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The past year has been an extremely difficult one for dairy farmers, with milk prices plumbing nine-year lows following one of the longest downturns in memory. But British dairy farmers have really risen to the challenge, cutting costs to the bone and finding new efficiencies where many thought there were none. What has been particularly interesting is how producers are making more milk from their grassland, cutting out more expensive feeds and focusing on profitability rather than turnover. Kingshay figures show the average herd produced 33% of milk from all forage in the rolling year to September 2016, against 30% the previous year. And the biggest improvement has been made by the bottom quartile of producers, when ranked by milk from forage.

Kathryn Rowland, senior farm services manager at Kingshay, says: “The bottom quartile improved their forage use in 2016, producing 1,316 litres per cow from forage – or 15% of their milk, compared to just 905 litres in 2015 (11% of their milk). The top quartile also made an improvement, but by a much smaller margin of one percentage point.” Even so, there is clearly scope for the bottom quartile to do more, as the top 25% of farmers produced 49% – or 3,871 litres – of their milk from forage.

Reassess purchased feed
The biggest change among the bottom quartile was greater use of conserved forages, as yields from grazed forage only increased from 365 litres to 368 litres, compared to 1,927 litres in the top 25%.

“We can also see many farmers have reassessed their rations, cutting out expensive supplements and minerals,” says Mrs Rowland. The bottom quartile cut ‘other purchased feed’ costs from £115 per cow to £89, although there is potential to go further given the top quartile only spent £21 in that area. Overall concentrate use remained relatively unchanged among the top 25% of producers, at 1.954kg per cow, with the bottom quartile trimming usage by 69kg to 3.079kg.

“Savings in purchased feed costs between the top and bottom 25% equate to £35,674 for a 150-cow herd yielding 8,000
Grassland Toolkit

Sources of energy

<table>
<thead>
<tr>
<th>Feed</th>
<th>Approx cost per tonne dry</th>
<th>Dry matter content (%)</th>
<th>MJ ME content (MJ ME/kg DM)</th>
<th>Cost of one MJ ME</th>
<th>Cost of energy to produce one litre of milk</th>
<th>Cost of energy to produce one kg LWG</th>
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<tr>
<td>Grass silage</td>
<td>£100</td>
<td>25-30%</td>
<td>11.5</td>
<td>1.24p</td>
<td>6.6p</td>
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<td>Feed wheat</td>
<td>£151</td>
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<td>1.11p</td>
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<td>86%</td>
<td>13.2</td>
<td>1.06p</td>
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<td>Concentrate (high energy)</td>
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<td>1.81p</td>
<td>9.6p</td>
<td>84.9p</td>
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<tr>
<td>Concentrate (medium energy)</td>
<td>£236</td>
<td>89%</td>
<td>12.5</td>
<td>1.89p</td>
<td>10p</td>
<td>88.7p</td>
</tr>
</tbody>
</table>

Source: CF Fertilisers

litres per cow,” she explains. But interestingly, the top quartile spent more per tonne on feed, indicating a choice of higher quality concentrates.

It is also worth noting the top quartile actually received less for their milk, at 22.16ppl against 23.59ppl in the bottom quartile. “It’s clearly all about efficiencies, as the former averaged a margin over purchased feed of 16.82ppl, compared to 15.27ppl for the latter,” says Mrs Rowland. “That is a much narrower gap than in 2015, when margins were at 20.21ppl and 17.12ppl respectively.”

With all of this cost-cutting going on, there was a risk it would impact on milk yields and cow health – but yields have remained relatively unchanged on the year, at 7,882 litres for the top echelon and 8,490 litres for the bottom sector.

“It remains to be seen if there’s been an impact on fertility due to the time lag,” Mrs Rowland explains. “But it’s clear production efficiencies can be made by producing more milk from forage, so it must remain the key area to focus on.”

More milk from grass

Grazed grass remains the cheapest feed available for dairy cows, with one megajoule of energy costing half the price of silage and just a third of purchased concentrates, says independent grassland consultant Dr George Fisher.

“The crux of profitable dairy farming is getting more milk from the lowest cost feeds.” He has calculated that producing a litre of milk from grazed grass at current prices costs 3.1p, compared to 6.6p from grass silage, 5.6p from feed barley and 9.6p from high energy concentrates.

But that does not mean producers have to switch to an extensive grazing system. Dr Fisher says: “Anyone can respond – even high input, high output producers can produce more milk from grass. We have seen shifts from producing less than 1,000 litres of milk from forage to 3,500 litres in a year, with profit per litre improving massively even though overall yields fall. A strong business is not all about turnover – it’s about profits. Every producer should decide what the priorities are in their business and act accordingly.”

Although tight milk prices have encouraged a lot of farmers to make more from grass over the past year, it is vital they do not allow inefficiencies to creep back in as milk prices improve, he warns.

“You can clearly make more profit by making more from home-grown energy, but your management has to be flexible and proactive because you can’t predict what the grass growing season will be like.”

Attention to detail

That said, it is possible to minimise volatility by choosing appropriate grass seed mixes, applying the correct amount and type of fertiliser, and paying attention to grazing and silage management. By getting all of the detail right, farmers can significantly boost both yields and forage quality throughout the year. Later on in this guide we explore every step of the grass management process, from variety selection to ensiling, with a focus on some new research and technology which can really improve both grass quality and milk yields.

But is there much point in doing that if you are not currently making the most of what you are producing? According to Dr Fisher, even the very best farmers are only utilising 70% of their grass silage, and most will be wasting a lot more than that.

“A good target is to use 85% of what you grow when grazing rotationally, 85% when set-stocking, and 70% through clamp silage. You might grow

12 tonnes dry matter/hectare but if you’re only getting 6t/ha of that into the cow then it’s a real waste of money.”

For example, from a 12t DM/ha standing crop, 5-10% will be lost at cutting, a further 10-25% during the ensiling process, 3-10% in spoilage, and 5-15% in passage refusals.

“At best, you’ll get 8.5t/ha into the cow – at worst it could be below 5t/ha. It’s all about attention to detail at every step of the way – there’s no magic wand, just lots of little improvements. But there’s no point improving grass growth if your utilisation is not good.

The key is to know your costs of production for each system, and then take control of them. “If cereal prices are on the floor, it may be cheaper to feed barley than silage – but nothing will be cheaper than well-managed grazed grass. It all comes down to making informed business decisions and doing everything as well as you possibly can.”

Grassland Toolkit
**Mixture selection**

**Select grass mixtures carefully**

Farmers are careful to balance cows’ diets when they are housed over winter – and they should be doing the same when choosing which grass mixtures to grow, according to John Spence, seed sales specialist at Limagrain.

Until recently, that has been quite hard to do, but new research has enabled plant breeders to test grass quality in more depth and provide nutritionally balanced mixtures, leading to improved milk production at minimal cost.

Mr Spence says: “There are two possible routes to improving animal performance through feed: Higher intakes and increased nutritional value. Most grass mixtures on the market are chosen on agronomic features alone, but now there is the option to include nutritional features as well.”

Analysis techniques like near infrared spectroscopy are now being used more widely to provide in-depth feed quality and comparative data across the whole growing season. This additional testing on grass varieties means feed quality can be more accurately determined. Plant breeders can therefore develop mixtures which offer not only good agronomic features, but which also have the potential to improve feed quality and promote more efficient milk production.

**Nutritional benefits**

Limagrain Animal Nutrition (LGAN) accreditation is only added to varieties and mixtures which are proven for their efficient production and contribution to animal performance, says Mr Spence.

“We use new varieties with improved digestible neutral detergent fibre [DNDF] as well as more palatable tetraploid varieties which the cows will graze in preference to diploid grasses. If varieties are digested more efficiently, intakes will improve, with resulting nutritional benefits.”

Fibre is needed in the diet to maintain a healthy rumen, but varieties with low levels of DNDF slow down the digestion. “If we can increase DNDF in the diet, then feed efficiency is boosted and this can lead to improved yields,” adds Mr Spence.

Research from Michigan State University has shown that even a 1% increase in digestible fibre leads to a 0.17kg/day improvement in intakes and 0.25 litres/day more milk.

When putting together a mixture with feed quality in mind it is all about finding the right balance between fibre, protein and sugar content.

“Some grass varieties will be high in sugar but low in protein, while others will be high in protein and low in digestible fibre – you’ll never get one variety which offers the best of every world,” says Mr Spence.

**Complementary varieties**

“That’s why it’s important to select complementary varieties within a mixture which are nutritionally balanced as well as having the necessary yield and agronomic attributes. There’s no point sowing grass which is nutritionally perfect if it doesn’t have good groundcover.”

**Grass seed mixtures**

- Limagrain has developed grass seed mixtures which have the LGAN accreditation with a range available through its Sinclair McGill portfolio. These comprise a dual-purpose silage and grazing mix; an intensive grazing mix; and an extended grazing mix which includes a New Zealand variety, Matrix, to give a longer grazing season. The silage options comprise a high energy mix or a high protein mix featuring red clover to reduce the need to feed supplementary protein in the diet.
Trials conducted at NIAB TAG, Dartington, Devon, compared popular grass mixtures containing RL varieties with the LGAN Intensive Grazing mix. Results revealed that the Intensive Grazing mixture produced 10% more energy (see table, above) than the control. The yield was 0.9 tonnes/ha, and the nutritional quality was better across the board.

"It produced 13.529MJ more energy/ha – enough to produce 2.553 litres of milk," says Mr Spence. "With a milk price of 23ppl, that’s worth £587/ha."

Unlike the RL trials, where forage quality is determined from just two cuts, the Dartington trials measured forage quality at all cuts throughout the growing season, thereby demonstrating the growth profile of the different mixtures.

"The Intensive Grazing mix delivered up to 140MJ/ha more energy – equivalent to 26 litres of milk," he explains.

### More milk from forage

Animal feeding trials at Schothorst in the Netherlands have proven the link between improved grass nutrition and higher milk yields, comparing a conventional dual-purpose grass mixture with a nutritional- balanced mixture. The LGAN grass seed mixture had a 3% higher ME and D Value, at 12.8MJ and 79.7%, respectively. DNDF was 8% higher, at 77.9%, with feed efficiency up 5% to produce 1.30 litres of milk per kg of feed.

"Milk yields showed a 5% improvement, at 29.9 litres a day," says Mr Spence. "Assuming a 300-day milking period and a milk price of 23ppl, that’s worth nearly £10,000 to a 100-cow herd."

### Reseeding boosts profits

Selecting improved grass seed mixtures is important, but grassland management – in particular a reseeding programme – is crucial to grassland feed efficiency.

"Farmers have been reluctant to invest in reseeding when margins are tight. But poor grass from old swards holds back grass quality and production," warns Mr Spence.

According to Defra’s land use survey, the amount of temporary grass (under five years old) reduced from 1.396 million hectares in 2014 to 1.145m ha in 2016.

"This indicates a reduction in the amount of reseeding taking place at a time when livestock farmers should be trying to achieve more production from forage."

Research by Shalloo et al (2011) showed grass utilisation increases proportionately to the amount of the farm reseeded each year, and net profits track the rising utilisation (see graph, below).

"The older a ley, the lower its dry matter yield and the poorer its quality," he says. Based on AHDB Dairy data, a two-year-old ley yielding 13.5t/ha at 12MJ/kg ME will drop to 11.2t/ha and 11.5MJ/kg by year five. By year 11, this will have dropped to just 7t/ha at 10.8MJ/kg.

"The milk losses from that equate to 4,698 litres/ha by year five and 12,226 litres/ha by year 11 – and the cost of replacing that energy by feeding concentrates instead would be £491/ha and £1,279/ha, respectively."

### Sward assessment

When assessing pasture, farmers should consider reseeding if productivity has fallen, the proportion of sown species is below 60%, there is a high weed burden, or significant evidence of compaction.

"Select your grass mixture based on the target use of the pasture, as well as considering its agronomic and nutritional balance," Mr Spence says.

"The total average cost of reseeding using full cultivation is £689/ha, so carry out a cost-benefit analysis and see how much better off you could be by investing in your pasture."

### Increasing the proportion of the farm reseeded each year increases net profit

Source: Shalloo et al, 2011

<table>
<thead>
<tr>
<th></th>
<th>LGAN Intensive Grazing</th>
<th>Control mix</th>
<th>LGAN gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM Yield (t/ha)</td>
<td>11.3</td>
<td>10.4</td>
<td>+0.9</td>
</tr>
<tr>
<td>D-value</td>
<td>85</td>
<td>84.1</td>
<td>+0.9</td>
</tr>
<tr>
<td>Energy content (ME MJ/kg)</td>
<td>13.60</td>
<td>13.46</td>
<td>+0.14</td>
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<tr>
<td>Energy yield (MJ/ha)</td>
<td>154,806</td>
<td>141,277</td>
<td>+13,529</td>
</tr>
<tr>
<td>Sugar content (WSC%)</td>
<td>20.2</td>
<td>18.8</td>
<td>+1.4</td>
</tr>
<tr>
<td>Protein content (%)</td>
<td>15.3</td>
<td>15.1</td>
<td>+0.2</td>
</tr>
<tr>
<td>Digestible fibre (% DNDF)</td>
<td>85.1</td>
<td>84.2</td>
<td>+0.9</td>
</tr>
</tbody>
</table>
Mixture selection

The independent view

Getting more milk from grass is all about farmers changing their attitude, according to independent nutritionist Diana Allen. “We’ve seen the potential, and there are lots of good practical resources out there to help, so if you want to improve your grassland management you just need to get on and do it,” she says. “Go and see what other people can achieve and it will change your mind.”

The two most important elements are measuring and monitoring grass growth and quality, so farmers should start by investing in a rising plate meter and a grass management programme, advises Mrs Allen. “You could get 20% better grass utilisation just by measuring and monitoring – and if you’re reseeding as well it’s not unusual to get a 50% uplift.”

Farmers should plan to reseed a certain proportion of their grassland each year, and then monitor pasture to check whether it needs replacing yet or not.

“Newer grass varieties can have much higher forage quality”

DIANA ALLEN

“The best measure is the weed burden - if you have 10% weeds that means 10% less grass - and it’s not unusual to find 20-30% weeds in a sward.”

When choosing grass mixtures, it’s important to realise that grass breeding has moved a long way in recent years, she adds. “Newer varieties, when well-managed, have much higher forage quality than older varieties, which really are outdated now. But as with any grassland it must be managed well.”

“Mix it up

In general, plant breeders have moved either towards high sugar grasses or highly digestible grasses, and Mrs Allen suggests using a mix of different varieties to balance the quality and spread the risk.

“If disease or competition wipes out one variety you still have the others to fall back on.”

The quality of grass varieties is also critical. “A 1% rise in D Value will increase milk yields by 5%, which is significant.”

Farmers should also choose grass mixtures based on their own production system and whether the pasture is destined for grazing, silage-making, or both. “If you have the right land to take an early first cut of silage you can have more early heading varieties in the seed mixture.”

Getting more milk from forage is possible, and highly influential on the bottom line, whether the system is fully housed or extensively grazed, she adds.

“Treat grass like a crop

The important thing is to treat grass like a crop, and consider its nutritional benefits in the same way as silage in a ration.

“If you’re rotational grazing you can get consistently good ME; if you manage your grass well the only fluctuation you’ll get will be dry matter as it’s so weather dependant.”

Decent grass producers will consistently achieve 12MJ/kg ME at 17-20% protein throughout the grazing season, while a good silage target is 11.5MJ/kg ME at 16% protein and with a D Value of 72-73. “The target volume of milk produced from forage will depend on whether you’re producing white water or high solids, but you should aim for each cow to eat 14kg DM of forage per day, whether that’s grazed or ensiled,” says Mrs Allen. “If it’s silage you’ll probably need two silage types to reach that level of intake, so perhaps use maize and grass silage together.”

Farmers should take advantage of the latest grassland research and new developments, she adds. “Grass utilisation in this country is a lot lower than it should be. The absolute key is to get your grazing management sorted and pay attention to every detail.”

“Getting more milk from grass is all about farmers changing their attitude,” says Diana Allen.

Grassland Toolkit
Top quality grass seed mixtures

Grass & Forage Crops

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Farmers could be losing thousands of pounds by choos-ing the wrong type of fertiliser, accord-ing to new research on urea, sulphur and ammonium nitrate (AN).

At a time when incomes are under immense pressure, the temptation to cut back and use cheaper alternatives is considerable, but it could be an extremely damaging false economy.

Independent grassland consultant Dr George Fisher warns ‘the chances of reducing your grass growth are surprisingly high’. Trials organised by CF Fertilisers and run independently at Reaseheath College and elsewhere over 2015 and 2016 found using ammonium nitrate rather than urea boosted silage yields by 18%.

This was due to losses of urea nitrogen to the atmosphere, even though the weather in 2016 was relatively suitable for urea use.

“The effectiveness of urea is very weather-dependant: There has to be enough rain within three days of application to wash it into the soil, and low temperatures are required,” says Dr Fisher. “If you have high temperatures and, most importantly, no rain, then you will get increased volatilisation loss of nitrogen as ammonia into the atmosphere, with the resulting impact on yield.”

Conditions are critical
In a damp, cold spring, urea can be just as effective as AN, but it is important to have accurate weather forecasting and to only use urea when confident the conditions are right, he warns.

“You certainly don’t want to use it throughout the growing season as it will be desperate-ly inefficient.”

For example, if the air temperature is 0degC you will need 5mm of rain within three days to wash the urea sufficiently into the soil.

“Over a five-year period in western Britain the chances of that happening in spring are only one-in-three – so there’s a two-in-three chance of losing nitrogen and yield,” says Dr Fisher.

“If it’s 5degC you’ll need 7mm of rain within three days, which only has a one-in-four chance of occurring. In terms of risk management within a
business taking these chances is hard to justify.”

Trial results at Reaseheath showed using AN instead of urea boosted silage dry matter yields by an average of 1.74 tonnes/hectare, to 11.26t/ha over two cuts a year in 2015 and 2016. Grazed grass yields increased by 0.41t/ha to 6.32t/ha over the first three rounds of grazing.

“Even though the weather occasionally allows urea to be as effective as AN for grass growth, it’s not worth taking the risk of losing valuable home-grown energy for milk production. What you lose in production potential chance of adequate spring rainfall for urea

**How to identify sulphur deficiency**

- Sulphur deficiency is not always visible. Paling and then yellowing of the leaves (similar to that observed in nitrogen deficiency) may be seen, although it is in the younger leaves first, whereas nitrogen deficiency is seen in older leaves.

  It used to be thought only lighter soils responded to sulphur fertilisers and mostly in mid and late season. But as time passes with low sulphur deposition from the atmosphere and the sulphur in soil organic matter depleting, sulphur deficiency is now being seen in medium and heavier soils, and responses are gained in early season as well.

  Sulphur status is normally assessed by herbage analysis. It is possible to obtain a soil analysis for sulphate content, but this is very variable and so plant tissue testing is more reliable.

- **Range**

  The amount of sulphur in grass normally ranges from 0.2% to 0.4% in the dry matter. The most recent advice suggests it should be at least 0.25% to avoid deficiency.

  Obtaining the nitrogen: sulphur (N:S) ratio of herbage is the usual way to assess whether sulphur is required.

  Samples should be taken when the grass is growing rapidly in spring, or during aftermath growth following silage cuts. A ratio greater than 13:1 is considered deficient, but a response may be seen down to 10:1. Care must be taken in interpreting results as very high or very low nitrogen contents can provide confusion.

  For example, a nitrogen concentration of 4.6% and a sulphur concentration of 0.35% gives a ratio of 13:1, which appears sulphur deficient, but the need for sulphur is borderline as the sulphur content is relatively high. Similarly, a nitrogen concentration of 2% and a sulphur concentration of 0.21% gives a ratio of 9.5:1, which appears sulphur sufficient, but the sulphur percentage is low and the sward would benefit from sulphur applications.

  A malate:sulphate analysis of fresh herbage may also be used to assess sulphur deficiency. This approach measures an important metabolite (malate) which is used in energy production in the grass plant and is dependent on sulphur to work efficiently. The test is arguably more accurate than the N:S ratio and can be obtained from CF Fertilisers.
Don’t forget sulphur
Another area where farmers could boost grass yields and quality for profit is by adding sulphur – something which very few people currently do even though a lack of sulphur produces similar results in the crop to nitrogen deficiency, says Dr Fisher.

“Grass needs sulphur to produce amino acids; the building blocks of protein which is needed for grass growth; without sulphur it won’t grow as well.”

In the past, sulphur deposition from the atmosphere in the form of acid rain was sufficient to meet the crops’ needs. “But deposition has been reducing since the 1970s and an increasing number of soils and crops are now deficient,” he adds. Advice to only apply sulphur to lighter soils and later in the season is now out-of-date.

“According to the British Survey of Fertiliser Practice, only 11% of grassland farmers applied sulphur to their silage ground in 2015, and 7% to their grazing swards,” says Dr Fisher. “But in replicated trials in 2016 adding sulphur to silage leys on a medium loam in Cheshire boosted yields by 29%, to 12.45t/ha over the first two cuts.”

The silage trial used 190kg/ha of AN plus 84kg/ha of sulphate applied as the granular compound SingleTop on a field reseeded in 2015. Replicated on grazing leys, at rates of 170kg/ha of AN plus 76kg/ha of SO₃, yields across the first four rounds of grazing increased by 14%, to 9.32t/ha.

More energy means more milk
So what is that extra 2.8t/ha DM of silage worth?

“At £25/tonne fresh weight for selling silage, that equates to £280/ha,” explains Dr Fisher. But when converted into megajoules of energy (MJ ME), and again into litres of milk, the returns are even greater.

“At 11MJ ME/kg DM and 70% utilisation, 2.8t/ha of silage is worth 21,560MJ to the cow.” It takes 5.3MJ to produce one litre of milk, so if milk is valued at 22ppl the extra yield produces a return of £895/ha.

“It’s also interesting to compare the benefit of feeding that forage to the cows against substituting the energy with concentrates, he adds. “To provide 21,560MJ of energy in a concentrate containing 13MJ ME/kg, and priced at £210/t, would cost £391/ha.”

When it comes to an extra 1.2t/ha DM of grazed grass, at 12MJ ME/kg and 85% utilisation, the value equates to £508/ha as energy for milk production. To replace that energy with concentrates would cost £223/ha.

“It’s more cost-effective to make the best use of the energy you are growing on-farm. By adding value to it in the form of milk you’ll always make more money than you would by selling the extra forage or replacing it with concentrates.”
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* vs blended alternatives
Grassland agronomy

Quality proves key for artisan cheesemaker

Grassland quality is absolutely critical to the Calver family’s business.

As artisan cheesemakers in Somerset, they produce unpasteurised cheeses including Cheddar, ricotta and Caerphilly; the taste of which is influenced by the cows’ diet.

Richard Calver, who manages the farming side of the business, says: “When we were grazing the cows day and night we found the flavours of the cheese were more variable as the weather changed, so we now house them overnight with a buffer feed to improve consistency. We’re supplying a high-end market, so flavour and consistency are absolutely vital.”

Mr Calver has two dairies at Westcombe Farm, near Shepton Mallet; one milking 180 cows and one with 200 cows. Until recently they were all pedigree Friesian, although there is now a small herd of pedigree Ayrshires as well.

“We calve at two years old, from June to January, and house the cows over winter from November until around mid-April,” he explains. The cows then graze rotationally over summer, moving to fresh pasture about once-a-week.

“The grazing leys are located close to the dairies, with further off fields in an arable/silage rotation or permanent pasture which is grazed by the youngstock. We’re on quite wet land here, so the ground doesn’t lend itself to intensive grazing.”

Although the cows start the season grazing a relatively small area around the dairy, they move to some silage fields after the first cut and then out again after the second and third cuts, until they end up grazing most of the farm.

The farm has around 40 hectares of wheat for crimping, 73ha of maize, and 200ha of grazing and silage leys with some steep permanent pasture.

“We plant wheat after maize

The cows’ diet influences the taste of the Calver family’s cheese.

Three cuts of silage are typically taken on-farm.

The Calvers believe happy cows make better cheese.
The cows are housed on sand cubicles at Westcombe Farm.

We like to have quite a lot of variety in the longer term leys as it can really influence the flavour of the milk.

RICHARD CALVER

and then reseed about 40ha of grassland each year – as we cut the wheat early for crimping we can establish the grass behind it at the end of August,” says Mr Calver.

Variety selection
When it comes to choosing grass varieties for silage, agronomist Keith Hallett, of Pearce Seeds, recommends high-quality, high-yielding Italian rye-grasses. A typical mix will include a hybrid Italian rye-grass. A 13kg mix will also include 4kg of red clover to fix atmospheric nitrogen and provide protein in the diet.

Grazing leys comprise high sugar diploid perennials.

“We like to have quite a lot of variety in the longer term leys as it can really influence the flavour of the milk.”

He typically takes three cuts of silage, and last year tried to cut earlier and more regularly to boost quality. “We took the first cut at the start of May but then it rained solidly for six weeks, so the second cut was later than we’d have liked,” he explains.

He uses a contractor with a self-propelled forage harvester but relies on farm labour for all the other forage jobs. “We have a few different silage clamps, so we can keep the first and second cuts separate.”

Although he aims for about 30% dry matter, last year it was almost 39%, with metabolisable energy of 12.1MJ/kg, a D Value of 67 and protein of 13.5%. “Yield was about 16 tonnes/hectare fresh weight for first cut and 11t/ha for second cut.”

Mr Calver feeds the winter ration and summer buffer feed through a mixer wagon, using grass and maize silage in equal volumes on a dry matter basis, plus soya, sugar beet, rape meal and crimped wheat.

“We also chop straw and hay and mix it into both the milking and transition diet; it improves the butterfat and protein content of the milk enormously,” he says. “The mixer wagon cut it a bit too long – using a straw chopper is better, and the hay definitely influences the flavour of the milk.”

Yields
Milk yields average 8,600 litres in the older unit and 9,200 litres in the newer unit, with protein and butterfat at 3.3% and 4.2%, respectively. Milk from forage averages around 3,500 litres.

“I built the older unit 34 years ago and the newer one five years go – we’ve learnt a lot in that time,” says Mr Calver.

He visited other cutting-edge dairy farms and copied the best of their designs. “The new unit is light and airy, with wide passageways and plenty of space – we definitely get higher dry matter intakes as a result.”

Mr Calver and his son Tom, who runs the cheesemaking side of the business, believe happy cows make better cheese, and they handle the milk equally carefully. “We don’t like to shake it about, so we have slow, gentle milk pumps and fill the bulk tanks from the bottom.”

The cows are housed on sand cubicles, and Mr Calver spreads the slurry throughout the growing season. “We’re not in a Nitrate Vulnerable
Grassland agronomy

SmartGrass

Farmers could boost their dry grass yields by 18% – and extend the grazing or cutting season – by applying SmartGrass, a natural growth promoter containing gibberellic acid. According to Dick Dyason, technical manager at Nufarm UK, rye-grass requires gibberellic acid to grow: ”It aids cell division; speeding up growth rates and boosting yields, and is a limiting factor for regrowth following cutting or grazing.

Chris Knowles produces milk from grass with spring-calving cows at Trink Farm, St Ives, Cornwall, and has benefited from extending his earlier grazing. “Our farm is surrounded by water so it is slow to warm up in spring, so any boost to early season growth is important,” he says. “We graze the cows in rotation from mid-February, so need the pastures which are grazed early to be ready for grazing again in April.”

Last spring I applied SmartGrass on April 18 to half a pasture three days after removing the cows, leaving the other half untreated,” he explains. “On the treated area the threshold of 2,800kg DM/ha was achieved seven days earlier than the untreated. This growth boost means I can bring the early grazed paddocks back into the grazing rotation sooner.”

Silage yield

Mr Dyason adds: “In one trial where we sprayed pasture with gibberellic acid, the subsequent silage yield was 55% greater by weight, and although there is an increase in bulk there is no reduction in nutritional values.”

It is important to apply the growth promoter within three to five days of grazing or cutting, and to make sure the grass is then grazed or cut at the optimum time afterwards, warns Mr Dyason. This may mean making a subsequent silage cut up to a week earlier than normal. “Once rye-grass has three leaves it’s reached its optimum growth stage – when it grows a fourth leaf it will drop the first one off, so you’re getting more stalk and less quality. There’s no point increasing yields and speeding growth rates if you’re not going to reap the benefits.”

It is also important to ensure the grass has sufficient nutrients and moisture to fuel that extra growth rate and yield, or they will become limiting factors themselves.

Weed problems

The main weed problems on-farm are docks, chickweed, with bracken on the steep permanent pasture. “We spot spray docks, and are busy tackling the bracken now,” says Mr Calver. “We were in a stewardship scheme which meant we had to delay grazing, so bracken really got a foothold. Now we’re out of the scheme we’re spraying it manually and then using a remote controlled vehicle to flail it, as it’s too steep to access with any other machine.”

The best time to spray grassland is when the weeds are actively growing in spring, at the rosette stage, says Mr Hallett. “Once the weeds are established you’ll probably have to spray for two seasons running because as quickly as you kill one generation the next seeds are growing.”

Docks, chickweed and dandelions can also be controlled by grazing grass down harder – as can crown rust, which was prevalent over autumn due to the warm and wet conditions. The warm autumn also resulted in rapid proliferation of chickweed in established leys.

“It can quickly swamp grassland so I would spray it with fluroxypyr up to October, with a 2,4-D, dicamba and MCPA mix if there’s no clover to protect.”

The cost of weeds

It is important farmers understand the real cost of weeds, warns Mr Hallett. “Docks and nettles can shade out grass, leaving bare patches where more weeds can germinate. If grass silage is worth £25/t, and good pasture is yielding 29t/ha fresh weight, weeds can reduce to 17t/ha and lower the quality. That will cost you nearly £310/ha, compared to a reseed cost of £250/ha.”

In permanent pasture which cannot be reseeded, Mr Hallett suggests keeping the grasses healthy through good fertiliser management. “Docks and thistles scavenge for nitrogen, so once the grass has used the nutrients in the upper levels of the soil the weeds will take it from lower down, making the weeds stronger and the grass weaker. If you keep your grass healthy, and top it up with productive grasses when you have poached or bare patches, that will prevent weeds from growing up.”

Weeds are also an indication of a problem in the grassland. “Rushes indicate poor drainage, and chickweed thrives in poached areas, for example,” Mr Hallett explains. “You need to look at the whole picture, not just at the herbicide choice.”

Zone, so we get on as early as conditions allow in January. We use a contractor and are hoping to start injecting it rather than using a splash plate,” he says.

He then applies 60-75kg/ha of ammonium nitrate to the grazing leys two or three times over the season, with silage ground getting 87-100kg/ha after each cut. “We don’t need to apply any phosphate or potash because that’s supplied through the slurry.”
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Smartgrass contains gibberellic acid, Easel contains MCPA, Depitox contains 2,4-D, Agritox contains MCPA, Cirran 360 contains 2,4-D and MCPA, Thrust contains 2,4-D and dicamba, Squire Ultra contains amidosulfuron.

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Grow a better tomorrow.
Grassland management

Step-by-step silage-making

Making good quality silage is all about attention to detail at every step of the process, says James Duggleby.

1 Quality grass
Select the right grass breeds and varieties for the pasture, to balance yield and quality over a defined reseeding period. Ryegrass is a common option, with clover to boost yields and protein and reduce fertiliser demand.

2 Nutrition
Low pH and nutrient levels will reduce yields and grass quality. Grass can use 2.5kg/ha of nitrogen a day, so take soil samples and account for manure, slurry and dung from grazed stock.

3 Pasture management
Weeds will decrease silage yields and quality, so assess pastures in spring and apply herbicides if required. Molehills will contaminate silage and can damage machinery, so carry out mole control in November and roll the field in early spring when conditions are suitable – this will also bury stones.

4 Timing
This is the most influential factor affecting silage quality which the farmer has control over. For example, silage cut in early May might have 25% crude protein, 75 D Value and yield three tonnes/ha dry matter. Two weeks later yields will have risen to 6t/ha but protein will have dropped to 18% and D Value to 68. After another fortnight yields might be at 8t/ha, with protein down to 12% and a D Value of 60. This illustrates the importance of assessing your silage needs and cutting accordingly – not just on the date the contractor can make it or the time of year you usually make silage.

5 Harvest techniques
When it comes to harvesting, preparation is everything.
Make sure equipment is well maintained and ready to go to avoid costly breakdowns at critical times. There are a number of different options when it comes to mowing, tedding, raking and harvesting, so it is important to assess the farm needs, labour availability and handling capacity to maximise efficiencies and silage quality.

**Mowing**
Sugar content is highest in the afternoon after the plant has photosynthesised, so that is the best time to cut, when the pasture is free from rain or dew. Choosing whether to condition can be difficult: Conditioning breaks the waxy cuticle on the leaf, speeding up water loss during wilting by up to 20%.

The problem is if it rains, as the leaves will then reabsorb water more quickly. If using a conditioner, it is important to set it correctly – too harsh and it will pulp the grass and increase fuel usage – too light and it will not work.

Stubble height should be set at 5cm – if you cut too low it will impede grass regrowth, blunt the mower blades, and increase the risk of contamination. The base of the plant is also low in D Value so does not contribute much to silage quality.

In-field checks and settings are vital to maximise efficiencies and silage quality. They do not take long and can have huge benefits. Change mower blades regularly – if they are blunt they will not cut the grass cleanly, dramatically slowing regrowth.

If the ground is dry, set the spread width to maximum to increase the surface area for rapid wilting. If the ground is wet, leave the grass in a swath, allowing the ground to dry out either side before tedding.

**Tedding**
Tedding will speed up wilting time, and mixes the grass to give a more uniform wilt and therefore more uniform quality, with fewer hot/wet spots in the clamp. Set the tedder height in the field, with tines 2-4cm above the ground. Drive forward slowly and check if they are scraping the soil or leaving grass behind. Too low and you’ll contaminate the silage and increase machinery wear, too high and you’ll leave a mat of grass behind.

It’s also important to match your tractor speed with the RPM of the PTO shaft – if you need to cover more ground go for a wider spread; do not drive faster as it will affect silage quality.

**Raking**
Presentation of the swath to the harvester has a big impact on efficiencies and quality – you want an even, box-shaped swath for a smooth, consistent flow. Row up just before harvest so that the grass quality remains uniform – too long in the swath and the top will wilt more than the bottom. Set your rake height...
Grassland management

Baler choices will depend on whether you want bales wrapped or not.

1 Forage harvester
   Whether trailed or self-propelled, a forage harvester ensures a uniform chop length and gets the crop into the clamp quickly. Having been chopped, it can also be consolidated quickly. Having a higher capital cost, this option will be chosen to suit the feeding regime.

2 Forage wagon
   Although it does not give a precision chop length, a forage wagon is cheaper to run than a harvester. However, the less uniform silage will take longer to buck rake and consolidate in the clamp, although there is an argument that longer chop lengths are good at slowing the cows’ digestion process.

3 Baler
   Choices will depend on whether you want bales wrapped or not. Round combi-balers wrap on-the-move, saving labour, but they are more expensive to buy. Square bales have to be wrapped separately but can be stacked and stored more easily.

Harvesting
A farmer’s choice of harvesting technique depends on what type of silage they require. Many will use a forage harvester or wagon for high-quality silage, with lower energy crops baled for feeding to dry cows. When choosing equipment, ensure there is enough capacity to manage the crop in the clamp at the same time as harvesting, so every stage of the silage-making process can be undertaken at the correct time. The same is true of using a contractor – ensure they can do what you want, when you want, to achieve the right quality silage.

Savings on contractor fees can quickly be lost through reduced quality forage.

Make sure equipment is well maintained and ready to go to avoid costly breakdowns at critical times.

JAMES DUGGLEBY

Grassland Toolkit 20

Grassland Toolkit
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Utilising grass silage

What can be learnt from last year’s silage quality?

Silage quality was unexciting last year – so what lessons can farmers learn to avoid a repeat in the coming season?

Weather will always have a major impact on silage quality – but 2016 was a relatively benign year. So why did quality fail to meet expectations?

According to Derek Nelson, product manager for Ecosyl, one of the main reasons behind the reduced quality was the low milk price, which led many farmers to cut costs to the bone.

He says: “We know people treated less silage with an inoculant. But farmers are now seeing the impact of that in silage which isn’t feeding out very well, and is suffering from lower energy and protein levels. It’s important not to make the same mistake again.”

Grass yields in some cases were also down, probably due to reduced fertiliser applications. Some farmers may also have cut back on the use of contractors, he adds.

“Remember, if cutting was late, the digestibility of grass silage after heading falls by about 0.5% a day.”

To improve silage yields and quality this year farmers should be honest and scrutinise the impact that cutbacks in all areas may have had in 2016.

“‘The recent increase in milk prices is clearly good news, but if silage quality or quantity isn’t there, you’ll have to rely more on bought-in feed to take advantage of this. A lot of feed costs.”

Mr Nelson recommends planning ahead now to ensure the best possible silage quality and yields in 2017.

“If cutbacks were made on grassland reseeding in 2016, there is an opportunity to reseed in spring. And when it comes to preserving the nutritional value of silage, look for a silage additive which is proven. That means proven not just for fermentation, but also for subsequent effects – in particular, for reducing dry matter losses, maximising feed value and, ultimately, for increasing milk yield per cow.”

Case study
Scott Kingston farms with his father Nigel and brother Matt, at Tresham Farm, Wootton-under-Edge, Gloucestershire. Milking 240 Holstein cows, they are always trying to get as much milk from grass and forage as possible to boost productivity or cut purchased concentrate costs.

Calving all-year-round, Mr Kingston houses the high yielders and feeds them a total mixed ration comprising grass and maize silage and concentrates. The low yielders, youngstock and beef cattle are grazed on a paddock system from spring to autumn, with buffer feed given when needed.

In total the farm comprises 200 hectares, of which 60ha are arable and 57ha are permanent pasture, with the rest sown to grass or maize.

“We reseed silage leys...”
The science behind silage – Dr Mark Leggett, microbiologist for Ecosyl

The basic premise of making silage is to preserve it through a process of fermentation, turning sugars into acids which essentially pickle the crop. But there is a lot which can go wrong, sapping the silage quality and increasing losses.

The first decision is when to cut: Are you aiming for maximum yield or high quality and digestibility? There is usually a compromise to be had, cutting earlier for high D Value and later for larger yields.

As soon as the grass is cut it starts changing, as plant enzymes begin the degradation process. Ideally, grass should be at 28-32% dry matter when it goes into the clamp – if it is too wet it will affect the fermentation process and increase effluent losses; too dry and it will be difficult to compact, leaving more air inside the clamp.

However, there is a balance to be found between increasing the grass dry matter and preserving its quality, so it is important to choose the optimum weather conditions for rapid wilting. Spreading and turning cut grass will speed up wilting, but you must avoid contaminating it with soil. It really is a race against time – the longer the grass is in the field the more natural bacteria, yeasts and moulds will be using up those nutrients you are seeking to preserve.

Fermentation
Once wilted, get the grass into the clamp, compacted and sealed as quickly as possible. Fermentation has to take place in anaerobic conditions, otherwise aerobic bacteria will use up important sugars, so it is vital you exclude as much air as possible.

The aim is to acidify the crop rapidly, dropping the pH from 6.5 to around 4 within 24-72 hours, to prevent the growth of undesirable bacteria. While this process will happen naturally, it can be quite slow, so adding an inoculant such as the beneficial lactic acid-producing bacteria Lactobacillus plantarum will speed it up and improve nutrient preservation.

Ecosyl contains the MTD/1 strain of freeze-dried Lactobacillus plantarum which is mixed with water and sprayed onto the silage when it’s chopped. At a cost of £1.40/tonne treated, Ecosyl can give a return on investment of three to one through improved silage quality and reduced wastage (see table, below).

Slow, inefficient fermentation – which can be measured both through pH and the lactate: acetate ratio (lactate should be high, acetate low for good fermentation) – means loss of valuable sugars. It can also lead to secondary clostridial fermentation resulting in excessive protein breakdown into ammonia and the production of butyric acid, both of which lead to bad smelling silage which may reduce intake.

Having made the best silage possible, it’s important to preserve that quality when it comes to opening the clamp and feeding it out. Once oxygen is present moulds and yeasts will begin to use up the lactic acid, leading to spoilage. Design the clamp to minimise the face area, and keep the clamp face as clean and tight as possible, using a block cutter rather than pulling the silage out.

<table>
<thead>
<tr>
<th>Treated and untreated grass with an initial DM of 27%</th>
<th>Untreated</th>
<th>Ecosyl treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>4.73</td>
<td>3.97</td>
</tr>
<tr>
<td>Lactic acid (g/kg DM)</td>
<td>31.9</td>
<td>91.9</td>
</tr>
<tr>
<td>Acetic acid (g/kg DM)</td>
<td>9.3</td>
<td>15.6</td>
</tr>
<tr>
<td>Butyric acid (g/kg DM)</td>
<td>44.1</td>
<td>0</td>
</tr>
<tr>
<td>Lactic acid:Acetic acid</td>
<td>3.4</td>
<td>5.9</td>
</tr>
<tr>
<td>Ammonia N (% total N)</td>
<td>10.7</td>
<td>4.3</td>
</tr>
<tr>
<td>Dry matter loss (%)</td>
<td>11.8</td>
<td>4.7</td>
</tr>
</tbody>
</table>

Kingston. He uses a mower conditioner and spreads the grass out to wilt for 36 hours. “We ted it and use a double rake to bring two mower widths into one swath to harvest with a trailed harvester. All the first and second cut goes into the clamp, along with some of the third cut – the rest is baled.”

Two tractors work on the clamp, with a buck rake and...
Utilising grass silage

The high-yielding cows are housed and fed a total mixed ration comprising grass and maize silage and concentrates.

double wheels on the tele-handler for good compaction. “We use clear and black plastic sheet and green nets to keep the birds off, all weighted down with tyres,” says Mr Kingston. “It’s slower using a trailer harvester than a self-propelled one, but I don’t know if we could deal with a faster rate coming into the clamp. Faster isn’t always better.”

In the past, feeding silage to the housed cows over summer has proven challenging. “We’ve had quite a lot of wastage as the face heats up,” he explains. “White mould isn’t ideal for the cows, and as you take the sheet back you end up with wastage on the top as it heats up so fast.”

This year Mr Kingston decided to use Ecocool, an additive which is applied to the silage as it is chopped in the forage wagon. As well as a bacterial inoculant to improve fermentation, it contains a second bacterium for improved aerobic stability.

Results

“I’m really pleased with the results – we’re about halfway through the clamp now and none of the face has heated up at all,” he says.

“We feed in troughs so it’s hard work clearing out bad silage, but I haven’t had to chuck anything out this year. That’s saved a lot of money, as well as time in not having to pull off bad silage from the clamp. It’s paid off many times over – you only need a minuscule improvement in quality and usage to make it worthwhile.”

The family try to leave the clamp shut for 10 weeks before opening it up, and this year it has averaged 11.5MJ ME, 14.8% protein and a D Value of 75.4.

“We’re averaging 4,500 litres from forage, with a lactation average of 9,800 litres per cow,” says Mr Kingston. His margin over purchased feed is 19.84ppl, with concentrate costs of 7.01ppl.

Doing all the feeding himself, he tries to keep the face as tight as possible, using a sharp sheer grab and only taking the sheet back as far as necessary.

“Unfortunately, the face is quite wide as eventually we want to increase cow numbers, so it’s not ideal, especially in summer. But by making the best quality silage possible, and preserving that quality, we can decrease concentrate use in our youngstock and push our milking cows just that little bit harder.”
They don’t understand the science but they do know fine forage when they’re fed it

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For consistently better silage
January
- Compile Nutrient Management Plan field-by-field for next growing season
- Assess yield potential and adjust targeted nitrogen input accordingly
- Assess silage harvesting equipment and have it serviced
- Carry out any repairs and maintenance
- Decide which fields are for first cut

February/March
- Pasture health check and prioritise spring work
- Make first manure and fertiliser applications
- Carry out weed control
- Roll fields
- Apply slurry early for maximum growth rates and minimise risk of silage contamination
- Consider applying gibberellic acid after early grazing

June/July
- Prepare for second silage cut
- Over-seed tired pastures after second cut
- Continue to apply fertilisers and manures as soon as possible after grazing/silage cuts
- Spray thistles as they come into bud
- Assess silage stocks and monitor wholecrop cereals
- Top thistles and nettles but never ragwort as it grows back stronger
- Spot spray ragwort and soft rush, or cut and treat soft rush regrowth with MCPA

August
- Establish red clover/grass mixtures but avoid sowing in drought conditions
- Drill pelleted white clover into existing grass leys
- Get your first cut analysed
- Pull up any post-flower ragwort to remove roots
- Consider weed control measures in newly-sown leys

November
- Take soil samples (once every three years in every field)
- Carry out mole control if necessary

December
- Make sure Nutrient Management Plan records for current year are completed
- Minimise wheeled traffic and control winter grazing to reduce sward damage and compaction
Manure and fertiliser closed periods in Nitrate Vulnerable Zones

Closed period for applying organic manure with high readily available nitrogen content (for example slurry, poultry manures, liquid anaerobic digestate or liquid digested sewage sludge)

<table>
<thead>
<tr>
<th>Start date</th>
<th>End date</th>
<th>Land use</th>
<th>Soil type</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 1</td>
<td>December 31</td>
<td>Tillage land</td>
<td>Shallow or sandy soils</td>
</tr>
<tr>
<td>September 1</td>
<td>December 31</td>
<td>Grassland</td>
<td>Shallow or sandy soils</td>
</tr>
<tr>
<td>September 16</td>
<td>December 31</td>
<td>Tillage land with crops sown on or before September 15</td>
<td>Shallow or sandy soils</td>
</tr>
<tr>
<td>October 1</td>
<td>January 31</td>
<td>Tillage land</td>
<td>All other soils</td>
</tr>
<tr>
<td>October 15</td>
<td>January 31</td>
<td>Grassland</td>
<td>All other soils</td>
</tr>
</tbody>
</table>

Manufactured nitrogen

Closed period for applying manufactured nitrogen fertilisers

<table>
<thead>
<tr>
<th>Start date</th>
<th>End date</th>
<th>Land use</th>
<th>Soil type</th>
</tr>
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<tr>
<td>September 1</td>
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<tr>
<td>September 15</td>
<td>January 15</td>
<td>Grassland</td>
<td>All soils</td>
</tr>
</tbody>
</table>

March/April

- Second fertiliser applications to silage where applications are split
- Allow time for fertiliser to be absorbed before mowing
- Make sure after cut fertiliser is ordered and delivered
- Over-seed tired pastures if less than 70% covered with sown species
- Establish clover in a grass ley (drilling clover later allows early weed control in new grass)
- Prepare clamps, speak to contractor and ensure forage additive has arrived
- Spray ragwort before it exceeds the rosette stage and observe the withdrawal period
- Spray buttercups before flowering and control chickweed

May

- Assess grass growth stage and weather forecast for appropriate time to take first cut
- Top and rake fields or mob graze if unmown grass or residue is left
- Apply fertiliser/muck/slurry to boost regrowth as soon as possible after silage cuts
- Reseed if less than 50% covered with sown species
- Spray docks and other weed regrowth around two weeks after silage cut

September

- Last opportunity for a full reseed or renovation in most parts of the country
- To reduce winter kill, swards should be no more than 3-4cm in height going into winter
- Obtain fertiliser in early market
- Consider taking third cut silage
- Treat reseeded ragwort and control weeds in newly-sown leys
- Spray dock regrowth after cutting

October

- Sow grass after maize by the end of the month
- Ensure fields are well topped and dead grass removed with raking
- Check herbicide labels as some do not allow autumn use

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