

# Soil Analysis and Improvement Report



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# 1. Introduction

This report contains a brief analysis of the types of soils most prevalent in gardens, description of the problems and recommendations on how to improve it.

## 2. General Information

Soil is formed when mineral material from rocks is combined with organic matter from plants and animals.

- Rocks fragments are broken down over time by physical (frost, heat, ice, water and wind), chemical and biological weathering.
- Living creatures such as mosses and lichens colonize debris and start to build up organic material as they die.
- Plants start to grow, allowing soil organisms such as worms, woodlice, fungi and bacteria to go into action in a ceaseless process.

### a) Soil texture

- Soil consists of mineral particles derived from rocks with different sizes, comprising:
- Stones/ gravel over 2mm, Coarse sand 0.6-2mm, Medium sand 0.2-0.6mm, Fine sand 0.06-0.2mm, Silt 0.002-0.6mm and Clay less than 0.002mm.
- Texture is the relative proportions of sand, silt and clay particles present in the soil.
- Soil texture is determined by the characteristics of the particles and cannot be changed.

### b) Soil structure

- Structure is the way sand, silt and clay particles are bonded together.
- Particles bond to form larger aggregates when the soil is subjected to shrinking and swelling, plant root penetration or freezing.
- Aggregates can be dusty/ granular, crumbly, or cloddy/ lumpy depending on their size and the pore spaces that are left between them.
- The ideal structure has stable crumbs 5 to 6mm wide and a network of fine and large pores, with good aeration and drainage, allowing rapid exchange of oxygen and water with plant roots.
- Sandy soils tend to be 'single-grained' because particles don't aggregate while clay soils tend to form large lumps and are referred to as 'massive'.
- Good structure or aggregate stability is dependent on the continuous supply of organic matter.

### c) Bulky Organic Matter (BOM)

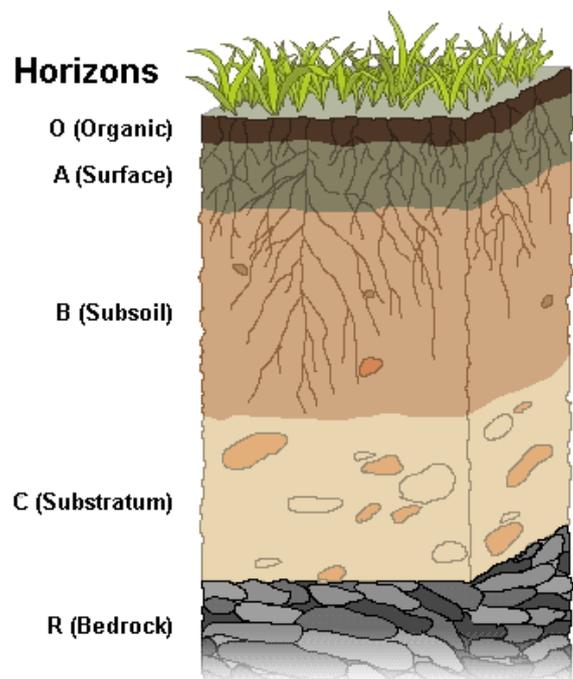
- Bulky Organic Matter (BOM), 'soil improver' or 'soil conditioner' are terms for partially decomposed materials of plants and animals added to the soil to increase its organic matter content.
- It ensures continued survival of soil microbial organisms. These break down OM, releasing nutrients, which are then taken up by plant roots. They keep the soil warm and create pores/ drainage channels with their movement.
- The dark, sticky and spongy residue of the breakdown is called **HUMUS**– it retains nutrients and moisture, keeps soil aerated, helps absorb heat and maintains the crumb structure.
- Organic matter is constantly being degraded by soil organisms and cultivation so, it needs to be returned to the soil on a regular basis.
- It can be added **mulching** (applying a 5-8cm layer to the surface) between winter and spring or **digging** between autumn and winter.
- Common materials are spent mushroom compost, shredded forest bark, garden compost and well-rotted manures.

## 3. Soil Profile

### a) Definition

A soil profile is a vertical section of the soil showing its layers or horizons:

- O. **Organic layer** – plant layer & partially decomposed litter, weeds on the surface suggest clay soil with poor drainage or waterlogging, a deep decayed leaf litter also indicates poor drainage as earthworms and bacteria are unable to break it down due to lack of oxygen.
- A. **Surface Topsoil** – 5-60 cm deep, has nutrients, living creatures, humus, light colour and few pores and fissures or horizontal fissures indicate clay soil with poor structure. Soil pans can occur between A & B.
- B. **Subsoil** – layer of mineral particles, infertile, long water seeking roots are found here, clay soil will be water logged and airless.
- C. Fragmented rock
- R. Parent rock or bed rock



Wikipedia image

- A soil profile is useful to show you the texture and structure of the topsoil, the level of compaction/ aeration and whether drainage is good or poor.
- It can show also if there is a soil pan, a solid layer beneath the topsoil, preventing plant roots and water from penetrating.

- Soil that has abundant pores and fissures indicates good structure allowing good drainage, aeration, root growth and biological activity.
- Once you know your soil you can manage it and improve accordingly.

## 4. Clay Soil

### a) Soil texture

- Clay has tiny particles less than 0.002mm, which are platey in shape with large surface area to weight ratio.
- These attract and hold large amounts of water, leaving soil waterlogged.
- Little air gaps in the soil mean less air for plant roots and soil organisms.
- The soil is slippery, sticky, dense and heavy to dig.
- It loses large amounts of water as it dries out in summer and develops cracks.
- It is cold and slow to warm up in spring.
- On the positive side, this is a fertile soil that holds onto nutrients.

### b) How to improve

To improve the structure of clay soils:

- Add horticultural grit, sand or gravel (75-100mm layer) before digging, to help to open up clay, making it less sticky and improving drainage.
- Dig in a low-nutrient organic matter such as garden compost, leaf mould or mulch composted bark (5-10kg of per sqm) to help particles clump together in larger groups, allowing water and air to pass between them. In clay soils this is best done in autumn.
- If the soil has been cultivated before, single-digging is recommended – dig one spit deep, add OM and turn soil from next section into trench. If the soil has not been cultivated before or if there is a soil pan, double-digging is recommended – dig down one spit, fork the second spit, add OM and turn soil from next section into trench.
- Avoid compacting the soil when soggy, specially if frozen, by adding a few stepping stones to work from.

### c) Suitable plants

Some suitable evergreen shrubs for clay soils that tolerate shade are:

*Viburnum tinus* Laurustinus



*Mahonia eurybracteata* subsp. *ganpinensis*  
'Soft Caress'



## 5. Silty Soil

### a) Soil texture

- Silt has properties between clay and sand.
- Silt particles are 0.002-0.6mm in size and feel silky and smooth when wet.
- This type of soil can hold on to some plant nutrients and is therefore more fertile than sand.
- However, it can also hold water as particles can block drainage.
- It is moderately heavy to work but not sticky like clay.

## 6. Sandy Soil

### a) Soil texture

- Sand particles are between 0.06-2mm in size and are irregular shaped, so they don't fit together tightly.
- Air gaps are formed between particles so water and nutrients drain too quickly.
- The soil warms up quickly in spring and dries out quickly after rain.
- It is light and easy to work and has a longer working season
- Organic matter breaks down too quickly and released nutrients are leached from the soil, which can become acid as calcium (lime) is lost.

- Iron oxides in pale yellow to rich red/brown sands can cause soil pans.
- Capping is an impenetrable layer on the surface common on finely tilled silts. Water moves sideways and prevents emerging seeds and gaseous exchange.

## b) How to improve

To improve sandy soils:

- Dig in organic matter high in nutrients and/or moisture retentive such as spent mushroom compost, well-rotted farmyard manure and home made garden compost. Its spongy texture sticks grains together and allows more water and nutrients to be retained. This is best done in late winter, early spring.
- In light sandy soils single digging is recommended.
- Mulch regularly with bark to reduce water loss.
- Apply a slow release inorganic chemical fertilizer before mulching, such as Vitax Q4 or, if you prefer a more environmentally friendly option, an organic one such as bonemeal.

Finally, it should be noted that regardless of the type of soil, once it has been prepared for planting, many gardeners adopt a 'no dig' approach as constantly disturbing soil at deeper levels can prevent a stable soil structure being formed.

## c) Suitable plants

Some suitable evergreen shrubs for sandy, sunny and dry areas are:

*Lavandula stoechas* subsp. *Pedunculata*



*Sarcococca ruscifolia*



# 7. Soil pH

## a) What is soil pH?

- Soil pH is the level of acidity or alkalinity in a soil. This is measured on a scale of 0 to 14 although generally pH ranges from 3 to 9.
- A soil with a pH above 7.0 is called **alkaline**. A pH below 6.5 is said to be **acid**.
- Most plants prefer a neutral pH between 6.5 and 7.0 because this is where most nutrients are soluble and available to them.
- Soil organisms are more prevalent in neutral to slightly alkaline soils (7.5). These are needed to break down organic matter so in acid soils this happens more slowly.
- Soil naturally becomes more acidic over time due to calcium being leached or removed by plants and carbonic acid being increased, released by rainwater or formed from CO<sub>2</sub> of plants and micro-organisms.

## c) Calcicole and Calcifuge

- **Calcifuges** are plants that need acidic soil and are known as lime haters.
- Below are some acid loving plants examples:

*Camellia japonica* 'Lady Vansittart'  
Evergreen shrub



*Acer palmatum* 'Bloodgood'  
Deciduous tree



- Plants like Rhododendrons require nutrients available in acid soil and can suffer iron deficiency if planted in neutral to alkaline soil. This causes yellowing foliage known as 'lime induced chlorosis'.
- In this case, plant them in containers or raised beds, using John Innes Ericaceous compost.

- Applying Flowers of Sulphur, Pine needle leaf mould or Seaweed Sequestered Iron can help increase soil acidity, although it should be noted that this has to be done regularly to maintain effect.
- A wool-based compost as a peat substitute can also help acid loving plants.
- **Calcicoles** are plants that tolerate a more alkaline, calcareous soil.
- Some examples of plants for chalk and limestone soils, which are almost invariable alkaline, are:

*Clematis* 'The President'  
Deciduous climber



*Jasminum nudiflorum*  
Evergreen or deciduous shrub



## 8. Soil toxicity

- Soil pollution from pesticides, heavy metals, sewage and manures can be very damaging. Water pollution by nitrates loss from cultivated soil is also concerning. Pollution should be identified by experts and dealt with by the correct authorities.
- A simple initial test that can be carried to determine if there is soil toxicity is to plant Garden Cress (*Lepidium sativum*) in the soil. This will grow quickly in only a few days and it can then be observed if the plant grows healthily or if it shows any signs of disease, which could be an indicator of soil contamination.
- Other tests include desk studies followed by a ground investigation and chemical testing of soil samples by accredited laboratories. These would need to be carried out by specialist companies.
- If the Cress test shows signs of disease that could indicate potential soil contamination, this should be reported to the relevant local authority.

## 9. Conclusion

- Texture is the relative proportion of sand, silt and clay particles in a soil.
- Structure is the way particles are bonded together.
- A soil profile is a vertical section through the soil that shows you its texture and structure to help you decide on the necessary improvements
- The back garden has dense clay soil that needs organic matter and other help to clump particles together in larger groups, improving drainage.
- The front garden has sandy soil that is light and drains too quickly so it needs high nutrient organic matter replenishment amongst other measures.
- The silty soil in the side garden has properties of clay and sand.
- pH is the level of acidity/ alkalinity in a soil and most plants prefer a neutral pH of 7 as this is where most nutrients are available.
- Rhododendrons are not thriving in the back garden because this is likely to be neutral to alkaline and they like acid soil. They need to be planted elsewhere or the pH needs to be adjusted.
- Soil toxicity can be tested at home with The Cress test and, if this confirms contamination, the next steps should be to contact the local Council and specialist companies.

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