THEME 3. CTF: THE OPPORTUNITIES

Controlled Traffic Farming: exploring the (likely) responses and associated benefits for soil biota

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Pauline is a microbial ecologist with specific interests in how microbes function in soil agri-ecosystems. In recent years, Pauline has adopted DNA based technologies and multivariate statistical approaches to gain greater insight into the biogeography of soil microbial communities and the relationship with soil type and management.
Pauline is a joint appointee with Latrobe University and DPI-Victoria and currently coordinates GRDC's $10 M Soil Biology Initiative which recently featured on ABC's Landline Program. She is committed to communicating the importance of soil microbial communities in maintaining the productivity of agricultural soils.

ABSTRACT: The study of soil biology has gained considerable momentum with the realisation that soil organisms, and specifically the microscopic bacteria, archaea and fungi provide critical functions that underpin the health of our agricultural soils. These functions include plant residue decomposition, nutrient generation and recycling, pesticide degradation, disease control and soil structure maintenance. The extent to which these functions occur in different soil types, the identification of soil management modulators of these functions and ultimately the link to plant performance are areas of ongoing interdisciplinary research.

It is widely accepted that controlled traffic is a management option that makes 'good sense' it restricts compaction to laneways thereby reducing the extent of compaction over a field. Reduced soil erosion and increased farm efficiency are two key benefits (Yule, 1995). Soil physical and hydraulic changes associated with compaction are relatively well described (van Ouwerkerk and Soane, 1995, Peth et al. 2010, Alaoui et al., 2011, Keller et al., 2013) and several examples illustrate how controlled traffic farming (CTF) reduces the impact of compaction on these properties compared to other management strategies (Tullberg et al 2007). Relatively little is known about how these changes modulate critical soil biological functions or indeed whether CTF provides relatively greater benefit with respect to these functions in terms of long-term profitability.

As microbial ecologists, we view soils in terms of available habitable pore space where 'habitable' is associated with design features such as water and oxygen availability, protection against predators and nutrient availability (CEC). This space, a function of soil texture and structure accounts for only a small part of the total pore space but is critical for microbes to function efficiently. Early studies (Papendick & Campbell, 1981) have shown that the proportion of pores with diameters less than 3µm were 72% for clay, 40% for silt and 22% for sandy soils. Bacteria are found in high proportion in soils with pore diameters less than 2.4µm because they are protected from predation and these pores retain water longer.

Fungi occupy larger pores and are more exposed to potential predators and antifungal chemicals but they have the advantage of forming extensive networks. Compaction therefore influences habitable pore space in terms of the amount and arrangement and therefore impacts overall community size and specific functions such as structure maintenance, decomposition, N cycling for plant uptake and disease suppression. The benefits of CTF with respect to these functions has yet to be quantified.

This presentation examines available data and evolving concepts to illustrate the impacts, real and potential, of controlled traffic farming on soil biota. It also focuses on the potential changes that are likely to occur in the microbial community including some likely consequences for overall soil health and productivity. It considers the challenge posed by Tullberg (CFC: What's known, what's next?) of how we can take advantage of the improved soil environment by managing fertiliser inputs, or improving herbicide application describing some of the current R&D activities in the GRDC Soil Biology Initiative.