National Dairy Conference 2018

'Making Dairy Farming more Sustainable'

Tuesday,
27th November
Rochestown Park Hotel, Cork

Wednesday,
28th November
Hodson Bay Hotel, Athlone

Teagasc
Agriculture and Food Development Authority

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Wednesday, 28th November - Hodson Bay Hotel, Athlone

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9.45am ***Welcome***
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Tom Kellegher, Regional Manager, Teagasc (Athlone)

10.00am SESSION ONE:
Chaired by: Liam Herlihy, Chairman Teagasc Authority (Cork)
Chaired by: Professor Gerry Boyle, Teagasc Director (Athlone)

10.00am ***Opportunities for Irish grass fed milk products***
Albert McQuaid, Global Chief Technology Officer, Kerry Group (Cork)
Mary Morrissey, Senior Sector Manager – Dairy, Alcohol & Seafood, Bord Bia (Athlone)
10.30am ***Dealing with weather risks: lessons from 2018***
Tom O'Dwyer and Joe Patton, Teagasc
10.55am ***New insights to the feeding value of grazed pasture***
Michael Dineen, Teagasc

11.20am SESSION TWO:
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Chaired by: James Keane, Regional Manager, Teagasc (Athlone)

11.20am ***Managing all calves to a high welfare standard: the Australian experience***
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Stephen Butler, Teagasc

12.30pm **Lunch**

1.45pm SESSION THREE

Choose three workshops to attend from the list of six below:

1) Managing our GHG and ammonia emissions targets
2) Grassland decisions made easy
3) Coping with the spring workload
4) Contract heifer rearing
5) Building fodder reserves in 2019
6) Making our dairy farms better places to work

Dr. Albert McQuaid

Global Chief Technology Officer for Kerry's Global Taste & Nutrition business. Ph.D. in Biochemistry at Trinity College Dublin.

Started with Kerry 25 years ago in Beloit, Wisconsin. Over the 25 years, Albert has held a number of different leadership roles in Kerry in the areas of business management and technical management.

Today Albert is responsible for Global R&D and Regulatory team in Kerry and ensuring that this team is fit for purpose to enable Kerry to deliver on our leadership in Taste & Nutrition solutions for the global Food and Beverage industry and for Kerry to deliver on our above market growth targets.

Dealing with weather risks: lessons from 2018

O'Dwyer, T. and Patton, J.
[1] *Teagasc, AGRI Centre, Moorepark, Fermoy, Co. Cork;*
[2] *Teagasc, AGRI Centre, Grange, Dunsany, Co. Meath*

Summary

- Weather risk is a reality of farming. Extreme weather events have the capacity to cause major stress in the short term and damage viability over the longer term. Consequently dairy farming systems must build in resilience to weather shocks.
- The multiple weather events of 2018 stretched farm resources – cash, labour and facilities. Underinvestment in labour and facilities, or the lack of a cash reserve, can leave the system exposed to shock or unexpected events.
- The impact of extreme weather events can be reduced by having a reserve of quality feed on the farm to compensate for weather-induced reductions in pasture growth. Teagasc recommends that a fodder reserve of 500 - 800 kg DM per cow be developed over time and maintained on a rolling basis.

Introduction

"We do not learn from experience; we learn from reflecting on experience."
(John Dewey, American educator)

Weather has always been a factor in farming. 2018 will certainly be remembered as a year when weather played a major role in farming operations, with many dairy farmers experiencing up to five extreme weather events between October 2017 and September 2018. Spring and summer 2018 provided some tough challenges and harsh lessons for dairy farmers. The disruptions caused by early season snow, abject spring grazing conditions and drought-induced summer feed crisis, will live long in the memory.

It is timely therefore, to reflect on the past 12 months and identify opportunities for increasing the resilience of our farming systems, especially in terms of how we create, use and replenish fodder reserves on a rolling basis. If as predicted, our weather becomes more variable with increased extreme weather events, then we must ensure that our farming systems are resilient to weather shocks.

To capture the collective lessons learned with regard to managing future weather risks, we interviewed approximately 60 dairy farmers across six representative discussion groups nationwide, during autumn 2018. This brief paper documents some of the main themes and outcomes identified during these discussions.

Principal lessons from 2018

Do not ignore a seemingly small deficit in winter feed budgets

It is clear from discussion with numerous groups that auditing of forage supply versus potential demand does not routinely take place. This is particularly risky where cow numbers are increasing on-farm. Also, there is a definite trend to '*hope for the best*' when completed budgets identify deficits of 10-15% or less. A key lesson from spring 2018 is that relatively small proportional initial shortages can turn into a complete lack of feed for a period by the end of winter (for example running a 10% feed budget deficit may equate to two weeks full feeding). This can be avoided by better planning.

Completing a winter feed budget and reviewing in early January should be standard practice on dairy farms. Taking early action to address even moderate deficits will prove beneficial. The various options are well documented and include early culling of non-productive stock, sourcing extra forage, and feeding restricted silage plus concentrates. This year has proven that hope is not a reliable strategy for managing feed reserves

A reserve of high quality forage simplifies feeding decisions

Prolonged feeding of silage to lactating cows was a costly and time-consuming necessity during spring and summer 2018. While quantity of feed was the immediate concern, farms that lacked a supply of quality silage were affected to a greater extent.

Firstly, margins over feed cost were eroded by a combination of lower milk solids output and increased concentrate feeding rate. Poorer quality silage also increased labour/complexity of feeding arrangements because a third concentrate feed was often required to balance cow nutrient requirements at peak milk production. In contrast, where high quality silage was available, milk yield could largely be maintained by simple in-parlour concentrate feeding at moderate rates.

There has been a common assumption among spring calving dairy producers that silage quality is much less relevant than '*bulk in the pit*'. However as stocking rates increase, the balance of dry cow versus lactating cow silage begins to shift. Figure 1 outlines this effect for a typical spring calving herd with mid-December dry-off at two annual grass growth rates. Furthermore, this year showed that 100% of extra silage reserves required to deal with weather-related shortages should be of high quality.

Management decisions that drive silage quality - fixing background soil fertility, N application rate, reseeded swards and good cutting schedule - also drive total tonnage. Managing silage yield and quality should also be complementary to overall pasture management and utilisation.

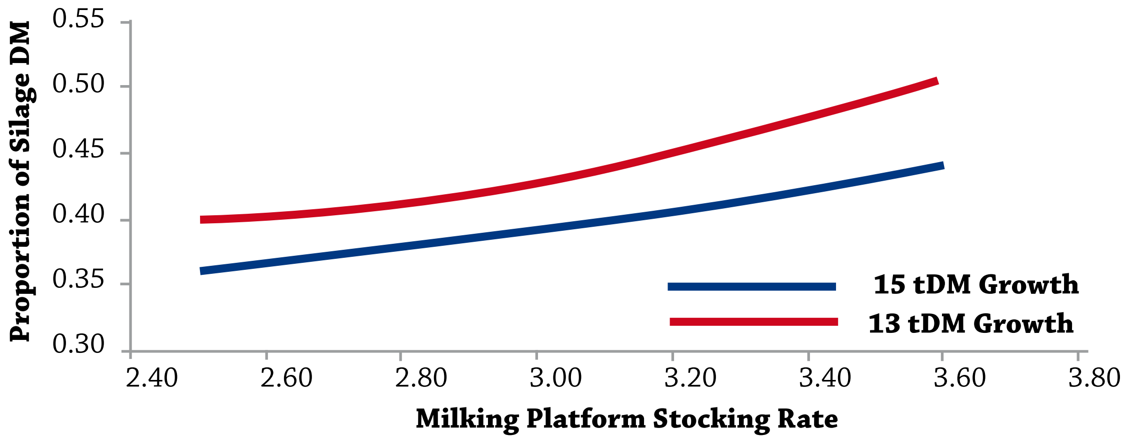

Figure 1. Effect of annual growth and stocking rate on proportion of silage fed during lactation

Avoid panic buying when faced with fodder shortages

Feeds are always best valued on the basis of net energy (UFL) and protein (PDI) content per kg dry matter, discounted for potential losses. This can be done using barley and soya as reference feeds (http://interactive.teagasc.ie/Open/FeedStuffs). Consideration should be given to functional fibre (NDF) characteristics if forage is in short supply. Of course, value considerations tend to go out the window when faced with a crisis and limited availability of fodder. So the advice has to be to recognise the emerging problem early, identify a workable solution and then to act decisively. Delayed action will limit the available options. Buying forage on a *per-acre or per-hectare* basis is fraught with risk due to potential yield variation (Table 1). Ensure that feed options secured are cost-competitive. A major lesson for dairy farms from summer 2018 is to build feed reserves during favourable market conditions to alleviate risk of panic buying.

Table 1. Effect of price per ha and whole crop silage yield on forage cost per tonne DM

Cash cost per ha	Yield t DM per ha	Cost per t DM
€1,970 (€800 per ac)	12.5	€158
€2,470 (€1000 per ac)		€198
€1,970 (€800 per ac)	9.5	€207
€2,470 (€1,000 per ac)		€260

Forage reserves are essential but separate to optimal stocking rate

A common refrain during 2018 has been that weather-induced feed shortages are proof positive of excess stocking rates in general and on dairy farms in particular. To address this, it is first important to define how excess stocking rate is measured. A reliable rule of thumb is that one livestock unit requires approximately 5.5t DM forage grown to meet annual demand. Therefore a farm capable of growing 11t DM per ha can support up to 2.0 LU per ha on a whole farm basis. Increasing herd size on a fixed grazing platform area therefore requires improved pasture production, additional 'support block' area for silage, or a combination of both. While there is certainly a cohort of dairy farms which are stocked in excess of average grass growing capacity, the primary cause of feed shortage issues has been a combination of extended poor growth rates *allied* with lack of feed reserves.

There has been a marked disparity between North/West and South/East regions during 2018 in this regard, reversing the 2017 trend. For illustration, annual grass tonnage deficits are approximately 0.8 and 3.0 tDM per ha for Ballyhaise and Curtin's farm respectively (Figure 2). The forage deficit incurred in 2018 is instructive as to the scale of rolling reserve required. For farms in the South East, this year's deficit equated to 1.0 to 1.2t DM per LU for well-stocked dairy farms. A guideline would be to carry 50-70% of this figure (500-800kg DM) as a feed surplus, above the normal stocks needed to balance the system. This would be built up over time and vary with degree of risk per farm.

The prevailing view among interviewed groups was that stocking rate, where previously aligned with grass potential, would not be significantly curtailed in 2019 to build forage reserves to this scale. Instead, farms would look to external sources to fulfil this function. Options include contract growing of silage or maize/ whole-crop silage. However the risks associated with *per acre* arrangements must be addressed up front. Contract rearing of heifers is an alternative approach to help build reserves that carries numerous other benefits. It was noted nonetheless that the cost/benefit of purchasing feed to retain low-performance animals (high SCC, late calvers in particular) must seriously be questioned. In summary, the consensus is that farms should aim for stocking rates to allow forage self-sufficiency on a 5-year average, building reserves from external sources where feasible.

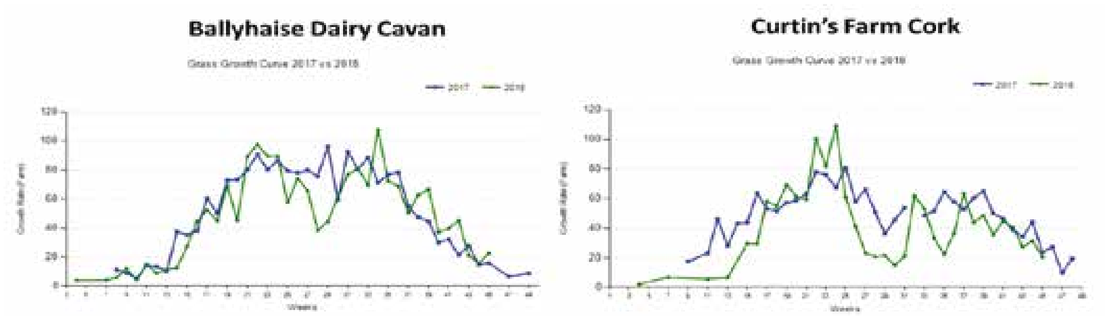

Figure 2. Pasture growth curves for 2017 (blue) versus 2018 (green) in Cavan and Cork

Labour is now a year-round consideration on dairy farms

A notable feature of conversations with groups was the repeated theme of labour and workload associated with adverse weather events. This year's back-to back weather issues effectively created a 10-month feeding period, with just a few weeks respite in between. This added significant pressure to already stretched resources. For many farms, workload was a greater problem than actual feed supply *('money can be borrowed, feed can be bought, but labour can't be found'* was a telling quote).

Among the interesting observations were that labour should now be considered a year-round challenge, and that the '*me plus help for the spring*' model leaves no room for shock events. Some farms operating at smaller herd scale found sharing hired labour to be very beneficial during the drought period. Using machinery contractor staff for silage feeding was another option used, though this was sometimes quite difficult to implement. Finally, a number of farm managers noted that core staff were frustrated and fatigued by the extra weeks of feeding, cubicle cleaning etc. Ensuring that all members of the team received appropriate time off (through use of relief milking etc.) was important for morale.

It is worth investing in workable facilities

Closely aligned to observations on weather effects on workload was the discussion on optimal facilities for herd management in poor weather conditions. Clearly, proper investment in workable facilities increased capacity to cope with adverse spring weather and summer drought. However, defining optimal becomes the essential debate in this context, especially for new or expanding dairies. The 'bottom line' facilities identified, in order of investment priority[1] are summarised as:

Investment	**Comment**
Grazing infrastructure	Increase grazing days in poor conditions. High return rate plus labour saving. Priority investment
Parlour feeders	Simple batch feeding system adequate. Easy supplementation up to 6kg DM per cow per day.
Linear feed space	Up to 0.7m per cow, simplify buffering and restricted silage feeding. In-paddock silage feeding preferred during dry conditions
Power supply/ generator	Essential, depending on location

[1]Balancing return and labour effects. Assumes that slurry storage already meets compliance standards

Interestingly, silage pits to allow storage of recommended reserves were not considered a priority. The cost of building 0.5 to 0.7t DM surplus silage storage is estimated at €30 per cow at average herd scale (before grant aid) over 10 years. This may be an important consideration where currently available pit space precludes carrying reserves. Spending on feed handling machinery was deemed a poor use of capital overall.

Summary and Conclusions

Teagasc believes that a compact calving, grass based model of milk production is a 'fit for purpose' system as it can provide a good level of milk production at a competitive cost of production, within the general averages of climate, input price, and milk price uncertainty. Despite the numerous weather challenges posed in 2018, the prevailing grass based system demonstrated good resilience as evidenced by the overall milk production figures for 2018. At the end of September, the volume of milk supplied for processing was slightly ahead of 2017 albeit with reduced cumulative protein and butterfat content.

Nonetheless, this resilience of production came at a much increased feed cost; and at significantly greater time input from individual farmers, their families and staff. Detailed discussions with numerous dairy discussion groups have highlighted a real need for more and better planning around the key areas of labour, forage feed security, and facilities. These were common themes across region and scale of operation.

Across these key management themes, dairy farmers need to be in a position to make tactical changes more quickly in order to respond to adverse weather events or other shocks to the system. There are no 'off-the-shelf' options that will work for every farm so it essential to fully consider potential for lessening the risk against investment costs or possible reductions in short-term profitability. Auditing what went wrong in 2018 and listing possible future solutions are the important first steps. Imagination and flexibility of thought will always yield better outcomes than reactionary capital spending.

New insights to the feeding value of grazed pasture

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[2]*Teagasc, Animal and Grassland Research and Innovation Centre, Moorepark, Fermoy, Co. Cork*

Summary

- Grazed pasture is a high quality forage but its feed chemistry can vary due to seasonal and climatic variations
- New feed chemistry analysis and nutritional modelling are providing new insights into the feeding value of pasture and how it's utilised by the lactating dairy cow
- A greater understanding of the specific nutrients first limiting milk solids production from grazed pasture has the potential to increase animal performance

Introduction

As the population of the planet and demand for human-edible plant resources is increasing rapidly, livestock production in the future may not have access to arable land and the current inventory of grain products. Milk production systems based on utilising large quantities of pasture result in the conversion of human inedible feed resources into edible human food of high biological value, contributing significantly to net food production (Dijkstra et al., 2013). Pasture-based systems also support environmental sustainability and an animal welfare friendly image (van Vuuren and Chilibroste, 2013). However, there is opportunity to consistently increase milk solids production from pasture-based systems as evident when white clover is incorporated into perennial ryegrass swards (Dineen et al., 2018, Egan et al., 2018). This new collaborative project with Cornell University is developing new tools to help further understand the feeding value of grazed pasture. Active exploration is underway to determine the mechanisms that enable increased delivery of milk solids from pasture-based production systems.

New tools

The dairy industry in the United States have been developing and utilising nutritional models over the past three decades. Nutritional models such as the Cornell Net Carbohydrate and Protein System (**CNCPS**; Van Amburgh et al., 2015) are designed to evaluate the nutrient requirements of cattle over a wide range of environmental, dietary, management and production situations. Inputs are required such as the animals' current performance, body weight, body condition score, days in milk, while also requiring environmental inputs such as distance walked and ambient temperature. This information is used to calculate the animal requirements for the amount of energy and protein required to meet physiological needs such as maintenance, pregnancy, lactation, growth and reserves. On the supply side, the model utilises the most modern feed chemistry analysis and combines it with mathematical approaches to determine the diets adequacy in meeting the animal's requirements. The model develops estimations of carbohydrate and protein degradation and passage rates to predict the extent of ruminal fermentation, microbial growth, and the absorption of metabolisable energy (**ME**) and metabolisable protein (**MP**) throughout the gastrointestinal tract. This modern feed chemistry provides the core strength to the CNCPS and is a tool that can be utilised to unlock further insight into the true feed value of grazed pasture. By adopting this approach, the U.S. dairy industry has benefitted dramatically by increasing milk production efficiency, reducing feed costs while at the same time increasing animal productivity. The precise understanding of how their ingredients interact with the animal, through feed analysis and modelling, is providing the platform to formulate diets at a level comparable with the swine and poultry industries, which is a tremendous feat when dealing with a ruminant species. Recognition of these achievements has grown, not just within the U.S. but also worldwide, with adoption of the CNCPS in many dairy regions including South America, Italy, Germany, Eastern Europe, South Africa and China. Our goal is to investigate if new knowledge and understanding of the feeding value of grazed pasture can be attained by applying this approach to pasture-based systems.

Feed chemistry

All plant material can be fractionated out into Crude Protein (**CP**), Non Structural Carbohydrates, Soluble Fibre, Neutral Detergent Fibre (**NDF**), Fat and Ash. The proportion of each fraction in the diet, their digestion characteristics, and how they interact with one another, determines the potential for an animal to meet their nutrient requirements from a particular diet. In Ireland, we have been quantifying this primarily through the measurement of organic matter digestibility (**OMD**). Organic matter digestibility is a measure of the total availability of nutrients in the organic matter of a feed. To simplify this, OMD estimates the proportion of total organic matter eaten by the animal, which is not recovered in the faeces. The proportion not recovered is the digestible organic matter. This measurement has done our industry a great service and has contributed significantly to our understanding of maintaining the correct pasture pre-grazing yield. Many experiments utilising lactating dairy cattle at Teagasc Moorepark, have shown that cows grazing medium pasture mass swards with very high OMD have increased milk solids production per hectare compared to cows grazing high pasture mass swards with a lower OMD (McEvoy et al., 2010). Further, work from France describes that a one percentage unit increase in grass OMD will result in an extra 0.24 kg milk/cow per day (Peyraud et al., 1996). High OMD has a number of beneficial factors, and hence why we have depended on it for so long. However, OMD combines all of the feed fractions together and cannot distinguish the contribution of each different feed fraction on nutrient availability. Recent work carried out in Moorepark has shown that the digestibility of NDF (**NDFD**) was a better predictor of dry matter intake (**DMI**) than OMD (Beecher et al., 2017). While OMD and NDFD are closely associated, the direct measure of the contribution from each fraction, such as NDFD, has greater potential to quantify their impact on animal performance. Additionally OMD does not measure the rate of breakdown of nutrients which can have a big influence on the feeding value of feeds.

Neutral Detergent Fibre digestibility

In the U.S. routine incorporation of NDFD as a standard procedure in feed laboratories has only recently been achieved. Over the last few years, extensive work has been undertaken to develop an in vitro NDF digestibility assay that is repeatable, has low variability and has the capability of being adopted by commercial laboratories as a wet chemical method for routine forage and feed analysis (Raffrenato et al., 2018). This procedure has removed some of the 'art' of animal feeding and allowed us to quantify why certain feeds achieve higher animal performance than others. A faster degradation of the NDF fraction in the rumen will reduce physical fill over time and allow greater voluntary feed intake to be achieved i.e. cows can eat more the faster the fibre fraction of the diet is digested. It will also provide more digestible material which will contribute to the growth of rumen microbes, who themselves contribute a high quality protein supply to the animal. Higher microbial growth rates also increase volatile fatty acid production, which is the main energy source for the cow. Many agronomic conditions (e.g. light, heat, water stress, soil type), sward maturity, plant genetics and season can impact NDFD. An example of this can be seen when we analysed Irish pasture samples using the NDFD procedure in Cornell. The procedure allows the user to fractionate the NDF into two pools, one that is unavailable to microbial digestion (uNDF; 240 hour in-vitro digestion) and a potentially digestible pool (pdNDF) which is NDF minus uNDF. The procedure can incorporate further fractionation of the pdNDF pool into 'fast' and 'slow' degrading pdNDF. The rate at which the pdNDF pool degraded was faster for spring compared to autumn pasture (9.5 versus 7.8% hour^{-1}, respectively; Figure 1). Furthermore, the extent to which NDF was digested was greater for spring compared to autumn (9.8 versus 15.5% uNDF, respectively; Figure 1). Predictions of the ME per kg of dry matter (**DM**) of the swards showed that spring pasture had a higher energy density and also supplied a higher amount of grams of MP to the animal.

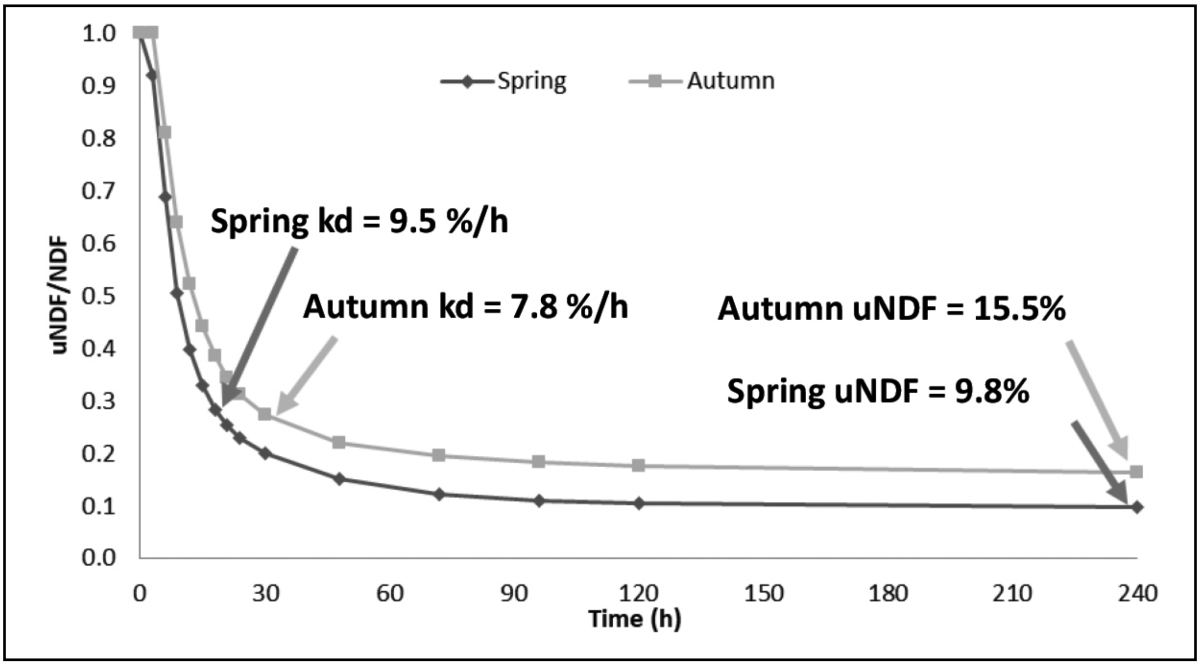

Figure 1. The in vitro digestion of NDF from 0 to 240 hr in spring and autumn pasture

This analysis shows that the NDF fraction of pasture can behave differently, even within plant species and impacts the supply of nutrients to the animal. The NDFD procedure can also be applied to many other diet ingredients such as grass silages, maize silages and fibrous by-products. When the NDFD of intensively managed grazed pastures was first described in the Cornell laboratory, it was discovered that this is the most rapidly degrading NDF source to have been measured with rates of degradation comparable to that of some starches i.e. Irish pasture was digested as quickly as some types of concentrates. This highlights that well managed grazed pasture is a very high quality feed and provides evidence as to why such high intakes and animal performance can be achieved with 100% grazed pasture.

The rate with which disappearance of NDF is occurring, can have a dramatic effect on rumen emptying and consequently intake, due to the space created by microbial degradation of the forage independent of particle size reduction. To evaluate NDFD impact under in-vivo conditions (i.e. in the cow) we utilised the omasal flow sampling technique (Huhtanen et al., 1997), for the first time on lactating dairy cows consuming pasture-based diets, in the summer of 2017. This technique, using cannulated cows, allows the digesta leaving the rumen to be sampled periodically across the 24-hour day. To complement this procedure, rumen evacuations and faecal sampling were also undertaken to help quantify the impact of NDFD. Although laboratory analysis of the samples collected in this study is still ongoing, early observations suggest a close relationship between the feed laboratory analysis and in-vivo conditions. When the measures of NDFD are combined with the modelling approach of CNCPS, the model predicted a rumen pool size of uNDF to be 1.47 kg compared to the measured in-vivo pool size of 1.65 kg. These types of mechanistic experimental procedures will help provide a greater knowledge of how different pasture swards impact outcomes such as intake, digestibility, milk solids production and feed conversion efficiency.

Crude protein fractionation

Crude protein as its name suggests is a crude measure of the total amount of protein in a feed. This feed analytical procedure measures the total amount of nitrogen (**N**) in the sample and multiplies the quantity by 6.25. For example, if a grass sample contains 3% N and we multiply by 6.25, it is determined that that grass contains 18.8% CP. There are limitations to this 6.25 factor as it assumes that all protein contains 16% N (1/0.16 = 6.25). We know this to be false and it can have a significant effect on the estimate of CP being supplied to the cow (Jones, 1931). Therefore, to increase the precision of quantifying nutrient supply to the animal, a N based approach is more appropriate. Similar to NDF, CP is also not uniform and can be further differentiated into five different fractions. Each of these five fractions differ in the size of the pools and the rate at which they degrade in the rumen. Factors such as N fertilisation, weather and plant maturity alter the size of the pools. Using modern feed chemistry shows that a large proportion of the protein in grazed pasture degrades in the rumen. While this is beneficial in terms of providing N for microbial growth, very little grazed pasture protein escapes ruminal digestion with large quantities being de-aminated to ammonia and, depending on carbohydrate supply for microbial incorporation, a proportion will be excreted in the urine as urea (Van Soest, 1994). This makes grazing ruminants extremely dependent on microbial protein as the main source of MP i.e. a large proportion of the protein absorbed by the grazing cow is in the form of microbes washing out of the rumen rather than coming directly from the feed eaten by the cow. The omasal sampling technique, mentioned in the previous section, will also allow us to quantify the actual amount of both microbial and feed protein flowing out of the rumen of pasture-based animals. There is evidence in the literature to support that while pasture can be high in protein, the composition of this protein may not be ideal, and that supplementation of protein ingredients that escape ruminal digestion at certain times can increase milk solids production. However, this has not been studied comprehensively and further work is required to quantify specifically when pasture-based dairy cows may face these limitations. Feed laboratory analysis such as the Neutral Detergent Insoluble Nitrogen (NDIN), Acid Detergent Insoluble Nitrogen (ADIN) and uN_{Ross} (measure of indigestible N) along with in vitro degradation profiles, will provide a mechanism to forward predict and characterise the type of protein offered to our grazing dairy cows.

Animal evaluation

Based on these new research outcomes, an experiment was designed to investigate the effect of refining dietary carbohydrate levels and the inclusion of heat treated soybean meal on milk production and DMI of grazing dairy cows. The experiment was undertaken at Teagasc Clonakilty Agricultural College in the summer of 2018. Eighty dairy cows were randomly assigned to one of four treatments at 120 days in milk. Dietary treatments consisted of cows on a perennial ryegrass only treatment (GO), cows on a perennial ryegrass plus 4.8 kg DM of citrus pulp (Citrus); which consists of rapidly degrading NDF and contains a large proportion of sugar, cows on perennial ryegrass plus 0.8 kg DM of a heat treated soybean meal (TSBM) and cows on perennial ryegrass plus 3.1 kg DM of a mix of citrus and heat treated soybean meal (Mix). Heat treating soybean meal would reduce the degradability of the protein, thereby allowing a greater proportion to escape ruminal digestion and pass directly into the small intestines. Feed chemistry results generated from mid-season summer pasture samples taken in 2015, 2016 and 2017 were used to predict the type of pasture that would be available during our experiment. However, due to drought conditions across the country in summer 2018, the chemical composition of the pasture offered was drastically different with higher NDF and uNDF concentrations measured (Figure 2). Average NDF and uNDF were 36% and 4% in 2015 to 2017 compared to 43% and 8% in 2018 respectively.

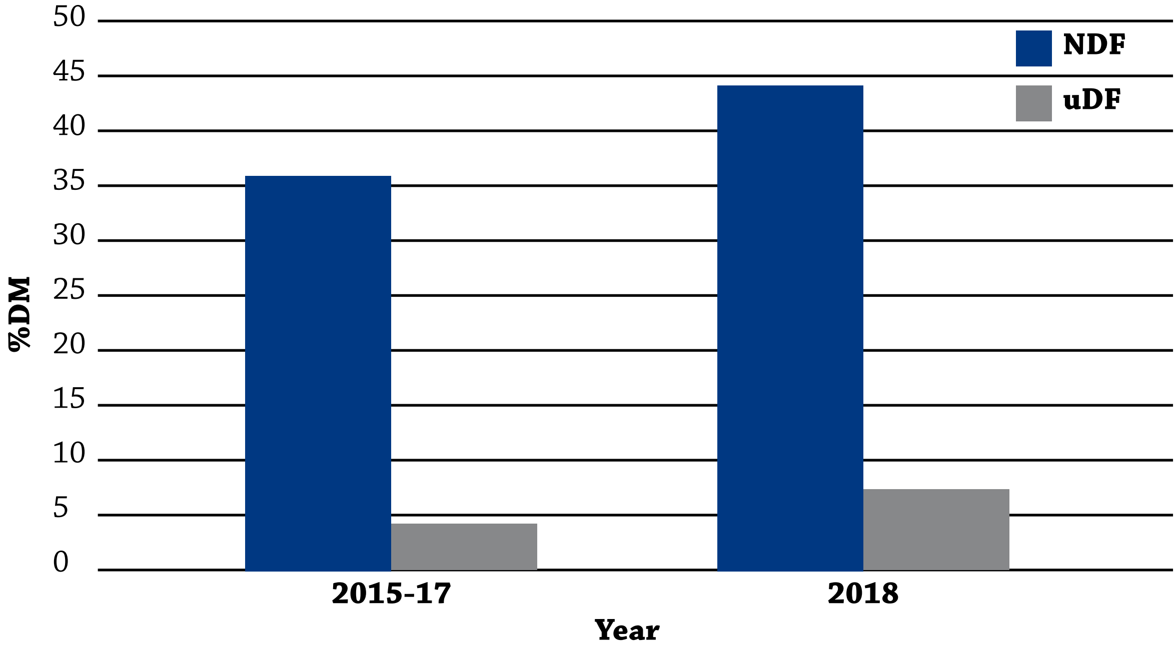

Figure 2. Comparison of Neutral Detergent Fibre and its digestibility across years

Total DMI was the highest on the Citrus treatment, achieving 2 kg DM/day greater intake in comparison to the GO (Table 1). Although a greater DMI was achieved on the Citrus treatment, the milk solid production tended to be higher for the treatment that incorporated the heat treated soybean meal and citrus (Mix) suggesting that, under these scenarios, MP may have limited milk solids production rather than ME.

Table 1. Dry matter intake and milk production results

	GO[1]	Citrus	TSBM	Mix	S.E.	P-value
Grass Intake (kg DM day^{-1})	15.6[a]	12.8[b]	15.3[ac]	13.8[bc]	0.47	<.001
Supplement intake (kg DM day^{-1})	0[a]	4.8[b]	0.8[c]	3.1[d]	0.03	<.0001
Total intake (kg DM day^{-1})	15.6[a]	17.6[b]	16.1[ab]	16.9[ab]	0.48	0.02
Milk production (kg day^{-1})	18.5[a]	20.6[b]	20.3[b]	21.3[b]	0.34	<.001
Fat (g kg^{-1})	42.2	40.7	42.1	41.6	0.79	0.51
Crude Protein (g kg^{-1})	33.9[ab]	33.0[a]	34.7[b]	33.7[ab]	0.30	0.004
Milk solid production (kg day^{-1})	1.41[a]	1.49[ab]	1.55[b]	1.59[b]	0.03	<.0001

[1]GO = perennial ryegrass only, Citrus = perennial ryegrass + citrus pulp, TSBM = perennial ryegrass + heat treated soybean meal, Mix = perennial ryegrass + citrus and heat treated soybean meal

[a, b, c, d] Different superscripts within a row for a given treatment signifies $p < 0.05$

A greater response to supplement (supplement kg DM/milk kg above control) was achieved for the TSBM than the Citrus treatment (2.25 and 0.44, respectively) as the citrus was offered at a much higher rate. These results reinforces the importance of understanding what is first limiting the animal and the ability to provide these nutrients at the correct level. This experiment is likely to be repeated under more typical mid-season conditions to assess if such results are repeatable when a higher quality pasture is offered.

Conclusion

The current use of nutritional models in pasture-based systems is extremely limited. The analyses described in this paper are the first steps in a developing dairy cow nutrition programme at Teagasc Moorepark. By incorporating these in-depth feed chemistry techniques, a more quantitative approach will be utilised to help understand the feed value of grazed grass going forward and what nutrients are first limiting milk production from grazed pasture. The overall goal of the programme is to help quantify the nutrient(s) first limiting milk production output and feed conversion efficiency in pasture-based systems and to provide ways to complement such forages in a sustainable manner.

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The Australian/New Zealand system for managing non-replacement dairy calves

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Summary

Australia and New Zealand (NZ) have a system for processing non-replacement dairy calves that is relatively unique. Calves 5 days old or more are transported off farm to be slaughtered at abattoirs. While this system benefits farmers by utilising unwanted calves, there are inherent animal welfare and social licence risks associated with it. This paper will discuss some of the benefits, risks and pitfalls to the system.

Introduction

In Australia and NZ, bobby calves are classified as calves < 30 days old and not accompanied by their mothers [1]. In Australia, most bobby calves are male dairy or dairy-beef cross calves, which are typically slaughtered at the age of 5-10 days old. Due to their young age, bobby calves are at an increased risk of poor welfare outcomes. Young calves are more vulnerable due to low body fat percentage, immature immune systems, decreased ability to adapt to stressors, and poor herding behaviour [2]. Calves need to be carefully managed to maintain an acceptable level of animal welfare, particularly when being exposed to stressors such as handling, transport, fasting and social mixing.

Calf industry overview

An estimated 400,000-700,000 bobby calves are slaughtered in Australia annually [3, 4]. In Australia, some dairy or dairy cross calves are also raised for beef; numbers vary depending on beef and grain prices. No public information is available on the numbers of dairy calves raised for beef.

In New Zealand, dairy or dairy cross breeds account for two thirds of the national beef kill [5]. This includes bobby calves, dairy bull beef, and cull cows. A significant proportion of NZ Friesian bulls are raised for beef [6]. Despite the reasonably sized dairy beef industry in NZ, approximately 2 million bobby calves are still slaughtered per year [7].

Calf health and welfare

Young calves are more vulnerable to poor welfare outcomes than older animals. Low body fat percentage means that calves have limited energy reserves. An immature immune system makes them more susceptible to infectious disease, particularly if colostrum has been inadequately managed. Additionally, young calves have a decreased ability to adapt to stressors, as their physiological stress response is not yet mature. Finally, calves have not learned herding behaviour, making them more difficult to handle, and thus increasing the risk of poor handling.

To minimise welfare risk, good preparation of young calves is vital. Colostral management, feeding practices, provision of shelter, good hygiene and appropriate calf selection are all important parts of calf preparation. Calves should be selected by assessing their fitness for the intended journey. Neonatal calf mortality has been shown to increase exponentially with increasing distance travelled [8]. This indicates that the longer the journey to be taken, the more robust the calf needs to be. Current mortality rates for bobby calves in Australia are not available publicly. In New Zealand, there has been a substantial improvement in calf mortality rate from 0.68% in 2008 to 0.12% in

2016 [7]. This has been achieved through a combination of extension programmes and changes in NZ animal welfare legislation [7]. The push for a change in legislature came in response to the release of footage of calf mistreatment by animal activist groups [7].

Legislation

Australia has a recommendation of no more than 30 hours off feed for calves, but this is self-regulated by industry [9]. Bobby calf welfare legislation NZ states that the maximum time off feed for a bobby calf is 24 hours [10]. Experimental data has suggested that 24 hours off feed represents the ideal upper limit for best practice calf management [11]. Maximum transport time is 12 hours in both countries [1]. Calves must be able to stand up, and be in good health [1]. Recent (2016) legislation in NZ has further tightened regulations, stipulating, for instance, that calves must be sheltered whilst waiting for pick up on farm [10].

Public perception and social licence

Bobby calf slaughter is a sensitive issue and represents a significant social licence risk to the dairy and beef industries. Other potential social licence risks in the dairy industry include early cow-calf separation, and cow and calf housing systems (especially indoor-only and individually housed systems) [12]. The Irish, Australian and NZ dairy industries have a public perception advantage because cows have access to pasture, and most calves are raised in group pens rather than individual stalls. Bobby calf slaughter and cow-calf separation, however, remain key social licence risks. This risk may escalate in coming years; the public are currently not widely aware of these practices, however consumers are becoming increasingly interested in where their food has come from, how livestock are farmed, and in allowing farm animals to express natural behaviours [12].

Current bobby calf welfare research

Currently a research project is underway to assess the welfare of bobby calves at Australian abattoirs. Blood samples from more than 4,500 calves were collected at 3 different abattoirs. Blood parameters measured gave indications of hydration (packed cell volume (PCV), total protein (TP), urea), energy status (beta-hydroxybutyrate (BHB), glucose), muscle damage/fatigue (CK) and colostral immunity (TP, gamma-glutamyl transferase (GGT)). Results are summarised in Table 1 below.

Table 1. Blood results from Australian bobby calves at the time of kill, compared to published reference ranges for normal calves on farm.

	Reference range	% < Ref. range	% > Ref. range	% Within ref. range	Mean	n
PCV (%)	17-47[13]	1%	0.2%	98.8%	29.5	1723
Glucose (mmol/L)	2.8-7.5[13]	1.4%	0.5%	98.1%	5.0	4345
Urea (mmol/L)	3.6-15.7[13]	35.2%	1.7%	63.1%	5.0	4348
GGT (IU/L)	>75[14],*	23.9%	-	76.1%	397.3	4347
CK (IU/L)	11-125[13]	0.02%	90.5%	9.3%	355.4	4348
TP (g/L)	>50[15] (39-70[13])	30.3% (4.2%)	- (19.1%)	69.7% (76.7%)	58.7	4348
BHB (mmol/L)	<1[14], **	–	0.2%	99.8%	0.2***	4346

*for calves 5-7 days old.

**for adult cattle.

***results reported as <0.1 were converted to 0.05 to calculate mean.

Results suggest that most calves had adequate hydration and energy, as the majority fall within the reference range for glucose and PCV measurements. The results for total protein and GGT indicate poor colostral immunity in around 30% of calves; this is a similar proportion to a recent on farm study in Australian heifer calves [15]. CK is high compared to reference ranges – further analysis/research is needed to establish whether or not this indicates a welfare problem. Further analysis will also be utilised to assess the effects of distance travelled, time in the supply chain, and weather conditions on blood parameters.

Conclusion

Dairy calf welfare remains underpinned by good farming, handling, transport and abattoir practices. Public perception of the dairy industry is an important consideration when contemplating options for non-replacement dairy calf management, as this will influence the economic and social sustainability of the industry. Future trends for managing non-replacement calves may include sexed semen, dairy bull beef, premium veal or beef products, as well as perceived high welfare farming systems such as calf at foot dairies.

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A dairy-beef index to rank beef bulls on profitability when mated to a dairy cow

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Summary

- A dairy-beef index ranks beef bulls for use on dairy cows based on their estimated genetic potential to produce profitable, high quality cattle, born with minimal consequence on subsequent performance of the dairy dam.
- Such an index should include traits related to calving performance, efficiencies of production, carcass merit (i.e. yield and quality) as well as addressing current and futuristic societal demands.
- Work under-taken to-date indicates considerable differences between active AI bulls in their dairy beef index value, with a difference of +/- €100 being observed amongst the bulls and breeds used widely within the national dairy herd.
- ICBF and Teagasc are working towards the implementation of this new index for the Spring 2019 breeding season.

Introduction

The expanding dairy herd, coupled with the ever improving reproductive performance of the national dairy herd imply (a) a greater quantity of slaughtered animals in Ireland will originate from dairy herds and, (b) a demand for a tool that ranks beef bulls based on suitability for use in a dairy herd. Such a ranking system should ideally rank bulls on estimated genetic potential to produce a quality high-value carcass with minimal repercussions on the milk, health and reproductive production of the dairy cow but also that the resulting carcass can be produced efficiently. Breeding indexes have been successfully used globally in a multitude of species, including both dairy and beef cattle to achieve balanced gains in performance. For example, the genetic gain achieved since the deployment of the dairy EBI in 2001 has been cumulatively worth €1.72 billion to the Irish Agri-Food sector.

Construction of a breeding goal

Three criteria need to be fulfilled for a trait to be considered in a breeding goal:

1. Importance: traditionally the metric of importance in breeding goals was exclusively monetary-based; more lately, the meaning of importance has expanded to also consider societal and environmental importance. Traits of societal and environmental importance in cattle include animal well-being (e.g., polledness) and greenhouse gas emissions.
2. Genetic variability: in the absence of genetic variability, breeding programmes will be fruitless; luckily all traits are under genetic control although the extent of this control varies per trait.
3. Measurable: either the trait itself needs to be measurable in a large population, or should be linked with trait(s) measureable in large populations. Ideally the trait(s) should be measurable at low cost and, if possible, early in life.

The traits and sub-indexes explicitly included in the Irish national dairy and beef breeding goals are in Figure 1. Each index is made up of several components each affecting the respective farm profit either through increasing revenue or reducing costs. Such indexes are constantly under review with the list of constituent traits and their respective emphasis having changed 10 times in the dairy EBI since its introduction in 2001. Such revisions are necessary to ensure the index is always up-to-date and pertinent to the future production environments.

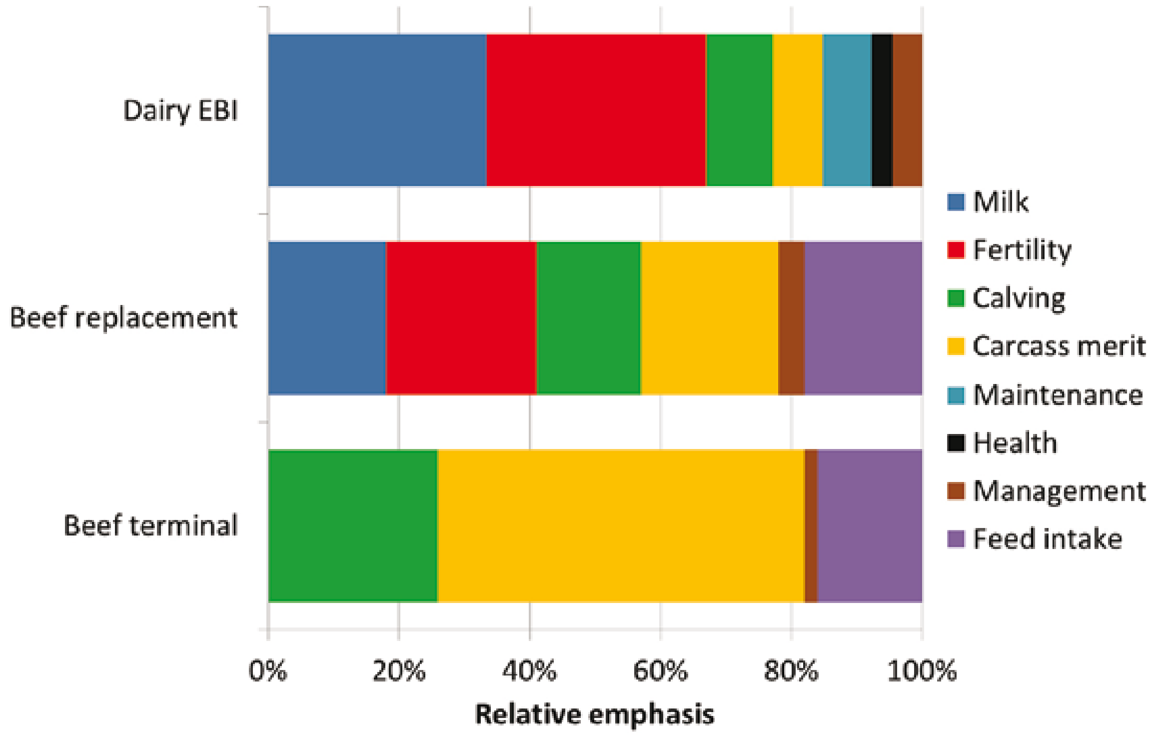

Figure 1: Relative emphasis of the different sub-indexes in the dairy economic breeding index (EBI), the beef replacement index and the beef terminal index.

Dairy-beef index

Traits that could be considered as part of an index to rank beef bulls for use on dairy cows are listed in Table 1. Data and the underlying genetics research on several of these traits is already completed and ready for deployment with research on-going on other traits. Research is also underway on the relative economic importance (i.e., revenue versus costs) of the component traits.

Calving performance traits

The importance of calving performance to the dairy farmer is obvious. Genetic differences among animals contribute up to one third of the variability in observed calving performance traits (Table 1) and thus breeding programmes can be used to improve calving performance metrics in the national dairy herd. The impact of calving difficulty on subsequent performance in dairy cows is well established and therefore an easy calving bull is desired. Costs associated with calving difficulty include additional labour, veterinary costs, cow mortality, compromised cow reproductive performance and survival, and reduced milk yield; costs associated with calf mortality are captured within the calf mortality trait included in the index. Short gestation length is a crucial component of ensuring the dairy cow calves early in the subsequent calving season to maximise profit; this is particularly important for a dairy-beef index where beef bulls tend, on average, to be used on later calving dairy cows. In dairying, each one day delay in calving date costs, on average, €3.86; hence a bull with a five day longer genetic merit estimate for gestation length will be penalised €19.30 for just that lactation but of course the effect of delayed calving can persist for all remaining lactations. The impact of breeding for shorter gestation length on calf mortality and vigour are negated against by the simultaneous consideration of calf mortality and vigour in a breeding objective. The opportunity cost of calf mortality is also obvious; over the last 10 years, the average value of a 14-day old spring-born calf from a Holstein-Friesian dam was €188. Costs such as labour and milk replacer, however, are incurred by the dairy farmer to produce a 14-day old calf for sale and therefore must be included in the economic value.

Table 1: List of traits and their sub-indexes which could make up a dairy-beef breeding index.

Sub-index	Trait	% under genetic control
Calving	Calving difficulty Gestation length Calf mortality Calf vigour	10% 35% 2% Under research
Efficiency	Feed intake Environmental footprint Age at slaughter	33% Under research 13%
Carcass	Carcass weight Carcass conformation Carcass fat Ability to meet carcass specs Meat quality	35% 35% 35% Under research 16%
Societal	Docility Polled	20% 100%

Efficiency traits

Consideration of efficiency, either feed intake or environmental footprint, must consider the entire lifetime of the animal. While feed intake is measured only over a relatively short period of an animal's lifetime, total lifetime feed intake can be extrapolated using knowledge of age at slaughter. The same is true for environmental footprint; animal methane emissions are of primary concern for breeding programmes. Genetic evaluations already exist for feed intake in Irish beef bulls and research has just begun, through the GREENBREED project, to collect individual animal methane emissions. As part of the Meat Technology Ireland initiative (http://www.mti.ie) research on genetic evaluations for age at slaughter is at an advanced stage with considerable inter-animal genetic differences detected even when corrected to the same carcass weight and fat score. Reducing age at slaughter through breeding is a far easier approach to trying to reduce feed intake per day; the extent of inter-animal genetic variability are similar for both traits but data on age at slaughter is routinely available at no cost for all slaughtered animals. While the value of an extra kg of feed is known, no monetary value currently exists for environmental footprint. However, breeding programmes operate with a long time horizon and there is a chance that someday greater methane emissions may incur a financial penalty.

Carcass traits

Given the existence of heritable genetic variability in carcass-related traits (Table 1), genetic evaluations are currently undertaken for carcass weight, conformation and fat score, the latter two characterised by the EUROP carcass classification system. Using a population of 662 dissected beef carcasses, Teagasc research estimated a correlation of 0.85 between this EUROP classification system and carcass meat proportion. Hence, the EUROP carcass classification explains only 73% of the variability in saleable meat yield and thus scope for improvement in the precision of the genetic evaluations possibly exists. Moreover, the EUROP classification system attempts to predominantly guessestimate yield and not quality. Research as part of the Meat Technology Ireland initiative (http://www.mti.ie) is underway to (1) evaluate alternative technologies to more accurately predict carcass yield with the resulting predictions having potential use in genetic evaluations, and (2) generate the largest database globally on meat tenderness metrics of animals with the objective of generating accurate genetic evaluations for meat tenderness. While the monetary value of improving carcass weight and EUROP is known, less is known about the monetary value of improving meat quality. Consumers can however take up to 3 months to again purchase beef after a bad eating experience and thus there is monetary value for tenderness and other quality attributes.

Societal traits

The intensifying interest among the modern-day consumers on the origin of their food necessitates breeding programmes to take cognisance of current and impending concerns. Moreover, the number of injuries and fatalities on Irish farms, largely attributable to livestock, demands action; because docility is partly under genetic control (Table 1), then breeding programs may offer a complementary solution to improving animal temperament. Polledness, which important for animal and operator safety, is being ever-more scrutinised by consumers, particularly so when breeds, but also some animals within breeds, are naturally polled. Monetary costs also exist for polledness such as those associated with labour, medicinal treatment and equipment (depreciation); any potential impact in stunted animal growth is captured elsewhere in the index.

Adaptation for trading animals

Scope exists to use such an adapted version of the dairy-beef index as the unit of currency when trading animals. Once the calf is born (i.e., when being sold), the monetary costs of calving performance are already realised and therefore are of limited interest to the purchaser. Because the remaining traits are all highly heritable, this means that the genetic merit of the animal relates closely to its subsequent performance credentials. Moreover, it is the index value of the calf which is important and not that of the sire; this is because (a) only half the genes of the calf originated from the sire with the other half being inherited from the dam, and (b) it is a random half of genes which is inherited for the sire and thus paternal half-sib progeny (i.e., animals from the same sire) can have considerably different index values. Access to low-cost DNA screening tools provides a strategy to (1) verify parentage of each calf, (2) verify breed composition, and (3) generate more accurate estimates of genetic merit for that calf. This DNA-based estimate can be supplemented with ancillary information such as calf gender, heterosis level, and dam parity to predict, more accurately, the expected total merit of the animal. Such a technique should aid in identifying animals, at a young age, most suitable for different production systems and markets.

Initial results, including potential implementation.

Initial results from the Teagasc and ICBF teams responsible for developing the new index are positive, with an expectation that a new dairy beef index will be available to dairy farmers for the spring 2019 breeding season. These results are indicating a difference of some +/- €100 between the range of bulls that are available for widespread use in AI in terms of their dairy beef value. Importantly large differences are being observed within the beef breeds used more highly within the dairy herd, such as the Angus, Hereford and Belgian Blue. In addition, top listings of available AI bulls are expected to indicate a range of breeds that are positive for this new index.

ICBF and Teagasc are currently working on aspects of implementation, with a number of new traits being considered for publication. These include; (i) suitable for use on heifers, and (ii) % not in spec (as an indication of carcass weight and quality). In addition, it is expected that only active beef AI bulls meeting a certain minimum criterion for publication, will receive a dairy beef index value in the first instance. This is to facilitate promotion, support and roll-out of the new index in this initial introduction phase. Expanding the index (including underlying workings) to other animals and indexes (including the EBI, €uro-Star Replacement and €uro-Star Terminal index) will then be a priority for 2019.

Discussions regarding the new index, including its implementation, are underway with the broader cattle breeding industry, with the initial feedback being very positive. A final decision on implementation (or otherwise, pending further work) will be taken by the ICBF board ahead of the spring 2019 breeding season.

Conclusions

The expanding dairy herd, coupled with the every improving reproductive efficiency in Irish dairy cows, necessitate an easy-to-use tool to aid dairy farmers in identifying suitable beef bull that will produce high quality calves for sale but without negatively impacting cow performance. Such an index must be applicable across breed and should ideally consider traits relevant to the beef herd as much as those relevant to the dairy herd. The objective therefore of this new index will be to identify bulls that, on average, produce efficient progeny with good carcass credentials born with minimal fuss to the dam and farmer. The index can also form part of the Sire Advice system taking cognisant of the cow-level factors such as date of calving, previous experience with calving difficulty and cow parity.

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What role can sexed semen play?

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Summary

- Sex-biased semen is a revolutionary technology that provides many potential advantages for the Irish dairy industry:
  - Reduce the number of male dairy calves;
  - Provide opportunities to increase the value of beef output;
  - Streamline heifer rearing;
  - Improve biosecurity in expanding herds.
- A field trial using lactating dairy cows was conducted in 2018 to compare the fertility performance of conventional semen versus sexed ULTRA 4M
- The conception rate (**CR**) was 59.9% for conventional semen and 45.5% for sexed semen, resulting in a relative CR of 76%. The relative CR varied from 84% for bulls located in a bull stud at (or near) a sorting laboratory to 71% for ejaculates that were brought from Ireland to a sorting lab in the UK.

Introduction

Sexed semen technology is now commercially available in many countries around the world, and is primarily used in dairy cattle breeding. Despite reliably producing a 90% sex bias, the fertility of the sexed semen product is compromised compared with conventional semen. Sexing Technologies Inc. are the predominant producers of sexed semen globally. Recently, Sexing Technologies reported that the relative conception rates (**CR**) achieved with sexed semen improved from ~65% in 2012 to ~88% in 2015 in both cows and heifers. These improvements were a result of fewer handling steps, better equipment and increasing the number of sperm per straw from 2 million to 4 million, and the resulting new sexed semen product is called sexed ULTRA 4M. A high fertility sexed semen product that delivers a 90% sex bias has potentially important implications for the future of breeding management in pasture-based dairy production systems.

In studies comparing conventional semen and sexed semen, the mean CR achieved with sexed semen is often expressed as a percentage of the mean CR achieved with conventional semen, and is termed the relative CR. For example, if the conception rate with conventional semen was 60%, then sexed semen would need to achieve a conception rate of 54% to result in a relative conception rate of 90% (i.e., 54/60 x 100). A large field trial was undertaken during the 2018 breeding season to assess the fertility performance of sexed ULTRA 4M versus conventional semen. The objective of this study was to test if sexed semen could achieve a relative conception rate of ≥90% in Irish lactating dairy cows.

2018 field trial

Ten bulls were identified to produce conventional and sex-sorted semen straws. Of the 10 bulls, four were located in a bull stud at (or close to) the Cogent-ST lab in the UK (2 bulls) or the ST Benelux lab in the Netherlands (2 bulls). These are termed resident bulls in the analysis. Additional bulls located in Ireland (6 bulls) were selected for inclusion in the trial, with ejaculates being directly transported from the Irish bull stud to Cogent UK (~6 h door to door). These are termed shipped ejaculates in the analysis. All ejaculates collected from each bull were processed to produce approximately equal numbers of conventional and sexed straws, frozen and stored in liquid nitrogen. The sexed straws were X-sorted to 90% purity and packaged at 4 million sperm cells per straw (commercial name SEXED ULTRA 4M).

Potentially suitable herds were identified by ICBF from the national database in conjunction with the participating AI companies (Dovea Genetics, Munster AI, Progressive Genetics). Each research herd that enrolled were required to purchase 60 dairy semen straws (30 sexed and 30 conventional) using a team of 5 bulls (same bulls used for conventional and sexed within farm). The experimental design is illustrated in Figure 1. After the inseminations had been completed, 142 herds were visited for pregnancy diagnosis via transrectal ultrasound. The total number of cows with an ultrasound scan pregnancy diagnosis result for the Project insemination that were available for analysis was 7246.

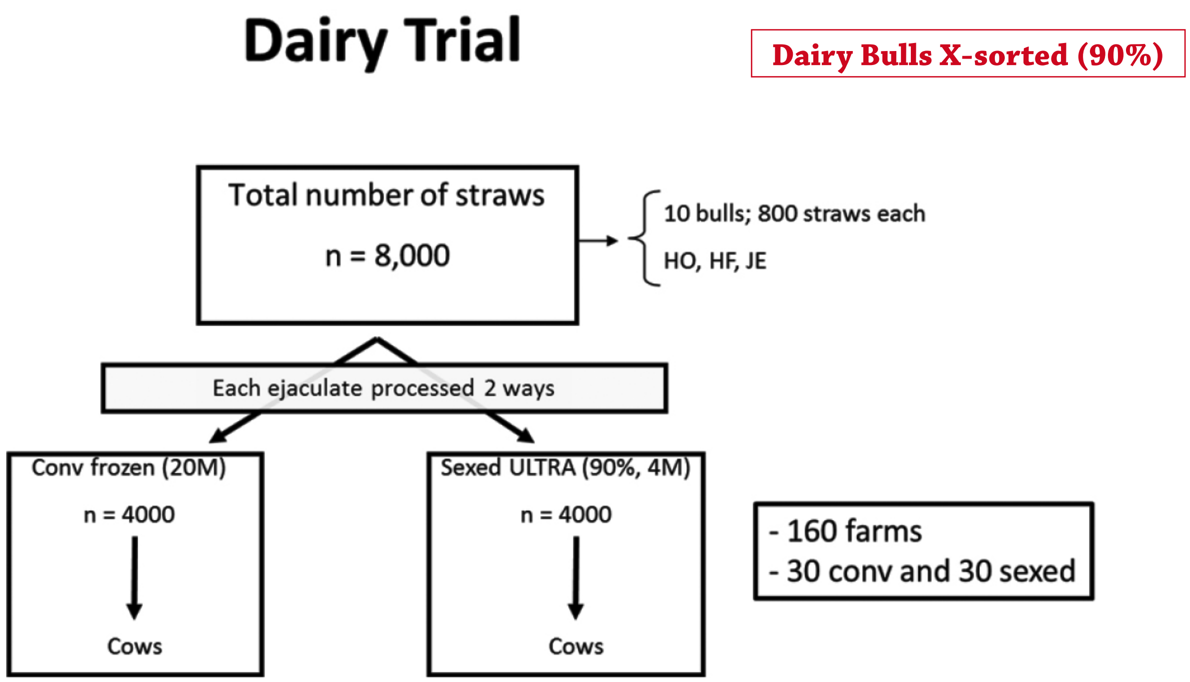

Figure 1. Schematic outline of the experimental design.

Effect of sexed semen treatment on conception rate

Semen treatment had a significant effect on CR. Cows inseminated with conventional semen had a mean CR of 59.9% versus 45.5% for cows inseminated with sexed semen. The relative CR in the current study was 76.0% (i.e., 45.5/59.9).

Did the effect of semen treatment differ depending on the bull?

There was evidence that the effect of the sexing treatment differed depending on the bull (Figure 2). The biggest differences between conventional and sexed semen treatments were noted for bulls with shipped ejaculates. All four of the resident bulls exceeded 80% relative CR, with little variation between bulls (mean = 84%, range = 81% to 87%). Of the bulls with shipped ejaculates, only one bull exceeded 80%, and 4 of the bulls with shipped ejaculates had relative CR ≤75% (mean relative CR = 70%, range = 45% to 86%). Bull 7 had the poorest relative CR (45%), but it is important to note that his CR for conventional semen was good. This study was not designed to test the fertility of resident bulls vs shipped ejaculates. The reasons for the difference between resident bulls and shipped ejaculates are unclear, but there are several potential explanations:

1. Transport conditions used for the shipped ejaculates (media, temperature, door to door transit time) were not optimal to achieve high fertility performance, especially for sperm that go through the sorting process;
2. It was simply a bull effect, whereby the bulls that had ejaculates shipped had inherently poorer fertility and/or were inherently less suited to sex-sorting compared with the resident bulls. It was impossible to predict this before the trial;
3. Some bulls had a low number of insems, and the estimate for CR in these bulls is inaccurate and unreliable.

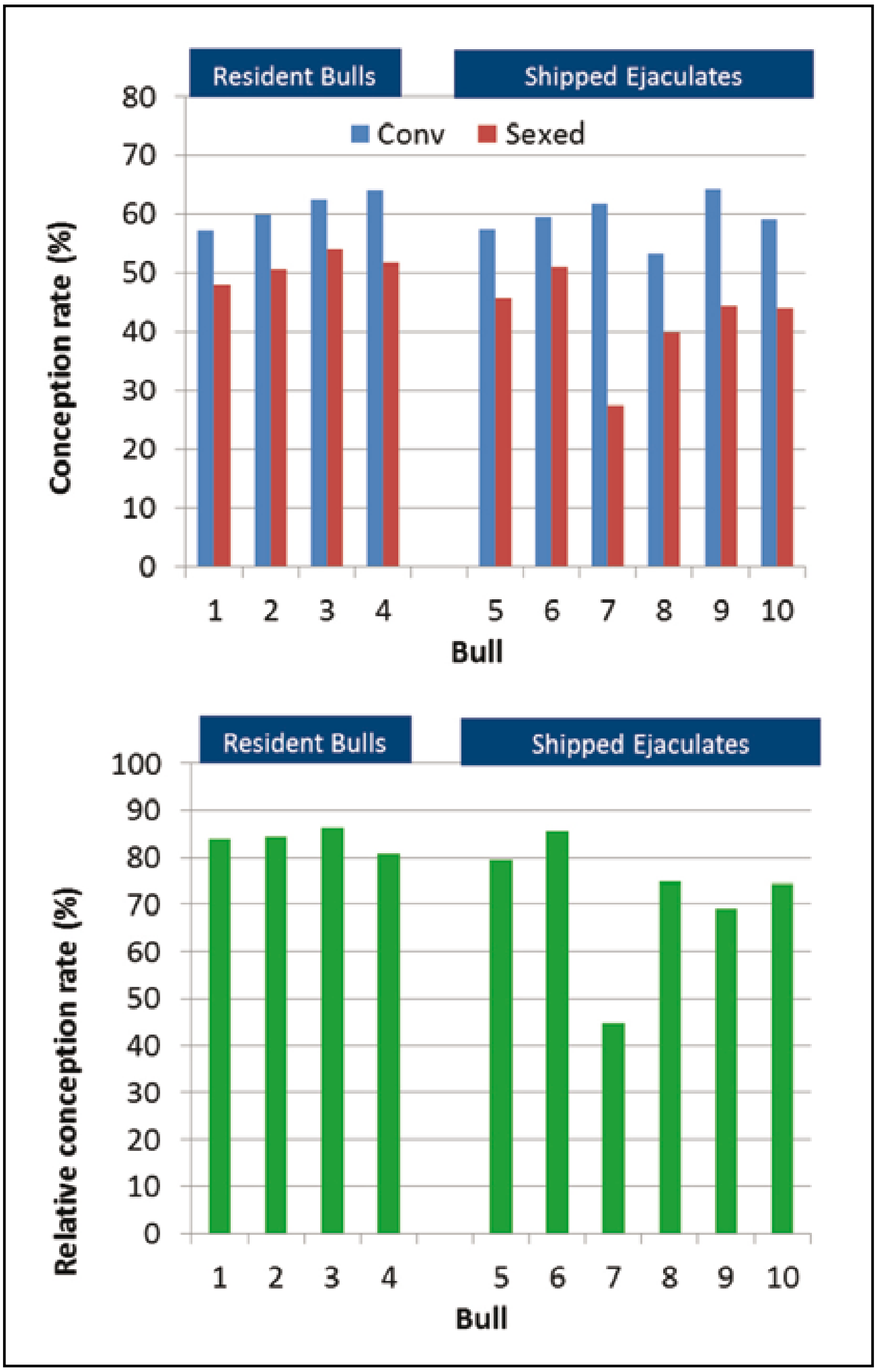

Figure 2. Top panel: Conception rates for conventional and sexed semen treatments for each individual bull. **Bottom panel:** Relative conception rates for each individual bull.

Herd to herd variation in relative conception rate

When herds were ranked based on relative conception rate, approximately one third of herds had a relative CR of >90, and within this subset, most exceeded 100% (i.e., sexed semen performed better than conventional semen). This was an unexpected finding, and suggests that the heat detection management on some farms are particularly suited to sexed semen, and warrants further investigation.

Conclusions and future plans

In the current study, farmers identified the cows in heat, and the AI technician randomly allocated conventional and sexed straws to the cows that were presented for insemination. Under these field conditions, the relative conception rate achieved with sexed semen was on average 76%.

Since this study was conducted, preliminary results from a similar study in New Zealand comparing conventional and sexed ULTRA have emerged. That study also reported a mean relative CR of ~75%. Why is there such a difference in relative CR between North American confinement systems and pasture-based systems? A potential explanation is that the timing of AI is not sufficiently controlled in systems that rely primarily on tail paint removal for heat detection, with AI being conducted once per day an all eligible cows with little regard for time interval since onset of oestrus. The expected lifespan of conventional semen in the female reproductive tract is ~24 h, but much shorter for sexed semen. Hence, inseminations with sexed semen should be conducted close to the time of ovulation. It is likely, therefore, that studies reporting 90% relative CR in confinement systems are a result of better timing of AI relative the (known) time of ovulation because most cows (and increasingly heifers) are bred using fixed-time AI synchronization protocols.

The sexed semen technology failed to deliver the desired target of >90% relative CR in high fertility dairy cows under the methods used for identifying cows in oestrus in this study. Nevertheless, the four resident bulls all had similar (reliable) CR with sexed semen, and averaged 84%. Further research into the optimum timing of AI is the next priority to raise the relative CR to >90%.

Acknowledgments

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Making our dairy farms better places to work

Kelly, P.[1]

[1] *Teagasc, AGRI Centre, Moorepark, Fermoy, Co. Cork*

Workshop objective

- Highlight the importance of viewing your farm as a work place
- Discuss the key requirements of a good farm workplace
- Get a farmer's perspective on their farm as a work place, changes made and future plans
- Get an employee's view of what they look for on a farm they want to work on

Opening statement/background

The dramatic increase in Irish dairy cow numbers (from 1.1 million cows in 2010 to over 1.4 million cows in 2018) has meant that many more dairy farmers are now employing either full or part time people to manage the increased workload.

During this time frame the availability of labour has reduced due to unemployment rates nationally decreasing (from 15% in 2010 to 5.4% in 2018) and increased competition from expanded farms. Between 2010 and 2016 the number of employees working on Irish dairy farms increased by over 40%; from 2,900 to 4,100 people. Attracting and retaining employees is crucial for the success of Irish dairy farmers and so it is essential Irish farms are attractive places to work.

Having a farm that is a good workplace is crucial for not just employees, but also the farm family and the farmer himself. A good farm workplace is a safe place to work, well organised, and people have the resources they need to efficiently complete all tasks. This workshop will explore the key aspects of making a farm a good place to work.

Questions (to lead discussion)

- What makes a farm a good place to work? Conversely, what are the things that can really frustrate employees when working on a farm?
- For the employer – what changes have you made on your farm to improve it as a place of work? What were the cost and benefits?
- For the employee – what do you look for in a farm that you would like to work on?

Summary

To successfully attract and retain employees it is crucial that your farm is a good place to work. There are many aspects of providing a good farm workplace including:

- Being a good employer – ensuring that the farm follows best practice in recruiting and managing employees including meeting all legal requirements;
- Promoting good communication;
- Providing adequate farm facilities in good working order well e.g. milking parlour, cow and calf accommodation; and
- Setting the farm up for success – farm maps, whiteboards, standard operating procedures (SOPs).

Additional resources

For more guidance on how to effectively hire and manage employees check out the Teagasc Farm Labour Manual – https://www.teagasc.ie/publications/2017/teagasc-farm-labour-manual.php

Managing the spring workload

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Workshop objective

Identify facilities and technologies to make the calving workload easier to manage.

Background

Spring is one of the most demanding times of year on a dairy farm. Weather challenges combined with the workload associated with compact calving and inadequate facilities can result in increased stress and workload for farmers, their families and employees. There are practical approaches that can be used to help it go smoothly and with less stress.

Accurately reviewing 2018 by answering three questions will help identify actions to be completed that will help set you up for a better calving in 2019; (1) What worked well? (2) What were the challenges? and (3) What could be improved for 2019?

Teagasc dairy advisors completed a survey, consisting of 20 questions, with their dairy discussion groups reviewing spring 2018. In total, 349 responses were collected from 37 discussion groups in 12 counties.

Table 1: Results from 349 farmers reviewing spring 2018

What worked well?	What were the challenges?	What could be improved for 2019?
Enough people for the workload	Weather	Facilities
Other ('bobman', 'kept myself warm', 'went out for breakfast once a week')	Workload and labour	Keep less stock (sell cull cows and male calves earlier)
OAD milking and calf rearing	Feed issues	Hire more people

Summary

The success of spring on your farm will largely be determined in advance. Time spent planning now will pay rewards. Even if it feels like an extra chore now, good planning is smart farming and it will reduce stress and save time during calving. Preparation that can be completed in advance of calving will help reduce the peak workload. A checklist can help organise what needs to be done for you and others working on the farm:

- Prepare the calving area (e.g. prepare a calving kit –jack, ropes, gloves, lubricant, wash, disinfect and bed pens)
- Set up the calf shed (e.g. wash and disinfect, order tags, purchase electrolytes)

- Set up the milking parlour (e.g. arrange to have parlour serviced, change liners and repair any broken items)
- Do a stock take and purchase items (e.g. calcium and magnesium etc. and store safely in the medicine cabinet)
- Have a farm office where a farm map with paddocks numbered is visible.
- Prepare a spring grass plan and have plenty of reels and make any necessary repairs to fences.
- Organise work stations (e.g. set up areas of the farm with the equipment used at that location. It may be necessary to have multiples of certain items such as a shovel/fork/brush/scraper. Keep all calf equipment in one location. Have stock rooms tidy and have a white board with weekly and monthly plan on display.

Labour saving practices

To reduce the workload on farm during spring, farmers should adopt more labour saving practices. The percentage of farmers implementing labour saving practices is presented in Figure 1. Using a contractor to spread slurry was the most commonly used practice (74%) while contract feeding was the least commonly used practice (6%). One third of farmers were using once-a-day milking; previous research has shown that labour efficient farmers milk once-a-day for four weeks in spring. Having a set finishing time in the evening is essential to being labour efficient. The most efficient farmers start evening milking by 4pm and are finished milking by 6pm, while research shows no effect of 16:8 hour compared with a 12:12 hours milking interval.

After milking, calf care is the most time consuming task in spring. This spring, 37% of farmers practiced once-a-day feeding of calves. This along with having adequate facilities (enough shed space for all calves), close to the milking parlour which can be mechanically cleaned out are essential. To further reduce the workload, bull calves should be sold from 14 days.

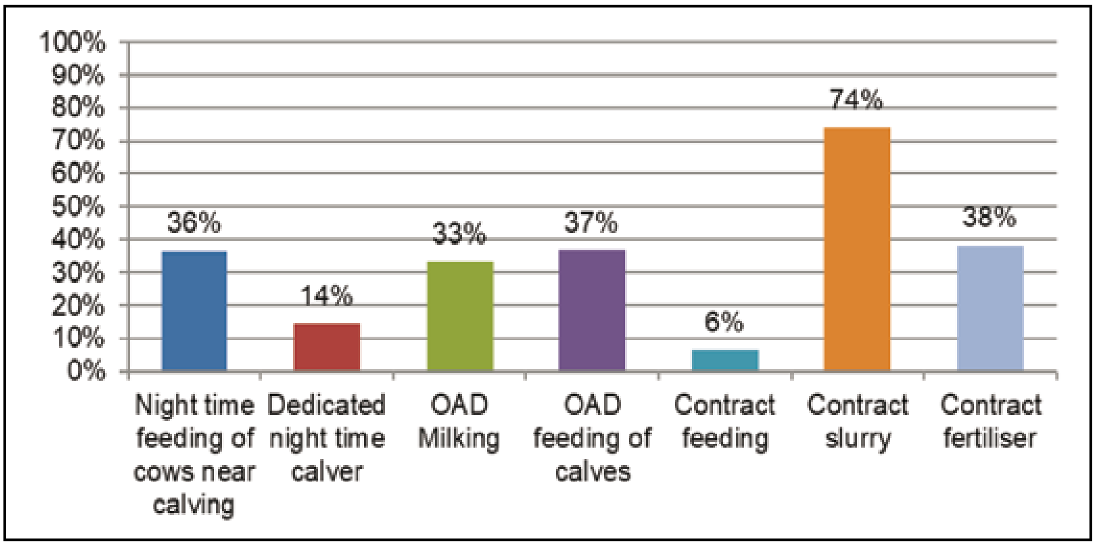

Figure 1: Percentage of farmers implementing labour saving practices in spring 2018

Acknowledgements

The authors would like to thank the dairy advisors who conducted the survey with their discussion groups.

Contract rearing dairy replacements: the experiences learned to date from a discussion group involved in contract rearing heifers

Tom Coll

Teagasc, Business and Technology Advisor, Mohill, Co. Leitrim.

Summary

- The increase in popularity of contract rearing is driven mainly by expanding dairy herds and farmers who want to streamline labour at their current scale.
- As with any collaborative farming structure, there are benefits and risks for both parties involved.
- Dry stock farmers view contract rearing as a means of increasing stocking rate with little capital outlay, to increase gross output and the overall profitability of their holdings
- A detailed contract agreement specific to the farms involved should be put in place and agreed including a herd health plan and target weights on arrival and return.

Introduction

Contract rearing of dairy heifers has become more popular in recent years. The increase in popularity is driven mainly by expanding dairy herds but also by dairy farmers who want to streamline labour at their current scale. As with any collaborative farming structure, there are benefits and risks for both parties involved. It is perhaps fair to say that the majority of information published to date has focussed on the issues at hand for the dairy producer. However, this paper will outline the pros and cons of contract rearing from the rearer's perspective, using the collective experiences of farmers in a dedicated contract rearing discussion group based in the Sligo/Leitrim region.

Group profile

The Sligo/Leitrim contract rearers group consists of 19 farmers currently rearing 2,090 dairy heifers. The numbers reared on individual farms ranges from 30 heifers by farmers starting out to 300 heifers in the more established farms. The age at which heifers arrive on farm differs between farms from 3 weeks, 12 weeks and 9 months of age. Initially some members have summer grazed heifers before moving into longer term contracts. In general most contracts consist of one owner and one rearer, however owners have supplied multiple rearers and rearers are rearing for more than one dairy farmer. The group is made up of members who contract rear in conjunction with an existing suckler or sheep enterprise and members where contract rearing is now the sole enterprise on the farm. The group have established benchmarking linkages with the Aurivo farm profitability programme and with the Teagasc Ballyhaise heifer rearing unit.

Contract rearing in practice

In November 2015, a number of drystock farmers in the Sligo/Leitrim area came together to investigate the potential of contract rearing dairy heifers as a means of increasing stocking rate and increasing the profitability of their farms. An initial meeting was held on a farm that had been successfully contract rearing heifers since 2010. The Sligo/Leitrim contract rearers discussion group was duly formed and now consists of contract rearers and farmers who intend to contract rear in the near future. To look firstly at the farmers in the group, they were all relatively good grassland managers, some are on the PastureBase grassland measurement system, and all had the ability to make high quality silage. They all looked on contract rearing as a means of increasing stocking rate with little capital outlay, to grow gross output and the overall profitability of their holdings. Group members were asked to list the benefits associated with contract rearing from their perspective and those are outlined hereunder:

- A means of increasing stocking rate with immediate effect, making better use of available land and buildings without the requirement to invest in stock.
- Allows for a clear direction in farm planning as the risk associated with market and price fluctuations is eliminated with an agreed contract price per day established.
- Docile animals to work with and facilitate an extension of days spent at grass.
- It is good for cash flow as the rearer gets paid on a monthly basis by direct debit.
- Clear guidelines are outlined regarding targets weights and pregnancy rates which keeps the rearer focused on the job in hand.
- A means of building a long term trustworthy relationship with the dairy farmer with each farmer focused on how the relationship will benefit both.
- Contract rearing has substantially increased the profitability of farms involved either as a sole enterprise or in combination with an existing enterprise on the farm.
- An immediate source of income which facilitates the development of the existing farm infrastructure where future direction and plans can be based.
- Gross margins for the contract rearing enterprise ranged from €743/ha-€1,394/ha and was influenced heavily by stocking rate and the time period the heifers spent on the farm annually.

Group members were also asked to list the negatives and associated risks

- It takes time to build trust and form a working relationship with the dairy farmer - the first bump on the road and how it is dealt with is vital.
- Heifers arriving on the rearers farm under target weight for age was one of the main problems. These animals will be the ones that the rearer will continually struggle with to meet the targets and the ones that will reduce farm profitability. Dairy farmers need to ensure that all heifers sent out for rearing are on target.
- Heifers arriving on the farm sick will also have a huge effect on their potential to reach targets. The dairy farmer and rearer need to draw up a health plan with a veterinary surgeon to manage the health status of the animals leaving both farms.
- The initial contract is difficult to get up and running with some dairy farmers pulling out at the last minute and leaving the rearer without stock.
- The contract rearer needs to be technically efficient, an excellent grassland manager and aware of the benefits of reaching target weights
- There is a cost associated with changing the annual herd test date to earlier in the year to allow enough time for retesting stock in the case of a TB outbreak. The rearer should liaise with his local DVO prior to entering into an agreement.
- There is a disease risk when stock are taken onto the farm especially where there are existing animals on the farm.

Finally, group members were asked to advise on some key factors and targets that should be put in place and agreed upon between dairy farmer and rearer in advance of the first animals arriving on farm:

- A detailed contract agreement specific to the farms involved put in place and agreed including terms and conditions, a herd health plan, target weights at arrival and return and a breeding plan.
- Planned meetings with the local district veterinary officers by both farmers.
- Regular weighing of stock should be undertaken to identify underperforming animals for timely corrective action. The ICBF weight recording link will allow the dairy farm to view weighings and monitor heifer performance.
- In the first year of the contract agreement, both parties found it beneficial for the dairy farmer to hold onto a percentage of the heifers and rear them himself as a means of comparison. This can be used as an aid in the trust building process.
- The use of heat synchronisation and tail paint/patches as an aid to heat detection to ensure pregnancy rate targets are reached and reduce workload on the rearer.
- The use of an independent intermediary person appointed by both parties to dissolve disputes and find solutions when things don't go to plan.
- To continue to meet as a discussion group sharing experiences and acquiring additional knowledge to reduce the cost of heifer rearing and ensure targets are met.

Conclusions

Contract rearing is a win-win for dairy and dry stock farmers. The dairy farmer has the use of the contract rearers land, labour and buildings which should reduce his own labour requirement and need to invest in additional building for heifer rearing. The drystock farmer, who has good animal husbandry skills, is technically efficient, a good grassland manager and makes excellent quality silage, will meet the dairy heifer rearing targets and generate a viable farm income. The Sligo/Leitrim contract rearers group are focused on farm income and want to build long term contracts with suitable dairy farmers. They treat the heifers as their own and take pride in reaching targets. I would say that the heifers reared by group members far exceed the performance of heifers reared on dairy farms nationally.

Contract rearing dairy replacements: a Teagasc advisor's perspective

Gerry Cregg

Teagasc Business and Technology Advisor, Castlerea, Co Roscommon

Introduction

In my experience over the past 20 years working with technically efficient beef farmers in Co. Roscommon, the returns from improvements made to their farm business have not been financially remunerative. As a result, the cohort has been looking for other opportunities that better reward the changes made.

Over a period of time, beef farmers providing a contract rearing skillset and land-base can build solid relationships with dairy farmers becoming instrumental in developing better dairy businesses. A key element in developing trust in such relationships is ensuring that contract rearers are working to the highest of standards and returning in-calf 95% or more of the heifers reared and at the appropriate target weights.

Teagasc's research-based knowledge and on-farm advisory programme has the capacity to support well-structured heifer rearing partnerships and develop, in conjunction with other industry experts, a quality contract heifer rearing service which financially rewards both parties in the partnership.

Background – Roscommon Contract Rearing Group

Six years ago, I along with a group of top beef farmers in Roscommon began to research the potential of contract rearing as an income source. We visited Moorepark and a number of existing contract rearers around the country quickly realising that potential contract rearing business opportunities existed, but the group of potential rearers were not yet ready to provide a quality service.

Most of contract rearers that we visited took in weaned calves. We realised that acquiring the skill set and establishing a technical support network necessary to contract rear younger calves (approximately 3 weeks of age) could further reduce the workload and pressure on dairy farmers. It would also benefit the calf owner by removing calves from a higher health risk environment to one fully focused on calf rearing with likely lower health challenges.

In 2014, the Green Acres Project was established. Its purpose was to demonstrate profitable dairy calf to beef systems on a whole farm basis through a network of ten demonstration farms through the application of high levels of technical efficiency. I nominated one of my group members Christy Dowd as one of the ten demonstration farms. A calf to beef group was subsequently formed to learn from Christy's experiences on the Green Acres Programme. Group members began to apply the knowledge and protocols developed on the demonstration farms to their own holdings. For three years, the technical days and the farm walks provided by Gordon Peppard (then National Programme Coordinator) in conjunction with Programme partners provided a bank of knowledge for our own group members.

On-farm calf rearing protocols were set up for our emerging contract rearing group along the lines of those being applied on the demonstration farms. Recognising the value of the industry partners supporting the Green Acres Programme, our group set up a diverse support team partnering with Volac for their calf feeding expertise, MSD for disease control, Iomlán for animal health and nutrition, Teagasc and an independent veterinary consultant to facilitate the refinement of best practice. Our group initially honed their skills by rearing beef calves. This provided an opportunity to identify those competent and interested in progressing to contract rearing of dairy heifer calves. The suckling farming background of this group ensured they were competent stock men and hence breeding heifers was not a big challenge. To continue improving rearers' technical skill levels, over the past four year we have visited Moorepark, attended dairy open days, visited other contract rearers and most recently visited five top dairy calf rearing farms in England.

Group – fourth year in operation

- Currently there are 10 members contract rearing and five others at the start-up stage.
- We are rearing 1,100 dairy heifers for dairy farmers based in Cork, Limerick, Tipperary and Westmeath.
- We will continue to identify new dairy farmers for the coming years who want to form contract rearing partnerships.
- Our group's aim is to focus on providing dairy farmers with the 'complete package' with high standards of heifer rearing, taking calves at three weeks of age and returning close to 95% in calf at 20 months of age at an agreed target liveweight.
- Our aim is to minimise the number of 'sick days' to increase profitability for the dairy farmer owners.

Prerequisites to becoming a member of our contract heifer rearing group include:

- Having the relevant proven skill set and competence;
- Following group health protocols;
- Weighing calves and yearling heifers at 6-week intervals (monitored by the adviser);
- Recording a minimum of 30 grass measurements during the grazing season;
- Attending all group meetings and hosting group meetings.

Support team

In my experience the backroom team supporting our discussion group are key and have become an integral part of the group. Experience from the 'Green Acres' and 'Better Farm Programmes' has shown that the greatest threat to our group are animal health breakdowns. We need to be pro-active in heading off such challenges.

The recent introduction of the Department of Agriculture's national TB protocols regarding contract rearing are helping to alleviate concerns around contract rearing. Adhering to strict health protocols on farms and following individual health plans are most important. Understanding treatment protocols and measuring performance is key to improvement and reducing risk. Having the plans in place and access to the relevant veterinary expertise to solve on farm problems when health breakdowns do occur is essential. Without such support individual contract rearers are very exposed and could find themselves in major financial difficulty should such a breakdown occurs. In the long term to avoid potential conflicts between dairy farmers and contract rearers we must ensure as an industry we tap in to the opportunity to establish structurally adaptable contract rearing systems to support a dairy industry which will maximise milk production in a sustainable environment.

From the contract rearers' perspective, they expect that rates and contracts are fair and reward the farmers bringing the required knowledge and skill set to support the dairy industry. Respect for people working hard to achieve high technical standards should be a given and where systems breakdown there is a team approach to resolving individual problems. Similar to the high standards set on rearers' farms there also has to be checks and protocols in place on the heifer owners' home dairy farm and some measure of technical efficiencies to verify pre- and post- calving management to reduce sick days and later targets being achieved. Only then can we have viable and sustainable contract rearing partnerships into the future.

Identifying good operators on both sides are important and Teagasc advisors can play an important role in firstly identifying suitable dairy farmers and contract rearers and subsequently working together. Building support systems around these partnerships in group structures is critical.

Contracts and rates

Contracts are a legal document and need to be specific and penalties for health breakdowns are the biggest risk factor for both parties. In determining budgets and rates, variable costs are easily measured but fixed costs are not. The requirement to upgrade facilities on contract rearing farms needs to be considered when rates are being established. Further on farm research and measurement needs to be carried out in this area.

Managing our GHG and ammonia emission targets

William Burchill
Teagasc/Dairygold Joint Programme, Teagasc Moorepark, Fermoy

Summary

- Meeting Ireland's GHG and ammonia emissions targets is a challenge that will have to be confronted by the agricultural sector
- Increasing the length of the grazing season, improving animal performance (through genetics and management) and improving nitrogen efficiency, reduce emissions while also reducing farm costs
- Changing fertiliser type from urea or CAN to 'protected' urea fertiliser reduces emissions
- Low emission slurry spreading techniques (trailing shoe or dribble bar) reduce emissions and have the added benefit of reducing slurry contamination of grass and odour

Background

It is well recognised that Irish dairy farmers are among the most environmentally sustainable food producers in the world. Despite this, recent revisions to both Irelands national greenhouse gas (GHG) and ammonia emissions targets will create a significant challenge to the Irish dairy sector going forward. Agriculture accounts for 32% of Ireland's national GHG emissions and virtually all national ammonia emissions (>98%). Agricultural GHG and ammonia emissions have increased in recent years and are projected to increase further in the future. It will be ultimately up to individual farmers to come together as a sector to confront this challenge. As a result, steps will need to be taken within the Irish dairy sector to reduce GHG and ammonia emissions while maintaining and improving profitability. The aim of this workshop is to raise awareness of the challenge of GHG and ammonia emissions targets for dairy farmers and discuss some of the practical steps that Irish dairy farmers can implement on their own farms to reduce GHG and ammonia emissions.

What are the sources of GHG and ammonia emissions on Irish farms?

The majority of GHG emissions come from methane gas produced by cattle. The remainder is associated with nitrogen fertiliser use and the management of livestock manures.

The sources of agricultural ammonia emissions differ to GHG. The majority of agricultural ammonia emissions arise from cattle housing, cattle yards, slurry storage and application of livestock manure to land (92%). Nitrogen fertiliser use accounts for the remainder of agricultural ammonia emissions.

What can be done to reduce emissions?

A large range of options are available to reduce GHG and ammonia emissions and several are linked to the technical efficiency of the farm. Options that have the potential to improve farm profitability, while reducing GHG and ammonia emissions at the same time include; increasing the length of the grazing season, improving animal performance (through genetics and management) and improving nitrogen efficiency (fertiliser timing, place, type and rate). Additionally, altering the timing of slurry application from summer/autumn to spring time to reduce ammonia emissions is cost beneficial. The use of low emission slurry spreading techniques (trailing shoe or dribble bar) is a more expensive way to reduce GHG and ammonia emissions but has other benefits including reduced slurry contamination of grass and odour.

Recent research has shown that using 'protected' urea instead of CAN and urea will reduce emissions while giving similar annual grass dry matter yields but may increase farm fertiliser costs depending on the relative price of 'protected' urea.

The selection and adoption of one or more of the options mentioned above on your farm will have a significant impact on us as a sector to help meet the challenge of GHG and ammonia emissions targets.

Grassland decisions made easy

Maher, J., O'Leary, M. and Bogue, F.

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Workshop objective

To improve grassland management decision making, leading to increased grass production and utilisation

Background

Every additional 1 tonne of grass dry matter (DM) eaten per hectare by the herd will increase profit by €173. So how grassland management decisions be made easier so that more dairy farmers can increase grass production and utilisation … and profit.

The average level of grass production on PBI dairy farms is 14 tonnes over the last 5 years. However, information from the National Farm Survey suggests that the average dairy farm grew about 70 - 75% of farmers measuring grass on a regular basis. The winners of the Grassland Farmer of the Year competition are growing over 16 tonnes of dry matter per hectare. There is tremendous scope to increase the level of grass grown and utilised at farm level.

There is tremendous scope to increase the level of grass grown and utilised at farm level. To achieve greater change in the level of grass grown and utilised farmers will need to up-skill their grazing management practices. This means regular measurement of grass cover, using specialised grassland focused software to analyse grass production and, making and implementing grazing management decisions. These are the key drivers to increasing grass production on the farm. New technologies are now available which make grass cover assessment and the decision making process much easier. PastureBaseIreland (PBI) is an internet-based grassland management tool. In operation since 2013, it offers farmers 'grassland decision support' and stores a vast quantity of grassland data from dairy farmers in a central national database.

The 'PBI Grass' offline app is available for download from both the Play Store (Android devices) and the App Store (iOS devices). This offline app will make the capture of data in the paddock easier and more efficient. Farmers can record grass covers, graze/silage dates, fertiliser/slurry applications and milk details. Also a weekly grazing planner has been developed which ranks the paddocks from highest cover to lowest and calculates the amount of time it will take the stock to graze out the paddock.

Questions

Why measure grass on your farm?

Why use PBI to make decisions about grazing?

How can these grassland management decisions be made easier?

What are the key decisions to be made about grazing in spring 2019?

Expected outcomes from the workshop

- Increased clarity of all of the benefits of regular grass measurement
- Key grassland measurements identified for decision making
- Increased awareness of the PBI Grass app

Building fodder reserves

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Background

This year has been a very challenging year regarding grass production. It is likely that grassland production will be reduced by 3.5 – 4.0 t DM/ha on average across farms. While some of this production has been already replaced in the diet of the herd with both concentrate and grass silage, some farms face the winter with insufficient feed supply. A fodder survey completed at the end of October showed that one third of farmers nationally are still short 15% of fodder. This is equivalent to a deficit of 3 weeks feeding, based on a 145 day winter. Figure 1, shows the grass DM production up to November 1st for 2018 compared to the last number of years. Reflecting on the pattern of 2018 grass growth, spring grass growth was reduced by 500-700 kg DM/ha with the remainder of the deficit arising from the drought period which affected the country from mid-June.

Building a fodder reserve

The challenge facing dairy farmers is to ensure that feed supplies are increased on farms for future winter and drought periods. Building a high feed reserve will take a number of years – however there are a number of key principles to bear in mind:

- Stock the farm to the grass growth capacity of the farm, do not build a farm system based around imported feed
- Only over winter priority stock on the farm, if retaining cull cows or if selling replacement heifers make sure the winter feed is available
- Ensure that the fertiliser regime is reflective of what is required for first and second cut silage crops – know the amounts and cost of this input
- Close sufficient silage for first cut – stock farm at 4.0-4.5 cows/ha (grass demand – 75-80 kg DM/ha) during the first cut silage period
- Make sure the out blocks of the farm are preforming adequately, otherwise the home block is under too much pressure
- As surplus grass appears during the season it should be harvested for bale silage
- Ensure the silage in the yard is analysed and utilised properly
- If restricting silage to the herd, ensure the feed space per cow is adequate.
- If possible try to create a minimum feed reserve of 2 bales of silage per LU (400kg DM silage/per cow).

Contract cropping

Contract cropping is an arrangement where a tillage farmer enters into a contract with a dairy farmer to grow a forage crop. Tillage farmers have the expertise and the machinery to grow high quality forage crops. This type of arrangement enables dairy farmers to focus on their grass based systems while having the benefits of a high quality forage crop to bridge the fodder gap. Measurement of yields and quality are important for successful long term arrangements.

The main forage options are:

- Maize - site key to quality
- Fodder beet - high energy but handling and feed-out limit usage.
- Wholecrop cereals – high yielding crops such as winter wheat are essential for quality
- Brassica – ideally have to be grazed in-situ , infrastructure essential.

A contract forage cropping agreement is essential to protect both the grower and the purchaser. The key elements of the forage cropping agreement are:

- Agreed tonnage / area.
- Payment terms.
- Crop husbandry – organic manures, variety etc.
- Delivery date
- Nominated facilitator for dispute resolution

A specimen contract forage agreement can be found at **https://www.teagasc.ie/rural-economy/farm-management/collaborative-farming/contract-forage-cropping/**

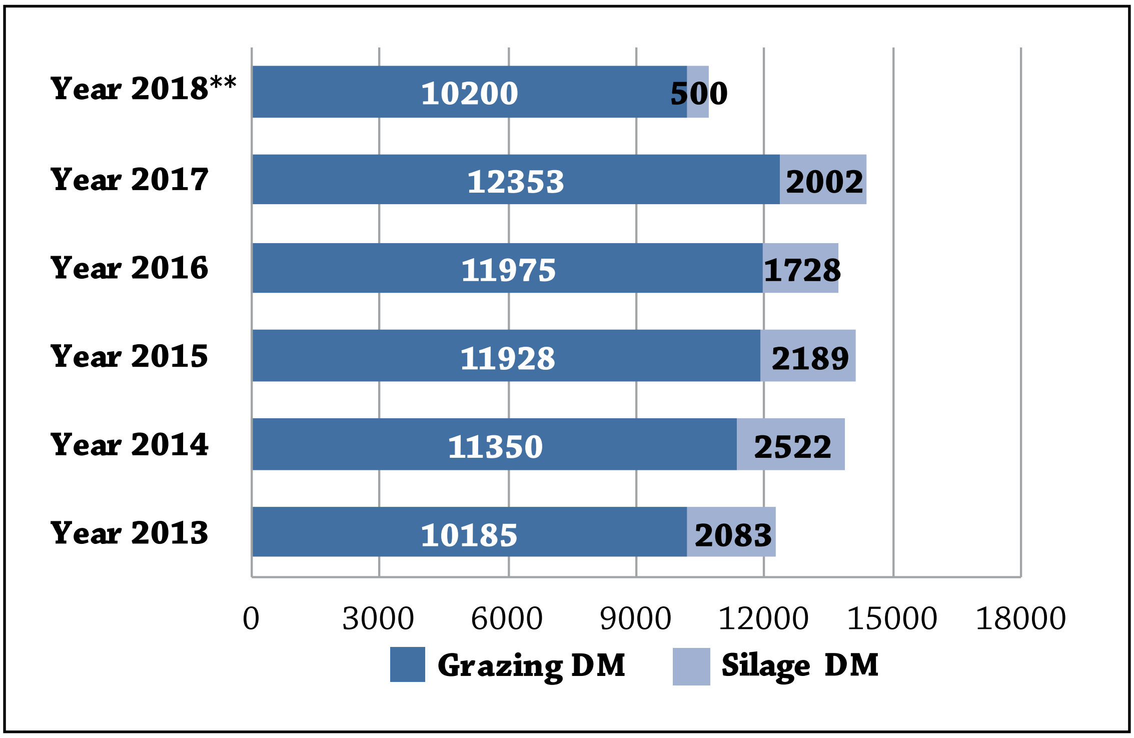

Figure 1: PastureBaseIreland farms grass DM production for the last six years.

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