# Soil protein: an indicator of carbon storage and soil health?

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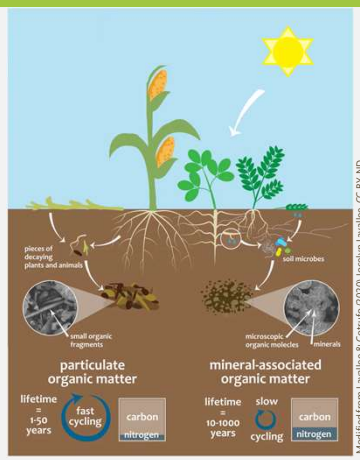
## Not all soil carbon is equal: 'Liquid carbon' feeds and builds soil

**Building soil carbon improves soil health, including water-holding capacity, but soil carbon stocks often change slowly in response to management changes.**

**Dead plant carbon:**

Crop residues and other dead plant material is fragmented into the soil by earthworms and other invertebrates, and broken down by soil microbes.

This Particulate Organic Matter (POM) can hold water like a sponge, but tends to be recycled and lost quickly.




Modified from Lavallee & Conrufo (2020) Jocelyn Lavallee, CC BY-ND

**Root-fed microbial carbon:**

Plants make sugars using sunshine and $CO_2$.

This 'liquid carbon' exudes from the roots and feeds a plethora of soil micro-organisms.

These microbes grow and die, making large quantities of organic compounds, including proteins, that stick to clay and other minerals.

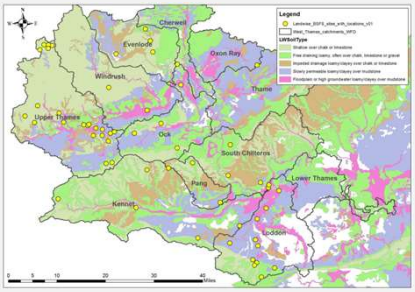
This Mineral Associated Organic Matter (MAOM) has a slow turnover, so stores carbon.

The proteins bind soil aggregates. → Important for **soil structure**

Proteins also contain Nitrogen. → The key **soil N store**

## The plan: LANDWISE soil samples measured for protein content

**I will be using soil samples taken for the LANDWISE Broadscale survey from farms across the West Thames catchment.**




Broadscale survey sampling sites, on base-map of aggregated Soilscapes classes from NSRI soil data (Blake, 2020)

- ~160 fields/woods
- 5 soil types
- 4 land use classes:
  - Broadleaf woodland,
  - Permanent Grassland,
  - Arable – rotation with grass,
  - Arable – rotation no grass
- Management practices: Crop, tillage, grazing etc.

I will measure soil protein stocks from a subset of these samples, and correlate the results with data that the LANDWISE team have already collected, including:

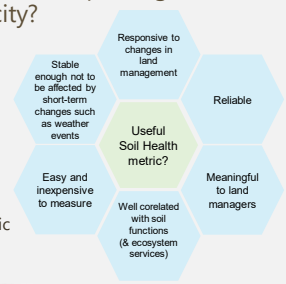
- Total organic carbon
- Soil texture
- Bulk density
- Slaking (particle stability)
- VESS (Visual Evaluation of Soil Structure)

## Research questions to explore

- Do soil protein stocks corelate with recorded soil carbon measurements and 'soil health' physical parameters?
- Do soil protein stocks vary with type of land use and land management? Do land management methods that support soil microbes (no ploughing or min-till, diversity in plants and rotations, and year-round plant cover) produce more soil protein?
- Do soil protein stocks in POM and MAOM fractions differ depending on soil type, land use and management?

## Overall aim

Are soil protein measurements useful indicators for helping farmers and land managers to know if management changes are improving soil health and water capacity?




Features that suggest protein may be a useful Soil Health metric (from Doran & Zeiss, 2000)

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