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Driving a revolution in the paddock

The environmental and productivity benefits of precision driving are converting Australian and international farmers to a technique called controlled traffic farming. **Steve Davidson** reports.

Gargantuan harvesters and other modern machinery used on today's grain, cotton and sugar farms can weigh up to a massive 20 tonnes. Their considerable crushing pressure, exerted by multiple wheels, has a severe deteriorating effect on soil quality, and the often random paths of machinery traffic during sequential tillage, sowing, weed control and then harvesting, mean that more than half of a paddock can experience damaging wheel compaction every time a crop is produced.

Dr Jeff Tullberg, an agricultural engineer at the University of Queensland, likens field traffic to driving a vehicle over your garden flower-beds several times a year – you just don't do it – and says it doesn't have to happen on Australian farms either. President of the International Soil Tillage Research Organization, Tullberg is a strong advocate of a burgeoning farming method known as Controlled Traffic Farming, or CTF, which addresses the problem and generates a suite of favourable outcomes.

In CTF, all paddock traffic is restricted to permanent lanes that are normally left untilled and unplanted. These compacted areas comprise about 15% of the field, give good traction for machinery and allow farming operations to continue even when soil is moist. The rest of the field suffers no traffic at all and the farmer can manage it for optimum crop performance – more than compensating for the portion of land sacrificed for the permanent wheel tracks.

Farmer–researcher cooperation

A decade ago, the idea of CTF was about as alien to grain growers as crop circles, yet adoption of the new technology has been remarkably rapid. The technical basis of CTF has been known since the 19th century and adoption was advocated in the United States and Europe years ago, but with little success. Here in Australia, only a few enthusiasts used the system before 1990. Cotton growers were using semi-permanent crop beds, a form of CTF, but adoption of the concept in broadacre grain crops was virtually non-existent.

Then, in 1994, Dr Don Yule and Mr Stuart Cannon of Queensland's Department of Natural Resources – building on Tullberg's 15 years of foundation research on wheel-soil interactions – initiated an 'action learning' approach to directly involve grain growers in farm trials of CTF. Just half a dozen commercial grain growers in central Queensland agreed to participate. These growers were able to compare their CTF paddocks with

Modern farm tractors and harvesters are large and broad for efficiency. But what benefit farmers gain from size and multiple machine use, they can lose to soil compaction through unrestricted driving routes. In controlled traffic farming, all heavy wheels are restricted to permanent traffic lanes occupying about 15% of the field area.

others on their farms and with those of neighbours over the fence. Once these innovators became convinced of its value, many other growers also decided the system was worth a try. Within five years, 100 000 hectares of cropland were under controlled traffic in central Queensland.

Adoption subsequently snow-balled and now some form of CTF is being used on more than a million hectares of Australian farm land in several States. Grain growers were won over by the enthusiasm of their pioneering peers for the system's practicality and economic viability. A similar pattern of adoption is now emerging in the sugar industry.

Sustainability on track

In contrast to the litany of reports chronicling the progressive degradation of cropping soils under traditional tillage, the great advantage of CTF is that it appears to be environmentally efficient. Results so far demonstrate that it usually improves water infiltration, crop production, soil structure and soil health, while reducing inputs and a range of broad environmental impacts.

Controlled traffic farming, used in combination with minimal or zero-tillage, as it often is, increases earthworm numbers eight-fold over 'tilled plus wheeled' treatments and boosts overall biological activity. Air and water penetrate the soil better when it is not compacted by wheel traffic and CTF increases the water that is available to plants in some soils by some 25%.

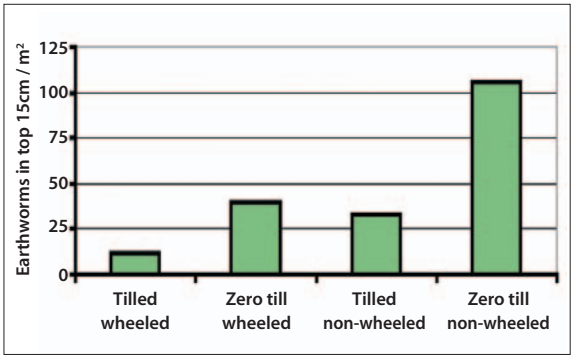
Yule and his colleagues also reasoned that planting, spraying and harvesting up and down the slope would ensure that any runoff water would follow the wheel tracks or crop rows in many small, non-erosive rivulets as it flowed downwards. This suggested 'downslope' working was controversial as the conventional wisdom is to work on the contour to minimise the risk of erosion.

Contour working is certainly effective during minor rainfall events, but during heavy rainfall, rows and furrows on the contour actually promote runoff concentration, according to the researchers. And it is these extreme storms that tend to cause really damaging erosion. In one severe rainfall event, a combination of downslope controlled traffic and zero tillage resulted in less than 10 tonnes of soil loss by erosion per hectare, while neighbouring contour-farmed land lost 50–100 tonnes of soil per hectare.

Many CTF grain growers in Queensland and New South Wales now use a downslope pattern for

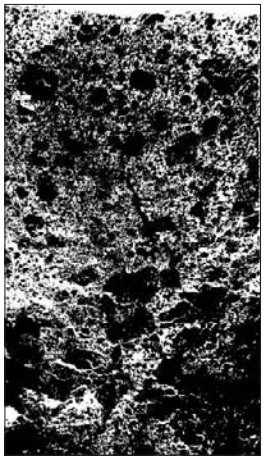
Greg Butler, NSW Department of Agriculture

Deep compression wheel tracks, exposed after sheet erosion of topsoil, clearly showing how compaction has affected 80% of this field.



Tullberg, Yule and McGarry, 2003

Earthworm abundance and productivity is dramatically higher in controlled traffic fields.



Des McGarry, Queensland NRM

Far right: Profiles through the top of 'non-wheeled' and 'wheeled' soil layers clearly showing compaction and the reduction of natural air and absorption water space important to soil health.

Black = soil; White = space for air or water.

farm operations. This means working across the contour banks, which provide for safe disposal of runoff water. It can only occur in genuine zero tillage systems because tillage across contour banks would destroy the banks.

The controlled traffic system does require commitment from growers. It takes courage for a grower to modify an expensive farm machine so that it matches the wheel-span of other implements on the property, probably voiding its warranty. It also requires accurate guidance of farm equipment. Technology first developed by an Australian farmer/engineer is now being widely used to automatically steer farm machines from GPS satellites. Farmers can now buy tractors with the guidance system from the major machinery manufacturers.

'If we in Australia could raise the soil organic matter content by just 0.1% across the entire cropping zone, it would lock up billions of tonnes of CO_2'

Locked in savings

The advantages of precision controlled traffic are far-ranging. Tullberg has calculated, for example, that about half the power output of a tractor can be dissipated in the process of soil compaction and decompaction. Put another way, half the power output of a tractor doing conventional tillages is used in soil degradation – and the accompanying tillage or seeding operation cannot undo all the damage. So CTF, by virtue of its firm, smooth, permanent wheel tracks, saves fuel and reduces the cost of running farm machinery.

Zero tillage plus controlled traffic can even play a part in countering global warming. This combination boosts the carbon content of the soil and, if widely adopted, could potentially absorb huge quantities of the main greenhouse gas, carbon dioxide.

'If we in Australia could raise the soil organic matter content by just 0.1% across the entire cropping zone, it would lock up billions of tonnes of CO_2', says Tullberg. 'And as a bonus this means better soil fertility, healthier landscapes and more food production.'

Better soil structure also reduces waterlogging and the release of nitrous oxide and methane, two other greenhouse gases, from soil. Furthermore, CTF minimises the runoff that transforms fertiliser and agricultural chemicals into waterway pollutants.

As one grower put it, CTF was 'the right idea at the right time'. For many growers, the new farming system has delivered sustainability, viability and a bright future. The scientists predict that the system's popularity will grow rapidly both here and overseas.

This article was based on a keynote paper by Jeff Tullberg, Don Yule and Des McGarry given to the International Soil Tillage Research Organization's conference at University of Queensland, in July 2003.

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Tullberg, Yule & McGarry, 2003

This CTF-modified header is driving in permanent paddock lanes rather than a varying route, and is getting better traction while using far less fuel.