

Understanding soil organic matter and why it's important

123



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Increasing soil organic matter is widely regarded as beneficial to soil function and fertility. In agricultural production systems, it is integral to sustainable farming.

Many of the farming practices undertaken on cane farms, such as green cane harvesting, growing fallow legume crops and reducing tillage, are aimed at maintaining or increasing soil organic matter levels.

To gain a better understanding of soil organic matter, we will have a look some of its key features.

Soil organic matter functions

Organic matter is central to the functioning of many physical, chemical and biological processes in the soil. These include nutrient turnover, soil structural stability and moisture retention.

What is the optimum level of soil organic matter?

An optimum level of soil organic matter is difficult to quantify because the quality and quantity of different organic matter fractions needed to support various functions varies with soil type, climate and management. However, it is generally considered that soils with an organic carbon content of less than one per cent are functionally impaired.

What is the difference between soil organic matter and soil organic carbon, as measured on soil tests?

Soil organic matter is derived from the breakdown of plant and animal material. Soil organic matter is difficult to measure directly. On the other hand, soil organic carbon isn't. So laboratories tend to measure soil organic carbon and use a conversion factor to estimate the amount of organic matter held within a soil. About 58 per cent of the mass of organic matter exists as carbon. Therefore, if we determine the amount of soil organic carbon in a sample and multiply it by 1.72, we can estimate the proportion of organic matter in the soil sample:

$$\text{Organic matter (\%)} = \text{Total organic carbon (\%)} \times 1.72$$

Calculating the amount of soil organic matter in soil

For a soil with one per cent soil organic carbon:

$$\text{Amount of soil organic matter} = \text{Total organic carbon (\%)} \times 1.72 \times \text{soil mass (t/ha)}$$

$$= 1.0 \times 1.72/100 \times 2400$$

(for a soil with a bulk density of 1.2 and sampling depth of 200 mm)

$$= 41.28 \text{ tonnes organic matter per hectare}$$

How much organic carbon remains in the soil?

Microbes digest up to 90 per cent of organic carbon that enters the soil in organic residues. In doing so, they respire the carbon back into the atmosphere as carbon dioxide (CO₂). Microbes continually break down organic residues, eventually converting a small proportion of them to humus, which gives the topsoil its dark colour. Although up to 30 per cent of organic inputs can eventually be converted to humus, depending on soil type and climate, this value is often significantly less.

Clay soils in cool dry climates have the greatest ability to increase soil organic matter level. On the other hand, sandy soils in warm wet environments have the lowest ability to increase in soil organic matter. Many of the soils found in the sugarcane industry are sandy soils in warm wet environments and this makes building soil organic matter levels difficult.

What are the components of soil organic matter?

All soil organic matter comes from plants. It can be divided into 'living' and 'dead' components in various stages of decomposition. Generally, soil organic matter is comprised of:

- > 85 per cent dead material
- > 10 per cent living root material
- > 5 per cent soil biota.

How much soil biota do I have in my farming system?

The amount of soil biota in cane fields can be calculated by multiplying the amount of soil organic matter (in tonnes) by the typical percentage of soil biota.

Using the examples above, if we have 40 t/ha of soil organic matter, of which 5 per cent is soil biota, then the amount of soil biota is calculated thus:

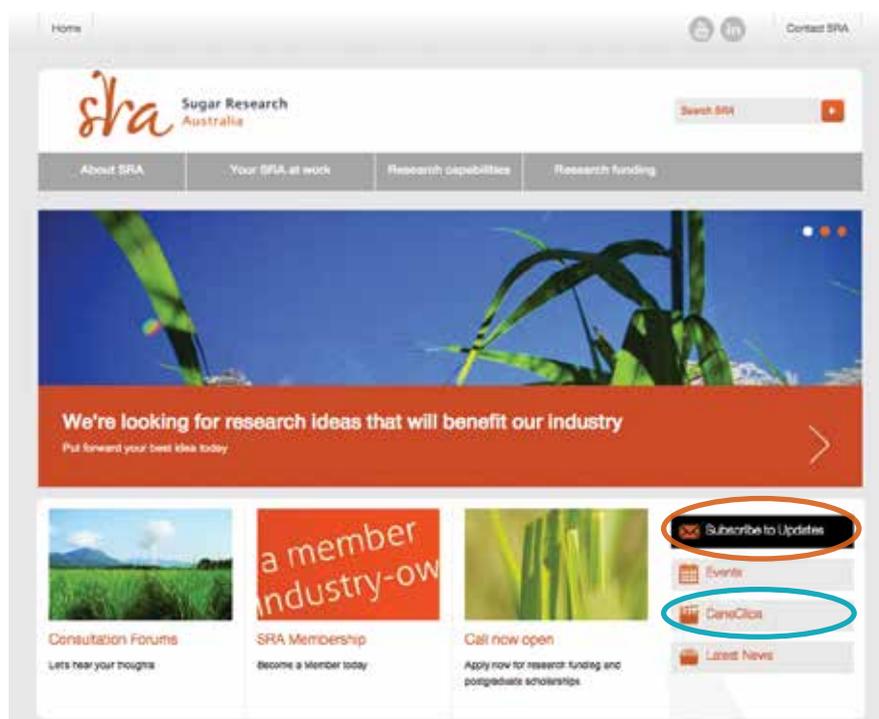
$$40 \times 0.05 = 2 \text{ t/ha.}$$

Advice for maximising soil organic matter on a cane farm

1. It is a long and difficult process to increase soil organic matter levels because much of the organic matter added to the soil is consumed by the soil biota and respired back to the atmosphere as CO². Continual inputs of organic matter are required to maintain the current soil organic matter levels. Green cane harvesting and legume crops can contribute to these inputs.
2. Growing large crops and green manure crops returns as much organic matter as possible to the soil. Choosing not to burn is also a positive step.
3. Tillage increases the rate at which soil organic matter is lost. Moving to a reduced tillage system slows the rate of organic matter loss from the system.
4. Adding soil biota brews to the soil may have little or no effect as there is already a large soil biota pool. The size of that pool is limited only by available food sources. If you want a bigger soil biota pool, add more soil organic matter.

More information on the management of soil organic matter

This can be found in the *Managing Soil Organic Matter* practical guide from the Grains Research and Development Corporation. This publication can be read and downloaded at www.grdc.com.au/GRDC-Guide-ManagingSoilOrganicMatter



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