Soils are Alive Newsletter

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Centre for Land Rehabilitation — The University of Western Australia

Lyn Abbott

Welcome...

This is the fourth issue of our *Soils are Alive* Newsletter for 2000.

www.soilhealth.com

A new website *www.soilhealth.com* is now available. The objective of this website is to answer common questions regarding soil biological processes, organic matter, soil organisms, and the soil management practices that affect these.

The website seeks to extend knowledge of soil biological processes to land managers and other members of the community and complements our scientific objectives, which are to:

- **increase your understanding of soil biological processes that influence soil fertility in natural and managed ecosystems**
- **provide a stimulating and collaborating environment for research on a wide range of soil organisms in diverse ecosystems**
- **ensure strong links are maintained between research activities and teaching in the area of soil science, especially in relation to soil fertility and soil management.**

If you have any soil biology questions, please forward them to us by email and we will endeavour to address your question on our website.

Acknowledgements

The *Soils are Alive Newsletter* was established with support of the Ian Potter Foundation which also supported the development of the website ***www.soilhealth.com***

Ruth Morgan helped prepare this newsletter. Ruth, a Year 11 student at Penrhos College, was awarded a Faculty of Agriculture Scholarship at The University of Western Australia to work on soil biology and soil physics projects this summer.

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Living soil organic matter

by Dr Daniel Murphy
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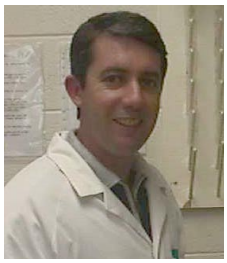


Your soil is full of millions of unseen workers – they are the microscopic organisms and they form the living component of soil organic matter.

Managing our soils in a sustainable way is essential for the viability of WA's agricultural sector. The amount of organic matter (OM for short) in the soil is an important factor controlling the potential sustainability of a system. Soil OM plays a key role in supplying plants with the nutrients they require (especially carbon, nitrogen, sulphur and phosphorus). OM also helps to improve soil structure, binds pollutants, and influences soil-buffering capacity. Thus the challenge is to identify management practices for our WA soils that promote soil OM formation and ensure profitability.

We can learn more about changes in soil OM by examining the 'active' components of OM. This is because the total amount of OM changes very slowly (over many years or even decades). 'Active' components include recent partially decomposed OM (light fraction) and microorganisms. Microorganisms are the living component of soil and so they are sensitive to soil conditions, climatic changes, land use and management practices. They are often used as an early indicator of changes in 'active' OM – well before a difference in total OM is detected.

THE LIVING COMPONENT

Soil microorganisms (bacteria and fungi) only make up a few percent of the total OM, but this still equates to hundreds of kilograms of living organisms per hectare. The microorganisms continually 'turn-over' as individuals divide, grow and then die. Microorganisms use the dead OM in soil as food. As they breakdown the OM, any excess nutrients they don't need are released into the soil in forms that plants can use. This process is called mineralisation. Soil animals such as earthworms also play an important role in breaking up OM into smaller pieces, but it is the micro-organisms that are responsible for the actual release of nutrients.

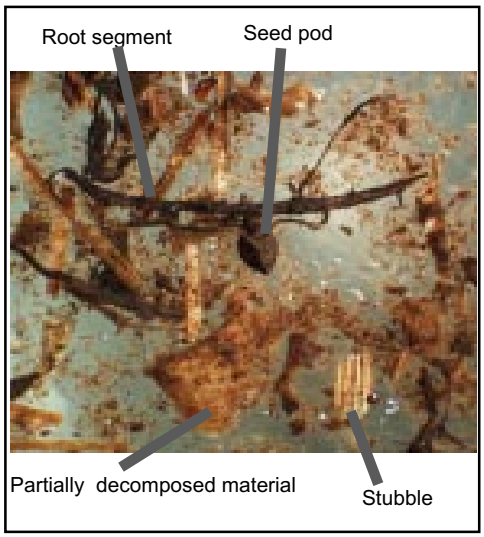


Fig 1. Light fraction extracted from soil laboratory viewed under the microscope. Microorganisms colonise this material and decomposition occurs.

Soil microorganisms are also responsible for immobilising mineral nutrients like ammonium (NH_4^+) which they require for their own growth. Immobilisation reduces the availability of nutrients for plants. It is the net difference between these two processes (mineralisation and immobilisation) which determines the amount of soil derived nutrients that are available for plants or potentially lost from the soil. Whether net mineralisation or net immobilisation occurs is closely linked to carbon availability and to the ratio of carbon:nitrogen in the OM.

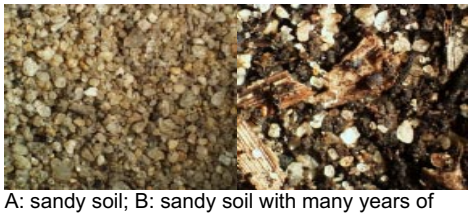
GRDC
Grains Research & Development Corporation

Daniel Murphy, a GRDC funded Research Scientist is investigating the role of biologically active fractions of organic matter in soil.

SOIL OM FORMATION IN WA SOILS

WA soils are naturally infertile and have little OM – but this still equates to tonnes of OM per hectare. They are also often sandy and have a low clay content. Generally, the higher the clay or OM content, the better the soil can protect soil microorganisms and provide suitable living environments for them. Adding clay to the soil (which effectively changes soil texture) is one way to increase micro-organisms and nutrient storage in some soils.

Increasing soil OM levels will improve soil fertility and structure everywhere. To maintain or improve OM levels we need new OM (from plant debris and/or animals) to exceed the rate at which the soil OM is decomposed (mineralised).



A: sandy soil; B: sandy soil with many years of accumulated organic matter

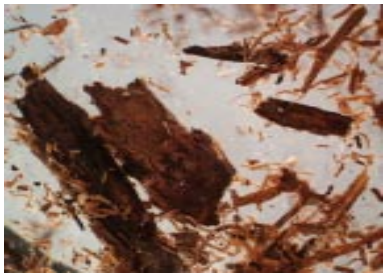
Farming systems have traditionally 'mined' the soil for nutrients, causing soil OM levels to decline. This decline continues until management practices are improved. Following are three considerations of how soil conditions influence OM formation.

SOIL EROSION

When soil is lost by erosion OM, microorganisms and nutrients are also lost. Most animal waste and plant material (except deep roots) are returned to the soil at or near its surface. Soil OM therefore accumulates at the soil surface. The OM is food for microorganisms so they also concentrate in the surface few centimetres of soil. The loss of even a thin layer of soil during wind or water erosion results in a disproportionately large reduction in OM and micro-organisms. This problem is increased in our soils because they usually have poor soil structure and minimal plant cover during summer. Reducing soil disturbance, creating wind breaks, maintaining crop cover or increasing clay content are all practices that can help to minimise soil loss.

SOIL DISTURBANCE

Large losses of soil OM can be attributed to cultivation because OM that was previously 'protected' from microbial activity becomes available for decomposition. No-till systems overcome this problem. No-till systems also reduce soil erosion. OM and microorganisms are restricted to the top layers of the soil. This increases the potential for losing OM (soil fertility) if bad management practices that cause soil loss are subsequently introduced.



Light fraction OM.

LACK OF SUMMER RAINFALL

Our Mediterranean climate means that we have very little summer rainfall, and little plant growth in summer. This absence of plant growth limits the production of new OM and restricts microbial activity. Increasing the length of time that plants are growing actively tends to increase the amount of soil micro-organisms. This is because there is more plant debris and root turnover – food sources for microbes.

Management strategies that include perennials, warm season crops, brown manuring and phase cropping with trees in the farm program will increase the amount of OM added to the soil and also help maintain active micro-organisms during summer.

Also when possible, summer cover crops may be used to 'trap' nutrients released from the microorganisms when summer rainfall events do occur.

The laboratory extraction of organic matter from soil using vacuum filtration. Jennifer Carson (pictured) used this method in her honours project.

A simple method to extract light fraction organic matter.

1. Collect a sample of surface soil with a piece of PVC pipe (5cm long, diameter 72mm). Crush soil with a piece of sheet metal to destroy aggregates (Fig 2). Remove organic matter larger than 2cm and put soil into a 2L drink bottle. Add water to the height shown (Fig. 3). Shake vigorously for 1 minute

Fig 2. Crushing soil aggregates.

2. Lay bottle on its side and slowly roll back and forwards like a rolling pin for one minute. Slowly tilt the bottle upright, fill with water and allow to settle overnight.

3. Cut the bottom out of a plastic conainter and secure a handkerchief over one end with an elastic band.

4. Pour the light fraction organic matter floating on the surface through the handkerchief filter. (Fig 4).

Fig 3 (left). Fill bottle with water to this evel.
Fig 4 (right). Pour light fraction through handkerchief filter.

The light fraction we removed using this method is shown in Fig 1.

If you would like to be included in the email circulation of this newsletter, please contact **labbott@cyllene.uwa.edu.au**