Soil structure is a permanent feature unless soils are subjected to rapid erosion, deposition, or removal. Many of the physical and chemical properties of the soil depend on soil texture. Soil texture affects the movement and availability of air, nutrients and water in a soil and is often used to estimate other soil properties, particularly soil water properties, the potential infiltration, movement, and storage of soil water. Moreover, much of the reactivity of soils (acidity and buffering) is related to the amount of surface area available. As the average particle size decreases, the surface area per unit weight increases.

Soil structure affects plant growth by influencing root distribution and the ability to take up water and nutrients. Soil structure facilitates oxygen and water infiltration and can improve soil water storage.

Soil structure can be classified from class 1 to class 10 expressing from poor soil structure to optimal soil structure, respectively (see the below table).

<table>
<thead>
<tr>
<th>Class 1 – 2 (Poor structure)</th>
<th>Class 3 – 4 (Very moderate structure)</th>
<th>Class 5 – 6 (Moderate structure)</th>
<th>Class 7 – 8 (Good structure)</th>
<th>Class 9 – 10 (Optimal structure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large compact clods (50 – 100 mm)</td>
<td>Mainly firm large clods (20-50 mm) that are angular with smooth faces and no pore.</td>
<td>Few medium and large firm, rounded aggregates (5 – 30 mm).</td>
<td>Friable soil with many rounded aggregates (5 – 20 mm).</td>
<td>Porous loose soil with many rounded, unregular shaped aggregates (2-10 mm).</td>
</tr>
<tr>
<td>Few fine aggregates.</td>
<td>Clods are angular or plate-like with smooth sides and no pore.</td>
<td>Mostly finer aggregates (&lt; 2 mm).</td>
<td>Many fine rounded aggregaes (&lt; 2 mm).</td>
<td>Large aggregates have many holes for good aeration and drainage.</td>
</tr>
<tr>
<td>Clods are angular or plate-like with smooth sides and no pore.</td>
<td>Clods and overworked soil break into loose powdery soil.</td>
<td>Some powdery unaggregated soil.</td>
<td>Little or no powdery unaggregated soil.</td>
<td>Little or no powdery unaggregated soil.</td>
</tr>
<tr>
<td>Few fine aggregates.</td>
<td>Clods and overworked soil break into loose powdery soil.</td>
<td>Some powdery unaggregated soil.</td>
<td>Often have abundant very fine roots.</td>
<td>Often have abundant very fine roots.</td>
</tr>
</tbody>
</table>
The importance of soil structure

Soil structure has an important bearing on: permeability of the soil to water and air; root penetration and of seedling emergence; resistance to the erosive forces of water and wind. The structure of a soil is one of the most important factors in determining soil health and therefore the soil productivity. Soil structure will influence the drainage and water holding capacity of the soil as well as other crucial factors including the aeration available in the soil. Soil structure also has a big physical impact on plants by influencing root growth and penetration and aiding the flow of nutrients. Soil organisms including microbes and earthworms will also benefit from a good soil structure as oxygen is available while moisture is able to be held and movement through the soil is easier.

For production, good soil structure relies on the formation of small soil aggregates which do not break down when wetted, with good pore spaces between the aggregates. In the right conditions, soil particles will cluster together and become stabilized by organic matter, fungal hyphae and polysaccharides produced from root, fungi and bacterial exudates and organometallic complexes. In the wrong conditions, aggregates will not form, or will break apart when wetted, reforming into large, dense and impermeable clods with few pore spaces.

Therefore, soils with poor structure will probably be low in clay or organic matter and high in minerals, such as sodium, that reduce the ability of clay particles to bind together. Management practices that break down organic matter cause soil structural degradation. This is indicated by hard setting soil surfaces and crusting in tilled soil.

How to Enhance Soil Structure

It should be remembered that organic matter not only helps to hold soil particles together, but it also helps hold them apart, creating pore spaces. Add organic matter in the form of crop residues or green, compost manures. Because soil organic matter helps bind soil particles together in crumbs and also directly improves the moisture holding capacity of soil.

- Introduce pastured plants with deep roots to increase porosity and add organic material that helps bind soil particles together. In compacted or clay soils, spreading roots break up soil and create pathways through which water can seep deep within the subsoil. In dry, sandy or rocky soils, organic material helps hold soil together and increases water retention.
- Add lime - Calcium availability helps flocculation (binding aggregates through holding colloids, humus and clay particles, together). Calcium is important for good soil structure as this double charged cation has the effect of flocculating or drawing together soil particles to help form a nice crumbs structure in soil (bringing good drainage and soil aeration).
- Reduce stock loading to reduce the likelihood of compaction.
- Add a Microbial inoculant – an inoculant like EM will help build soil structure by stimulating the biological function in the soil. EM adds both fungus and bacteria to a soil and stimulates resident microbes to speed up the biological function of a soil to breakdown organic matter and build a stable soil structure.

Soil structure assessment at Eurofins AgroScience

Based on NIRS technique together with other conventional analysis methods and other properties such as soil texture, Eurofins AgroScience can assess the specific class of your soil structure in optimal-, good-, moderate-, very moderate- or poor structure as an example shown in the below figure (soil structure triangle). The assessment of soil structure is based on the Ca-CEC and Mg-CEC ratio to K-CEC, Na-CEC, H-CEC, Al-CEC… Of course, actual soil structure is also not merely depending on these ratios, but also on weather conditions, moisture condition of the soil, and the weight of the machinery applied for cultivation.

About Eurofins Agro

Eurofins Agro is a leading laboratory in the agricultural sector with nearly 100 years of experience. We provide innovative analyses, accurate and timely data and clear, case-specific advice, to help agricultural entrepreneurs to manage their production process. Our products and services are the result of everyday, practical knowledge supported by scientific research.

Eurofins Agro’s Vision and Mission

We help you to collect the right data, and provide insight into soil and crop health, fertilization, irrigation, feed value, and food safety. We give you greater insight with the prospect of profitable growth – growth that you can be proud of.