Farm Carbon Calculator

Testing soils for organic matter

Rationale

In order to understand fully what is going on within your soils on the farm, especially regarding soil carbon sequestration, a key action is to take some soil and send it off for analysis. However taking the sample and making sure that what is sent to the lab is representative of the field, soil and management conditions is the crucial first step.

Testing soils for organic matter and organic carbon is slightly less straightforward than testing for nutrients, and warrants care and attention.

When to take my sample for analysis?

The best time to sample fields is either the spring or the autumn (whichever fits best with your cropping patterns). Making sure that any repeat samples are taken at the same time of year is also important and soil organic matter will fluctuate throughout the year. Deciding on a spring or autumn timescale and then sticking to it is the first step.

The most important thing is to **avoid sampling soils which have been ploughed within the last six months.** These soils have had a high level of disturbance and so it is important that they are left to settle before samples are taken. This is especially important when samples are being taken looking at organic matter at different depths, as the results that come back will not accurately reflect what is going on in the field and will be a waste of money and time. Although ploughing will have the most impact on soil organic matter results, it is important to avoid testing for at least 6 weeks after **any** soil disturbance to ensure that the samples that are taken show true results.

What equipment will I need?

The gold standard for taking soil samples for organic matter is to use a soil auger. This allows you to extract the soil to a consistent depth at each point and will avoid having to dig multiple holes. However a trowel or a spade will also work very well and allows you the opportunity to also assess soil health and structure while you are taking samples!

A bucket to mix the soil prior to sending to the lab is important too, to make sure that there is a representative sample sent.

Bags, labels and pens are also useful in order to mark where samples have been taken from, which field and to send the samples away to the lab. Sandwich bags are a cheap source of bags (but make sure that the top is well sealed!) and mark the bag clearly so that the lab can read field names. Some labs will send you out specific sample bags so it's worth asking your lab before you take your samples – as they may have specific codes that you need to attach to samples so they know what analysis is required.

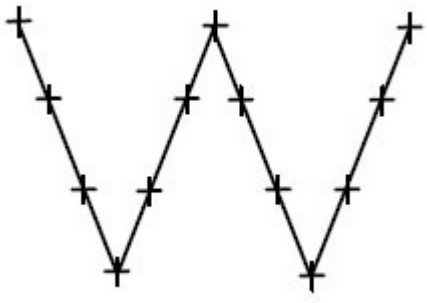
Having a map of the farm is also an important tool for planning your analysis regime, this will allow you to set out a rotation of when fields on the farm can be sampled that avoids cultivation and other agronomic considerations. If this is the first time that you are sampling for organic matter, it can be a good idea to think about the different cropping patterns on the farm and choose fields that are at different parts of the rotation or are cropped differently to test so that you get an idea of the range on the farm.

Choose fields that represent your current management on-farm. If you are thinking about changing management (for example changing cultivation or grazing practices) then baseline by taking a sample before you start so that you can evaluate the impact of your management change. This will enable good decision making in the future.

Taking the samples

Sampling for soil organic matter is not a quick process and the results that you get back will only be as good as the samples you send, so it is worth taking some time and making sure that you are accurately representing your soils within the sample that is sent.

The general recommendation is to walk your field in a W pattern stopping at a minimum of 15 points to take a sample. For larger fields (over 15 hectares),



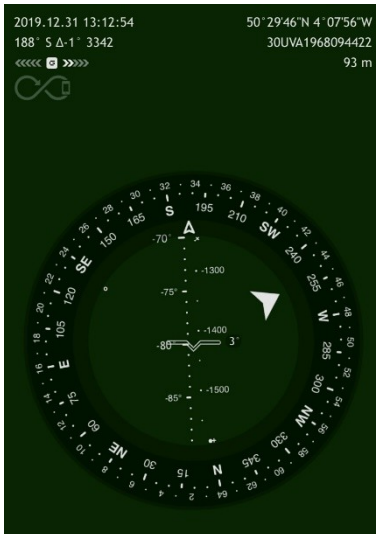
subdivide the field and walk multiple W's to make sure the field is covered. If there are different soil types within the same field, then sub divide the field according to the soil types.

For horticultural growers if there are different rotations or soil management strategies within the same field then sample these separately to get the best results.

Assess field shape and boundaries to look at where to walk the W shape across the field. Make sure to avoid any areas of the field that aren't representative (tramlines, areas where round bale feeders have been, poached areas around water troughs etc).

Arrive at starting point of W with soil auger and bucket.

Walk a W shape across the field stopping at 15 points across the field that are equidistant from each other (this will depend on field size as to the exact distance between the points)



A good tip is to log the GPS position of each of the sampling points (most modern phones have this capability built into them) so that you are sampling from similar points in the field each time you sample.

Then insert the auger or spade into the ground to the required depth and place the soil in the bucket.

Repeat this process across the field, GPS logging each point of the W.

Once all samples have been taken, mix the soil within the bucket well, remove any plant roots / crop residues / stones and bag and label the sample to send for analysis (send about 200g per sample).

How deep should I test?

With samples that are taken for nutrients and pH testing, samples are usually taken to 20cm, however when testing for soil organic matter, the recommendation is to **test to 30cm**. The current work taking place with the Soil Carbon Project is evaluating the impact of testing depth, and is taking three separate samples, 0-10cm, 10-30cm, and 30-50cm to understand the transfer of soil organic carbon down the soil profile.

General recommendations are to ensure that samples are taken where possible to 30cm which will give you a good understanding of current levels. It is also good practice to discard the top inch or so of the sample which may well have crop debris, leaves and other sources of organic matter that will distort the results.

What about using Precision Farming soil mapping?

Some work currently taking place within the Soil Carbon Project is looking at how organic matter varies across the field and what are the factors that account for variation. There are various companies that are offering precision mapping services, some of which are including soil organic matter as part of the testing package. Understanding how many samples are taken, and at what depth is a good starting point for deciding whether this is a service that is useful for your farming business.

Regarding field variation, early results seem to be showing that there is more variation in soil organic matter across permanent pasture fields than arable fields, however more work is being done on this. If your sample locations are GPS logged, then repeat samples will ensure that you are sampling the same locations.

Where should I send my sample for analysis?

There are numerous labs that will analyse your sample for organic matter and use different analytical techniques to achieve it. The two main analytical techniques for organic matter are the Loss on Ignition and Dumas method. Ask your lab which test they use when you enquire. Ensure the samples are sent either by post or courier for next day delivery and that the lab is open to receive them!

The Loss on Ignition method is widely used. The sample is prepared and sieved and then burnt in a furnace at a high temperature. The sample is weighed before and after the furnace, and the difference calculated. The Dumas method uses a much higher temperature (950°C) for a much shorter time (15 minutes) and has been suggested to be a more accurate method for Brash soils.

Consistency of lab is the most important way to be able to pick up changes in your soils in repeat samples. In a similar way to the use of carbon calculators, make sure that samples are all sent to the same lab and you are clear about what test they are using for analysis. If the results don’t look right – ask them to sample again. Ask for the results to be sent to you to **two decimal places** – some of the changes that you will be seeing will be small, so it is worth being able to understand the detail.

How frequently should I test my soils for organic matter?

The best practice recommendation is that all soils on your farm are tested every 5 years. What we are looking for is long term trends, and whether over time our soils are improving or losing carbon. Testing more frequently has some value but may provide a lot of ‘noise’ and can confuse the issue. However testing every 5 years isn’t all that is required! In the gaps between lab analyses, evaluating your soil health is really important. Testing for structure and compaction, looking at worm numbers and types, assessing how water moves across your farm and looking at aggregate stability will inform you about how your management is impacting on your soils and will complement any lab analysis.

The Carbon Calculator works on percentage change in soil organic matter every year to calculate your soil sequestration, however if you can group fields together and sample them in rotation, then you should be able to get an understanding of whether your carbon levels are maintaining, being lost or gaining.

What does the result mean in terms of amount of carbon within my soil?

The lab will report back a soil organic matter results as a percentage. Depending on your soil type that percentage could range from 0.5% to 30%. Soil organic matter is also not all carbon, only a proportion of that percentage is soil organic carbon (about 58%). In order to convert percentage into a carbon stock, you also have to test for the soil’s bulk density at the same depth that the samples were taken at. Once you have the bulk density a simple equation can be applied to allow you to calculate the tonnes of carbon that are held within your soil.

FCCT can provide more guidance and advice on taking soil samples for carbon testing. The Soil Carbon project will also be providing updated recommendations as it progresses, keep an eye on progress on the project webpages here.

Bulk density

Bulk density simply is the weight of soil in a given volume, which allows you to understand how tightly packed together the soil particles are. It is reported as grams per cm3 of soil.

Bulk density is a useful indication of how compacted your soil is; concrete has a bulk density of 2.2! The value will depend on your soil type as well as its structural condition, as sandy soils typically have a higher bulk density than clay soils due to their physical properties.

In order to calculate the bulk density, a sample of soil needs to be extracted carefully at the required depth as a core using a cylinder that has a known volume. The sample is then taken back to the lab and sieved through a 2mm sieve to remove stones (which are weighed and have their volume calculated separately). The sample, once sieved is then dried in the oven to provide the dry weight of soil.

Using the bulk density allows carbon content of soils to be compared across soil types (as the bulk density is taken into account) and can also be used to calculate the 'yield' of carbon per hectare. Labs will provide the bulk density analysis for you for under £10, however you need to have a cylinder which has a known volume that you can use to take the sample to send off.

Costs for testing

Organic matter analysis can be requested as a stand-alone test and is not an expensive analysis to have done (around £5.00 plus VAT per sample) or can be added to a sample that is being sent away for nutrient analysis. If one sample is being sent off for multiple analyses, it is worth considering the depth that the sample is being taken at (as soil is usually sampled at 20cm for nutrients and 30cm for organic matter).

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