Nutrition of the Spring calved dairy cow in the early lactation period

The Spring period is the most challenging period for grazing and feeding the grass-based dairy herd correctly. The transition from dry-period diets to milking diets and the transition from indoors to grazing are happening simultaneously, while cows are also at highest risk of nutritional problems. There has been some debate in recent difficult Spring seasons as to whether good nutrition of the herd is compatible with the drive and focus on grass. However, the benefits of getting the transition to grazing right, even in poor weather years, are very significant; reduced feed costs, improved sward quality for subsequent grazing rotations, better cow health and milk solids performance because grazed grass is a far superior feed to grass silage even when grass silage is of high quality.

On-farm data over across multiple years shows that growing and utilising more grass is the key to increasing profitability of milk production systems. The target is 10+ tonnes grass dry matter utilised per hectare, and the journey to meeting this target starts in the Spring. This short review answers some of the most commonly asked questions in relation to feeding the herd in Spring, while also keeping firmly focussed on achieving more grass utilised on the farm.

How much energy, protein and fibre does the cow need in early lactation?

Energy is the first limiting factor to production in early lactation and is the focus in terms of feeding the dairy cow well in Spring. Access to grass will increase the total energy density of the diet, as it is 20-40 % higher in energy than silage as the base forage. Table 1 outlines the energy requirements (on a UFL basis) for a 550 kg cow producing 25 kg milk in early lactation. Fibre (measured as neutral detergent fibre, NDF) is critical to maintain optimal rumen function and the diet should be approximately 32-36 % of the dry matter (DM) for optimum milk performance while maintaining rumen health in a grazing diet. If diet NDF is meeting this requirement, adding very fibrous feeds such as low digestibility silage or straw can restrict total energy intake due to its slower passage rate. On the other hand, if the diet is marginal to low in fibre (< 32 % of the DM), then issues such as acidosis or rumen displacement can arise; this generally occurs due to total forage DM intake (grass and/or silage) being below target, or indeed too high concentrate feeding rate as a proportion of the diet.

The protein of the diet (on a Protein Digestible in the Intestine (PDI) basis) should be around 105 g PDI protein per 1 unit UFL of energy intake, e.g. a 17.5 UFL intake should be matched to a diet PDI content of 1840 g per day. This will usually translate to a diet of 15.5% to 17% in crude protein (CP)

terms for the overall diet. Dietary protein value will naturally be higher with the inclusion of grass in the diet, which offers the scope to reduce the CP % of the concentrate component of the diet dependent on grass quality.

Table 1. The requirements of a 550 kg dairy cow producing 25 kg milk in early lactation at 4.3% fat and 3.4 % protein on 20 % concentrate and 80 % grass diet

Component	UFL/day
Maintenance	6.1
Activity (+ 15 %)	0.90
Milk production	11.5
0.5 BCS loss[1]	-1.4
Neg. Assoc. Effects[2]	0.6
Total required	17.7
UFL required from forage	13.8

[1] The UFL supplied per day as a result of mobilising 0.5 BCS (85 UFL) over the first 60 days of lactation

[2] Negative Associative Effects (NAE) accounts for the reduced digestibility of the total diet as concentrate proportion increases. The NAE of feeding 20 % of the diet as concentrate (3.5 kg DM) is equivalent to 0.6UFL per day

What level of dry matter intake is possible in early lactation?

Dry matter intake (DMI) will be at its lowest in the week after calving but increases steadily by approximately 1kg DM each week in the first 4-5 weeks, and a more gradual increase of 0.3-0.5 kg DM until it reaches peak DMI at 8-10 weeks in lactation. For a mature cow this will increase from 13-14 kg DM/day to 19-20 kg DM/day at peak, while heifers will increase from approx. 10 kg DM/day to 15 kg DM/day at peak. For a typical herd, with 25 % heifers this will result in a herd average intake of about 18 ± 1 kg DM/cow/day at peak.

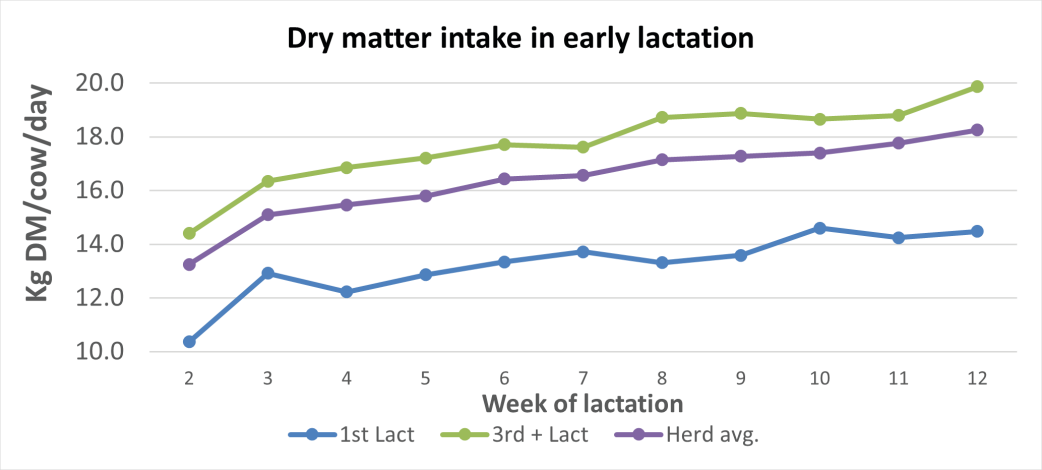


Figure 1: Dry matter intake of mature cows (3rd lactation +), heifers and a herd average with 25% replacement rate, measured in weeks 2-12 of early lactation as published by Walsh et al., 2024.

The DMI curves outlined in Figure 1 were measured on freshly calved animals offered grass and 3 kg of concentrate feed in the parlour. Wet weather can result in poorer utilisation of allocated grass due to soiling of the available feed, thereby limiting DMI. External water on the plant does not significantly physically restrict DMI, although cows' drinking water intake will reduce accordingly. However, if the internal DM of the plant is reduced this will limit DMI of the animal, which may occur during prolonged periods of wet weather. A reduction in plant DM from 16 % to 12 % can reduce total intake by approx. 1.1 kg DM. This limiting effect on intake should not mean exclusion of grass from the diet however, but instead can be offset by offering an additional 1.5-2 kg DM of high quality silage in a restricted/on-off grazing situation.

What is the nutritional benefit of getting one or two grazings into the diet each day?

Every Spring there is a debate about the merits of getting cows out to grass early. Does it pay, what about the damage to paddocks, is it too hard on cows, etc.? It is worth remembering, however, that the aim of getting grazed grass into the diet is dual purpose, it is to improve the nutrition of the freshly calved cow, and to prime sward quality for April-May. Achieving at least one grazing per day can reduce feed costs and increase milk yield, to the combined economic value of c. €2.80/cow/day, or €1960/week for a 100-cow herd.

Table 2 shows the nutrient values for a range of feeds commonly offered on dairy farms. Comparing Spring grass to average quality silage, it is almost 40 % higher in feed energy and 70 % higher in protein on a dry matter basis. Where one grazing per day (6 kg of grass dry matter) replaces silage in the diet, the increased energy and protein intake will support an extra 0.40 kg milk solids or 0.25 kg milk solids approximately, for average or good quality silage respectively. Additional milk solids production and/or a reduction in daily concentrate allowance (2-3 kg per cow per day) are possible where two grazings per day occur. This further improves milk value while cutting daily feed supplement costs and has an impact on milk fat and protein percentage across the lactation.

Concentrate feeding also increases energy and protein intake per day. However, inclusion rate in the diet is limited due to factors including the cow's requirement for physically effective NDF (fibre from forage), the negative effect of a lower forage-to-concentrate ratio on total diet digestibility, and the cost per unit of nutrient purchased as concentrate. Spring grazed grass compares quite well to concentrate ingredients in terms of energy and protein per kg dry matter, with a relative cost that is approximately four times less for that early lactation diet.

Table 2. Nutritional values forage and concentrate feeds

	Energy UFL/kg	Protein PDIE g/kg	Fibre NDF % of DM
Grazed grass	1.03	112	40
Average quality (67 DMD) silage	0.75	66	54
Good quality (74 DMD) silage	0.85	80	45
Barley Straw	0.43	40	84
16% Hi-Energy concentrate	1.10	114	-
Beet pulp	1.14	110	54*
Soybean meal	1.18	270	-
Rolled barley	1.16	103	-
Rapeseed meal	1.05	151	

** Beet pulp is not a source of physically effective NDF but is superior to high starch ingredients as a supplement in low forage intake situations*

What should I do if I am tight on grass or ground conditions prevent grazing?

The availability of grass per cow for Spring grazing is determined by demand factors (stocking rate, calving pattern, 6-week calving rate) and supply factors (opening farm cover, Spring growth pattern), traffic ability, grazing infrastructure. On farms with high Spring demand, an opening farm cover of 900-1000 kg DM per ha is required to keep grass in the diet from early Spring until start of the second rotation in early-mid April. Average farm cover should not be allowed to drop too quickly, and not to below 500 kg DM per hectare for the start of the second rotation, otherwise grass growth and availability will be impeded in the second rotation.

Average farm cover should be monitored weekly and grass budgets revised accordingly throughout the Spring (see the PastureBase website for details and support tools). If a clear grass deficit is visible on the farm, front-loading supplementation of high quality silage in the diet has less of an impact on performance in the first six weeks of lactation than if the cows are at or approaching peak milk production. The advice is to graze low pasture cover paddocks during this period, which will complement silage feeding and increase grass available to feed the cows as demand increases. Utilise on-off grazing, if and when ground conditions deteriorate; cows can achieve up to 90 % of their pasture intake potential in 2 x 3 hour grazing bouts after milking's. However, if poaching damage is excessive even with on-off grazing, and cows must be housed fully for a short period, feed high quality silage (> 75 DMD) and supplement according to silage quality (~4-6 kg concentrate) until they can return to grass. Always plan for these events and ensure to have access to high quality grass silage that can be accessed at any time. Choose drier paddocks with good grazing infrastructure during periods of poorer weather conditions to increase opportunities to maintain grass in the diet.

Ground conditions can recover quite quickly in Spring so the decision to keep cows housed needs to

be made daily. In other words, make grazing the default situation in Spring and house if needed, instead of housing as default and grazing if possible. This represents an important shift in management thinking for some but is the default position for the most progressive grassland managers.

What quality of silage is need for milking cows? What should I feed if silage quality is poor this Spring?

Silage for milking cows should be at least 74 % DMD, well preserved with good energy and intake characteristics. Cows will voluntarily eat > 13 kg dry matter of this type of silage, making early lactation feeding and supplementation very straightforward. On the other hand, cows will struggle to eat 10-11 kg DM of poor quality silage (< 68 % DMD or less). This intake effect combined with lower UFL value per kg of feed, significantly limits the cows' energy and protein intake and milk solids yield supported by the diet (Table 3). In early lactation, cows will exceed these levels of milk production (Table 3) supported by the diet due to mobilization of body reserves, as there is a metabolic imperative to produce milk in the weeks immediately after calving. For this reason, there is a particular risk of excess body condition score (BCS) loss in early lactation where diet are inadequate over a prolonged period.

Table 3. Early lactation milk yield supported at different concentrate feeding rates & silage quality

	Concentrate kg as fed		
Silage DMD	**4**	**6**	**8**
66	13.8	16.4	19.1
74	18.4	20.9	23.5

Extra meal feeding will not fully solve the nutritional problem of low DMD silage. This is because the realised feed value of the extra concentrate declines as the proportion of concentrate in the diet rises, due to a reduction in whole diet digestibility. In other words, the cow utilizes her whole diet less efficiently when concentrate feeding rates are high relative to forage intake. There is also the risk of clinical digestive upsets and acidosis to consider with very high concentrate proportions, in addition to the extra feed costs incurred.

In farm situations where the only silage available is low DMD and access to grass is limited:

- Put grass in the diet at least once per day, even if ground conditions are less than ideal. Cows will eat 5-6 kg DM grass in 3-4 hours which adds energy and protein to the diet
- Feed 2kg of a high fibre straights like hulls or beet pulp where grazing is impossible
- Review your silage plan for 2025. A typical Spring calving dairy herd needs >50 % of its silage at 74 % DMD plus. National average in 2024 was 69 % - there is much scope to change.

What level of meal feeding is optimum? What is the expected response?

When we compare the cow's energy requirement for milk (0.43 to 0.45 UFL per kg) to the energy content per kg concentrate as fed (typically 0.92 to 0.95 UFL), there is, theoretically, sufficient energy in 1 kg concentrate to produce more than 2 kg milk. However, in a grazing scenario with adequate pasture allowance and quality, a 2:1 milk yield response to additional concentrate supplementation is impossible. A more standard range of expected response is 0.5 kg to 1.3 kg milk per kg concentrate fed, around a mean of 0.8 to 0.9 kg milk per kg concentrate fed depending on a whole range of considerations.

A key underlying factor determining milk responses is substitution rate, or the proportion of forage displaced by increasing concentrate supplementation. Factors that affect substitution rate and the milk yield response to concentrate include the proportion of concentrate in the diet, pasture and silage quality, quantity of forage offered, type and quality of supplement offered (alternative forage/ concentrate).

In early lactation, there is typically minimal substitution observed for the first 3 kg concentration offered. Increasing concentrate allocation beyond this will result in reduced grass DMI and reduced total diet digestibility. However, an increase in total DMI and milk yield are observed. This increased milk production is not linear, and thus the marginal milk response for each additional kg of concentrate is typically lower than at the previous rate of supplementation. Table 4 illustrates this pattern of response to increasing concentrate across two different levels of pasture quality. There is a diminishing financial return to the farm as the supplement rates increase and the response rate declines. This also means that, by definition, feeding extra concentrate to maximize milk yield will not result in maximum profitability of the farm. In fact the expectation would be that as concentrate feed levels are increased that the profitability would be reduced.

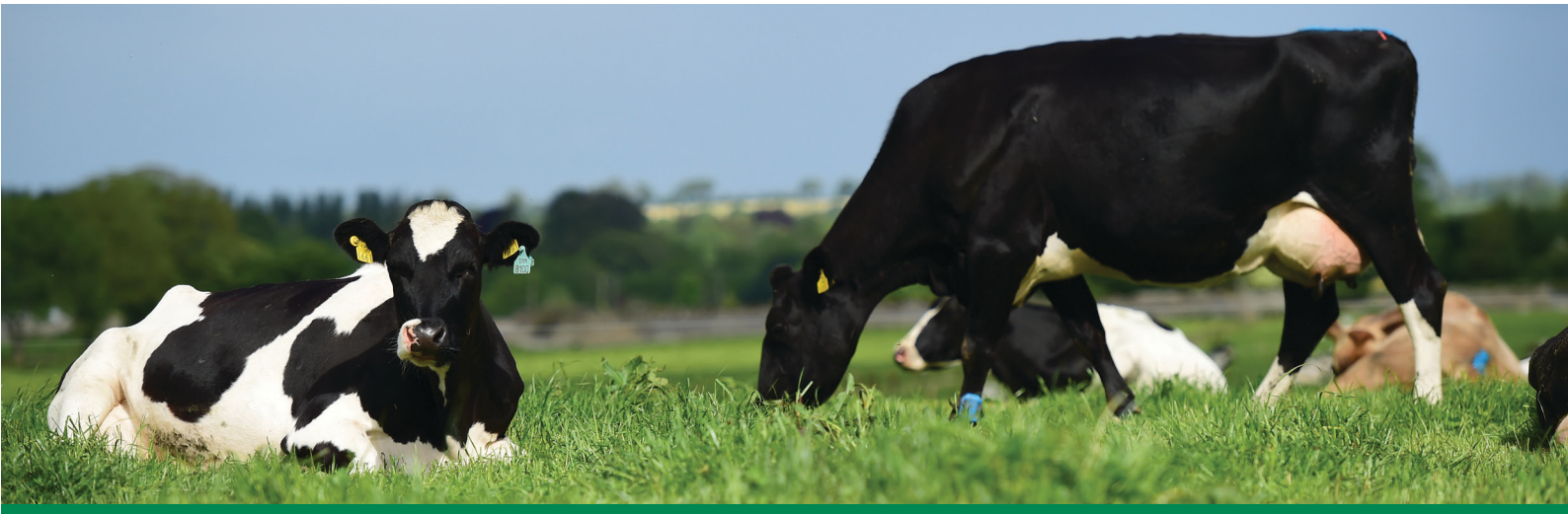
Note also that the marginal response to concentrate is best where pasture quality is poorest, i.e. where the diet and cow performance is least favourable. For this reason, it is not valid to evaluate the overall economics of pasture and supplement strategies on a response-to-concentrate basis. It is much more important to focus on increases in pasture utilisation, proportion of grazed grass in the diet, and milk solids efficiency per kg of pasture consumed.

Table 4. Impact of pre-grazing cover and concentrate allocation on grass DMI, total DMI, milk yield and response to concentrate in mid-season

High quality pasture Leafy, low NDF content 1,400 kg DM/ ha pre-grazing cover	Meal kg as fed (0.88 DM)	Grass Intake*	DMI	Milk kg	Response per kg as fed
	0	16.8	16.8	23.9	-
	2	16.2	17.9	26.2	1.15
	4	15.6	19.1	27.8	0.8
	6	14.9	20.2	29.0	0.60
Low quality pasture **Stemmy, high NDF content, >2,000 kg DM/ ha pre-grazing cover**	**Meal kg as fed (0.88 DM)**	**Grass Intake***	**DMI**	**Milk kg**	**Response per kg as fed**
	0	14.8	14.8	17.1	-
	2	14.5	16.3	19.7	1.32
	4	14.0	17.5	21.8	1.03
	6	13.4	18.7	23.7	0.95

Will increased meal feeding for a higher peak increase milk production for the remainder of lactation?

Ample studies have looked at offering varying levels of concentrate in early lactation and feed-to-yield type systems across a variety of systems, assessing both the immediate and carryover effect. In early lactation grazing studies increased milk yield in response to increasing concentrate feed rate from 3 to 6 kg was not sustained once all cows were subsequently returned to the same feed rate. The positive impacts on performance are outweighed by the poor economic response, poorer sward utilisation and subsequent impact on pasture quality. We typically see a more pronounced carryover effect in research studies where one cohort of cow's energy balance/BCS loss is more severely impacted than the other, as when they are offered a diet of increased energy density a greater proportion of nutrients will be partitioned to recovering BCS lost in the preceding period of the study. Pasture quality in the mid-season also has a significant impact on maintaining daily production.



Often the problem after a wet Spring is poor grass in April and May, as was observed in 2024 where late-grazing resulted in heavier swards, poor utilisation through continued wet weather and a greater proportion of stem and dead material in the sward. This has a negative impact on sward quality and high levels of stem in the sward can also limit intake. Mid-season stocking rate on the milking platform should be designed to maximise high quality pasture intake and allow capacity in the system to correct grass quality by baling surplus paddocks or poor quality paddocks when surpluses arise.

What level of crude protein should be in the ration?

Crude protein is a very basic measure of the nitrogen component of a feed. Alternatively, the metabolisable protein value (measured by PDI) is a more accurate description of the quality of a protein source. Ruminants are unique in that with the sufficient supply of energy in the rumen they can utilise ammonia from protein and nitrogen sources to produce microbial protein to support production. In a grazing scenario, energy is typically the limiting factor to microbial protein production. A good rule of thumb is that for every UFL the cow requires she needs 100-105 g PDI. The excess supply of protein above requirement results in an energy cost to the cow for converting un-utilised ammonia back to urea for excretion. However, this is largely inevitable in a grazing diet and would be costly to mitigate.

Where grass can be consistently included in the Spring diet, a 14 % CP dairy nut will suffice (see example spec in Table 5). If cows are housed for a short period (a few days) due to severe weather conditions and the concentrate available on farm is 14 % crude protein, there is relatively little need/long term benefit to adding extra protein to counter the reduced PDI of grass silage. The priority should be to return to grazing as soon as possible. However, if the farm has a heavy soil profile, and cows are routinely housed in the Spring period, then a high-energy 16 % crude protein concentrate may be more suitable for the first few weeks of the season before moving to the lower protein formulation. However, where cows remain housed with no access to grass for a prolonged period (> 2 weeks) then a higher protein ration is required. Note that higher concentrate protein levels usually result in increased purchase cost per tonne, and have implications for annual nitrates excretion calculations. Avoid purchasing concentrate with low quality ingredients in early lactation, intake capacity is limiting so it is important to make every kg of intake count.

Table 5. Sample 14 % crude protein dairy nut spec and characteristics

Ingredient	%	Characteristics	
Maize	30.5 %	**UFL as fed**	0.94
Maize distillers	30 %	**PDI as fed**	97 g
Soya Hulls	30 %	**CP as fed[1]**	14 %
Molasses	5 %	**Starch**	22 %
Minerals*	2.5 %		
Cal Mag	2 %		

**MMineral pack to supply macro and trace elements except Mg, 1% MCP and approx. Selenium 1.5mg, Iodine 4.0mg, Cobalt 4.0mg, Copper 90mg, Zinc 115mg, Manganese 115mg*

[1]To formulate to 18 % CP, replace 18 % maize distillers with soya bean meal

Some cows in the herd are very high yielding - should they be fed extra concentrates?

For any milking herd on any given day, there will be a considerable range in individual cow performance around the herd average, with factors such as stage of lactation, parity and genetic potential for milk yield all contributing to variation. An example in Figure 2 shows milk recording data from a compact Spring calving herd selling 520-530 kg milk solids per cow annually. At the time of the milk recording in April, the herd was averaging 27.5 kg milk @ 2.12 kg milk solids, and offered 17 kg grass plus 2 kg parlour concentrate, in good grazing conditions. The distribution of individual milk yields is illustrated as of the proportion of the herd exceeding a given yield threshold, for example 50 % of cows are yielding in excess of the daily herd average. On the day of recording, 7 % of cows in the herd were yielding in excess of 35 kg per day (>2.80 kg milk solids). This is very much in line with many other herds analysed in this way.

A common query then is 'are the higher yielding cows underfed, and if so should they receive extra concentrate?' A key point to consider here is that there will also be significant variation in daily pasture DM intake around the mean of 17 kg offered. Intake data from grazing studies in Moorepark (measured on individual grazing cows using the n-alkane technique) has shown a typical cow-to-cow range of 14 kg DM to 23 kg DM in grazing herds offered 17-18 kg daily herbage allowance. In general, lower pasture intakes corresponded to first lactation heifers and lower yielding cows, whereas cows at higher daily milk solids yield tended also to have the highest daily pasture intakes.

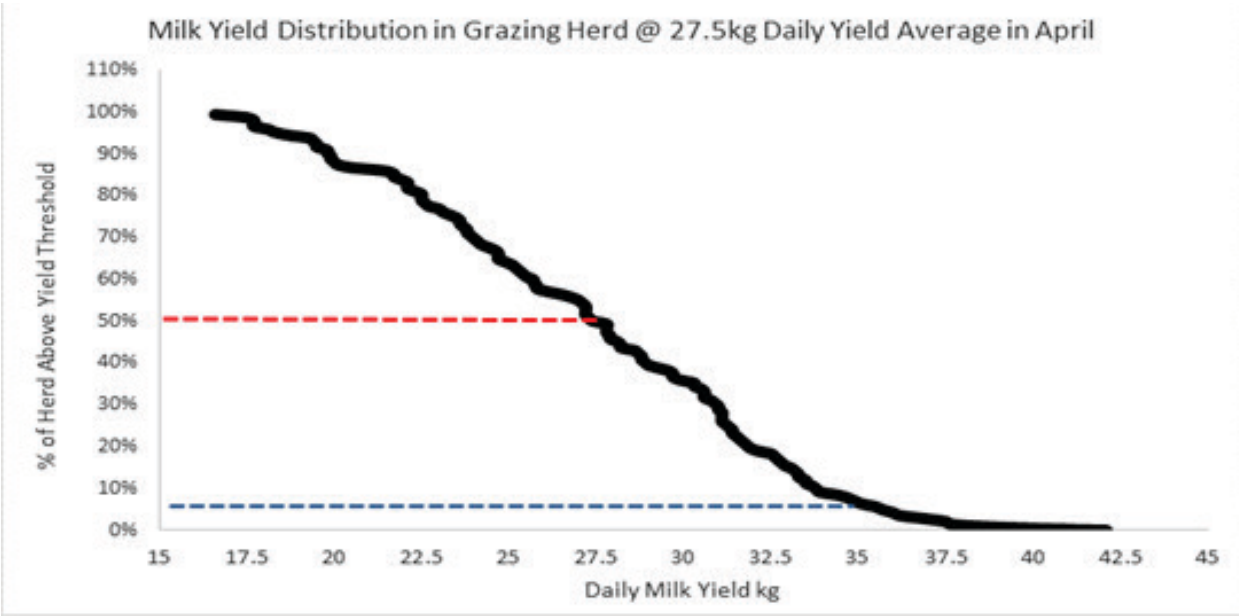


Figure 2. Milk yield distribution of a herd at milk recording in April, averaging 27.5 kg milk/cow/day at 2.12 kg MS/cow/day.

Therefore, once pasture quality is of high, pasture allowance and supplement rate are appropriate for current average performance, and herd genetics are suitable for grazing systems, there is little requirement to differentially manage the higher yielding individuals in the group; it could also add complexity and capital cost for no financial return.

How do I prevent negative energy balance? Does it affect subsequent herd fertility?

Negative energy balance (NEB) in early lactation measures the difference between energy intake and energy required for maintenance, activity and milk. Some degree of NEB is inevitable in early lactation because the intake capacity of the rumen is not sufficient to meet the rapidly increasing energy demands of the cow to produce milk. If NEB is too severe then excess body condition score (BCS) loss will occur which has detrimental effects on fertility, lameness and general herd performance. A typical target is to keep BCS loss to less than 0.5 units in the first 10-12 weeks of lactation (ideal BCS profile is calving at 3.25 and minimum 2.75 at breeding); therefore, the energy balance deficit should be no more than 1.0 UFL per day on average in early lactation.

We can minimise the duration and the severity of this period of NEB, and therefore the rate of BCS loss, by ensuring that the cow is optimally fed during this period. This means getting grass in to the diet as much as possible, monitoring residuals, and ensuring grass deficits are met with high-energy ingredients. Across a number of early grazing studies, a 13-14kg DM grass allowance plus 3-4 kg high energy concentrate offered daily during the early lactation period has been sufficient to ensure a good energy balance profile. When grazing conditions are good, high levels of utilisation can be achieved at grass, which helps maintain grass quality in subsequent rotations, however, it should not come at the expense of total DMI, therefore a post-grazing residual of 3.5 to 4 cm is considered optimal during the first rotation. If grass availability is below target, high quality forage should be included early in the season and if grass availability is ahead of target concentrate feed levels should be reduced in order to increase grass intake.

Cows are losing a lot of body condition even though meal feeding rates are high. What can be done?

Rate of body condition loss in early lactation is a function of BCS at calving, quality of diet in the early lactation period, and herd genetics. The dry period diet and duration should ensure that cows calve down at a BCS of 3.0 to 3.25, often described as 'fit but not fat'. Cows that have excess body condition at calving (3.5+) have inevitably a greater risk of BCS loss, and metabolic issues such as milk fever and ketosis. It is therefore critical to monitor BCS from late lactation, through the dry period and to limit the daily energy intake of later-calving cows in particular.

Increased concentrate feeding in early lactation will typically result in increased milk yield output, substitution of the lower cost forage as well as reduced efficiency of digestion in the rumen as the proportion of concentrate increases. Therefore, there is limited scope to arrest a drop in BCS by feeding extra concentrate alone, if forage quality or allowance is inadequate. Ensure cows are getting an appropriate and increasing allocation of forage, by monitoring post-grazing residuals, as dry matter intakes increase throughout early lactation. Where BCS of individual animals is very low (BCS 2.5 or less), these animals should be considered for once a day milking to reduce energy demand for milk, whilst maintaining a high plane of nutrition to the animal.

It is important also to consider the effect of herd genetics on BCS profiles. While much focus is given to feeding rates, it is also the case that some herds have a genetic makeup that makes retention of BCS in early lactation BCS more difficult. Such cow types have a predisposition to mobilize body reserves after calving and to partition a higher proportion of their daily energy intake to milk at the expense of BCS, meaning they are genetically thinner all through lactation and are more prone to a whole range of metabolic and other issues.

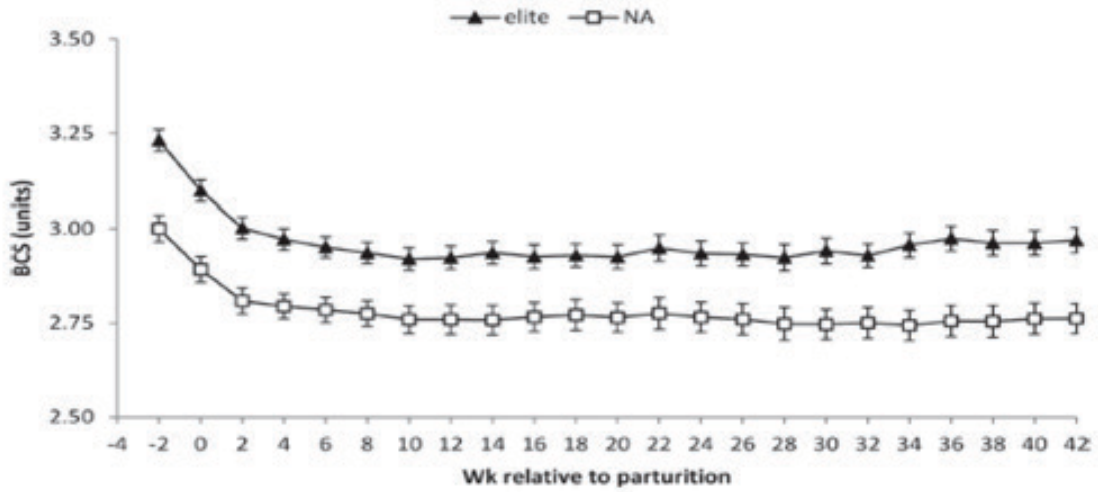


Figure 3. Effect of herd genetics on BCS profile in a pasture based system

This is illustrated in Figure 3, where the BCS of elite EBI versus national average EBI animals are compared on an identical diet; higher EBI cows produced more milk solids but also held BCS better through lactation. This has proven knock-on effects on fertility. Importantly, feeding extra concentrate pre-breeding has shown little to no beneficial effect on fertility in low EBI herds, because it has relatively little effect on key metabolic profiles and BCS. If your herd is routinely struggling to meet BCS and fertility targets, make sure to review EBI profiles and set targets for fertility sub-index of >€120 for sires used.

Milk protein in the bulk tank has dropped to below 3.20 %. Why is this? What is the solution?

Milk protein concentration will be at its lowest at peak milk production, however this curve will be influenced by herd genetics for milk protein and the forage quality/digestibility of the diet. On-farm studies have demonstrated that approximately 65 % of the herd-to herd variation in milk protein is due to genetics (Predicted Transmitting Ability (PTA) for milk protein %), and >75 % of the cow-to-cow variation is explained with a similar reason. Pasture digestibility accounted for a further 30 % of the herd-level variation. Concentrate feeding rate has a relatively minor effect on milk protein content and will not compensate for poor forage quality or low genetic merit for protein content (see Figure 4 for typical milk protein concentration curves for three given annual milk protein concentrations).

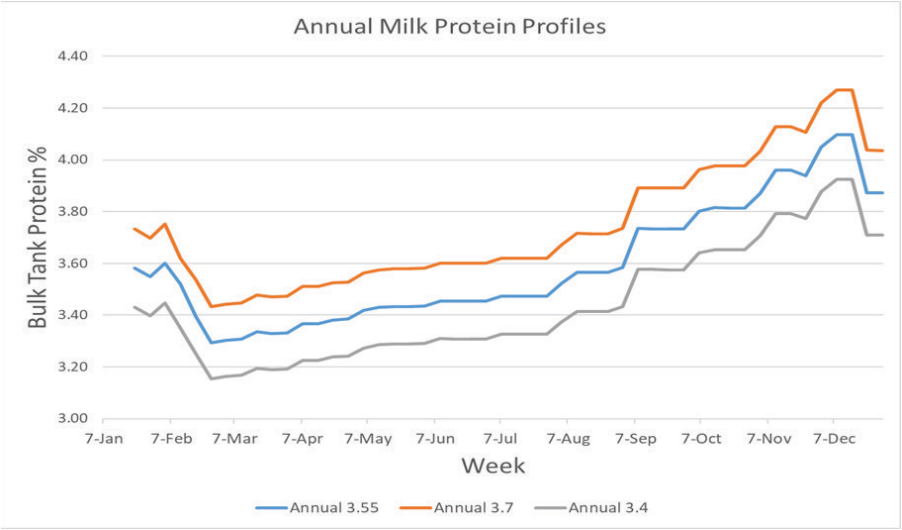


Figure 4. Expected weekly milk protein profiles for 3 levels of annual milk protein %

A rapid drop in milk protein concentration and/or milk protein concentrations below 3.20% in herds with high genetic merit for protein % can indicate that fermentable energy is limiting in the diet. Figure 5 illustrates this effect at a national level in Spring 2024.

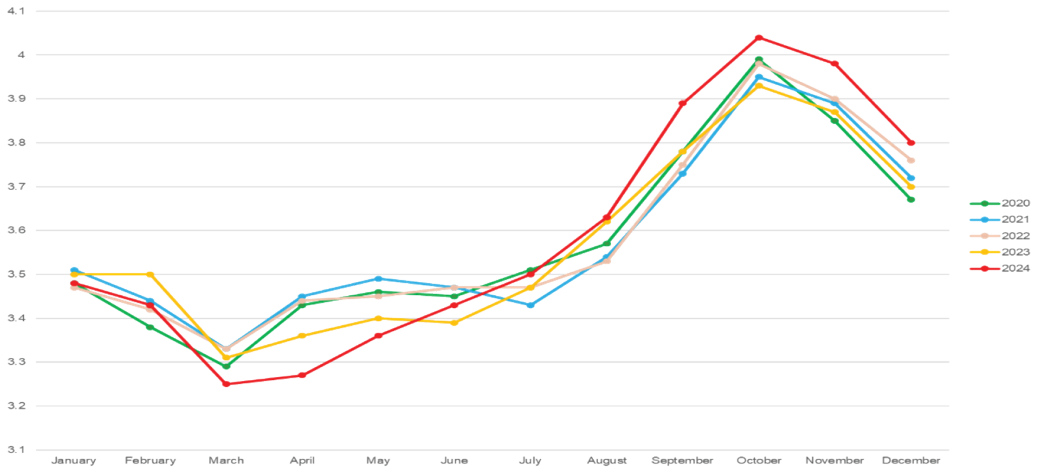


Figure 5. Annual milk protein % profiles across 2020-2024 period

This will often occur where cows are housed due to poor weather conditions on poorer quality forage as the energy density of the diet and digestibility of the forage is lower. This dietary-driven drop in milk protein occurs in low protein genetic merit herds also, however for such herds the effect can often be to reduce milk protein to below 3.0 %.

It is important therefore to consider genetics and diet in tandem when assessing bulk tank solids content; altering diet to improve solids content in the short term is very much limited in comparison to the potential gains from changing breeding targets. Consult your EBI report within ICBF to determine your current PTA for fat and protein %, and seek breeding advice to select sires for higher milk solids content.