CTF: What's Known, What's Next.

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INTRODUCTION

"Wheels work better on hard soil, plants grow better in soft soil". This is obviously true for the great majority of soils and crops, but with few exceptions it has been totally ignored until 20 years ago by farmers in the developed world. Bright ideas have been discussed for 100 years, and serious research done for 50 years, but practical farm-scale controlled traffic did not happen until the early 1980s. Adoption increased rapidly across Australia from the mid-1990s, and different varieties of controlled traffic are now in place on 1-2Mha.

The object of this paper is to summarise what we know to be important in terms of the science and practice of controlled traffic farming, and suggest future directions. It is important to note that most of the hard evidence to date has been concerned only to demonstrate what we know already: uncontrolled wheel traffic causes major soil damage.

Controlling field traffic transforms random damage into a concentrate benefit, but this is only the starting point controlled traffic farming -- achieving the system changes and multiple benefits which are possible when farming healthier soil. These system advantages of CTF are the important outcome, and we hope to learn more information about these, and the process of getting there, from the grower papers at this conference.

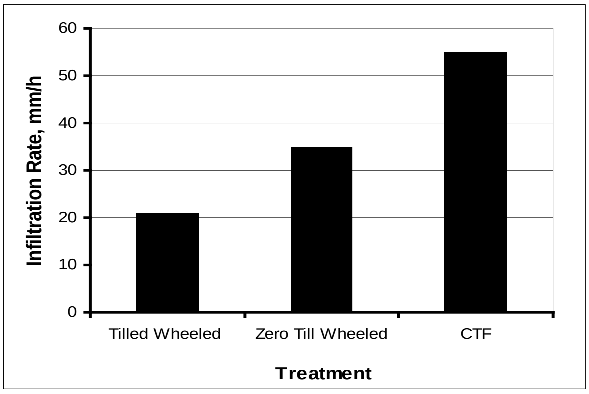
WHAT'S KNOWN

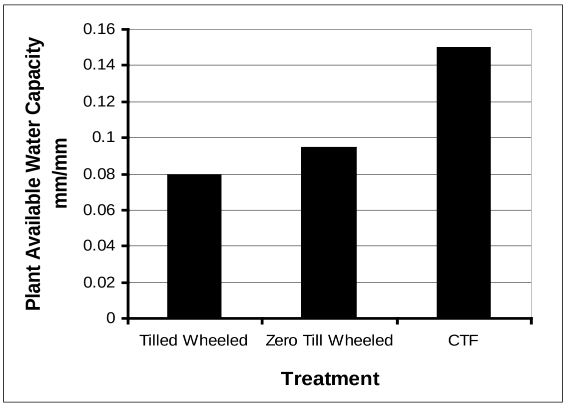
Soil in optimum condition for plant growth is relatively weak and permeable. When a wheel or track rolls over that soil, it compacts until it is strong enough to carry the applied load. The processes of transmitting surface loads to lower layers of the soil are not straightforward, but it is generally accepted that tyre pressure is the most important factor in surface damage, but total axle load is a more important influence on subsurface damage, and the depth to which it penetrates.

In most soils, natural processes can repair that damage, slowly, from the surface downwards. This occurs at a time scale in years at 20cm depth, even on "self-ameliorating" soils. Natural processes, or tillage can hide the surface damage quickly, but with heavy wheels driving over 50% of paddock area per crop, causing damage at 30cm depth and below, root zone damage is almost universal in cropped soils.

Soil damage occurs instantly, on the first wheel pass. Second and subsequent wheel passes do little further damage if they are on the same track. Fixing this damage takes years. Damage is less severe on dry soil, but extreme wheel loads imposed by the largest grain harvesters penetrates a long way down the profile, and certainly below the maximum depth of traditional deep tillage.

The impact of this soil damage on infiltration rate, plant available water capacity and soil life is illustrated in figure 1. This is data from Queensland's black vertisols, but broadly similar outcomes have been found in totally different soils in Victoria , Western Australia, and many other parts of the world. For all practical purposes, wheeled soil produces more runoff and absorbs less rainfall, stores less moisture in plant-available form, and is less able to cycle nutrients.





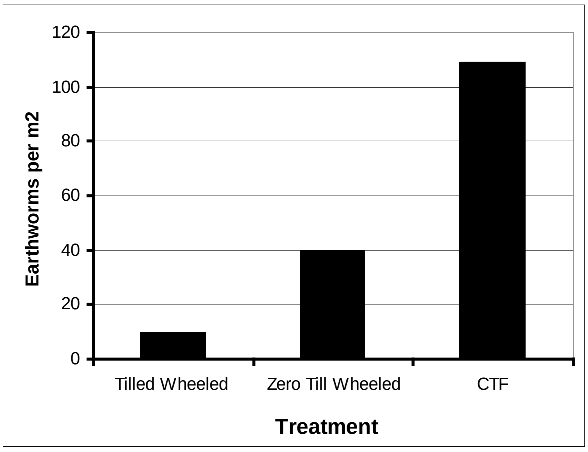


Figure 1 The Impact of Traffic and Tillage on:

a) Rainfall infiltration in and 80 mm/hour storm .

b) Plant available water capacity (0 -- 30 cm after two years CTF.

c) Earthworm numbers (0 -- 15 cm, average over two years)

The soil damage process also absorbs a loss of power. At least 25% of a tractor's power will be lost in the soil under the wheels when operating on normal field surfaces. This power is dissipated in rolling resistance and slip, in the process of compacting and increasing the strength of surface soil. The tractor needs to supply even more power to the implement to plant or till this stronger compacted soil behind the wheels.

Restricting field traffic to permanent laneways significantly reduces the power wasted in the traction process. The reduction in implement power requirements for planting or tillage is even greater. Importantly, eliminating the surface ruts and damage of random wheel traffic also gets rid of another of the major reasons for tillage.

When traffic is controlled we will have a healthier soil making a greater proportion of rainfall available to our crops. Soil disturbance will be required only where there is an identified need, and then it will require a lot less energy than current tillage.

WHAT'S NEXT

We know a lot about the problems caused by wheel traffic, and some of the direct benefits which occur when these problems are eliminated. We know very little about the broader system effects, simply because nearly all of our knowledge -- whether derived from research or practice -- is based on the issues of cropping damaged soil.

We are learning more about the immediate challenges of controlled traffic, and the solutions. Australian farmers and their suppliers have been the major innovators in developing and adopting accurate guidance systems, moving to a common track width, and achieving modular working widths. These are the immediate requirements of lining up all heavy wheels on permanent laneways.

We are also learning more about the immediate benefits: more rapid access to paddocks after rain, more efficient, timely operations with less power, less unnecessary soil disturbance, more moisture, more planting opportunities and better crops. We are starting to see more possibilities of using yield maps and satellite images to improve systems, that are no longer confused by random traffic effects.

We know amazingly little about the integration of this set of opportunities and benefits, or the new challenges that might arise. The whole topic has not yet registered on the institutional research radar: my hearing is not good, but I hear no discussion of the new opportunities that might come from -- for instance -- breeding crops, managing fertiliser inputs, or improving herbicide application in this improved soil environment.

Perhaps this is unavoidable in an environment that generally prefers to ignore machinery effects. Funding bodies obviously regard tractors and machinery as overheads to be provided by the research provider, while the provider institutions simply don't have the resources for equipment investment. This is a shame, because machinery is usually the major limitation. Farming would easier and cheaper, for instance if:

- Depth control was independent of load-bearing wheels, without parallelograms on everything.
- Accurate implement guidance could be achieved with drawbar equipment.
- Harvesters transferred products into multiple, towed bins, to allow quality differentiation.
- This integrated "commodity cart" approach could be applied to all field materials handling.

Controlled traffic farming is the integration of all the challenges and benefits of permanent traffic lanes and uncompromised soil, to achieve a more productive, profitable and sustainable agriculture. The objective is to optimise cropping systems in the absence of the constraints of random wheel traffic. This is a matter of taking advantage of the opportunities of improved timeliness and greater precision. For instance, planting immediately after harvest when soil moisture is available; capitalising on the ability to access growing crops without causing crop damage; using greater precision to better target the application of fertiliser and herbicide.

The research institutions might address some components of this challenge, but the system issues will have to be sorted out by farmers, individually and in groups, working with input from scientists and consultants. This conference is an important step along this pathway, and I am sure we will hear more innovative developments which are already underway in the paddock, using the best available technology.