Addressing soil compaction

Compaction in grassland can cost dairy farmers up to £250/ha per year in lost dry matter yields, delayed grazing and field working days, and inefficient nutrient use, according to the AHDB. It can also increase the risk of drought stress. So what can be done?

Soil needs to function like a sponge, explains Jo Oborn, of FWAG South West, who has been studying soil structure problems and how to overcome them. "It should contain a network of pore space to absorb and store moisture, and supply air to support soil biology and root growth."

"In a 'normal' year, compaction in grassland will have several negative effects on dry matter production—plants have restricted root development and will be less efficient in utilising applied fertiliser and soil moisture.

"In addition, oxygen exchange to the roots is reduced, thereby limiting growth. The wet anaerobic conditions in compacted soils will also compromise soil biological activity, which is essential for the breakdown and recycling of nutrients—earthworms do not thrive in cold tight soils.

"Compacted fields will also stay wetter for longer after rain. Areas of standing water may be seen, increasing the risk of poaching and potentially leading to grass kill.

"Where grassland is grazed, spring turnout may need to be delayed due to wet ground conditions, adding to feed costs.

"There are environmental issues too. The run-off of water across compacted ground will take away applied nutrients, as well as soil, and can ultimately pollute water courses."

Assessing soil structure and compaction

Assessment overview	Good soil structure	Poor soil structure
Roots: distribution and depth	Lots of roots, deep, growing vertically	Few roots, shallow, growing horizontally
Soil units: size, shape, packing	Generally smaller and more rounded. Crumbly and lots of pores (gaps for air and water)	Generally larger and angular. Dense with few pores
Cracks	Mostly vertical	Horizontal
Colour and smell	Bright colour, earthy smell	Dull, greyish colour, sour smell
Moisture	Even moisture throughout	Dry and/or wet layers

Drought effects

"Long periods of dry weather add to the negatives of having poor soil structure," explains Jo. "Compacted soils store less plant-available water and this, together with compromised root development, means when the weather turns dry, the sward will suffer drought stress and yield penalties sooner. And when it does rain, infiltration will be impeded and the water will be more likely to run off the surface instead of going down to the roots.

"Following this prolonged dry weather, although the ground in some grassland has cracked, this won't restructure the soil in-between the gaps. Some soils—sandy, silty loams—don't crack anyway. So farmers shouldn't assume that this dry weather has resolved their compaction issues."

The decision to address compaction in grassland soils should be based on the extent and severity of the problem. Jo explains: "Mechanical intervention can damage the sward and can reduce productivity immediately after treatment. Therefore, mechanical intervention should only be considered where soil compaction is identified, and the associated yield losses outweigh the temporary damage to the sward when rectifying the problem. Avoid recreational subsoiling or slitting!"

The autumn is the ideal time to address compaction that is deeper than 10cm, by using a sward-lifter.

Signs of compaction

The most obvious signs of compaction in a field are standing water, or ground that remains wet and boggy for longer than other fields after heavy rainfall, or in the spring. Other clues include: disappointing dry matter yields, a purple/reddish tinge to the grass colour indicating stress, and an ingress of weeds—particularly creeping buttercup, rushes and moss, which thrive on wet ground.

"To check for compaction in fields, farmers need to examine their soil. This autumn they will need to wait until sufficient rain has fallen to moisten the soils before they can diagnose any structural issues. Fields that were compacted before the summer will still be compacted now. Some problem fields may already have been identified."

The table above outlines the elements to consider in evaluating soil structure.

"In water-logged and wet lying grassland, first check the field drains to ensure they are functioning, before attempting to address any compaction," advises Jo.

"The best way to identify any compaction issues is to take a spade and dig a hole to examine the soil profile. Look for vertical fissures not horizontal ones, the presence of pore spaces, and the sod should crumble easily in the hand.

"A sour smell and the presence of grey/green mottled areas and rusty mottles within the cultivated layer are an indication of anaerobic conditions symptomatic of waterlogging and likely compaction.

Shallow compaction—as caused by livestock—will be resolved with slitting or aerating.

Deep compaction: No vertical fissures, no earthworms, and shallow rooting plants.

Conversely, the presence of earthworms indicates a healthy soil.

"Once a problem has been identified, it is then necessary to select the right tool to tackle the problem.

Slit or sward-lift?

"If compaction is diagnosed, then determine to what depth it is present. This is fundamental to selecting the right tool to remove it. The working depth of the implement should be approximately one inch or 2.5cm below the extent of compaction.

"If compaction is shallow—less than four inches (10cm)—then aerating, or slitting the field will be sufficient to loosen the soil and improve drainage."

If compaction goes deeper than four inches, a grassland subsoiler or sward-lifter is required.

"Soil moisture status at the time of intervention is critical—too wet and the cultivations can result in smearing and further damage to the soil, exacerbating the problem. Too dry and interventions can result in excessive damage caused by sward tearing—sward slitter blades may be unable to penetrate to the correct depth, and subsoilers may create excessive heave resulting in an uneven surface.

"Farmers should aim to address compaction in the autumn when grassland growth and temperatures are declining, and the risks of prolonged dry weather are minimal, to avoid potential damage caused by root pruning.

"Freshly disturbed soils will have a reduced weight bearing capacity and can easily be recompacted. Once a field has been sward-lifted, keep livestock and traffic off of it for at least six weeks, to allow soils to reconsolidate naturally and avoid compacting them again," advises Jo.

Long term benefits

"Improving soils under grassland can have multiple benefits to the business and the wider environment," says Jo.

"These include: improved productivity and nutrient-use efficiencies, and increased resilience of the sward to extreme weather events. This has been particularly evident this year during such a dry summer—well-structured soils with deep-rooted plants have been more able to access the moisture at lower depths.

"In the wider catchment, rainfall is more likely to infiltrate into well-structured soils, reducing run-off and the associated sediment and nutrient losses. Rainfall is therefore stored and released more slowly, helping to reduce peak flows and flooding."

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Assessing benefits of subsoiling

FWAG SW is a partner an EU project, working on building resilience in catchments to climate change and flooding using natural flood management measures to reduce climate change and deliver 'win: win' scenarios to farmers. Soil management plays a critical role in this.

A split trial was set up in a grass ley near Taunton in Somerset, which was to be cut for quality haylage, but where compaction in the soil had been diagnosed. The objectives were to assess the impacts of grassland subsoiling on water infiltration rates and grass yield—and, importantly, to see if subsoiling resulted in economic benefits to the land owner.

Soil was assessed in spring 2017 and revealed severe compaction throughout the soil profile caused by previous cultivations and historic farm traffic. The ability of the soil to accept water was assessed using infiltration tubes. Well structured soils will be able to accept water more readily. Grass productivity was assessed in early 2018.

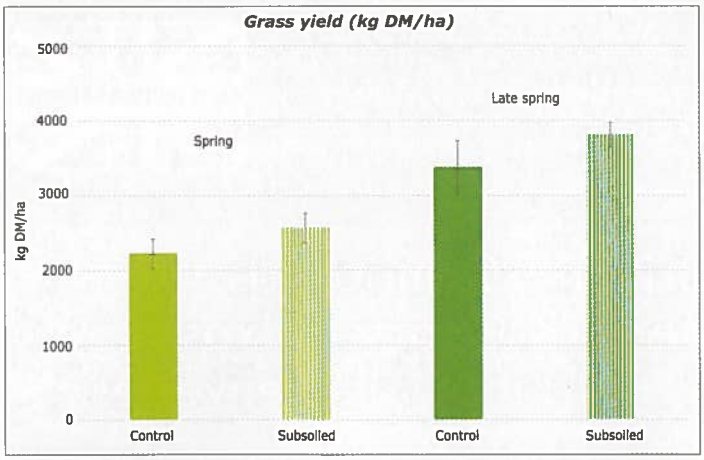
Trial results

The infiltration rate of water increased by 215% in the subsoiled area compared to the untreated control area.

In the picture the soil clod in the left hand is from the untreated area, while that in the right hand has been subsoiled and has more roots, soil is looser and has more pore space.

In the spring, the soil that had been subsoiled held more moisture at depth due to improved infiltration of spring rainfall compared to untreated areas where water was still puddled on the surface.

Grass yield was assessed in the spring (April) and late spring (May), and indicated that the subsoiled area was yielding 15% higher in April following the wet spring, and 13% higher in May than the control area (see graph below)



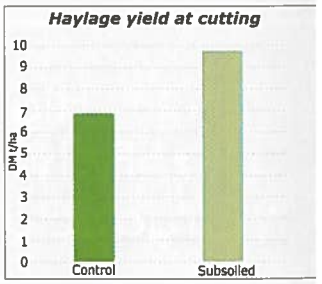
Grass yields in spring of subsoiled and non-subsoiled grassland areas.

Soil profiles from the trial showing a untreated compacted soil clod in the left hand and subsoil treated soil clod in the right hand.

Yield & financial benefit

Haylage cut in June yielded on average 42% higher DM in the subsoiled area of the field in comparison with the untreated area—9.74t/ha compared to 6.85t/ha DM in control. That's an extra 2.89t/ha. This increased yield gave a net financial gain of £51.89 per hectare allowing for subsoiling costs and the additional costs to bale and wrap the extra haylage.

During the recent drought conditions, a visual assessment of regrowth in the subsoiled are of the field post-cutting appeare better than the non-treated area.



Haylage trial yields in June.