

## **The essentials of good soil and what you need to remedy problems.**

By JERRY COLEBY-WILLIAMS RHS, Dip. Hort. (Kew), NEBSM, MAIH

Soil is a limited natural resource. You can improve it, you can modify it, you can move it around – and you can lose it. What you can't do is make it. Only nature can do that. Sustainable cultivation and soil improvement is vital to our gardens, and it's important to see soil as a living part of a system, not just the dirt that stops your crops from falling over!

What gardeners are aiming for is well composted soils that are carbon-rich, which makes them 'strong'. This means in part that the soil retains moisture well and buffers crops against fluctuating moisture levels. They soak up heavy, persistent rain and retain minerals yet drain efficiently, reducing flooding and crop losses.

### **Dealing with extremes**

Ultimately though, most gardeners do not have perfect soil, certainly not to start with. The two extremes gardeners must battle are sand and clay. A gardening friend on Queensland's Sunshine Coast had dune sand that poured between her fingers. Unfortunate for vegetable growing! Five years of organic stewardship – by adding lots of organic matter – transformed it into fertile, crumbly soil.

In contrast, I grew up gardening on heavy clay in London, but even I was surprised when I moved to Brisbane where my clay soil broke a hired rotary hoe! It took five years of remedial organic gardening before I became proud of my soil (see [organicgardener.com.au](http://organicgardener.com.au) for details of how I did this).

To find out where your soil sits on the clay–sand spectrum, moisten some and mould it into a ball. If it won't hold together, you've probably got sand or a sandy/silty mix. If it forms a ball easily, your soil is clay or a loamy/clay mix.

To improve clay soils, you need to add lots of organic matter on a regular basis in the form of compost and well-aged manures. This helps to change the soil structure from big hard clods to smaller aggregates which create air spaces for water to enter and drain away more freely. Working natural gypsum into the soil can have a similar effect, but only on certain clay types. Conduct a simple test. Drop a small 5mm aggregate of soil into a glass of water and leave it sit still for 24hrs. Watch it carefully. If it disperses slowly into the water, it will respond positively to gypsum. If it does nothing, then gypsum will have no effect.

A regular application of organic matter is the key to improving sandy soil too. Some sandy soils are known to become hydrophobic from time to time, which means they repel water, so it pays to use an organic humus-based wetting agent occasionally to maintain the 'wettability'.

### **Soil testing**

If your soil has mineral deficiencies, this influences crop health and its nutritional value. Compost made from mineral-deficient plants recycles deficiencies. The more reliant you are on home grown food, the more valuable laboratory soil testing becomes. The results guide soil improvement work and may save time, effort and resources.

Testing can also identify contaminants that may limit your range of crops. Residues from termite treatments or heavy metals like lead tend to accumulate in root crops. The National Measurement Institute can discuss which tests, if any, might be appropriate for your garden.

Soil tests can be done at government and commercial laboratories with costs ranging from \$50 to \$500 depending on how much detail you want and the lab. Here is a selected list of laboratories. For more options, look online or in the Yellow Pages under 'Soil Testing and Investigation'.

### **pH – the holy grail**

The gardener's 'holy grail' is soil that is slightly acidic to neutral (pH 6.5 - 7). In these conditions the majority of beneficial minerals become chemically available so that plants can use them. In more extreme conditions valuable minerals may be present but not available to plants or, like manganese, become too available and harmful.

Testing is quick and simple. All you need is a test kit (available at garden centres) and a level teaspoonful of your soil per test. Expect results to vary between different parts of the garden, so use multiple tests to build an overall picture. The best time to test is in autumn after crops have been cleared – it's also a convenient time to condition soil.

Note that soil pH is a measure of the hydrogen ion activity, and is recorded on a scale ranging from 0 (extremely acidic) to 14 (extremely alkaline) and 7 is neutral. It is important to follow a manufacturer's recommended rate of application for concentrated soil conditioners, like iron sulphate, because this scale is logarithmic. So soil with a pH of 4 is 10 times more acidic than a pH 5 soil, and 1,000 (one thousand) times more acidic than a neutral, or pH 7 soil.

## **Soil conditioners**

Once you've established what condition your soil is in and its nutrient content, you can go about improving it. Here are some general notes you can use, along with the soil improvement table.

Most Australian soils are acidic. Adding garden lime or dolomite counteracts this acidity or 'sweetens' the soil. Both contain calcium, a mineral underestimated for its contribution to plant health and vitality. Dolomite also contains magnesium, a mineral plants use to photosynthesise. Lime is cheap, and magnesium readily leached from soil, so I recommend gardeners use both, mixing them in equal proportions before application. South Australian gardens are known for their alkaline soils, a condition neutralised by raking in powdered sulphur. This mineral is slow acting, and one application may last three or more years. For quick effect, gardeners water in iron sulphate which lasts for around one season.

Gypsum has no effect on soil pH, instead it breaks up thick clay into smaller, 'crumbly' particles. It's also essential for making saline (sodic) soils suitable for cropping. The only drawback is that gypsum makes clays found in acid-sulphate soils more gluey. Soils with this potential are found all around coastal Australia, including Tasmania. Contact your local department of primary industry to find out if your region is affected.

## **Animal Manures**

In the paddock, dung beetles recycle droppings, burying them to feed their larvae. Horse, pig and poultry manures are classed as 'hot' manures. They contain lots of nitrogen which fuels thermophilic bacteria into a feeding frenzy, and this generates sufficient heat to destroy weed seeds.

Poultry manure is probably the most concentrated fertiliser organic gardeners use. It's useful for hungry crops, like corn, taro, and especially banana, providing a wider range of essential minerals than any so-called 'complete' artificial fertilisers.

'Cool' manures, like sheep, cow and goat; contain relatively small amounts of minerals, so they're generally classed as soil conditioners. They are still biologically active, especially if they contain nitrogen-rich urine soaked bedding materials, like straw. It's wise to harness the nitrogen component of fresh manures through composting; otherwise it may be wasted as ammonia gas, which can harm plants.

## **Things to avoid**

Avoid concentrated chemicals like superphosphate, sulphate of potash, muriate of potash, and urea. Concentrates injure earthworms and are not permitted in certified organic systems. Organic soils better resist erosion and they don't leach nutrients so creeks, wetlands and coral reefs are spared pollution, which makes any food you grow taste even better!

## **[DID YOU KNOW?]**

Legume green manures

It's popular misconception that simply growing legumes, such as lentil, fenugreek, soy, or broad bean adds nitrogen to soil. Nitrogen fixing bacteria live in 'nodules', small swellings on roots, where they convert atmospheric nitrogen into nitrates. Only when a green manure is dug in and the nodules rot are nitrates released for plant use.

## **POSSIBLE EYECATCHER**

If your soil has mineral deficiencies, this influences crop health and its nutritional value to humans and livestock.

## **J1 CAN GO ANYWHERE**

Jerry always has a selection of soil and nutrient improvers to hand: poultry manure, dolomite and lime mix, iron sulphate, seaweed solution, trace elements.

JERRY COLEBY-WILLIAMS RHS, Dip. Hort. (Kew), NEBSM, MAIH;  
Director, Seed Savers' Network;  
Patron of Householders' Options to Protect the Environment (HOPE) Inc. and  
Co-founder of Bellis, Brisbane's award-winning sustainable house and garden.  
This article first appeared in 'The Organic Gardener' magazine.