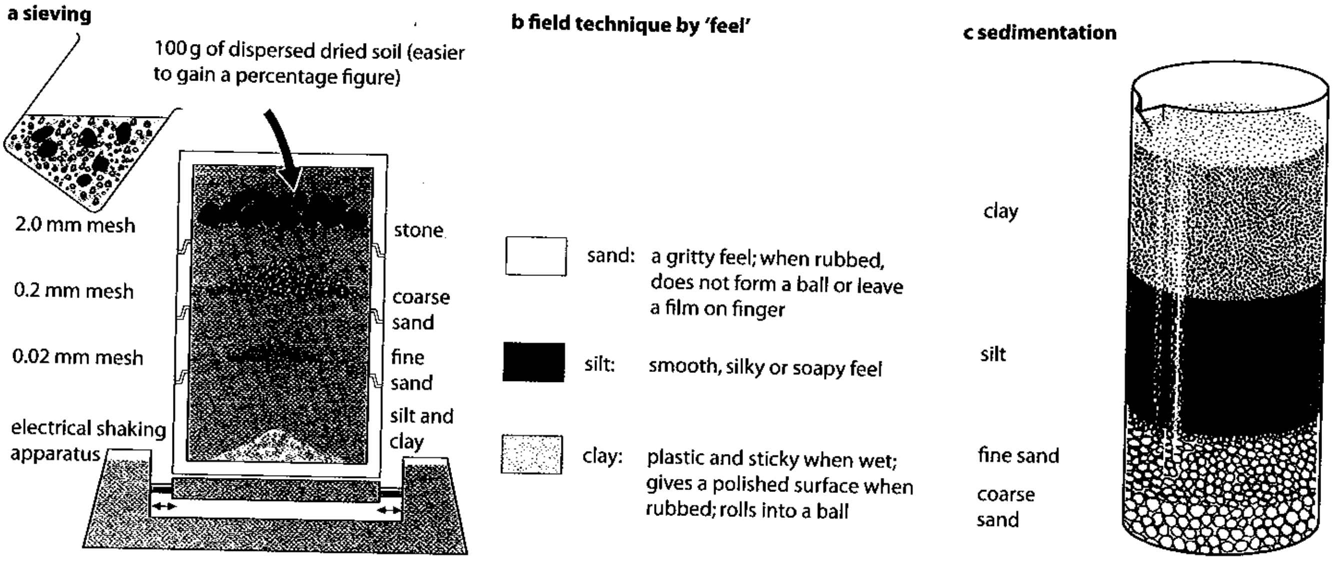


Figure 10.7

Measuring soil texture (*after* Courtney and Trudgill)

2 Soil texture

The term 'texture' refers to the degree of coarseness or fineness of the mineral matter in the soil. It is determined by the proportion of **sand**, **silt** and **clay** particles. Particles larger than sand are grouped together and described as stones. In the field, it is possible to decide whether a soil sample is mainly sand, silt or clay by its 'feel'. As shown in Figure 10.7b, a sandy soil feels gritty and lacks cohesion; a silty soil has a smoother, soaplike feel as well as having some cohesion; and a clay soil is sticky and plastic when wet and, being very cohesive, may be rolled into various shapes.

This method gives a quick guide to the texture, but it lacks the precision needed to determine the proportion of particles in a given soil with any accuracy. This precision may be obtained from either of two laboratory measurements, both of which are dependent upon particle size. The Soil Survey of England and Wales uses the British Standards classification, which gives the following diameter sizes:

Heading	Description from case study
coarse sand	between 2.0 and 0.6 mm
medium sand	between 0.6 and 0.2 mm
fine sand	between 0.2 and 0.06 mm
silt	between 0.06 and 0.002 mm
clay	less than 0.002 mm

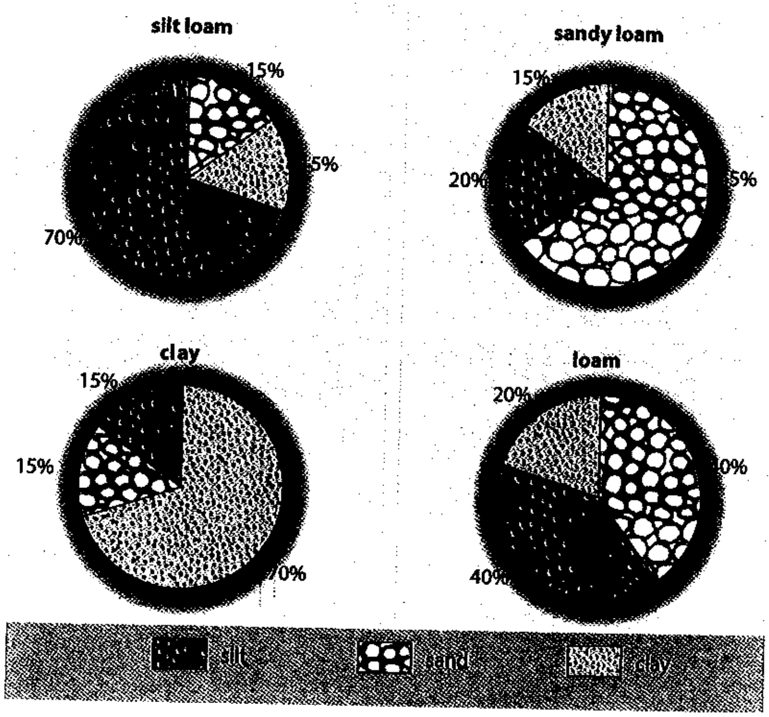
One method of measuring texture involves the use of sieves with different meshes (Figure 10.7a). The sample must be dry and needs to be well-shaken. A mesh of 0.2 mm, for example, allows fine sand, silt and clay particles to pass through it, while trapping the coarse sand. The weight of particles remaining in each sieve is expressed as a percentage of the total sample.

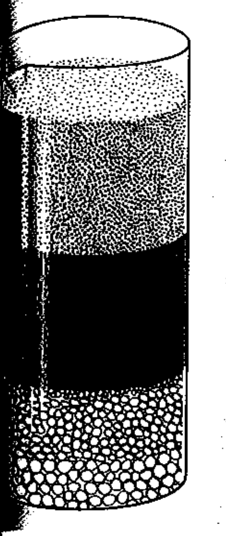
In the second method, sedimentation (Figure 10.7c), a weighed sample is placed in a beaker of water, thoroughly shaken and then allowed to settle. According to **Stoke's Law**, 'the settling rate of a particle is proportional to the diameter of that particle'. Consequently, the larger, coarser, sand grains settle quickly at the bottom of the beaker and the finer, clay particles settle last, closer to the surface (compare Figure 3.22). The Soil Survey and Land Research Centre tends to use both methods because sieving is less accurate in measuring the finer material and sedimentation is less accurate with coarser particles.

The results of sieving and sedimentation are usually plotted either as a pie chart (Figure 10.8) or as a triangular graph (Figure 10.9). As the proportions of sand, silt and clay vary considerably, it is traditional to have 12 texture categories (Figure 10.9).

Figure 10.8

The texture of different soil types





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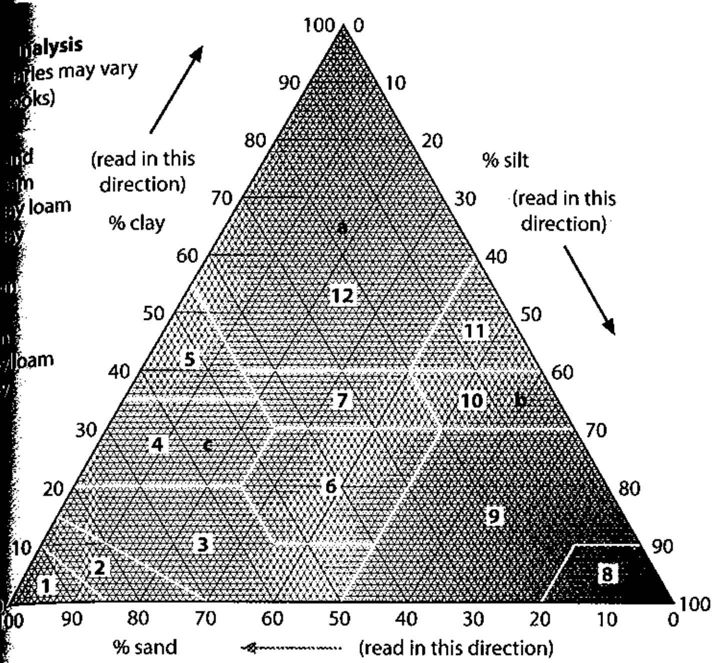

	% clay	% silt	% sand
a	65	18	17
b	35	59	6
c	27	17	56

Figure 10.9
Soil texture analysis: the use of a triangular graph

The importance of texture

As texture controls the size and spacing of soil pores, it directly affects the soil water content, water flow and extent of aeration. Clay soils tend to hold more water and are less well drained and aerated than sandy soils (page 267).

Texture also controls the availability and retention of nutrients within the soil. Nutrients stick to – i.e. are adsorbed onto – clay particles and are less easily leached by infiltration or throughflow than in sandy soils (page 268).

Plant roots can penetrate coarser soils more easily than finer soils, and 'lighter' sandy soils are easier to plough for arable farming than 'heavier' clays.

Texture greatly influences soil structure.

How does texture affect farming?

The following comments are generalised as it must be remembered that soils vary enormously.

Sandy soils, being well drained and aerated, are easy to cultivate and permit crop roots (e.g. carrots) to penetrate. However, they are vulnerable to drought, mainly because, due to their relatively large particle size (Figure 8.2a), they lack the micropores that would retain moisture (page 267) and partly because they usually contain limited amounts of organic matter. They also need considerable amounts of fertiliser because nutrients and organic matter are often leached out and not replaced.

Silty soils also tend to lack mineral and organic nutrients. The smaller pore size means that more moisture is retained than in sands but heavy rain tends to 'seal' or cement the surface, increasing the risk of sheetwash and erosion.

Clay soils tend to contain high levels of nutrient and organic matter but they are difficult to plough and, after heavy rain and due to their small particle size (Figure 8.2b) which helps to retain water (page 267), are prone to waterlogging and may become gleyed (pages 272 and 275). Plant roots find difficulty in penetration. Clays expand when wet, shrink when dry and take the longest time to warm up.

The ideal soil for agriculture is a **loam** (Figures 10.8 and 10.9). This has sufficient clay (20 per cent) to hold moisture and retain nutrients; sufficient sand (40 per cent) to prevent waterlogging, to be well aerated and to be light enough to work; and sufficient silt (40 per cent) to act as an adhesive, holding the sand and clay together. A loam is likely to be least susceptible to erosion.

3 Soil structure

It is the aggregation of individual particles that gives the soil its structure. In undisturbed soils, these aggregates form different shapes known as **peds**. It is the shape and alignment of the peds which, combined with particle size/texture, determine the size and number of the pore spaces through which water, air, roots and soil organisms can pass. The size, shape, location and suggested agricultural value of each of the six ped types are given in Figure 10.10. It should be noted, however, that some soils may be structureless (e.g. sands), some may have more than one ped structure (Figure 10.11), and most are likely to have a distinctive ped in each horizon. It is accepted that soils with a good crumb structure give the highest agricultural yield, are more resistant to erosion and develop best under grasses – which is why fallow should be included in a farming crop rotation. Sandy soils have the weakest structures as they lack the clays, organic content and secretions of organisms needed to cause the individual particles to aggregate. A crumb structure is ideal as it provides the optimum balance between air, water and nutrients.