Do Soil Microbes Know their Fractions?

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Abstract
The size and activity of the soil microbial community (SMC) is often correlated to the availability of carbon and nutrients. However, carbon exists in soils in a diverse range of pools/fractions that differ in their chemistry and rates of turnover.

Improved knowledge of the distribution of carbon (C) and nutrients (N and P) across different soil organic matter (SOM) fractions will potentially improve our understanding of drivers of the structure of the SMC, carbon utilisation and nutrient cycling functions, and predictions of nutrient mineralisation from SOM turnover.

Agricultural soils collected across Southern Australia, varying in soil type and management practices, were characterised for i) chemical composition via mid-infra red (MIR) spectroscopy; ii) distribution of carbon, nitrogen, and phosphorus in measurable SOM fractions; iii) the structure of the soil bacterial and fungal communities using community DNA fingerprinting; iv) the carbon utilisation potential of the soil microbial community (MicroResp). Using integrative multivariate analysis we explored stoichiometric relationships between abiotic and biotic properties of these soils. The results will provide greater insight into the relationship between SOM chemistry and the role of bacteria and fungi in nutrient cycling processes.

Key Words
Soil organic matter, stoichiometry, microbial community, carbon, nitrogen, phosphorus

Methods
Soil was collected from a range of long-term agricultural trials in Southern Australia (Hart, Harden, Hamilton, Junee reefs, Urrbrae, Waikerie, Yass). Management practices included permanent pasture, pasture-wheat/pea/fallow rotations, conventional tillage, stubble-burn, N or P fertilisation. Full details are described within Wakelin et al (2008). MIR spectroscopy was carried out according to Forrester *et al*., (2003). Soils were fractionated according to Sjemstad *et al*. (2004), providing >2mm buried plant residue (BPR), >53µm (POM) and < 53µm (HUM) size fractions respectively. Bacterial and fungal community structures were characterised using PCR-DGGE and catabolic potential was assessed using the MicroResp™ method (Campbell **et al**., 2003) as described in Wakelin *et al*., 2008.

Results and Discussion
Preliminary data indicate average C: N ratios of approximately 31, 15, and 10 for BPR, POM, and HUM respectively. The observed decreasing trend in C: N ratios across SOM fractions is consistent with increasing extent of decomposition. The data also demonstrated greater variability in the C: N ratio of plant residue inputs compared to component fractions of SOM. POM and HUM fractions, with consistently lower C:N ratios, are likely to contribute to N mineralisation, while the ratios of surface (SPR) and BPR materials are likely to lead to immobilisation.
Across these range of soils pH was found to be a stong driver of SMC structure and function. Further data analysis looks to identify the extent to which SOM chemistry correlates with SMC structure and function.

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