Soil Health

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Focus Areas

- Soil Biology
- Soil Chemistry
- Soil Physical
- Visual Soil Assessment

What is Soil Health?

Organic Matter
Biology
Soil Structure
Nutrients & Nutrient Balance
Lack of Stones
Eco System
Water
Oxygen/Air
Sustainability
Suitability

Soil quality / soil health – they are the same thing. Is not a new concept.

Suitability is probably a more appropriate term. Is what you are wanting to do on your soil type, suitable for that soil type. Can you create the right suitability with the appropriate mix of chemical, physical, and biological properties.

Past management of soils has the biggest impact on soil degradation. Market gardens are the hardest industry on soils due to the frequent disturbance of soil.

Chemical Properties: often the easiest to fix such as lifting pH, Olsen P etc.

Physical Properties: more difficult to fix. Soil types naturally prone to compaction may not respond to remediation. Stony soils are impossible to change.

Biological Properties: the most difficult to measure. Earthworms are a good measure but their abundance and activity vary over time, and they are better indicators in pasture soils compared with cropping soils – time of day & time of year can influence how many worms you might find.

Improving your organic matter will in turn take care of soil biology, and the most effective means of sustaining and increasing organic matter in soil is through growing plants.

Two essential nutrients that determine productivity

- Nitrogen (N)
- Phosphorus (P)

95% of N in the soil is Organic Matter (OM) and is tied to carbon in organic matter, as is half of the P.

Plants can only take up N as nitrate and ammonium from the soil solution, which means that N attached to carbon/organic matter is not plant-available. Plants release soluble carbon (mainly sugars) from their roots every day which encourages bacteria and fungi to grow – these organisms then breakdown organic matter to release N for their own needs. Predators such as nematodes then consume/graze bacteria and fungi, which releases N and other nutrients into the soil next to roots for uptake – see attached.

A good grazed and irrigated dairy system should have fairly good soil health although this does not mean you won't have issues.

Organic Matter is the key to the system: We have lost 40% of our soil carbon stores dues to soil disturbance. Leaving soils and the organic matter on them to decompose is the best way to store carbon and therefore nutrients for our plants to continue growing.

Green Manure or Cover Crops are great for increasing OM. Both of these crop options are generally made up of N rich fixing plants and they are put back into the soil before they reach maturity. Not harvested or grazed.

Most Canterbury soils, especially the light stony soils which cover most of the plains, will have a carbon limit of around 4-4.5% carbon = 7-8% organic matter.

Nutrients

pH: The optimum range is 5.8-6.0 for a Ryegrass White Clover pasture.
If re-grassing, aim for a pH of 6.1 will be beneficial.
Above pH 6.5 you start running into other important trace element issues, especially Copper.
There is no benefit in aiming for a pH of 6.5 in a pastoral system. Different crops will require different pH ranges, example for lucerne pH 6.2-6.4, check the pH optimum for the crop before applying lime.

Fungi & Bacteria.

An acidic soil will attract/produce more fungi. These soils dominate in forest areas due to the low pH and nature of organic matter in the system. It is hard to breakdown but fungi can do this job. Bacteria thrive one easily decomposed organic matter and dominate in grassland systems. In cropping system the change from conventional tillage to minimum or no-till results in an overall increase in soil biological activity and an increase in the proportion of fungi to bacteria due to increased retention of hard-to-digest stubble material.

Often the fungi and bacteria are there – they just don't have the right food source to do their job. Understand what they need. Feed your underground mouths.

Increasing root mass will increase bacteria activity. There is a huge amount of biomass (bacteria, fungi, nematodes, protozoa, hyphae, worms etc) in the top 15cm of the soil profile.

How to improve/reduce compaction:
Appropriate management
- Identify more vulnerable soil types on farm

Management practices to suit soils and critical times
- Avoid soil structural damage

Corrective actions
- Aeration & cultivation.
- Winter crops - longer spells on some areas
- Arable crops – sow restorative crops
- Strong root systems and earth worms help but won't necessarily fix.
- What is causing your compaction – livestock, can you remove them for a period. Is it your soil type & it is just naturally prone to compaction.
- Time

Understanding Nutrient Requirements

pH: Aim for 5.8-6 for pastoral systems (can aim slighter higher when regressing pH 6.1)

Olsen P: Optimum range comes back to the blocks/farm production. Normally between 20 & 30 is adequate. However, a high performing dairy farm optimum range is 30-35. It comes down to what the soil/plant demand is to what you need to put back in.

Potassium: Cropping, the optimum range is 5-8 (MAF) is ok.
For a pastoral dairy system this is 6-9.
TBK Test – Total Bound Potassium indicates the total bound K in your soils that it is not plant available. Your Quick Test K is what is available.

Sulphur: generally levels in NZ are poor, that is why regular annual application is recommended.

Magnesium: This is important for plant and animal health. Plants optimum range is between 8-10 (MAF units) but for lactating animal (cows/ewes) the optimum range is between 25-30 (MAF units). Increasing your soil Mg will benefit livestock.

Calcium: You want this to sit between 6-10. Can be fixed with Lime or Dolomite (fine lime is of no specific benefit over regular lime).

Start out by fixing your most deficient nutrient.

Ballance have a Soil Health Check Test (an additional $60 to your normal soil test and can be done at the same time) that looks further into:

Total Carbon
Total Nitrogen
C:N Ratio – agricultural soil stabilises at about 8-12
Organic Matter
Anaerobically Mineralisable Nitrogen (AMN) – Used as a proxy for measuring the health of the soil biological activity
Hot Water Extractable Carbon (HWEC) - Similar to AMN

A nutrient is only plant available when it is in the root zone.

Know what is economical: what returns will you get from the investment you make in the fertiliser.