REFERENCE SHEET – SOIL HEALTH EVALUATION TOOL KIT

METHOD TO QUANTIFY PARTICULATE ORGANIC MATTER (POM) IN SOILS

MATERIALS:

1. 2mm and 0.25mm (250 micron) sieves. There are different options for this, such as official laboratory sieves, 250-micron mesh bags, mesh fixed in a cylinder, modified containers with holes, etc. In this sheet method, two options are considered for 250-micron sieving, a 0.25 mm mesh bag or a handmade 0.25 mm sieve (Fig. 1), but it is easy to adapt the process to different types of sieves, as long as the size fraction between 0.25 and 2mm is isolated through wet sieving.
2. Rinse bottle. This can be made from a 500 mL water or soda bottle, poking about 20 to 30 holes in the lid with a safety pin, needle, or thumbtack.
3. Small to medium tubs or buckets (2 to 5 liters)
4. Measuring cup (250 to 500 mL) or similar with a spout, to decant the particulate organic matter.
5. An open cylinder made of a plastic or metal container or bottle, and an elastic band to fix a cloth on it to capture the sample, e.g. a metal can cut open at both ends.
6. Fabric squares of approximately 15 x 15 cm to capture organic matter. It must be of a type that water can easily pass through, for example, T-shirt fabric.
7. (Optional) Small V-shape channel made of cardboard or rigid plastic sheet, about 20 cm long, to qualify the amount of POM (see fig. 7)
8. A precision balance (0.01 g or 0.001 g precision) can be used to weigh the POM more precisely, in addition to visual or qualitative evaluation among samples from different fields.

PROCEDURE :

1. Obtain a well-sampled and homogenized soil sample, about 0.5 to 1 kg or more.
2. From this larger amount, measure 100 g of soil. If the soil has not been sieved, remove the stones manually so that the 100 g does not contain stones larger than 5 mm in diameter. If the soil has already been sieved to 2mm, only the mesh bag or 0.25mm sieve below may be necessary.
3. Assemble two sieves made of simple materials: a bottle with 2 mm diameter holes, inside a mesh bag with 0.25 mm holes. The bag can also be replaced with a sieve made of a plastic container and a 0.25 mm mesh (Fig. 1c, below), or a standard laboratory sieve of size 250 microns. The bag is a little easier to use in clay soils because it allows you to break up small soil aggregates by hand inside the bag (Fig. 3b), while both work well in loamy and sandy soils.

Figure 1. a. A plastic bottle with 2mm holes and a 0.25mm mesh bag**. b.** The bottle inside the mesh bag**. c.** An alternative to the mesh bag is a 0.25 mm sieve that can be made from local materials, in this case with a mesh and a reusable plastic container cut open at top and bottom, and the mesh clamped between the lid and the container.

4. Prepare tubs or small buckets of water, each with 1.5 l inside. If water is scarce, the second bucket may need only 1 liter of water. Also fill the wash bottle or bottles with water. Tap water or any clean water source is suitable.

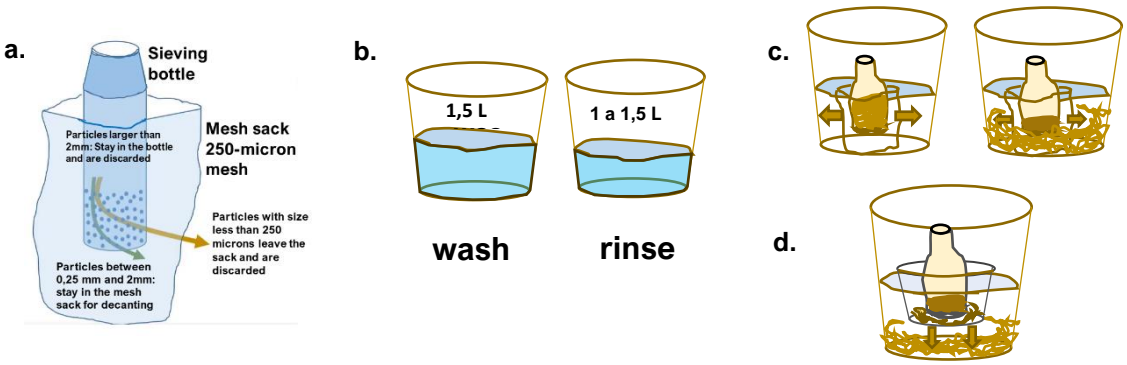

Figure 2. a. Particle flow through the two sieves to retain only the size fraction between 0.25- and 2-mm. **b.** Buckets of water to wash and then rinse the sample. **c.** Shaking the bottle inside the bag, in the bucket of water to remove all fine material < 0.25 mm. **d.** Washing and rinsing can also be done with the sieve bottle plus an 0.25 mm open sieve in the bucket, instead of the mesh bag.

5. Place the 100g of soil into the sieving bottle inside the mesh bag or 0.25mm sieve. Lower the bottle/bag combination into the first bucket with 1.5 L of water and shake well for a few minutes, so that all particles smaller than 0.25 mm come out of the bag into the bucket, while medium particles (0.25 mm to 2 mm) remain in the bag or on the 0.25 mm sieve (Fig. 1a).
6. In clay soils, be patient as you gently break up any large aggregate inside the bottle to loosen its particles, using a stick or other utensil (Fig. 3).
7. Once you have broken up all the aggregates inside the bottle, do a final rinse of particles into the bag from the bottle, making sure to capture those that have stuck to the inside and outside of the bottle. Then begin washing and working the bag by hand, breaking up the small aggregates to release any organic particles that small clay aggregates may contain (Fig. 4). This process is important in clay soils, where smaller, more stable aggregates tend to form. As you do this you will notice of the contents of the mesh bag start to feel more like gritty sand than like smooth clay. Be careful not to work so aggressively that you are breaking the POM inside the bag, and causing it to escape from the bag.

Fig. 3. Use a stick or utensil to break up the clumps inside the bottle.

Fig. 4. Break up the small aggregates or 'crumbs' of clay inside the bag by hand.

8. When you see that what is left in the bag or mesh is only sand with organic particles, switch to the second tub or bucket to rinse the bag. When you finish rinsing, there should not be much cloudy clay or 'dirt' coming out of the bag or mesh.
9. Transfer the mixture of sand and POM to the measuring cup or similar container for decanting (Fig. 5). Use the wash bottle and water to move all material into the container. Leaving a few grains of material in the mesh bag or sieve is acceptable.

Fig. 5. Transfer the sand plus the organic matter to a new container for decanting.

10. Prepare the open cylinder (from a metal can or plastic bottle or jar with a diameter of 6 to 10 cm) with a square of cloth attached to one side with an elastic band (Fig 6a.). The cloth will serve to capture the organic matter that you're going to decant out of the sand using flotation.

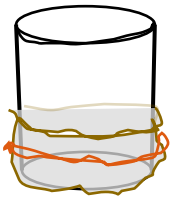

Fig. 6a. Prepare a plastic tube with a cloth at one end to catch the decanted organic matter.

Fig. 6b. Decant the organic matter that is floating above the sand after stirring the water and letting settle for a few seconds.

11. Add water to the measuring cup or other decanting container and stir so that the organic matter in the water is suspended. Wait a few seconds then pour or decant these grains of organic matter into the tube with the cloth, making sure that the fine mineral sand grains with the organic matter do not come out with the organic matter. Shaking the measuring cup with a slight tremor in your hand will make POM float to the top of the sand more efficiently.
12. Repeat this cycle: add water, stir, decant, until there is no more organic matter floating in the cup. All the POM will then be on the fabric in the cylinder. In the cup you can see dark grains, floating just above the sand layer, these can be organo-mineral complexes, and sometimes carbon, and you should try to capture them as part of the POM. Don't worry if some POM grains remain with the sand.
13. Next, remove the fabric with the POM from the cylinder. Take care to rinse with a little water so that all the POM remains in the fabric and not in or around the edges of the cylinder.
14. POM can be evaluated directly in wet form, based on its volume, or dried and weighed on a precision balance later. To evaluate the POM directly, distribute it on the cloth so that it forms a disk with a thickness of one or two particles only (Fig 7a). If there is a small amount of POM, the particles must be brought together, if there is a lot of POM, they must be spread out.

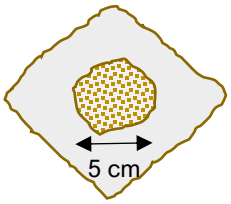

Fig. 7a. Make a uniform POM disk on the square of cloth and measure its diameter.

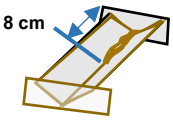

Fig. 7b. Place the POM in a cardboard or plastic channel, so that the POM is the thickness of a pencil. Measure the length of the POM.

Figure 7. Two POM evaluation methods based on the volume washed from the soil.

15. Measure the diameter of the circle of POM (Fig. 7a)
16. ***Another way to measure the amount of POM (Fig. 7b):*** you can make a right-angled channel out of thick cardboard or rigid foam or cardboard sheets like those used in architectural models. Then, in this channel, the POM is spread (wet or dry, but preferably dry) to be the width of a pencil at the bottom of the channel (Fig. 7b). The length of POM in the channel is then compared to a guide.
17. It is recommended to save the POM to dry and weigh it, and then store it to compare it with the quantity in a future measurement of the same field or other land use.
18. Consult the guide to see the qualitative level of POM (Fig. 8) and management criteria, depending on the diameter or length of the POM channel that has been observed.

SCORING GUIDE AND INTERPRETATION OF THE TEST

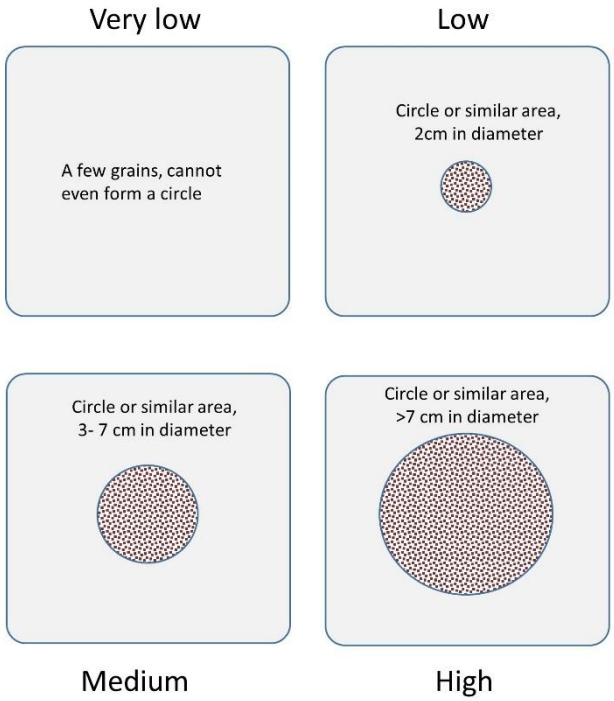

Fig. 8. Qualitative POM levels based on the diameter of a POM circle after decanting on the filter cloth.

19. Table showing interpretation of the different levels of POM in the test.

POM qualitative ranges	Score or level	Description and Recommendations
A few grains, barely forms a circle	**Very low**	The soil is very depleted of new organic matter and has not received recent additions. Erosion may also be robbing the soil of organic matter particles. Apply organic residues high in carbon like cereal stover, manure, and biochar. Erosion needs to be prevented.
Circle 2 cm or less in diameter	**Low**	The soil is still depleted of new organic matter. Continue to apply organic materials and prevent erosion as above.
Circle 3 to 7 cm in diameter	**Medium**	The soil is likely receiving organic residues. Levels are high enough that they are improving soil health and crop productivity. Keep improving these soils by continuing to recycle manures, crop stover, composts, biochar, and other materials
Circle greater than 7 cm in diameter	**High**	The soil is receiving large amounts of organic residues or has recent history as a forest or grassland. Keep these soils in good health by continuing to recycle manures, crop stover, composts, biochar, and other materials.