

The importance of soil

Soil is the most important element in a water efficient garden. Soil supports plants physically and provides them with water and nutrients. It acts as a reservoir, holding water in pore spaces where it is extracted by plant roots. Canberra soils can be very clayey, subject to compaction and drying out, and can be very difficult to cultivate effectively. By using appropriate methods you can minimise these effects.

SOILS AIN'T SOILS

Your soil type and condition will determine:

- how much water can be held in the reservoir;
- how long it can retain water at the root zone;
- how fast water can be absorbed when you irrigate; and
- how much water you need to give your plants in addition to rainfall.

Canberra soil conditions can vary dramatically between locations and even within a garden. Get to know your soil and its water holding ability by digging gently around the root zone before and after irrigating. Do this a few times and you will get a clearer picture of whether your garden needs watering and if you are applying the right amount of water.

Water will be wasted on compacted soil and soil low in organic matter because it runs off the soil surface or drains below the plant root zone.

The two most important steps you can take to ensure you provide just enough water for your plants to stay healthy are to:

- understand your soil type, structure and depth; and

- improve your soil so that water infiltrates into and is held in the root zone.

SOIL TYPES

Soil is made up of three main components:

- mineral particles;
- organic matter; and
- air spaces.

The most coarse soil particles are sand. Clay particles are the finest, and silt is intermediate in size. The classification of soil into three main textural types – sand, loam and clay – refers to the relative content of these particles. Often soil is a mixture of different mineral particles. In Canberra the majority of soils are clay based, with varying amounts of sand and small pebbles. This variation can affect water penetration. Canberra soils are often compacted and can be subject to extremes of temperature, which dry out the clay. Dry clay soils repel water, reduce water penetration, do not allow plant roots to absorb soil water and make watering ineffective.

To create a good gardening soil from Canberra's naturally-occurring soil, you generally need to improve the soil condition and introduce organic matter. This often means changing the clay based soil to a more free draining clay loam.

SOIL STRUCTURE

Soil structure describes the arrangement of the particles and the pore space between them. Individual particles cluster into aggregates or crumbs that are held together by humus or decomposed organic matter.

You can test your soil structure using a spade. Carefully push your spade into the soil using a



moderate degree of effort. If your spade penetrates to around 100-200 mm your soil has good structure. Penetration to around 50-100 mm means your soil is slightly compacted or desiccated and has an average structure, and less than 50 mm means that the soil is compacted and has a poor structure.

Poorly structured soil has no aggregates. In the Canberra heavy clay soils, particles are joined together into a dense mass or hard clod, with few pore spaces. These soils form a crust when they dry. In the extremes of the Canberra climate this can result in a deeply compacted and dry soil with very little water penetration. Plants will struggle to thrive as their water needs will not be satisfied and roots will have difficulty penetrating.

An average soil structure will hold together slightly, but the aggregates will break apart when disturbed by digging, wind or water. Plants will survive, but will not thrive.

A well structured soil will look crumbly with clearly identifiable aggregates or crumbs that do not break apart during digging. These aggregates increase the number of large pores in the soil, allowing air and water to move freely through the soil. Plant roots can easily spread to access water and nutrients and your garden will thrive.

IMPROVING YOUR SOIL

The key to saving water is to ensure you have enough topsoil, at least 250 mm, with a good structure (regularly aerated) and texture (ideally sandy loam or loam).

You can improve poorly structured soil by using both physical means such as digging, aerating or ripping and also by incorporating decomposed organic matter.

In a typical Canberra clay soil, physical disturbance using digging, aeration or ripping breaks soil crusts and allows water to penetrate to depth. Adding organic materials such as humus to the soil binds the particles together into crumbs, opening the structure, allowing water to infiltrate and to drain more freely. Decomposed organic matter also adds nutrients to the soil. It is best to use organic matter that has been composted to ensure it contains no toxins or diseases. Avoid uncomposted woody materials.

Potential soil improvers include:

Compost and/or worm castings – fine compost particles are especially good for sticking to fine sand particles; coarse compost is good for clay soils.

Aged animal manure – especially cow manure or chicken manure pellets.

Coir or cocopeat – a relatively new product made from compressed coconut fibre that comes in bricks or blocks that you re-hydrate. It absorbs about 10 times its volume in water and has excellent water holding capacity as a soil additive.

Mushroom compost – use sparingly. It can be quite alkaline and is not good for acid-loving and native plants.

Composted bark or horticultural grade bark – usually only available from landscape suppliers.

Grass clippings and leaf mould – ensure they are thoroughly mixed into the soil.

Make sure your soil is aerated to at least 250 mm deep. Depending on your garden or lawn area, manual forking may be sufficient to decompact or aerate your soil. Large areas may require specific machinery.

DO AND DON'T TIPS

- **Do** dig the decomposed organic matter through your topsoil before planting.
- **Do** apply organic matter regularly, as it breaks down, especially in sandy soil. You need to be persistent – it may take several years to improve a poorly structured soil.
- **Don't** dig clay or clay loam soil when it is wet – you'll only add to the compaction.

WILL GYPSUM HELP?

Adding gypsum (calcium sulphate) is often recommended to improve poorly structured clay soil, but it doesn't work on all clay soil—only on what is called 'sodic' clay soil.

Before you spend your money on gypsum, seek expert advice or try this quick test. Take a 5mm clump of soil and place it in a jar of rainwater or deionised water. Don't disturb the jar for 24 hours. If the aggregate remains unchanged or falls apart into smaller aggregates that remain where they are, gypsum won't help your soil.

If the clump has dispersed after 24 hours, producing a general cloudiness in the water, gypsum will improve the soil. In this case, apply 1-2 kg per square metre and dig or water it in.

SOIL DEPTH

Soil depth is the distance you can easily dig down before you hit an impenetrable layer such as hard clay or rock. The deeper the soil (and the better its texture and structure), the more water it can hold, and the less you need to water.

The top layer is usually composed of organic matter. While some plants can be very deep-rooted, the majority of garden plants have fine feeder roots about 300 mm deep. So a water efficient garden should have good quality soil to at least 250 mm depth.

In Canberra this can be done using several methods, with varying degrees of effort depending on the condition of your soil. First check your soil and then consider using some of the methods detailed in the section on improving your soil.

When making new garden beds, combine the new soil with some subsoil of a different texture to avoid placing topsoil over a compacted layer of clay or rock. This will prevent roots hitting a water well, sitting on the impenetrable layer and becoming waterlogged.

Another method is to mound imported soil on top of the original soil to create free draining and nutrient rich garden beds. Use a good quality garden mix appropriate to your plant choice. Be sure to aerate and disturb the soil that will be beneath your mounds to ensure that waterlogging does not occur. Make your mounds between 200 and 300 mm deep.

When cultivating the soil, loosen any compacted subsoil, but do not bring clay subsoil to the surface by digging too deeply.

Soil should be watered deeply and infrequently. Frequent light watering encourages more root growth nearer the soil surface that dries out quicker. The aim of deep watering is to fill the 250 mm 'reservoir', making water available at the root zone and encouraging roots to go deeper. High water use plants such as vegetables, ferns and shallow rooted annuals need more frequent watering.

WATER REPELLENT SOILS

If your soil is hydrophobic, water will not enter the soil or be available for your plants. The water will puddle on the surface and evaporate, drop straight through leaving the soil dry, or you'll see the water stay in beads and then run off without sinking in. Apply a wetting agent or surfactant to the soil to reduce the surface tension of the water and help it penetrate the soil.

Soil wetters are also useful for potted plants when the potting mix has become hydrophobic and you see the water you apply pour down the inside of the pot and out the drainage holes.

Soil wetters come in granular form that you sprinkle on the surface of the soil and lightly dig through. You can also buy liquid wetting agents. Hose-on liquid applicators are good for turf areas where water is running off the grass rather than penetrating the soil. If you apply a liquid wetting agent using a watering can, first put the water in, then add the recommended amount of wetting agent and stir well. If you put the liquid wetting agent in first, it will produce suds that froth everywhere. Liquid soil wetters are detergent based, so they will degrade and need to be applied regularly.

WATER CRYSTALS

Many people confuse soil wetters with water crystals. Water crystals are synthetic plastic materials that swell into a jelly-like substance when they absorb water.

Only use hydrated crystals as a slurry in the planting hole around the roots of new plantings. Do not sprinkle dry crystals on the surface of soil or potting mix. If you do, they will swell up and absorb water that they remove from the soil. It is also best to avoid using water crystals when planting native species.

MORE INFORMATION

For more information on water efficiency tools rebates and *Think water, act water* initiatives:

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