Soil sampling and preparation

1. Surface soils may be sampled using an auger up to a depth of 20 cm.
    a. If large volumes are sampled but only small volumes are required, keep representative sub-samples from several depths and composite.
2. Collect soils using cores (100-300 cm^3) of known volume if bulk density must be determined.
    a. Topsoils can be sampled from the surface downwards, but deeper samples can only be cored after excavation of a soil profile.
    b. Place core at the desired sampling depth, cover opening with a paint knife and hammer into soil surface/ profile face.
    c. Carefully loosen soil around core to enable removal of core without loss of soil from the opening. Use paint knife to scrape excess soil protruding from openings.
3. Note depth of sample collection.
4. Dry soils at 40 ^{0}C to preserve organic carbon (C) (dry soils may take less than three days and very wet soils may require a week or more to dry sufficiently).
5. Crush soil with mortar and pestle to break aggregates, but do not grind clay particles.
6. Remove coarse fragments by sieving (2 mm diameter mesh). Weigh dry soil before and after sieving to calculate the coarse fragment (CF) content.

Soil C stocks should be calculated as follows (Poeplau *et al.*, 2017):

$$\text{FSS} = \frac{mass(fine\,soil)}{volume} \text{ x depth} \quad (1)$$

$$\text{C stock} = \text{C content (fine soil) x FSS} \quad (2)$$

where fine soil refers to the soil that passed through the sieve and volume refers to bulk volume of the core (including CF).

Clod method: Alternative method for very hard or clayey soils

1. Remove intact peds (100-300 cm^3) from the face of a soil profile using a soil hammer. Transport in bubble-wrap or newspaper to prevent disintegration.
2. Note depth of sample collection
3. Divide ped into smaller peds (40-60 cm^3) if replicate measurements are desired
4. Determine volume
    a. by X-ray tomography (CT scan) or
    b. by coating the clod with paraffin and weighing it in air, then again while immersed in water, making use of Archimedes' principle to calculate the volume of the clod –reference (Blake, 1965).
5. Crush soil with mortar and pestle to break aggregates, but do not grind clay particles.
6. Dry soils at 40 ^{o}C to preserve organic carbon (C)
7. Remove coarse fragments by sieving (2 mm diameter mesh). Weigh dry soil before and after sieving to calculate the coarse fragment (CF) content.

Soil C stocks should be calculated as follows (Poeplau *et al.*, 2017):

$$\text{SOC stock} = \text{SOC (fine soil) x BD (fine soil) x depth x (1 – CF)} \quad (3)$$

where BD of fine soil is calculated according to the equation:

$$\text{BD (fine soil)} = \frac{mass(bulk\ soil) - mass(CF)}{volume(bulk\ soil) - \frac{mass(CF)}{\rho(CF)}} \quad (4)$$

where $\rho(CF)$ was assumed equal to the particle density of quartz i.e., 2.6 g cm^{-3}

Excavation method: Alternative method for very gravelly or sandy soils

1. Use a small, sharp spade to remove approximately 100 cm^3 of soil from soil surface.
2. Determine soil volume in-field by lining the hole with plastic film and filling the hole with a measured volume of sand or silicon beads – reference (Grossman & Reinsch, 2018)
3. Dry soils at 40 ^oC to preserve organic carbon (C).
4. Crush soil with mortar and pestle to break aggregates, but do not grind clay particles.
5. Remove coarse fragments by sieving (2 mm diameter mesh). Weigh dry soil before and after sieving to calculate the coarse fragment (CF) content.

Soil C stocks should be calculated according to equations (1) and (2)

References

Blake, G. 1965. *Methods of Soil Analysis, part 1*. C. Black (ed.). American Society of Agronomy.

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