

## ABSORBENT SOILS MUST HAVE THE FOLLOWING CHARACTERISTICS

### GOOD TEXTURE & STRUCTURE

Why	What hinders this?	What you can do
<ul style="list-style-type: none"> <li>• For sufficient water absorption</li> <li>• To aid movement of water, oxygen, plant roots, animals micro-organisms</li> </ul>	<ul style="list-style-type: none"> <li>• Compacted soils</li> <li>• Low humus content</li> <li>• Dead soils with no or little biological life that help build soil structure</li> <li>• Soils bare of plant and/ or mulch cover makes soils vulnerable to erosion and temperature extremes</li> </ul>	<ul style="list-style-type: none"> <li>• Texture is difficult to change; work with what you have</li> <li>• Top-dress with a layer of organic mulch</li> <li>• Prevent compaction – soften impact with mulch &amp; reduce machine use. Keep off soils in beds, and never walk on wet soils. If you need to weed or prune lay down a plank to spread your weight across the ground</li> <li>• Throw away pesticides &amp; chemical fertilisers</li> <li>• Don't dig!</li> </ul>

### BIOLOGICAL LIFE

Why	What hinders this?	What you can do
<ul style="list-style-type: none"> <li>• Break down animal and plant detritus into organic matter</li> <li>• Cycle nutrients by converting minerals into a form absorbed by plants</li> <li>• Connect with plants to aid water and nutrient absorption</li> <li>• Hold nutrients so prevents their leaching from soils</li> <li>• Help control pathogens, diseases and plant pests</li> <li>• Plants associated with mycorrhizae are more drought-tolerant and disease resistant</li> <li>• Build soil structure which aids movement of water and oxygen, animals and plant roots</li> <li>• Remove carbon from the atmosphere holding it in the soil</li> </ul>	<ul style="list-style-type: none"> <li>• Compacted soils</li> <li>• Reduced oxygen reduces beneficial bacteria and increases harmful bacteria</li> <li>• Over-use of pesticides and chemical fertilisers</li> <li>• Frequent digging or tilling of the soil that kills beneficial bacteria and fungi</li> <li>• Lack of organic matter that provides habitat and food</li> <li>• Bare soils affected by temperature extremes and compaction</li> </ul>	<ul style="list-style-type: none"> <li>• Stop using pesticides and chemical fertilisers.</li> <li>• Don't till the soil as it destroys this frail, filament network.</li> <li>• Fungi: add woody pruning's, sawdust, shredded paper, and brown, dormant or dead plant material in the mulch and compost as food for the fungi</li> <li>• Bacteria need nitrogen so add green grass clippings, fruits, vegetable skins</li> <li>• Animals: provide them with habitat and food; leaves, twigs, old plant matter</li> </ul>

<b>ORGANIC MATTER</b>		
<b>Why</b>	<b>What hinders this?</b>	<b>What you can do</b>
<ul style="list-style-type: none"> <li>• Improves soil structure and texture</li> <li>• Absorbs, holds and releases water</li> <li>• Provides habitat and food for micro and macro organisms, bacteria and fungi</li> <li>• Provide plant nutrients</li> </ul>	<ul style="list-style-type: none"> <li>• Compacted soils that reduce living organisms</li> <li>• Removal of plant material</li> <li>• No mulch layer to be worked into the soil profile</li> <li>• No biological life to break down plant and animal matter that build humus</li> </ul>	<ul style="list-style-type: none"> <li>• Top-dress with a thick mulch layer to retain moisture and encourage microbes and animal activity</li> <li>• Prevent soil compaction</li> </ul>
<b>EFFECTIVE GROUND COVER</b>		
<b>Why</b>	<b>What hinders this?</b>	<b>What you can do</b>
<ul style="list-style-type: none"> <li>• Covered soil retains moisture, is effectively insulated against temperature extremes, reduces evaporation and wind and water erosion, intercepts raindrops that cause soil compaction</li> <li>• plants help to build soil structure and feed many organisms</li> <li>• Enables water to percolate and recharge groundwater systems, slows water movement giving it time to soak in</li> <li>• Provides animal habitat</li> </ul>	<ul style="list-style-type: none"> <li>• Large expanses of solid and impermeable surfaces</li> <li>• No mulch turns soil into brick</li> </ul> <p><i>The following prevent healthy plant growth:</i></p> <ul style="list-style-type: none"> <li>• Soils with little or no humus</li> <li>• Poor water absorption</li> <li>• Poor air &amp; water movement &amp; nutrient recycling</li> <li>• Lack of beneficial organisms</li> <li>• Compacted soils that prevent root movement and beneficial fungi associations to form</li> </ul>	<ul style="list-style-type: none"> <li>• Prevent compaction</li> <li>• Top-dress with a thick mulch layer</li> <li>• Don't use pesticides</li> <li>• Reduce large areas of impervious surfaces</li> <li>• Don't dig</li> <li>• Improve conditions to encourage healthy populations of bacteria and fungi</li> </ul>

*Digging Deeper – scroll to read further*

## DIGGING DEEPER:

### Good texture and structure:

These are critical to optimal water and air (oxygen) movement through the profile which in turn improve plant health and populations of soil bacteria, microbes and fungi and animals critical to healthy soil structure and texture. Roots can grow strong and as deep as necessary, efficient nutrient cycling aids plant health, and soils can handle temperature changes well.

**Soil texture:** is determined by particle size which categorizes it as clay, silt and sand. The ratio between sand, silt and clay is critical and gives soil its characteristics like drainage. To improve drainage capacity of clay soils, for example, gardeners are often encouraged to add sand. Yet, to take on the characteristics of sandy soil, i.e. freely draining, you'd have to change its proportions so that the clay soil now contains at least 50 % sand by volume. For most gardens, this would require far too much sand to make it a feasible and affordable exercise. Rather work with what you have.

**Soil structure:** The percentages of clay, silt and sand determine its structure, and this is easier to influence than texture. One of the least invasive and most cost-effective ways to improve the structure is to top-dress with a layer of organic mulch. A sufficiently deep layer aids the soil in retaining moisture, reduces the impact that would cause compaction, and provides habitat for bacteria, fungi and soil-living organisms.

Strong root growth and a healthy community of soil organisms create the spaces and channels typical of a good soil structure. Plus, they add organic matter to the soil when they die. Ensure you provide the right conditions for a living ecosystem – spread mulch, throw away the pesticides and chemical fertilisers, and, don't dig!

### Compacted soils:

Vehicles, machinery, even heavy foot traffic push heavily on the soils, breaking it down by collapsing the pores between soil particles and aggregates that are so crucial to the movement of water and air, and animals. Hard soils act like a brick and water flows across and off rather than soaking in. Plants that develop shallow roots or misshapen roots, as a result, are susceptible to damage in high winds, drought and overly wet conditions. Prevent soil compaction: don't walk on wet soils. If you need to weed or prune lay down a plank to spread your weight across the ground. Keep heavy machinery off as much ground as possible. Cover soils with a thick mulch layer to retain moisture and encourage microbes.

Don't till the soil; the ages-old practice of loosening the soil and turning it over interferes with life below ground, destroying important fungi in the process. Only dig holes when establishing plants. The mulch layer and organic matter keeps soil loose and friable without the need to dig.

### Organic matter:

Organic matter helps to build texture and structure, and the continued removal of plant biomass strips soils of nutrients and humus. For areas already severely compacted, dig it in. Where the structure is adequate, spread a thick layer as a top-dressing. Soil organisms will gradually move it deeper into the soil without damaging the structure. Allowing old leaves to die off and remain on the soil surface improves structure over the years. A thick mulch layer encourages animals above and below ground to dig, turn over the soil, and scratch around in it. This activity improves water and air movement, creating the right conditions for beneficial bacteria. And the mulch layer provides them with food.

## Lack of biological activity:

Soils without living organisms, bacteria and fungi can form a hydrophobic surface layer that prevents water penetration. Lack of organic matter and compacted soils kill off populations of beneficial bacteria. Stop using pesticides and chemical fertilisers. A healthy biological soil community provides sufficient amounts of plant nutrients year round – and in such a way that allows plants to take just what they need when they need it.

**Fungi:** Break down organic matter too tough for other decomposers to work on – wood, sawdust, paper, straw. They improve soil structure by binding soil particles into larger aggregates thus improving water and air circulation. Importantly for current high carbon levels, fungi take carbon from the atmosphere and store it in the soil. Many fungi feed on garden pests, so are valuable natural pest controllers. Plants form complex mutually beneficial associations with soil fungi. The most famous fungi are the mycorrhizae fungi: studies show that 80% of plant species surveyed form mycorrhizal associations. Their filaments often spread for meters through the soil, bringing in nutrients from far and wide to the plant roots to which they attach, and they transform nitrogen into a form used by plants. Digging destroys this frail, filament network. Studies show too that plants associated with mycorrhizae are more drought-tolerant and disease resistant than same species without mycorrhizae connections.

**Bacteria:** transform nutrients into forms absorbed by plant roots. Help to break down organic matter. Beneficial bacteria help protect plants from diseases, and filter soils of man-made contaminants. Plants actively encourage bacteria populations to live around the root zone by releasing foods on which they feed.

## How to improve conditions for:

**Bacteria:** Bacteria need nitrogen; add green grass clippings, fruits, vegetable skins. Bacteria are food to soil protozoa that release nutrients for plants and the soil food web as they eat the bacteria. Add this material as a top layer for microorganisms to cycle through the soil profile.

**Fungi:** They require less nitrogen than bacteria: add woody pruning's, sawdust, shredded paper, and brown, dormant or dead plant material in your mulch layer.

**Animals** too have an effect on soil structure: As they burrow, scratch, dig for food, even just excavate when in need of a quick shelter, they build soils and maintain good soil structure, help to aerate the soil, break down organic matter on which other microorganisms feed, and mix it into the soil profile. They return nutrients to the soil through their excretions and as they decompose. To harness their help, we should provide them with habitat and food; leaves, twigs, old plant matter, and invite insects of all kinds into the garden. And a hefty layer of organic mulch.