viti-notes
[vineyard activity guides]

Research to Practice

Measuring organic carbon in soil

Viti-note Summary:

- Equipment, timing and method
- Analysis
- Optimal values

Soil organic matter is material in the soil derived from living species. This includes the decomposing remains of plants and animals in various stages of breakdown, the cells and tissues of soil organisms and substances made by plant roots and soil microbes. Well-decomposed organic matter forms humus—a dark brown, porous, spongy material that has a pleasant earthy smell. Soil organic matter is generally measured as the amount of carbon in the soil.

There are many beneficial roles that soil organic matter plays in soil:

- Provides food for soil microbes;
- Provides nutrients to plants (particularly nitrogen, phosphorus and sulfur);
- Stabilises soil structure and increases water holding capacity;
- Makes it easier for water to enter the soil;
- Reduces run-off and erosion;
- Improves the soil's ability to hold nutrients thereby reducing pollution potential;
- Helps buffer the soil against changes in pH;
- May protect plants against disease.

Many factors affect soil organic matter level:

- Soil depth – the organic matter content generally decreases with depth;
- Soil type - sandy soils generally have lower soil organic matter than heavier soils such as loams;
- Management practices – excessive cultivation reduces organic matter levels;
- Temperature - organic matter breaks down faster in as temperature increases;
- Soil water content - organic matter breaks down faster in moist soil (though not permanently saturated) than dry soil.

Organic matter can be classified into 'pools'. Each pool has a different function in the soil. The main pools are outlined in the table below.

Table 1. Organic matter classifications in soil.

Organic matter pool	What is it?	What does it do?
Microbial biomass	Bacteria and fungi (i.e. the living part)	Decomposes the organic matter
Light fraction	Organic matter that has recently be incorporated	Food for microbes, releases soil nutrients
Soluble organic matter	E.g. root exudates	Moves through the soil profile – Binds soil particles, available for plant uptake
Protected organic matter	Protected chemically or physically	Can't be decomposed by microbes
Inert organic matter	E.g. charcoal	Does not breakdown, but helps soil structure
Humus	Well decomposed organic matter	Supplies nutrients

Other topics in this Viti-Notes series include:

- Measuring the infiltration rate of water into soil using the ring infiltrometer method
- A method for examining grapevine root systems
- Soil moisture monitoring
- Measuring soil porosity
- Measuring soil strength
- A method for assessing soil structure
- Taking soil samples
- Measuring soil pH
- Measuring soil salinity
- *Measuring organic carbon in soil*

Equipment, timing and method

The same as described in the *Taking soil samples* activity guide in this Vitinote series.

Analysis

The analysis of soil organic matter status must be carried out in a laboratory. There are two ways in which it will be done in two ways:

- Loss on ignition - the soil is heated at very high temperatures and the organic matter is essentially 'burnt off'. This results in an estimation of the organic content only;
- From organic carbon measurements - carbon compounds are determined by laboratory instruments and then converted to soil organic matter levels using a simple calculation. This method is more accurate.

Optimal values

There is very little information about organic matter levels in vineyards—most of the work in this field has been done in pasture or cropping situations. The values in the table below are a rough guide to the general organic matter levels (%) considered to be high, medium and low for several different soil types in South Australia.

Rather than comparing the level of organic matter to a set of values as above, it might be better to compare results from different sites within the vineyard, remembering that in a very general sense more organic matter usually means a 'healthier' soil. It is also worthwhile noting that:

- Most Australian soils are low in organic matter by world standards – a reflection of our geological/ biophysical history and our climate.
- It can be difficult to increase the (stable) fraction of organic matter in soil. Organic materials such as mulch or straw usually have to be applied at high levels (e.g. several tonnes per hectare) for many years to appreciably increase organic carbon levels.
- When looking at options to maintain or raise organic matter levels, consider growing grasses and other plants with fibrous root systems in the vineyard as cover crops or swards. The roots of such plants and their attendant soil microorganisms are significant contributors to organic matter levels within the soil.

Acknowledgement

The Australian Wine Research Institute would like to acknowledge:

- Cooperative Research Centre for Viticulture (CRCV) and all involved in the VitiNotes series (1996 – 2006).

Further information

- Nicholas, P. 2004. Soil, irrigation and nutrition. Adelaide: Winetitles.
- Baldock JA and Skjemstad JO, 1999. Soil Organic Carbon/Soil Organic Matter, in Soil Analysis: an Interpretation Manual, Eds. Peverill, KI, Sparrow, LA and Reuter, DJ, CSIRO Publishing, Melbourne, pp 159-70.

Product or service information is provided to inform the viticulture sector about available resources and should not be interpreted as an endorsement.

AWRI

www.awri.com.au

gwrdc
GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

Table 2. Organic matter levels (%) in different soil types. Adapted from Baldock and Skjemstad

	Sand	Sandy loam	Loam	Clay loam/clay
Low	0.9	1.2	1.6	2.1
Moderate	0.9-1.7	1.2-2.4	1.6-3.1	2.1-3.4
High	>1.7	>2.4	>3.1	>3.4