Microdialysis: a new technology for investigating soil nitrogen fluxes in the rhizosphere

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The complexity of soil

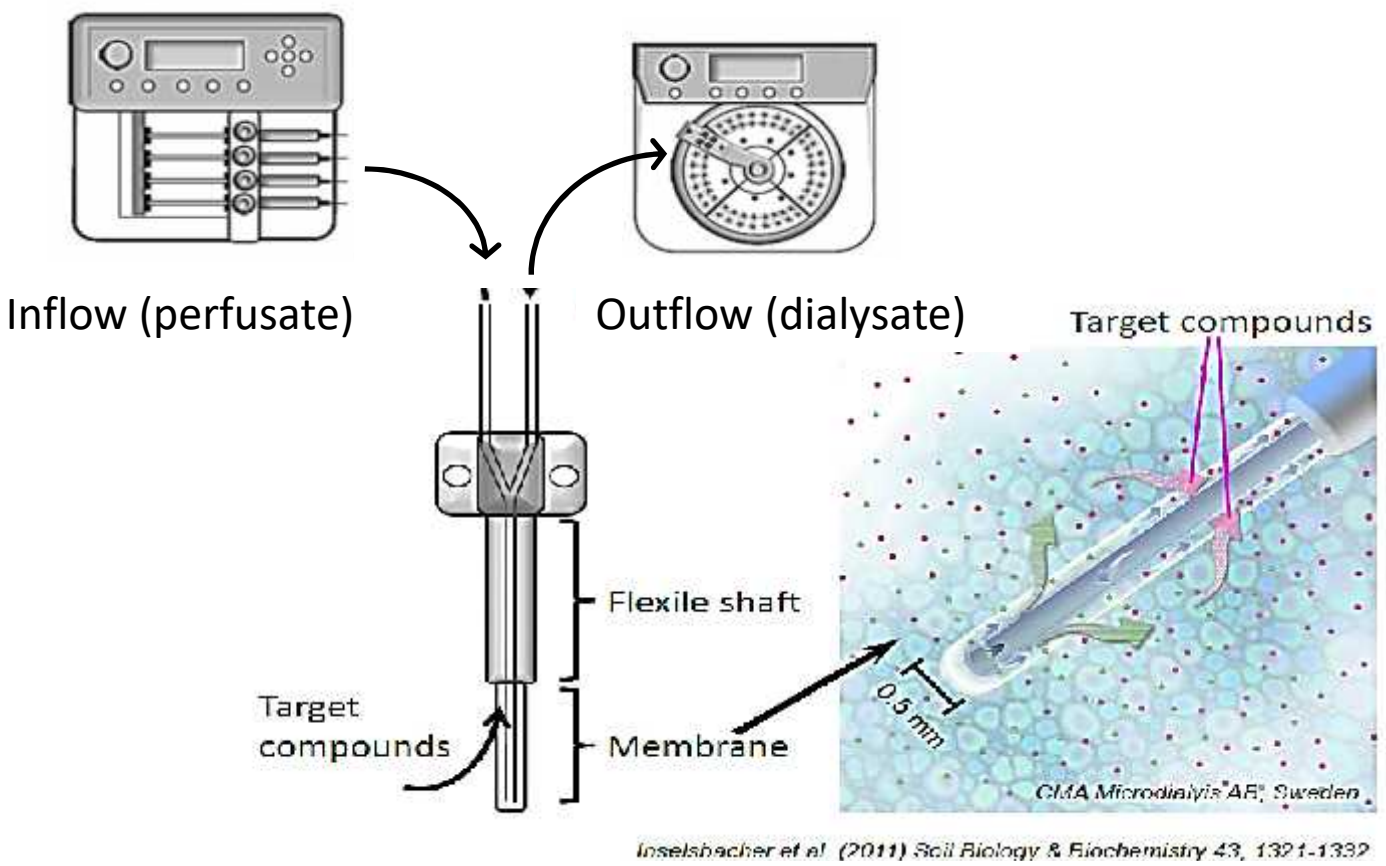
Measuring soluble soil nitrogen

- Dig a hole
- Put soil in a plastic bag
- Put plastic bag in a cooler
- Travel
- Store in the fridge…?
- Sieve?
- Extract using water or salt
  - -Disturbance of soil structure[1]
  - -Damage of roots or hyphae[1]
  - -Mineralisation of nitrogen[2]

[1] Hobbie & Hobbie 2012; *Biogeochemistry* **107**:339-360

[2] Inselsbacher 2014; *Soil Biol Biochem* **71**: 76-86

Microdialysis



Inselsbacher et al. (2011) Soil Biology & Biochemistry 43, 1321-1332

Microdialysis

Advantages

- Low disturbance
- Samples sterile
- Similar mode of action to plant roots
- Measures fluxes rather than concentrations

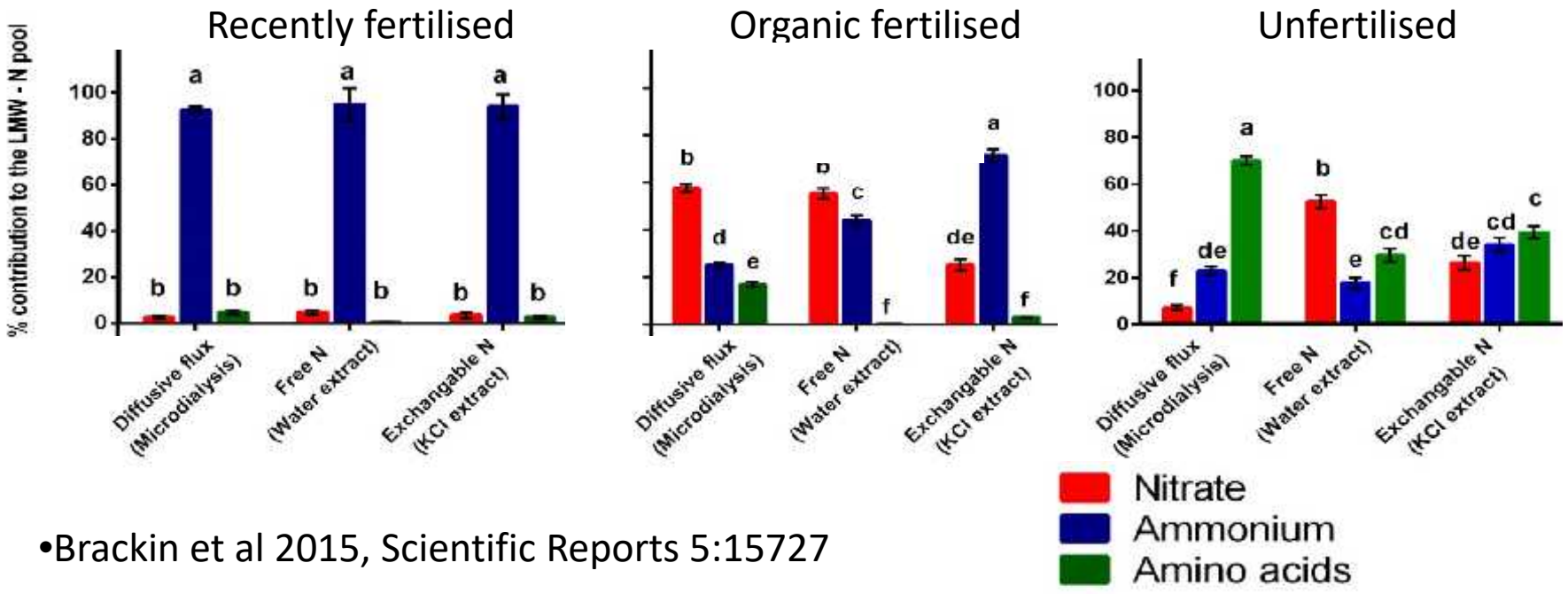
Disadvantages

- Not optimised for field
- Requires dexterity and patience
- Small size limits depth
- Requires some soil moisture
- Doesn't measure concentrations
- Won't work well below 0°C, or above 40°C

Microdialysis shows greater proportions of high-turnover amino acids

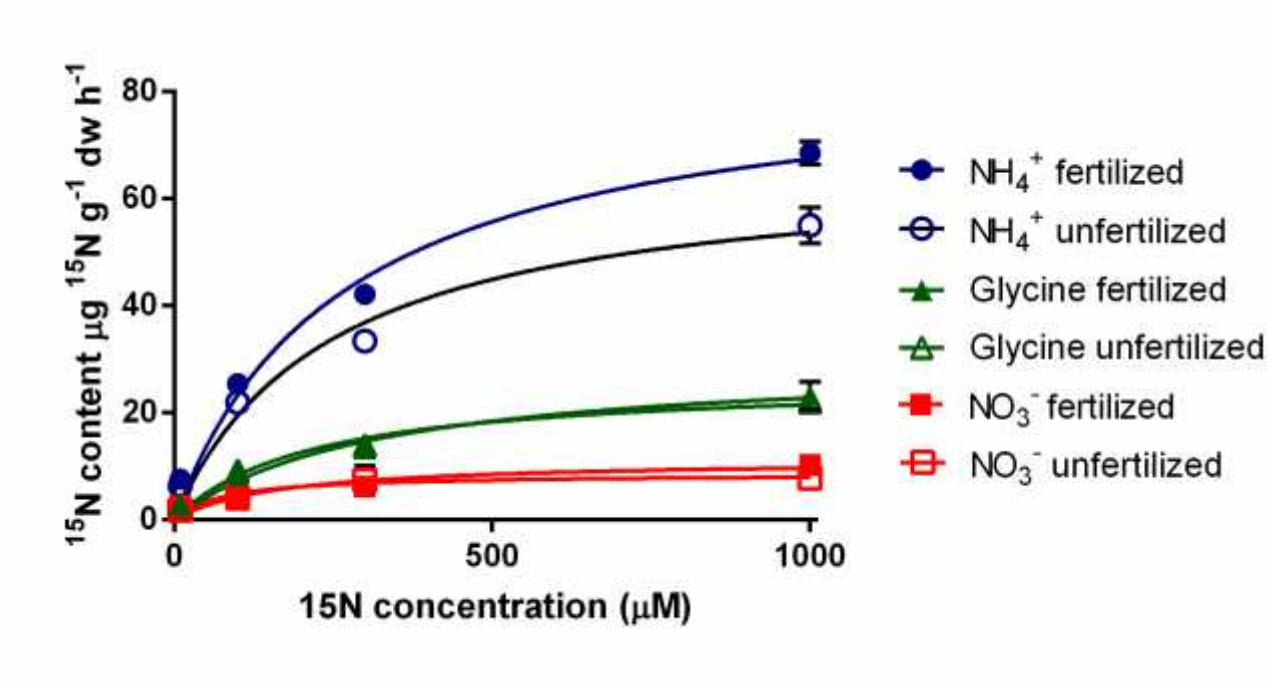
Microdialysis shows greater proportions of high-turnover amino acids

Microdialysis of sugarcane soils: November, Jacob's Well QLD



•Brackin et al 2015, Scientific Reports 5:15727

Sugarcane N uptake preferences



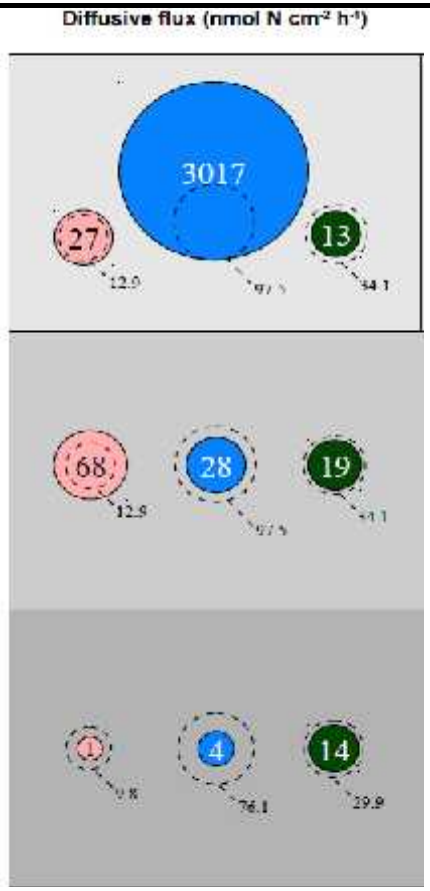
•Brackin et al 2015, Scientific Reports 5:15727

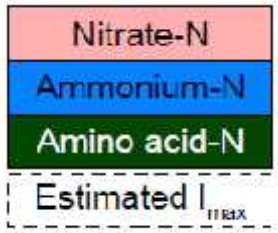
Microdialysis allows comparison to root uptake

Recently fertilised

Organic fertilised

Unfertilised

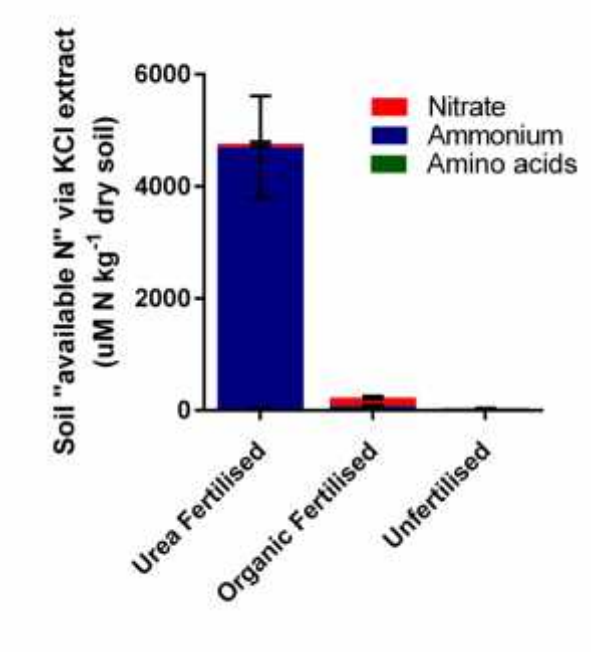




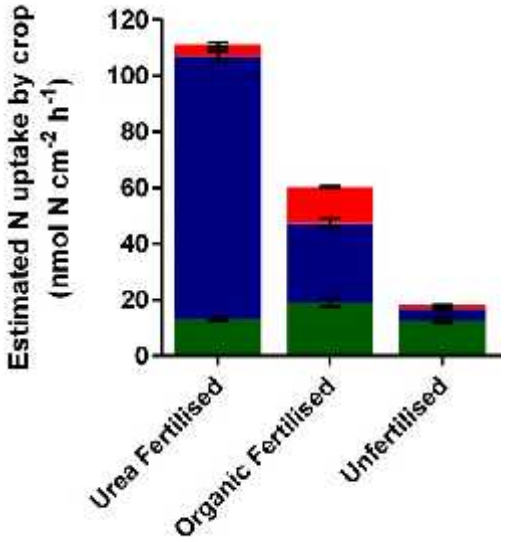
•Brackin *et al* 2015, *Scientific Reports* 5:15727

Modelling N form uptake

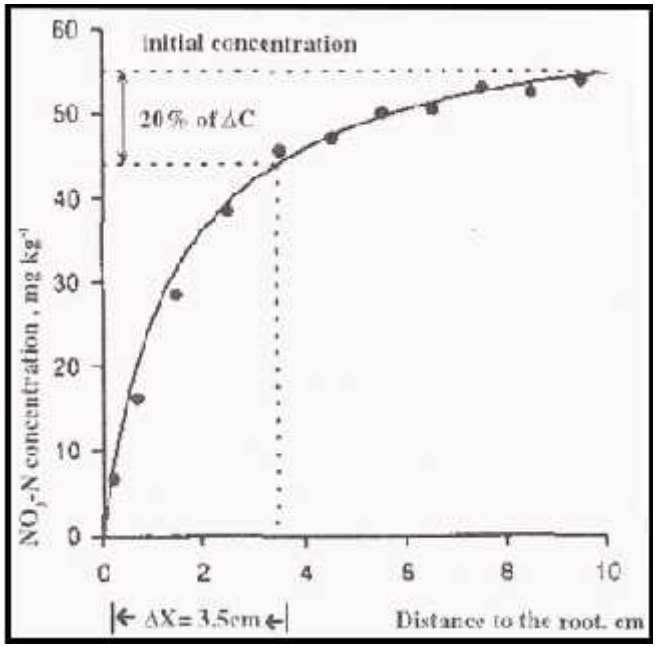
“Available N” as per soil extract



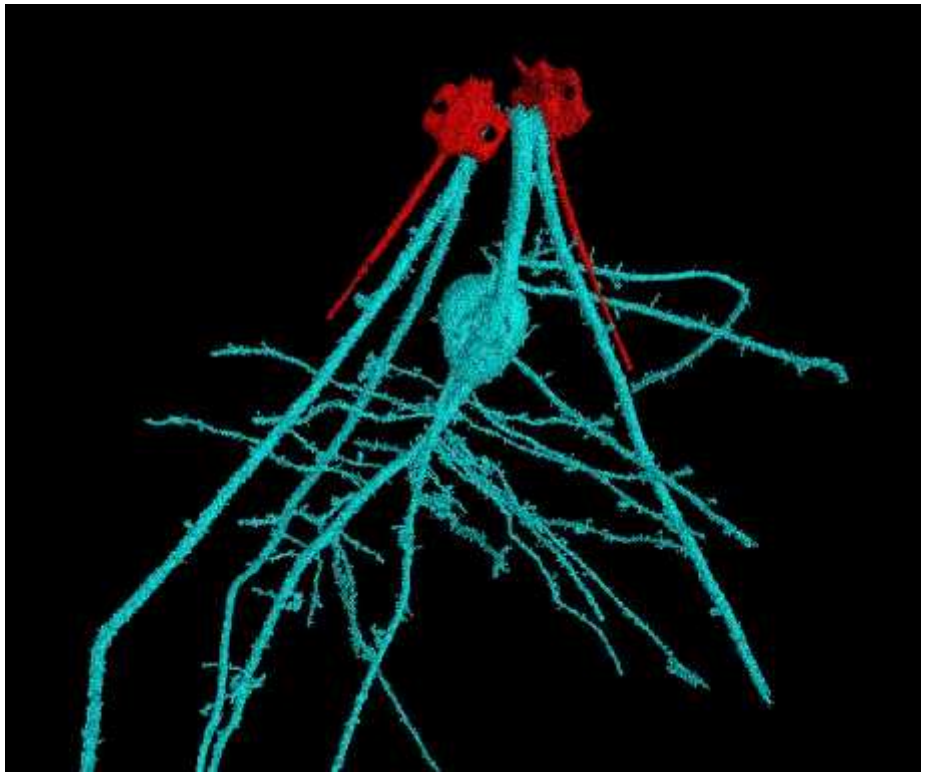
Estimated N uptake



Investigating depletion zones



Claassen and Steingrobe (1999) (in Mineral Nutrition of Crops).



Conclusions

- Digging, sieving and extracting soils alters N composition
- Microdialysis results in minimal disturbance, and operates similarly to plant roots
- High temporal resolution for monitoring turnover
- Small scale, for measuring in precise locations
- Allows direct comparison of soil fluxes and plant physiology

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