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This event is being run by SAC Consulting

What is Soil?

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Typical soil make-up

Soil Texture



- It describes the physical composition of the soil
 - % of sand, silt and clay
- Refers to the mineral fragments of the soil only
 - water and organic material are not considered
 - only considers particles <2mm
- Texture is a stable soil property - does not change measurably over a long period of years



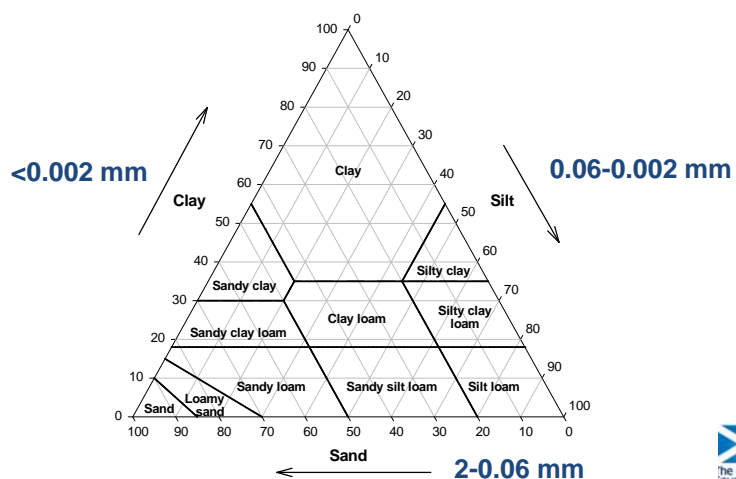
Particle size classes



- Sand - between 2.0mm and 0.06mm (visible by eye)
- Silt - between 0.06mm and 0.002mm (coarse silt only visible using magnifying glass)
- Clay - less than 0.002mm or <2µm (high powered microscope with at least x2000 magnification)



Soil texture classes



Texture – Cultivation Classes

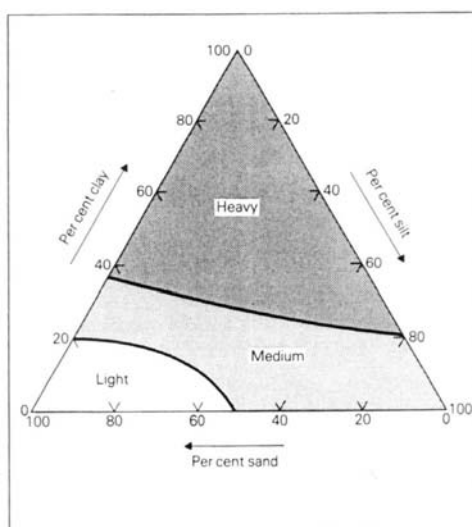


Figure 9.1 A grouping of texture types



Soil texture influences:



- Retention of nutrients - clay particles hold on to plant nutrients
- Lime requirement - sandy soils acidify more quickly than clays but need less lime
- Cultivation - light sandy soils are more easily cultivated than heavier clay soils
- Cropping - early crops on light sandy soils
- Erosion - fine sand & coarse silt are likely to blow away or be washed away by rain

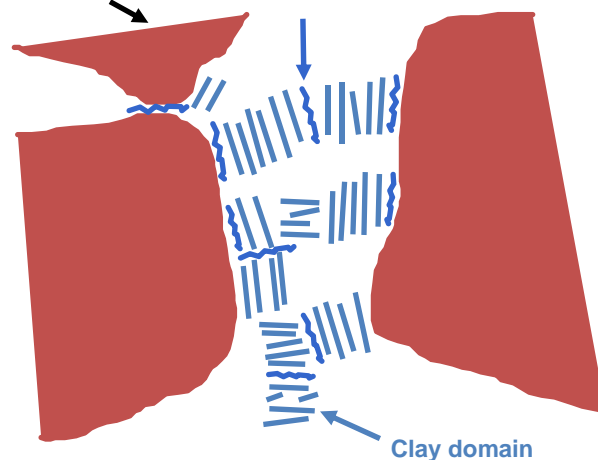


Soil



Mineral grain

Organic matter



Benefits of soil organic matter



- Develops and maintains soil structure
- Supplies mineral nutrients
- Increases water holding capacity
- Retains nutrients that might be leached out
- Increases availability of micronutrients to plants
- Substrate for soil organisms
- Darkens colour - increases rate of warming



Soil pores and plants



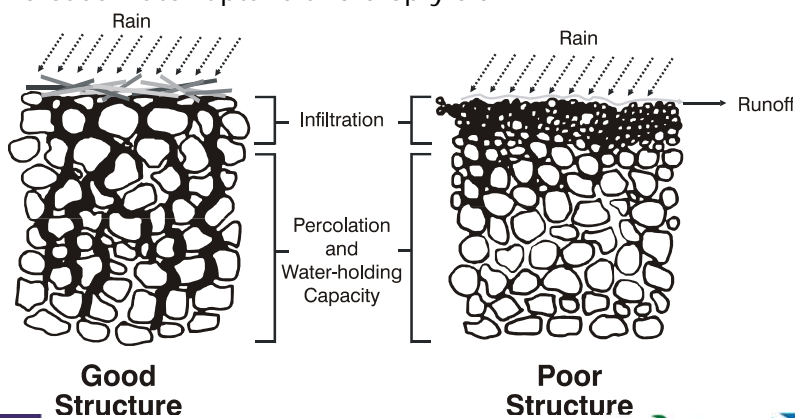
- Plants need water
 - it carries nutrients through the plant
 - it allows chemical reactions to take place in the plant
- Plants also need air
 - roots need to breathe **oxygen**
 - allows roots to take up nutrients they need
 - roots produce **carbon dioxide**, which must be able to escape from soil























Soil Structure

Soil structure: the importance of macropores

- Macropores and cracks : allow water infiltration and drainage, keep the soil aerated reducing nitrous loss and increase water uptake and crop yield



Structure quality	Size and appearance of aggregates	Visible porosity and Roots	Appearance after break-up: various soils	Appearance after break-up: same soil different tillage	Distinguishing feature	Appearance and description of natural or reduced fragment of ~ 1.5 cm diameter
Sq1 Friable Aggregates readily crumble with fingers	Mostly < 6 mm after crumbling	Highly porous Roots throughout the soil			 Fine aggregates	 The action of breaking the block is enough to reveal them. Large aggregates are composed of smaller ones, held by roots.
Sq2 Intact Aggregates easy to break with one hand	A mixture of porous, rounded aggregates from 2mm - 7 cm. No clods present	Most aggregates are porous Roots throughout the soil			 High aggregate porosity	 Aggregates when obtained are rounded, very fragile, crumble very easily and are highly porous.
Sq3 Firm Most aggregates break with one hand	A mixture of porous aggregates from 2mm - 10 cm, less than 30% are < 1 cm. Some angular, non-porous aggregates (clods) may be present	Macropores and cracks present. Porosity and roots both within aggregates.			 Low aggregate porosity	 Aggregate fragments are fairly easy to obtain. They have few visible pores and are rounded. Roots usually grow through the aggregates.
Sq4 Compact Requires considerable effort to break aggregates with one hand	Mostly large > 10 cm and sub-angular non-porous; horizontal/platy also possible; less than 30% are < 7 cm	Few macropores and cracks All roots are clustered in macropores and around aggregates			 Distinct macropores	 Aggregate fragments are easy to obtain when soil is wet, in cube shapes which are very sharp-edged and show cracks internally.
Sq5 Very compact Difficult to break up	Mostly large > 10 cm, very few < 7 cm, angular and non-porous	Very low porosity. Macropores may be present. May contain anaerobic zones. Few roots, if any, and restricted to cracks			 Grey-blue colour	 Aggregate fragments are easy to obtain when soil is wet, although considerable force may be needed. No pores or cracks are visible usually.

Structure & nutrients



- Good structure improves aeration & reduces waterlogging
 - easier for roots to access nutrients
 - leaching of nutrients less likely
- Good structure reduces compaction
 - more extensive root system
 - better water & nutrient uptake
- Good structure reduces droughtiness
 - improves nutrient uptake



Structure-forming processes



- Activity of roots and soil organisms, especially earthworms
 - mixing, cementing, transforming
 - needs organic matter
- Wetting & drying
 - swelling & shrinkage
- Freezing & thawing
- Cultivation – the only rapid improvement process
- **Organic matter is key to structure formation and maintenance**



Summary: What is good soil structure?



- Crumb and small (fine) blocky aggregates
- Soil is easy to cultivate
- Roots are dense and deep
- Soil has a rough surface
- No sign of waterlogging
- No long-term reduction of soil organic matter



Soil Compaction

Main causes of compaction

- Over-cultivation
- Continuous cultivation
- Heavy machinery
- Working in wet conditions
- Over-grazing

Waterlogging makes Compaction worse



- Symptoms of compaction in seasonally waterlogged soils
 - Shallow rooting
 - grey mottles (see Soil Profiles)



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Soil structure is affected by management



- **Compaction**



- **Poaching**



Image: Farmers Weekly

- **Waterlogging**



Effects of compaction



- Lower crop yield
- Poorer water infiltration
- More runoff & erosion
- More fuel, lower fertiliser uptake & pesticide efficiency
- More pollution of air & water



Dealing with compaction



- Avoid compacting the soil in the first place (Prevention)
- Change management systems to protect soil
- Make the soil more resistant to compaction
- Protect the soil against raindrop impact - protects soil structure
- Eradicate the compaction (Cure)



Flat Lift Type subsoiler

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The European Agricultural Fund
for Rural Development
Europe Investing in Rural Areas



The Scottish
Government
Riaghaidh na h-Alba

Remediation of poaching, shallow compaction

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The European Agricultural Fund
for Rural Development
Europe Investing in Rural Areas



The Scottish
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Riaghaidh na h-Alba

Grassland Subsoilers / Swardlifters

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Pre-cutting Disc and Closer leg spacing



Roller for depth control and break back legs to reduce brining stones to the surface



Spiked roller to help aerate surface



Roller to level surface following treatment



Grassland Surface Spikers

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Grassland spiker



Effect of surface spiking



Pasture Harrow



Roller spiker with grass seeder and frame for extra weights



Spiker with water tank for extra weights

