for seedbed preparation, including less rolling resistance when driving over the compact traffic lanes (average saving of 25% in fuel).
- Improved soil structure through reduced compaction resulting in improved water holding capacity.
- Less nutrient leaching by placing fertilisers closer to the plant and encouraging more efficient uptake. The soil is also in better condition to provide nutrients to plants (studies worldwide have shown that uptake of fertiliser improves around 15%).
- Possible integration with surface water control structures when broad-based banks are used with downhill tramline patterns; especially for raised beds.
- Generally less herbicide and fertiliser use from managing paddocks in 'zones' of approximate soil types (reduced input costs of 3 to 10% from less overlap due to more accurate driving). Herbicide use is reduced by removing double sprayed corners, thus less opportunity for herbicide to drift into remnant vegetation and waterways.
- Less tractor capital; firm permanent tramlines and softer soil between tramlines reduce power requirements.

All these benefits will result in improved crop yields (table 1). An added benefit of CTF if removing subsurface or seedbed compaction through deep ripping, is that soil will continue to remain loose and friable for many years after natural 'settling' as soil is not being trafficked back to its original compacted state.

Table 1: *Grain yield and value from 9 m wide harvester cuts for normal (NT) or controlled traffic (CT) after initial deep cultivation in 1997 at Mullewa, Western Australia (average annual rainfall = 320 mm).*

	Lupins	Wheat	Canola
CT yield (t/ha)	1.21	2.75	1.04
NT yield (t/ha)	1.10	2.43	0.94
CT vs NT (%)	10	13	11
Difference kg/ha	110	316	103
Grain $ at gate	170	172	313
Benefit $/ha	18.7	54.3	32.4

Possible downsides to CTF

- Poor compatibility of tramline based field traffic layouts with surface water control structures and revegetation patterns in the landscape.
- Increased soil erosion risk when surface cover is low and the topsoil is compacted by grazing; especially gully development and where traffic patterns are across slope.
- Satellite dependence, risks of serious interruptions from downtime of navigation systems.
- More electronic management (probable loss of driving skills)/ less staff and rural population.

What about overland flow?

New approaches to avoiding the risks of soil loss from heavy rainfall for downhill controlled traffic systems are being evaluated. Widespread use of techniques such as tramline farming, controlled traffic and auto-steer means that working on the contour is often not practical. Queensland research has shown that controlled traffic systems working downhill on slopes up to 2% can reduce the incidence of gully erosion from intense storms compared to contour planting, provided there is good ground cover and water infiltration.

The greatest runoff rate at Pindar and Buntine paddocks in Western Australia was from tramlines in a downhill working system (slopes of 1.5–3%), and the least runoff from a deep cultivated soil between the tramlines, where compaction had been removed. As the tramlines cover only 15–20% of the overall paddock area, there was less runoff from downhill working than across slope system provided the soil was not compacted.

Where the soil is compacted or groundcover levels are low (especially after grazing), runoff from downhill systems can be larger than when working across the slope. This indicates a need for appropriate earthworks to control the rate of overland water flow and minimise the risk of soil erosion from intense rainfall events.

Technical difficulties of grass weed control and rutting in permanent tramlines still persist, but chaffy (furry) tramlines, zero tramline disturbance and better tyre choice may offer improvements, as well as improved management of water flow.

Further reading and references

Davies S (2007). Subsurface Soil Compaction. Fact sheet for Soil Quality website (www.soilquality.org.au).

DAFWA (2006). Map unit accessed 25 May 2006, Department of Agriculture and Food, Western Australia.

Hamza M and Penny S (2005). Improving compacted soils in the eastern wheatbelt. Department of Agriculture and Food, Western Australia Farmnote No. 53/2005.

Webb B, Blackwell P, Riethmuller G and Lemon J (2004) 'Tramline Farming Systems: Technical Manual' Department of Agriculture and Food, WesternAustralia Bulletin 4607. (online)

The controlled traffic website: www.controlledtrafficfarming.com/index.htm

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