

GRASSLAND DEVELOPMENT CENTRE

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101.01 Recognising and Solving Soil Physical Problems

Well structured soils are essential for grass and crop growth throughout the year. Compaction, smearing and surface capping of soils result in reduced air movement, poor drainage, restricted plant root growth and limited uptake of soil and fertiliser nutrients. This will mean a shorter growing season, reduced stock carrying capacity, nutrient loss, increased soil erosion and poorer grasses and weeds replacing the sown species.

This factsheet will help identify soil physical problems, suggest ways to correct them and outline management strategies to prevent problems re-occurring.

Soils in good condition should have an open friable structure, with an extended root network, no discolouration and a healthy worm population.

The Problems and the Causes

Compaction – compression that reduces air space within the soil at a range of depths depending on the cause.

Causes

- Heavy or repeated machinery traffic
- Long-term poaching by livestock
- Repeated cultivation at one depth creating a plough pan – *seen at cultivation depth*
- Primary cultivations under wet ground conditions
- Over-use of secondary cultivations
- Depletion of soil organic matter through continued cultivation and traffic (arable) leading to collapse of soil structure

Smearing – dragging and sliding across wet soils smears and blocks soil pores.

Causes

- wheel slippage
- use of cultivation implements or seed drill during unsuitable conditions

Surface capping – blocking of soil pores at the surface, preventing the soil from breathing and causing water to pond on the surface.

Causes

- Light poaching/puddling
- Heavy rain splash on bare soil
- Heavy slurry applications
- Sediments deposited by standing water

Identifying compacted soils

First, dig a hole where there is likely to be compaction, in gateways or near troughs, to learn to recognise signs. Then dig at several sites across each field to get an overall assessment of soil conditions. Dig out a spade-sized, intact soil section and look for the following signs of compaction:

- the soil does not break up easily in your hands.
- the soils splits horizontally
- the grass roots do not go down more than 6 inches - or have horizontal growth.
- there are brown rust-like deposits - particularly around stones and roots.
- dull grey colours and grey patches or mottles, indicating anaerobic conditions or periodic waterlogging.
- an obvious change in soil structure (hard layer) at around 6-8 cm or at plough depth. This is easily checked by pushing a penknife tip into the sidewall of the hole.
- little or no evidence of earthworms.

Above ground, look for:-

- standing water
- a reddish tinge to grass leaves in spring
- “wet loving” species: rushes, marsh thistles, -Yorkshire Fog.
- scorch marks from urine patches.

Correcting Problems

Mole ploughing – dual purpose; creates a drainage channel and breaks a deep compaction layer. Works best in clay-rich soils. Ideally when there is a moist subsoil (to hold the mole) and dry top soil to maximise shattering - conditions typical of late summer.

Disturbance of soil profile – There are implements which can shatter compaction layers to, or just below plough depth and loosen the soil structure. Best results are obtained during summer when soils will crack.

Aerating top soil – a spiked or knifed roller will break surface or shallow compaction. Allows the soil to 'breathe' and water to penetrate the soil, improving root distribution and nutrient uptake.

Lime or organic matter – will improve the stability of a soil and promote earthworm activity.

Deep ploughing – destroys plough pans created by previous cultivations. Not suitable in shallow soils where there is a risk of turning up subsoil.

Installing and maintaining drains – wet soils are more prone to damage than dry soils. Good drainage promotes 'shrinkage cracks' and encourages earthworms.

Managing soils to prevent damage

- Maintain or renew tile, pipe and mole drains. Keep drainage ditches clear.
- Avoid travelling on soils and cultivation when soils are particularly wet.
- Minimise secondary tillage - each additional pass destroys aggregates and increases soil density.
- Remove excess weights when ploughing – only use enough ballast to reduce slippage.
- Reduce surface pressure – by lowering tyre pressure or using lighter axle loads
- Use 4WD traction where possible to reduce wheel slippage.
- Rotate cropping including maize, silage/grazing as much as possible.
- Avoid grazing during very wet times.
- Correct any damage as soon as possible. Damaged soils collect water and get worse rapidly.
- Avoid very heavy applications of slurry/manure on wet, cultivated land.
- Consider using an umbilical slurry system rather than tankers.

Soil Types and Stability

Factors which make a soil stable are clay, organic matter and lime. Unstable soils are most prone to soil structure problems and lose their structure easily when rain pools on the surface or is held up in the soil. Particularly at risk are soils with enough clay content to make them claggy and form clods – but with not enough clay to give them stability. Soils like the red sandstone around Llandovery have lots of air space between the large sand particles, but these can easily be filled with the smaller clay and silt sized particles – which can lead to a very hard compact soil. All clay-rich soils are prone to smearing in wet conditions.

Clovers Improve Soil Structure.

Recent work at IGER has shown white clover to benefit soil structure. Clover roots have been found to open up the soil down to 12cm - decreasing soil density and increasing air movement. Initial trials suggest that these effects can lead to a 20% improvement in fertiliser use efficiency.

Caution:

Deep cultivation and reseedling of permanent pasture on poorly drained clay soil can destroy natural drainage developed over many years. Refer to DEFRA Soil code if considering deep cultivation and protect archeological features. Not all compacted soils exhibit all these signs and some may be caused by other factor. Avoid over liming on peat soils; aim for pH 5.5.