Exploring soil organisms:
Loss on Ignition

· EXPLORE ·
SOILS

Summary:

Soil organic matter is that component of the soil that derives from living organisms. It comprises the living organisms themselves, fresh plant material entering the soil as litter or dying roots, organic compounds exuded from roots, and other forms of organic matter that have passed through the decomposition process. Different soils contain different amounts of organic matter. The dry matter in peaty soils and other "organic" soils can be almost entirely made of organic matter. In other "mineral" soils the percentage of organic matter is much lower (typically 2-15%), and the SOM content is not easy to see.

The amount of organic matter in soil is strongly correlated with many other soil properties, with more organic matter being associated with greater soil water content, greater biomass of soil organisms, greater capacity to retain and exchange positively charged ions (including many plant nutrients), and also with lower density, more porous soils. Most of the organic matter in a mineral soil is old material that is well decomposed and its ongoing decomposition is very slow in undisturbed soils. This slow decomposition causes it to build up over time, and as a result soil organic matter is the largest store of terrestrial organic carbon in the world. If this carbon were to decompose it would release a huge amount of greenhouse CO2 into the atmosphere, accelerating global warming.

Loss on Ignition measures the weight of a dried soil before and after burning away its organic matter. Different types of organic matter burn at different temperatures, but most organic matter burns away at 375oC. Laboratories have special high-temperature ovens that are used for this analysis but you can get a good idea of the SOM content of your soil using a camping stove and a tin!

Try this test on soils from land under contrasting management (eg. Woodland, grassland, arable land), and try running it alongside other tests to see if how the differences in organic matter correspond to other soil properties.

This test is **not suitable for soils from chalky areas**, because chalk is mainly calcium carbonate, and during this test the soil may burn hot enough to cause this mineral to release CO2. This would represent a loss weight from the soil mineral material, not the soil organic matter. This loss will give you a high false result.

Leanring Objectives:

- Understanding of the importance of soil organic matter in retaining soil moisture.
- Understanding of a common method used in soil science.

Equipment for a group of 5:

A notepad and pen/pencil.
A metal take-away tray for drying the soil.
Balance or digital kitchen scales – the more accurate the better
A fan oven
A sieve
A spoon
A bowl
1 empty tuna tin (with top and label removed)
Tongs or long metal tweezers with a heat-proof cloth or gloves.
A camping stove and an outdoor area, away from buildings or flammable hazards, to use it.
A metal biscuit tin (optional)
Silica gel sachets (optional)
A calculator

Preparation:

You may wish to prepare the dried soil first. It is a good idea to combine this test with a test for bulk density (amount of dried soil per unit volume).

Time Required:

- 3-4 hours drying time if preparing dried sample.
- Introduction - 5 minutes maximum
- Weighing and adding sample – 5 minutes
- Burning on stove - 15 minutes
- Cooling- 15 minutes
- Re-weighing and calculating SOM – 10 minutes max.
- Total timing 1 hour and 30 minutes.

Description of Activities:

Preparation and Soil Water Content

1. Get a piece of paper and write the letters A to L in a column down the left hand side. We'll use these to note down weights and values during the test.
2. Use your kitchen scales to weigh the metal take away tray and note its weight next to A.
3. Crumble a sample of soil freshly collected from the field (taking away major plant roots) into the metal take-away tray and re-weigh it noting the weight with the soil added next to B.
4. Calculate the weight of fresh soil B - A (weight of fresh soil and tin - weight of tin) – write this value next to C.
5. Put the soil in a fan set to a low temperature (60-80oC) for 4-6 hours. Sandy soils will dry more quickly than clayey ones.
6. Remove the soil and tray carefully from the oven using heatproof gloves and leave somewhere dry to cool.
7. Reweigh the soil and tray it and noting the weight next to D.

8. Calculate the weight of the dry soil D - A(weight of dry soil and tin - weight of tin). Write this value next to E.
9. Calculate the soil water content as a percentage (C - E) / C x 100 ((weight of fresh soil - weight of dry soil) / weight of fresh soil x 100). Write this value next to F. This is the percentage of the weight of the fresh soil that is water.

Soil organic matter
10. Put your dry soil sample into the sieve over the bowl and crush it to a powder with the back of the spoon. Larger stones and roots should remain in the sieve and be discarded (or weighed if you like to establish stone content!).
11. Mix the soil in the bowl well.
12. Weigh the empty tuna tin and note the weight next to G.
13. Put a dessertspoon full of the sieved, mixed, dried soil into the tuna tin and reweigh it, noting the weight next to H.
14. Calculate the weight of the soil in the tin H - G (weight of soil and tin – weight of tin). Write this value next to I.
15. Go outdoors and set up your camping stove in a sheltered place away from anything that might catch fire.
16. Light the stove and hold the tin over the flames using the long tweezers or tongs, holding these with the gloves or cloth to avoid getting burnt.
17. Gently move the soil sample from side to side as it heats to mix air into the sieved soil material – the soil will begin to burn and smoke will rise from the sample. The tin may become red hot. Be very careful not to burn yourself or anyone else!
18. When the smoke stops, continue to burn the soil for a few minutes more, then place somewhere dry to cool. A metal biscuit tin with some silica gel in is ideal.
19. The dry environment stops the soil from re-absorbing water from the atmosphere.
20. Once the tin is cool, reweigh it on the scales. Write the weight next to J.
21. Calculate the amount of dry mineral material left in the tin J - G (weight of mineral material minus weight of tin). Write this next to K.
22. Calculate the percentage of Soil Organic Matter that has burnt away (I - K) / I x 100 (weight of Soil after Burning minus weight of dry soil in tuna tin, divided by weight of dry soil in tuna tin x 100). Write this value next to L. This is the "% Loss on Ignition" and is the percentage of the weight of dry soil that is organic matter.

Extension activity:
23. Gather data from many different soil types and create a plot of % Loss on Ignition against fresh soil water content. How do they relate? Try plotting % Loss on
24. Ignition against any other soil properties you can measure (eg. Bulk density). What factors might contribute to inaccuracies of this method? What other approaches could be used? Some issues are discussed here: http://onlinelibrary.wiley.com/doi/10.1111/ejss.12224/abstract;jsessionid=C449B0CC1067574BA56CDD6BFE29EEEA.f01t03


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