

# Soil is like a Jar of Jellybeans

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Understanding how soil works isn't so hard – it's just like a jar full of Jellybeans! Just as a Jar can hold just so many Jellybeans and no more, each soil has its own particular capacity for holding certain elements.

In soil, positively charged elements are held by negatively charged particles of clay and organic matter (collectively termed “colloids”). The extent to which a soil can do this is called its Cation Exchange Capacity (CEC). Since the amount of clay and organic matter is unlikely to change much over time, the CEC should be a relatively constant characteristic of any particular soil.



*Like soil, every jellybean jar is different in size and the assortment of jellybeans it contains.*

So the size of the jar does not change, but the assortment of colours it contains can.

The different colours of jellybeans in the jar represent different elements in the soil. Here we will be looking at the main positively charged elements that occupy available “exchange sites” on colloids in the soil. This means that we only need to have five colours in the jellybean jar – Red (Calcium), Blue (Magnesium), Green (Sodium), Yellow (Potassium) and Black (Hydrogen).

Also, since we are interested in getting a good assortment of jellybeans we will be less interested in the numbers of each colour in the jar, as the relative proportions of all the colours.

There are two other characteristics of our Jellybean jar that we need to be aware of. Firstly, it is important to realise that we have an “Exchange Jar”. That is, if you take a Jellybean out you must put another one back – in Exchange! Because of this we also need to remember that ***The Jar Must Always be Full!***

## Why are Cation proportions so important?

The Jellybeans in our Jar represent the five important elements – Calcium, Magnesium, Sodium, Potassium and Hydrogen. Four of these are plant nutrients, but we must not be distracted by plant nutrition. We are interested in their impact on the physical attributes of the soil – NOT plant nutrition. In other words: Is the soil crumbly and friable? Does it hold plenty of moisture? Is it hard when dry or sloppy when wet?

These things are important for farm productivity, but are not directly related to plant nutrition. Still, many people can be heard saying things like: “If your Magnesium is too high you will have a Calcium deficiency”. In fact, if your Calcium-Magnesium ratio falls below 2:1 your soil will set hard as a rock!

This is where the notion of “Soil Balance” comes in. If our jar were to represent a well-balanced soil, the Jellybean proportions would be 65-70% Red (Ca), 12-15% Blue (Mg), 0.5-5% Green (Na), 3-5% Yellow (K), and <20% Black (H). But within these ranges, the Ca:Mg ratio would also be between 2:1 and 4:1.

An important point to note here is that Balance in soil is not a precise set of proportions; there is a range of percentages within which the soil will have the physical properties we are seeking.

### What do all these Black Jellybeans do?

In relating our Jellybean Jar to the way soil works, the Black ones are the key to the process. In short, they are the ones that keep the jar full.

It must be emphasised that we are working with an “Exchangeable” system. So you can take as many Jellybeans as you like, but you must replace each one you take out with another – IN EXCHANGE!

Processes in the soil can lead to the gradual accumulation of Hydrogen. If we were to test soils over many years – but ignore the Hydrogen – it would seem that our Jar-full of Jellybeans was getting smaller, when in fact it was being progressively filled with Black ones. This is particularly relevant to Australian soils.



*Over time, many soils will tend to accumulate Hydrogen at the expense of other elements (similar to the jellybean jars above). But if we were to ignore the Hydrogen, it might appear that the jars were actually getting smaller (below).*



Many Australian soils are old and have lost a lot of their cations (coloured Jellybeans) – but remember the Jar is Always Full! Instead of the jar shrinking over time, Black jellybeans have replaced the coloured ones.

### What can be done about these changes?

Fortunately, the exchange system works both ways, to get the proportions of our Jellybeans right all we need to do is find someone who loves Black Jellybeans and make sure they have the right number of each colour to exchange for Black ones, so that they end up leaving the proportions of all the colours where we want them.

In soil, we do this mainly by applying Lime (Calcium Carbonate) &/or Dolomite (a mixture of Calcium & Magnesium Carbonates). Carbonate is the ‘Lover of Black Jellybeans’ (Hydrogen) and in taking these out of the system Calcium or Magnesium is left behind – in exchange.



*Managing soil structure and function is a bit like changing the assortment of jellybeans in a jar: Find someone who loves Black jellybeans and make sure they put back as many coloured jellybeans as the black ones they take out.*

### **What happens if the Cation Proportions are not balanced?**

Many of our so-called “Troublesome soils” can be shown to be suffering from a Cation Balance problem and (more importantly) will be responsive to appropriate corrective measures. Problems of this kind include:

- Hard setting soils
- Soils forming a surface crust after wetting or with poor moisture infiltration
- Soils that become either soft and sloppy, or sticky and ‘porridge-like’ when wet
- Soils that are especially prone to compaction
- Soils that are easily damaged by cultivation

Often we try in vein either to bash these soils into shape with heavy equipment, or apply a treatment that seems to work, but overuse it until we create a whole set of new problems. The bottom line is that you cannot manage what you cannot measure and you cannot fix a problem if you don’t understand what is going on in your soil.

But with the right information, fixing the problem is as simple as getting the right coloured Jellybeans back in the jar!

*If you have any questions about soil balance or would like a Free sampling kit, please call SWEPP Laboratories on (03) 9701 6007.*