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Converting Percentage of Carbon to Tonnes of Carbon

Soil organic carbon is reported as a percentage result on a laboratory soil test.

To convert this percentage result into tonnes of carbon the following calculations can be used.

Sampling your Soil

1. Push or hammer a piece of tube (steel/PVC, depending on soil type) of known dimensions so the top of the tube is flush into the soil. Recommended insertion depth is 15 - 30 cm. Know the depth of the tube before inserting it into the soil.
2. Dig around the tube to release it from the ground making sure the soil sample inside remains intact.
3. Remove excess soil from the outside of the tube and cut off any plant matter at the surface and base of the tube.
4. Empty soil into a sealable bag or container.

The dry weight of the soil can then be calculated.

1. Weigh a container that is oven and microwave-proof.
2. Empty your soil sample into this container.
3. Microwave the sample for 10 minutes or place it in the oven for 2 hours at 105°C.
   Note that soils should not be handled in areas used to prepare food – do not use a kitchen microwave.
4. Once the soil is dry, weigh the sample in the container. Note, weighing will need to occur soon after removing soil from the oven before it absorbs moisture from the air, becoming heavier.

Australian Government | National Landcare Program

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To calculate the dry soil weight:

Dry soil weight* = dry soil in container weight - container weight

*Immediately after removing it from the oven.

Example Calculation – Bulk Density

For the purposes of this working scenario:

Weight of container and dry soil = 420 g and container weight = 250g.

Therefore,

Dry soil weight = 420 g – 250 g = 170 g

To calculate bulk density, we need the dimensions of the tube used to take the sample to calculate volume, where:

Volume = π x radius^2 × length

For the purposes of this working scenario, the diameter of the tube was 5 cm (therefore, the radius was 2.5 cm) and the length of the tube was 10 cm. Therefore,

Volume = π × (2.5 cm × 2.5 cm) × 10 cm = 196.3 cm^3

To calculate the bulk density of the soil:

Bulk density = dry soil weight ÷ volume of the tube

For this working scenario,

Bulk density = 170g ÷ 196.3 cm^3 = 0.87 g/cm^3

*It is important to note here that 1 g/cm^3 is equivalent to 1 tonne/m^3.

Adjusting tonnes/ha for Gravel Content

If there is gravel present in the soil, the laboratory results will need to be adjusted to accommodate this. Gravel is removed prior to carbon analysis.

The calculation for this is:

Soil organic carbon = Soil test carbon percentage – (soil test carbon percentage × soil gravel content percentage)

To continue the working scenario, where soil organic carbon = 3% or 0.03 and soil gravel content = 25% or 0.25,

Soil organic carbon = 0.03 – (0.03 × 0.25)
= 0.03 – 0.0075
= 0.0225 or 2.25%

Soil Carbon Percentage into Carbon Tonnes Per Hectare

To convert the organic soil carbon percentage (received in your soil test results) to the amount of carbon per hectare at a given soil depth, we first need to calculate the volume of the area.

To calculate the volume into tonnes/ha, we need to convert the size of the area and testing depth to volume. Therefore, to calculate the volume of a given area / paddock, we use:

Volume = area / paddock × depth of sampling

For this working scenario, the paddock is 1 ha, and the sampling depth is 10 cm.

First, we need to convert the measurements into the same unit of measure.

Convert ha to m^2: 1 ha = 10,000 m^2

Convert cm to m: 10 cm = 0.1 m

Therefore,

Volume = 10,000 m^2 × 0.1 m = 1000 m^3

To calculate the tonnes/ha of soil carbon:

Soil carbon tonnes/ha = volume of soil × bulk density of soil x percentage of soil organic carbon (from soil test result)

Therefore, for this working scenario if soil organic carbon = 3 % or 0.03, then,

Soil carbon = 1000 m^3 × 0.87 tonnes/m^3 x 0.03
= 25.98 tonnes /ha

Using the soil organic carbon value adjusted for gravel content, the carbon tonnes per hectare is:

Soil carbon = 1000 m^3 × 0.87 tonnes/m^3 x 0.0225
= 19.58 tonnes/ha

Note: A usual soil carbon range is between 0.5% (very low) and 7% (very high).

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MORE INFORMATION

The Carbon Farming Series Fact Sheets have been produced to support carbon farming literacy. Download more in the series from nrmnorth.org.au/resources/

Dr Matthew Harrison's webinar, *Simple Methods for Estimating Soil Carbon and Greenhouse Gas Emissions Abatement*, is another resource to support your soil carbon estimation understanding: youtu.be/FtOTQq3x21M

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ASSUMPTIONS

This calculation assumes the soil quality across a hectare is the same as the soil test site.

Soil organic carbon levels can vary from site to site and independent advice should be sought.

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