

# **BETTER SOIL AND GRASSLAND MANAGEMENT FOR SCOTTISH BEEF AND LAMB PRODUCERS**







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## THE IMPORTANCE OF YOUR SOIL

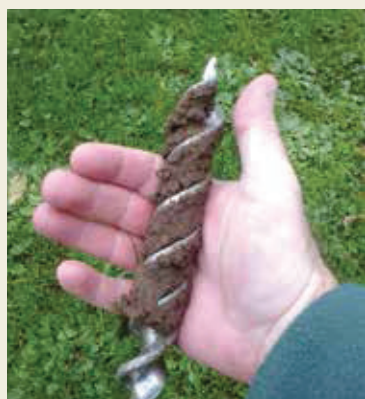
Soil is the raw material from which most food is produced, and is a precious natural resource. Soil conditions on beef and sheep farms directly influence how well grass and forage crops grow, and the quality of feed they produce. As soil plays such an integral part in farming, it is important to assess and monitor its chemical and physical properties.

Simple tests can highlight shortfalls and surpluses in nutrients which, when corrected, could save farmers significant amounts of time and money. Annexes 1 and 2 have more details of the soils found in Scotland and how the land classification system works.

A spade is one of the most important pieces of equipment when it comes to checking soil health. Digging a hole and handling the top and subsoil can reveal a great deal about its current state and likely future performance. Compaction is the enemy of good crop growth. Steps must be taken to relieve compacted soils; and everything done to limit compaction in the first place.

### TESTING YOUR SOIL

Like animals, plants need nutrients to grow. If any are in short supply, development will be compromised and performance disappointing. Any shortfalls can be made up by applying manures, slurries or artificial fertilisers.



A soil test will help decide how many additional nutrients are required, allowing a more targeted approach to fertiliser use, saving time and money. A soil test, costing £15-20 will give you the pH, Phosphate, Potassium and Magnesium levels and can save money on wasted fertiliser.

### HOW TO SOIL TEST

- Twist a sampling auger/soil corer down to 7.5cm
- Walk the field in a 'W'. Avoid gateways, feeding areas or other unrepresentative areas of the field.
- Collect 25 plugs of soil per field- split larger fields or fields with different soil types for separate analysis
- Seal soil in plastic bag and label
- Send to your local SAC Farm & Rural Business Services office or other approved laboratory along with details of past cropping and what the field is to be used for

Sample approximately every five years, in the same season and at least two months after the last application of manure, fertiliser or lime.

Include fields that: underperform, are going to be reseeded, which receive a lot of Farm Yard Manure (FYM) and slurry or where the perennial ryegrass content is noticeably declining.



# LIME - THE MOST LIMITING NUTRIENT

Correcting the pH status of the soil by applying lime is a simple and effective way to increase grassland productivity. Applying other fertilisers will be ineffective without correct soil pH.



How much lime to apply depends on soil type and liming material. Five tonnes of lime per ha should raise pH by 0.4 units. Do not apply more than 5t lime/ha in any one season and don't re-test for a year as it takes between 9-12 months for pH to increase. There are many liming products and choice should be based on neutralising value (NV), fineness of grinding and hardness of the parent rock. More details from the Agricultural Lime Association, go to [www.aglime.org.uk](http://www.aglime.org.uk) or tel: **0207 963 8000**. Your local SAC Consulting Farm & Rural Business Services office, part of Scotland's Rural College (SRUC) can also help you to decide on the best lime product for your situation.

## SOIL TEST RESULTS

(see Annex 3 for typical soil analysis from SAC laboratory)

### pH (Acidity)

- Essential for interaction of nutrients and optimising plant growth
- Apply lime if too low, monitor after 12 months
- Ideal pH is 6.0 to 6.5 (5.8 to 6.0 on peaty soils)
- Heavy cropping will reduce soil pH
- Difficult to change naturally without applying lime

### Phosphate (P)

- Essential for root development, drought tolerance and allows efficient uptake of Nitrogen. Moderate status is required.
- Apply Phosphate from bagged fertiliser or slurry/Farm Yard Manure (FYM), slow release products (rock phosphate) for slow build up of reserves, more available phosphate products are more expensive but will act quicker
- Phosphate is locked up at incorrect soil pH (under 5.5 or over 6.5)
- Avoid over application of phosphate as there is a risk of algal bloom, eutrophication and it is a waste of money. Phosphate is an expensive nutrient and only finite resources exist.

### Potassium (K – Potash)

- Essential for transport of nutrients around the plant. Crucial to replace Potash removed by cutting. Aim for moderate status.
- Apply from bagged fertiliser or slurry/FYM.
- Do not apply to spring grazing as magnesium can be locked up leading to staggers
- Excess K is not harmful to the environment but it is an expensive nutrient so avoid over application

### Magnesium (Mg)

- Essential to reduce the risk of staggers (Hypomagnesaemia) in grazing animals
- Can be applied in the form of magnesium lime
- Identify fields that are prone to staggers risk in spring and autumn
- Excess Mg reduces efficiency of Potash and Nitrogen and can lead to soils that are difficult to break down while cultivating

These can all influence how efficiently nitrogen will be used. Correct soil analysis may allow less nitrogen to be applied without yield reduction or more N can be applied for higher yields. Nitrogen is sourced from artificial fertiliser, legumes, soil organic matter and the atmosphere.

### Nitrogen (N)

- Essential for grass production and conversion of protein into meat and milk
- 50kg N/ha can give an extra 2000-3000 kgDM/ha, 100kg N/ha can give an extra 3000-5000kg DM/ha
- Too much N can lead to poorer silage quality, potential pollution problems from leaching and is also a waste of money unless soil conditions are correct and the crop requires more N
- If you farm in a Nitrate Vulnerable Zone (NVZ) there are additional restrictions on Nitrogen applications. Seek advice from a FACTS qualified consultant.

**For more information refer to SAC Technical Note TN652- Fertiliser Recommendations for Grassland. PLANET is a free web based resource for nutrient management. See Annex 4 for links to these and other useful sources of information.**

# SOIL TEXTURE

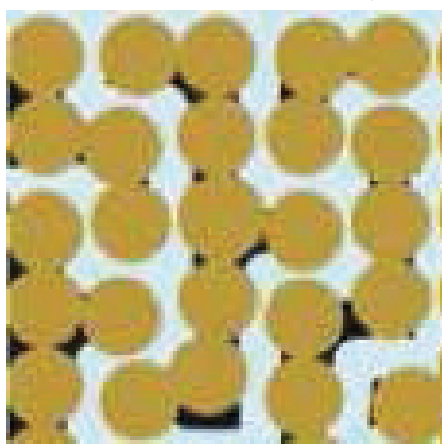
The physical properties of soil vary between and within fields, at different depths and depending on how it is managed. Soil Texture refers to the relative proportions of clay, silt and sand. These are the main components of all soils but they occur in differing amounts.

## Assessing soil texture

Rub some moist soil between finger and thumb. Sand feels gritty and is difficult to mould into a ball. Silt feels smooth, silky or floury, while clay feels sticky when wet, looks shiny when smeared and will hold a ball shape. Soil texture cannot be changed, but knowing what it is will help when planning future management.

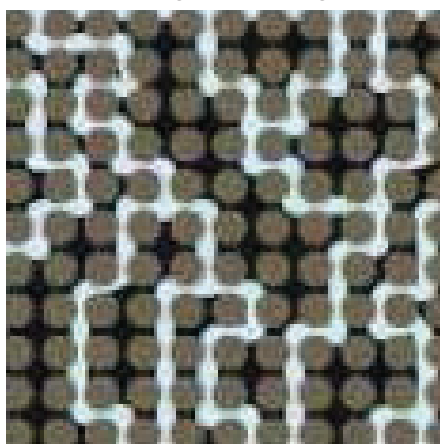
## Characteristics of sand, silt and clay soils

**Sand - water drains freely**

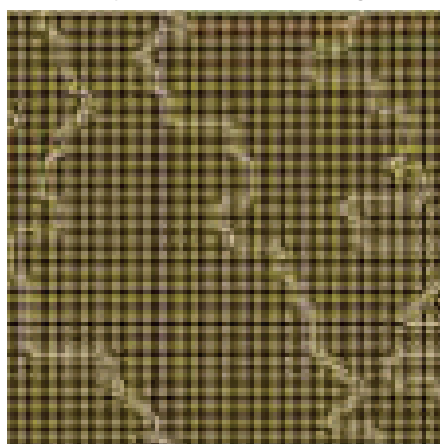


Largest particles  
Largest airspaces  
Free draining

**Silt - good drainage**



**Clay - restricted drainage**



Smallest particles  
Smallest airspaces  
Restricted movement



# SOIL STRUCTURE

Refers to the arrangement of the sand, silt and clay particles into blocks. See the diagram “Visual evaluation of soil structure” on page 8 for more information.

**Good soil structure** – characterised by well formed porous blocks with rounded edges, easily broken between the fingers when moist. Vertical fissures lead roots downwards. Hard to damage. Good soil structure will enable soil nitrogen to be used more effectively and will also give good drainage and better uptake of minerals via the roots.

**Poor soil structure** – much harder, sharper blocks which are more difficult to break apart. Horizontal fissures restrict root growth and development. Easier to damage.

## Assessing soil structure

Take a spade and dig a square hole 50cm wide down to 40cm depth. Lift out a section of soil and examine it carefully. Look at the

- Topsoil depth - shallower under permanent pasture than cultivated soils
- Colour - topsoil rich in organic matter will be dark. Rusty grey mottled soils indicate poor drainage and previous water logging.
- Smell - if water lies trapped in the soil for any length of time, the air-less conditions prevents breakdown of organic matter and manures leading to a foul smelling layer of dead material.
- Roots - should extend to beyond 30cm in a healthy, well structured soil.
- Earthworms - there should be 10-15 earthworms in the section removed.
- Cracks and pores - ideally there should be vertical channels 5mm wide between the blocks to allow free movement of water, air and nutrients.

## Signs of poor soil health

- Poor spring grass and overall yield.
- Weed grasses dominate over productive species.
- Low stocking rates and poor animal performance.
- Water collects on the surface and more prone to poaching.
- Muck and slurry does not break down for months.
- Poor feed value in the grass, reduced uptake of soil minerals and trace elements due to restricted root development.
- Few earthworms found and root growth is blocked by compaction.



















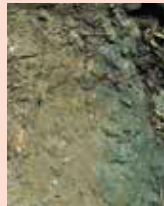



Compacted soil



Friable soil

# VISUAL EVALUATION OF SOIL STRUCTURE

Structure quality	Size and appearance of aggregates	Visible porosity of roots	Appearance after break-up: various soils	Appearance after break-up: various soils	Distinguishing feature	Appearance and description of natural or reduced fragment of - 1.5 diameter
<b>Sq1 Friable</b> Aggregates readily crumble with fingers	Mostly < 6mm 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 
<b>Sg2 Intact</b> Aggregates easy to break with one hand	A mixture of porous, rounded aggregates from 2mm - 7cm Nocolds 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 
<b>Sq3 Firm</b> Most aggregates break with one hand	A mixture of porous aggregates from 2mm - 10cm: less than 30% are < 1cm. 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 
<b>Sq4 Compact</b> Requires considerable effort to break with one hand	Mostly large > 10cm and sub-angular non-porous; horizontal/platy also possible: less than 30% are < 7cm	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 
<b>Sq5 Very compact</b> Difficult to break up	Mostly large > 10cm, very few < 7cm, 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 usually visible 



# COMPACTION

Compaction is where soil has been squashed into a solid, impermeable layer, either at the surface or within the topsoil. This band restricts the movement of air, water and nutrients down through the soil profile.

This type of damage leads to poor root growth, which stresses the plant and reduces its response to nitrogen. Applying fertiliser to compacted soils is a waste of time and money, as the plant will not be able to fully utilise it. The risk of fertiliser run-off will increase by as much as 50–60%.

Compaction can also cause temporary waterlogging. Wet soils stay colder for longer reducing the number of available grazing days. This can also make harvesting difficult, which is likely to reduce the quality of the resulting silage.

## Signs of waterlogging

- Standing water
- Reddish tinge to grass leaves indicating stress
- Rushes, marsh thistle and Yorkshire fog
- Scorch marks from urine patches where urine could not drain away.

## Identifying compaction

Dig a hole at least a spade's depth when the soil is not excessively wet or dry. Look how far roots and moisture extend down the profile and for any obvious change in soil structure.

Where the spade meets resistance is where the compaction starts. This depth will give a clue to the cause. It is also possible to use a soil penetrometer or a thin steel rod to determine where the compacted layer starts.



Using a soil penetrometer

## Tackling soil compaction

TYPE OF COMPACTION	CAUSE	REMEDY
Surface capping 0–10cm	Grazing in wet conditions	Lime, organic matter to encourage earthworms  Soil aerator with spikes or knives, ploughing
	High stocking densities	
	Rainfall after cultivations	
Machinery 10–15cm	Silage and muckspreading	Soil aerators, subsoiler or sward lifter, ploughing
Plough pans 10–15cm or deeper	Repeated ploughing to the same depth over time	Subsoiler or sward lifter, mole ploughing or deeper ploughing below the plough pan depth

While compaction can be alleviated in existing swards, it is more commonly tackled as part of a reseed, especially if it involves full ploughing. **DO NOT** subsoil established swards in wet conditions or the problem will get worse. Serious poaching or run-off must be dealt with quickly to meet Cross Compliance rules.

## POACHING

Poaching is the name for damage done to grass and the underlying soil by livestock which has been allowed to stand and walk on it for prolonged periods in wet conditions.

Cattle can leave compacted depressions or pockets in the surface of the ground 10–12cm deep in which water can lie. Beneath may be a grey, smelly, unhealthy layer of soil. These are usually in areas of greatest activity – in gateways or around drinking troughs and feeders. The destruction reduces grass growth and allows weeds to infiltrate the bare areas.

### Cattle poaching

Sheep damage grassland differently. They are less likely to break the soil surface, but at high stocking densities they pound the ground as a flock, producing a solid compaction layer over a wide area, at 2 to 6cm deep.



Cattle poaching



Sward lifter



Grassland subsoiler

## HOW TO PREVENT POACHING

- ✓ • Create multiple entry points to fields
- ✓ • Outwinter only on light, free-draining, well structured soils
- ✓ • Use dedicated tracks for moving beef cattle
- ✓ • Minimise traffic into fields by storing bales close to where they will be fed
- ✓ • Allow cattle access to a sacrifice area, accepting poor grass performance next season, but knowing that the most important/productive pastures have been protected
- ✓ • Feed sheep using a mobile snacker system rather than fixed troughs
- ✗ • Don't drive across fields in wet conditions



# WHAT COMPACTION MEANS TO GRASS GROWTH AND LIVESTOCK PRODUCTIVITY

## Yield

A young grazing ley is capable of producing 12t DM/ha/yr or under a cutting regime up to 14t DM/ha/yr can be produced. Permanent pasture can produce 9–10t DM/ha/yr. However these levels of production can only be sustained in soils that have adequate nutrient reserves and are appropriately managed.

When soils of similar nutrient status are poorly managed, they may only yield 6–7t DM/ha/yr. This means the farmer may have to buy-in feed to last the winter at much greater cost than it would have been to produce it on-farm.

Every 1t DM/ha increase in utilised grass equates to a potential increase in stocking rate of 1.4 ewes per hectare (at 150%) or 100kg of beef live weight gain per ha/year. Another way of putting this is that each tonne of grass DM utilised would require almost a tonne of concentrates to be purchased as an alternative feed source.

## Quality

Poor soil nutrient content and condition encourages competition from indigenous and less productive grasses. These are less digestible and contain lower levels of energy and protein. This reduces feed quality, animal intake and performance.

Under excellent grazing and soil management, a beef steer can gain 1.2kg liveweight a day on a high quality perennial ryegrass/clover sward. However, industry data suggest that many producers achieve only 0.6kg live-weight a day on pasture so there is significant room for improvement.



Compacted and poached area showing bare patches



# CONTROL OF COMMON WEEDS IN GRASSLAND

Weeds reduce sward yields, energy content and quality. Some are poisonous and if left uncontrolled will spread and shed seeds causing even more headaches in future years.

## Why weeds establish

Weeds are often linked to poor management e.g:



## Do I need to control weeds?

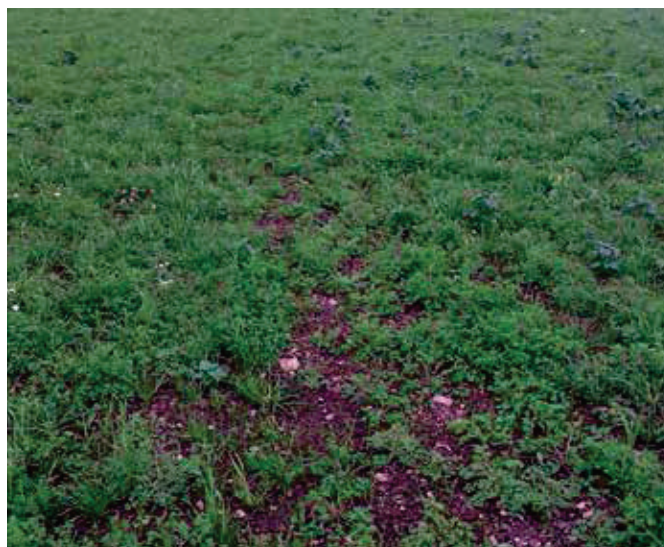
Assess 50x50cm squares at a number of places around a field. If more than 10% of a square has weeds, production is being compromised.

Broad-leaved and grass weeds can be controlled in a sward, or during sward destruction, ie two or three weeks after grazing/mowing and before reseeding.

Topping reduces the spread of thistles and nettles, but spread may still occur via roots. Timing of sprays is important, always seek advice from a BASIS-qualified adviser and only use a qualified sprayer operator. Spot spraying and weed wiping are useful for tackling small areas of invasive weeds.



Docks are a major problem on many farms



This failed reseed had to be ploughed up



WEED	FEATURES	CONTROL OPTIONS
<b>Chickweed</b> 	<p>Seeds throughout the year and fills bare patches. Can control in a sward, but may also need to fill gaps, e.g by over-seeding. A particular problem in reseeds.</p>	<ul style="list-style-type: none"> <li>• Heavy autumn grazing</li> <li>• Autumn harrowing</li> <li>• Include clover to fill gaps</li> <li>• Herbicide use</li> </ul>
<b>Thistles</b> 	<p>Spread by seeds and roots. Topping helps but will not stop spread completely.</p>	<ul style="list-style-type: none"> <li>• Control when actively growing by frequent topping or herbicide</li> </ul>
<b>Buttercups</b> 	<p>Indicate low soil fertility, particularly nitrogen. Consider why this weed has invaded into bare patches in the soil.</p>	<ul style="list-style-type: none"> <li>• Improve drainage by aeration etc</li> <li>• Increase ground cover</li> <li>• Herbicide use</li> </ul>
<b>Nettles</b> 	<p>Nettles like rich soils. Spreads by seeds and roots.</p>	<ul style="list-style-type: none"> <li>• Topping helps but will not stop spread completely</li> <li>• Control when actively growing</li> <li>• Herbicide use</li> </ul>
<b>Docks</b> 	<p>Seeds remain dormant for many years, can also seed after cutting. Twenty docks in a 5m x 7m area can reduce grass yield by 3.4t/ha. Even at half this level of infestation spraying is economic.</p>	<ul style="list-style-type: none"> <li>• Repeat treatment required as seeds germinate throughout the year and roots spread</li> <li>• Apply herbicide at rosette stage, post cutting and grazing</li> </ul>
<b>Rushes</b> 	<p>Associated with poorly drained soils in permanent pastures and rough grazing. Produce large numbers of seed that are widely dispersed by wind. High seed numbers are present in most soils, so the risk of infestation is high where there are gaps in the sward.</p>	<ul style="list-style-type: none"> <li>• Improve drainage</li> <li>• Maintain soil fertility</li> <li>• Topping before seeding</li> <li>• Spray glyphosate (via weedwiper) or MCPA to young actively growing rushes</li> </ul>
<b>Ragwort</b> 	<p>Ragwort is a poisonous plant, particularly when ensiled as livestock cannot avoid it. This is a notifiable weed under the Injurious Weed Act of 1959 and there is a legal requirement for land occupiers to control spread.</p>	<ul style="list-style-type: none"> <li>• Hand pulling (wear suitable gloves)</li> <li>• Spray larger areas</li> <li>• Careful disposal of plants</li> <li>• Control at rosette stage</li> <li>• Sheep grazing</li> </ul>

# RESEEDING



## Grass weeds

Grass weeds include Annual Meadow Grass, Creeping bent, Yorkshire Fog, Rough Stalked Meadow Grass and Couch grass. Being grasses they do have a nutritional value and are not toxic to livestock. However their presence indicates the need to reseed a sward. Weed grasses are not as productive as sown species, their digestibility is much lower and they will not respond to inputs of fertiliser. They cannot be controlled by herbicides and even oversowing can be unsuccessful if a dense mat of weed grasses exists. Spraying off the old sward with glyphosate before reseeding is a good idea.

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**NB** SAC Technical Note TN 643- "Weed Management in Grassland" can be accessed at [www.sruc.ac.uk](http://www.sruc.ac.uk) and covers this area in greater detail.

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## When to reseed?

It is useful to have a set of guidelines to follow when deciding on whether a field needs to be reseeded. Some farms may have short term leys in a fixed rotation but the majority of beef and sheep farms will have longer term leys from 4 years to 15 years or more. The decision to reseed must be taken in the context of the overall farm stocking rate and when the demand for grass is on the farm. The four areas to consider are, soil structure, soil analysis, weed content and the amount of sown species v weed species present. The table opposite is modified from the British Grassland Society (BGS) pasture improvement flow chart



AREA	FIND OUT THE ISSUE	POTENTIAL FINDINGS	WHAT TO DO
<b>Soil structure</b>	Dig a hole to 30cm	- Compacted layer identified - No compaction	- Correct by aeration, subsoiling or cultivations for reseeded - No action required
<b>Soil analysis</b>	Take a soil sample and test for pH, P, K & Mg	- pH is below 6 - pH is above 6 - P & K indexes are reducing - P & K indexes are increasing - Low magnesium - Magnesium levels correct	- Lime required, seek advice on how much and product - No lime required - Review application rates and use of manures - Reduce rates and save money - Consider Mag Lime - No need for Mag Lime
<b>Weed content</b>	Assess weed levels and species	- More than 10 docks per 35m <sup>2</sup> - Broad leaved weeds above target levels - No broad leaved weed issues	- Control in existing sward or reseed if low level of sown species - As above - Assess grass weeds and sown species %
<b>Sown species</b>	Pull up some grass plants in several locations, identify species	- Sown species above 70% - No clover - Sown species below 50%	- Sward still productive but consider yield potential of the field and benefits of introducing new varieties - Consider introducing clover to improve forage protein and to fix nitrogen - Reseeding will increase yields, feed value and response to nitrogen

Most beef and sheep farms have a variety of grass types – from productive short term cutting leys to semi natural or even rough grazing. Environmental issues and payments often form an important role on the farm. Every field does not need to be reseeded in the same rotation. Identify the areas of the farm that will give the most cost effective response to investment in reseeded and other inputs. These areas can form the “engine room” for Dry Matter production on the farm with other areas managed more extensively. Every farm will have a different set of priorities – what suits you might not be right for your neighbour.

## USING RECOMMENDED LISTS

In Scotland SRUC (Scotland's Rural College) carry out variety trials for grass and clover at three sites: Edinburgh, Aberdeen and Ayr.

This is funded by the merchants participating in the grass levy scheme and the Scottish Government. When purchasing grass and clover seed you should ensure the suppliers participate in the scheme as this will give them access to the most up to date information on the varieties best suited to Scottish conditions.

### Why use varieties recommended by national trials?

Few farmers these days would want to use bull or ram genetics from the 1950s, but many have outdated varieties in their grassland, along with unsown species of weed grasses. The Recommended Grass and Clover Lists provide information on the best performing grasses and clovers available today. The varieties that make it onto the lists have been independently tested and heavily scrutinised by a panel of experts to ensure that only varieties of genuine value to farmers are included. As few as 1 in 20 varieties of ryegrasses tested will actually make it onto the recommended list.

By relying on old varieties, farmers are missing out on the benefits the newer recommended varieties can give. In the UK farmers tend to reseed with a mixture of different grasses and clover, rather than sowing a single variety. Mixtures have scientifically proven yield benefits, compared to the same varieties sown individually as they allow farmers to capitalise on the strengths of different species.

### Working with your seed supplier

Your merchant can help you make the best decision on what types of grasses are appropriate for your system and requirements, eg silage only, grazing only or both. Ask them to look at all the results of the independent trials, which should include information on persistency, seasonal growth patterns, ground cover, winter hardiness, digestibility and disease resistance. Tell your seed supplier about the field to be reseeded and your plans for its future use and management. This will ensure that the mixture is matched to each field's particular needs and the most cost effective varieties are included. Seed amounts to 25% of the total cost of reseeding so saving £10-20/acre by using cheap seed is false economy.

### Benefits of reseeding

Depending on the starting point it is likely that a substantial yield benefit will result from reseeding in addition to better quality grass, more grass in spring and autumn and in addition, reseeding presents an opportunity to correct soil deficiencies, cure any compaction issues and control broad leaved weeds.

### Benefits include:

- ✓ • Modern improved varieties improve each year
- ✓ • Increased palatability – from ryegrass and clover
- ✓ • Increased protein – from white and red clovers
- ✓ • Improved nitrogen efficiency – and less leaching
- ✓ • Reduced nitrogen requirement – with clover
- ✓ • Opportunity to tackle weeds
- ✓ • Less disease, eg crown rust – resistant varieties
- ✓ • Improved drought resistance – through using clover and suitable grass varieties
- ✓ • Matching sward to growth objectives – using heading dates and seasonal growth



A full reseed, including ploughing, costs up to £700/ha (£240/ac), however, this will quickly be recouped in yield benefit. For example an extra 3 tonnes of DM/ha is the equivalent feed value of 3 tonnes of concentrates. It is sometimes felt that a farm cannot afford to take a field out of production – these figures suggest that you can't afford NOT to reseed.

Look at the size of your fields. Temporary fencing to split larger fields may mean it is easier to reseed half the field each year (as well as making grazing management easier). Look at other practical options such as catch crops to fill in gaps in the feed budget or taking an early silage crop before reseeding a field when grass growth is high and the field will not be out of production for more than 6-8 weeks.

### Ploughing or direct drilling?

Ploughing will be the most expensive option but will give good establishment. Assess whether ploughing is right for your farm (or field). Consider both the costs and environmental issues especially if the grass is classed as permanent pasture.

#### Ploughing

- Releases soil Nitrogen - leaching may be high when no crop uptake
- May bring up stones that will need removing
- Will improve soil structure and alleviate compaction while aerating the soil

#### Direct drilling

- Quicker and cheaper than ploughing and full cultivations
- Less disruption to ground, sward and livestock
- Contractors job generally using specialised equipment
- Must reduce competition from existing grass and weeds by harrowing or full/half rate herbicide treatment.
- Does not alleviate soil compaction so if present this also needs attention



Erth Agriseeder



Moore's unidrill



Aitchison drill

## FEATURES OF THE MAIN SOWN GRASS SPECIES

SPECIES/FEATURE	FEATURES
<b>Perennial Ryegrass (PRG)</b>	Productive, good persistence, high D value, good response to nutrients, range of heading dates (early to late), early heading are better suited to short term cutting mixtures, late heading for longer term grazing. Some varieties of PRG have been bred with higher sugar content. This provides extra energy which helps to utilise crude protein in the grass
<b>Italian Ryegrass (IRG)</b>	Easy to establish, cheap seed, higher yields than PRG, only last 1-2 years, suitable for bulky silage crops – 3-4 cuts plus late grazing
<b>Hybrid Ryegrass</b>	Cross of PRG & IRG, can last 3-5 years, cutting use mainly, suitable for red clover mixture
<b>Timothy</b>	Slow to establish, lower yielding than PRG, suits wet, heavy soil and tolerant of winter sheep grazing, late heading and good palatability in late season
<b>Cocksfoot</b>	Lower palatability and lower yielding than ryegrass, drought tolerant, early heading
<b>Fescues</b>	Low yields but useful in upland/extensive grazing mixtures
<b>Westerwolds/Forage Rye</b>	One year crop of bulky material, Westerwolds for cutting, Rye for winter/early spring grazing
<b>Diploid and Tetraploid Ryegrasses</b>	Diploid - Good ground cover (tillering), persistent, used in medium to long term mixtures  Tetraploid - Twice the number of chromosomes than Diploid varieties. Larger seeds, faster establishment, higher yielding at first cut, open growth habit, less persistent.

### Managing reseeds in the first season

- Encourage tillering with a light grazing by sheep or young cattle at 10cm height. Avoid hard grazing as new shoots can be harmed. On-off grazing is best
- Graze well down before winter to reduce winter kill but do not overgraze as green leaf area is required for photosynthesis
- Remove stock in wet weather to reduce poaching. Don't graze with heavy cattle.
- Alternate cutting and grazing to prolong productivity but avoid a late summer cut that can deplete plant reserves and lead to slow recovery

### Improving long term grazing

The value of long-term grassland is often underrated. The maximum annual yield that can be achieved is less than for a new ley – 9t DM/ha compared to 12t DM/ha, but the cost of production is less. It also has a denser sward and is able to carry more stock, especially through the winter months, and the diversity of plant species gives livestock more choice in their grazing. On the downside, the growing season for permanent pasture is shorter and the quality of the grass can be poorer, depending on the ryegrass and clover content.

Permanent pasture needs managing as much, or even more, than a newly-sown ley. If the soil and the sward are managed well, grass and animal production can be very good, and no herbicides or mechanical topping will be needed to control weeds or maintain quality. Soil nutrient shortfalls are very common under permanent grass and addressing any deficits is crucial for improving production and feed value. Grasses produce stem and go to seed much faster if soil nutrient levels are below optimum for growth.

Up until a decade ago, lime was regularly applied when fields were ploughed, but with greater focus on cheaper methods of seed introduction, lime has been overlooked. This means many soils under long-term grass are now more acid than the ideal pH 6.2. Pastures that have been cropped for silage or hay and have not had nutrients replaced to balance off-take, will also underperform. Where land is not under any environmental restrictions, a soil test should be taken so that appropriate fertiliser inputs can be applied.



Soil structure is important for grass health and production. Over the years soils can easily become compacted, restricting the movement of air, water and nutrients down through the soil profile. As ploughing is often not an option to break up horizontal pans, alternative methods such as aeration may be needed to allow adequate root development and nutrient uptake. Having adequate drainage is important to prevent unproductive and unpalatable species such as rushes encroaching into the pasture.

A good quality permanent sward should consist of 50% ryegrass and 20% white clover. In a permanent sward there may be eight to twelve different grasses, and a similar number of broad-leaved species. Some of these will be less desirable plants such as thistles but good nutrition and tight grazing down to a uniform height to produce a dense sward will make it harder for unwanted species to gain a foothold.

If swards do become damaged and ryegrass contents dip below the desired 50%, extra seed can be introduced by over - or slot-seeding. If the ryegrass percentage falls to 30% or less, a complete reseed after ploughing will be the best option, if allowed. Poached areas in gateways and around feed troughs should be reseeded regularly to prevent weed ingress.

### **Grassland management in the hills and uplands**

Livestock producers relying on grass in hill and upland areas face different and more difficult challenges to low ground farms.

Air temperature drops 1°C in every 100m rise above sea level, which impacts directly on grass growth, particularly the length of the growing season. North-facing pastures take longer to get going in spring than fields looking south. Annual rainfall is much higher and soil depth and quality significantly poorer at higher altitudes. The soils tend to be more acidic and lacking in nutrients as these are leached away with the rain.

In these areas, total yield may not be the principal requirement from a grass crop. Winter hardiness and the ability to grow at low temperatures may be key. New varieties of late heading perennial ryegrasses, which produce early spring growth and good ground cover are worth considering. Other grass species such as fescues and timothy have greater roles to play in upland swards. In trials, red fescue and timothy swards gave 70% and 30% more lamb output/ha in spring respectively, than ryegrass on wet peaty soils.



The introduction of new seeds is limited to late spring (April or May) or late summer (July or August), when there is adequate soil temperature and moisture. Leaving reseeding later than early August is inadvisable as the risk of frost damage to tender, young plants – particularly clover – increases greatly. White clover will fix nitrogen in upland swards as it does in the lowlands, but here lime and phosphate deficiencies often limit its growth and activity. Investing in lime and phosphate will reap dividends. Current research is developing clovers capable of good performance under lower phosphate levels.

### Spring Nitrogen fertiliser for grass

A spring application of nitrogen will kick-start spring growth. Timing should be governed by soil temperature, assuming that ground conditions are good enough to travel. Measuring soil temperature using a soil thermometer is the most accurate way of deciding when to apply. As a guide, soil at 10cm deep should reach 5°C for at least five days. Some farms continue to record TSUM 200 which is when cumulative (positive) ground temperatures from 1st January reach 200. This indicates the soil temperature is warm enough to apply nitrogen.



Typical upland farms in Scotland with improved and rough grazing

## WHITE AND RED CLOVER

### Benefits of clover

Clovers can replace bagged nitrogen in conventional and organic swards. How much nitrogen is fixed depends on the clover content in the sward. Clovers produce a high protein and palatable feed which improves animal intakes and performance.

Clovers require soils to be 8°C for growth to commence but are more drought tolerant than Ryegrass. A grass/clover sward can out yield a grass only sward (depending on N input). Clovers require soil pH to be 6 to 6.5 and moderate P & K indexes. Clover will fix nitrogen for the current and subsequent crop.

However there are few herbicides that are clover safe and if ensiling clover extra care must be taken to avoid leaf shatter. Clovers are also low in sugar so additives may be required for very high clover silage crops.

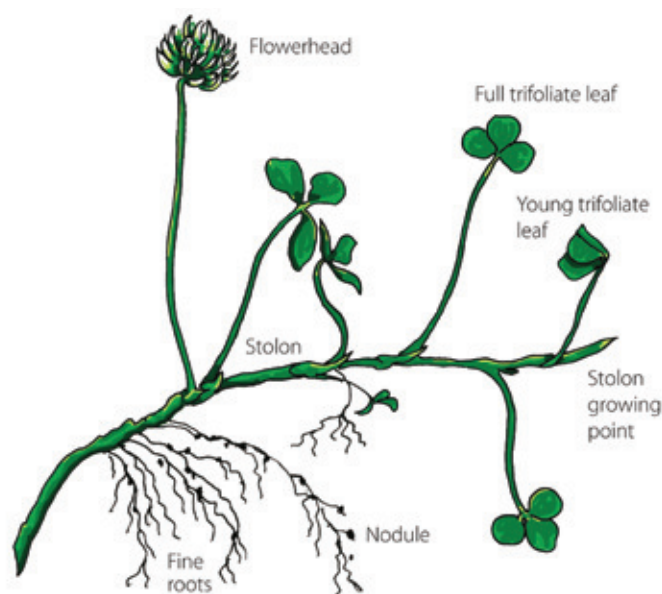




## Characteristics of white clover

Small leaved white clover suits continuous hard sheep grazing, medium leaved suits frequent cutting and rotational grazing systems while the larger leaved white clover suits cutting and cattle grazing.

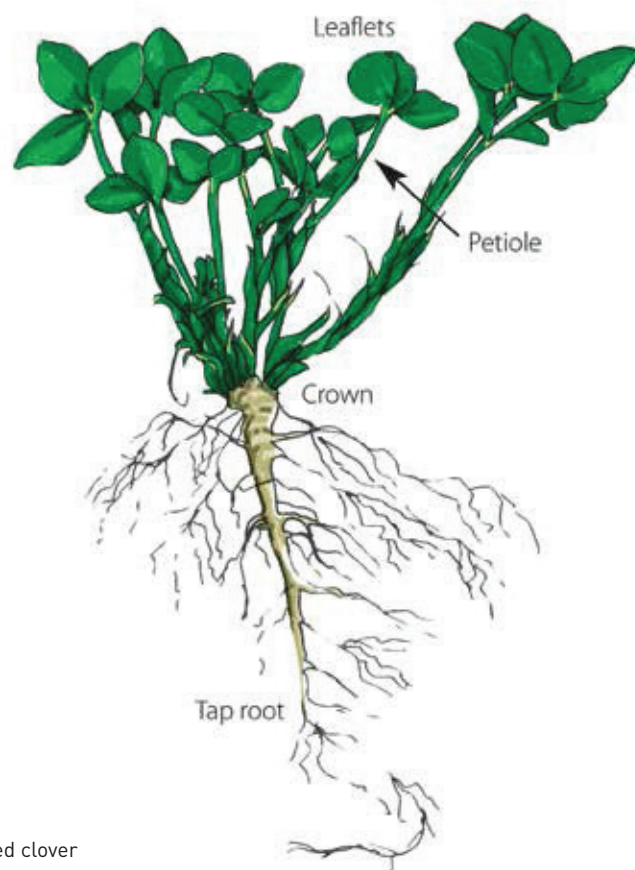
- White clover can fix up to 280kg N/ha, although more typically 150kg N/ha
- It is a longer-term crop, less disease-prone than red clover
- Newer varieties can tolerate higher N levels but this reduces the amount of N it can fix from the atmosphere.
- For every 10% increase in white clover, the protein content of forage will be 1% more, and in late summer sward crude protein can increase to 25%
- Target 25–35% of sward DM as clover. Be patient for full nitrogen fixing effect in grass production
- Up to 50% of sward can become clover and look like an entire clover sward from above
- Clover can be established at a later date to a main reseed, either at a more suitable time of year, such as after first cut silage or after weed control in a reseed. (Avoid introducing clover until the spray residual has been de-natured)
- Weed control choice is limited
- Sowing is best in April to August, adding or replacing 2.5kg/ha (1kg/acre) seed. Broadcast or drill to an optimum seed depth of 5–10mm



White clover

## Characteristics of red clover

- Red clover swards can fix between 200–300kg/ha of nitrogen, producing the same yield as a short term ley with the same amount of N applied
- Best sown with grass, especially hybrids, to optimise forage yield
- Crude protein up to 19% in silage depending on % in sward and cutting date
- High protein content makes it excellent for finishing lambs and cattle in autumn
- Cutting too low, or overgrazing in autumn/wet conditions, damages plant crown and risks killing plants
- Soil-borne disease and pest control create need for a rotation with breaks of five to eight years
- Sowing is best in spring or mid-July to end-August, replacing 7.5kg/ha (3kg/acre) of grass seed with clover seed. Broadcast or drill to an optimum seed depth of 5–10mm
- Unsuitable for sheep grazing for six weeks pre/post-tupping due to high oestrogen levels that can lead to fertility problems. It should be avoided from six weeks pre mating to six weeks after mating



Red clover

## IMPROVING GRASS UTILISATION

Up to now the focus of this booklet has been on managing soil, growing more grass and better quality grass. However there is little point in incurring the expense of improving your soil and grassland if you either don't need the extra grass or are unable to utilise it.

Unlike arable crops where the whole crop is harvested in one day grassland utilisation is far more challenging as there are a number of variables involved. Grazing systems typically only utilise 50-70% of the available Dry Matter while cutting management utilises 70-90%. This section looks at ways to improve utilisation of Dry Matter and how best to integrate grazing and cutting management.



## INTEGRATING GRAZING AND CUTTING

There is often a conflict on beef and sheep farms regarding the integration of silage and grazing. Firstly ewes with twin lambs may be grazing silage fields which require shutting up to make silage for the cattle. Secondly the quality of silage required for different classes of stock will vary.

Suckler cows require bulky poorer quality forage while growing cattle and sheep require a much higher quality to support growth and pregnancy. Each farm will have slightly different circumstances to consider regarding the amount of silage or hay fields they have, balance of cattle to sheep, cattle marketing policy etc.

The first issue often resolves itself as grass growth increases and grazing livestock can be tightened up to release the silage/hay fields. However in late growing years this may not be the case and the silage fields will be shut off later. Having productive re-sown fields means that grass growth will be earlier in spring and the system is not under so much pressure. Your silage fields should be in the shortest rotation on the farm with leys from four to six years while grazing only fields can be re-sown every six to ten years as the need arises.

It is usually more cost effective to dilute good quality silage with straw (e.g. for suckler cows) than to improve poor quality silage by adding concentrates. Therefore while a balance of quantity and quality must be found it is preferable to make the best quality forage you can. The issue of whether to make one bulky cut of silage or two higher quality cuts also forms part of this discussion. One cut systems may suit more extensive farms that sell calves at weaning and do not house sheep while farms that sell store cattle and house pregnant ewes will be better served with a two cut system giving higher quality silage. It may also be possible to integrate some environmentally managed grassland to make more stemmy silage or haylage that would be suitable for suckler cow feeding.

Some beef farmers have commenced the policy of grazing their silage fields once to get an earlier turnout before shutting them up for silage. This will slightly depress the first cut yield but it will be of higher quality and the yield reduction is generally less than the amount of silage saved by turning the cattle out earlier. In addition there will be savings in housing costs and cattle will be acclimatised to a grass diet sooner, so higher overall weight gains from grass should be possible.



## Early season



## Mid season



## Late season



### One third/two third system

Many farms operating a two cut system will adopt a system where in early season 1/3 will be grazed and 2/3 cut for silage, in mid season 2/3 will be grazed and 1/3 cut and in late season the whole area will be grazed. This reflects the higher grass growth in spring and early summer, the need to conserve the surplus grass and that more grazing land is required in late summer as grass growth declines and livestock demand increases.

The above scenario works well on better beef and sheep farms where most of the fields can be cut for silage. However many beef and sheep farms in Scotland have a range of pasture types and perhaps only a small proportion of the farm can be cut for silage. It is not necessarily the area cut that is important but that the right amount of silage is made from productive fields with the more extensive fields grazed.



Cattle grazing a well managed high clover ley

# GRAZING SYSTEMS

## Sward height targets for beef and sheep

Managing grass by using sward heights is a simple method of keeping grassland under control whilst also ensuring that livestock requirements are best met for good performance. All that is required is a ruler or sward stick or other objects such as golf balls, beer cans etc can be used. A simple mark on your boot is also effective.

TYPE OF STOCK	PERIOD	ROTATIONAL PRE GRAZING HT-CM	ROTATIONAL POST GRAZING HT - CM	SET STOCKED CM
<b>Lactating suckler cows</b>	T'out- May	10-14	5-6	5-6
	June-July	12-15	7-8	7-8
	Aug-Nov	12-15	8-9	7-9
<b>Dry cows</b>				4
<b>Growing/finishing cattle</b>	T'out- May	10-12	5-6	5-6
	June-July	10-14	6-7	6-7
	Aug-Sept	10-15	7-8	7-8

TYPE	PERIOD	ROTATIONAL PRE GRAZING HT-CM	ROTATIONAL POST GRAZING HT-CM	SET STOCKED CM
<b>Ewes &amp; lambs</b>	T'out- April- May-wean	8-10	4-5	4
		8-10	4-6	4-6
<b>Dry ewes</b>	July-Aug			3
<b>Pre-tupping</b>	Sept-Nov	8-10	4-5	6-8
<b>Weaned lambs</b>	July-Sept	10-12	5-7	6-8

There are many ways to achieve sward height targets. One strategy does not fit every farm and there is always a need for flexibility depending on the year. It may be that set stocking is practised early in the year with cows and calves, and growing cattle are grazed using a paddock system. Maximising production from grassland is a balance between utilisation and yield, and management input.

## Rotational grazing

### Is the hassle of moving fences and updating infrastructure worth it?

Generally with a strategy that gives the grass a rest, e.g. by moving stock to another field, the Dry Matter yield will increase by around 20%. If the grazing pressure is then tightened by putting in temporary fences, utilisation will be increased. The example on page 25 suggests moving from set stocking to paddock grazing can almost double the yield of Dry Matter utilised. If the cost of buying in an extra 3.9t DM/ha of feed is compared to buying some fencing and troughs that will last five years or more then it is a very worthwhile practice to consider. In addition higher animal performance is also possible as the stock will be eating a higher quality diet for a longer period.



GRAZING SYSTEM	ANNUAL YIELD (T DM/ha)	UTILISATION (%)	USABLE YIELD (T DM/ha)	INCREASE (%)
Set stocking	8.5	50	4.3	
Rotational	10.2	65	6.6	2.3 (53%)
Paddock	10.2	80	8.2	3.9 (91%)



Simply implemented rotational cattle grazing system using electric fencing



Weaned lambs grazing a high quality sward

## Comparing grazing systems

GRAZING SYSTEM	FEATURES	PROS & CONS
<b>Set stocking</b>	One area grazed by a group of livestock all season	<p><b>Pros</b></p> <ul style="list-style-type: none"> <li>- Low management input</li> <li>- Low capital costs</li> <li>- Can work well in some years if sward height targets met</li> </ul> <p><b>Cons</b></p> <ul style="list-style-type: none"> <li>- Lower forage yield and poor utilisation due to trampling</li> <li>- Difficult to maintain grass quality and correct sward height</li> <li>- Uneven manure distribution</li> <li>- Weeds can build up</li> </ul>
<b>Rotational</b>	Stock are moved around a small number of fields (large fields can be split using electric fencing) based on sward height or grass cover targets- generally every 4-7 days	<p><b>Pros</b></p> <ul style="list-style-type: none"> <li>- Higher productivity than set stocking</li> <li>- Allows pasture to rest and re-grow</li> <li>- Can extend the grazing season</li> <li>- More even manure distribution</li> <li>- Some flexibility to take surplus grass for silage</li> </ul> <p><b>Cons</b></p> <ul style="list-style-type: none"> <li>- More fencing and water troughs required</li> <li>- Forage production and utilisation is not optimal if grass grazed beyond 3 days as stock will start eating regrowth</li> </ul>
<b>Paddock</b>	Livestock are moved frequently (every 1-2 days) based on sward heights or grass budgeting	<p><b>Pros</b></p> <ul style="list-style-type: none"> <li>- Highest forage production and utilisation/ha</li> <li>- Very high quality grazing - 11-12ME</li> <li>- Higher stocking rates possible</li> <li>- Even manure distribution</li> <li>- Weeds controlled by grazing</li> <li>- Reduced silage requirements as grazing season extended</li> <li>- Very high flexibility to take surplus grass for silage</li> </ul> <p><b>Cons</b></p> <ul style="list-style-type: none"> <li>- More management input required - grass monitoring and feed budgeting</li> <li>- High initial costs of infrastructure - fencing and water troughs</li> </ul>



## Other grazing management options for Scottish beef and sheep farms

### Buffer grazing

Buffer grazing is a simple and cheap way to improve grass utilisation over a set stocked system. Part of a field is fenced off with an electric fence and not grazed with the rest of the field. If grass growth is slow this buffer area can be grazed whereas if grass growth is adequate the fenced off area is conserved as silage and grazed thereafter. Sward height targets should be used to determine the need to graze or cut the buffer area.

It is a low risk method of increasing flexibility of grassland management on a beef and sheep farm. It is important that grazed areas have water supply and that if silage is taken from part of the field that any nutrients removed by cropping are replaced.

### Deferred grazing

Deferred grazing is where stock is removed from a field so a wedge of grass is built up which can then be fed in autumn and early winter by strip or block grazing to ensure good utilisation. A back fence can be used to keep the stock off the previously grazed areas to allow recovery. This system avoids the cost of having to make that area of grass into silage or hay and the cost of feeding it.

SRUC trials for QMS on deferred grazing showed that feed value of deferred grass was capable of keeping dry suckler cows until the New Year after which point the reducing quality of the grass was insufficient to meet the increasing demands of the calf. Additional feed would then be required if cows are to remain longer on deferred grass. One option in this respect is to make second cut silage from half the field, with wrapped bales left in situ and fed alongside the deferred grass. On the right choice of field this system offers a lower cost wintering option for suckler cows.

### Mixed grazing of cattle and sheep

This is the practice of grazing cattle and sheep on the same field. It is common on more extensively managed farms and is best suited to continuous grazing systems.

#### Advantages

- Improves sward quality and utilisation
- Sheep will graze closer to dung pats
- Cattle will graze rough grasses that sheep reject
- May improve parasite control by dilution of host specific parasites
- May help to increase white clover content

#### Disadvantages

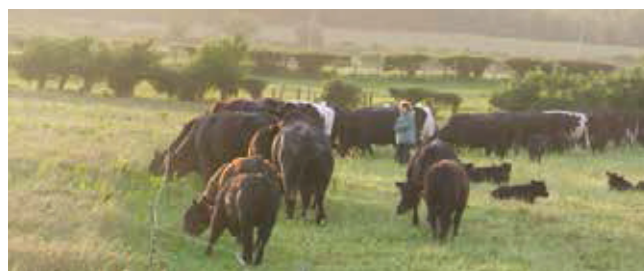
- May be difficult to gather stock separately
- Different fencing requirements of sheep and cattle
- Difficult to supplementary feed one class separately
- Risk of cross species infection with Johne's disease

### Worm control and grazing management

Grazing management can be used to reduce the dependence on wormers, but requires significant planning. Reduced parasite burdens can result from: grazing with other classes of stock (eg grazing with sheep one year and cattle the next): using the fields for conservation for some or all of the year, or; grazing new reseeds after a forage or arable crop.

High risk fields are any that had any sheep (including ewes and lambs, store lambs or replacements) or goats grazing the previous year or earlier in the season. The risk reduces to medium if only adult non-lactating sheep were grazing the year before, or if a cut of hay or silage was taken from that field the previous year. Grazing with cattle the previous year or earlier in the season also reduces the risk to medium.

For cattle systems, apply the same principle – land that has seen cattle the year before is generally high risk, while sheep being in the system reduces the risk. The objective is to dilute the number of worms that affect cattle with sheep worms, and vice versa.



Buffer grazing system using electric fence

### Clean grazing

It is sometimes possible to operate a clean grazing system. This can work well where there is a reasonably even balance of cattle to sheep and if there are many fields that can be cut for silage. The rotation should be Cattle – Sheep- Hay (or silage)- CASH. It is possible in a true clean grazing system to not have to worm young-stock which will save both time and money. We know that lambs and calves that are unchallenged by worms will grow faster than those that are challenged and dosed regularly.

However while on most beef and sheep farms it is not possible to operate a strict clean grazing system it is still possible to make use of the basic principles which will benefit young lambs in particular. These are that if fields are kept free of lambs for 10-12 months there will be little or no carryover of worm larvae to the following spring, so the field can be classed as clean grazing, which will be safe for lambs to graze.

It should be pointed out that these days there is more knowledge on worm control and the SCOPS principles should be practiced wherever possible. Discuss these with your vet.

## SILAGE PRODUCTION

The basic principles of silage making are just as important to beef and sheep farms as they are to a dairy farm.

As previously mentioned while there will always need to be a balance of quantity (to get through the winter) and quality (for performance) it is usually always advisable to make the best quality silage that you can. Then, once analysed and you have carried out a feed budget you can take the necessary steps to match your feed supply to the demand from your livestock.





## GENERAL ISSUES

### • Rolling silage fields

- Roll to push any stones below cutting height and to level mole hills to avoid soil contamination (also deal with the moles)
- If neither of these issues is a problem then rolling is a waste of time and money
- Never roll severely poached areas

### • Quality or quantity?

- Make the best silage that can be fed to most nutritionally demanding stock, can dilute with poorer quality forage for stock requiring poorer diet
- However planning is essential so you know how much you need to last the winter. Use expected stock numbers, normal diet and winter length plus 10%

### • Clamp vs bales

- Bales allow flexibility to cut surplus grass or separate fields when they are ready. Lower DM losses than pit silage and lower investment and storage costs. However they are more labour intensive at feeding, can be variable in quality, not suitable for wet grass, more expensive/tonne and have plastic disposal issues
- Clamps allow speedy harvest and consistent quality and are suitable for a range of Dry Matter grass. However there tends to be higher DM losses, the cost of the pit etc must be accounted for and there can be heating/mould development at the face whilst feeding

### • Nitrogen, P & K

- Allow 2.5kg/day (2 units/day) uptake plus 5 -10 days from last application. Too much N in grass results in lower sugar levels and poorer silage
- Need to consider yield of silage so adequate applications of 80-120kgN/ha (including slurry and N applied prior to grazing) is required for good yields
- Soil test to determine P&K indexes and seek to maintain at Moderate (2)
- Match applications to crop offtake and take account of slurry and FYM

### • Contractor or own equipment?

- Generally most pit silage done by contractors although larger farms now looking at forage wagons and own equipment for more control
- If you do any of your own operations consider mowing (so you can control sugar levels and height of cut) and clamp rolling to ensure good consolidation. These operations require less investment as well

### • Mowing

- Mow when crop at desired stage (D value) for quality required
- Mow when sugars are highest and when the grass is dry
- Leave a stubble of 6-8 cm to prevent soil and manure contamination and encourage faster regrowth

### • Wilting

- Spread the swath (or use mower conditioner) as soon after mowing to achieve a fast wilt to 25-30% DM in 12-24 hours. Most wilting occurs in the first 2 hours after mowing.
- Excessive wilting leads to crop deterioration and poorer consolidation and may lead to toxic moulds/ yeasts developing
- Be prepared to take crop sooner if poor wilting weather
- Red clover requires wilting but don't use mower conditioner and only turn the swath once otherwise leaf shatter will occur

## CLAMP SILAGE

### • Chopping

- Row up as close to chopping as possible
- Set pick up correctly to avoid soil contamination
- Chop dry crops shorter to aid consolidation, wetter crops can be longer chop
- Short chop gives better intake but too short is poorer for digestion

### • Additives

- Inoculants contain one or more lactic acid bacteria to reduce pH rapidly, preserve protein and promote efficient fermentation. Can also promote DMI and improve protein N utilisation

- Acid based additives preserve the crop
- Additives will not turn a bad grass crop into good silage but can improve fermentation and animal performance when used correctly on good grass
- Additives should be tailored to the conditions, i.e. Dry Matter and sugar content will vary each year
- Seek advice from your supplier on the most appropriate additive for your crop

#### • **Clamp filling**

- Make sure the clamp is clean and that the walls are airtight
- Side walls can be covered with an old sheet but make sure you allow for this sheet to sink with the crop  
The aim should be for rainfall (if outdoor clamp) to escape behind the sheet not into the silage
- Slow down contractors if you are worried about consolidation - it is your crop so get them to slow down or take a trailer out of the system. However you generally want to fill clamps quickly and evenly
- Keep surrounding areas clean and ensure all tractor tyres are clean. Avoid carting silage through muddy areas as this will contaminate the silage
- Spread grass in 9-12 inch layers for effective consolidation
- Use a second tractor for (safe) cross rolling if possible
- Don't over consolidate wet crops
- Keep sides slightly above centre to keep tractors away from the walls
- Sheet the clamp overnight if more than one day's task, however avoid rolling before the next day's filling as this can draw air in
- Cover a very dry crop with a wetter final layer to seal the top

#### • **Sheeting**

- Seal as soon as consolidation is complete
- Use thin (cling film types now common) sheet first followed by thicker protective sheet. This can lead to almost zero waste.
- Cover with bales, tyres or weighted bags and protect from bird damage

#### • **Effluent management**

- Most effluent is produced in the first 10 days and there must be capacity for 2 day's flow and ability to dispose of it
- Silage above 25% DM will have very little effluent
- Dilute 1:1 with water before spreading to prevent scorching grass and reduce pollution risk
- Do not spread near watercourses or boreholes

## **BIG BALE SILAGE/HAYLAGE**

#### • **Useful when**

- You don't have a pit or effluent storage
- You have surplus grass from grazing fields that you want to cut to get the field back into a grazing rotation
- You have fields that may not fit in with the rest of your silage system, ie. too far away, different type of grass or stage of maturity etc
- You want a more readily saleable crop

#### • **Cutting**

- Mow with conditioner when dry and sugars at highest
- Don't mow too low to avoid soil contamination
- Match swath to baler width (or combine swaths)

#### • **Wilting**

- Wilt to 35% (25% minimum) to prevent bales collapsing and air entering
- Use inoculant if required

#### • **Baling**

- Gather several swaths together to improve baler performance
- Bale at the highest density or chop - reduces number of bales, transport etc
- Chopping also reduces air and improves speed of fermentation



### • Wrapping

- Use a net wrap to speed up baling round bales
- Wrap as soon as possible at site of storage, this reduces chance of damaging wrapped bales in transit that would let air in
- Use high quality film wrap that will shrink around the bale, creating a seal
- Use 6 layers of wrap to improve sealing and reduce listeria
- Green or white wrap has been shown to reduce surface heat and formation of subsequent moulds etc

### • Storage

- Choose a level site which will be accessible when feeding the bales
- Stack wet bales (under 25%DM) one high, over 35% DM can be stacked 3 high.
- Stack more than 10m from watercourses
- Net the stack to protect from birds and place bait for rats
- Check the stack regularly and repair damage as soon as it is seen



### Other options for storing forage

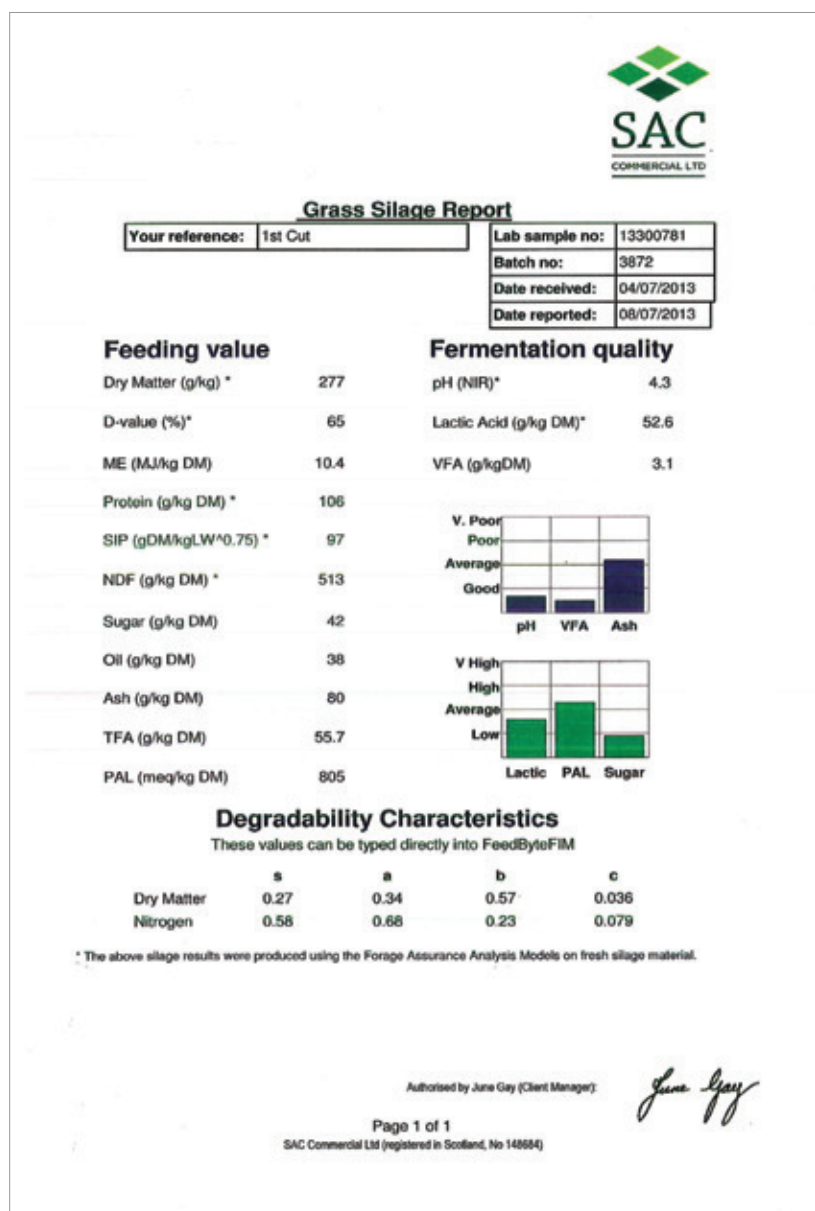
- Ag bags - useful for quantities from 100 to 300 tonnes, little wastage
- In some areas the local contractors may not have the equipment

### Silage analysis

Always get your silage analysed by an approved laboratory. Knowing the quality of your forage means that poor silage can be supplemented with more concentrates and, if silage quality is good then savings in concentrates can be made. The key findings will be the Dry Matter %, D value, ME (Metabolisable Energy), Crude Protein and Intake Potential. These will give you an idea of the feed value of the silage. However you will also get a range of other indicators which will inform you of the fermentation quality of the silage, its acidity, soil contamination and protein degradability characteristics. The following table gives an idea of what is termed Good, Average or Poor quality silage and the classes of stock for which each is suitable.

	GOOD SILAGE	AVERAGE SILAGE	POOR SILAGE
D Value	70	65	60
ME (MJ/kgDM)	11.5	10.5	9.5
Crude Protein (g/kgDM & %)	160 (16%)	120 (12%)	100 (10%)
Dry Matter %	28-30	25	20
Suitable for	Finishing beef cattle, ewes carrying multiples	Growing cattle, autumn calving cows, ewes carrying singles	Dry stock, spring calving suckler cows

## Silage analysis from SRUC Commercial laboratory



## FEED BUDGET

A simple feed budget will tell you how much silage you have in store and its quality as well as what the demand will be from your livestock.

- Measure your silage pits and work out the tonnage based on the volume and settled height. Also count bales of silage, hay & straw in store.
- Look at the quality of each feed you have.
- Assess the number of stock you will have in each category to get through the winter.
- Assess the suitability of your feeds for the classes of stock.
- Draw up a basic ration for each class of stock and multiply daily amounts by the number of stock and number of days your winter normally lasts for.
- Assess whether you will have a shortfall or surplus of forage.
- You have a number of options to match feed supply and demand, these include; buying or selling livestock, purchasing feed, growing a forage crop or amending rations which may mean different performance targets have to be acceptable.



## Typical quantities of silage required by various classes of stock

CLASS OF STOCK	DAILY REQUIREMENT Kg FW/hd/day	DAILY REQUIREMENT for 100 hd - fresh weight @ 25% DM
650kg dry cow	28 kg- restricted	2.8 tonnes
650 kg autumn calving cow rearing calf	43 kg – ad lib	4.3 tonnes
300 kg weaned calf 1.0 kg/day lwg	13.0 kg (+ 3.4 kg barley)	1.30 tonnes
400 kg store beast 0.8 kg/day lwg	22.4 kg (+ 2.1 kg barley)	2.24 tonnes
500 kg finishing beast 1.2 kg/day lwg	19.4 kg (+5.6 kg barley)	1.94 tonnes
75kg ewe – single bearing- last month of pregnancy	4.1 kg (+ concentrates)	410kg
75 kg ewe – twin bearing- last month of pregnancy	3.7 kg (+ concentrates)	370kg

This table is a general guide for average silage. Other feeds such as concentrates or straw may need to be fed in addition to these amounts or in some cases instead of some silage.

## FORAGE CROP OPTIONS



Brassica crops such as kale, forage rape, grazing turnips, stubble turnips, swedes and rape/kale hybrids, can provide nutritious, cost effective feeds for beef cattle and sheep.

They can increase output/ha, both in terms of dry matter (DM) feed and animal performance. Out-wintering on brassicas can also allow more animals to be kept, with minimal extra capital investment in buildings.

Feed costs can be reduced by grazing in situ, because high DM yields can be produced quickly and little or no machinery is needed for harvesting and feeding out.

The crops can be used for out-wintering, to extend the grazing season or to help to fill a forage gap in dry summers. The aim is always to increase the amount of grazed forage in the diet, rather than relying on expensive supplements.

Brassicas can be useful in both arable and grazing rotations, and make a good break crop between grass to grass reseeds as they can give you more time to correct deficiencies in pH, P, K, soil compaction and weed control. They can also be used as a pioneer crop in uncultivated areas.

These crops do not fit into every system, and site selection is crucial – especially when used for out-wintering. However, many more producers could potentially benefit from introducing them onto their farm.



A well established field of kale

Crops can be either full season crops or catch crops. A full season crop must be grown on good land with correct agronomy to ensure high DM yields to justify the cost and the length of time taken out of production. A catch crop can be grown after silage or wholecrop cereal to give a bonus crop of forage and allow an early reseed the following spring.

Forage crops should only be fed to livestock up to 70% of the total Dry Matter intake and a grass runback and fresh water should always be provided. Another source of forage should be supplied, for example straw for dry cows, silage or hay for more productive stock. For lamb finishing - concentrates can also provide additional nutrition.

Leafy brassicas are generally high in protein while roots/ bulbs are higher energy. Encourage stock to eat the whole crop evenly by initially rationing them to a small area so they clear up the whole plant or by grazing behind an electric fence.

Feeding behind an electric fence is advisable to ensure high utilisation. This can either be done by daily moves of cattle so the fence is moved up to the crop or less frequent shifts of cattle or sheep where the fence is placed some way into the crop in breaks. Either way it is important to assess the yield of the crop (by cutting and weighing several 1m<sup>2</sup> sections) and then accurately working out the area the group of stock requires each day.

The following table summarises the features of some of the most popular forage crops now grown in Scotland. The QMS booklet "Cattle Outwintering Systems" has more information on growing brassica crops for cattle.



## Forage crop summary

	Kale	Forage rape	Hybrid	Swede	Turnips	Stubble turnips
<b>Sown</b>	May- July	Apr- Aug	Apr-Aug	Mar-May	Apr- Jun	Jun-Aug
<b>Utilised</b>	July-Mar	Aug- Dec	Jun-Jan	Oct-Apr	Sep-Apr	Aug-Dec
<b>Seed rate (kg/ha)</b>	6.25	6.25	6.25	1.00	5.00	5.00
<b>Cost/ha £</b>	242	173	173	237	184	173
<b>Days to grazing</b>	150-220	90-110	90-110	170-250	60-100	60-100
<b>Grazings possible</b>	1	1	2	1	1	1
<b>DM %</b>	15-17	10-12	12-15	17-20	12-15	12-15
<b>ME (MJ/ kgDM)</b>	10-11	10-11	10-11	12-13	10-11	10-11
<b>CP%</b>	14-17	19-20	18-19	10-11	17-18	17-18
<b>% utilisation</b>	80	80	80	80	75	80
<b>Av DM yield (t/ha)</b>	10	7	8	11	6	7
<b>Cows/ha -100 days</b>	19	7	11	16	9	10
<b>Lambs/ha - 100 days</b>	49	30	49	68	38	49



Lambs grazing turnips at Kirkton with grass runback



## SUMMARY

This booklet has given an outline of the numerous factors that are involved in improving soil and grassland management. Many farmers will be implementing these practices already in part but there is always room for improvement.

Grassland is also a continuously changing environment with many factors such as stocking rate, balance of cattle to sheep, soil type, altitude, species mix etc all contributing to the challenge of managing it effectively.

There is a wealth of information available from the internet, levy bodies, trade companies, consultants etc. Many of these sources are listed in Annex 4. You may find it useful to discuss technical issues with a consultant or join a group where you can discuss your issues with a group of like minded farmers with similar problems to you.

Beef and sheep farmers have a vital role to play in producing meat from poor resources whilst managing environmental concerns as well. Managing your soil and grassland more effectively will lead to reduced costs, higher profitability and a reduced carbon footprint.



# ANNEX 1

## TYPES OF SOIL IN SCOTLAND

Soils are formed over thousands of years and reflect past geology, climate, vegetation, landscape and human activity. Healthy, fertile soil is a dynamic living system consisting of biological, physical and chemical components. One gram of healthy soil contains one billion organisms including 10,000 different types of bacteria. Humus – derived from the microbial breakdown of organic matter, plays a crucial role in supplying nutrients for crops ensuring a good environment in which they can grow.

### Scotland is dominated by four soil types –

#### Podzols

Podzols are widespread throughout Scotland, generally associated with acid parent material and semi-natural heath or coarse grassland vegetation and coniferous woodland. They are characteristic of any topographic position where aerobic conditions prevail and water can percolate freely through the upper part of the profile. They are found at all elevations from sea level to the summit of the Cairngorms. Podzols are generally infertile and are physically limiting soils for productive use. They are extremely acidic and are lacking in most plant nutrients. Where they are used for arable cropping long-term fertilisation is required.

#### Brown earths

Brown earths are well drained with brownish sub-soils where iron oxides created through weathering processes are bonded to silicate clays. In Scotland, their occurrence is restricted to the warmer, drier climate characteristic of eastern areas but they also occur in sheltered Highland glens at lower elevations and on areas of base-rich parent materials. Under natural conditions the soils would form under broadleaf forest which promotes rapid decomposition of plant residue and consequent recycling of plant nutrients. Given the deep nature of these soils, their free drainage and often high levels of natural fertility, brown soils are often cultivated. These soils at lower levels in the Straths and glens of the Highlands are often cultivated for fodder crops or support the better quality grassland.

#### Gleys

Gleys are widespread throughout Scotland, being developed under conditions of intermittent or permanent water logging. Gleys are often confined to sites where anaerobic conditions result from periodic or long-term water logging, either a direct result of surface water collection or groundwater conditions. They also occur where the soil is dense and water is prevented from moving through the soil. They are found at all elevations. Where the upper soil horizons are wet for much of the year, they are generally rich in organic matter with intergrades to shallow peat (peat >50cm) being widespread. They require adequate drainage for proper agricultural use. In humid upland areas gley soils with peaty topsoils develop under moorland or blanket bog vegetation and rough grazing or forestry are the principal forms of land use.

#### Organic peat soils

Often referred to as peat deposits, organic soils represent accumulations of partly or completely decomposed plant residues formed under anaerobic conditions. Current land management practice does not consider extending areas of cropping. However, in the past the suitability of these soils for arable cropping, when adequately drained, hinges on their sense of working and capacity to supply nitrogen whilst retaining water and nutrients. Continual cropping does result in significant shrinkage and the soil being subject to various physical and chemical limitations. In the semi-natural state, peat provides grazing of low quality but has no other agricultural value.

## ANNEX 2

### Land Capability for Agriculture

The LCA classification is used to rank land on the basis of its potential productivity and cropping flexibility. This is determined by the extent to which the physical characteristics of the land (soil, climate and relief) impose long term restrictions on its use. The LCA is a seven class system. Four of the classes are further subdivided into divisions. Class 1 represents land that has the highest potential flexibility of use whereas Class 7 land is of very limited agricultural value.

The LCA classification is applied through a series of guidelines that allows a high degree of consistency of classification between users. The classification is based upon a number of assumptions. These specifically include the potential flexibility of cropping and agricultural options, assuming a high level of management. However they exclude other factors, such as distance to market and individual landowner choices, all of which can influence actual land use decisions. The thirteen classes and divisions of the Macaulay LCA system have been simplified into four categories which are broadly indicative of the land's agricultural capability:

### Land capable of supporting Arable Agriculture (Class 1 to Class 3.1)

Land in these classes, often referred to as prime agricultural land, is capable of being used to produce a wide range of crops. The climate is favourable, slopes are no greater than 7°, the soils are at least 45cm deep and are imperfectly drained at worst. This land is highly flexible for other uses as well although current management may make other options, such as heathland restoration, difficult in the short term.

### Land capable of supporting Mixed Agriculture (Class 3.2 to Class 4.2)

Land in these classes is capable of being used to grow a moderate range of crops including cereals (primarily barley), forage crops and grass. Grass becomes predominant in the rotation in Class 4.2 whilst other more demanding crops such as potatoes can be grown in Class 3.2. The climate is less favourable than on prime land, slopes up to 15° are included and many soils exhibit drainage limitations.

### Land capable of supporting Improved Grassland (Class 5.1 to Class 5.3)

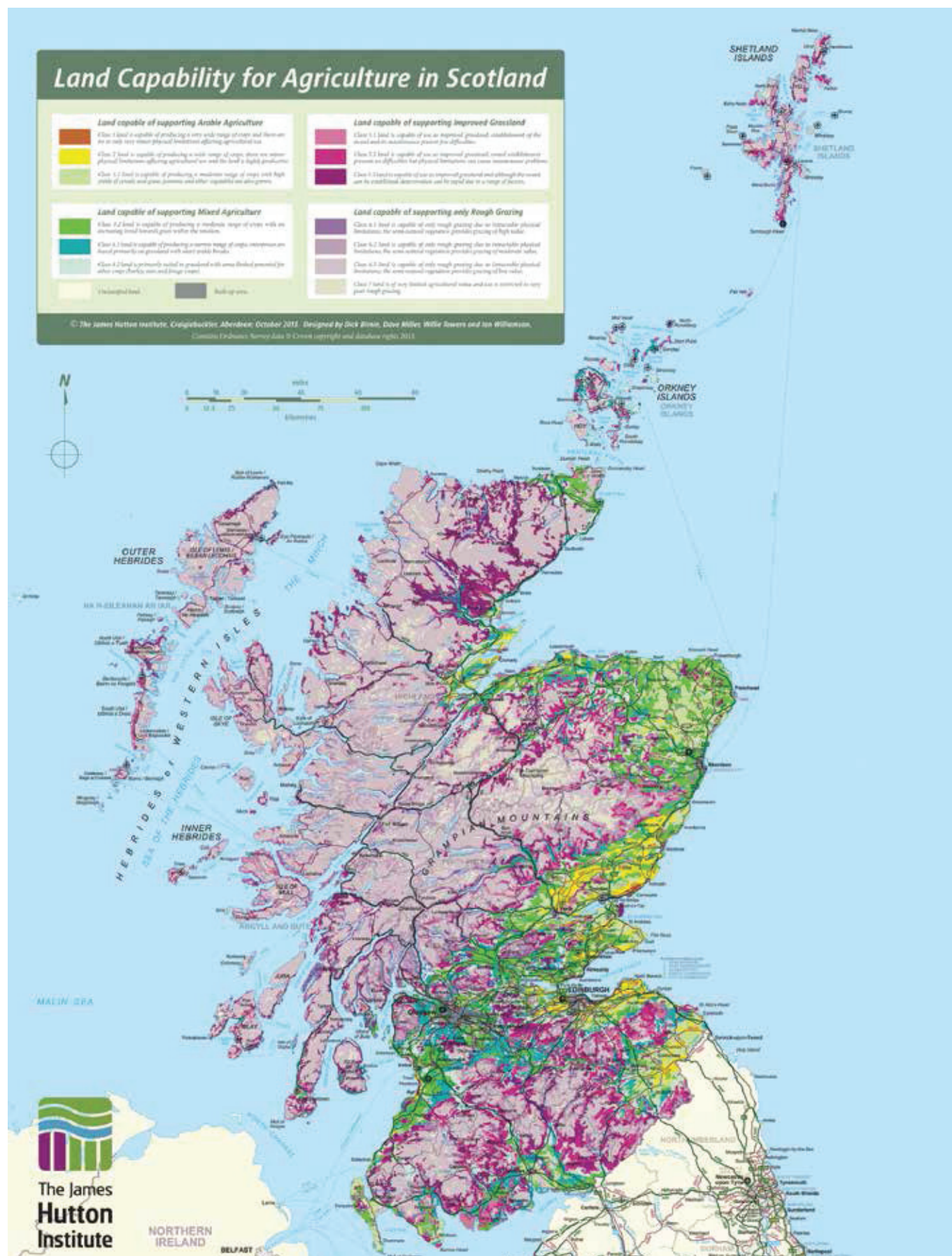
Land in this class has the potential for use as improved grassland. A range of different limitation types, either operating singly or in combination, can restrict the land capability to this class. These limitations include climate, slope, wetness, and often a heterogeneous pattern of conditions that render even occasional cultivation unsuitable. Land which has had this potential for improvement exploited is much more productive than land which remains in its unimproved state.

### Land capable of supporting only Rough Grazing (Class 6.1 to Class 7)

This land has very severe limitations that prevent sward improvement by mechanical means. This land is either steep, very poorly drained, has very acid or shallow soils and occurs in wet, cool or cold climate zones. In many circumstances, these limitations operate together. The existing vegetation is assessed for its grazing quality (Class 6.1 is of high grazing value for example) but Class 7 land is of very limited agriculture value. Nonetheless, this ground often has a high value, for example in terms of storing carbon in its organic soils and supporting rare species and habitats.




## ANNEX 2 cont.




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## ANNEX 3



7624

### Advisory Soil Report



Client: Mr Farmer  
Big Farm  
Scotland  
PA20 2JG

Farm Sampled: LITTLE FARM

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 30%;">Your reference:</td><td>Steeding Field</td></tr> <tr><td>Last crop:</td><td>Grass - silage</td></tr> <tr><td>Next crop:</td><td>Grass - silage</td></tr> <tr><td>Soil type:</td><td>Mineral</td></tr> </table>	Your reference:	Steeding Field	Last crop:	Grass - silage	Next crop:	Grass - silage	Soil type:	Mineral	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 30%;">Lab sample no:</td><td>13099999</td></tr> <tr><td>Batch no:</td><td>599999</td></tr> <tr><td>Date received:</td><td>07/01/2013</td></tr> <tr><td>Date reported:</td><td>10/01/2013</td></tr> </table>	Lab sample no:	13099999	Batch no:	599999	Date received:	07/01/2013	Date reported:	10/01/2013
Your reference:	Steeding Field																
Last crop:	Grass - silage																
Next crop:	Grass - silage																
Soil type:	Mineral																
Lab sample no:	13099999																
Batch no:	599999																
Date received:	07/01/2013																
Date reported:	10/01/2013																

Determination	Result	Units	Status
pH	5.5		
Lime requirement arable	6	t/ha	
	2.4	tons/acre	
Lime requirement grass	3	t/ha	
	1.2	tons/acre	
Extractable phosphorus	6.3	mg/l	M(-)
Extractable potassium	73.9	mg/l	Low
Extractable magnesium	99.6	mg/l	Mod


**SAC scales of interpretation, results in mg/l**

SAC status	Extractable phosphorus	Extractable potassium	Extractable magnesium
VI	0 - 1.7	0 - 39	0 - 19
I	1.7 - 4.4	40 - 75	20 - 60
M-	4.5 - 9.4	76 - 140	61 - 200
M+	9.5 - 13.4	141 - 200	61 - 200
H	13.5 - 30	201 - 400	200 - 1000
VH	> 30	> 400	> 1000

Contact: ASD  
ASD

**PLANET**  
ANALYTICAL SERVICES

Authorised by Jane Gray (Client Manager)



Page 1 of 1

Analytical Services Department, Central Analytical Laboratory, SAC Bush Estate, Perth, Scotland, EH12 9JG  
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## ANNEX 4

### Further reading

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SAC Technical Note TN652 Fertiliser Recommendations for Grassland

SAC Technical Note TN643 Weed Management in Grassland

(Both available via **[www.sruc.ac.uk](http://www.sruc.ac.uk)**)

British Seed Houses “Clover Management Guide” **[www.britishseedhouses.com](http://www.britishseedhouses.com)**

Cattle Outwintering Systems **[www.qmscotland.co.uk](http://www.qmscotland.co.uk)**

Soil Organic Matter and Carbon Content App. **[www.hutton.ac.uk](http://www.hutton.ac.uk)**

Nutrient management software **[www.planet4farmers.co.uk](http://www.planet4farmers.co.uk)**

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EBLEX

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