SOIL STRUCTURE AND AGGREGATE STABILITY

DEFINITION

As a physical indicator, soil structure and aggregate stability tend to be correlated with the ability of a soil to provide water and air for roots and soil organisms.

Soil structure is the shape in which soil particles group together and form aggregates. A soil aggregate is made of sand, silt, clay, and also organic material; it may have a variety of different shapes.

Aggregate stability refers to the ability of soil aggregates to resist disintegration when disruptive forces associated with tillage and water or wind erosion are applied.

TEST

Two complementary tests can be done to determine the soil structure:

1. Soil structure score -> Drop & Shatter test
2. Aggregate stability score -> Soil slaking test

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1. DROP & SHATTER TEST

The drop & shatter test is a useful method for determining the soil structure type and aggregate sizes in a soil horizon.

FIELD

- **Material:** Garden spade, firm big container (large bucket) and large transparent plastic bag/sheet to organize the aggregates.
- **Time needed:** 1 hour per sample (3x20min = Time for digging (depends on soil compaction), aggregates organization and scoring).
- **Procedure:**

1. At each sampling point, first remove the roots and plants above ground.
2. Dig and remove a 30x30x30cm cube of topsoil with the spade.
3. Drop the soil sample a maximum of three times from a height of one metre (waist height) onto the firm base of your container. If large clods break away after the first or second drop, drop them individually again once or twice. If a clod shatters into small units after the first or second drop, it does not need dropping again. Do not drop any piece of soil more than three times.
4. Transfer soil onto large plastic bag
5. Organize the aggregates by size: move the coarsest parts to one end and the finest to the other end to obtain a measure of the aggregate-size distribution.
6. Compare your distribution of aggregates with the three photographs below.

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RESULTS

Compare your aggregates size with the following photographs to give a score to your soil sample:

2 = GOOD **1 = MODERATE** **0 = POOR**

- Good condition (2): Good distribution of finer aggregates with no significant clodding.

- Moderate condition (1): Soil contains significant proportions of both coarse firm clods and friable, fine aggregates.

- Poor condition (0): Soil dominated by extremely coarse, very firm clods with very few finer aggregates.

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2. SOIL SLAKING TEST

The slake test is a simple way of assessing soil structure. Slaking indicates the stability of soil aggregates, resistance to erosion and suggests how well soil can maintain its structure to provide water and air for plants and soil organisms when it is rapidly wetted.

***Note:** the slaking test is not very effective in soils with a high content of clay.

FIELD

- **Material :** glass bottle/jar per sample, 1cm mesh, water
- **Time needed:** around 15 minutes per sample
- **Procedure:**
    1. Fill the jar(s) with water
    2. 'Hang' a piece of the mesh inside-/at the top of each jar (to prevent the soil sinking to the bottom directly)
    3. Take an air-dry soil aggregate (4-6 cm diameter) from each zone (if you have conducted the drop and shatter test, select three pea-sized aggregates of soil from each soil zone)
    4. Place different soil fragments in different meshes/jars
    5. Observe soil fragment for 10 minutes
    6. Take a photo for record

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RESULTS

Note: Soils with high SOM do not readily slake (fall apart) when wetted (left side).

The soil test on the right would be more likely to crust after a heavy rain.

Good (3) **Moderate (2)** **Poor (1)**

Give a score to your test after 10 minutes:

1= Complete slaking/poor condition (aggregate breaks down completely into grains)

2= Partial slaking/moderate condition (aggregate breaks but some remain intact on top)

3= No slaking/good condition (no change, water is clean)

Record your results in the table below:

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Site						
Date						
Slacking score						

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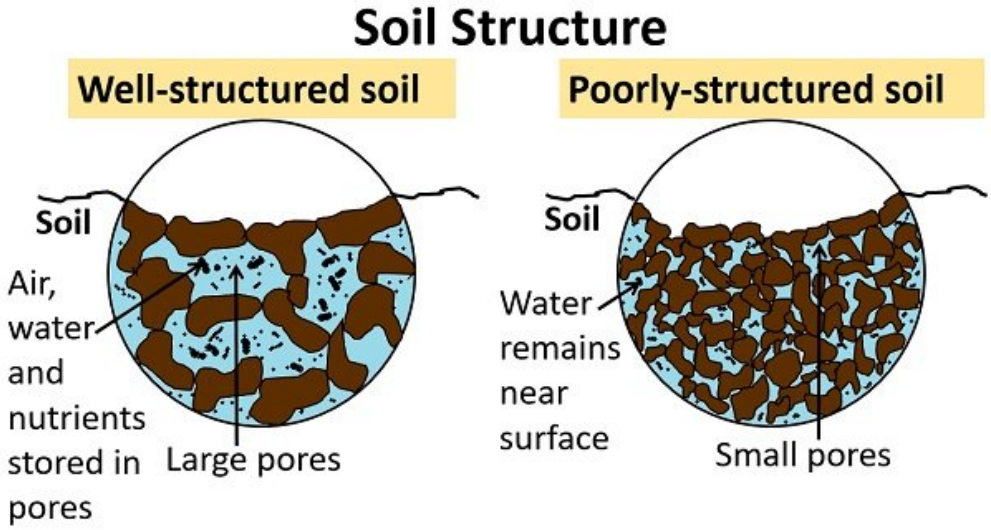
Limited slaking suggests that organic matter is present in soil to help bind soil particles and microaggregates into larger, stable aggregates.

INTERPRETATION OF THE TWO SOIL STRUCTURE TESTS



- Good structure means good air and water flow for soil ecosystem and plant roots.
- Good structure will hold water in dry weather, but will not become waterlogged in wet weather.
- Good soil structure allows roots to explore a larger volume of soil, giving plants access to more nutrients and water.
- In contrast, a “bad” structure means loss of nutrients from run-off, erosion and drainage.

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HOW TO IMPROVE SOIL STRUCTURE

Usually, you can improve soil structure by incorporating organic matter in your soils. If you are dealing with a 'shallow pan', planting root crops like potatoes may help. For deeper compaction issues, you could consider not doing anything or tilling once to loosen up the soil and subsequently adopting soil conservation practices and again, adding organic matter.

- ☐ **Add organic matter:** This can be in the form of compost of well-rotted manure. By adding organic matter the micro-organisms in the soil will thrive and breakdown the matter to form humus. On clay soils, humus will force tightly packed soil aggregates apart, this improves soil drainage and makes it easier for plant roots to penetrate. On sandy soils humus will loosely bind particles together. It will also act like a sponge and will slow drainage. In summary: increased nutrients increased micro-organisms increased humus and better soil structure.

- ☐ **Dealing with a pan:** If you have a pan (a hard, compacted layer running horizontally through your soil) it will prevent roots, nutrients and moisture reaching the deeper parts of your soil. If the pan is shallow (less than 25 cm) a crop of deeply planted potatoes will probably break it up. If you look after your soil properly, pans will not recur once dealt with.