Soil Fact Sheet 4

Soil Aggregate Stability

Well aggregated (pedal) soil is important. It has pores *between* peds and *within* the ped. Large pores allow for the exchange of oxygen and other gases with the atmosphere, while small pores hold plant available water and dissolved nutrients. The stability of peds in water depends on several interacting parameters:

Soil texture - how much clay, silt or sand is present in any given soil. The more clay present in the soil, the more likely the soil is to form peds (clays carry an electric charge and can stick together or repel). However, the clay is also the part of the soil that disperses if ped stability is poor.

Clay mineralogy - the type of clay present in a soil. Different clays produce different types of peds and many need to be managed with care due to the susceptibility to disperse when wet.

Binding agents - iron and silica help to stick the clay particles together and prevent them from dispersing.

Organic matter - plays a very important role in bonding peds together (particularly freshly decaying organic matter) and improving pedal stability.

Sodium - can cause very poor pedal stability.

The mechanics of aggregate breakdown

When a fragment of soil is immersed in fresh water, there are four things that can happen:

1. It can remain unchanged
2. It can swell
3. It can fall apart into smaller fragments (it slakes)
4. It can disperse into a fine milky suspension

Figure 1.
An air bubble escaping from an air-dry aggregate submerged in water

Swelling causes the volume of the ped to increase, and is often followed by the soil slaking.

Slaking is when the air-dried ped breaks into smaller peds when immersed in water. This indicates that the peds are not strong enough to withstand the pressures involved in wetting. Some soils are strong enough to withstand this pressure, and increasing the organic matter content of the soil may increase pedal stability. Slaked soils can also disperse.

Dispersion is caused by breakdown of the clay ped into individual clay particles.

Poor aggregate stability can result in:

- Hardsetting soils
- Soil crusting impeding water movement and seedling emergence
- Limited water holding capacity
- Compaction due to structure collapse
- Waterlogging
- Erosion hazard increase

What can I do to improve aggregate stability?

Pedal stability is influenced by both soil properties, and the history of management. Improvement can therefore be achieved both by modifying soil properties, and by increasing the utilisation and incorporation of organic matter.

Figure 2.
A crusted soil surface resulting from the dispersed clay forming a layer of clay particles (left), and a dense surface soil resulting from a decrease in large pore spaces in poorly aggregated soil (right).

Retain crop stubble – this can help to protect the soil surface from the impact of rain drops and can improve soil structure by increasing organic matter. The roots of stubble also help to create cavities in the soil for macrofauna to live in and provides a food source for soil biota. Shade is also provided by stubble, creating a better environment for soil biota.

Limit vehicle traffic – controlled traffic and the removal or limitation of livestock from wet paddocks helps prevent soil degradation.

Apply gypsum – if your soil is sodic then applications of gypsum can help to correct the imbalance of exchangeable sodium. Seek advice on applying gypsum before you proceed, particular relating to sodicity at depth.

Green manure or compost – will increase organic matter content and help to bond peds together.

Raised beds – in areas where waterlogging is a problem, raised beds can alleviate pressures on soil structure by draining excess water away.

Direct drill or minimum tillage – will prevent degradation of the soil and thereby encourage better pedal stability. Less mechanical pressure placed on the soil will allow the 'natural' stability of the soils peds to develop.

Reference

Baxter NM & Williamson J (2001) Know Yours Soils – Assessing Yours Soils (Part 2). Department of Primary Industries, Bendigo Victoria. ISBN: 0 7311 4557

Further Information

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