thinksoils

Examining soils in the field
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the soil surface
Looking for rill erosion

Erosion is a severe form of soil degradation where topsoil is removed by running water carving out channels.

Small channels are known as rills. These can be removed by ploughing.

Looking for gulley erosion

Deep gulley erosion occurs where large volumes of surface water collect at the base of slopes and in valley bottoms. This is a severe form of erosion that can not be removed by ploughing.
Examining soils in the field / the soil surface

Looking for signs of soil deposition caused by erosion

When soil is eroded, the coarse heavier fraction of soil may be deposited at the bottom of the slope.

The finer material and organic matter is often carried further away from the field into watercourses.

Looking for signs of wind erosion

Some sandy soils and peaty soils are at risk of wind erosion.

Sandy soils at risk to wind erosion are those with a low clay content (including sand and loamy sand textures), and those with fine soil particles. Sandy loam soils are slightly more stable and have a lower risk of being blown.

Signs of wind erosion include drifting soil, buried seedlings, and soil blown into hedgerows, ditches and onto nearby roads.
the soil surface

Looking for signs of runoff and compaction

Examining soils during or just after rainfall is a good time to see signs of compacted soil. Where water cannot infiltrate into the soil it ponds at the surface. Where this occurs on slopes, water flows downhill but does not necessarily cause rill or gulley erosion.

Excessive water flow and slight soil erosion can cause turbid or brown water runoff (often termed soil wash).

Looking for wheel ruts

Wheel ruts are caused by farm traffic travelling on wet soil. This causes compaction and reduces the ability of the soil to absorb rain.

Wheel ruts can channel water (for example towards the farm gate and the adjacent road).
the soil surface

Looking for signs of soil erosion in the uplands

Treading of soil by stock in upland areas can lead to soil erosion.

Crescent shape erosion features (known as scars) are caused by stock trampling, rubbing and scratching. These scars can join together forming a large area of exposed soil that is vulnerable to erosion.

Looking for a poached soil surface

Poached soil is caused when livestock trample wet soil. Poaching causes compaction and ponding of water.

Although the hoof marks provide some surface storage of water, runoff can occur during heavy rainfall.
Looking for a surface cap

Slaking is the process of breaking down soil aggregates. Rain impact breaks down soil fragments which are then dispersed in solution and fine particles are washed into pores, forming a crust or cap.

Capped soils reduce the ability of rain to soak into the soil, causing runoff.

A cap can be identified by gently prising the soil open with a spade.

Good surface condition

A good surface condition is where soil aggregates have not disintegrated either by the action of rain or by compression from farm machinery or livestock.
examining soils in the field

the topsoil
Examining soils in the field

Preparing a hole for examination

Normally at least three holes need to be dug in a field to obtain a representative picture. More holes will be needed in large fields and where there are a range of soil types. Areas prone to compaction and possible sources of runoff should be examined (for example, headlands and wet spots), and areas where crop growth is poor should also be looked at.

Mark out the edges of a square hole to be dug. Each edge needs to be about 50cm so that a sufficiently deep hole can be dug. (Depth of the overall hole would normally be at least to 40cm.)

Preparing a section of topsoil to be examined

Dig out soil from one half of the square to a depth of about 20cm within the cultivated layer. The remaining soil is the section of topsoil to be examined, so do not trample on this half and do not smear the face with the spade.
Looking at pores and fissures

Lever out a spadeful of soil from the undisturbed half of the square so that soil structure can be examined.

The first step when examining soil structure in a spadeful of soil is to look for spaces (either fissures between soil structural units, or pores within the units).

Soil with good structure has abundant pores and fissures allowing good drainage, aeration, root growth and biological activity.

Soil with poor structure is where there are few pores and fissures, or where there are horizontal fissures.
Examining soils in the field / the topsoil

The second step to examining soil structure is to look at the soil structural units. This is most easily done when the soil is moist.

Carefully tease the soil apart along its lines of natural weakness, breaking the soil into structural units.

A structureless soil is without any aggregation of soil particles. It is massive when soil particles are bonded together into one single mass, or single grain when soil breaks to individual soil particles.

A soil has structure when soil is aggregated into units. Structural units that are naturally formed are called peds. These are formed by shrinking and swelling of clay, producing angular shapes, or by biological processes that produce more rounded faces. Calcium also helps to bind clay particles together.

Cultivation produces artificial aggregates and these are less permanent than peds and often do not persist through cycles of wetting and drying. These aggregates are termed clods (or fragments if they are less than 10cm).

A strongly developed ped structure is where peds are clearly evident, separating cleanly from one another when the soil is disturbed. Conversely a weakly developed ped structure is where peds are less obvious and there is much unaggregated material.

Looking at structural units

Peds are naturally formed structural units that separate cleanly from one another when gently teased apart.
Looking at shape, size and colour of soil structural units

Spherical structures are termed granular. Square shapes are called blocks. Flattened structural units are called plates.

Where blocks have mainly curved /rounded faces they are termed subangular. Where faces are mostly flat the blocks are termed angular.

Small blocks are called very fine when they are <5mm, fine when they 5-10mm and medium when they are 10-20mm. Large blocks are called coarse when they are 20-50mm and very coarse when they are >50mm.

Soils with coarse and very coarse angular blocks, and those with plates, have poor drainage and aeration because blocks and plates can fit tightly together. Conversely, fine granules and fine subangular blocks allow good drainage and aeration.

Soil colour is a good indicator of the degree of waterlogging. When soil is poorly drained it has less oxygen, and iron is reduced, producing a grey colour. Conversely, a well-oxygenated soil is brown in colour. Repeated cycles of oxygenation and reduction produce grey and rusty mottled colours.
Assessing the packing density of soil

Porosity of soil is affected by the packing density of soil particles. Soils with high packing density have lower porosity.

Packing density can be estimated by assessing the strength of soil and comparing this with size, shape and degree of development of peds.

Soil strength is determined by applying pressure to a 3cm cube of soil using an extended forefinger and thumb. The cube can either be a ped or part of a ped, or a block fashioned from massive soil. The cube should be orientated according to how the soil is found in the profile.

Where a moist cube cracks under gentle force it is described as friable. A soil is generally at least risk from compaction when in a friable state. Where a moist cube fails under the maximum pressure that can be applied by extended thumb and forefinger it is described as very firm.

Where a moist cube fails under pressure that is much less than the maximum that can be applied, it is described as firm.

A friable soil has a lower packing density and is more porous than a firm and very firm soil of the same texture.
Examining soils in the field

the subsoil
Examining soils in the field / the subsoil

the subsoil

Preparing a hole for examination
Subsoils should be examined when the soil is moist.

Dig out half of the soil in the pit to a 30-40cm depth. Take care not to smear the face or trample the soil in the remaining half of soil to be examined.

Preparing a section of subsoil to be examined
Dig into the remaining half of soil and cut out a block of soil.

Lever out a block of soil with the spade and hold the soil with the hand to stop it falling and carefully remove from the hole.
Looking at pores and fissures

Subsoils with natural soil structure tend to have larger peds than structural units in the topsoil. This is because the natural processes that form peds (such as swelling and shrinkage of clay during wetting and drying cycles) are not as frequent in the subsoil. There is also less biological activity, root growth and organic matter in the subsoil.

Subsoils can have continuous pores created by earthworm channels.

Abundant fissures and pores allow for good rooting and water movement (where the water-table allows).

When examining the subsoil it is important not to confuse a change in soil texture with structural degradation. There is often a boundary between the tilled and untilled soil, and this change should not be mistaken for degraded soil structure.
Examining soils in the field

the subsoil

Carefully tease apart the subsoil, breaking it along its natural lines of weakness. Assess the degree of ped development, and the size, shape and colour of peds.

A structureless subsoil can either be natural, for example where the clay content is low and the soil has naturally slaked (slumped), or it can be formed by compression of moist soil by farm traffic and cultivation.

A strongly developed ped structure is where the peds are clearly evident and easily break apart into well-defined units.

Looking at structural units
the subsoil

Looking at shape, size and colour of soil structural units

Subangular blocks, angular blocks and prisms tend to be found in subsoils.

Prisms are where the peds have long vertical faces. Prism size range from very fine (<10mm width), through to fine (10-20mm width), medium (20-50mm width), coarse (50-100mm width) and very coarse (>100mm width).

Root and water movement is more likely to be restricted where the peds are coarse (large) and where they are angular, prismatic or platy.

Subsoils that are mottled indicate poor drainage, and a high risk to structural damage.
Assessing the packing density of subsoil

Packing density can be estimated by assessing the strength of subsoil and comparing with size, shape and degree of ped development. Apply pressure to a 3cm cube of soil using an extended forefinger and thumb. The cube can either be a ped or part of a ped, or a block fashioned from massive soil. The cube should be orientated according to how the soil is found in the profile.

Where a moist cube fails (cracks) under gentle force it is described as friable. Where a moist cube fails under the maximum pressure that can be applied by extended thumb and forefinger it is described as very firm. Where a moist cube fails under force that is much less than the maximum it is described as firm.

A friable soil has a lower packing density than a firm and very firm soil of the same texture. Soils with low packing density are more porous than soils with high packing density.

Sandy and light silty soils with a friable soil strength are moderately or very porous even though they may be structureless.
examining soils in the field
plants and plant roots
Using plant growth as an indicator of poor soil structure

Crop and grass growth can be affected by poor soil structure.

Plant growth is most at risk on headlands, near gateways, and wet areas in the field (where soil is prone to structural damage by vehicles or stock). These areas are also potential sources of runoff and erosion.

Wet areas in the field can either be natural, for example where the water table is high, or they can be caused by poor soil structure.

Soil structure is often degraded in wet areas, which further compounds problems of waterlogging and poor crop growth.
Roots are very sensitive to soil structural condition, wetness and aeration. They can extend 2m deep in the soil, and autumn sown crops often have roots deeper than 1m by the following spring.

The soil should be examined to determine root abundance, root depth, direction of growth, and whether roots have penetrated structural units, or are confined to fissures.

Roots will take the path of least resistance and hence are good indicators of soil structural conditions and porosity. Ideally, they will grow vertically through fissures or cracks and pores present in a well structured soil. On encountering zones of compaction they are likely to be impeded vertically and so will grow horizontally. This will limit the depth and hence volume of soil from which the roots can extract water and nutrients for the growing crop.

Roots can grow in poorly structured soil provided there are pores for the roots to grow through (e.g. worm holes). In some soils, roots can not penetrate into dense structural units, and are confined to fissures where they may find moisture and nutrients.