

BETTERRETURNS



# Making grass silage for Better Returns



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# Introduction

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Grass grown for silage has different needs to grass grown solely for grazing. Done well, it can provide high-quality forage for winter feeding.

As with all crops, good silage depends on using the right varieties of grass, while optimising soil conditions for growth. There are then many management decisions to make, including when to cut, how to store and how to feed.

Producing silage is not cheap. The challenge is to produce a sufficient quantity at an appropriate quality for the stock that is going to eat it, be it pregnant ewes, dry cows or finishing cattle.

This manual covers many of the key considerations when making silage. It all starts with the soil, followed by selecting the right grasses and cutting them at the appropriate stage. The pros and cons of bales and clamp silage are also covered, along with guidance on how to calculate winter feed requirements. Finally, it shows how much it costs to make good silage.



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# Growing good grass

The starting point for growing good grass for silage is the soil. Having adequate soil fertility and good structure is crucial.

Less than 30 per cent of beef and sheep producers regularly test their soils and few dig holes to check what is happening under the surface. If attention to the soil is not given, grass and silage yields will be compromised.

For more information on soil analysis, see the BRP manual **Improving soils for Better Returns**, at [beefandlamb.ahdb.org.uk](http://beefandlamb.ahdb.org.uk)

## Selecting the right types of grass

Silage can be cut from a variety of field types, from specialist short-term leys to permanent pastures that are primarily grazed.

Ryegrasses have been bred for many decades for yield, quality and their ability to utilise nutrients. They are important for silage making.

Both white and red clover can also make excellent conserved forage, but selecting the right type is essential.

The Recommended Grass and Clover Lists (RGCL) are updated annually, providing information on the best-performing grasses and clover available from merchants.

The scheme is funded by plant breeders through the British Society of Plant Breeders and the ruminant levy boards AHDB and Hybu Cig Cymru (HCC Meat Promotion Wales). The varieties that make it onto the list have been independently tested.

Table 1. Summary of how and when to use grass and clover types

	Specialist silage leys (1–3 years)	Medium-term cutting and grazing leys (2–4 years)	Long-term cutting and grazing leys (5+ years)
Perennial ryegrass (diploid)	X	✓	✓
Perennial ryegrass (tetraploid <sup>a</sup> )	✓	✓	X
Italian ryegrass	✓	X	X
Hybrid <sup>b</sup> ryegrass	✓	✓	X
White clover (small leaf)	X	✓	✓
White clover (medium leaf)	✓	✓	✓
White clover (large leaf)	✓	✓	X
Red clover	✓	✓	X

Notes:

a Tetraploids have a more upright growth habit and work better in a cutting system

b Hybrid ryegrass is a cross between perennial and Italian varieties, combining the strengths of the two parent species

## Growth stages

Good grassland management prevents the grass plant from reproducing and throwing up seed heads. With silage, the aim is to optimise the amount of heading so that the nutrient content available, in particular the digestibility and energy, is correct for the type of livestock that will feed on the silage.

Grass varieties have different heading dates, which are triggered by different temperatures, eg, early heading grasses can start to grow at lower temperatures, earlier in spring.

The stage of growth at which the crop is cut will have more influence on the eventual feeding value of the silage than any other factor under the farmer's control.

## Heading date

Grasses are classified according to heading date. This is the date on which 50 per cent of the ears in fertile tillers have emerged. Choose a silage mixture that contains grasses with similar heading dates.

There is a tricky balance to achieve between producing low yields of highly digestible young grass and high yields of mature, stemmy herbage with low digestibility (see Figure 1).

The target will depend on the type of stock being fed, eg dry cows or growing youngstock.

## Weed control

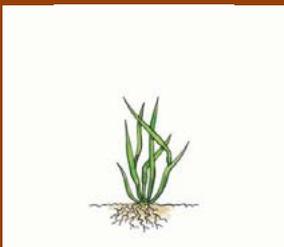
High levels of perennial broad-leaved weeds such as docks and thistles reduce silage yield and quality. Weeds also use up expensive nutrients that are applied to boost grass growth. A 20 per cent weed infestation will reduce grass yield by at least 20 per cent.

Effective herbicides take up to three weeks to get into the roots. Plan spray dates and balance ideal growth stage of the weed for treatment with the anticipated cutting date.

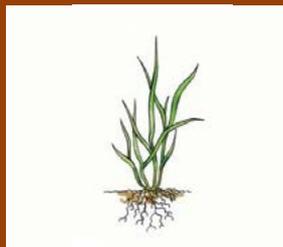
Use a targeted product whenever possible. Ensure the weed is actively growing and follow manufacturers' recommendations.

When considering whether to spray clover swards, first assess the density of clover, then compare the value of the nitrogen being supplied by the clover with the cost of the yield reduction caused by the weeds.

Go to [www.voluntaryinitiative.org.uk/grassland](http://www.voluntaryinitiative.org.uk/grassland) for more information on current weed control advice and crop protection regulations.



72 D-value, leafy growth.  
Typical first cut yield of a long-term ley – 4.6t DM/ha



68 D-value, lengthening of stems.  
Typical first cut yield of a long-term ley – 6.1t DM/ha



65 D-value, flower heads emerging.  
Typical first cut yield of a long-term ley – 7.5t DM/ha

Figure 1. D-value will vary depending on the proportion of leaf and stem present

# Nutrients for silage

Application of inorganic fertilisers can boost the nutrient status of grassland. However, the value of nutrients contained in organic manures, which have been deposited by animals or spread mechanically, should be taken into account before any inorganic fertiliser is applied.

## Acidity (pH)

If pH falls below the ideal of 6–6.5 then yields will be reduced.

Table 2. Yield reduction with pH reduction

pH	<4.5	4.5–5.0	5.0–5.5	5.5–6.0	6.0–6.5
Yield	87%	88%	91%	96%	100%

## Phosphate and potash

Fields that are regularly cut for silage have a higher requirement for phosphate and potash.

Silage with 30 per cent dry matter (DM) contains 2.1kg of phosphate and 7.2kg of potash per tonne of fresh material, so the addition of potash is particularly important to maintain grass yields.

Even at a potash index of 2+, the maintenance requirement of a multi-cut silage system is between 40–60kg/ha at each cut. At index 2, on a grazing-only pasture, the maintenance requirement is nil.

## Sulphur

Sulphur deficiency is increasingly common in grassland, especially in second or later cuts where high rates of nitrogen have been applied. Sulphur deficiencies can cause large reductions in yield and may be worse on shallow or sandy soils.

Sulphur deficiency is indicated by poor growth and a yellow tinge to the leaves. When this is observed, apply 40kg of  $\text{SO}_3/\text{ha}$ , as a sulphate-containing fertiliser, at the start of growth before each cut.

## Nitrogen (N)

Grassland can utilise 2.5kg N/ha per day (around two units of N/acre per day) under ideal growing conditions. This can come from soil N, manures and inorganic fertiliser.

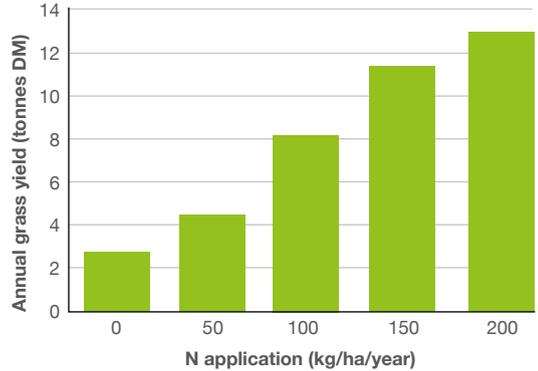


Figure 2. Effect of nitrogen on grass yield

The average amount of N fertiliser applied on UK beef and sheep farms is between 40 and 60kg/ha per year. Clover and manure deposition increases the amount.

Too much N produces grass with low sugar levels and the resulting silage can have high ammonia and butyric acid levels, making it less palatable. Too little N compromises yield and protein levels can be low.

Over the past few years, silage crude protein levels have been falling. Carefully consider whether N fertiliser applications are either too low or too high in advance of harvest. The return on investment for fertiliser N compared to bought-in N in the form of high-protein supplementary feeds in the winter is at least 3:1.

Clover's ability to 'fix' N and make it available in the soil for plants reduces the need for additional fertilisers or manure on grass/clover swards. For further information, see the BRP manual **Managing clover for Better Returns**, available at [beefandlamb.ahdb.org.uk](http://beefandlamb.ahdb.org.uk)

# Bales or clamp?

The choice between storing silage as bales or in a clamp depends on the farm management system. Both have a place and a mixture is often beneficial. Bales are often seen as expensive, but the value of their flexibility cannot be under-estimated. Whether using clamp or bales, management is key to making the system cost effective.

It tends to be quicker to harvest large areas into a clamp rather than bales. However, you need investment in infrastructure, the ability to collect the effluent, and labour and expertise to consolidate and sheet properly. These factors can have a big effect on losses and therefore the cost of silage per kg of DM fed.



Bales can be useful to harvest smaller areas, producing good-quality silage while also maintaining grazing quality; eg, taking cuts of silage from surplus grass in rotational grazing systems. There is greater flexibility when using bales, but the plastic must be disposed of appropriately.

DM losses can be higher for clamp systems compared to bales (25 per cent versus 8 per cent). This can be caused by poor consolidation and clamp sheeting, which leads to wastage.

Bale quality can be easily targeted to livestock needs. It is often easier and quicker to feed out from clamp systems, but there is a risk of wastage at the feed face. If constructing new silage pits, consider the width of the face in relation to the number of stock to be fed from the face each day.

## Top tips:

Record the yield (number of bales or number of loads) harvested from each field to calculate total production. This will highlight underperforming fields.

To avoid soil contamination:

- Roll fields when ground conditions allow
- Carry out mole control in November
- Do not cut too low

Acid-based additives can help reduce the impact of soil contamination.

## Red clover in silage

Crops that contain red clover need to be treated slightly differently:

- Cut when clover is in the late bud stage for high protein content, or in early bloom for lower protein content
- Leave a stubble of 7–8cm
- Do not use a conditioner, leave in wide swaths and do not ted to reduce leaf shatter
- Chop the crop
- Wilt for a maximum of 48 hours
- Use a homofermentative inoculant
- Red clover is naturally more aerobically stable than grass, so good silage management will produce a good end product



# The ensiling process

Silage making preserves grass in the lactic acid that is produced by bacteria naturally present on the fresh crop.

These beneficial bacteria allow fermentation to take place, which maintains nutrient content even after months of storage. This process also prevents undesirable bacteria and moulds from developing.

## Wilting

As soon as the crop is cut, plant respiration and the growth of unwanted microorganisms cause the grass to lose nutrients as sugars and proteins are broken down.

Rapid wilting and ensiling minimises these losses by quickly creating acid levels that stop further respiration. These reactions require anaerobic (air-free) conditions, which is why good consolidation in the clamp and quick sealing is crucial.

## Sugar

For best results, the crop needs an adequate sugar content: 2–3 per cent sugar in the fresh grass is equivalent to 10–15 per cent sugar in the DM.

Young, leafy grass that has received full nitrogen recommendations, grass/clover mixtures and autumn cuts tend to have low sugar levels and lactic acid production may be insufficient to stop all spoilage. Applying additives can help prevent this.

## pH

The required pH drop will depend on the DM of the crop: low DM silages need a greater pH drop compared to higher DM silages.

Clamp silage of a given DM will generally have a lower pH than baled silage of the same DM. This is because baled silage is not as well chopped, so the fermentation is more restricted and a higher pH is acceptable to achieve a stable silage.

## Wet crops

Wet crops have to reach a lower pH to inactivate all undesirable bacteria. Under these conditions, acid additives can help achieve a better preservation as they need less sugar to drive the fermentation process.

### Fermentation

#### Aerobic stage (air present)

Lasts a few hours  
Oxygen levels reduced

#### Fermentation stage

Begins when no air left  
Can last several weeks  
Lactic acid should dominate

#### Stable stage

Can be reached in two to three days if additive used  
Aim for pH 3.8–5 depending on the DM

#### Storage stage

Acidic conditions limit microbial activity as long as clamp/bale is air tight  
Microorganism populations gradually decline  
Potentially dangerous organisms such as clostridia and bacilli can survive as spores

#### Feeding stage

Aerobic spoilage begins on exposure to air  
Mould begins to grow and can produce harmful toxins  
Aerobic spoilage is minimised by good clamp and feed-out management

Well-fermented silage has a fruity smell and should look bright.

## What happens when it goes wrong?

Poorly made silage has a noticeable, usually unpleasant smell. Animals will not be keen to eat it and there will be a high degree of wastage. Some silages can be dangerous to feed.

### Listeriosis

Listeria bacteria thrive in soil and can be picked up at harvest if the crop is cut too low or if there are molehills in the field.

The problem can be greater with higher DM, later-cut silage as it's more difficult to consolidate to exclude air.

Listeria only need a small amount of oxygen to survive. Generally they are not found in the mouldy patches, but in areas of visibly good silage around the mouldy patches. Be sure to remove as much silage from around the mouldy patch as possible if feeding to sheep.

### Sheep

Sheep are susceptible to small doses of Listeria bacteria. Do not mix any potentially contaminated silage through a mixer or bale chopper with the aim of diluting it, as this increases the spread of the contamination.

Affected ewes have drooping faces, drool and walk in circles because of abscesses in the brain. Listeriosis also causes abortions in pregnant ewes and presents a risk to pregnant women. Most cases occur four to six weeks after eating affected silage.

### Cattle

Silage eye (bovine iritis) in cattle can be caused by Listeria infection.

Affected cattle are likely to walk in circles and it presents an abortion risk. Healthy cattle are quite resistant, but poor feed quality or stress factors can increase the risk of infection.

### Botulism

*Clostridium botulinum*, or the toxin produced by these bacteria, can be transmitted through silage. The most likely cause is a dead animal containing high levels of this organism, which has become ensiled in the forage. Even if the fermentation is good and controlled, the toxin will survive and kill livestock. Field surfaces spread with poultry litter containing animal carcasses is a risk factor.

Table 3. Troubleshooting silage problems

Problem	Cause
Rancid, fishy odour; slimy, sticky texture; dark brown/black colour	High butyric acid levels caused by poor consolidation, inadequate sealing, soil contamination, late manure application or low DM (<25 per cent)
Mouldy silage with a musty odour	Presence of oxygen caused by poor filling and sealing, high DM (>35 per cent) or feeding-out management
Smells of vinegar	Acetic acid fermentation caused by high levels of unwanted bacteria
Sweet-smelling silage	High levels of ethanol produced by yeasts, plus some acetic acid
Ammonia odour	Excessive breakdown of proteins to ammonia, or clostridial fermentation, or high pH
Tobacco-like or burnt odour; orange brown colour	Poor consolidation Not sheeting overnight when filling takes longer than one day Excessive heating in the first few days after sealing or DM too high

# Making good silage

## Cutting date

Cutting date has a significant impact on silage yield and quality. As the crop starts to bulk up and yield increases, quality declines as the grass begins to produce stems and heads. These are less digestible than leafy growth.

Optimum cutting date is influenced by the class of stock the silage will be fed to (see Table 4).

As a rule, D-value falls by 0.5 units a day from when the grass starts to push up flowering stems. Fresh grass analysis can be useful to provide an estimate of D-value, nitrate N and crude protein. However, the sugar analysis will not resemble that in the field at cutting because it changes considerably from hour to hour and day to day, depending on the weather.

## Moisture content

Reducing the moisture content of a crop by wilting saves carrying water and reduces effluent.

The target DM should be:

- 28–32 per cent for clamp silage
- 35–45 per cent for bales of silage

Rapid wilting ensures minimum losses in the field and better silage preservation.

Long wilts increase the field DM losses and increase the likelihood of aerobic spoilage at feed-out.

Good practice for when silage is in the field:

- Mow after the dew has dried off. Plants contain higher sugar levels in the afternoon. A rapid wilt concentrates the sugars, allowing a quick and effective fermentation
- A conditioner on the mower splits the grass, so there is a greater surface area for water loss. This can increase wilting speed by up to 20 per cent
- Leave a stubble of at least 5cm to allow air movement beneath the lying grass
- Spread the crop quickly and over a wide area. Water loss is highest for the first two hours after cutting
- Ensure rakes and tedders are set at the right height so they work efficiently and do not pick up soil or manure
- Wilt as rapidly as possible for a maximum of 24 hours. Crops with high amounts of clover can be wilted for 48 hours
- Row up into even 'box-shaped' swaths immediately before pick-up or baling

See page 7 for details on making silage from red clover leys.

Table 4. Targets for silage quality

	Good	Moderate	Low
D-value	70	65	60
% of ear emergence	25	50	100
Energy ME (MJ/kg DM)	11.5	10.5	9.5
Crude protein content %	16	12	10
Feed to	Finishing stock, ewes carrying multiples	Growing cattle, autumn-calving suckler cows, ewes carrying singles	Dry stock, spring-calving suckler cows

**Key:** D-value = measure of feed digestibility

## Chop length

Chopping grass when it is being picked up or baled results in a more efficient silage fermentation because more sugars are released and trapped oxygen is dispersed. Chopped material is easier to consolidate in a clamp and tends to make denser bales that are 8–12 per cent heavier.

Chopped silage also breaks down more rapidly in the rumen, leading to higher animal intakes and performance.

## Additives

Additives cannot turn a bad grass crop into good silage, but used effectively on good grass, can improve fermentation and animal performance.

Additives are generally applied when the grass is being picked up or baled, via a specific applicator.

Table 5. Summary of inoculants and how they work

Type	How they work	When to use it
Bacterial inoculants	<b>Homofermentative</b> inoculants contain bacteria such as <i>Lactobacillus plantarum</i> , <i>Pediococcus</i> and <i>Lactococcus</i> , which convert grass sugar to lactic acid. They improve the speed of pH decline and reduce protein breakdown. To be effective on grass, 1 million bacteria per gram of fresh forage must be applied	High-quality grasses over 25 per cent DM, late-cut grass  High DM silage over 32 per cent; not on bales or low-sugar crops such as legumes
	<b>Heterofermentative</b> inoculants contain species such as <i>Lactobacillus buchneri</i> , <i>L. brevis</i> and <i>L. kefir</i> , which convert grass sugars to lactic and acetic acids. Designed to improve aerobic stability not fermentation quality. Require more sugar for the fermentation	
Enzymes	Convert fibre in grass into sugars that bacteria can convert to lactic acid, or improve digestibility of low D-value silage at feeding	Crops low in sugar; results are generally marginal
Acid, eg formic and propionic	Direct acidification of crop, so can be useful under wet or low sugar conditions. Propionic acid inhibits yeasts and moulds and can improve aerobic stability. Can be hazardous	Low DM silages, crops low in sugar
Sugar supplements eg molasses	Increases amount of sugar for the lactic acid bacteria to convert. High rates and equal distribution needed	Crops low in sugar. Often needed with a homofermentative inoculant, to convert the added sugar into lactic acid

Always evaluate the use of an additive before buying, considering its effect on the forage and livestock performance versus the cost.

Follow the manufacturers' application instructions. Ask the retailer/sales representative for independent scientific trial results.

# Making good silage bales

Silage destined for bales can be wilted to 35–45 per cent DM. Drier crops are lighter, but are more prone to moulds and are used less efficiently by livestock.

Bales can be round or rectangular. Modern round balers that chop the crop give high density and a good fermentation, similar to rectangular bales. Rectangular bales are easier to transport, but need heavy-duty handling equipment because of their weight. They require eight layers of plastic wrap and if the top is damaged, more oxygen can penetrate the silage than in a damaged round bale.



## Baling

- Ensure baler is well maintained
- Aim for dense, well-shaped bales to produce heavier but fewer bales per hectare, reducing baling and wrapping costs
- For a round baler, clean the rollers regularly to avoid build-up of material
- Use net wrap that also covers the edge of the bale by 2–5cm to help remove lumps and bumps. This will improve wrapping and reduce the amount of trapped oxygen
- To prevent soil contamination, check ground conditions and adjust stubble height to minimise risk

## Wrapping

- Ensure wrapper is well maintained
- Wrap bales as quickly as possible, preferably at the store site and within at least 12 hours of baling. If bales are wrapped in the field, move them to the store site as quickly as possible. They should ideally be moved within hours to prevent disrupting the bale once fermentation is underway, which can allow oxygen to enter and cause mouldy silage
- Use high-quality film with 55–70 per cent pre-stretching
- Use six layers of wrap, counted on the barrel sides of the bale
- Handle and store carefully to avoid damage to the wrap

## Stacking

- Ensure site is level and winter access is possible
- Follow HSE guidance on stacking bales:
  - One bale high = <25 per cent DM
  - Two bales high = 25–35 per cent DM
  - Three bales high = >35 per cent DM
- Bales within the stack retain their quality better than bales on the outside, so place the best silage within the stack
- Stack more than 10m away from watercourses
- Net and bait stack to prevent bird and rodent damage



# Making good clamp silage

## Preparing the clamp

- Remove any old, mouldy or rotting silage and clean thoroughly
- Use a side sheet to ensure silo walls are airtight – it is almost impossible to obtain a good seal from oxygen without one
- Check there is adequate effluent drainage at floor level



## Clamp filling

- Fill the clamp quickly, spread silage evenly and consolidate well
- The pressure exerted under the wheels of a heavy tractor will only be effective down to 20cm depth, so fill the pit in shallow layers
- If silaging continues the next day, sheet down overnight but do not roll the following morning. This creates a vacuum and pulls more air into the silage, when the aim is to get all the air out
- Prevent soil contamination by cleaning tractor tyres before rolling. Keep the tipping area clear of mud
- Aim for 250kg DM/m<sup>3</sup> or 750kg fresh matter (FM)/m<sup>3</sup>. This will improve quality and reduce DM losses and aerobic spoilage at feed-out
- Do not over fill a clamp. Compaction above the walls is at least 10 per cent lower than if the silage is level with the walls. Poor compaction increases silo losses both during storage and at feed-out

## Clamp sealing

- Seal as soon as consolidation is complete
- Cover with two sheets of plastic, preferably a thinner oxygen barrier sheet first and a thicker protective sheet above it. Or use a new sheet covered by last year's old sheet
- Place tyres or bales on top. Ensure all tyres touch each other
- Ensure the sheet is not punctured. Protect from birds with netting
- Ensure that unroofed clamps do not allow rainwater to seep in, make sure they shed rainwater evenly and freely

## Managing silage effluent

- Effluent must be collected because it is highly polluting
- Most effluent is produced in the first 10 days after ensiling. Short chop lengths increase early peak flow, as do acid-based additives
- Clamps should have an effluent storage capacity of at least two days at peak flow
- Collected effluent can be spread onto land, but should be diluted 1:1 with water to reduce the risk of pollution and sward scorch. Aim for a rate of between 25 and 30m<sup>3</sup>/ha (2,200–2,700 gallons/acre). Do not spread near watercourses or bore holes
- In Nitrate Vulnerable Zones (NVZs), silage effluent must be treated as an organic manure, so closed periods must be followed

Table 5. Effluent released from silage

DM % of crop	Amount of effluent released
25	Little
18	100 litres/tonne fresh weight per day at peak flow
15	200 litres/tonne fresh weight per day at peak flow

# Silage analysis

Before planning winter rations, analyse silage quality because this will be the largest component of animals' winter diet.

Detailed silage analyses can be carried out by independent laboratories or feed companies. Some basic indications of silage quality can be carried out on farm.

## On-farm testing

### Dry matter (DM)

The DM of conserved forages of less than 30 per cent can be estimated by squeezing a handful of silage.

In drier chopped silages, the DM can be estimated by taking a handful of silage and compressing it tightly for 30 seconds, before suddenly releasing and noting the effect on the silage 'ball'.



Table 6. Effluent released from silage of differing DM

Amount of squeezing	DM %
Juice easily expressed by hand	<20
Juice expressed with some difficulty	20–25
Little or no juice expressed but hands moist	>25
"Ball" shape	DM %
Ball retains its shape and some free juice expressed	<25
Ball retains its shape but no free juice is expressed	28–32
Ball slowly falls apart	32–40
Ball rapidly falls apart	>40

### Metabolisable energy (ME)

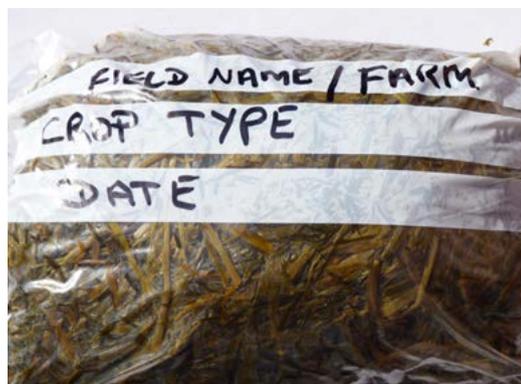
In ryegrass-based swards, energy can be estimated by looking at the leaf and stem content.

Table 7. Estimation of metabolisable energy (ME) content of different stages of a ryegrass crop

Leaf and stem content	ME (MJ/kg DM)
Very leafy – no stem visible	12
Leafy – some stem present	11
Leafy with some flowering stems	10
Moderately leafy with large numbers of flowering stems	9
Stemmy – grasses at flowering stage	8
Stemmy – grasses at post flowering stage	7

### Acidity (pH)

All silages can be measured with pH (litmus) paper. Put 10g of silage in 90ml of water in a polythene bag. Mash gently by hand for two minutes before dipping litmus paper into the liquid. Portable pH meters can also be used.



Silage samples can be sent off for analysis. Above shows 250g in a sealed bag with the air squeezed out. See page 15 for more information on silage sampling.

## Understanding forage analysis

### Dry matter (DM) (%) – what is ‘not’ water

If silage is too wet (less than 25 per cent DM), it can be difficult for animals to eat enough to meet their nutritional requirements. If this is the case, more concentrate feed may be required.

Clamp silage



Bale silage



### D-value (%) – feed digestibility

The higher the D-value, the less concentrates will be needed to balance a ration.



### Metabolisable energy (ME) (MJ/kg DM) – usable energy

When buying a supplement, make sure the ME is higher than that of the forage.



### Crude protein (CP) (%) – protein content (not protein quality)

It is important to make up protein shortfalls using supplementary feeds.



### pH – acidity

Target pH will vary depending on the percentage of DM in silage.



### Ash (%) – mineral and trace element content

For grass, a maximum of 8 per cent ash should be the target. A silage with 10 per cent ash should not be fed as it reduces ME and indicates soil contamination and poor fermentation.

However, it is normal for legume silages to have a high percentage of ash because of their high mineral content.

### Taking silage samples

If feed-out management is poor, the silage at the clamp face can be very different from the cored silage sample. If this is the case, take more samples from the face at feed-out and adjust the ration accordingly.

1. Wait until six weeks after harvest.
2. Take several cores across the clamp at least 1.5m deep, or from five bales of the same batch to make it representative. Sample different cuts and fields separately.
3. Pack into a polythene bag and squeeze air out before sealing tightly.
4. Send to laboratory early in the week.
5. Give the laboratory as much information as possible, eg grass only, red clover, first or second, bale or clamp, additives used.

There are two types of analysis:

- Wet chemistry uses laboratory techniques to analyse the sample
- NIRS (Near-Infrared Reflectance Spectroscopy) uses the way light is absorbed and reflected to analyse the components of a sample.

If the amount of clover in a sample is greater than 30 per cent, NIRS results may not be accurate. To obtain the protein content, ask for wet chemistry analysis.

# Calculating winter feed requirements

Work out how much forage is available, then estimate how much is needed to feed the animals through the winter. Fresh weight (FW) does not reflect the nutrient status of a feed, so focus on DM requirements and availability.

## How much clamp silage is available?

It is important to assess the density of the clamp, as this will affect the amount of silage being stored per square metre. It will be influenced by chop length, DM and consolidation of the clamp.

To do this you will need a silage corer, a tape measure and a set of scales.

**Step 1** – Take a cored sample from the face and weigh in kg – it may be useful to do this at various points across the clamp as density may change.

Example: Cored sample weighs 0.147kg

**Step 2** – Calculate the volume of the sample

Measure the hole (width and depth) in the silage clamp where the sample was removed, in metres. The radius needs to be calculated by halving the full width.

**Example: 0.025m width is a 0.0125m radius and the hole is 0.5m depth**

Volume of cylinder equation =  $\pi \times r^2 \times \text{depth}$ .

Where  $\pi = 3.142$  and  $r^2 = \text{radius squared}$ .

**Example:  $3.142 \times (0.0125 \times 0.0125) \times 0.5 = 0.00025\text{m}^2$**

**Step 3** – To calculate the density, divide the weight of the sample by the volume

**Example:  $0.147 \div 0.00025 = 588$**

By measuring the density at various points in the silage clamp, the silage quantity can be more accurately predicted (see Table 8, column E). Knowing the difference in density at various places should help improve consolidation across the clamp in future years. Low density is often found in areas where there is aerobic spoilage in the clamp.

Table 8. How big is the clamp?

	A	B	C	D	E	F	G	
Silage type	Clamp details (m)			Capacity (m <sup>3</sup> ) AxBxC	Density	Tonnes (FW) DxE/1000	DM%	Tonnes (DM) FxG/100
	L	H	W					
Eg first cut grass	30	10	3.5	1,050	588	617	30	185

## How much baled silage is available?

For round bales, the calculation is (no. bales x bale fresh weight (t) x DM%) ÷ 100. See table 9 for the working example.

As a guide:

5ft wide round bales = 0.63t FW

6ft x 4ft rectangle bale = 0.35t FW

Weigh a sample of bales to obtain an average, as a large variation in weight is common

Table 9. How many tonnes of silage are in the field?

	A	B	C	
Silage type	No. of bales	Bale weight (t)	DM%	Tonnes (DM) A x B x C/100
Eg second cut grass	400	0.63	30	76

## Calculating available forage - in the field

Table 10. How many tonnes of silage are in the field?

	A	B	C	
Silage type	Crop area (ha)	Expected yield (t/ha)	DM%	Tonnes (DM) $A \times B \times C / 100$
Eg first cut grass	20	20	25	100

Table 11. Total amount of forage available in this example

	Tonnes (DM)
Clamp silage	185
Round bale silage	76
Crops in field	100
<b>Total</b>	<b>361</b>

As a rule of thumb, dry matter intake (DMI) is 2–2.5% of bodyweight, see **Grazing Strategies for Better Returns** manual for more details.

Table 12. Silage requirements

	A	B	C	D	E	
Type of stock	Number	Average liveweight (kg)	DMI	Daily requirements (kg) $A \times B \times C$	Feeding period (days)	Total tonnes (DM) $D \times E / 100$
Ewes	600	70	0.02	840	100	84
Suckler cows	80	600	0.02	960	150	144
Growing cattle	75	300	0.03	675	150	101
<b>Total DM to be eaten (tonnes)</b>						<b>329</b>
<b>Safety margin – allow for losses, eg 5–10%</b>						<b>33</b>
<b>Total tonnes of DM required</b>						<b>362</b>

Notes: \*DMI may exceed 3 per cent in early lactation

## Calculating stock requirements

To work out the stock requirement, you will first need to work out the daily requirements.

Equation: Number of stock x average liveweight (kg) x DMI (2–2.5%)

**Example: 600 ewes with an average liveweight of 70kg**

$$600 \times 70 \times 0.02 = 840$$

To calculate the total tonnes of DM required, multiply the daily requirements with the feeding period (for example 100 days) and divide by 100.

**Example:  $(840 \times 100) \div 100$**

## Work out the difference

Finally, deduct the DM required from the DM available to give the overall surplus or shortfall.

Remember that forage quality is key to animal performance. Reducing forage costs by growing bulky crops with low D-value is a false economy.

# Making up a forage shortfall

- If planning early enough, sow a brassica crop
- Reduce stock numbers or out winter some stock
- Find alternative forage sources, eg standing maize or buy in moist feeds
- Consider straw and concentrates or liquid feeds, eg pot ale syrup
- Plant a grass catch crop to allow early spring turnout
- Reduce waste
- Check weighing scales on mixer/feeder wagons are accurate

## Buying in additional feeds

Feed cost per tonne has a big effect on total feed costs. Remember to work out the cost per tonne of DM when comparing the value of one or more potential feeds.

To keep the cost down when buying in feed, take full loads, reduce transport costs by locating local sources of alternative feeds and ensure you get a good price by obtaining quotes from multiple suppliers.

## Reducing avoidable losses

Dry matter and feed value can be lost at every stage of the silage making process.

Exposure to air causes spoilage because yeasts destroy the preserving acids, so the pH rises and heat is generated. Moulds grow, which can produce harmful mycotoxins.

### *Where losses occur:*

- 2–12 per cent in the field at harvest
- 5–18 per cent in the clamp (from respiration/fermentation)
- 0–8 per cent in effluent
- 1–15 per cent feeding out (from exposure to air)



## Feeding out from a clamp

Minimise the amount of air that reaches exposed silage.

- Expose only the silage needed each day
- Use narrow clamps. Aim to get across the face in three days to avoid aerobic spoilage
- Use a shear grab and sharpen regularly
- If using bales make sure that each one is consumed within five days of unwrapping, or sooner if DM is lower than 25 per cent

## Managing feeding

Animal competition and fighting means that silage can be wasted in the feeding area. Ensure there are enough feeding spaces for all animals to eat at once.

Feeders that cause animals to eat with their heads down can reduce waste, as can slanted bar barriers and feeders with solid bottoms.

Find a way to remove rejected silage before putting out fresh material.

Bales fitted tightly into ring feeders increase wastage. Leaving 30cm around the bale and the feeder will reduce wastage because silage that is pulled out is more likely to drop into the feeder rather than outside it.

# Calculating the cost of silage

Knowing how much it costs to grow, make and feed silage allows producers to make decisions about future feeding, ie whether cheaper alternatives can be bought in or whether different crops should be grown

## Step 1: Work out costs on an area basis

**Rental value** – everything grown on a farm carries a rental value. £250/ha/year is a standard figure.

**Establishment and grassland management** – ie reseeding costs £250/ha\* on average, so for a five-year ley, this equates to £50/year. Allocate 40 per cent to first-cut silage, including weed control.

**Inputs** – limited on grassland, but with crops like maize, include sprays, plastic etc.

**Machinery** – most contractor operations are easy to allocate on an area basis. Use the contractor price guide if the farm makes its own silage.

**Other costs** – eg additives, sheeting, analysis. These are probably recorded on a per clamp basis. Simply divide the total by the area going into the clamp.

\* Full reseed, including ploughing = £375/ha.  
Overseeding = £175/ha.

These calculations do not take losses into consideration. Weigh spoiled and deteriorated silage to give a wastage cost and encourage waste reduction in future. Invisible losses, such as poor fermentation and the production of carbon dioxide and water in the clamp, are much more difficult to determine, but can add up to another 5–10 per cent of the total. Once this is done, re-calculate the real cost, because it will be different from the standard calculation.

## Step 2: Use the calculations on pages 16 and 17 to calculate the yield

## Step 3: Work out costs – pence per kilogram of DM (p/kg DM)

Divide the total area costs by the estimated yield, eg 20t FW/ha:

$$£491/20t \text{ FW} = £24.55/t \text{ FW} = 2.5p/kg \text{ FW}$$

To convert costs of FW into DM variable costs = cost/kg FW x (100/DM%)

$$\text{So at 25\% DM} = 2.5 \times (100/25) = 10p/kg \text{ DM}$$

To compare the cost of silage to other feeds available to buy, convert the costs of 1kg DM into p/MJ of ME

$$\text{So at 11MJ of ME/kg DM} = 10/11 = 0.91p/MJ \text{ of ME}$$

Example (40ha, first cut, 68 D-value)

### Costs/ha

Rental value - £250 x 40%	= £100
Reseeding costs	= £20
<b>Fertiliser</b>	
(400kg of 20:10:10) £270 x 40%	= £108
Slurry application	= £49.50
Rolling	= £26
Fertiliser spreading	= £5
Mowing	= £12
Tedding/rowing	= £19.50
Carting/clamping	= £128
Additive = £800/40ha	= £20
Sheet and analysis cost	
£120/40ha	= £3
<b>Total/ha</b>	<b>= £491</b>

Note: Some fixed costs should also be allocated, eg the cost of the clamp

# Beef and sheep BRP Manuals

- Manual 1** Improving pasture for Better Returns
- Manual 2** Assessing the business for Better Returns
- Manual 3** Improving soils for Better Returns
- Manual 4** Managing clover for Better Returns
- Manual 5** Making grass silage for Better Returns
- Manual 6** Using brassicas for Better Returns
- Manual 7** Managing nutrients for Better Returns
- Manual 8** Planning grazing strategies for Better Returns
- Manual 9** Minimising carcass losses for Better Returns
- Manual 10** Growing and feeding maize silage for Better Returns
- Manual 11** Using medicines correctly for Better Returns

See the AHDB Beef & Lamb website [beefandlamb.ahdb.org.uk](http://beefandlamb.ahdb.org.uk) for the full list of Better Returns Programme publications for beef and sheep producers.

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