Soil Structural and Functional Diversity across different Agroecological Zones in NSW

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WE KNOW

✓ May hold up to 10 billion microorganisms of thousands of different species.

✓ Less than 1% of the cells observed by direct counting can be recovered using standard cultivation methods. *Torsvik L., V Ovreas (2003)*

✓ From this ~ 1% we obtain multiple benefits/applications
  
  • Agriculture — N₂ fixers bacteria, pest control, nutrient cycling
  • Industry — Pharmaceutical, biotechnological
  • Environment — Bioremediation, waste recycling

✓ New technology for microbial identification

*Next-generation sequencing (NGS) technology*
WE STILL DO NOT KNOW

- 99% remain unexplored
  - Who/where are they? What/how are they doing?
- Does the loss of Soil Biodiversity reduce Soil function?
- Which environmental variables are driving the microbial communities structure?
- Our understanding of how microbial communities are distributed at landscape scales remains unclear.

“1510 We know more about the movement of celestial bodies than about the soil underfoot” Da Vinci
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Based on Next-Generation Sequencing technology:

1. Identify the structural diversity of major soil microbial taxa, i.e., bacteria, archaea and fungi.
2. Evaluate soil microbial distribution patterns under different agro-ecological zones in NSW.
Soil sampling results

- **49** sampling sites - every 50 km
- **588** microbial - 3 rep
- **392** chemical - 2 rep
- **196** physical - 1 cylinder
Methodology

Microbial analyses

- Power Soil DNA Isolation Kit
- PCR1 amplification
  - 16S Bacteria/Archaea
  - 18S Fungi
- PCR2 amplicon libraries
- 18M sequences (7GB)
- Paired ends reads

Physicochemical analyses

- Ammonium, nitrate
- P, K, EC, pH
- Exc. (Al, Ca, Mg, K, Na)
- TC, TN
- CEC, Ca/Mg, C/N
- Aggregate stability
- Particule size
- pF curve: moisture, Db porosity
Preliminary Results

From 0-5 cm depth

Bacteria & Archaea Communities
PCoA (weighted Unifrac distance)

Soil VIS-NIR spectra
Physicochemical properties
PCoA

Cumulative explanation: 45%
Cumulative explanation: 98.59%
Highlights

Soil bacterial community structure (composition) reflects a stronger correlation to soil gradients rather than land management.

Further work

Complete analysis of structural and functional diversity of bacteria, archaea and fungal communities for both transects.
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