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Grange

BEEF 2014

'The Business of Cattle'

Wednesday, 18th June 2014

Teagasc, Grange, Dunsany, Co. Meath

teagasc
Agriculture and Food Development Authority

FBD Trust

ACKNOWLEDGEMENTS

Teagasc acknowledges with gratitude the support of FBD Trust, sponsor of BEEF 2014

Compiled and edited by:
Padraig O'Kiely, Mark McGee and Aidan Moloney, Teagasc,
Grange, Animal & Grassland Research and Innovation Centre

Agriculture and Food Development Authority

BEEF2014

The Business of Cattle

SITEMAP

STANDS
1 Welcome and introduction
2 Suckler beef systems
3 Calf to beef systems
4 Exploiting genetics
5 Grassland stand
6 Achieving compact calving
7 A healthy herd

VILLAGES
8 BETTER village
9 Optimally feeding cattle village
10 Animal health village
11 Business management village
12 New technology village (Enterprise Ireland)
13 Environment village
14 Drainage village

15 Grassland village and trial plots
16 Cattle display
17 ICBF G€N€ Ireland marquee
18 Bord Bia marquee
19 HSA Dept Teagasc services; BTAP registration; HQ and media hub
20 FBD stand
21 Main forum

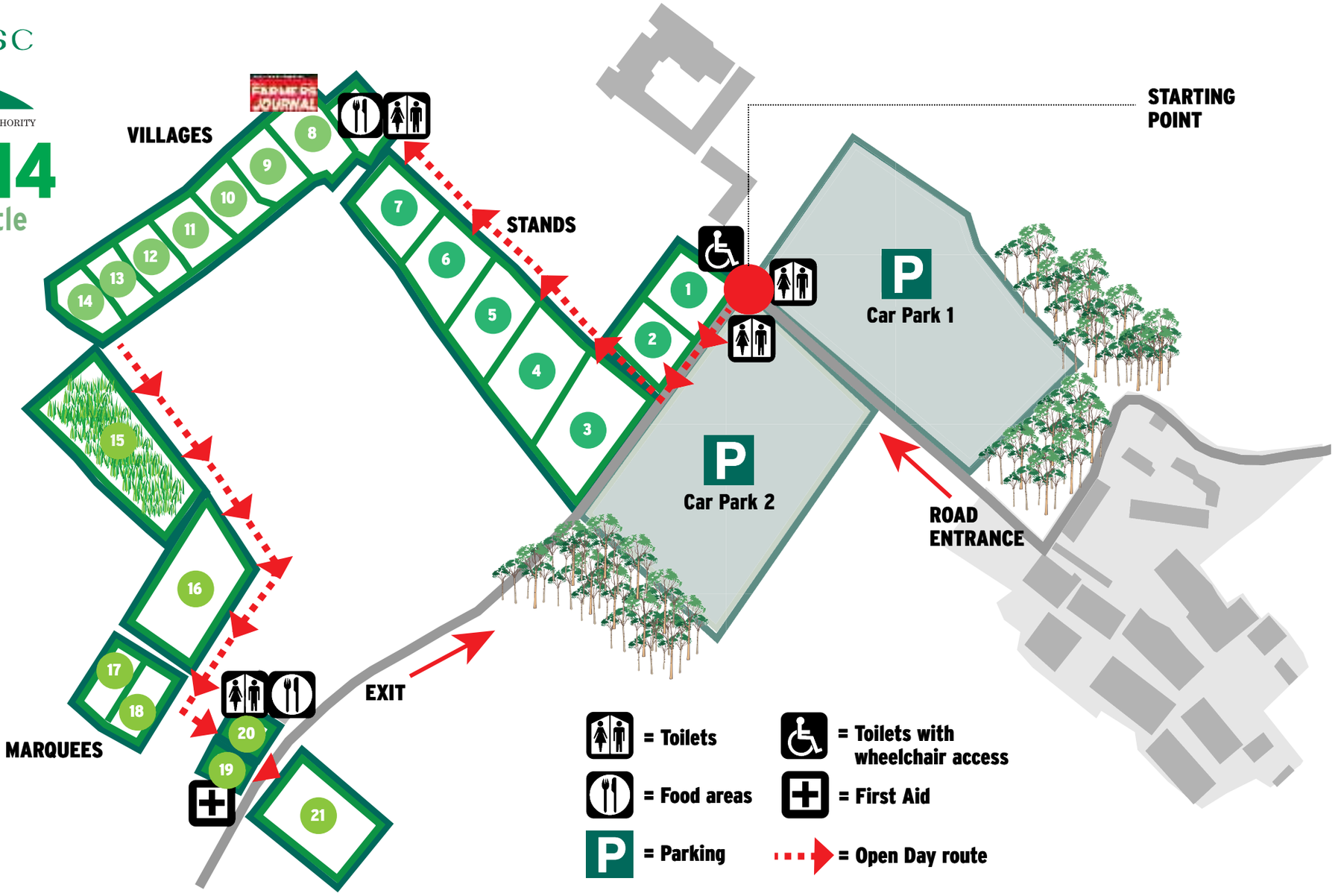

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Table of Contents

KEY PRINCIPLES OF BEEF PRODUCTION

TECHNOLOGY VILLAGES

TEAGASC / IRISH FARMERS JOURNAL BETTER FARM HERD PROGRAMME – BUILDING A BETTER FUTURE

OPTIMALLY FEEDING CATTLE

IMPROVING ANIMAL HEALTH

THE BUSINESS OF BEEF SYSTEMS

NEW TECHNOLOGIES FOR ANIMAL BREEDING

SUSTAINABLE FARM ENVIRONMENT

EXPLOITING GRASS ON IRISH BEEF FARMS

SUPPORTING BEEF SYSTEMS

Health, Safety and Bio-security

To minimise disease risks and accidents, visitors entering and leaving Grange are asked to:

- use footbaths
- not handle cattle
- not enter pens or paddocks containing cattle

Bí cúramach!

Go raibh maith agaibh

Beef 2014

Foreword

You are all very welcome to this major Teagasc National Beef Open Day for 2014. Here in the Teagasc Animal & Grassland Research and Innovation Centre in Grange, we have brought together our advisers, specialists and researchers along with the main stakeholders involved in the beef sector to address the issues and challenges facing beef farmers and the industry in the years ahead.

The cattle and beef sector is hugely important, not just to the agricultural sector, but to the entire economy. It accounts for 30% of gross agricultural output, valued at €2.1 billion in 2013. Annual beef output is 518,000 tonnes, with 90% exported, valued at €1.8 billion. So it is an important contributor to economic activity in Ireland. Last year there were 6.9 million cattle in Ireland of which 1.1 million were suckler cows. Over 90,000 farms have a cattle enterprise.

Notwithstanding the economic importance of the sector, it faces a number of significant challenges. Higher weather related costs impacted on incomes last year and volatile prices along with problems with timely sale of animals created difficulties for beef producers this year. There is also an underlying structural issue with many small beef farms.

Today's Beef 2014 event provides a great opportunity to see the latest in animal breeding and grassland research and examine the economics and profitability of the different production systems. There is also an opportunity to get the latest updates on the Maternal Index herd and the Derrypatrick herd, while the lessons learned and the technologies adopted by the farmer participants in the Teagasc / Irish Farmers Journal BETTER Farm Beef Programme will be spelled out for all to see.

The forum at the end of today's open day will allow you as farmers to have your say and to comment on, and contribute to, the discussion on the information presented. You will also have an opportunity to hear from some of the country's leading beef farmers talking about what direction they are taking on their own individual farms.

I would like to thank all my Teagasc colleagues who have worked hard to ensure that this Beef Open Day is a success. I would also like to thank all the other organisations who partnered with us to participate in this event. I would like to acknowledge the support of FBD Trust for Beef 2014. I hope you have an enjoyable and educational day and that this comprehensive booklet will provide you with the technical knowledge that you need to take home and apply to your own cattle business.

Professor Gerry Boyle
Teagasc Director

Beef 2014 – Fáilte to Grange

Edward G. O'Riordan[1], Larry O'Loughlin[2] and Con Feighery[3]
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Introduction

On behalf of the staff at the Teagasc Animal & Grassland Research and Innovation Centre, Grange, and the Teagasc specialist, advisory, education and administration staff, involved with today's event, it is a pleasure to welcome you to **Beef 2014**. This major event highlights relevant technologies that help farmers achieve more sustainable production, with farm profitability to the fore. Teagasc, with its integrated programmes of research, advice, training and education, is well positioned to assist Irish farmers with technical developments aimed at improving the economics of beef farming.

The Irish beef industry is of major national importance with the sector having a current annual output exceeding €2 billion. This, in turn, accounts for ~30% of Irish agricultural output. Nevertheless, while the sector is of major national importance, profitability at farm level is, unfortunately, generally low compared with some other enterprises. While there are many factors affecting farm profitability, some of which are outside the farmer's immediate control, farm income is ultimately derived from the difference between costs and revenues. Therefore, **Beef 2014**, 'the business of cattle', aims to address the main on-farm factors contributing to profitable beef farming.

Beef 2014 '*The business of cattle*' – key principles for beef production systems

The key principles in profitable beef production, which are mainly under the farmers control, are initially outlined in the first six presentations, and these topics are later elaborated upon in 'technology villages'.

As beef production is based on utilising output from the national beef suckler and dairy herds, each of which approximates to 1 million cows, the first two presentations deal with profitable beef systems (1) using the suckler herd and its calves (**Technologies underpinning grass-based suckler beef systems**) and (2) using progeny from the dairy herd (**Dairy calf-to-beef production systems**). (3) **Exploiting genetics**: The genetic potential of the national cattle population is hugely important, and exploiting the potential of the animal through the use of the best available animal genetics (dam and sire choice) must be seen as a key feature in beef production. (4) **High performance from pasture**: Grazed pasture continues to provide a competitive advantage in lowering the cost of animal production, and fully exploiting this pasture resource by achieving high performance from pasture-based production, is also key to profitability. (5) **Achieving a 365-day calving interval in beef cows**: In the case of the beef suckler herd, achieving a compact calving pattern is important for matching grass supply with herd demand, and thus, system profitability. (6) **A healthy herd**: Herd health has emerged as an important cost on farms. Thus, the broader issue of disease control and prevention is important in livestock farming.

Technology villages

The key beef principles outlined above are addressed in more detail in technology villages, each of which has a series of further stands that deal with specific topics in detail. These villages include:

- **The Teagasc/Irish Farmers Journal BETTER farm beef programme**: The advances participants have made in the programme will be showcased, and the crucial steps underpinning success will be outlined in detail.
- **Optimally feeding cattle**: Feeding cattle is a major production cost and, while aiming to fully exploit grazed pasture, the provision of additional feedstocks is an absolute necessity. Thus, making conserved feeds, the choice of concentrates and their supplementation during the winter and at pasture, are described in detail. Suckler bull beef production systems and meat quality of beef are also summarised.
- **Improving animal health**: Addressing herd health at farm level and planning to control diseases and their related ill-health in animals is of importance and can be a major cost to producers.

- **The business of beef systems**: Farming is a business and, like all enterprises, costs and revenues must be measured. The impacts of CAP reform, farm planning, profit monitoring and cost control, collaborative farming and organic farming are outlined. A Teagasc beef systems research update is provided, including ongoing research at both Grange and Johnstown Castle. In addition, all the stock associated with the Derrypatrick and New Maternal Index herds will be on display.
- **New technologies for animal breeding**: There will be an outline of the scope for genomic tools for cattle breeding and the use of emerging technologies to improve animal growth, feed efficiency, fertility, and health, to reduce disease and parasite problems, and to develop opportunities such as sexed semen.
- **Sustainable farm environment**: The farming environment village explains the broader issue of sustainable farming, and topics such as greenhouse gasses, carbon footprints associated with livestock, biodiversity and cross compliance will be addressed.
- **Exploiting grass on Irish beef farms**: Exploiting grassland to reap its full potential is a major contributor to farm profitability. A range of pasture covers will be displayed and the key principles of grassland management addressed. Additionally, fertilisation of grasslands and the roles for clover, land drainage, reseeding of pasture, weed control in swards, the Pasture Profit Index and PastureBase Ireland, will be addressed.
- The G€N€ Ireland programme (ICBF and the breed societies) will be outlined, together with the current and future national breeding programmes.
- As over 85% of Irish beef is exported, the marketing and sale of beef is of huge importance, Bord Bia and some of the main beef processors will be present to explain current market requirements.
- Farm safety and farmers health are important issues, and a range of aspects will be addressed.
- **Teagasc services**: Information will be available on the full suite of educational and advisory services provided by Teagasc.
- **Beef farming forum**: At the end of Beef 2014, there will be a forum where a number of beef farmers operating a range of production systems will discuss 'My future in beef'.

As in previous years, there are heightened bio-security measures in place, so please use the footbaths provided and follow the direction signs. Livestock at pasture are displayed behind 'double' fences for bio-security and safety reasons, and visitors are requested not to enter areas containing livestock. Your help and cooperation with these requirements will be appreciated.

Again, on behalf of Teagasc and Grange staff we hope you find the day worthwhile and enjoyable. If you have any suggestions or comments regarding **Beef 2014**, or about our beef research and technology transfer programme, please let us know –
edward.oriordan@teagasc.ie; pearse.kelly@teagasc.ie; larry.oloughlin@teagasc.ie

Fáilte go dtí an Ghráinseach

Thar ceann na foirne ag Lárionad Theagaisc um Thaighde agus Nuálaíocht maidir le hAinmhithe agus Talamh Féaraigh, an Ghráinseach, agus baill foirne eile a bhfuil baint acu le himeacht an lae inniu, tá áthas orm fáilte a chur romhaibh go dtí **Beef 2014**. Ag an mórimeacht seo, dírítear aird ar na teicneolaíochtaí ábhartha a chabhraíonn le feirmeoirí táirgeadh níos inbhuanaithe a bhaint amach, agus cuirtear an bhéim ar bhrabúsacht feirme. Tá Teagasc, a bhfuil cláir chomhtháite taighde, comhairle, oiliúna agus oideachais á reáchtáil aige, suite go maith chun cuidiú le feirmeoirí na hÉireann le forbairtí teicniúla atá dírithe ar fheabhas a chur ar eacnamaíocht na feirmeoireachta mairteola.

Mar a bhí amhlaidh sna blianta roimhe seo, tá bearta breise bithshlándála i bhfeidhm, mar sin bain úsáid as na folcadáin chos atá ar fáil agus lean na comharthaí treo. Tá beostoc atá ar féarach ar taispeáint taobh thiar d'fhálta 'dúbailte' ar chúiseanna bithshlándála agus sábháilteachta, agus iarrtar ar chuairteoirí gan dul isteach i limistéir ina bhfuil beostoc. Is mór againn do chabhair agus do chomhoibriú maidir leis na riachtanais sin.

Arís eile, thar ceann bhaill foirne Theagaisc agus na Gráinsí, tá súil againn go mbeidh lá fiúntach, taitneamhach agat.

Key Principles of Beef Production

Technologies underpinning grass-based suckler beef systems

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[2]Teagasc, Tullamore Advisory Office, Clonminch, Tullamore, Co. Offaly.

Summary

- Suckler beef production is a key contributor to economic activity in Ireland.
- Key principles underpinning profitability of suckler beef systems are:
  - Attaining high performance from grazed grass while producing sufficient grass silage of appropriate quality for feeding indoors.
  - Optimising animal growth and reproductive performance by using high genetic merit animals and adopting the best management strategies available.
  - Operating production systems that optimise the genetic potential of beef cattle within grass-based production systems in order to maximise economic returns.
- Current prices and technologies can deliver the following net returns from suckler beef systems: weanling system, €100/ha, steer/heifer beef systems, €200/ha and bull/heifer beef systems, €300/ha. These margins are very sensitive to changes in weanling/beef price.
- It is important to be aware of market specifications to return the highest price – communication with meat processors is critical.
- The carbon footprint of suckler systems is ca. 10 kg CO_2e/kg beef live weight.

Introduction

Suckler beef production is the most widespread farm activity in Ireland. Suckler farms have a broad geographic distribution in contrast to many other farming enterprises and make an important contribution to economic activity in diverse regions throughout the country. The value of beef and cattle output in 2013 for Ireland was €2.1 billion, representing 30% of total agricultural output, and was the largest single agricultural sector. Approximately half of total beef production, and a greater percentage of output value, derives from suckler beef production and therefore, this sector is a key income generator for the national economy. There are a myriad of production systems operated on suckler beef farms throughout Ireland, based on markets, tradition and demographics. Ireland has a natural comparative advantage to grow grass and, consequently, grass-based beef production systems are most profitable. For the purposes of this paper some of the most typical systems, including both calf-to-weanling and calf-to-beef, are examined. However, the principles discussed are applicable to most production systems.

Key principles for profitable suckler beef production systems

Grass-based nutrition

Due to the considerably lower comparative cost of grazed grass as a feedstuff, maximising the proportion of high digestibility, grazed grass in the annual feed budget is critical. Grassland management revolves around a flexible rotational grazing system, with the objective being to achieve high animal performance from high digestibility leafy grass over a long grazing season. Grass conservation is very important due to the obvious necessity of producing silage for the indoor winter period and because a high proportion of the total

annual feed bill is for grass silage production. Additionally, silage harvesting is an integral part of grassland management on beef farms. In Grange, the objective is to produce high digestibility first-harvest grass silage for progeny (75% dry matter digestibility (DMD)) and moderate digestibility (higher yields) silage for cows (67% DMD). The annual feed budget (dry matter (DM) basis) for the Grange calf-to-weanling system comprises *ca*. 70% grazed grass, 25% grass silage and 5% concentrates and for the calf-to-beef system, *ca*. 60% grazed grass, 30% grass silage and 10% concentrates. Obviously, these proportions are largely constrained by the prevailing environment and, thus, will differ accordingly.

Concentrate supplementation is necessary to make up the deficit in nutrient supply from forage and when grass or grass silage supply declines. In integrated calf-to-beef systems, supplementation of calves (1 kg/day) occurs pre- and post-weaning; supplementation levels are typically higher (2-3 kg/d) in calf-to-weanling systems. Weanlings are generally supplemented with 1-2kg concentrate daily during the first winter to grow at ~0.6 kg live weight per day and avail of compensatory growth during the subsequent grazing season. Finishing cattle receive higher levels of supplementation daily – heifers 3-4 kg, steers 4-5 kg and bulls 5 kg to *ad libitum* concentrates. Concentrate supplementation of cows (1-2 kg daily) is confined to first-calvers, from calving until turnout to pasture.

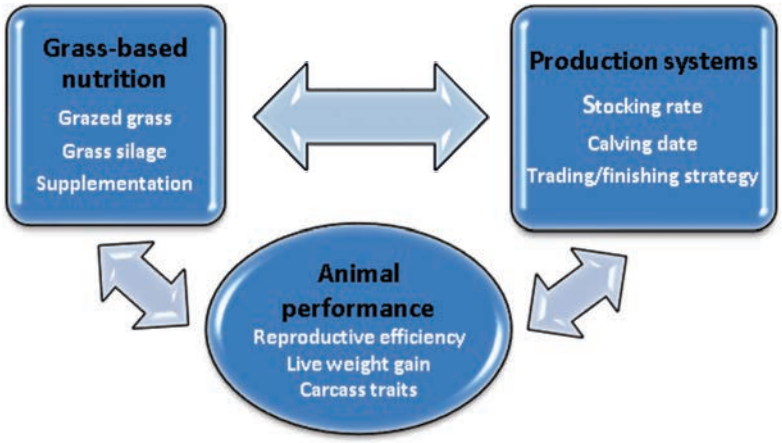

Figure 1: Key principles underpinning profitable suckler beef production systems

Animal performance

The overall objective is to maximise the value of carcass beef produced per suckler cow exposed for breeding. The breeding policy should exploit breed differences and hybrid vigour or heterosis (advantage to crossbreds over the average of the parent breeds). The advantages of hybrid vigour from crossbreeding are due to a combination of enhanced reproductive performance, lower calf mortality and higher calf growth. Research shows that the advantage expected from using a cross-bred suckler cow as opposed to a purebred in terms of kg of calf weaned per cow put to the bull is about 13%. In addition, using a sire from a third breed increases the weight of calf weaned per cow exposed for breeding by approximately a further 8 %. Animals of high genetic merit should be used and sires selected on the basis of the new beef breeding indexes: Replacement Index where replacement heifers (homebred or purchased) are selected for breeding and Terminal Index where progeny are produced for slaughter. Good reproductive performance (i.e. producing close to one healthy calf per cow exposed for breeding) is critical, and ideally cows need to first calve at 2 years old. High lifetime live weight gain of progeny, i.e. attaining high weight for age during pre-weaning (combining cow milk yield and the animal's own genetic capacity for growth) and post-weaning (genetic merit, feeding management and exploiting compensatory growth) coupled with good carcass traits (high kill-out proportion, good carcass conformation and adequate carcass fat score and meat quality traits), is essential.

Production systems

The objective is to maximise financial returns by enabling the potential of beef cattle to be met within grass-based systems. Economic analysis of calf-to-beef production system comparisons at Grange has shown that where individual animal performance remains high, stocking rate is the main driver of farm profitability. Consequently, operating at a relatively high stocking rate is important. Mean calving date should coincide with the start of the grass growing (grazing) season. Research at Grange has shown that in general, earlier calving and turnout to pasture improves farm net margins by reducing the proportion of more expensive grass silage (and concentrates) in the annual feed budget and replacing it with cheaper grazed grass. Furthermore, slurry handling costs are reduced. However, earlier calving and turnout will only increase farm net margin where an adequate supply of grass is available and soil conditions permit grazing i.e. calving too early, or too late, reduces profitability. An important issue surrounds market specifications particularly for bull beef production systems. It is critical to be aware of market requirements for gender, age, carcass weight and carcass fatness. Markets outside of these specifications may be limited or lead to reductions in beef price payable and, therefore, communication with meat processors is essential.

Production systems comparisons

A weanling system and four integrated calf-to-beef suckler spring–calving production systems were compared (Table 1). In the weanling system, weanlings were sold at 9 months of age following a 90-day creep feeding (210 kg/calf) period. For all integrated calf-to-beef systems, heifers were finished indoors at 20 months of age, at the end of the second grazing season and at a carcass weight of 310 kg. Two steer systems were compared: in the first system, steers were finished off pasture at 20 months of age after receiving 5 kg concentrates daily for the final 75 days of the grazing season. The second system involved finishing steers at 24 months of age following a second indoor winter. Two bull systems were compared: in the first system weaned bulls were housed and offered high digestibility grass silage and concentrates prior to slaughter at 15/16 months of age. In the second system, weaned bulls were stored for the first winter, turned out to grass for a 100 day grazing period and then housed for finishing on *ad libitum* concentrate at 18/19 months of age. For all systems, the farm area was 40 hectare and mean calving date was 12 March. Replacements (16% replacement rate) were purchased as maiden heifers, 12 months prior to calving. A 2-harvest silage strategy was assumed and total herbage utilised was set at 10 t DM per hectare.

Table 1 highlights the key findings from the production systems comparison. The number of cows calving per hectare was lower where progeny are retained on the farm for longer e.g. there are more cows calving in the weanling system than in the calf-to-beef systems. Feed budgets differed considerably across systems with the proportion of grazed grass being lower and proportion of concentrate being higher for calf-to-beef systems, especially bull/heifer systems, when compared to the weanling system, reflecting the concentrate feed requirements of the finishing phase. Live weight produced per ha was similar for the weanling and steer/heifer beef systems and somewhat higher for the bull/heifer systems due to the higher daily live weight gain achieved in the bull beef systems.

Analyses of costs indicate that the annual cost per suckler cow calving is approximately €700. This includes all variable and fixed costs and, additionally, the cost of replacement heifers. Given these costs and the output generated at the weanling stage, the calf-to-weanling system was least profitable within the three price scenarios investigated. Although variable costs for the bull beef systems were highest, higher sales more than offset these costs and, therefore, gross and net margin were highest when compared to the other systems (bearing in mind the aforementioned potential market sensitivities to bull beef).

Table 1 — Comparison of alternative suckler beef production systems[1].

Male age at sale (months; m)	9m	20m steer	24m steer	16m bull	19m bull
Heifer age at sale (months; m)	9m	20m	20m	20m	20m
Cows calving/ha	2.28	1.64	1.49	1.83	1.69
Grazed grass – % total feed	67	62	63	58	61
Concentrates/cow calving (kg)	258	411	529	853	784
Male carcass weight (kg)	–	338	397	372	398
Live weight output[2] (kg/ha)	1,014	1,064	1,027	1,202	1,145
Carcass output[2] (kg/ha)	86	567	556	660	630
Variable costs (€/ha)	947	924	923	1,157	1,040
Of which: Concentrates	174	152	180	362	295
Grazing	184	180	181	178	182
Grass silage	372	411	397	414	377
Other	217	181	165	203	186
Fixed costs (€/ha)	624	645	659	669	629
Total farm costs (€/ha)	2,046	1,911	1,892	2,209	2,022
Total farm costs (€/kg[3])	2.02	3.37	3.41	3.34	3.21
Gross margin[4] (€/ha)					
Base price[5]	708	845	846	926	968
High price[6]	909	1,097	1,096	1,222	1,251
Low price[7]	508	592	597	631	685
Net margin (€/ha)					
Base price[5]	85	200	190	257	339
High price[6]	285	453	437	552	622
Low price[7]	-116	-52	-58	-38	56
GHG emissions (kg CO_2e/kg live weight)	10.8	10.5	10.9	10.0	9.9

[1]**Assumptions**: Grass utilised, 10 t DM/ha. CAN, €320/t. Urea, €360/t. Concentrate feed ration, €260/t. Maiden heifer cost, €1,000/hd. Opportunity costs for owned land and family labour are not included. [2]Includes cull cow output. [3]Costs per kg live weight for the weanling systems, costs per kg carcass weight for the systems taking progeny through to beef. Includes replacement heifer costs. [4]Gross margin = sales – replacement heifer costs – variable costs. [5]Base price; €2.50/kg live weight for the weanling systems, €4.00/kg carcass for the finishing systems. [6]High price; €2.75/kg live weight for the weanling systems, €4.50/kg carcass for the finishing systems. [7]Low price; €2.25/kg live weight for the weanling systems, €3.50/kg carcass for the finishing systems.

Fitting the system to the farm

It is critically important that beef farms have a farm plan in place and that this plan sets out the production strategy for the farm including calving date, planned turnout dates, grazing management, planned housing dates, trading system (weanling, store, finish, etc.) and replacement strategy. Clearly, it is necessary to incorporate flexibility within the plan since factors like turnout and housing dates are subject to weather volatility, and date of sale must allow for opportunistic selling during high price periods.

The production systems presented in Table 1 can be categorised as 1) weanling system, 2) calf-to-steer and -heifer beef systems, and 3) calf-to-bull and -heifer beef systems. Many of the underlying management decisions are the same for these systems particularly regarding the suckler cow component of the system, e.g. calving date and replacement strategy. Thus, in the context of these 5 options, the decision largely rests around identifying the most appropriate production system for the male progeny for a given farm. The risk factors to take into consideration for producing male progeny from the suckler herd are identified in Table 2. The decision-making process includes the following components:

- **Market risk**. Market risk refers to the uncertainty surrounding product (weanling live or beef carcass) price and marketability (particular issue for production systems which do not conform to generic, e.g. Meat Industry Ireland (MII), market specifications) at sale, and in the price of inputs (Table 2). For example, in the production systems outlined, finishing bulls older than sixteen months requires close communication with processors and preferably a contracting arrangement should be put in place. Similarly, finishing bulls at less than 16 months of age and/or steers at 24 months of age should take into account prevailing industry specifications around age and carcass weight limits. Weanling production systems are also subject to large market risk since this market is dependent on the live export trade, which varies considerably from year to year. The sensitivity of gross and net margin to weanling and beef price is highlighted in Table 1. It is clear that all systems are highly sensitive to prices.
- **Weather risk**. The production systems outlined above assume "normal" or average weather conditions for Grange. It is assumed that the grazing season begins in early March and that cattle are housed in early November. Average herbage yield is approximately 12 t DM/year. Clearly, any deviation from these targets can have very severe impacts on productivity and profitability of the production systems. A particular example is the winter/spring of 2013 when commencement of the grazing season was delayed until mid-May resulting in a very significant increase in purchased feed costs and reductions in animal live weight performance owing to longer than anticipated store periods.
- **Level of management skills**. Each of the systems in Table 1, and the economic returns achieved, assume that grassland management, animal genetics, breeding and husbandry and, farm business management skills are of a very high standard. Each system requires a cow type with good maternal (calving, fertility and milk) traits. The requirement for grazing management and animal performance are elaborated on somewhat in Table 2. Additionally, silage quality requirements differ with moderate digestibility silage adequate for weanling systems, whereas very high quality silage is essential for finishing systems. Where these factors are less than optimal, very considerable productivity and profitability reductions are likely. In particular, bull beef, especially 16 month production systems, are subject to high risk largely due to the requirement for high growth at all stages in the life cycle.
- **Expectancy of income**. Highest returns are possible from the production systems producing bull beef. However, as noted above these systems are more volatile with respect to management skills and market risk. An additional consideration is facility requirements and safety concerns with handling bulls, which do not arise to the same extent with weanling and steer beef production systems. In contrast, although economic returns are lower for the steer beef systems, these systems predominate nationally, are less risky and are likely to appeal to most farmers.

Table 2 — Risk factors for finishing male progeny from the suckler herd.

System	24m steer beef	16m bull beef	19m bull beef
Market risk	Highest volume demand; suitable for all markets. Industry specifications around age & carcass weight critical.	Lower volume demand; primarily targeting UK market. Age specification critical.	Lower volume demand, primarily for Continental EU markets.
Concentrate price risk	Lowest exposure to concentrate price changes	High exposure to concentrate price changes	High exposure to concentrate price changes
Contract selling	Lowest requirement for contracts.	Lower volume market; contract selling advisable.	Lower volume market; contract selling strongly recommended.
Income potential	Moderate.	High – see above regarding market risks.	Highest – see above regarding market risks & contracts.
Grazing management	Excellent grassland management required for a full grazing season; high grazing demand in autumn	Lowest grazing demand	Excellent grassland management required for spring grazing
Live weight performance	System incorporates a "store" period & average life time gain of ca. 0.9 kg/day	High live weight performance at all stages in the life cycle (ca. 1.3 kg/day)	System incorporates a "store" period & average life time gain of ca. 1.2 kg/day
Animal injury	Lowest risk of animal injury	Risk of animal injury during the indoor finishing period	Risk of animal injury, following turnout & rehousing
Farmer safety	Vigilance to animals required	Very high level of vigilance to bulls required at all times	Very high level of vigilance to bulls required at all times

Environmental sustainability

A key issue at present is the environmental sustainability of production systems particularly greenhouse gas emissions, more commonly known as the carbon footprint (Table 1). There are many different greenhouse gases generated in livestock systems each of which has a different global warming potential and, therefore, the potency of these different gases are measured in carbon dioxide equivalents (CO_2e). Results indicate that suckler beef systems generate approximately 10 kg of CO_2e per kg of beef live weight produced. The lowest carbon footprint was for the 19 month bull/20 month heifer system, thus highlighting the importance of both achieving high daily live weight gains and maximising performance from grazed grass. The 24 month steer/20 month heifer system and the weanling system had the highest carbon footprint.

Dairy calf-to-beef production systems

Robert Prendiville and Pearse Kelly
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Summary

- With the abolition of milk quotas in 2015, it is expected that there will be a greater number of dairy calves available for beef production.
- Dairy calf-to-beef production systems are sensitive to the price of calves, concentrates and finished beef.
- Pasture-based early-maturing dairy crossbred beef production systems can produce carcasses that have adequate weight and fat cover at slaughter. With their greater carcass production, late-maturing dairy-beef systems can deliver a high output per hectare.
- Utilising high quantities of pasture and achieving high output of animal product per hectare are fundamental to the profitability of the systems.

Introduction

With the forecasted expansion of Irish dairy cow numbers following the abolition of milk quotas in 2015, there will likely be a greater number of dairy-bred calves available for beef production. Since Ireland's competitive advantage in milk production is based on efficient utilisation of pasture, milk production will continue to be focused on seasonal spring-calving production systems. In 2012, approximately two-thirds of dairy cows were mated to dairy sires, 22% were bred to early-maturing breeds and the remainder were bred to late-maturing continental types and other breeds. Given the low value for male dairy breed calves this spring, the plentiful supply of replacement heifers on dairy farms and the adoption of sexed semen on some dairy farms, it is possible that there may be an increase in the proportion of dairy-beef crossbred calves. Nevertheless, there will be a plentiful supply of male dairy breed calves (mainly Holstein-Friesian) coming from the dairy herd. With current market trends, issues surrounding age at slaughter and target carcass weight, finding the most profitable beef production systems for these male dairy calves is a challenge for the industry. Irrespective of the production system, it is imperative that a market outlet, and the approximate sale price, is established from the outset.

A wide range of beef systems are possible for dairy calves reflecting differences in breed, gender and finishing age. A production system must be decided on before calves are purchased. This will ensure that the optimum stocking rate that utilises grazed grass, facilities and labour efficiently for that production system is selected. Care must also be taken when purchasing calves as overpriced calves can greatly reduce the profitability of the system.

Outline of male dairy calf-to-beef production systems

- **15 month bull system:** in this system early-born calves are turned out to pasture following weaning in April/May for the first grazing season and supplemented with concentrates. Animals are housed in late October/early November, remain indoors, and are finished on *ad-libitum* concentrates with a limited proportion of roughage or with excellent quality silage and concentrates. Bulls are slaughtered in May/June. A target carcass weight of 275 kg is required for bulls in this system with conformation scores of O=/O+ and fat scores 2=/2+. This system meets UK market requirements in that young bulls are slaughtered at less than 16 months of age.

- **19 month bull system:** management and performance for the first season at pasture is identical to that described for the 15 month system. However, calves are "stored" over the first winter on good quality grass silage and concentrates daily. In general, animals are turned out to pasture for 100 days in early March, housed in June and finished on concentrates *ad-libitum* over a 100 day period. Target carcass weight for this system is 320 kg.
- **21 month steer system**: for spring-born calves, indoor winter finishing can generally only be avoided by slaughtering cattle at a lighter carcass weight at the end of the second grazing season. Management is similar to the bull systems described previously, however calves are castrated towards the end of the first grazing season and are "stored" through the first winter on good quality grass silage and concentrates before turn-out for a second grazing season. Calves must have good life time performance and have an early birth date for this system. All breed types can be considered if their carcasses are commercially acceptable. Target carcass weight is 280 kg.
- **24 month steer system:** this is a commonly practiced system for Holstein-Friesian steers and targets are based on research carried out at Teagasc, Grange. Finishing occurs during the second winter and cattle are offered good quality grass silage and 5 to 6 kg concentrates. The target carcass weight is 320 kg.

Results from dairy calf-to-beef systems in Johnstown Castle

Calves in the 15 month bull production system typically gained 0.80 kg/d during the first season at pasture. At housing, calves were built up to *ad-libitum* concentrates over a three week period. They remained indoors on concentrates *ad-libitum* and were slaughtered in May/June. Total concentrate input during the finishing period was 1.8 tonnes/head. Average daily gain during the finishing period was 1.35 kg. Bulls finished in this production system achieved a carcass weight of 265 kg, which was lower than the target carcass weight. Carcass conformation were 'O= and '2=', respectively.

Bulls in the 19 month bull production system were pasture-grazed as calves, stored through the first winter and returned to pasture in early March for 100 days. They were then housed in June and finished on *ad-libitum* concentrates for 100 days. Concentrate input during the finishing period for bulls in this system was 1.2 tonnes/head and carcass weight was 320 kg. Conformation score was 'O=' with a fat class at slaughter of '2+'.

Steers in the 24 month system were slaughtered in spring with a concentrate input of 1 tonne/head. Carcass weight was 320 kg, with conformation score and fat class of O- and 3=, respectively. The earlier finished 21 month steers were slaughtered in November following a period of concentrate supplementation at pasture at the end of the second grazing season. Both steer systems utilise more grazed grass per head than bull production systems which reduces the costs of production. While the stocking rate potential is reduced when compared with a bull system the steer production systems are less vulnerable to an increase in concentrate price.

Table 1 shows the economics of the production systems described above. Assuming a calf price of €100, a base beef price (R3 steer) of €4.05 and a finishing concentrate price of €255, the 19 month bull production system was the most profitable on a gross margin per hectare basis, mainly due to the higher output per hectare and heavy carcass weight. Actual price payable depends on carcass grading, seasonality and eligibility for quality assurance bonus. However, it is important to note that with price discounts on bulls relative to steers, steer production systems become more profitable. The 15 month bull system has a very modest land requirement although it is important to bear in mind the organic nitrogen and slurry contribution of these cattle with regard to the stocking rate and slurry capacity limitations of the Nitrates Directive. This system was the least profitable on a per head basis. Gross margin per head for the steer production system ranged from €447 to €460. However, net margin per head was greater for the 21 month steer system. This is due to the large difference in capital costs for these systems. The 21 month system has no requirement for second winter housing in contrast to the 24 month steer system.

Table 1 — Performance targets and gross margins of male dairy calf to beef systems.

	Bulls		Steers	
Age at slaughter	15 months	19 months	21 months	24 months
Body weight (kg)				
Turnout	90	90	90	90
1st winter	240	240	240	240
Turnout (2nd season)	–	330	320	320
Live weight at start of finish	–	450	490	510
Live weight at slaughter	520	610	550	620
Beef price (€/kg)	4.12	3.66 (3.36[2])	3.81	3.87
Carcass weight (kg)	256	320	264	320
Net income[1] (€/hd)	974	1,092 (996)	927	1159
Variable costs (€)	739	691	480	700
Gross margin				
Per head (€)	235	401 (305)	447	460
Per hectare[3] (€)	–	1,403 (1,068)	1,341	1,150
Net margin				
Per head (€)	67	220 (124)	258	201
Per hectare (€)	–	770 (434)	774	503

Note: [1]Net income = sales – calf purchase price, [2]Beef price of €3.36 representing a reduction of 30 c/kg and [3]stocking rate of 200 kg organic N.

What are the appropriate systems for dairy-beef crossbred calves?

For beef producers early-maturing dairy beef crossbred animals have the potential to achieve a commercially acceptable level of carcass fatness at a young age and are, therefore, suitable for systems of production that aim to finish at the end of the second grazing season producing saleable carcasses at a relatively low slaughter weight. Previous research carried out in Grange evaluated the merits of late maturing dairy beef crossbred animals. Robust, breed-specific, blueprints were developed. Carcass conformation for late-maturing heifer production systems were predominately 'O=/ O+' with carcass fat classes of 3-/=. Conformation scores for late maturing steer production systems were 70% R and 30% O with fat scores of '3'.

Outline of dairy beef crossbred calf-to-beef production systems

- **19 month early-maturing heifer**: animals are at pasture for the first grazing season and are stored during the first winter on grass silage *ad-libitum* with limited concentrate supplementation. Heifers are slaughtered off pasture at the end of the second grazing season. Live weight at slaughter was 460 kg with a carcass weight of 235 kg.
- **21 month early-maturing steer**: animals are at pasture for the first grazing season and stored during the first winter on grass silage *ad-libitum* with limited amounts of concentrates. They are turned out to pasture for the second grazing season and slaughtered in November before the second housing. The target carcass weight in this system is 280 kg.
- **21 month late-maturing heifer**: is managed similarly to the 19 month early maturing heifer system. Heifers remain at pasture for an additional two months and are slaughtered in November at the end of the second grazing season. Live weight at slaughter is 520 kg with a target carcass weight of 270 kg.
- **24 month late-maturing steer**: this system is identical to the steer system described above for dairy steers. Finishing occurs during the second winter and cattle are offered good quality grass silage and 5 to 6 kg concentrates/head. The target carcass weight is 350 kg.

Table 2 — **Performance targets and gross margins of beef crossbred dairy calf-to-beef systems.**

	EM heifer[1]	EM steer	LM heifer	LM steer
Age at slaughter (months)	19	21	21	24
Body weight (kg)				
Turnout	90	90	90	90
1st winter	230	240	240	240
Turnout (2nd season)	300	320	320	330
Live weight at 2nd housing	–	–	–	520
Live weight at slaughter	460	530	520	640
Calf price (€)	200	240	280	310
Beef price (€/kg)	3.98	3.81	3.84	3.92
Carcass weight (kg)	235	280	270	350
Net income[2] (€/hd)	716	796	763	1046
Variable costs (€)	431	437	437	661
Gross margin				
Per head (€)	285 (344)[3]	359 (429)	326	385
Per hectare[4] (€)	998 (1,204)	1,077 (1287)	978	963
Net margin				
Per head (€)	140 (199)	257 (327)	223	126
Per hectare (€)	490 (697)	771 (981)	669	315

Note: [1]EM = early maturing and LM = late maturing, [2]Net income = sales – calf purchase price, [3]Gross and net margins from early maturing systems including producer group bonus and [4]stocking rate of 200 kg organic N.

Results from dairy beef crossbred production systems

Heifers in the 19 month production system were 462 kg at live weight at slaughter yielding a carcass of 234 kg. Carcass conformation for heifers in both production systems were predominately 'O=' with carcass fat classes of 3-/=. Steers slaughtered in the 21 month production system had a live weight and carcass weight of 533 kg and 277 kg, respectively. Carcass conformation for steers in both production systems were predominately 'O=/ O+' with carcass fat classes of 3-/=.

Table 2 shows the economics of the dairy beef crossbred production systems. Assuming the calf prices outlined in Table 2, a base beef price of €4.05 plus quality assurance bonus and a finishing concentrate price of €255, the steer production systems are more profitable than heifer systems on a per head basis. Aside from the 24 month late-maturing steer system, which was greater due to the indoor finishing period, variable costs were similar across the production systems. Gross margin per head was greater for steers compared to heifers. However, on a per hectare basis small differences were apparent between the systems. The early-maturing producer group bonuses greatly increased the profitability of the systems.

Conclusion

Various finishing systems can be employed on dairy calf-to-beef enterprises depending on the breed type, gender and production system. The success of the systems is based on achieving a high proportion of total life time gain from grazed grass. Profitability is vulnerable to increases in calf purchase price and concentrate input costs, as well as the selling price (incl. bonuses) of beef.

Exploiting genetics

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Summary

- Breeding is an integral component of profitable beef production systems.
- The €uro-star Replacement and Terminal Indexes are profit-based indexes which should be used to identify genetically elite animals.
- Result to date show that animals with 5-star ratings across a range of maternal traits consistently outperform animals with lower star ratings.
- Genomic selection is a new tool to help better predict the genetic merit of an animal at a younger age.
- The Gene Ireland maternal beef programme is helping to identify bulls with superior Replacement Index value, thereby accelerating genetic gain in the maternal characteristics of Irish suckler cows.

Introduction

Animal genetics is a powerful tool that aids farmers in identifying superior animals as the parents of the next generation. Genetics involves the transmission of favourable or unfavourable genes from one generation to the next. Therefore, genetics is permanent and cumulative, resulting in long-term change. On-going research in Grange, as well as close collaboration with industry partners such as the Irish Cattle Breeding Federation (ICBF), tools such as the €uro-star indexes, the Gene Ireland maternal breeding programme, genomic selection, etc., present farmers with the necessary information to identify the most profitable genetics for Irish grass-based systems.

€uro-star Indexes – a tool to identify elite animals

The ICBF beef €uro-star system was introduced to Ireland in 2007 and is calculated for each animal based on the results from the genetic evaluations. Individual animal performance records (such as calving surveys, weights, carcass data) and all ancestry records (i.e. sire and dam) are used to predict the genetic merit of each animal. Economic values are thereafter applied to these genetic evaluations to generate a combined index value. A comprehensive review of the €uro-star Suckler Beef Value index was undertaken in 2012 and, after consultation with industry, the decision was taken to split the Suckler Beef Index into two overall indexes (see Table 1):

1. **Replacement Index** for the identification of animals (sires and/or suckler female replacements) suitable for breeding and selecting high profit replacement females. This index includes maternal cow traits but also terminal traits to account for progeny of the dam that are destined for slaughter. A bull with a replacement index of €264 is expected to sire daughters that are, on average, €264 more profitable than the average Irish suckler cow.

2. **Terminal Index** for the identification of sires suitable for breeding high profit animals for slaughter. A bull with a terminal index of €148 is expected to sire cattle for the meat industry that are, on average, €148 more profitable than the average animal.

Table 1 — Relative weighting (%) and direction goal of the traits included in the Replacement and Terminal Indexes.

Replacement Index		
Trait	**Goal**	**Relative wt.**
Calving difficulty	Less	15%
Feed intake	Less	24%
Carcass wt. (for age)	More	26%
Maternal milk	More	13%
Female fertility	More	18%
Docility	More	4%

Terminal Index		
Trait	**Goal**	**Relative wt.**
Calving difficulty	Less	29%
Feed intake	Less	20%
Carcass wt. (for age)	More	32%
Conformation score	More	10%
Fat score	Less	6%
Docility	More	3%

As with all national breeding objectives, the €uro-star indexes are reviewed annually to ensure they are pertinent to future production systems. The most recent changes to the €uro-star indexes include genetic evaluation for calving traits with the addition of birth weight and early live-weights as predictors for calving performance.

Bull selection

Bull selection, irrespective of the breed, should be based on the €uro-star indexes. Prior to selecting a bull, the most suitable animal for the prevailing circumstances must be determined. For example, if farmers are interested in targeting the weanling or finishing markets then they should pay particular attention to the Terminal Index prior to purchasing a bull. On the other hand, farmers looking to breed or purchase replacements should focus on the Replacement Index. Irrespective of the type of animal that is needed, careful attention should be placed on both the star rating of the animal and the associated reliability. The greater the reliability the more information that is known about the animal and thereby the fluctuations in animal star ratings are reduced.

Genetic gain achieved to date

Figure 1 illustrates the annual rate of genetic gain for the Terminal and Replacement Indexes across the national herd; for comparison the genetic gain in the Dairy Economic Breeding Index (EBI) is also included in Figure 1. The graph shows that levels of genetic gain remain low for both the Terminal and Replacement Indexes in comparison of the gain achieved in the dairy industry. Since 2000, genetic gain in the Terminal Index has been increasing by approximately 6% per annum but this has occurred to the detriment of maternal traits in the national suckler herd. The increased terminality of Irish suckler cows has eroded profits in the beef sector and clearly highlights that genetic gain in terminal traits alone is not sustainable. The deterioration of the maternal characteristics in the suckler industry is similar to the decline in fertility that occurred in the dairy industry in the 1990s. However, since the introduction of a more balanced breeding goal (i.e. the EBI) that placed increased emphasis on cost of production traits (i.e. fertility), output in the dairy sector has increased but fertility has also increased. Therefore, the successful implementation of a balanced breeding goal has been applied to the beef sector and will aid in the acceleration of genetic gain in both the Replacement and Terminal Indexes.

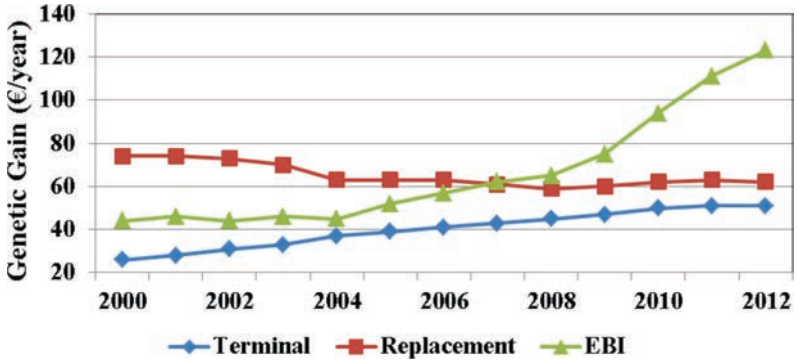

Figure 1 — Annual rate of genetic gain in the beef Terminal and Replacement Indexes, and EBI.

Do the genetic evaluations work for maternal traits?

To quantify the relevance and accuracy of Irish maternal genetic evaluations for improving fertility and milk yield in the national beef herd, ICBF sire breeding values for maternal traits were compared to performance on-farm. The results (Figure 2) clearly show that beef cows of higher star ratings for fertility had greater reproductive performance on-farm. Cows with a 5-star rating for maternal weaning weight (i.e. milk yield) produced weanlings that were 15 kg heavier. Similar results were obtained in the Derrypatrick Herd, where a difference of 8.2 kg in recorded daily milk yield was observed between cows with the highest and lowest star ratings for maternal weaning weight. Results for other key maternal traits has further highlighted the importance of genetic merit; relative to a cow with 5 stars for each of the maternal traits, 1-star cows were 40% more likely to have some level of calving difficulty, 7.4% more likely to have a dead calf and 3.2% less likely to survive to a subsequent calving. These results indicate that selection of breeding animals for favourable maternal genetic attributes will result in favourable improvements in performance and profitability on farms.

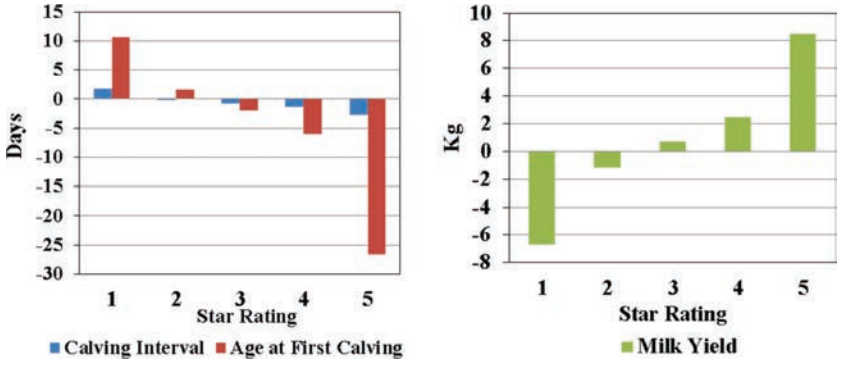

Figure 2 — Mean on-farm performance of cows differing in star ratings for calving interval, age at first calving (measured in days) and milk yield (measured in kg at weaning weight).

Increasing genetic gain using genomic selection

Key to the success of any breeding program is the ability to accurately identify the best (and worst) animals. The performance of any animal is a function of its genes and the management system to which it is exposed. Genes (made of DNA) remain the same throughout an animal's life, and are identical in every cell of the body. Therefore, knowledge of the DNA profile of a calf at birth and how the DNA profile affects performance, can facilitate a more accurate prediction of how the animal will perform. This process is called genomic selection and has been operational in Ireland since 2009. Retrospective analysis shows it is up to 30% more accurate than traditional genetic evaluations and has massively increased the genetic gain in dairying. The potential now exists to implement genomic selection in beef, thereby increasing the accuracy and reducing the fluctuations in bull proofs overtime.

The beef genomics scheme (BGS) is an initiative launched by the Irish Department of Agriculture, Food and the Marine to generate DNA information on a very large population of beef cows for inclusion in a genomic selection breeding program. Currently, an animal's €uro-Star index at birth is based solely on the information of the sire and dam and the reliability is approximately 20%. Although at the early stages of research, the reliability is expected to at least double with genomic selection. The reliability of the genetic evaluations of Irish dairy bulls has almost doubled with the introduction of genomic selection and has instilled greater farmer confidence in the genetic evaluations, thereby increasing uptake.

Beef G€N€ Ireland 'Maternal Progeny Test' programme

Having an index to genetically rank animals is futile without having a constant supply of high index sires from different breeds being generated and available for AI. The Gene Ireland 'Maternal Progeny Test' programme was designed to help consistently deliver measurable genetic gain in beef breeding and reverse the decline in maternal traits in the national suckler herd. The programme is run by ICBF in conjunction with the Irish beef breed societies from 11 participating breeds and partner AI companies. A breed committee has been formed for each breed to identify high replacement index bulls within their respective breeds that will enter a comprehensive progeny testing in commercial herds. Once identified, the genetically superior young bulls are then purchased by Gene Ireland and placed in an AI stud where one thousand doses of semen are collected from each bull. A total of 500 doses will be used in commercial herds for progeny testing. Following successful progeny testing of the bulls, the remaining 500 doses from the most successful bulls will be used on pedigree cows to generate the genetically elite test sires and stock bulls for the national herd.

Conclusion

Genetic evaluations remain an important tool for beef farmers to make more informed breeding decisions for increasing farm profitability. Teagasc will continue to work closely with the industry to further enhance beef breeding and ensure that the benefits are clearly realised at farm level.

High performance from pasture

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Summary

- Profitable beef production is based on the provision of sufficient quantities of high quality pasture to produce quality beef at a reduced cost.
- Increasing grass utilisation, farm stocking rate and the number of grazing's achieved on the farm are the main drivers of increased grazing efficiency.
- The target on all farms should be to have priority stock graze grass as soon as weather conditions allow in spring.
- Mid-season management should focus on offering high quality leafy swards which can sustain high grass dry matter (DM) intakes and animal performance.
- High animal and sward performance can only be achieved with the use of regular measurement and adoption of key grazing technologies such as the spring rotation planner, grass wedge and autumn grass budget.
- Successful grazing management is based on having a flexible approach.

Introduction

Irish farmers have an important competitive advantage in producing beef over many of their European counterparts. On average, the cost of producing 1 kg of live weight from grass is 80-85% less when compared to an intensive concentrate-based system. In Ireland, when a calf is weaned from the cow, there is potential to deliver 80% of its live weight gain from weaning-to-slaughter from grazed grass.

Improving grass utilisation is a key driver of farm profitability. Management of grass and the achievement of high animal performance can be broken down into key management steps. In the past number of years a number of key grassland technologies have been developed. There are huge opportunities for beef farmers to achieve better performance from grass but, to achieve this, these key grassland technologies need to be used.

Can the potential of grass be harnessed in beef systems?

In Ireland, beef farms are lowly stocked. With low stocking rate, grass tends to be underutilised and there is not sufficient stock on farms to capitalise on the feed that could be produced. Within the latest profit monitor analysis, the top third eProfit Monitor cattle farms are stocked at 1.9 livestock units (LU)/ha, with the bottom third stocked at 1.3 LU/ha. Liveweight output/ha was 682 kg versus 318 kg for the top and bottom thirds, however gross output value was €1407/ha for the top third compared to €616/ha for the bottom third. The corresponding variable costs were €114 higher (€603/ha) for the top compared to the bottom third of farms. The most striking figure was the net profit (excluding premia) which was €305/ha for the top third of farms, €611/ha higher than that of the bottom third of farms (who were in a loss making scenario). It is clear that increasing stocking rate (carrying more saleable stock) on beef farms can return higher profits to the system.

Grassland measurement is a key aspect of improving grazing management on all farms. Pasturebase Ireland, the national grassland database, is now capturing grass production data from dairy, beef and sheep farms. Table 1 shows the DM production from 12 beef farms across the country in 2013. Mean grass DM production was 10.1 t DM/ha (range 13.0 to 7.3 t DM/ha), with 8.2 t grass DM produced for grazing (81% of total growth) and 1.8 t DM produced for grass silage (19% of total growth). On average the number of grazings achieved

across farms was 4.6, which equates to a mean pre-grazing yielded of 1782 kg DM/ha across the season. In 2013, there were a number of challenges with an especially poor period of growth in the spring; the grass production performance on the farms presented was relatively good. Overall, grass DM production on beef farms in 2013 was 17% less than that of the dairy farms recorded in PastureBaseIreland.

Table 1 — Grass production (t DM/ha) from 12 drystock farms in PastureBaseIreland in 2013.

Farm location	Average DM production	Grazing DM production	Silage DM production	Number of grazings*
Cork	11.3	8.9	2.5	6 (9)
Wexford	12.2	9.9	2.3	5 (7)
Wicklow	10.0	8.2	1.8	7 (9)
Limerick	13.0	10.4	2.6	4 (7)
Tipperary	11.5	10.3	1.2	5 (7)
Wexford	7.9	6.9	1.0	3 (4)
Wexford	7.3	6.08	1.3	4 (6)
Galway	11.5	9.7	1.8	5 (7)
Galway	12.4	10.4	2.0	5 (7)
Kilkenny	7.5	6.3	1.2	4 (6)
Longford	8.2	6.2	2.0	4 (6)
Waterford	7.4	5.4	2.0	4 (6)
Average	**10.1**	**8.2**	**1.8**	**4.6**

*Maximum number of grazing per paddock in brackets

Increasing spring grass utilisation

There are two clear focuses with spring grazing, displace silage and concentrate from the animals diet and set up the farm for subsequent grazing rotations. Turning animals out to grass early can substantially reduce the overall concentrate and grass silage inputs in the feed budget. During the early grazing season (February – April) a balance must be found between feeding animals adequately to sustain high animal performance and conditioning the sward for the late spring/summer grazing season. Generally on beef farms this can be easily done as priority stock can be given preference for earlier turnout.

With spring grazing, farmers must adopt a flexible attitude. For example, animals may have to be rehoused for certain periods (due to poor ground conditions etc.). However, this should not be seen as a failure. The most successful grazing managers are those who can react in time to the challenges that they meet during the grazing season.

A recent spring grazing study at Grange compared the effect of early turnout of spring-calved first-calving suckler cows and their calves to retaining a comparative group indoors. The study took place from March 1 to March 29. Table 2 shows that a number of performance increases were observed for full time grazing – milk yield per cow grazing increased by 24%, average daily gain (ADG) of the calves was increased by 29%, and increased by 7% overall to weaning. The key opportunity afforded by earlier spring grazing was a saving of **€1.54/cow/day** in feed costs and higher milk yield. The reduced requirement for slurry storage is not factored into this cost saving, but it is substantial, as

one is not accumulating slurry nor is there the need to spread it. Such efficiency, driven by a simple management practice and use of the spring rotation planner, could be a key driver to increased production potential across beef farms.

Key technology: Spring rotation planner – every extra day at pasture – €1.54/cow/day

Table 2 — Effect of indoor feeding compared to full time grazing in spring (1-29 March) on intake and performance of first-calving cows, and the weight gain of their calves.

	Indoors full time	Grazing fulltime	Difference
Dry matter intake (kg/day)			
Grass	0	9.9	
Silage	9.2	0	
Concentrate	1.6	0	
Cow milk yield (kg/day)	7.0	8.7	+24%
Calf (average daily liveweight gain)			
During experiment (kg)	0.83	1.07	+29%
To weaning (kg)	1.06	1.13	+7%

Source: Gould et al. (2011).

Mid season grazing management

The key during the grazing season is to maintain grass quality while offering the target herbage allowance. Aim to have cattle graze grass covers of 1300-1700 kg DM/ha while maintaining a rotation length of between 17-21 days. This helps the pursuit of increased grass quality in the May to July period. During this period the farm needs to be walked weekly and necessary changes made promptly. During mid-summer when grass starts to head-out it produces a reproductive stem. This changes the balance of the plant from producing green leaf to producing high stem proportions. Green leaf content is directly related to grass digestibility. A 5.5% change in leaf content is equal to a one percentage unit change in digestibility. Poorly managed swards can result in large reductions in green leaf content during the reproductive period.

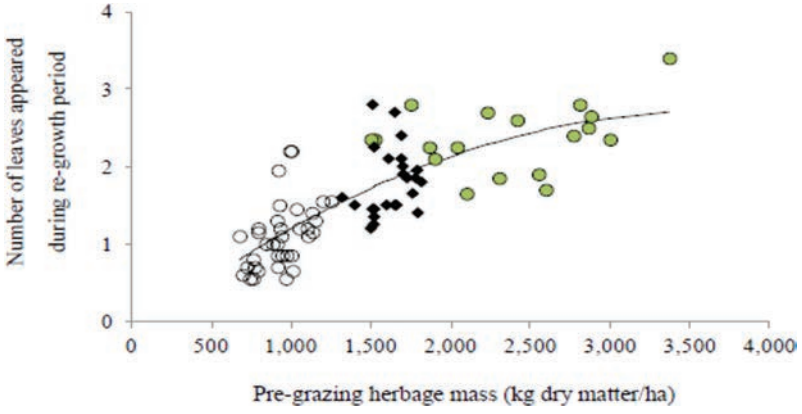

Figure 1 — Pre grazing herbage mass (kg DM/ha) and leaves appearing per tiller during the regrowth period that were grazed at low (○), medium (◆) and high (●) pre-grazing herbage masses over a 24 week period.

Achieving three leaves on perennial ryegrass tillers is desirable to ensure canopy closure which stimulates high rates of growth (Figure 1). Swards grazed at the medium and high leaf herbage mass both had up to 3 leaves per tiller available at grazing time, while the low mass sward had only 1.5 to 2 leaves per tiller. The recommendation is to target pre-grazing yields of 1300 – 1700 kg DM/ha during the mid-season period (April to late August). When pre-grazing yield increases above this the paddock or paddocks should be harvested for round bale silage or closed for a main cut of silage.

Well-grazed swards (4.0 – 4.5 cm post grazing sward height) will contain a high proportion of leaf in the mid grazing horizon (4 to 10 cm). This is the grazing horizon which has greatest influence on the grass DM intake achieved by the beef animal. Beef farmers must adopt a policy of offering swards with high leaf content throughout the season and ensuring these swards are grazed to the correct height. Pasture topping can be completely eliminated from the farm when a focus is made to targeting 1300-1700 kg DM/ha across the mid-season period.

Key technology: Use the grass wedge –Target 1kg average daily liveweight gain

Autumn grazing management

The clear focus of autumn grazing management is to increase days-at-grass and increase animal performance as was achieved on many farms in autumn 2013, but also to set the farm up on the final rotation to grow grass over winter and provide grass the following spring. There are two key periods in autumn: (i) the period of autumn grass build up and (ii) managing the final rotation. Generally rotation length should be extended from August 10. The aim during this period is to gradually build pre-grazing herbage mass, targeting covers of 2000-2300 kg DM/ha in mid-September. Pre-grazing covers >2500 kg DM/ha are difficult to utilise and should be harvested as surplus (round bales before September). Removing paddocks after the first week of September should be avoided if possible. Such paddocks have only one rotation left for grazing at that stage, removing these paddocks in September is too late. Such paddocks do not have enough time to regrow to make any meaningful contribution in the last rotation. Such decisions can be easily made if the farm cover targets are achieved at the right time, many farmers fall into the trap of building cover too late and are pushed into harvesting excess grass in September.

Key technology: Use autumn grass budget – target 60% of farm to be closed by 7th November

Summary

The beef industry has currently low grazing stocking rates and has huge potential to deliver substantial increases in grass utilisation A stronger focus on increasing grass utilisation throughout the grazing season will need to take place on beef farms. The key periods to increase grass utilisation are in early spring and late autumn. The widespread adoption of best practise grassland and grazing management techniques will be required to increase efficiency on beef farms.

Achieving a 365-day calving interval in beef cows

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Summary
Reproductive efficiency is key to the biological and economic sustainability of suckled beef enterprises and is influenced by four main factors:
- Puberty and age at first calving.
- Duration of the post-calving anoestrous interval which is largely influenced by cow-calf bonding and pre-calving nutrition.
- Heat detection efficiency where AI is used.
- Bull fertility in herds using natural service herds.

Introduction
Reproductive efficiency is a major factor determining production and ultimately the profitability of beef cow enterprises. In Ireland there is evidence that less than 10% of heifers first calve at 24 months of age, the calving-to-calving interval is frequently in excess of 400 days and less than 25% of cows produce a calf within a 12-month period.

Targets for a beef herd
The following are the reproduction and production targets for a beef suckler cow herd: 1) 365 d calving-to-calving interval; 2) <5% cows culled annually as barren; 3) >95% of cows calving to wean a calf; 4) heifers calving at 24 months of age; 5) compact calving with 80% of cows calved in 42 days; 6) replacement rate 16-18%; 7) sustained genetic improvement of the cow herd for economically important traits relating to reproduction, calving ability and calf weaning weight; and 8) close alignment of calving date with onset of pasture availability in the spring. There are four key benchmarks that must be achieved in a timely fashion in order to meet the above targets. These are:
1) Occurrence and timing of puberty and breeding of replacement heifers.
2) Resumption of oestrous cycles post calving.
3) Expression and detection of oestrus.
4) Breeding and the establishment of pregnancy.

1. Occurrence and timing of puberty and breeding of replacement heifers
Replacement heifers represent the next generation of cows in a herd and ideally each year's cohort of heifers should be genetically superior to their predecessors. Significant costs are incurred during the rearing of replacement heifers and it is imperative that they become pregnant early in their first breeding season, encounter minimal dystocia, are successfully rebred to calve again within 365 days and ultimately have long (>8 lactations) and productive lives within the herd. Delaying first calving to 3 years of age significantly increases costs. Therefore, the target should be calving at 2 years of age. Beef heifers that conceive early during their initial breeding season and calve as 2-year-old females have a greater probability of becoming pregnant as first calving cows, have greater lifetime

production (calf weaning weights), and tended to calve earlier in subsequent years compared with heifers that conceived later in their first breeding season. Hence, age at which puberty occurs (defined as the developmental stage that supports normal oestrous cycles combined with the ability to become pregnant) will impact on the time of conception in the first breeding season and ultimately, lifetime productivity. Additionally, conception rates are typically lower at the pubertal compared with subsequent heats.

Factors affecting puberty in heifers: Crossbred heifers typically reach puberty up to 6 weeks earlier than the average of their parental breeds. Larger European continental breeds of cattle are older at puberty than traditional early-maturing beef breeds or dairy breeds. Breeds historically selected for milk production such as the Simmental reach puberty at a significantly younger age than breeds such as the Charolais and Limousin. Replacement heifers should reach circa 0.65 of mature body weight at the start of the breeding period in order to conceive early in the breeding season with a target of 60-70% pregnant after 3 weeks of the breeding season. Target weights for some breed types are presented in Table 1.

Breeding of heifers: It is frequently suggested that heifers should be bred up to one month in advance of the cow herd, allowing these young animals more time to recover between first calving and second breeding. While this in theory is commendable, it does extend the calving season and requires that heifers have reached puberty at approximately 12.5 months and are undergoing regular ovarian cyclicity at 13-14 months of age, where the objective is first calving at 24 months. The attainment of a target 65% of their expected mature bodyweight at 14 months of age may be too difficult or costly to achieve particularly with late-maturing breed types. An alternative strategy might be to commence the breeding of replacement heifers coincident with the breeding of mature cows and use hormonal regimens to advance breeding dates and to restrict the breeding period for heifers to 6 weeks.

Table 1 — Recommended target weight at 14 months of age for heifers of some of the common beef breed crosses.

Breed	Target weight at 14 months of age
Aberdeen Angus X	370
Hereford X	370
Shorthorn X	370
Simmental X	400
Limousin X	420
Charolais X	430

2. Resumption of oestrous cycles post calving

Beef cows are on average much longer calved when they resume oestrous cycles than dairy cows. Studies at Teagasc recorded average calving to first ovulation intervals of 50-55 days in beef cows, which is almost twice as long as the interval for dairy cows. For first-calving beef cows (heifers) this interval is usually 10-15 days longer than mature cows.

Cow-calf bonding: The predominant reason for this long anoestrous interval is the strong maternal-offspring bond that exists between the dam and her calf. This bond is predominately affected through sight and smell. Teagasc studies have shown the "cow-calf bonding effect" is further compounded by having beef cows in a low body condition score (BCS) at calving. The effects of low BCS at calving are only partially reversed by

putting cows on a high plane of nutrition after calving. The combined effects of long gestation lengths and long post-partum anoestrous intervals leaves a very short interval to ensure the achievement of a 365-day calving interval and 95% of cows successfully bred. For herd owners planning to use calf separation the following is recommended:

Commence calf separation and twice daily suckling at day 30 post calving and continue for 2 weeks. Ideally keep the calves and cows 50 metres apart. Between 85-90% of cows will exhibit fertile heat within 18-22 days. About 10-15% of cows fail to ovulate in response to calf separation (nutritional anoestrus). It is unlikely that these cows will respond to synchronisation until such time as their BCS has improved. Calf separation is particularly applicable to late calving cows and first-calvers. However, it does entail some additional labour.

Role of nutrition: From the published literature it is clear that 1) prepartum nutrition is more important than postpartum nutrition in determining the duration of postpartum anoestrus; 2) energy is the primary nutrient regulating reproduction in female beef cattle and inadequate dietary energy during late pregnancy lowers fertility even when dietary energy is adequate during lactation; and 3) a BCS of 2.5-3.0 (scale 0-5) will ensure that body reserves are adequate for postpartum reproduction. The reported effects of increased nutrient intake after calving on duration of the postpartum anoestrous interval are inconsistent. However, there is evidence that thin cows at calving and particularly first-calvers and young cows respond to increased postpartum nutrient intake with enhanced reproductive performance although reproductive performance may still be less than adequate. It may well be that a certain level of body fatness may be a prerequisite for occurrence of puberty and resumption of postpartum oestrous cyclicity.

Use of body condition scoring: Body condition scoring has been frequently advocated as a practical tool for the nutritional management of beef cows. From the foregoing and from published literature it is clear that the critical time to achieve a minimum target BCS is at calving. The recommended BCS at calving for mature cows and first and second calving cows are score 2.5 and 3.0 on a scale of 0-5, respectively. The somewhat higher BCS is warranted for younger cows and heifers because, after calving, they have an additional feed requirement for growth.

3. Expression and detection of oestrus

To be detected in standing heat a cow must engage the attention of a herd mate willing to mount her. Numerous factors affect the expression of heat, the more important of which are briefly discussed.

Floor surface: Cows dislike being mounted while standing on concrete and have a preference for softer underfoot surfaces such as grass, earth or straw bedded yards. Mounting activity is reduced by almost 50% when cows are on concrete as opposed to softer underfoot conditions while the duration of oestrous activity is reduced by about 25%. Cows distinctly dislike being mounted by herd mates if the floor surface is either slippery or very coarse.

Status of herd mates: The number of cows in heat simultaneously has a major impact on overall heat activity and on the average number of mounts per cow. The number of mounts per cow increases with the number of cows that are in heat simultaneously (up to about 3-4 cows in heat). In smaller and even in larger herds as more cows become pregnant, the likelihood of more than one cow being on heat on any given day is less, thus making heat detection more difficult.

Understanding the signs of heat: Standing to be mounted by herd mates or by a bull is the primary sign of heat and is the most definite and accurate sign that a cow is in heat.

Because standing heat may not always be observed, stockmen must frequently use other signs (secondary signs) of heat in arriving at a decision as to whether or not to inseminate a cow. These secondary signs of heat may indicate that a cow is coming in heat, in which case closer attention should be given to her over the following 48 hours, or they may be indicative of a recent heat in which case she should be given close attention 17-20 days later. Indicators to look for are: vaginal discharge of clear mucus, mounting other cows, restlessness, swelling and reddening of vulva, hair loss and dirt marks. Blood stains on the tail or vulval area (metoestrous bleeding) are normal and indicative of a recent heat.

Use an aid to improve heat detection

Vasectomised bulls with chin-ball marking harness: Active vasectomised teaser or detector bulls are useful in identifying cows either coming into or on heat. Vasectomy should be carried out 40-60 days prior to introduction to the herd. The cost of the vasectomy varies from €90-120 per bull. Many herds are now finding that teaser bulls are particularly useful after the first 3 weeks of the breeding season when fewer cows are in heat each day and when the level of heat-related activity in the herd is reduced as more cows become pregnant.

Heat detection patches: Recently a number of "scratch card-type" patches have come on the market. These are affixed to the cow's tail head. Friction from mounting activity rubs off the silver coating to reveal a bright colored patch underneath. These devises, when properly applied, are very useful as an aid to heat detection. They cost between €1.00 and €1.50 per patch.

Checking cows: The use of either a teaser bull or a heat detection patch will increase the detection rate and also reduce the duration and the number of observation periods from 3 times daily to twice daily that cows need to be checked. When one of the above aids is used cows should be observed at least twice daily- early morning and late evening, otherwise cows should be checked 3-times daily. Spend a minimum of 20-30 minutes observing them during each observation period. Disturb the cows and carefully check and record cows that are sliming or exhibiting any signs of restlessness as these are important secondary or indicator signs of an imminent heat. Early morning and late evening are critical times to check cows.

Importance of commitment: Where AI is the chosen method of breeding, farmers must be committed to heat detection, at least twice daily (early morning and late evening), for each day of the breeding season. In order to reduce the work time involved it is highly recommended that one of the aids described above is used.

4. Breeding and the establishment of pregnancy

In beef cows, unlike dairy cows, there is no substantial evidence of a decline in conception rate and typical conception rates of 60-70% are achievable to either AI or natural service, unless there are problems with semen quality, AI technique or bull fertility. Conception rates reach a normal level in cows bred at 60 or more days after calving. However, when cows are bred at 40 days or less after calving conception rate is usually <40% but it is still advisable to breed such cows once breeding has commenced. What's more, post-calving conception rates are often lower for first-calvers compared to mature cows, which is a reflection of the increased nutritional demands of the young cow for growth in addition to maintenance and lactation requirements. Fertility is highest following A.I. at 12-18 hours after heat onset but is not greatly reduced following early insemination. However, late insemination, at 24 hours or later, after onset of standing heat, should be avoided.

A healthy herd

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Summary

- Next time your veterinary practitioner is out ask him/her about a Herd Health Plan for the whole year, not just for the problem to hand.
- A Herd Health Plan details the practices you put in place to prevent diseases coming into your farm and stopping disease spread within your farm.
- The most critical component of this plan will be to ensure good calf and weanling health.
- Healthy calves and weanlings result from the nutrition of the pregnant cow, calving management, newborn calf care and scour, pneumonia and parasite control.
- Effective biosecurity systems can keep diseases out of your herd and prevent the re-introduction of infection once you have eradicated them.
- The most economical way to keep disease and production losses low is prevention rather than treatment.

Introduction

The objective of a well-designed herd health programme is to address multiple areas of management in order to reduce the likelihood of disease outbreaks occurring in calves and adult animals, and is a necessary step if sustainable economic returns are to be realised. Biosecurity is the attempt to keep infectious agents away from a herd, and to control the spread of infectious agents within a herd. A successful herd health programme for a specific herd must be re-examined on a regular basis, both to adjust for changes in herd management and to incorporate new information.

Calf health – prevention of disease

To ensure a healthy calf, the aim is to minimise the calf's exposure to disease, and maximise its defence against disease. In minimising a calf's exposure to disease, providing a clean, disease-free environment is fundamental. This involves:

1. Thorough cleaning and disinfection, before and during the calving season, of all areas used by calves.
2. Providing a clean, straw-bedded lying area with no draughts and good ventilation.
3. Accommodating cows and calves in batches based on order of calving so that young calves are never mixed with or accommodated in areas used by older calves.
4. Avoiding introduction of disease from sources such as purchased calves. Isolate all purchased animals from young home-bred calves.

In maximising a calf's defence against disease, control measures include:

✓ Adequate nutrition of the pregnant cow, including feeding a suitable mineral supplement pre-calving.
✓ Vaccination of cows for control of any organism(s) known to be responsible for infection in calves on the farm e.g. *E. coli*, rotavirus and coronavirus. In this respect, vaccination

alone is not a replacement for good management, good hygiene or good biosecurity. A veterinary practitioner should always be consulted with regard to specific health problems.

- ✓ Disinfecting the calf's navel immediately after birth.
- ✓ Ensuring that each calf receives sufficient colostrum (first milk) immediately after calving. Adequate intake of quality colostrum is one of the most important factors in ensuring survival and health of the calf. For suckler beef calves, research at Teagasc Grange has shown that feeding the calf 5% of its birthweight (e.g. ~2 litres of colostrum for a 40 kg calf) within 1 hour of birth, with subsequent suckling of the dam 6 to 8 hours later, ensures adequate passive immunity. Colostrum provides not only food but also maternal antibodies to protect the young calf against the common infections that it is likely to encounter in early life.
- ✓ Regular temperature checking is useful to guide both diagnosis and observation of a clinical problem.

Use the following as a general guide in a health check – these are important characteristics of healthy calves:

Body temperature:	38.5 to 39.5°C
Pulse:	72 to 92, strong and regular
Breathing:	Calm, regular, even. Respiratory rate: 20 to 40 per minute
Elasticity of the skin:	Raised skin fold levels out again within 1 to 2 seconds.

Calf scours

Scours are the main cause of calf mortality. The majority of calf scours are caused by viruses such as rotavirus and coronavirus, bacteria such as *E. coli* and *salmonella*, and protozoa, such as cryptosporidia and coccidia. As outlined below, vaccination of the dam will help reduce the probability of calf scours but cannot solely be depended upon for prevention. Furthermore, there is no vaccine available to combat cryptosporidium. However, good hygiene and management practices reduce the likelihood of infection from cryptosporidium.

Pneumonia in calves

The underlying cause of pneumonia or bovine respiratory disease (BRD) is extremely complex with the involvement of viruses, bacteria and mycoplasma. The incidence of infection is usually high, but the mortality rate is variable. The main viruses that cause outbreaks of pneumonia in calves are infective bovine rhinotracheitis (IBR), respiratory syncytial virus (RSV), parainfluenza-3 virus (PI-3 virus), and bovine virus diarrhoea/mucosal disease (BVD/MD virus). These also occur in older cattle. Factors associated with susceptibility to pneumonia are stress (disbudding, castration, weaning), overcrowding, inadequate ventilation, draughts, fluctuating temperatures, poor nutrition and/or concurrent disease. In most cases the main infective agent is a virus, which causes respiratory tract damage. This effect is worsened by mycoplasmas and secondary bacterial infections (e.g. *Mannheimia (Pasteurella) haemolytica*). Viruses and mycoplasmas are unaffected by antibiotics, however, antibiotic treatment is usually administered to kill off the secondary bacterial infections and offer the calf the opportunity to fight the disease.

In order to direct the appropriate treatment strategy, nasal swabs should be submitted to the Regional Veterinary Laboratory for accurate identification of the pathogen(s) involved. Calves should be vaccinated where specific problems arise. Veterinary advice should be sought and the widest protection against pneumonia will be achieved where a vaccination programme includes the three most common respiratory viruses (IBR, RSV and PI-3) and the bacterial pathogen *Mannheimia (Pasteurella) haemolytica*.

Management of the weanling

In suckler herds, calves generally remain with the cows at pasture until they are weaned, usually between 5 and 9 months old. In addition to removal from the cow, the weaning procedure may be compounded by other stressors occurring around the same time, e.g. change of diet (grass and milk to conserved feed with or without concentrates), change of environment (outdoors to indoors), and transport/marketing. Weaning therefore can be a multi-factorial stressor in which nutritional, social, physical, and psychological stresses are combined. Psychological stress is present in the form of maternal separation and social disruption, whereas physical and nutritional stressors are often present through the introduction and adaptation to a novel diet and novel environment. Reducing the cumulative effect of multiple stressors around weaning time results in a less marked stress response in the calf. For example, research at Teagasc Grange, has shown that compared with the more traditional practice of weaning and housing at the same time, delaying housing of calves post-weaning reduces the magnitude of the stress response. Similarly, experimental data from Grange has shown that, calves supplemented with concentrate prior to weaning had a lesser reduction in some immune cells (i.e. gamma delta T lymphocytes), started consuming meal faster when housed indoors and spent more time lying down (rather than standing and walking) post-weaning compared with non-supplemented calves.

Weanling health

A good herd health programme should be designed to prevent major disease, and it is important to consult with a veterinary practitioner prior to weaning to discuss the prevalent diseases and associated risks specific to the farm. Internal parasites (stomach worms, hoose and fluke) and respiratory disease are the two main health concerns that affect weanlings.

- To ensure a healthy weanling, the aim is to minimise their exposure to disease, and maximise their defence against disease.
- Minimising a calf's exposure to disease, may be achieved through the use of a closed herd, screened replacements and positive herd immunity.
- Good housing conditions (e.g. adequate ventilation) and good stockpersonship also play a key role in preventing respiratory disease.
- Outbreaks of pneumonia amongst weanlings are thought to be highly associated with situations where the immune system is suppressed. These risk factors include the stresses associated with weaning, as described above, and should be minimised where possible. Nutrient deficiency can significantly suppress the immune system, resulting in a poor response to vaccination, as well as resulting in calves that are unable to fight off infections. Furthermore, adequate nutrition minimises the long-term negative effects of disease and permits a more rapid recovery.
- A disease prevention programme for pneumonia usually involves vaccination. Viral specific vaccines are available but their effectiveness is dependent on management procedures and timing of administration. Depending on the causative agent (virus) and product, the vaccine should be administered prior to weaning, bearing in mind that some products require a booster dose. A vaccination programme should include vaccines to protect against the specific respiratory diseases on the farm. Where possible, do not mix calves from different sources until after the vaccinations have had time to produce immunity (2 to 3 weeks).
- Work in close association with a veterinary practitioner. Collection of nasal mucous samples or swabs for laboratory diagnosis will direct the selection of the appropriate vaccine and/or antibiotic treatment.
- Regular temperature checking is also useful for monitoring clinical problems.

In summary, a programme for minimising the negative effects of disease in newly weaned calves includes: reduced exposure to disease, minimal stress, adequate nutrition, parasite control, and timely and appropriate vaccination and/or treatment of animals.

Vaccination

- ✓ Take veterinary advice on viral vaccination strategy. Strategies should be based on the viral spectrum present on any particular farm which may change from year to year.
- ✓ Vaccination strategy should be based on a cost-benefit analysis reflecting predicted morbidity and mortality rates.
- ✓ Vaccines may not prevent disease and the usefulness of certain vaccines is adversely affected by the presence of residual maternal colostrum-derived antibodies at up to 10 weeks of age.
- ✓ Highly effective intra-nasal vaccines which induce a rapid immunity can be used in the face of an outbreak of IBR. Vaccines containing IBR virus are advisable where weaned calves have passed through a mart.
- ✓ To achieve full protection against RSV virus by housing, vaccination of autumn-purchased calves must commence at least six weeks prior to the housing date.
- ✓ Vaccines requiring priming doses must be given sufficiently ahead of the second dose for the second dose to stimulate adequate immune protection. Failure to follow the administration instructions in this regard is a common error that markedly reduces vaccine efficacy.

Stomach worms, lung worms (hoose) and fluke

The two most important species of parasitic roundworms for grazing cattle are stomach worms (Ostertagia), which cause scouring, and lung worm (Dictyocaulus), which causes parasitic pneumonia (hoose). Both species overwinter on pasture and, therefore, can affect calves shortly after turnout. Animals affected with hoose have difficulty in breathing, develop a characteristic deep, husking cough and lose condition extremely fast. It is necessary to dose young calves with anthelmintics in their first summer at grass and again at the end of the grazing season – the specific timing of the treatment depends on the product used. Cows and yearling cattle that have previously been exposed to a low level of parasitic challenge can develop an effective immunity, but some treatment may be required.

Liver fluke disease (Fasciolosis) is a common parasitic disease caused by *Fasciola hepatica*. The disease manifests itself mainly in acute or chronic forms. During wet summer conditions, grazing cattle ingest the intermediate stages of the fluke from contaminated pasture with invasion of the liver causing disease during the winter months. The major presenting clinical findings are persistent diarrhoea and chronic weight loss with resultant poor thrive. A control programme should include a flukicide treatment.

The need for herd health planning

'Proactive not reactive' should be the mantra going forward regarding herd health. In the future, strategies of prevention through herd health planning need to become the norm and accepted practise among veterinary practitioners and farmers.

Work closely with your veterinary practitioner to assess and prioritise the health risks on your farm. Plan the control measures that need to be put in place. Record and review the health status of your herd on an on-going basis. Herd health planning will boost your efficiency, output and profitability. Remember prevention really is better than cure!


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Technology Village:

Teagasc / Irish Farmers Journal BETTER farm beef programme – building a BETTER future

A TEAGASC/IRISH FARMERS JOURNAL INITIATIVE, SUPPORTED BY INDUSTRY SPONSORS:
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BETTER financial progress – improving the bottom line

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Summary

- The Teagasc/Irish Farmers Journal BETTER farm beef programme commenced in 2009 with 16 participants and increased to 34 participants in 2012.
- It is a joint industry initiative between Teagasc and the Irish Farmers Journal with key stakeholder support from ABP, Kepak, Dawn Meats and FBD.
- The participating farms are situated throughout the country on a range of soil types, size of farm and type of beef system (suckler-to-weanling, suckler-to-store, suckler-to-bull beef, suckler-to-steer beef and trading systems).
- The programme focuses on 4 main areas: output from the farm, grassland management, breeding efficiency and animal health.
- A requirement of participation in the programme is that a Teagasc e-Profit Monitor is completed in each year of the programme.
- In 2013, the average gross margin on the 34 participating farms was €565/ha. This represented a 17% drop when compared to the 2012 gross margin of €669/ha.
- Farmers in bull beef systems had the highest gross margin of €795/ha in 2013.
- Farmers in weanling and store systems took the biggest financial hit in 2013 when compared to 2012, a drop in gross margin of €196/ha or 31%.

Introduction

The Teagasc/Irish Farmers Journal BETTER farm programme commenced in 2009 with 16 participants and this increased to 34 participants at the commencement of Phase 2 of the programme in July 2012. Results from Phase 1 demonstrated that technology at farm level can have a positive effect on farm profits. The programme concentrated on 4 main areas: output, grassland management, breeding and genetics, and animal health.

Addressing low output on Irish beef farms

At the start of the programme, a plan was developed to enable each farm generate more output during the following three years. The plans were tailored for each individual farm, focussing on areas where improvement was identified as needed. Reports such as the Teagasc e-Profit Monitor, ICBF Herdplus and animal weighings were used in formulating the three-year farm plan. On many of the farms low output was identified as a critical limitation – if sufficient quantity of beef is not sold off a farm then the revenue and income will be low. Each plan addressed this issue by increasing stocking rate either by increasing cow numbers or by keeping stock for longer. Some of the farms also choose to buy-in extra stock for the grazing season to generate higher output. The programme set initial targets of 750 kg live weight output/ha and in the region of €1600-€1800 sales/ha per year. The farm plans addressed three simple questions:
Where am I now?
Where do I want to go to?
How will I get there?

Financial analysis

e-Profit monitor analysis (Table 1) at the end of Year 3 of Phase 1 of the programme highlighted the progress made on each farm in response to the changes in management, and documented how this translated into higher gross margins.

Table 1 — Responses to management-derived changes in productivity during Phase 1

	2008	2011	2011
	Base year	Actual	No gains
Production (kg liveweight/ha)	532	729	532
Revenue (€/kg liveweight)	1.91	2.20	2.20
Variable cost (€/kg liveweight)	1.22	0.94	1.18
Gross margin (€/ha)	367	879	541
Gross margin from productivity (€/ha)			338
Gross margin difference (actual 2011 vs. base year 2008)			512
Gross margin change from productivity			65.9%

Of the €512 increase in gross margin achieved between 2008 and 2011, €338 or 66% came from productivity gains. Thus, on average, two-thirds of the gain in gross margin came from production gains and not from an increase in beef price.

2013 financial analysis

Gross margin decreased on the 34 farms participating in the programme, from €669 in 2012 to €565 in 2013. This was due to severe weather conditions experienced across the country in the spring of 2013. This was especially evident in the North-West where cows on some demonstration farms were housed for 8 months. Reduced performance during the first half of the year also had an impact on liveweight gain/ha.

The top performing farms operated bull beef finishing systems while the lowest performing farms were suckler-to-weanling farms based in the North-West. With the high cost of maintaining a suckler cow in 2013, weanling sales on some of the farms did not cover the cost of keeping the cow. An added disadvantage in 2013 was that famers made extra silage to boost reserves and incurred the cost of doing this in 2013. However, participating farmers are confident that in 2014 they will be able to recoup some of the initial gains made and return to a higher gross margin in 2014. The farms that had the highest stocking rate and highest output were still the top performing farms in 2013.

Conclusion

The Teagasc/ Irish Farmers Journal BETTER farm beef programme has clearly shown that with a targeted and focussed approach farmers can make significant gains in improving their output and their gross margin through adopting straightforward technologies. Simplifying systems and having targets to work to in a focussed approach can have a very positive impact on beef farm profitability. While 2013 financial performance was disappointing, the farms are well placed with adequate fodder supplies to deal with future weather-related crisis.

BETTER grass – grow your profits

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Summary
- Maximising the proportion of grazed grass in an animal's lifetime diet has the potential to increase farm output and profitability.
- It is important to have paddock divisions and water troughs in place.
- Aim to graze each paddock for 3 days and allow to re-grow for 3 weeks.
- Walk the farm on a weekly basis to measure growth and assess farm cover.
- Maintain pre-grazing yields at 1300-1600 kg dry matter (DM)/ha (8-10 cm) and graze down to 4 cm.
- Rotationally close up paddocks each autumn to facilitate early turn-out in spring.
- Take soil samples and target slurry, farmyard manure and compound fertiliser to low index soils.
- Identify poor performing paddocks and implement a reseeding programme.

Benefits of grazed grass

Grazed grass is the cheapest source of feed in Irish livestock production systems. Throughout the BETTER farm programme, much emphasis has been placed on improved grassland management as a means of increasing output and profitability. The main objectives are to prolong the grazing season, reduce feed costs and increase animal performance. There are a number of management tools which the programme participants have successfully employed on their farms that are significantly increasing the quantity and quality of grass grown and utilised throughout the grazing season. This facilitates increased stocking rates and hence increased output, produced cost efficiently.

Getting the most from grazed grass on the BETTER farms

The key to successful grassland management is planning. In order to prolong the grazing season grassland management starts a season in advance of when grass is required. For example, planning for early spring grass starts in the autumn by rotationally closing up paddocks from mid-October using the '60:40 autumn planner'. Similarly, the programme farmers will use the '40:60 spring rotation planner' for their first rotation to ensure that they have sufficient grass covers on the farm for the 2nd rotation. Using a rotational grazing system maintains grass quality throughout the year and is an effective method of growing more grass. However, it is essential that the farm is walked on a weekly basis to measure grass growth and to assess the supply of grass. This is one of the most important aspects of grassland management as it allows the farmer to budget grass to maintain enough grazing day's ahead, facilitate good utilisation and ultimately maintain a highly digestible leafy sward. Grass budgeting using the "grass wedge" will identify if there is a shortage or surplus of grass coming and will allow the farmer to react in advance. The target pre-grazing yield is 1300-1700 kg dry matter (DM)/ha (8-10 cm) and to graze paddocks down to 4 cm to ensure good utilisation. Identifying poor performing paddocks and implementing a reseeding programme are very important to maintaining productive swards. Swards with a high content of perennial ryegrass are capable of growing more grass during the year to carry higher stocking rates and produce more digestible herbage to promote lightweight gain. Soil fertility is the foundation of grass production and plays a key role during spring growth. Thus, target the spreading of slurry and compound fertilisers to low index soils and maintaining soil pH at 6.3 – 6.5.

A farmer's experience

Since joining the Teagasc/*Irish Farmers Journal* BETTER Farm beef programme Co. Wicklow farmer Trevor Minion has intensified his rotational grazing system to grow and utilise more grass by increasing the number of paddocks on his farm from 11 to 21. Trevor has between 6 and 7 paddocks per grazing group and aims to graze them for 3 days and re-grow them over 3 weeks. Trevor has been measuring grass growth with a plate-meter on a weekly basis for the last 2 years and this forms the basis for any management decisions. Once Trevor can establish the number of grazing days ahead he can make a decision as to whether he needs to take out surpluses grass as baled silage or alternatively spread extra fertilizer (if he identifies a potential deficit). Grass budgeting is key to maintaining a high quality grass sward at all stages during the grazing season. Trevor is now focussing on maintaining pre-grazing yields of 1,300-1,600 kg/DM/ha (8-10 cm) and grazing them down to 4 cm.

Trevor has been using the Teagasc online grass measurement programme PastureBaseIreland as his grass measuring tool since the beginning of 2013. The programme has shown that the farm grew a total of 9.4 tonnes DM per ha during the year. This was comprised of 7.6 tonnes DM per ha as grazed grass and 1.8 t DM per ha as silage. However, Trevor aims to grow 12 tonnes DM per ha per year to cater for his planned increase in stocking rate. On average, including silage ground, Trevor got 6 grazings from his paddocks last year. Figure 1 illustrates the yields of grass grown in each paddock during 2013, ranking them from the most productive to the least productive paddock. This will help with management decisions and assist identifying poor performing paddocks that may need correction of poor soil fertility or even reseeding. Since soil sampling the farm, slurry is now targeted to silage ground and to paddocks with low P and K indexes, along with compound fertilisers.

The main emphasis on this farm is to maximise the proportion of highly digestible grazed grass in the animal's annual feed budget. Therefore, it is essential that paddocks are rotationally closed in the autumn to facilitate early turnout in the spring, and thus help prolong the grazing season and shorten the expensive winter indoor feeding period. Since joining the programme, Trevor now starts turning his cattle out to grass in mid-February rather than late March/early April.

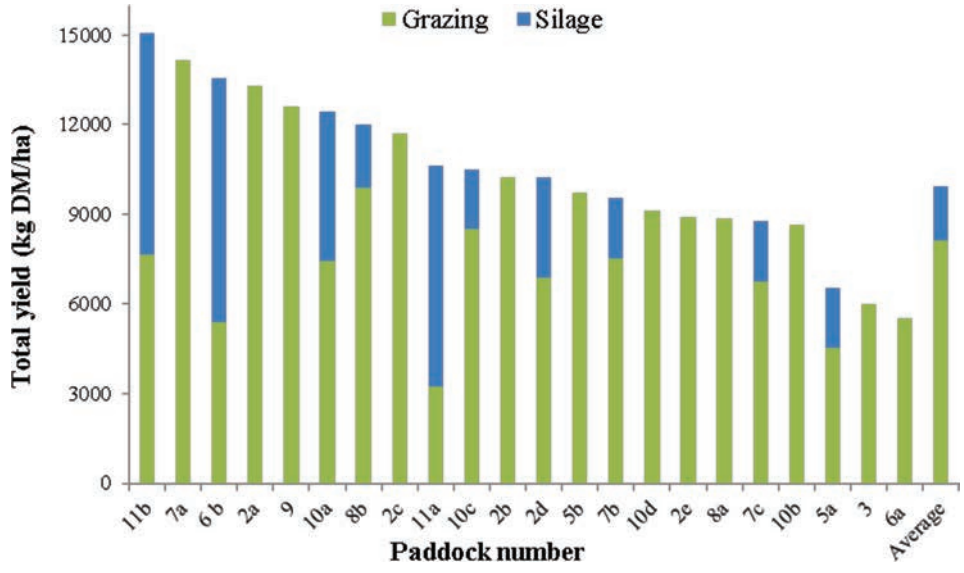

Figure 1 — 2013 Cumulative paddock yield.

BETTER breeding: increased output and efficiency

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Summary

- Key aspects of running an efficient suckler beef system include good breeding management and herd fertility.
- Poor herd fertility will have a negative impact on farm output and income.
- Cow condition score, bull fertility, the incidence of difficult calving and herd health are some of the main factors that affect fertility in the herd.
- Having a defined compact calving period and setting out clear objectives for targeting a 365 day calving interval, a 12 week calving spread, less than 2.5% mortality at birth and less than 5% mortality by 28 days of age, are very important.
- A simple action plan with achievable targets over a 3 year period is the starting point on any farm. It has worked very well on the BETTER farms.
- A disciplined approach to breeding can make real progress at farm level which in turn will have a positive effect on farm output and profitability.

Why improve breeding and fertility?

Beef output/ha is low on many cattle farms across the country. By focusing on breeding efficiency it will be possible to increase kg liveweight/ha, kg liveweight/livestock unit, calves/cow/year, etc. This can contribute to reducing costs and labour per unit beef sold, and to increasing profit. The key areas we need to focus on are the number of calves produced, the weight of calf weaned and the quality of calf. In 2013, the average national calving interval was 395 days (ICBF, 2013). This means that the average sucker cow had a calf every 13 months. In comparison, the BETTER farm average calving interval was 378 days in 2013.

A prolonged calving period drives up production costs, reduces farm output and increases labour demand.

Regardless of when the calving season starts, your key focus should be to keep the calving spread to a maximum of 12 weeks. A tight calving pattern allows for easier management of stock. All calves will be around the same age and, therefore, can be managed as one group and grassland management is much easier. As shown in Table 1, a calf born between 1-22 February will, on average, result in a weaning weight of 310 kg versus a calf in the herd born from 26 April-17 May. There is 93 kg difference between the two calves, and at a value of €2.35/hg this is worth €218.

Table 1 — Effects of time ofcalving

Calving date	Age at weaning (days)	Weight at weaning (kg)
1 Feb – 22 Feb	245	310
22 Feb–15 Mar	224	287
15 Mar-5 April	203	263
5 April-26 April	182	240
26April-17 May	161	217

Factors affecting fertility in the herd

Numerous research studies indicate that body condition score at calving is one of the most significant factors affecting reproductive performance. A body condition score of 2.5 in

mature cows and 3.0 in heifers at calving is required to minimise calving difficulty and reduce the calving-to-conception interval.

Herd health is a crucial aspect to maximise fertility. A proactive approach to herd health is essential. Diseases such as bovine viral diarrhoea (BVD) and leptospirosis in herds can have a devastating effect on fertility by increasing the calving interval in the herd, delaying the calving pattern and increasing costs to the farmer. It is recommended to get veterinary advice at the first signs of a problem. A herd health plan that includes bio-security, vaccinations and the culling of carrier animals, drawn up in consultation with your veterinary surgeon, is the best way to address disease problems.

The bull also plays a very important role in the herd to achieve the 365 day calving interval. It is estimated that up to 5% of bulls are completely infertile and a further 15-20% will be partially or periodically infertile. Therefore, by failing to properly inseminate these cows while in heat, the calving interval will be extended. Bulls need to be in good physical condition, but not fat.

It is important to avoid difficult calvings in the herd. Conception rates decrease as calving difficulty increases. Therefore it is important to choose sires that suit the cow – prevent difficult calvings by using bulls with a high reliability of low calving difficulty. Farmers breeding replacements for their own farm should use maternal bulls to increase milk production. Reproductive and maternal traits of the dam should be considered when breeding replacements. Replacements should be kept from the top performing cows in the herd. This will ensure a functional replacement heifer calving every 365 days, with good temperament, longevity, a high milk yield, and good calving ease and calf quality.

Case study

Billy Gilmore farms a mixed sheep and suckler-to-weanling enterprise in Cortoon just outside Tuam in Co. Galway. He has an autumn calving herd of 42 sucker cows. The cows are mainly Limousin crossbred, Charolais crossbred and Simmental crossbred cows calving during August-October. Mostly Belgian Blue bulls are used, with Billy caring out all his own AI. Good heat detection is crucial for 100% AI to succeed. Billy sources mainly Limousin crossbred weanling heifers in the mart. From these he selects the top performing heifers to breed from. Billy observes cows in heat numerous times a day when they are housed, in particular during early morning and late evening. Since joining the BETTER Farm programme in 2009, considerable breeding efficiency changes have been made on the farm.

The number of calves produced per cow has increased by 0.25 since 2010 (Table 2). This is an increase in output of €169/cow or €7098 extra from the herd. Calving interval on the farm has reduced since 2010 from 382 days to 370 days in 2013. Recent data from ICBF indicate that each 1 day reduction in calving interval is worth €7.50, and that would amount to €90 per cow. On Billy's farm this results in a saving of €3780. Billy has tightened his calving spread from calving in both spring and autumn to a compact 10 week period during August-October. Billy has succeeded in doing this by culling late calvers and setting clear dates for the start and end of the breeding season. The weanlings are evenly matched at sale time for size, weight and age. Grassland management on the farm is much easier with fewer groups of animals. Mortality on the farm is low (2.3% at birth and 28 days).

Table 2 — Increase in calves/cow/year

	2010	2013
Average on the farm	0.75*	1.00*
Average weaning weight	300	300
Price (€)/kg liveweight	2.25	2.25
Output (€)/cow €	506	675

BETTER herd health: reducing cost and improving performance

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Summary

- Herd health plays an important role in performance on beef cattle farms.
- Similar to testing soil and silage for nutrient status, beef cattle can be tested for health related issues such as BVD, leptospirosis, rumen and liver fluke and stomach worms.
- Herd ill-health problems in Irish suckler and beef herds have a detrimental impact on farm profitability.
- High animal mortality rates, poor thrive and the cost of veterinary treatment bills can lead to reduced output on farms and increased variable costs.

Why improve herd health?

Herd ill-health effects on the profitability of suckler beef farms are manifested through animal mortality, ill-thrift, cost of treatment, cost of prevention and additional labour. A key component of prevention of herd health problems on suckler beef farms is the identification of those management factors that can significantly impact herd health status. In Ireland, the recorded mortality rates for suckler beef calves at birth and in the first 28 days of life (includes mortality at birth) in 2012 were 5% and 6%, respectively. Considering that a target of 0.95 calves weaned per female mated is the desired production goal, this level of early-life calf mortality is of concern.

BETTER Farm programme experience

During Phases 1 and 2 of the BETTER Farm programme, herd health has remained a key metric for profitability. In phase 1, BVD was targeted and, from the 14 herds that used the ear notch test to detect persistently infected (PI) animals, 32 PI animals were found, with up to 10 PI animals in the more severely affected herds. Involvement of the local veterinary surgeon, the regional veterinary laboratories and Animal Health Ireland has led to a more proactive approach in dealing with animal health issues on the farms.

To date in Phase 2, the programme has focused on liver and rumen fluke. Participating farmers undertook faecal sampling at housing in 2013, and winter dosing plans were based on the results. Stock showing negative or low infestations of fluke were left untreated, but were tested later to determine if any infestation had built up in the interim. Stock showing positive or highly positive results were treated with a suitable product. Each farmer took a pooled sample from five faecal samples from each group of stock (e.g. cows, weanlings, finishers) and sent them for testing (see results in Table 1).

Table 1 — Results from faecal sampling for the incidence of rumen and liver fluke

	Rumen fluke incidence			Liver fluke incidence		
	Positive	Low positive	Negative	Positive	Low positive	Negative
South East	6	20	24	2	2	46
South West	7	9	13	0	0	28
North East	3	9	17	0	2	27
North West	14	6	9	3	1	25

From the results it can be seen that there are generally less liver fluke than rumen fluke. The farms in the North West region showed a higher incidence of rumen fluke than the southern region, leading to a greater number of farms treating stock for rumen fluke.

Case study: Mike Dillane's farm

Mike Dillane currently runs a 90 cow autumn-calving beef suckler herd in Lixnaw, Co. Kerry. Prior to joining the BETTER Farm programme, Mike was producing weanlings for the export market, using replacement heifers purchased as 2 year olds, inseminated on-farm and calved at 3 years of age. In 2011, Mike's farm suffered a breakdown in herd health even though he had been vaccinating all cows for leptospirosis, salmonella and rotavirus.

Herd health problems

The first 10 cows calved in October 2011 and within five to six days the calves were showing signs of sickness, beginning with coughing and then developing scour and a high temperature. They were treated with Nuflor for the high temperature and Synolux tablets for the scour. The symptoms were not cured and calves became worse and were placed on drips. A total of 6 calves died. Blood samples were taken from the cows and the results showed that cows in the herd had IBR, with the infection being passed onto the calf by the cow when it was born.

Action taken

On veterinary advice, Mike began to vaccinate all cows with an IBR live marker. Calves were treated with IBR marker through the nose at 2 weeks of age. This process has been repeated at 6 month intervals since then and Mike has noticed a significant improvement in herd health.

Attention has also been focussed on the both the calving spread and the replacement heifer policy. Calving spread on the farm was long and drawn out, with the majority of cows calving from October to January, but with a smaller percentage of calvings staggered over the months February to April. This made herd health management more difficult as more days were needed to assemble stock for different vaccinations across a variety of calf ages and cows calving in different seasons. Mike decided to cut the calving spread back to one season, with 90% of the herd calving from September to Christmas. This allowed more focus of the tasks at hand such as calving and calf health until the breeding season began. Purchasing replacement heifers was an easier way for Mike to ensure adequate milk production, and he bought Blonde/Friesian crossbred heifers. This practice left the herd open and susceptible to encountering infectious diseases. Since Mike is now using 100% AI, it has provided an ideal opportunity to breed his own replacements and maintain a closed herd. For the past two breeding seasons, Mike has used maternally-tested bulls on his best milk producing and most fertile cows and heifers, so as to create a supply of suitable replacements each year.

Economic cost of herd health

In 2011, Mike's veterinary bill came to €16400, or €277/ha, due to the IBR issue. By 2013, with the health issue now under control, his bill has reduced to €8024, or €136/ha, which is less than half of the previous year. The veterinary bill may not reduce much lower than this due to the high cost of vaccination, but in terms of increased animal performance, minimal losses and reduced labour input, the cost has been justified.

Technology Village:

Optimally feeding cattle

Grass silage

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Summary

- In conventional beef systems at Grange, grass silage accounts for 24-27% of total intake of feed, but for 29-39% of the total feed bill (land charge included).
- Losses during silage production can range from below 20% to well in excess of 30%. This range has a major impact on the cost of providing silage to cattle. Thus, there is a clear reward for good management practices that minimise these losses.
- Besides delayed harvesting, low silage digestibilities occur when dead vegetation accumulates at the base of swards. This can be avoided by grazing swards to a stubble height of 5 cm or lower when they are being closed for silage production.
- Soil fertility status must not be limiting if good silage yield and quality are to be achieved with consistency.

Perspective

Grazed grass, grass silage and concentrate are the primary feed inputs on beef farms, and collectively account for over 70% of direct costs. Within the Grange suckler calf-to-beef (steer) system, grazed grass, grass silage and purchased concentrate account for 66, 27 and 7% of feed dry matter (DM) intake, respectively, but for 44, 39 and 17% of feed costs (land charge included). Correspondingly, within the Grange dairy calf-to-beef system, they account for 55, 24 and 21% of feed DM intake, but for 31, 29 and 40% of feed costs. The economic sustainability of these beef production systems therefore depends on optimising the contribution of grazed grass to the lifetime intake of feed and on providing silage and concentrate as efficiently and at as low a cost as feasible.

Losses during silage-making are costly

Quantitative and qualitative losses occur during silage making. Of every 1000 kg grass DM in a silage sward, between 150 and over 300 kg does not make it into the animal's mouth as silage. Furthermore, the digestibility of ingested silage can be 0-7% units below the digestibility of the silage sward. These losses occur in the field (leaf shatter, respiration, leaching by rain, soil contamination, incomplete pick-up, etc.), at the silo (respiration during silo filling or feedout, effluent, inefficient fermentation, etc.) and in the feed trough (respiration, spillage, etc.). Some of these losses are unavoidable but others can be greatly reduced or prevented.

For example, a sward yielding 6000 kg grass DM/ha produces 5040, 4620 and 4200 kg edible silage DM/ha where quantitative losses of 16% (excellent management), 23% (good management) and 30% (poor management) occur. Corresponding quality losses could be 0, 1.5 and 4% units digestibility. The yield loss difference between 16 and 30% DM loss results in over 80 fewer animal feed days/ha. The digestibility loss difference of 0 vs. 4% units digestibility requires over 1 kg concentrate/animal daily to undo. Thus, DM losses of 16, 23 and 30% (+ digestibility loss) result in costs of €207, €230 and €263 to provide cattle with feed energy (1000 UFL) as silage.

These values demonstrate the importance of management practices that reduce losses during silage production and feedout. They include efficient mowing, conditioning and pick-up, effective wilting during good drying weather, fast filling and perfect sealing of the silo, ensuring good fermentation and relatively little effluent, fast and tidy feed-out, and sensible feed provision and waste removal at the feed trough.

Avoid pitfalls if you want highly digestible silage

Silage quality (digestibility, preservation and mould-incidence) depends on both the quality of the harvested sward and the success of the silage-making and feedout processes. The quality of the harvested sward depends firstly on its growth stage – leafy grass has a much higher energy value (digestibility) than stemmy grass with mature seed-heads. The species and varieties of grass, and the presence of clovers (good) or 'weeds' (bad), also impact on digestibility. Together with fertiliser (including slurry) application rate and timing, and prevailing weather conditions, they also establish the ease with which the sward will preserve properly in the silo.

The optimal balance between grass yield and digestibility for producing silage of high feed value is achieved by harvesting intermediate-heading ryegrasses when their seed-heads start to emerge. To achieve comparable feed value with late-heading ryegrasses it may be necessary to harvest before seed-heads appear. These general relationships between grass growth stage and digestibility can be misaligned if there is an accumulation of dead vegetation at the base of the sward. Dead vegetation accumulates, for example, if fields for silage production are not grazed bare (i.e. to a stubble height of 5 cm or lower) in late autumn or early spring. Sward digestibility is reduced because this dead vegetation, accumulated over several months, can have a digestibility below 50%. The scale of impact of such dead vegetation is summarised in Table 1 and shows that, on a given date in mid-May, it can reduce sward digestibility by 6-7% units. It would take almost 2 kg supplementary concentrate per head daily to undo the impact of this scale of unplanned reduced digestibility. The message, therefore, is that sward regrowths need to start from a 'bare stubble' when they are to be used for producing high digestibility silage.

Table 1 — Grass digestibility (DMD%) for a first-cut harvest on 18 May, depending on previous management (average of two years results)

	Previous grazing management		
	Ungrazed in	Graze to 5cm stubble	
	autumn or spring	In late autumn	In early spring
DMD%	75.4	82.1	81.8

Soil fertility – accelerator or brakes?

Sub-optimal soil fertility (and sometimes impeded drainage) is probably the core reason that target silage yields and (indirectly) digestibilities are not achieved on many farms. Low soil phosphorus (P), potassium (K) or pH values reduce the potential yield response to fertiliser nitrogen (including from slurry). As a consequence, the yield of grass available to harvest when the sward is at an optimal growth stage will likely be lower than required. In many cases, the management response will be to defer harvesting by some weeks until sward yield has increased sufficiently. However, since each 1 week delay in harvesting results in a 2-3% unit drop in sward digestibility, subsequent silage intake, feed efficiency and growth rate by cattle will suffer. It will require 0.6-0.9 kg concentrate/animal daily to undo the effect of the drop in silage digestibility and restore animal performance. In addition, sub-optimal soil fertility makes it difficult to maintain the persistence of perennial ryegrass in swards. The latter increases the frequency and thus the cost of reseeding, and facilitates the development of swards that are more difficult to preserve as silage.

Thus, soil P and K status both need to be at Soil Index 3 and pH at approximately 6.3 (mineral soils), based on soil analyses. Correcting a soil nutrient deficiency is costly and should be addressed as part of a longer term farm business plan.

Concentrate feedstuffs for beef cattle

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Summary

- Energy is the most important nutrient in concentrate feedstuffs.
- Buy concentrate mixes on the basis of energy density, not protein and price.
- Always check the label of the concentrate mix being purchased.

Energy is the most deficient nutrient in cattle feeding systems. Energy drives milk production, live weight gain and foetal growth. Therefore, when choosing a concentrate mix, the ingredient mix and the energy density of the mix of ingredients are most important. Energy can be expressed in one of two ways, depending on the class of animal being fed. For suckler cows and growing animals the UFL value is used. For finishing animals including bulls, steers and heifers the UFV value is used.

Protein is a key nutrient for milk production, reproduction and growth. But the protein demand of beef cattle is low. Therefore, less emphasis needs to be put on level and quality of protein in concentrate mixes, unless low protein feeds are being used. Protein is commonly expressed as crude protein %. Protein quality can be further defined by PDI values.

Table 1 — **Energy and protein content of concentrate feedstuffs (per kg as fed)**

	Energy		Protein		
	UFL	UFV	Crude protein %	PDIN g	PDIE g
Energy feeds					
Barley	1.00	1.00	10.4	64	89
Wheat	1.00	1.00	10.3	67	92
Maize	1.05	1.04	8.4	71	103
Oats	0.89	0.85	9.6	65	73
Citrus pulp	1.01	0.92	6	40	80
Beet pulp, unmolassed	1.01	0.93	9.1	56	97
Soya hulls	0.91	0.87	11.0	68	94
Molasses, cane	0.76	0.76	4.5	24	50
Protein feeds					
Soyabean meal	1.02	1.02	48	342	232
Maize distillers grains	1.03	1.00	25.7	178	119
Maize gluten feed	0.92	0.86	19.8	137	108
Rapeseed meal	0.91	0.85	33.9	219	130
Urea	0	0	273	1398	0
Sunflower meal	0.59	0.50	25	159	89
Palm kernal meal, exp.	0.86	0.84	15	117	127
Wheatfeed (pollard)	0.70	0.64	15.3	101	79

Buying concentrate mixes

There is significant variation in the quality of concentrate mixes on the market. It is important to do a little homework before choosing a concentrate mix. A recent Teagasc survey showed that just 55% of people could identify a high energy ration from the label. Questions that need to be asked to understand the label:

1. What is the energy density of the mix? There is no requirement to print the energy density on the label / docket. However this information should be available, if requested. Always ask for the energy content of the mix. Target energy (UFL) for young stock and autumn calving cows is 0.93-0.94 UFL / kg as fed. Target energy density for finishing bulls, steers and heifers is 0.93-0.94 UFV / as fed. Be careful how the energy is expressed. Energy can be expressed a number of ways, as Table 2 demonstrates with a number of examples.

Table 2 — Energy content of concentrate feedstuffs (per kg as fed)

Method of expression	UFL	UFL	UFL	UFV	UFV	UFV
With minerals / kg as fed	0.88	0.92	0.96	0.88	0.92	0.96
With minerals / kg DM	1.01	1.06	1.10	1.01	1.06	1.10
Without minerals / kg as fed	0.90	0.94	0.98	0.90	0.94	0.98
Without minerals / kg DM	1.03	1.08	1.12	1.03	1.08	1.12

*Assumes a dry matter of 87% and a mineral inclusion of 2.5%

For example, if the energy content of the ration is expressed by the supplier as 1.03 UFV / kg DM without minerals, that is the equivalent of 0.88 / kg as fed, which is lower than the target of 0.93-0.94 UFV / kg as fed for finishing animals.

2. What are the ingredients in descending order? The ingredients on the label will always be expressed in descending order i.e. the ingredient at the top of the list is included at the highest rate, while the ingredient at the bottom of the list is included at the lowest rate. Don't assume that because the first ingredient on the list is a high energy ingredient that the following ingredients will also be good. When examining the label of a ration, list all the ingredients on a page, and opposite each ingredient write the UFL or UFV of the ingredient using Table 1 above. It will quickly become clear what is the likely energy density of the mix. If the target is a high energy density ration, avoid low energy feeds such as sunflower meal and wheat feed in the top 5-6 ingredients.
3. What is the crude protein content of the mix? The protein content of the mix must be specified on the label. Too much emphasis is put on protein content. The protein content is of less significance in comparison to the energy content. Dont buy rations solely on the basis of protein – remember that energy is more important.
4. Are there minerals included in the mix? Vitamin and mineral supplementation should be included in rations for beef animals.
5. What is the price of the concentrate mix? Price should not be the sole criterion for picking a mix. When comparing mixes, do so on the basis of comparable energy, protein and mineral values.

Optimal concentrate supplementation for growing-finishing cattle

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Summary

- Comparisons of feedstuffs should be based on their net energy (and protein) values.
- Increasing the level of concentrates in the diet reduces forage intake and increases live weight and carcass weight gains, although at a progressively diminishing rate.
- Subsequent compensatory growth diminishes the advantage of concentrate supplementation of young cattle.
- High digestibility grass silage with moderate concentrate supplementation can sustain a large proportion of the cattle performance achieved on high concentrate diets.
- Feeding management is especially important when feeding concentrates *ad libitum*.

Introduction

The comparatively lower cost of efficiently produced grazed grass, and to a lesser extent grass silage, as feedstuffs dictates that maximising their proportion in the annual feed budget is central to sustainable beef production systems. Although grass-based animal nutrition is fundamental, feeding concentrates is a key component of beef production systems, especially during the indoor winter period and with finishing systems, but also at pasture, mainly in autumn. The role of concentrates is to make up the deficit in nutrient supply from forages in order for cattle to reach performance targets. Indeed, in situations where there is a shortage in winter supplies of forage, it may be better to buy concentrates and feed less forage than to purchase expensive low-quality forage. Comparisons of feedstuffs should always be based on their net energy (and protein) values on a dry matter (DM) basis. It is important to ensure that adequate levels of an appropriate mineral/vitamin mix are included in the ration.

Feeding concentrates: key principles

Dry matter digestibility (DMD) is the primary factor influencing the nutritive value of forage and, consequently, the performance of cattle. Low DMD forage means higher levels of concentrate supplementation have to be used to achieve the same growth rates or performance (Table 1). Increasing the level of concentrates in the diet reduces forage intake (substitution rate) and increases live weight and carcass weight gains, although at a diminishing rate. Production response to concentrate supplementation is higher with forages of lower DMD and greater in high growth potential animals. Animal response to concentrate supplementation at pasture primarily depends on the availability and quality of pasture and level of supplemented concentrate. Increasing concentrate supplementation reduces the importance of forage nutritional value, especially so when feeding concentrates *ad libitum* (to appetite). The optimal level of concentrate supplementation primarily depends on animal production response (kg gain/kg concentrate), forage substituted and the relative prices of animal product and feed stuffs.

Weanling cattle

To minimise feed costs and exploit subsequent compensatory ("catch-up") growth at pasture during the following grazing season, live weight gains of 0.5-0.6 kg/day through the first winter are acceptable. Due to compensatory growth, there is little point in over-

feeding weanlings during the first winter. However, cattle growing too slowly during winter will not reach target weights. Target animal performance level can be achieved on grass silage supplemented with concentrates as outlined in Table 1.

Finishing cattle

Efficiency of feed utilisation by finishing cattle primarily depends on the weight of animal (decreases as live weight increases), potential for carcass growth (e.g. breed type, gender, compensatory growth potential) and duration (decreases as length increases) of finishing period. Even high quality grass silage is incapable of sustaining adequate growth rates to exploit the growth potential of most cattle so concentrate supplementation is required. Each 1 percentage unit decline in DMD of grass silage requires an additional ~0.33 kg concentrate daily to sustain performance in finishing cattle. Concentrate supplementation rates for finishing steers to achieve ~1.0 kg live weight/day with grass silage varying in DMD are shown in Table 1. For finishing heifers (lower growth potential) daily supplementation is reduced by about 1.5 to 2.0 kg and for finishing bulls (higher growth potential) rates should be increased by 1.5 to 2.0 kg. Where silage DMD is poor (e.g. 60%) and/or in short supply, and animal growth potential is high, feeding concentrates *ad libitum* should be considered. However, when feeding concentrates *ad libitum,* particularly cereals, there is a risk of acidosis. Therefore, it is critical to ensure; (i) gradual adaptation to concentrates, (ii) minimum roughage inclusion (~10% of total DM intake) for rumen function, (iii) meal supply never runs out, and (iv) a constant supply of fresh water is provided.

Table 1 — Concentrate supplementation (kg/day) necessary for weanlings to grow at ~0.5 kg and for finishing steers (600 kg) to grow at ~1.0 kg, live weight/day when offered grass silage of varying dry matter digestibility (DMD) to appetite

Grass silage DMD (%)	60	65	70	75
Weanlings	2.0-3.0	1.5-2.0	1.0-1.5	0-1.0
Finishing steers	–	7.0-8.0	5.5-6.5	4.0-5.0

Concentrate type

Cereals are a primary component of cattle rations. Studies at Grange showed that carcass weight gains and feed conversion efficiency to carcass gain were similar between rolled barley and wheat offered as supplements to grass silage. In addition to cereals, a wide variety of other feed ingredients are available. Grange research has shown that cattle offered concentrates formulated to have similar energy and protein levels but contrasting feed ingredients had similar intake, growth, feed efficiency and carcass traits. Ingredients ranged from rapidly fermented starch (barley-based), to slowly fermented starch (maize-based), to rapidly fermented starch + fibre or fibre only (pulps-based) and, were offered either as a 5 kg/day supplement to grass silage or *ad libitum* (plus 5 kg fresh weight grass silage daily). Comparable findings were also obtained with grazing cattle. This means that net energy (and protein) levels of beef rations are more important than ingredient content *per se*.

Protein supplementation

Weanling and finishing, steers and heifers generally do not require protein supplementation when fed barley-based concentrates and high DMD grass silage but, for suckler bull weanlings, recent research at Grange showed a significant, but small, response to protein supplementation. However, all cattle are likely to respond to supplementary protein in barley-based concentrates when grass silage has moderate to low DMD and/or low protein content, especially weanlings and young bulls.

Early finishing of males from the beef suckler herd

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Summary

- High concentrate diets result in high growth rates and younger slaughter ages.
- Late-maturing breeds are more efficient on high concentrate diets.
- Steers and bulls can be produced off pasture at 19/20 months old, but concentrate supplementation may be needed to achieve an acceptable level of carcass fatness in late-maturing breeds

Introduction

The majority of progeny from the suckler herd are spring-born, late-maturing breed types. Steer beef systems, typically slaughtering at over 24 months of age, predominate – until recent years they accounted for ~95% of suckler male output. The relatively poor margins in winter finishing have led producers to explore different finishing options. Bull beef systems have expanded over the past decade and now account for ~25% of male slaughtering. When compared with steers reared similarly, bulls have better feed conversion efficiency, higher live weight and carcass gains, higher lean meat yield, better conformation and, when fed high concentrate diets, may be slaughtered at a younger age. Until autumn 2013, bull beef was sold at prices broadly equivalent to steer beef. However, the orderly marketing of older (over 16 months of age) and heavier (over 400 kg) bull carcasses was seriously disrupted in 2013 and the market for finished bulls changed to the extent that a clear outlet needs to be established before a producer enters a bull beef system of production. On-going research shows that the best margins for suckler beef are associated with 18-19 month bull systems incorporating grazed spring pasture (for ~3-months) before finishing on a high concentrate diet. However, producing bulls outside the current market specifications should only be considered after discussions with the factory outlet. More recent information on reducing the age of slaughter of suckler bulls, and steers, is summarised below. Bull beef production should be seen as a specialised enterprise requiring a high level of technical expertise.

Indoor finishing of suckler bulls

A system of bull beef production was developed at Grange many years ago in which suckler weanling bulls were fed a diet of *ad libitum* good quality grass silage plus, on average, 5 kg concentrate/head daily from winter housing until they were 15-16 months of age. The system produced a carcass of ~370 kg and showed positive profit margins. Performance of spring-born, early- and late-maturing suckler bulls, offered *ad-libitum* concentrates (from January) until they achieved carcass weights of 260, 300, 340 and 380 kg, was recently compared. At the lowest carcass weight, early-maturing bulls were fatter (~3- v 2+), but at carcass weights over 300 kg all carcasses had acceptable fat covers, with early-maturing breed bulls being fatter. Feed conversion efficiency was best for the late-maturing breed bulls. Estimated carcass gain was 0.8-0.9 and 0.6-0.7 kg/day for late- and early-maturing bulls, respectively. Overall, to achieve the same carcass weight, the early-maturing breeds needed to be ~25 kg heavier at slaughter, had a ~2.5% lower kill-out, were ~1.0 con-

formation score poorer and ~1.5 fat classes higher (15 point scales) and were older at slaughter. Previous studies at Grange, taking suckler-bred bulls to carcass weights over 420 kg, showed the rate of carcass gain remained high for late-maturing breeds but decreased for early-maturing breeds. These high concentrate systems offer the opportunity of finishing at a younger age. Margins can, nevertheless, be low and are highly influenced by the price of concentrate, carcass value and rate of daily gain achieved.

Finishing suckler-bred male cattle at 19 to 20-months of age

A study was recently undertaken at Grange where spring-born, late-maturing, weaned, suckler breed males (~345 kg, 9.5 months old) were reared as bulls or steers. After a common first indoor winter (store period – average daily liveweight gain ~0.7 kg/day) steers were either: 1) grazed for 175 days, 2) offered 5 kg concentrate/head daily for the last 75 days at pasture, 3) housed and offered *ad libitum* concentrates for the final 75 days, or 4) remained indoors on *ad libitum* concentrates for 175 days. Treatments 3) and 4) were repeated for the bulls. At the end of the 175 days all animals were slaughtered (19/20 months of age). Steers offered pasture only for the 175 days achieved a carcass weight of 300 kg and a fat score of 2=. When supplemented at pasture for the final 75 days, steer carcass weights and fat scores increased to 338 kg and 2+/3-, respectively. When housed and offered *ad libitum* concentrates for the final 75 days, steers reached a carcass weight and fat score of 363 kg and 3=/3+, while bulls on the same treatment achieved 406 kg carcass and a fat score of 2+/3-. Feeding *ad libitum* concentrates throughout resulted in carcass weights of 382 and 420 kg for steers and bulls, respectively, and fat scores of 3=/3+ and 3=. With steers, the additional carcass response to pasture supplementation exceeded the cost of concentrate feeding, and it also improved kill-out proportion and both fat and conformation scores. For steers offered *ad libitum* concentrates indoors for the final 75 days, the value of the additional carcass gain was matched by the cost of additional concentrate fed. Finishing the animals as bulls enhanced carcass weight by approximately 40 kg and improved the financial margins in the system.

Conclusions

Late-maturing suckler-bred steers and bulls can be produced off pasture at 19/20 months old, but concentrate supplementation may be needed to achieve an acceptable fat cover. Compared to steers, bulls at this age had superior performance.

‘On-farm’ influences on beef quality for the consumer

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Summary

- Increasingly farmers must produce beef to specific market specifications.
- The diet of cattle can affect the colour of fat but has little effect on the colour of meat; Jersey-sired cattle have more yellow carcass fat than other breed types.
- Post-farm management has a greater effect on tenderness than on-farm management.
- When slaughtered at a similar fatness, there is little difference between breeds in tenderness or overall consumer acceptability of meat.
- The diet of cattle can influence the amount of healthy components in beef.
- Based on current evidence, increasing age at slaughter does not negatively influence the tenderness of suckler or dairy bull beef.
- Considerable flexibility exists among on-farm production options to meet market specifications.

Introduction

Purchasers of beef at all points in the production chain (e.g. factory or retail buyers, processors, restaurateurs, individual shoppers, etc.) can be considered as beef consumers. As more than 85% of Irish beef is exported there are a myriad of markets and consumers for Irish beef. Each consumer may therefore have a different definition of beef quality and beef farmers need to understand the preferences of their particular target consumer. Aspects of the appearance and eating quality of beef can be affected by management of the animal on-farm, its carcass during the early post-slaughter period and its meat during maturation and cooking. The objective of the meat quality research programme is to provide beef farmers with the information to allow them to produce beef that is suitable for specific markets.

Colour of beef

The appearance and/or colour strongly influences the decision to purchase beef, either as a carcass or as an individual cut of meat e.g. some EU markets require carcasses that have white fat and bright red or pink meat colour, while individual purchasers will generally choose bright red rather than darker beef. The diet of beef cattle can change fat colour. The yellowing effect on fat of different feeds can be ranked in decreasing order as follows: grazed grass, grass silage/concentrates, concentrates/straw, maize silage/wheat silage. The colour of fat from cattle fed a barley grain-based ration was similar to that of cattle fed maize grain or fodder beet-based rations. Carcass fat from Jersey-sired cattle was more yellow than that from other breeds. Animal age appears to be a more important determinant of muscle colour than diet with younger cattle having muscle that is lighter and less red in colour. Minimising pre-slaughter stress is important, particularly for bulls, to ensure that muscle does not become dark due to the higher than normal pH that develops in the muscle of stressed animals.

Nutritional quality of beef

Beef is generally recognised as a good source of protein, minerals and anti-oxidants but there is also a perception that beef is rich in "unhealthy" fatty acids. However, lean beef with less than 4% fat can be considered a low-fat food. Medical authorities advise a decrease in the consumption of saturated fatty acids and an increase in the consumption of monounsaturated and polyunsaturated fatty acids (PUFA). Within the PUFA, increasing the intake of omega-3 fatty acids is particularly encouraged. Conjugated linoleic acid (CLA) is a fatty acid that may protect against cancer and other diseases. Cattle nutrition is the major factor influencing meat fatty acid composition. Feeding grass and/or concentrates containing linseed or fishoil, compared to a standard concentrate ration, results in beneficial changes in the omega-3 PUFA and CLA in beef. These benefits can be enhanced further by preventing dietary PUFA from being digested (hydrogenation) in the rumen through feeding 'protected' forms of supplement. When rumen-protected PUFA were fed to cattle, muscle with very high concentrations of beneficial omega-3 PUFA was obtained, such that it complied with the European Food Safety Authority definition of a "source" of omega-3 PUFA. Collaborative studies with UCD demonstrated that beef enriched with CLA had beneficial effects in mouse models of obesity and diabetes. This research provides information to facilitate the production and marketing of beef as a food that is more in line with human health requirements.

Sensory quality of beef

Tenderness is considered to be a major determinant of the enjoyment that comes from eating beef. Overall acceptability is an assessment of satisfaction which also incorporates flavour and juiciness. Post-slaughter management of the carcass, such as rate of cooling, electrical stimulation and, in particular, ageing/hanging can have a big influence on tenderness and overall acceptability. With regard to on-farm influences, the composition of the diet and growth rate before slaughter do not greatly influence beef tenderness. When slaughtered at a constant carcass fatness there is little difference between breeds in tenderness, e.g. striploin from Belgian Blue-sired heifers from the dairy herd, slaughtered at a carcass weight of 327 kg had similar overall acceptability to striploin from Angus-sired heifers slaughtered at a carcass weight of 237 kg. The age at which an animal, particularly a bull, is slaughtered is of current interest specifically with regard to beef tenderness. Initial analysis of data from recent studies indicates that there is little commercially important difference in tenderness or overall liking of striploins, matured for 15 days, from continental breed sired suckler bulls slaughtered between 15 and 24 months of age or from dairy bulls aged 16, 19 or 21 months. There was some evidence that production system *per se* may influence eating quality of suckler bull beef. This is under investigation, as is a comparison of bulls and steers from the suckler herd and the dairy herd within a project supported through the Department of Agriculture, Food and the Marine Competitive Research Programmes (11/SF/322).

Conclusions

The expectations of the customer/consumer at each point in the supply chain must be satisfied. This requires information on the requirements and/or preferences of each consumer group in the production chain. To sustain the beef industry, beef farmers must also be adequately rewarded for meeting market specifications, especially if it is more expensive to produce novel or "enhanced" beef. Information is now available to assist farmers to more consistently meet consumer requirements.

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Technology Village:

Improving animal health

Herd health planning

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Summary

- On beef farms output can best be measured as kilograms liveweight gain / hectare. This takes into account animal fertility, mortality, thrive and stocking rate. Animal health is therefore an important limiting factor in farm output.
- Irish beef farms have room for improvement in efficiency. Only 78 per 100 cows produce a live calf. Calf mortality is approximately 6%.
- Herd health planning involves focusing on the prevention of health problems within the herd as opposed to dealing with them as they arise.
- Herd health plans are essentially an on-farm risk assessment and therefore are farm specific. Generic herd health plans invariably lead to over vaccination and poor farmer compliance.
- A meeting with your veterinary practitioner to discuss last year's health problems is the first step to a herd health plan.

Introduction

Herd health planning involves focusing on the prevention of health problems within the herd as opposed to dealing with them as they arise. Disease outbreaks are costly to treat due to veterinary bills, medicine costs and mortality. In addition, there are many hidden costs, such as the loss of liveweight gain, labour, and future relapses. For example, recent research in Northern Ireland indicates that a dairy heifer calf that has a case of bovine respiratory illness will have 4% less milk in her first lactation and 8% less in her second lactation. This effect on performance can be expected in beef animals also. Therefore the hidden costs are often the most costly to farm productivity.

Farm output is best measured as the kilograms of liveweight gain / hectare. This takes into account stocking rate but also the reproductive efficiency of the herd and the thrive realised by animals in the herd. Reproductive efficiency is affected by dam management and nutrition, heat detection, disease prevention, bull fertility and functionality, as well as reproductive losses through abortion and trauma. Calf mortality, currently approximately 6%, is a multi-factorial problem which is affected by dry cow management, sire selection, calving management, colostrum management, disease control, nutrition and housing. Animal health is a limiting factor in the output of beef farms and therefore planning is required to maximise output and efficiency.

Having a herd health plan in place will reduce the numbers of animals that need to be treated with antibiotics, which is an important consideration given the current debate on antimicrobial resistance. Higher levels of animal welfare also can be realised, leading to increased confidence in food safety and market assurance.

Designing a herd health plan

A herd health plan is essentially an on-farm risk assessment. The veterinary practitioner identifies the risks to animal health specific to that farm and puts them in order of priority. Then a plan is put in place with the farmer to deal with the risks identified. The most successful herd health plans are specific to the farm in question. On-farm knowledge is essential and almost all farms have subtle differences. Generic herd health plans in this author's experience lead to the phenomenon of 'over vaccination' which in turn often leads

to poor farmer compliance. Examples include blanket therapy for coccidiosis at ten days of age in the absence of an accurate diagnosis, IBR vaccination in small closed herds with no history of IBR outbreaks, or anti-scour vaccination without consideration of dry cow diet or colostrum management.

The plan should start with a review of the available records. The list of call-outs over the past year, medicines used, vaccination programmes in place and any laboratory diagnoses should be reviewed by the vet and the farmer with a view to identifying risks. Access to ICBF at this stage is very useful as herd fertility data and calf mortality data are available. Records of weight recordings, BCS scores as well as silage/forage analyses should also be considered.

Once the risks are identified they should then be prioritised in order of importance. It may be that the farmer tackles these one at a time or perhaps only the more critical risks at first. Some problems need to be investigated to arrive at an accurate diagnosis prior to addressing the risk. Plans must be realistic. If a shed has poor ventilation then perhaps the capital budget will not allow for significant expenditure. Reducing the stocking rate in the shed might be a more practical solution. The plan must be clear and concise. The farmer must understand what is needed and when it is needed, without having to study the plan for long periods. It is of little use filed away! Hence a calendar model is a useful part of the herd health plan.

Reviewing the plan

The most important part of herd health planning is to have a structured approach. Often herd health plans are borne out of the aftermath of a disease outbreak, and it is important to revisit the plan after a period of time to assess if it has been successful. Such revisits are an important part of the process. New risks may appear along the way and indeed some of the original risks may diminish over time. Record keeping is therefore important for an accurate assessment of herd health status and change.

Examples of herd health planning

In this presentation there are three examples of the herd health investigation and planning on farms that I attend in my practice. These are three different types of farms, the first being a beef farm that sources animals as weanlings from marts, the second is a 150 cow suckler herd that experienced severe calf mortality issues and the third rears 450 dairy calves to beef <16 months. All of these plans are different, yet key measurable parameters indicate successful outcomes for the farmers involved. Reassessment and adjustment are central to the outcomes realised.

Conclusion

Herd health planning can yield real benefits to the overall productivity and profitability of a farm. Animal ill-health limits output on many Irish farms. It is important to have a herd health plan in place at least three months in advance of the expected risk period i.e. calving season or weaning. Regular reviews of the plan are essential.

BVD eradication programme – update and challenges

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Summary

- There has been a high level of participation in the compulsory phase of the BVD eradication programme
- A reduction in PI births is occurring in 2014 compared to 2013
- Retention of PI calves born in 2013 into last year's breeding season has reduced the rate of progress
- Prompt removal of PI animals and adequate biosecurity are important components of the programme.

Introduction

The compulsory phase of the national BVD eradication programme began on 1st January 2013. The programme is designed to have an initial three year eradication phase followed by a further three year monitoring phase. During the eradication phase, tag testing of calves as they are born will identify those persistently infected (PI) with BVD virus (subject to the results of any confirmatory tests) and provide a negative test status (either directly or indirectly) for other calves and their registered dams. PI animals are recognised to be the main source of infection and for this reason their prompt removal is critical to the success of the programme within the above timelines. Where PI animals are detected, additional testing is required which at a minimum investigates the dam's status. Farmers are also encouraged to contact their veterinary practitioner to conduct further investigations to ensure that any other infected animals present are identified and removed as quickly as possible. By following this programme, after three years the majority of herds will contain animals that all have a negative status, allowing a negative herd status (NHS) to be awarded, subject to other conditions being met (including absence of PIs in the preceding twelve months and any associated herds also being eligible for NHS).

During the monitoring phase, herds with NHS will continue testing to demonstrate continued freedom while any remaining infected herds are also progressed to NHS. The testing options available to farmers during the monitoring phase may include blood-based sampling of limited numbers of animals for evidence of exposure, or continued tag testing.

Programme review

The level of compliance with the requirement to test all calves has been very high. Of the 2,098,204 calves registered in 2013, only some 1,600 (0.1%) remain alive and untested. By early May 2014, 95.8% of the 1,312,948 calves registered in 2014 had been tested.

During 2013, 0.8% of calves gave a positive or inconclusive result, falling to 0.67% (approximately 14,000 calves) when the results of confirmatory retests were taken into account. These calves were unevenly distributed across the country. PI calves were detected in 11.25% of the 80,000 herds from which samples were received, and 5,100 of these were beef herds. The detection of large numbers of PIs in beef herds was the exception; 73% of positive beef herds had a single PI, with over 96% of herds having 4 or less. Testing of the

dams of PI animals found 6.2% of these in turn to be PI, with the majority being born to younger dams, consistent with the reduced survival of PI animals relative to their non-PI comrades.

In 2014 to date, 0.45% of calves have had an initial positive or inconclusive result, falling to 0.42% following re-testing.

Retention of PI animals

Calves become PI when they are infected during early pregnancy (typically between 30 and 120 days). Therefore, PI calves detected in 2014 were born as a result of infection during the compulsory phase of the programme. Leaving aside the 6.2% where the dam was found to be PI, the remaining 93.8% became PI as a consequence of their dam being infected during early pregnancy, most typically through contact with a PI animal. A key tool to prevent this happening is therefore to remove PI animals in advance of the breeding season. The strong bias toward spring calving in the Irish national herd means that a large proportion of breeding animals go through this risk period for their calves becoming PI at the same time. Of the 14,000 PI animals identified in 2013, 21.8% (2,966) remained alive in May 2014 in 1,943 herds, of which 73% were beef. These PI animals had clearly been present throughout the 2013 breeding season, acting as a potential source of infection to create further PIs both in their own and in neighbouring herds. In a number of cases data show that the retention of small numbers of PIs resulted in the birth of multiple PIs the following year.

As the 2014 breeding season has already commenced, it is vital that all known PIs are removed as quickly as possible. In addition to the risk of creating further PIs, to be born in 2015, PIs already identified are likely to die or become ill-thriven before reaching slaughter weight and to contribute to scours and pneumonias in other calves.

Biosecurity

It is important that all herds take adequate steps to minimize the risk of introduction of infection during the programme, with protection of pregnant stock being the highest priority. The greatest risk of introduction is through movement of cattle, although as the programme develops, the proportion of animals that have a negative pre-purchase result is increasing. Pregnant animals pose a particular risk since while they may not themselves be PI, the status of the calves they carry remains unknown until birth. Data from 2013 shows that more than six hundred herds had PI calves born from such “Trojan” dams. Farmers should therefore at a minimum avoid knowingly buying in-calf replacements from herds where a PI animal has been present in the preceding twelve months.

Conclusions

The BVD eradication programme has made significant progress with a high level of compliance with the requirement to test calves, resulting in persistently infected animals being prohibited from sale. Prompt removal of these PIs, ideally in advance of the breeding season, and attention to biosecurity, are necessary to maintain this progress.

Parasite control for beef and suckler farms

Frank O'Sullivan
Veterinary Ireland and Patrick Farrelly and Partners

Summary

- Managing and controlling parasites is an essential element of successful farming in Ireland.
- Herd health planning with your veterinary surgeon and Teagasc advisor facilitates not only prevention of clinical cases of gutworm, lungworm and fluke but also helps increase production and reduce subclinical losses.
- Monitoring faeces in the laboratory and Collection and Communication of Inspection Results (CCIR) from the abattoir assist in key decisions.
- Anthelmintic resistance and residues need careful consideration.

Introduction

For Irish suckler and beef farmers the most important internal parasites to combat during the grazing season are stomach and intestinal worms (known as gut worms), lungworms (causing hoose pneumonia), and liver and rumen fluke.

Three months into the grazing season (July) is an excellent time to monitor animals and review parasite control strategies. Furthermore, because infections with all these parasites can build up over the grazing season, the period of greatest parasitic risk is during the second half of the grazing season (until housing). Control not only prevents animals from dying (e.g. acute hoose pneumonia or heavy fluke infestation) but perhaps more importantly reduces ill-thrift and helps animals thrive.

Understanding a parasite's life cycle is important – e.g. liver and rumen fluke

The liver fluke life cycle starts with fluke eggs passing out of cattle in their faeces. These eggs develop through various larval stages before entering the mud snail where they multiply (500 to 1000 times). They eventually leave the snail and become resident on the grass. The liver fluke larvae are then ingested by grazing cattle and eventually enter the liver. After 8 to 12 weeks they will have developed into immature fluke and have caused significant damage. In the bile ducts (within the liver) they develop into adult fluke, lay fresh fluke eggs, and the life cycle re-commences.

Typically, individual farms will have wet "flukey areas" which favour the development of the mud snail and are thus high-risk for fluke. Late summer to winter (depending on climatic conditions) is often the most critical period. It cannot be assumed that liver fluke infection is absent from any area of Ireland.

If animals have significant clinical signs such as diarrhoea, bottle jaw and weight loss with anaemia, this may represent the tip of the iceberg with significant ill-thrift and loss of feed conversion and production in other animals.

Recent research has shown that the species of rumen fluke in Ireland may also use the mud snail as its host. This means that flooding of pasture is not required for the rumen fluke life cycle to be completed. It is likely that it is the immature fluke in the small intestine that cause the real damage. Rumen fluke should be considered in stubborn cases of diarrhoea in cattle.

Parasite case histories from the suckler and beef herds

Let us take a typical 50 cow suckler farm, grazing mainly on old pasture with calves at-foot. This farm also fattens all stock to beef. In addition they purchase 30 weanlings in October every year to increase their beef numbers.

Query 1: In mid-September, just after weaning, the suckler calves are scouring and not thriving as well as expected. They are grazing with the cows on permanent pasture and have not been dosed yet. What could be the problem?

Veterinarians advice; There are a number of possibilities. Gutworms are high on the list. By mid-June worm eggs, even from the cows, will have hatched and developed into infective larvae (several cycles may have occurred) which, with moisture and rain, will have moved from dung pats onto the pasture. Close grazing will also increase the larva intake by the calves. The condition is called parasitic gastroenteritis (PGE). Faecal testing 10 to 15 samples (which may be pooled in the laboratory) will aid the diagnosis. Your veterinarian will likely also consider secondary copper deficiency and coccidiosis as part of the possible diagnoses. Be careful that lungworm levels may also be at critical levels. If necessary an appropriate anthelmintic will deal with this problem.

It is also possible to check the faecal egg counts after dosing to ensure there is no resistance to the anthelmintic used. Also, second year grazers need to be monitored.

Query 2: In our suckler farm described above, after housing in November, all the weanlings (both home-reared and bought-in) are coughing persistently. What is causing this?

Veterinarians advice: This is a tricky situation in that both virus pneumonia and lungworm are high on the list of differential diagnoses. Clinical examination plus laboratory testing will help the veterinarian decide where the problem and solution lie. In fact, both diseases could be interacting. The bought-in weanlings are challenging the biosecurity on the farm and possibly introducing new viruses that are causing pneumonia. Extended grazing may also have increased the season for lungworm so this may also need attention.

A herd health program with your veterinarian would likely prevent many of these diseases and keep thrive going well.

Query 3: Three cull cows are fattened for slaughter and the factory report live fluke in their livers. What does this mean?

Veterinarians advice; Collection and Communication of Inspection Results (CCIR) from the abattoir in this case has provided direct evidence that your cows are infected with fluke. It would be appropriate to faecal test other groups of stock and with your veterinarian put a fluke management program in place. This may include:

- Drainage or fencing off wet areas and avoidance of poaching.
- Strategic dosing in early summer to reduce the number of snails becoming infected. Also dose and quarantine bought-in animals.
- Monitor fluke burdens both by faecal testing and from the abattoir liver reports. Faecal sampling at an appropriate time after dosing with a flukacide will assist in the assessment of resistance.
- Appropriate treatment of affected groups with a flukacide.

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Respiratory disease in housed cattle

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Summary

- Respiratory disease is the most commonly diagnosed cause of mortality in housed cattle in Ireland with various viruses and bacteria implicated in respiratory disease outbreaks which may cause disease either alone or in combination.
- Understanding and counteracting the contributing factors responsible for the development of respiratory disease outbreaks is a vital step in prevention of same.
- Vaccination plays an important role in the control of respiratory disease in housed cattle but may not on its own prevent respiratory disease outbreaks if inappropriately used or if other risk factors are not addressed.

Introduction

Respiratory disease is consistently the most commonly diagnosed cause of death in cattle submitted to DAFM Regional Veterinary Laboratories (RVLs) for post-mortem examination as per the *All-island Animal Disease Surveillance Report*. It consequently represents both a significant financial loss and an animal welfare concern on Irish farms. Effective prevention of respiratory disease in weanlings avoids the direct costs of veterinary bills and animal losses but also significant indirect costs due to a longer term reduction in growth rates and/or stunting of affected cattle. There is a marked seasonal pattern in the occurrence of the disease, with most cases observed during the winter housing period. Many losses can be prevented by adherence to a number of basic husbandry principles and by an understanding of the causes, contributing factors and preventative measures which can be employed in defending your herd against disease.

The causal agents of bovine respiratory disease

A number of infectious agents are associated with respiratory disease in housed cattle and they can be broadly grouped as either viruses or bacteria.

Table 1 — Some of the viral and bacterial agents commonly indentified in bovine respiratory disease cases in housed animals in Ireland.

Viruses associated with bovine respiratory disease	Bacteria associated with bovine respiratory disease
Bovine Herpesvirus-1 (the causal agent of Infectious Bovine Rhinotracheitis (IBR))	*Pasteurella multocida*
Bovine Respiratory Syncytial Virus (BRSV)	*Mannheimia haemolytica*
Bovine Coronavirus (BCV)	*Mycoplasma bovis*
Parainfluenza-3 Virus (PI3)	*Histophilus somnus*

The viruses listed in Table 1 may be sufficient to cause respiratory disease in cattle when acting on their own but are often found alongside bacteria in pneumonic lungs. These bacteria are usually secondary invaders taking advantage of initial damage caused by viruses or other injury to become established in the lungs and then exacerbating that

tissue damage. Although lungworm infestation is primarily a problem in animals at grass, or of cattle that are not dosed for worms prior to housing, lungworm larval burdens acquired on pasture can continue to cause tissue damage in the housed animal, thereby facilitating viruses and bacteria in initiating respiratory disease.

Contributing factors to the development of disease

1. **Housing/Ventilation.** Ventilation is important in ensuring the health of housed cattle. The rate of air movement into and out of an animal house will determine the quality, humidity and temperature of the air within, and ultimately the ease with which infectious agents may be transmitted between animals in that airspace. Natural ventilation in well-designed animal houses relies on the 'stack effect' – produced when warm air from animals rises and escapes through the outlet at the top of the house, being replaced by fresh air entering through the inlet. Air movement in excess of 0.5 m/s represents a draught which can lead to chilling of the animal while insufficient air movement can lead to moisture and gas build-up.
2. **Mixing of animals of different ages and 'all-in/all-out' policies.** Housing of animals of different ages in the same airspace and failure to employ an 'all in, all out' policy with regard to housing, is a proven recipe for trouble. Older animals, while appearing clinically normal, can act as a source of infectious agents to younger naïve animals housed with them. This practice is compounded when an 'all-in, all-out' policy is not adhered to, amounting to a constant unbroken connection between all batches of animals and allowing the communication of respiratory agents from one batch to the next. Moving all animals from a house, and disinfecting before moving the next batch in allows a clean break to be made between batches and for the next batch to start with a clean slate.
3. **Biosecurity.** Poor biosecurity is a contributing factor in the incursion and spread of many diseases within herds such that when these poor practices are modified the animal health dividend which accrues can be significant. The advice in this respect is not new or revolutionary and includes maintaining a closed herd (where possible), avoiding nose-to-nose contact with other herds at boundaries and operating disinfection points, which are used by all, at entry points to the farm. The simplicity of such advice belies the importance of adhering to it in preventing disease outbreaks.
4. **Stress.** Stress adversely affects the immune system and, consequently, stressed animals are more prone to infectious diseases. Weaning, handling of animals to perform procedures such as castration and dehorning, and the transportation and mixing of animals associated with sales are all significant stressors to which juvenile cattle are often subjected immediately prior to winter housing. Prior "conditioning", whereby weanlings are not exposed to all of these stressors at the same time and are allowed to acclimatise before housing, will reduce the likelihood and negative impact of respiratory disease.

The role of vaccination in prevention or control of respiratory disease

Commercially available vaccines against many of the agents responsible for respiratory disease can help prevent respiratory disease and/or manage an outbreak on farms. However, vaccines are rarely 100% effective and their efficacy is determined by many factors including the level of challenge presented to the animal, the proper functioning of the animals' immune system and the timing of vaccination relative to infection.

Conclusions

In short, sourcing cattle from multiple sources and housing them together within the same airspace almost invariably leads to respiratory disease. Take steps to protect your animals and your profits by "conditioning" animals prior to housing, controlling the animals' environment, vaccinating your animals against respiratory pathogens and taking steps to exclude pathogens from your farm.

Technology Village:

The business of beef systems

Impact of beef production in the Irish economy

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Summary

- Beef production is Irish agriculture's most important activity in terms of output and farm employment.
- The volume of beef production has been relatively stable since decoupling.
- Ireland is the 20th largest beef producer and the 5th largest net exporter of beef in the world.
- The dependence of Irish beef production on the suckler herd is unusual in an EU context.
- There is a profitability problem in Irish beef production.
- Performance on best Cattle Rearing and Cattle Finishing farms shows that returns to labour employed on the farm and capital invested can approach those earned on dairy farms.

Introduction

Beef production together with dairy production dominates the Irish agricultural economy. In this brief note the salient economic characteristics of Irish beef production and the challenges faced by the sector are outlined.

Beef production in Ireland

Beef production occurs on the majority of Irish farms. In the 2010 Census of Agriculture 56% (77,738) of Irish farms were classified as specialised in beef production. This proportion varies regionally with over two thirds of all farms in the Midlands region classed as specialised in beef production. Meat processing in the last Census of Industrial Production (2011) accounted for 7% of industrial employment.

The value of Irish beef output varies from year to year due to movements in cattle prices and changes in the volume of cattle disposals (live exports plus slaughterings). Over the period 2001-2013, the average share of beef output in total agricultural sector output value has been 28% (the same share as milk production over that period).

The total volume of Irish beef production in 2013 was 518 kilo tonnes (carcass weight equivalent). This figure has declined somewhat over the last 10 years with the volume of output in 2013 being 4% lower than in 2005. This marginal decline in the volume of output has been more than offset by growth in prices, with the value of output in 2013 being over 50% higher than in 2005.

Irish beef production in a European and global context

In a global context Irish beef production is important, but not due to its absolute volume. Ireland in 2013 was ranked 20th of all global beef producers (USDA and Eurostat). With approximately 90% of Irish beef production exported, in 2013 Irish net exports of beef (exports less imports) were the 5th largest in the world (surpassed only by Brazil, India, Australia and New Zealand). Export earnings from beef production in 2013 were €2.1 bn (Bord Bia) with all Irish beef exports destined for high value UK and continental EU markets.

In an EU context the Irish beef sector is unique in terms of its export dependence. The importance of the suckler cow based beef production is also unusual. Two thirds of cows in the EU28 are dairy cows, whereas in Ireland one half of all cows are suckler cows. The dependence of Irish beef production on offspring of the suckler cow herd is only matched in the EU context by France, the UK, Portugal and Spain. Outside of the EU, suckler cow based beef production is more common, but is usually based on very extensive cow-calf farms and intensive feedlot finishing systems.

Profitability in Irish beef production

Teagasc National Farm Survey data have consistently highlighted the profitability problems associated with beef production on Irish farms. Since the decoupling of direct payment (DP) income subsidies from production in 2005 the average family farm income (FFI) on *cattle rearing* and *cattle other* farms has been less than the average of total DP receipts (see Table 1).

Table 1 — Cattle Rearing & Cattle Other farm systems: average output, income and direct payments (€/ha utilised agricultural area (UAA)) 2005-2012.

	2005	2006	2007	2008	2009	2010	2011	2012
Cattle Rearing								
Gross output (excl. subsidies)	450	465	459	492	414	446	557	661
Subsidies	604	447	459	455	451	446	431	441
FFI	466	300	277	261	221	222	336	348
FFI – subsidies	-138	-147	-182	-195	-230	-225	-95	-93
Cattle Other								
Gross output (excl. subsidies)	525	567	563	645	552	595	742	836
Subsidies	755	511	515	519	500	490	498	489
FFI	603	379	356	361	301	304	432	412
FFI-subsidies	-152	-132	-159	-157	-199	-185	-66	-77

Source: Teagasc NFS

The profitability problem in Irish beef production and the low to negative margins earned from beef production also characterises much of EU beef production according to the latest Agri Benchmark report. Compared to international competitors (such as countries in North and South America) costs of production in the EU are higher. This cost competitiveness issue may be important in the context of on-going Free Trade Agreement negotiations with USA and the Mercosur countries of South America.

Analysis of the performance of the top 10% of Single Suckling and Cattle Finishing farms in the Teagasc NFS suggests that when FFI is adjusted for the volume of unpaid (i.e. family) labour used on the farm, or expressed relative to the value of the non-land assets used in the farm business, the incomes earned from beef production (inclusive of subsidies) can be competitive with other agricultural production activities. The challenge for the industry is to both improve the average economic performance and to narrow the distance between best and average outcomes.

Conclusion

Beef production continues to be important to the Irish economy in terms of export earnings and employment. However, the lack of profitability at farm level continues and this profitability problem is the principal challenge in developing a sustainable Irish beef industry and economically sustainable beef production.

Types of cattle farms

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Summary

- The Department of Agriculture, Food and the Marine are funding a new project evaluating the evolution, structure and performance of the beef sector.
- The five categories of farms, farmers and farm households producing beef are specialist finishers, uncertain future, marginal sucklers, on-farm diversifiers and off-farm diversifiers.
- This classification system will be used to identify, within each group, the strategies and systems deployed by the most efficient or profitable farms and to provide this information to participants in the BTAP.

Introduction

Drystock, specifically cattle production, is the dominant form of farming in Ireland, despite the returns to most farmers involved being relatively low, if not negative. The sector is characterised by its heterogeneous nature with significant differences in the scale, structure, degree of specialisation, intensity, and combination with other farm and non-farm economic activities. Conventionally, farms producing cattle are divided between beef production specialities (e.g. suckler systems, finishers), but even within specialist groups there are a wide variety of different types of farm enterprises in terms of scale, output, profitability, etc. Despite this, initiatives targeting these farms do not take sufficient account of their differences, i.e. they are treated as being broadly similar. In a major study into beef production in Ireland, funded under the Research Stimulus Fund, Teagasc are identifying broad types of farms engaging in cattle production. This paper is a general introduction to this farm classification.

Table 1 — Variables used to define the cattle farm typology.

Variables	Specialist finishers	Uncertain future	Marginal suckler	On-farm diversifiers	Off-farm diversifiers
Gross margin €	High	Low	Low-Med	High	Low-Med
On-farm *hrs/yr*	High	Med-High	Low-Med	Med-High	Low
Calves/weanlings*	Zero	Zero	Many	Few-Many	Zero
Stores*	Zero	Zero-Many	Zero	Many	Zero-Many
Finished animals*	Many	Zero-Few	Zero	Zero-Few	Few
Stocking *cattle/ha*	High	Low-High	Low	Low-Med	Med
Other labour°	Unclear	No	No	Unclear	No
Invests in land°	Yes	Unclear	Unclear	Yes	Yes
Other enterprises°	Yes	No	Unclear	Yes	No
Off-farm job°	No	No	Unclear	No	Yes
Teagasc adviser°	Unclear	No	No	Unclear	No
Agric. training°	Unclear	No	No	Yes	No
AES°	Yes	No	Yes	Yes	Yes

*: Numbers sold. °: Yes or no; AES = Agri-environment scheme

Study framework

In addition to using published research, the development of this classification system drew on the views of Teagasc advisers and farmers participating in beef discussion groups. Any farm that held or produced cattle was included in the analysis. A latent class cluster model was applied to the 2012 National Farm Survey (NFS) data. This classifies individuals according to a number of descriptive variables (Table 1), and the five groups created were equally likely to occur in the 2012 cattle farm population. Table 2 shows how the five groups compare to each other for example variables.

Table 2 — Comparison of the typologies.

Variable	SF	UF	MS	OnD	OffD
Direct payment values €	1	5	4	2	3
Size of farm *ha*	1	2/3	4	2/3	5
Age of farmer *yrs*	2	1	4	3	5
Number of family labour *labour units*	3	2	4	1	5
Having offspring in school°	4	5	2	1	3
Having offspring in preschool°	4	3	1	5	2
Having offspring in college°	3	5	2	4	1
Having support from spouse°	4	5	1	2	3
Having less disadvantaged area°	5	2	1	3	4
Having severely disadvantaged area°	5	3	1	4	2

1-5: Highest to lowest/most to least likely occurrence for each variable by cattle farm type. °: Yes or no.
SF: Specialist finisher, UF: Uncertain future, MS: Marginal Suckers, OnD: On-farm diversifier, OffD: Off-farm diversifier.

Preliminary typology

A: "Specialist finishers" are most likely to sell finished, rather than other types, of cattle. They work a high number of on-farm hours and earn high valued gross margins. Of all five groups, they have the highest direct payments, the largest size farms and are the least likely to have disadvantaged land.

B: "Uncertain future" farmers have both mixed stocking rates and variable sales numbers for stores and finished animals. They have no off-farm job, on-farm hours are medium to high and farm gross margins are low. These farmers do not appear to strongly consider the future of their farms because they do not invest in their land, other enterprises or training. This group is characterised by an elderly age profile, and are the least likely to have support from spouses or to have children in school or college, suggests that they do not have successors.

C: "Marginal sucklers" sell calves and weanlings, have low to medium gross margins and on-farm hours as well as low stocking rates. They are the most likely of the five types to have both less and severely disadvantaged land. Despite being the most likely to have support from their spouse and to have children in each of the schooling categories, these farmers actually use the lowest amount of family labour units. Hence, although they have family labour available to them, the extent of what can be carried out on the farm may be constrained by environmental issues.

D: "On-farm diversifiers" sell varied numbers of calves and weanlings, and finished animals, and a large numbers of stores. Their farm gross margins are high, but, given their low to medium stocking rates, much of this is expected to come from other on-farm enterprises, e.g. tillage. They invest in land, training and agri-environmental schemes and have the highest levels of family labour of the five groups. The fact that they do not have off-farm jobs suggests that they may focus on diversifying income from on- rather than off-farm sources.

E: "Off-farm diversifiers" mainly sell stores or finished animals and record low to medium returns from farm gross outputs. They do not hire other labour and have the lowest levels of family labour of the five groups. "Off-farm diversifiers" have off-farm jobs that may provide income for land investment. They continue to farm despite being the second most likely to have severely disadvantaged land of all; this suggests a desire to continue to farm regardless of environmental constraints.

It is clear from this study that cattle farms in Ireland constitute a uniquely complex sector.

Investigating financial performance on cattle farms

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Summary

- The Teagasc eProfit Monitor links together the physical (hectares of land, kgs of liveweight) with the financial (income and expenses) characteristics of a farm.
- The reports from the system are laid out to allow you to clearly identify what is affecting the financial performance.
- The information can be used to guide and influence your decision-making for the year ahead.
- Tracking farm cash flow during the year keeps you in tune with how money is used by the business and should link one year's annual eProfit Monitor with the next.

Introduction

The business of cattle farming involves spending money in order to make money. Money comes in by way of stock sales and direct payments and money leaves to meet stock purchase costs as well as to cover farm running costs such as feed, fertiliser and veterinary costs, among others. The seasonality of many cattle systems means there is often an overlap of batches of cattle on the farm and therefore assessing financial performance is seen as a difficult task. Taking the time to pull together income and expense information to track financial progress during a distinct period of time (12 months) is well worthwhile to assess how the farm is doing. Teagasc provides a service called the Teagasc eProfit Monitor (ePM) to allow you to carry out this assessment with the help of your adviser.

The eProfit Monitor system takes information on the income and expenses of your business and puts them in a suitable standard layout to allow you to check how the farm performance compares from year-to-year or also how it might compare with other farms. The maximum benefit from the information can be extracted if a number of years are looked at in sequence – trends in the figures can be seen and the influence of one-off rises or falls in livestock prices or the price of feed/ fertiliser prices can be examined and the underlying trends in performance observed.

Benchmarking your farm

Many first time users of the Teagasc eProfit Monitor (ePM) ask "How do I rate my performance?" and "What do I compare my figures against?" The first comparison is often with your own farm figures from last year – that's if you have completed an ePM for at least two years. This can tell you a lot – and it can help tune you in to how the figures in the ePM reports relate to the years events on your farm – events such as the number and type of stock sold, the regular spending on inputs as well as the exceptional spending on building investment, reseeding, breeding stock purchase should be reflected in the reports from the ePM system. The eProfit Monitor creates a link between the farms physical measures (hectares of land used / kilogrammes of liveweight produced) with the financial measures (euro received and spent). The system breaks the financial story of the farm year into the broad categories of gross output, variable costs, gross margin, fixed costs and profit.

Once you have a reasonable understanding of the farm's financial progress during the year and you can link it back to the actual physical sales of stock and usage of inputs then you should begin to critically compare the farm against other operators. Those farmers that are

members of discussion groups where the eProfit Monitor information is shared can look at performance of other group members and gauge their own performance against them. This is very useful especially if you can tease out what these other farms are doing differently to affect their figures. If you are not a member of a discussion group your adviser can still give you some guidance here as to what is below or above average for each important measure.

	Per Ha	This Year	Last Year	% Change
Gross Output	€	2,289	2,105	+9%
- of which Stock Sales	€	2,118	2,028	+4%
Total Variable Costs	€	1,369	1,132	+21%
Gross Margin	€	920	972	-5%
Total Fixed Costs	€	878	712	+23%
Net Profit	€	43	260	-84%
Total Direct Payments	€	621	679	-9%
% Direct Payments Retained		107 %	138 %	

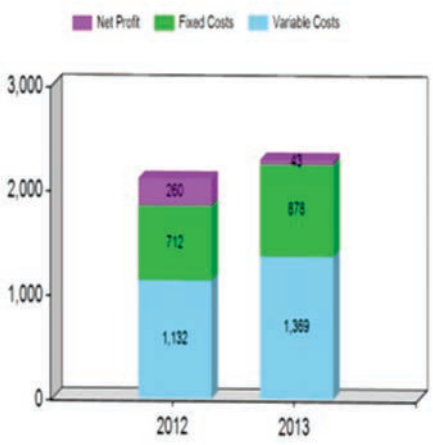

Figure 1 — An eProfit Monitor report showing a comparison of current year versus previous year financial performance.

Using the eProfit Monitor information

By clearly setting out the farm's financial story and by making comparisons using a benchmark you will be able to identify areas that are "above or below" what you would like to achieve (Figure 1). You can then start to look at setting achievable targets for improvement for your farm which you can measure against next year when you complete the next eProfit Monitor analysis. You also have the option of setting targets in the form of an annual (or monthly) cashflow to allow you to check on your progress during the year ahead (see below). If you are planning to invest on the farm by way of land purchase or spend on building then a forward financial plan covering up to five years ahead can be prepared by your adviser using your current year eProfit Monitor figures as the starting point.

Tracking farm cash movement

As well as the "end-of-year" examination of the financials using the eProfit Monitor, Teagasc also provide a way of allowing you to keep an eye on the financials DURING the year. The Teagasc Cost Control Planner allows you to track cash flow as the year unfolds essentially keeping an eye on how money comes in and leaves your farm's bank account. This process of tracking your cash covers the period between completing one eProfit Monitor analysis and doing the next one. Keeping a record of the money in and out during the year makes the task of completing the end-of-year eProfit Monitor very simple as all the information is already sorted into the necessary income and expense categories. The Cost Control Planner also allows you to easily record both your cattle sales and purchase information for the complete year in one place. The system also allows a cash flow budget to be prepared for the year ahead by putting together annual and monthly cash targets based on the eProfit Monitor analysis.

If you want to avail of the Teagasc eProfit Monitor service or get a copy of the Teagasc Cost Control Planner then contact your local Teagasc advisory office or contact us by email on **profit.monitor@teagasc.ie**

My farm, my plan, planning for my future

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Summary

- We look at the components and benefits of completing a farm plan.
- The thinking process is made up of three stages:
  — Where am I going?
  — What do I need to do to get there?
  — What are the extra costs, benefits and risks?
- The financial plan is developed in conjunction with your adviser; this includes net profit, balance sheet and cash flows.
- The best work any farmer can do is to invest time into thinking about their plan. Completion is then simply a matter of putting your thoughts down on paper.
- Get a copy of "My farm, my plan, planning for my future" today or access it as described below.

Benefits of farm planning

"*I have no plan, so nothing can go wrong*"…Spike Milligan.

Farm planning is deciding in advance what should be done, how it is to be done, when it is to be done and by whom. For example, when you go to the mart and you see a bullock that is good value, should you buy it even if it does not fit your system?

Have you asked yourself? "Are there weaknesses as well as strengths in what I am doing now and could a plan help me to farm better?" and also "what am I good at?" It is always good to play to your strengths and get some help where you need it. An important part of any plan is to ask who in your family helps out? We all need supports. The farming family network that supports your farm should also include your adviser, veterinary surgeon, bank manager, etc.

Given the demands of farming it is very easy to lose sight of what is happening outside the farm gate. For example, the changes from the single farm payment to the new basic payment system. This will now allow us to see the payment stream for the next five years and thus account for a vital element of income in your plan.

The farmer's plan

There are two main parts to a farm plan:
The thinking process i.e. what the physical farming operation will look like over the period covered by the plan.
The financial process, i.e. what the cash flow, farm profits etc. will look like during and at the end of the plan. This will help in an assessment to see if the proposed plan is viable.

The thinking process

This must be completed by the farmer before a financial plan is finalised. It involves asking yourself a series of questions in three stages:

Stage 1: Where am I are going?
Stage 2: How will I get there?
Stage 3: What extra costs, benefits or risks is my plan expected to generate?

Many of these ideas are already in your head but writing them down will help clarify them for you. It will also help in preparing your financial plan and give you a much better understanding of the background to the figures.

Stage 1: Thinking about where my business is going.
This involves looking at the "big picture" of your current situation and any plans you may have. The questions that may be considered under this heading are:

- Why am I farming?
- What am I thinking of doing?
- How is this going to deliver on my reasons for farming?

Stage 2: Thinking about what I have to do.
This involves bringing the "big picture" into greater focus and developing the practical steps required to implement the plan. The questions that may be considered under this heading are:

- Where am I now?
- What are the main issues I must focus on?
- What do I have to do to get there?
- When will I make these changes?
- How will my plan affect my working day?

Stage 3: Extra costs, extra revenues and extra risks.
This is a basic financial assessment of the proposed plans looking at the cost, benefit and risks before proceeding onto a detailed financial plan. The questions that may be considered under this heading are:

- What are the extra costs?
- What extra revenue will be generated?
- What could go wrong?

The financial process

Stage 4: Developing a financial plan.
Following completion of the farm plan, you and your adviser can then prepare a detailed financial plan to fully examine the financial viability of your proposals. This includes:

- Profit and loss statement
- Balance sheet
- Multi-annual cash flow

"My farm, my plan, planning for my future" is a workbook that is available at your local Teagasc office, on the Teagasc website at Teagasc.ie or download it by scanning the code below:

New opportunities for farmer collaboration in beef systems

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Summary

- Collaborative arrangements offer a great opportunity for beef farmers to come together with others to achieve scale, share facilities and improve lifestyle, or to become involved in a new and alternative farm enterprise.
- Registered farm partnerships will be open to all mainstream farm enterprises, including beef, from 2015 onwards.
- When these arrangements are managed well they have the ability to deliver greater income to the farm family. They can offer a gateway into dairy farming for beef farmers.
- For farming families, collaborative arrangements have the potential to make farming more sustainable into the next generation.

Introduction

Farmer collaboration has existed in Ireland for generations. There are many historic examples such as threshing and sharing silage machinery. Put simply, farmer collaboration is where two or more farmers come together in an arrangement that is to the benefit of those involved. Since the early 2000's, Teagasc has played a leading role in the development of formal collaborative arrangements such as milk production partnerships. Information including template agreements on all the collaborative arrangements is available on www.teagasc.ie. Support for collaborative arrangements has become government policy and these arrangements are catered for in all the supports to the agricultural sector. These arrangements include registered partnerships, contract rearing and share farming amongst others.

Registered farm partnerships

A partnership is where two or more farmers combine their farming operations into one business. The partners share the profit that the farm makes on an agreed basis. Partnerships present a new opportunity for beef farmers to pool their resources such as land, labour, facilities, machinery, etc., to the mutual benefit of all the people involved. Improved lifestyle comes from greater labour availability where there are two farmers working together. This means that there is another person there to help with bigger jobs and someone there to keep things running when a partner needs to take time off. Other benefits include the ability to bring a son or daughter into the farming business in a formal way as a stepping stone to full succession. The partnership allows the young farmer in the arrangement to benefit from any available EU government supports. Partnerships also provide a gateway for a beef farmer to enter dairying through partnership with an existing dairy farmer.

Registered partnerships have been in operation in Ireland since 2002. Initially they were quite restrictive but progress has been made over the years as people and organisations began to see the benefit of them to farmers. There are currently 700 milk production partnerships on the register. From 2015 onwards registered farm partnerships will be open to all mainstream farm enterprises including beef. The Department of Agriculture, Food

and the Marine will take over the responsibility for the maintenance of a new partnership register from March 2015 onwards. Proposed benefits under the new CAP agreement include the 25% young farmer top-up, increased level of grant aid for young trained farmers and a trebling up of any grant investment ceilings where three partners are involved. Another benefit of entering into a registered farm partnership is enhanced stock relief.

Contract rearing

Contract rearing is an alternative to traditional beef enterprises such as dry cattle or suckling systems. It is where a farmer enters into contract where he or she gets paid to rear heifers for a dairy farmer. It is critical that the rearer gets paid adequately to cover direct costs and make a margin on the enterprise. The advantages to the rearer are that cash flow is more favourable as payment is generally paid by direct debit on a monthly basis. Another advantage to the rearer is that there is no money tied up in stock, as ownership does not transfer to the rearer. Essentially the rearing period can be broken down into five stages: Calf Rearing; First Grazing Season; First Winter; Second Grazing Season and Second Winter. The rearing periods need to be borne in mind when planning a rate of payment. Rearing the calves to twelve weeks of age and keeping the animals over the winter periods are the most expensive. The grazing seasons are by far the least expensive rearing periods. In setting up these arrangements the parties need to agree the start and finish of the term of rearing. If this is to be extended, then the payment rate needs to be increased, especially where this leads further into the second winter when the heifers are approaching eighty per cent of maturity. Each party should draw up a budget to plan and monitor their own finances. Agreement must be reached at the start on which costs are to be incurred by each party. This will determine the rate of payment per head per day.

The priority for the rearer is to cover costs and get adequately paid for his or her labour, but this comes with responsibilities. The heifers must reach their target weights at housing after the first grazing season, at mating and approaching calving after the second grazing season. This is the dairy farmers' priority. It is critical to them that the heifers reach these weights. The rearer also needs to be aware of the average starting weight for the group of heifers and have realistic expectations for weight gain during the rearing period. Regular weighing of heifers is a recommended practice.

Share farming

Share farming is not widely practiced in beef enterprises. It is growing in popularity in the tillage sector and there is also an opportunity for it to develop in the dairy sector once milk quotas are removed in 2015. The concept remains the same across all enterprises. Share farming is where two completely separate businesses operate on the one farm. In a share farming agreement, the farm produce, in this case beef cattle, are sold and each person gets an agreed proportion of the sale proceeds. In addition to this, each person in the agreement pays a proportion of the variable costs such as feed, fertiliser, veterinary, etc. Some of the fixed costs may also be divided such as machinery running. The starting point for this venture is again a financial budget to cover potential income and expenditure from the enterprise. The share farmer generally provides the labour and in many cases the machinery. The landowner often provides the inputs such as feed, fertiliser and veterinary. How this is approached is up to the parties involved to agree upon.

Organic beef farming

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Summary

- Irish organic beef enjoys an excellent reputation amongst consumers both in Ireland and especially in Europe. The demand for Irish organic beef is set to continue to rise in the future.
- The Irish organic beef sector continues to grow. In 2012 there were 981 organic beef farmers in Ireland farming over 41,000 cattle.
- Organic beef farming can be a profitable system, and some of the most profitable beef farmers in the country farm organically. Premium prices of +15 to +20% have generally been achievable in recent years for organic beef compared to conventional beef prices.

Introduction

Organic farming is farming to a defined set of standards that adhere to the principles of organic farming and ensure that the integrity of the organic brand is maintained. Consumers purchase organic food for a number of reasons including: concerns about the build-up of chemicals in the body, taste, a return to traditional food values, animal welfare, and impact on the environment. After a recession-related decline, the organic markets in Ireland and Britain have stabilised and now returned to growth. Irish organic food enjoys an excellent reputation both at home and especially across Europe. Latest figures show the organic retail food market in Ireland is now worth over €98 million annually (source: Bord Bia, March 2014). In Europe the market for organic food has quadrupled in size over the last 10 years. This growth represents an opportunity for Irish farmers to supply more organic food, especially organic beef.

At farm level in Ireland, the organic sector continues to grow at a steady rate. In 2012, organically managed land occupied approx. 1.3% of the total farmed area in the country, and this was the result of a doubling in area during the previous decade. This compares with organic farming accounting for approx. 5% of the land area across the European Union (EU-27). The 2020 Food Harvest report has set a target of 5% of the utilizable land area of Ireland to have organic status.

Organic beef farming in Ireland

According to DAFM, in 2012 there were 981 organic cattle farms in Ireland, most of which were beef suckler farms (807). In total there were over 41,000 cattle including 13,600 suckler cows. This represented a 19% increase in cattle farm numbers and a 38% increase in cattle numbers since 2007. Figure 1 shows the location on a county basis of organic suckler cows and 12-24 month old organic cattle in Ireland.

Market demand for organic beef

In 2012, there were over 9,000 organic cattle slaughtered in Ireland by 526 farmers (source; DAFM). Beef farmers interested in organic conversion should speak with other organic farmers, processors and wholesalers about potential markets. The major factory outlets for organic beef are Goodherdsmen, Slaney Meats and ABP. Premium prices of +15 to +20% relative to conventional beef prices have generally been achievable for organic beef in recent years. According to processors the demand for Irish organic beef will continue to rise especially in the UK and Europe.

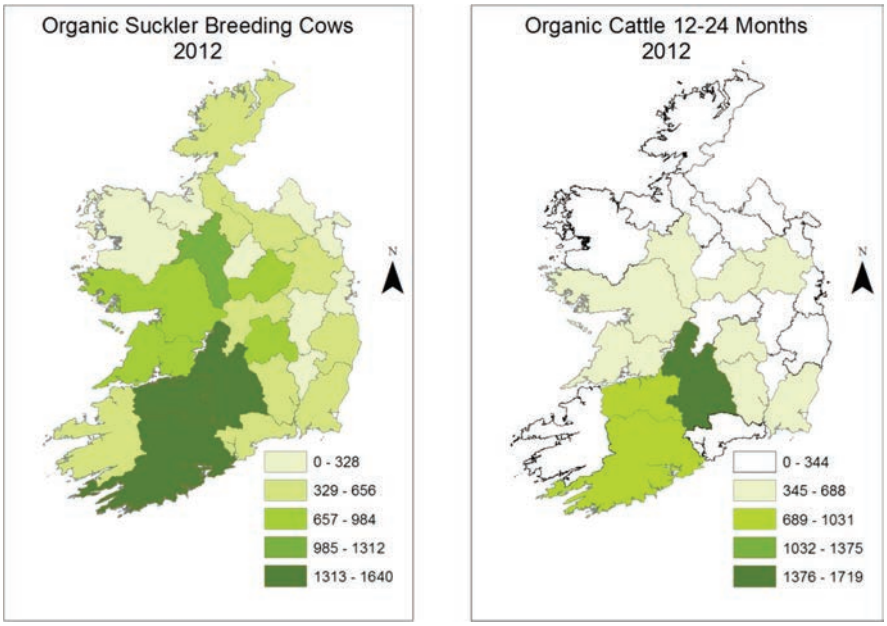

Figure 1 — Location on a county basis of organic suckler cows and 12-24 month old cattle in Ireland (2012).
Source: DAFM

Profitability of organic beef farming

Organic farming can be a profitable system of farming with some of the most profitable beef farmers in the country farming organically. This improvement in profitability is dependent on the following factors:

- Obtaining premium price for produce – produce that the market requires
- Maintaining high levels of productivity – with particular emphasis on clover
- Minimising inputs and reducing costs
- Maximising Organic Farming Scheme payments (due to re-open in 2015)

There is a perception that organic farming is difficult, contains a lot of red tape, is demanding on labour and returns low levels of productivity. The reality is quite different. The best organic farmers, using good husbandry and management skills, can achieve stocking rates up to 170kg N/ha. In terms of paperwork, detailed records must be kept but farmers in REPS/AEOS are already familiar with this type of record keeping.

Steps to successful conversion to organic production

1. Get acquainted with the adjustments required by attending Teagasc/Dept. Agric., Food and the Marine organic demonstration farm walk(s) – see: **www.teagasc.ie/organics**, and talk to other organic farmers and/or contact a local advisor.
2. Choose an Organic Certification Body (OCB) – IOFGA or Organic Trust and get an information pack.
3. Prepare a conversion plan and submit to OCB.
4. Apply to the Organic Farming Scheme. A new scheme is due to re-open in 2015. Consult DAFM website: **www.agriculture.gov.ie** for more details.
5. A 25 hour 'Introduction to Organic Production' course and a business plan has to be completed before acceptance into the OFS.

Update on the Derrypatrick Herd

Liam McWeeney, Denis Minogue, Paul Crosson, Rob Prendiville and Padraig French
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Summary

- Phase 1 of the Derrypatrick Herd, which evaluated the progeny of four cow breed types, has been completed. This work highlighted the importance of maternal traits in the economic performance of beef suckler herds and contributed to the development of the new maternal breeding index.
- Phase 2 of the Derrypatrick Herd will compare the performance of early- and late-maturing sire types finished as heifers and steers or young bulls.
- 2013 was a difficult year for the Derrypatrick Herd due to the very cold/wet spring. This had a significant effect on animal and financial performance and the herd had a calculated gross margin of €919/ha.

Introduction

The Derrypatrick Herd at Grange is a 70 ha research demonstration herd whose primary objective is to evaluate alternative suckler calf-to-beef production systems. The first phase of the Derrypatrick Herd (2009 to 2012) involved a comparison of four cow breed types Limousin X Friesian (LF), Charolais X Limousin (CL), Limousin X Simmental (LS) and Charolais X Simmental (CS). This phase is now complete with four crops of progeny produced. During this phase all cows were mated to late-maturing terminal sires and all male progeny were finished as 18-19 month old bulls on *ad-lib* concentrates for 100 days following a 3 month spring grazing period. Heifers were slaughtered at 20 months of age, at the end of their second grazing season. The LF cows produced the highest calf weaning and carcass weight and had the lowest bodyweight, therefore the highest weaning efficiency (Table 1). Reproductive performance (calves/cow/year) was similar across genotypes.

Table 1 — Reproductive performance and efficiency of 4 cow genotypes over 4 years.

	LF	LS	CS	CL
Weaning weight (kg)	313	287	282	279
Carcass weight (kg)	357	348	352	348
Calves weaned/cow mated/year	0.80	0.81	0.79	0.79
Calf weight weaned (kg) /cow to bull	251	233	223	221
Cow bodyweight (kg)	630	670	723	720
kg weaned/kg cow liveweight	0.50	0.43	0.39	0.39

Phase 2

The current phase involves a comparison of late- (Charolais and Limousin) and early- (Angus) maturing terminal sires and a comparison of steer and bull finishing systems. This began in late 2012 when 50% of the male calves were castrated. In spring 2013, 50% of cows were bred to early- or late-maturing sires. All replacements for this herd will be purchased based on Replacement Index values, and will come from both dairy and suckler herds. Because of the change in market requirements, all bulls (both EM and LM) will be slaughtered at less than 16 months without a spring grazing period. Steers from early- and late-maturing sires will be slaughtered at 22 and 24 months, respectively, and heifers from early- and late-maturing sires will be slaughtered at 18 and 20 months, respectively.

Performance for 2013

Because of poor grass growth in early 2013, the bulls had a longer than planned store period and it was not possible to have a grazing season for these animals. They were therefore built up onto meal *ad libitum* for indoor finishing. The overall result was that, at 18 months of age, average carcass weight at 358 kg was approximately 42 kg less than expected, and more meal was fed than originally planned (Table 2). In contrast, the excellent grazing conditions later in the season provided the opportunity to graze the finishing heifers for one extra month which helped to offset the long store period in early 2013. Consequently, average carcass weight for the heifers was close to target at 304 kg. The gross margin for the Derrypatrick Herd in 2013 was €64,299 or €919/ha.

Table 2 — Cow breed and calf gender effects on slaughter weight and carcass characteristics in 2013.

	Slaughter age (months)	Slaughter weight (kg)	Conformation score (1-15)	Fat score (1-15)	Carcass weight (kg)	Kill out %
LF		620	8.4	8.2	346	55.8
CL		604	9.0	7.6	334	55.3
LS		625	9.3	7.2	348	55.6
CS		614	8.9	7.2	340	55.3
Bulls	18	621	10.0	6.9	358	57.6
Heifers	20	563	8.3	7.5	304	54.1
Steers	23	662	8.4	8.1	364	54.9

The Maternal Herd

Robert Prendiville[1], Simone McCabe[2], Eddie Mulligan[1] and Noirin McHugh[2]
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Summary

- The function of the *Maternal Herd* is to allow us validate the €uro-star Replacement Index. It is a herd that will provide direction and confidence to stakeholders on the utilisation of the index to select animals suitable for breeding replacements.
- The *Maternal Herd* will be a valuable resource for collecting new information on maternal traits that are important for beef suckler systems.

Introduction

Genetics play an important role in overall farm profitability by facilitating optimal breeding decisions that have the potential to increase long-term animal productivity. The ideal suckler cow for Ireland is a cow that will efficiently produce a weanling that has a good weight-for-age, from a grazed grass diet, and that will go back in calf each year. Key drivers to profitability of suckler beef production include stocking rate, mean calving date, age at first calving, number of calves per cow per year, calf growth rate at grass and days to slaughter. However, all these drivers are irrelevant if the appropriate cow suited to a grass-based system of production has not been established. Current industry figures show that, on average, suckler cows are 30 months of age at first calving, have calving intervals of greater than 395 days and are, on average, producing 0.85 calves per cow per year. Since genetic gain is cumulative and permanent, an animal with high genetic merit for maternal traits should be superior for milk production and fertility traits, and this should extend to subsequent descendants. In autumn 2012, ICBF launched a new Replacement Index for beef cows that aims to identify bulls to breed heifers as suitable replacements for the beef suckler herd.

Teagasc's *Maternal Herd* has been established at Teagasc Grange. The research carried out with this herd will involve detailed observations on genotype for performance traits such as milk production, reproductive efficiency, weaning weight, body weight and body condition score, as well as detailed feed intake and energy balance measurements.

Establishment of the Maternal Herd

The herd was established in 2013 with the purchase of maiden heifers (weanlings) from commercial farms throughout the country. The primary goal was to validate the Replacement Index that was launched by ICBF in 2012. These heifers represent two divergent categories of animals – those of high and low genetic merit for maternal traits. Heifers were selected based on their sire's Replacement Index, as well as the breeding values for the key maternal profit indicator traits (i.e. age at first calving, calving interval, maternal weaning weight and maternal calving difficulty). Only heifers from sires with high reliability (>70%) values for the Replacement Index were selected. Two sire breeds were selected for this experiment, an early-maturing breed (Aberdeen Angus) and a late-maturing breed (Limousin). A total of 10 sires from each of the breeds were selected and 5 daughters per sire are used. Heifers were selected from two breeding sources, the dairy herd and the suckler beef herd. Figure 1 represents the composition of the Maternal Herd. The high Replacement Index heifers have an average maternal index of €179. Sires of these high Replacement Index heifers include: MPD, LSC, PBO, GIP, FL21, FL22, OMA, CVV and S511. The low Replacement Index heifers have an average Replacement Index value of €86 and their sires include: WLU, SYT, CMJ, PTN, ERW, PAM, NUF, TON, TKO and MBU.

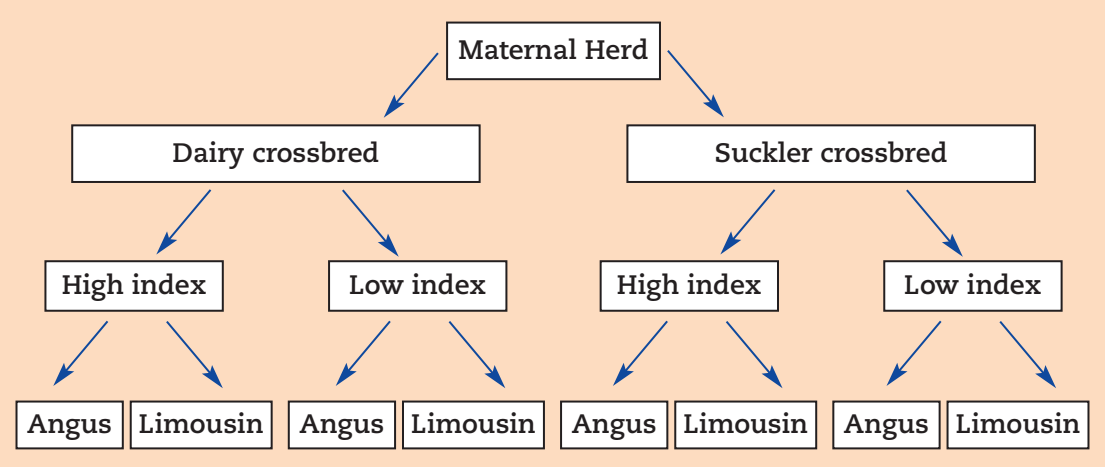

Figure 1 — Summary of the composition the new Maternal Herd.

Preliminary results

Mean calving date in year one of the study was March 21st 2014. Early production performance indicates no differences in cow live weight and body condition score at calving between the two genetically diverse groups. Results to date also showed no differences in calf birth weight or calving score between high and low replacement index animals.

Table 1 — Current performance of cows in the Maternal Herd.

	Dairy crossbred		Suckler crossbred	
Generic merit	**High**	**Low**	**High**	**Low**
Age at first calving (d)	*754*	*748*	*769*	*769*
Body weight at calving (kg)	*497*	*493*	*521*	*540*
BCS at calving	*2.28*	*2.31*	*2.35*	*2.39*
Calf birth weight (kg)	*39*	*40*	*39*	*41*
Calving score	*2.15*	*1.85*	*2.17*	*2.32*

Conclusion

The *Maternal Herd* is of fundamental importance to the industry and is an excellent research project that will provide direction and confidence to stakeholders on the utilisation of the Replacement Index. The herd will be a valuable resource for collecting new information on important maternal traits for beef suckler systems.

Beef crossing of the dairy herd

Brendan Swan and Robert Prendiville
Teagasc, Johnstown Castle Crops, Environment and Land Use Research Centre, Wexford

Summary

- Results from Johnstown Castle show that early maturing dairy crossbred beef production systems produce acceptable carcasses and have adequate fat covers at slaughter.
- Utilisation of pasture and focusing on a high output per hectare are fundamental to the profitability of these production systems.
- Preliminary economic analysis suggests that production systems that utilise pasture during the finishing period are the most profitable.
- Future research will investigate the influence of stocking rate and the use of clover for early-maturing dairy crossbred heifer and steer production systems. Alternative systems of production will also be investigated for late-maturing dairy crossbred beef animals.

Introduction

Beef bulls are used on the dairy herd to increase calf value when an appropriate amount of dairy sires have been used to generate dairy replacements. Given the low value of male dairy calves this spring and the use of sexed semen on some dairy farms, it is possible that there may be an increase in the proportion of beef crossbred calves coming from the dairy herd. For the last number of years, as dairy farmers were preparing for a non-quota environment, approximately two thirds of dairy cows were bred to dairy sires with the remainder bred to beef sires. Crossing dairy cows with early-maturing beef breeds, such as Aberdeen Angus and Hereford, is the most common approach given the ease of calving and short gestation traits associated with these breed types. For beef producers, these early-maturing dairy beef crossbred animals have the potential to achieve a commercially acceptable level of carcass fatness at a young age. They are therefore suitable for systems of production which are grass-based, producing saleable carcasses at a relatively low slaughter weight. Typically, early-maturing male dairy calves are finished as steers while heifers are finished off pasture at the end of the second grazing season or retained for breeding in the suckler herd. Theoretically, these early-maturing dairy calf-to-beef systems are sustainable in that performance is optimised from grazed pasture. Where grass growth is optimised and properly utilised these systems have the potential to achieve a high output per hectare.

Current research

On-going research at Johnstown Castle is evaluating a range of production systems for early-maturing dairy beef crossbred animals. February- and April-born calves (males and females) were assembled for the study. Varying production systems were generated by adjusting the age at slaughter for February- and April-born heifers and steers (Figure 1). Low input grazed pastures are the focal point for all production systems investigated. Performance results from the calves purchased in the first year of the three year study are presented. Results to date suggest that production systems for both heifers and steers that utilised grazed pasture during the finishing period were the most profitable.

Heifer production performance

February-born heifers in the 19 month production system were 454 kg at slaughter yielding a carcass of 228 kg. Live weight and carcass weight for heifers in the 21 month production system were 471 kg and 238 kg, respectively. Carcass conformation for heifers in both

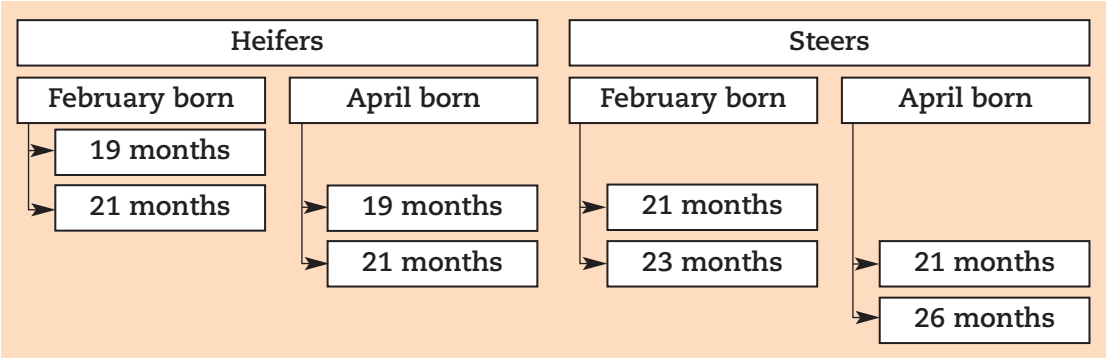

Figure 1 — Finishing systems for Aberdeen Angus and Hereford heifers and steers.

production systems were predominately 'O=' with carcass fat classes of 3-/=. The April-born heifers also had two ages at slaughter. The first group were slaughtered in November at 19 months of age following supplementation with 2.5 kg concentrates daily for the final 60 days at pasture. The remaining animals were housed and finished on silage *ad-libitum* with 5 kg concentrates per day. These animals were slaughtered in January at 21 months of age. April born heifers in the 19 month production system had a live weight at slaughter of 465 kg yielding a carcass weight of 234 kg. The heifers in the 21 month production system had a live weight and carcass weight of 501 kg and 249 kg, respectively. Carcass conformation for heifers in both production systems were predominately 'O=' with carcass fat classes of 3-/+.

Steer production performance

Consistent with the heifer production systems, the steers were either February- or April-born and had two ages at slaughter. The first group of February-born steers were slaughtered off pasture in November at 21 months of age, while receiving 2.5 kg concentrates/day. The remainder of the February-born steers were housed and finished indoors on silage *ad-libitum* plus 5 kg of concentrates per day. These animals were slaughtered in January. Live weight and carcass weight of 533 kg and 277 kg, respectively, were achieved for steers in the 21 month production system. February-born steers finished at 23 months of age were housed after the second season at pasture and finished indoors on silage *ad-libitum* plus 5 kg concentrate per day. Live weight at slaughter was 581 kg and a carcass weight of 293 kg was achieved. Carcass conformation for steers in both production systems was predominately 'O=/ O+' with carcass fat classes of 3-/=.

Late-born steers also had two slaughter dates. The first group were housed in November after the second season at pasture and finished at 21 months of age on silage *ad-libitum* plus 5 kg concentrates/day. These animals were slaughtered in January at 545 kg live weight. Carcass weight for these steers was 270 kg. The final group were housed and stored over the second winter on a silage only diet. These animals were turned out to pasture for a third season and were slaughtered in June at 26 months of age. Live weight at slaughter was 606 kg and a carcass weight of 315 kg was achieved. Carcass conformation for steers in both production systems were predominately 'O=/ O+' with carcass fat classes of 3=/+.

Future research

Future research at Johnstown Castle will investigate stocking rate and the use of clover for early-maturing heifer and steer production systems. Alternative systems of production are also being investigated for late-maturing dairy crossbred beef animals.

Dairy beef systems

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Summary

- Research at Johnstown Castle is evaluating a range of production systems for spring born male dairy calves where bulls are slaughtered at 15 and 19 months of age and steers are slaughtered at 21 and 24 months.
- Rearing males as bulls has inherent efficiencies due to their higher growth potential.
- Results suggest that bulls slaughtered at 15 months of age need to be finished on *ad-libitum* concentrates. However, concentrate costs are high and margins are low in this system.
- Profitability of dairy calf-to-beef production systems is affected when:
  - Calf price increases
  - Concentrate input costs rise
  - Beef price decreases.

Introduction

With the abolition of milk quotas in 2015, it is expected that the national dairy herd will increase considerably. Hence, a substantial increase in the supply of male dairy calves is anticipated. Currently, approximately two thirds of the dairy cows are bred to dairy sires to generate replacements for the herd. As a result over 300,000 male dairy calves are born each year. While some dairy farmers carry out calf-to-beef systems, it is anticipated that post quotas, dairy production will become more specialised and fewer dairy farmers will rear calves for beef production leading to a very significant increase in the number of male dairy bred calves coming on the livestock market. Finding the most suitable beef production systems for these male dairy calves is a challenge for the industry and for the last number of years there was renewed interest in bull beef production to the extent that bulls made up over 20% of the national kill in 2012. Rearing males as bulls has inherent efficiencies due to improved feed conversion efficiency and growth rate. However, with current market trends, issues of age at slaughter, target carcass weight and discounts on bulls older than 16 months of age, producers need to be vigilant before deciding on a production system. Research being carried out at Johnstown Castle is focused on establishing blueprints for systems of production that are profitable for beef producers.

Research at Johnstown Castle

Since 2010, a large-scale dairy calf-to-beef unit was established at Johnstown Castle to compare the performance of male dairy calves across a range of production systems. The ultimate aim of this research is focused on establishing blueprints of production for these calves. Animals are finished as bulls and steers and slaughtered at different ages. Avenues are also being explored to refine these blueprints in an effort to reduce the costs of production: increase the utilisation at pasture and increase carcass output per hectare. Alternative finishing strategies are investigating ways of reducing the concentrate input during the finishing phase. These studies will greatly assist beef producers identify the optimum production system that is best suited to their circumstances.

Bull production systems

15 month bull production system: a target carcass weight of 275 kg is required for bulls in this system with conformation scores of O=/O+ and fat scores 2=/2+. Results to date show that calves supplemented with 2 kg of concentrates daily during the first season at pasture and finished on a diet of *ad-libitum* concentrates from November to slaughter (May/June) produced carcasses of 265 kg. Conformation and fat scores were O=/O+ and 2=/2+, respectively. Total concentrate input during the finishing period was 1.8 t. This system is heavily reliant on high concentrate supplementation making it very vulnerable to changes in concentrate prices. Also, the requirement for grazed grass in the system was low to the point that it could not be a stand-alone system. Alternative finishing strategies were also explored where bulls were finished on grass *ad-libitum* silage supplemented with 5 kg/day of concentrate for the finishing period. While the costs of production were reduced, the carcasses were significantly lighter and carcass conformation score was also lower.

19 month bull production system: animals were turned out to pasture for 100 days in early March, housed in June and finished over a 100 day period. Concentrate input during the finishing period for bulls in this system was 1.2 tonnes and carcass weight was 320 kg. Conformation score was 'O=' with a fat class at slaughter of '2+'. Alternative finishing systems where bulls were finished off pasture supplemented with 5 kg of concentrates daily for 100 days pre-slaughter had lower carcass weights with lower fat scores. Despite these factors, it was more profitable to finish the bulls at pasture due to the saving in concentrate input costs. However, it is essential to have a market for these animals since demand is limited for bulls finished at older than 16 months of age.

Steer production systems

21 month steer system: carcass weight was 264 kg and conformation and fat scores were 'O-' and '2+', respectively. Animals received 5 kg of concentrates per head daily for 60 days pre-slaughter. The 21 month steer production system is an alternative to the 24 month steer system, as animals are slaughtered at the end of the second grazing season and so avoid the costly finishing period over the second winter.

24 month steer system: produced carcass weights of 317 kg. Conformation score and fat scores were predominantly 'O-' and '3=', respectively. Animals were housed at the end of the second grazing season and finished on *ad-libitum* grass silage plus 5 to 6 kg of concentrates/day, depending on silage quality. Concentrate intake for the finishing period was 600 kg. This system represents a commonly practiced system and the inputs and performance are very predictable and repeatable.

Conclusion

Research into a range of alternative production systems is identifying the optimum production systems. Despite bull production systems having the potential to achieve higher outputs per hectare compared to steer production systems, price discounts on bulls greater than 16 months of age relative to steers greatly reduces the profitability of the system.

Technology Village:

New technologies for animal breeding

Genomic tools for cattle breeding

Michael Mullen[1] and Noirin McHugh[2]
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Summary

- Teagasc, in collaboration with the Irish Cattle Breeding Federation (ICBF) and Weatherbys Ireland, have developed a custom DNA-chip called the "International Dairy and Beef" or "IDB" for dairy and beef cattle breeding.
- This genotyping platform provides, at a low cost to the producer, several types of useful DNA information to aid cattle breeding. The custom array facilitates the generation of accurate genomic selection proofs, as well as providing an extremely accurate tool for parentage verification and assignment.
- This custom DNA-chip eliminates the requirement for multiple testing (and associated costs) by also incorporating the tests to screen for lethal genetic defects, congenital disorders and known major genes (e.g., *myostatin* for double muscling).
- In addition to being a market leader in price and information content, the IDB provides improvements over existing approaches. Importantly, because it was developed in Ireland and its content is dynamic, it will always be optimised for Irish dairy and beef producers.

Background

Collaboration between Teagasc and the ICBF led to the development and implementation of genomic selection for Irish dairy cattle in 2009. Genomic selection uses the information on the DNA of individual animals to more accurately predict their genetic merit. DNA technologies are also used in parentage testing and testing for some genetic mutations (e.g., complex vertebral malformation (CVM), bovine leukocyte adhesion deficiency (BLAD), deficiency of uridine monophosphate synthase (DUMPS)). However, this typically requires multiple sampling and undertaking of separate DNA tests, all incurring their own individual costs. In 2012, Teagasc, the ICBF, and Weatherbys collaborated to develop a low-cost "all-inclusive" DNA-based array that could provide sufficient information for genomic selection, parentage testing and screening for genetic mutations of interest to both the beef and dairy industries. The motivation for such an endeavour was primarily cost reduction but also to remove the inconvenience of multiple sampling.

IDB content

The base information on the IDB is used internationally for dairy genomic evaluations. Our improvements to this international standard were three-fold:

1. **Improved accuracy of genomic evaluations:** To reduce the cost of genotyping, many countries genotype animals with fewer DNA markers on low density SNP panels and then subsequently predict (impute) markers found on higher density, and more expensive, panels. The more SNP on the low density panel the greater the accuracy of prediction (imputation) compared to higher densities and, therefore, the greater the accuracy of subsequent genomic evaluations. We added 5,500 additional DNA markers to the international standard for a marginal cost. This lead to a considerable improvement in the precision of the genomic evaluations through better prediction of the higher density genotypes of an individual, especially in beef cattle.
2. **Parentage verification and assignment:** Parentage testing changed from being based on blood-typing to DNA microsatellite technology in the 1990s. Because blood typing and

DNA microsatellites are different technologies all back-pedigree animals had to be genotyped for the DNA microsatellites. Genomic selection uses a different type of DNA marker called single nucleotide polymorphisms (SNPs). Large numbers of SNP markers can be measured on an individual animal at a lower cost, making it more accurate than microsatellites for parentage verification. In addition, SNPs can also be used for parentage assignment where the sire is unknown but his SNP profile is in the ICBF database. Transitioning from microsatellites to SNPs implies that all back-pedigree would have to be re-assessed on the SNP technology. However, the IDB incorporates an approach to accurately predict microsatellites from SNP genotypes, thereby eliminating the need and cost for all back-pedigree to be re-assessed for SNPs.

3. **Lethal mutations, congenital defects and major genes:** Most performance traits are governed by several thousand DNA variations. However, a select number such as double muscling and polled (i.e., no horns) are governed by one or only a few DNA variants. Moreover, if two copies of the same DNA variants exist in an embryo the pregnancy may fail; examples of such mutations include CVM, BLAD and DUMPS which are routinely tested for in sires used for artificial-insemination. We included tests for 53 such major genes on the IDB version 1. Fifteen of these tests are royalty bearing and incur an additional fee if their information is requested.

IDB genotyping in Ireland – progress to-date

Since its release in March 2013 and up to the 3rd May 2014, 26,709 Irish dairy and beef cattle have been genotyped using the IDB. While genomic evaluations for the dairy animals have been based on the results from the IDB, genomic selection for beef cattle is still underway and requires a larger population of beef animals with DNA information. To date, over 8,500 animals have been parentage-verified using the IDB. With microsatellite genotyping costs at €20 per animal this equates to savings of over €170,000 so far this year for Irish breeders.

Carriers of lethal recessive conditions, brachyspina and CVM have been detected in the Irish Holstein-Friesian population at 2% and 4% prevalence, respectively. In addition, congenital disorders citrullinaemia, osteopetrosis and syndactyly were identified at low frequencies (<1%). DNA variants in the *myostatin* gene (nt821, F94L and Q204X) were detected in Irish Angus, Belgian Blue, Charolais, Limousin and Simmental populations.

IDB version 2

The IDB is under continual development with re-evaluations planned on an annual basis. Version 1 was released in March 2013 and could test for 53 major genes. Version 2 was released in May 2014 and can test for 102 major genes. Additional DNA markers have also been included on Version 2 to assign cattle breed and improve the precision of genomic selection proofs even further. The IDBv2 will be the genotyping platform used for the Beef Genomics Scheme recently released by the DAFM and ICBF.

Conclusion

The IDB – designed for both beef and dairy cattle – is superior to the commercially available low-density panel, as it increases the accuracy of genomic evaluations, enables parentage testing and screens for mutations relevant to the cattle industry, all at a low cost.

Acknowledgments

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New tools to improve beef cow fertility

Michael Mullen, Kieran Meade, Sinéad Waters, Michael Diskin, Mark McGee and David Kenny
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Summary

- Reproductive efficiency of beef cows is influenced by a multitude of factors but is generally accepted to be in decline in Ireland.
- Recent evidence suggests that there is a significant genetic component to this poor reproductive performance
- Teagasc have commenced a number of new studies aimed at both understanding and improving the reproductive efficiency of beef cow herds as well as increasing the use of AI.

Reproductive efficiency is a major determinant of the profitability of beef cow enterprises. Despite this there is now clear evidence of a decline in the reproductive efficiency of Irish beef cow herds. For example, currently <0.8 calves are born per cow per year with <25% of cows producing a calf within a 12-month period; calving interval is increasing and now averages ~400 days; <10% of heifers calve for the first time at 24 months of age, with an average age at first calving of 32.5 months. Undoubtedly, while some of this inefficiency can be attributable to poor management practices, data from the Irish Cattle Breeding Federation show that this decline in reproductive efficiency of the national beef cow herd has a significant genetic component.

Advancing puberty of beef heifers

Central to reproductive efficiency is age at puberty, particularly when heifers are bred to calve as 2-year-olds and in systems that impose restricted breeding periods, such as in seasonal calving herds. Recent modelling studies at Teagasc, Grange showed that for spring-calving grass-based systems delaying age at first calving from 24 to 36 months of age decreased net margin per hectare by 50%. Consequently, breeding heifers to first calve at 24 months of age is a key target for beef cow herds. Ideally, replacement heifers need to reach puberty early, conceive early in the breeding season, calve with minimal assistance and rebreed early for their second calf. Research is on-going into the physiological and molecular control of puberty. One such project involves the identification of biomarkers by examining the expression of genes within the hypothalamic-pituitary axis during the onset of puberty. This research will contribute new information to our understanding of the biology of puberty and its regulation, and may provide genetic markers enabling the selection of animals which undergo sexual maturity at an earlier age.

Genes regulating uterine function and establishment of pregnancy

The worldwide decline in cattle fertility over the last four decades has largely been attributed to increases in early embryo loss. The period of greatest early embryo loss in cattle occurs before day 16 of pregnancy and has been shown to account for between 70 to 80% of overall embryonic and foetal mortality. Recent work by our group aimed at identifying molecular signatures associated with a uterine environment which is supportive of early pregnancy. This was based on studies that compared heifers that

consistently became pregnant following successive inseminations with their reproductively inefficient contemporaries. Further work is now on-going to validate these genetic markers in order to aid selecting animals with higher fertility potential.

Early diagnosis of post-partum uterine infection

While mainly a problem with dairy cows, postpartum uterine infections can be a cause of compromised fertility in some beef herds, particularly those with higher rates of dystocia and/or where cows are in poor body condition at calving. While considerable progress has been made in understanding the etiology of uterine infection, no definitive early prognosis or intervention strategies exist to aid farmers in getting cows back in calf. Work at Teagasc has identified uterine biomarkers of infection which distinguish cows at risk of developing uterine disease. Further research will determine if such markers can reliably be used for early diagnosis and intervention in post-partum cows.

On-farm research

At Teagasc Grange, we have recently commenced a large-scale beef cow herd fertility research programme, funded by the Department of Agriculture, Food and the Marine and involving University College Dublin, The Irish Cattle Breeding Federation, The Agri-Food and Biosciences Institute of Northern Ireland and the Irish Farmers Journal. The aim of this project is to examine the main factors affecting reproductive efficiency of beef cow herds across the island of Ireland. Particular emphasis will be placed on the role of specific minerals as well as the disease status of cows. This trial will run over two years with the aim of recruiting at least 200 herds and up to 4,000 cows in total.

Increasing use of AI

When compared with dairy herds, the use of AI in Irish beef cow herds is very low, with less than 20 calves born to AI sires per 100 cows calved. In order to make significant genetic progress, particularly in maternal traits, much greater usage of high genetic merit bulls, through AI, will be required. Recent initiatives in beef cattle genetic evaluations, including the development of the Replacement Index, have the potential to reverse the on-going trend towards poorer reproductive efficiency. However, in the absence of increased and sustained usage of AI, in both pedigree and commercial herds, its impact will be severely delayed. We have recently commenced a large on-farm study to evaluate various oestrous synchronisation programmes with the aim of developing a protocol to enable the use of fixed-time AI, thus obviating the considerable labour and management input associated with achieving high rates of heat detection.

Genomically assisted selection

Genetic gain for improved cow fertility through traditional selection is often slow due to the typical low heritability of the component traits, difficulties for accurate measurement and, in some instances, key traits may only be measured in mature females. However, the incorporation of genomic information into breeding programmes has the potential to significantly increase the rate of genetic gain in complex economically important traits, including fertility. The recent launch of the Beef Genomics Scheme by the Department of Agriculture, Food and Marine in conjunction with ICBF will put Ireland in prime position to implement a Genomic Selection programme for beef cattle which should accelerate the rate of genetic gain for improved reproductive efficiency. Teagasc research has underpinned the initiation and continued development of this technology.

Important issues and current research on bull fertility

David Kenny[1], Kieran Meade[1], Stephen Butler[2] and Michael Diskin[3]
Teagasc, Animal & Grassland Research and Innovation Centres at Grange[1], Moorepark[2]and Athenry[3]

Summary

- 5% of bulls can be infertile while up to 25% experience subfertility.
- It is essential that vigilance for bull fertility and mating performance is maintained on an on-going basis throughout the breeding season.
- Current Teagasc research is examining the effects of genetics and nutrition on bull fertility as well as the potential for sexed semen use on beef cows.

Bull fertility – be vigilant!

In Ireland, in excess of 80% of calves born to beef cows are sired through natural service stock bulls with the remainder bred by an AI sire. In such situations, and particularly when a single sire mating is used in a herd of cows, the fertility of the stock bull is of major importance. There is little doubt that there are significant differences in fertility among individual bulls. While the reported incidence of sterility is generally low (<4%), subfertility, at a consistent level of 20-25%, is much more common in breeding bulls. Subfertility may be caused by low libido, sperm quality/quantity, defects or physical factors affecting bull mobility or mating ability. While a subfertile bull is capable of getting some cows pregnant it will result in low pregnancy rates, an extended calving interval, reduced calf weaning weights and higher involuntary culling of cows for barrenness, unless the bull is operating within a herd with a very low cow:bull ratio. Frequently, subfertile bulls go undetected and the suspicion of subfertility does not become apparent until much of the breeding season has elapsed or until such time that cows are checked for pregnancy. Furthermore, there is no guarantee that a bull will retain his fertility from season to season or even within a season. It is well established, that for the production of fertile spermatozoa the temperature of the testes must be 2-6°C lower than core body temperature. Increased testicular temperature, irrespective of the cause, reduces semen quality and is a common cause of infertility in bulls. The duration of the decrease in semen quality, following a thermal insult, would appear to be related to the severity and duration of the thermal insult, with sperm morphology returning to normal within 6 weeks of the end of the thermal insult, though resumption of normal fertility may take somewhat longer.

Because of the serious implications of an infertile or subfertile bull on herd productivity, a Bull Breeding Soundness Evaluation (BBSE), or pre-breeding examination, has been put forward by a number of groups to help identify such bulls before the onset of the breeding season. The British Cattle Veterinary Association (BCVA) recently introduced a certification protocol for evaluating bulls for breeding purposes which involves 4 main steps: physical examination, semen examination, assessment of mating ability (not generally performed), and classification or overall prognosis. For each of the above examinations, bulls failing to reach a certain threshold will result in the bull being classified as "unsatisfactory". Bulls passing the physical and semen examination and/or assessment of mating ability examinations are classified as "suitable for breeding" While this does not classify a bull as "fertile" or "infertile", their objective is to reduce the risk of poor fertility performance in stock bulls. Those classified as "satisfactory" will have reached minimum criteria for semen motility, semen morphology and scrotal circumference, and no evidence of physical abnormalities will have been found. Bulls with serious semen or physical defects, or which

fail to meet minimum criteria for scrotal circumference, are classified as "unsatisfactory" for potential stock bulls. A number of Irish veterinary practices are BCVA-accredited and are offering this bull fertility assessment service to herds.

Observation during the breeding season

During the breeding season it is important to check a bull for locomotion, any evidence of injury or arthritic problems, and that he is physically capable of mating cows. The best check of a bull's fertility is his ability to get cows pregnant. Therefore, it is advisable to record the identity of the first cows bred and to obtain confirmation of a bull's fertility by ultrasonically scanning these cows for pregnancy 28-35 days after breeding. This is particularly important for young bulls joining the herd. It is impossible to be precise regarding the exact number of cows to assign to a bull. For yearling bulls the general recommendation is 20-30 cows with up to 50 cows assigned to mature bulls of known high fertility.

Nutrition and bull fertility

Although often overlooked in the past, there is now increased focus on the nutrition of bulls, and in particular young bulls, and its effect on both advancement of puberty or sexual maturity, and also on semen quantity and quality. Similar to heifers, young bulls well grown for age, will typically commence sexual activity earlier and have achieved a higher level of semen quantity and quality at the start of the breeding season than poorer performing contemporaries. A research programme, funded by the Department of Agriculture, Food and the Marine and involving the University of Limerick and University College Dublin has recently commenced at Grange with the objectives of better understanding (i) the effect of plane of nutrition from birth on the advancement of puberty of young bulls and (ii) the effect of supplementary dietary fats on the quantity and quality of semen in sexually mature bulls. Ultimately, the project aims to define clear guidelines for the rearing of young dairy and beef bulls to consistently achieve high fertility in their first season.

Genetic effects of bull fertility

The identification of genes in cattle which have been shown to regulate fertility in other species holds significant promise for understanding the regulation of fertility in bulls. Teagasc research has shown that these genes are expressed in the reproductive tract of the bull and are also present on the sperm themselves. The identification of variation in these genes may facilitate improved selection for fertility. Understanding the mechanisms involved in regulating fertility opens up additional opportunities to develop tools not only to treat sub-fertility but also to extend the function of sperm from elite sires during peak demand. Additionally and similar to current plans for female fertility traits, such information could be incorporated into national genomically assisted breeding programmes for beef cattle.

Sexed semen

There is increased interest in recent years in the use of sexed semen in both dairy and beef herds in Ireland. The Replacement Index developed by the Irish Cattle Breeding Federation (ICBF), in conjunction with Teagasc, now provides farmers with a tool with which to identify proven AI bulls with the potential to breed replacement heifers with improved maternal traits. The use of sexed semen from bulls with increased genetic merit for maternal traits could allow farmers to select the very best cows within the herd from which to breed their replacement heifers while breeding the remaining cows either through AI or natural service to bulls with a high terminal index. Currently, a large on-farm trial is being run by Teagasc, in association with ICBF, examining the efficacy of sexed semen use for beef cows under a fixed-time AI programme. The results of this trial will be available early next year.

Improving the feed efficiency of beef cattle

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Summary

- Feed is the single largest cost incurred in beef cattle enterprises, accounting for 60-80% of variable costs
- The efficiency with which feed is utilised by the animal for productive purposes such as growth and lactation is critical to both the economic and environmental sustainability of beef cattle production systems.
- The relative performance of cattle on different rearing regimes (i.e. high concentrate versus high forage diets) may not be consistent and is currently under investigation. This is critical to future breeding programmes in order to better match animals to our grass-based production systems.
- Despite its importance to profitability, much is still unknown about the biological control of feed intake and efficiency in cattle and this has resulted in little genetic progress. Teagasc research is currently examining the key genes affecting feed efficiency in cattle and how this information might be incorporated into a genomic selection programme.

Introduction

Feed is the single greatest variable cost in beef cattle systems, typically accounting for between 60 to 80% of the variable costs of production. Additionally, up to 70% of the dietary energy consumed by the animal is used for body maintenance while in the region of 75% of dietary nitrogen is excreted and thus, unavailable for productive proposes. Consequently, there is significant worldwide interest in feed efficiency (FE) as a means of improving both the economic but also the environmental sustainability of beef production systems. Despite this, however, when compared with monogastric species, such as pigs and poultry, little direct improvement in FE has been achieved to-date for cattle.

Feed efficiency

Traditionally, feed efficiency of livestock has been expressed as the level of bodyweight or carcass growth attained for a given quantity of feed. It is generally agreed that use of this type of ratio trait, commonly referred to as 'feed conversion efficiency' or its inverse 'feed conversation ratio (kg feed per unit of gain) in breeding programmes generally leads to selection of larger animals that grow faster but also have a higher feed requirement. Thus there has been much interest, worldwide, in examining alternative feed efficiency traits. The concept of residual feed intake (RFI), rather than feed conversion ratio, is becoming the preferred measure of FE across many livestock production enterprises, and in particular for beef cattle. Animals with low RFI (efficient) eat less than expected based on their weight and growth. We and others have also demonstrated significant genetic variance in the trait and that, genetically, it is not antagonistically associated with desirable growth or carcass traits in growing beef cattle. Indeed, Teagasc research has shown that in any group of growing cattle or suckler cows there can be up to 20% difference in the feed consumed by the most efficient compared to the least efficient animals for the same level of growth and performance. The challenge is, therefore, to reliably and cost-effectively identify these feed

efficient animals and proliferate their genetics through structured animal breeding programmes. However, the main impediment to genetic progress and adoption of selection strategies based on FE is the difficulty and enormous expense of measuring individual animal body weight and feed intake over a sufficiently long period. In Ireland, such measurements are routinely carried out by the Irish Cattle Breeding Federation at its Tully test facility in Co. Kildare, though the number of records generated per annum (c. 500) is very low when compared with other important traits such as carcass weight or conformation. Consequently, developing cost effective predictive biological markers specifically for improved FE is an attractive and necessary alternative to direct measurement on large numbers of cattle. Our own work at Teagasc to date has also clearly shown that FE is a complex multifaceted trait, under the control of many biological processes. These include inter-animal variation in feeding behaviour, digestion, absorption, metabolism, nutrient partitioning, and cellular energetics, as well as, potentially, susceptibility to stress. We have also shown that feed efficient cattle are likely to have different profiles of microorganisms in their rumen (forestomach) and emit less methane than their inefficient contemporaries. Additionally, there is evidence from our own work, and that of others, that although relatively repeatable, ranking of beef cattle for FE offered the same diet is not necessarily consistent over different phases of their lifetime, and this may be further exacerbated when diets differing in energy density are fed successively (i.e. forage versus concentrate based diets), as per commercial practice. This strongly indicates the presence of what is termed a 'genotype x environment' interaction for the trait, in other words that the relative feed efficiency of a particular animal depends on the type of feed it is offered or management system within which it is reared. However, the existence of such a phenomenon has not been adequately tested to-date.

Current Teagasc research on feed efficiency

Worldwide, breeding values of bulls for feed intake or FE are typically derived from progeny performance based on *ad libitum* access to energy dense rations whereas, in many countries including Ireland, the lifetime gain of most commercial beef cattle is achieved from diets consisting, to a significant extent, of lower energy density feeds such as grazed grass and/or ensiled forages. Recently, a large research programme, funded by the Department of Agriculture, Food and the Marine, has commenced at Grange with the objectives of (i) better understanding the biology underpinning improved feed efficiency in cattle; (ii) the repeatability of performance across different diets and (iii) identifying the key genes controlling the trait so that such information can ultimately be incorporated into the planned genomic selection based breeding programme for beef cattle in Ireland. This should, in time, aid the identification of animals that are most profitable to produce under our grass based production systems.

Understanding the rumen microflora to enhance nutrient utilisation and reduce methane emissions in beef and dairy cattle

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Summary

- Internationally, agriculture is faced with the major challenge of feeding a rapidly increasing human population, while adhering to strict environmental legislation.
- In cattle, the complex population of micro-organisms that inhabit the animals' 'rumen' or forestomach influences the efficiency with which feed is utilised as well as the quality of both meat and milk.
- Feed efficient animals have lower daily methane emissions. A core group of 'methanogens', or methane emitting micro-organisms, exists in the rumen of cattle regardless of feed efficiency potential. However, there are specific differences evident at both a species and genotype level between feed efficient and inefficient cattle.

Challenges facing the agri-food industry

The *Food Harvest 2020* report has set ambitious growth targets for the Irish beef and dairy industries, with increases in output value of 40% and 50%, respectively, by 2020. However, currently in Ireland, agriculture accounts for a higher proportion of national greenhouse gas emissions than any other EU country. Methane emissions resulting from fermentation in the rumen of cows and sheep are responsible for approximately 50% of this. Consequently, if projected increases in beef and milk output are to be met in an economically and environmentally sustainable manner, major improvements in the efficiency of these production systems at farm level are necessary.

Nutrient digestion and utilisation is enhanced by the rumen microbiome

The microbes in the rumen, or forestomach, play a central role in aiding the animal to effectively digest fibrous material like forages in a process called fermentation. The volatile fatty acids generated through this process can contribute up to 70% of the energy requirements of the animal. The rumen 'microbiome' is a complex and dynamic ecosystem of thousands of species of microbes. Consequently, a deeper understanding of the rumen microbiome will facilitate development of new strategies to manipulate rumen fermentation and improve nutrient utilisation. Recent advances in DNA technology now allow us to analyse the rumen microbiome in much greater depth than was previously possible. Using this technology, we and other researchers have been studying the extent to which the rumen microbiome influences the efficiency of feed utilisation by cattle.

Rumen methanogenesis, feed efficiency and the rumen microbiome

Despite being central to the ability of cattle to digest forages and other fibre containing materials, fermentation by the rumen microbiome is accompanied by the production of methane, a potent greenhouse gas. Methane is produced by methanogenic archaea (bacteria-like micro-organisms) which convert the hydrogen produced by ruminal

fermentation into methane. Although this process helps maintain rumen pH (i.e. avoiding acidosis) by preventing accumulation of hydrogen ions in the rumen, it also results in high methane emissions from cattle production. In addition, methane production in the rumen is an energetically wasteful process, accounting for up to 15% of dietary gross energy.

Feed accounts for up to 80% of the direct costs in beef cattle production. Therefore, improving the efficiency of utilisation of ingested feed by cattle is central to economic sustainability. The objective of Irish beef production systems is to maximise the utilisation of forage-based diets to reduce reliance on expensive purchased feedstuffs. Recently, residual feed intake (RFI) has become the measure of choice for feed efficiency in beef cattle. Feed efficient animals are those that consume less feed than their contemporaries of similar body weight and growth performance. There is some emerging evidence to suggest that feed efficient cattle may emit less methane, though the biological mechanisms involved are not fully understood. A study at Teagasc Grange was conducted to examine the relationship between phenotypic RFI and methane emissions in beef heifers. Simmental heifers were offered a grass silage diet over 120 days and methane production was measured. Heifers were ranked on the basis of RFI and divided into low (efficient), medium or high (inefficient) groupings. Mean live weight (485 kg) and daily live-weight gain (0.6 kg) did not differ between the groupings; but high RFI heifers (inefficient) consumed 9% and 14% more than medium and low RFI heifers (efficient), respectively. Similarly, daily methane emissions were lower for low RFI than for high RFI heifers (Figure 1).

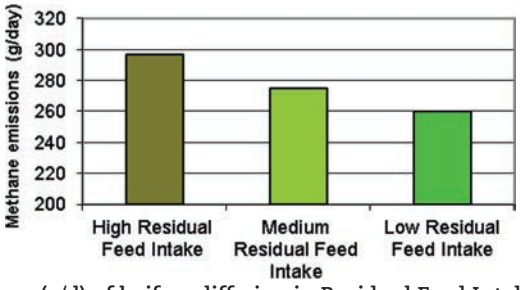

Figure 1 — Methane emissions (g/d) of heifers differing in Residual Feed Intake offered grass silage.

In a further experiment at Teagasc Grange, we examined the composition of the ruminal microbial population in low RFI and high RFI heifers and how this was affected by whether a forage-based or a concentrate-based diet was offered. Rumen digesta samples were collected sequentially from high RFI and low RFI animals fed both the forage and concentrate diets and analysed using a range of DNA sequencing technologies. We found that *Methanobrevibacter* spp. was dominant amongst methanogens in the rumen, with *Methanobrevibacter smithii* the most abundant species detected. Although the abundance of either total or specific methanogenic species did not differ between animals divergent in RFI, their relative abundance was affected by diet type. At the genotype level, however, we found that various genotypes of *Methanobrevibacter smithii* were more abundant in cattle of high compared to low RFI across diet. It is possible that these differences in genotype abundance may drive the observable changes in methane emissions between animals of high and low RFI.

Conclusions and implications

Our studies conducted to-date suggest that variation in the ruminal fermentation process affects the animal's ability to efficiently utilise feed and that this is mediated to some extent through the composition and activity of the ruminal microbiome. We will also examine interactions between, and the functional capacity of, these microbes. Such an approach will better facilitate the development of strategies focused on improving feed efficiency and methane abatement without compromising animal performance. This will ultimately give beef and dairy producers a competitive advantage by reducing the environmental footprint of Irish agriculture.

Coping with anthelmintic resistance in ruminants

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Summary

- Infections with gastrointestinal nematodes (gut worms) are a major threat to the health, welfare and productivity of grazing ruminants in Ireland and good gut worm control is dependent on effective wormer products.
- A direct and unavoidable consequence of the use of wormers is the development of anthelmintic resistant worm populations.
- Anthelmintic resistance is defined as the ability of worms to survive a dose of a wormer that would normally kill them.
- Anthelmintic resistance is the single most important worm control problem facing beef farmers today.
- The current method used to detect anthelmintic resistance is the Faecal Egg Count Reduction Test, but this method can only detect resistance when it is already well established (i.e. when a large proportion of the worms are already resistant).
- Thus, new and more sensitive methods are required for the early detection of anthelmintic resistance. These are currently being developed at Grange.

Introduction

Irish beef production is predominantly grass-based and 90% of all beef produced is exported. The Food Harvest 2020 report targets a 20% increase in Irish beef output value by 2020. The technical efficiencies required to meet this target will include improvements in animal health and reducing losses due to animal diseases. Gut worms can cause ill-thrift and disease, and good worm control is highly dependent on effective worming products. However, a direct and unavoidable result of continuous use of wormers is the development of drug resistant worms. These are worms that can survive a dose of the wormer that would normally kill them.

The gut worm lifecycle

Adult worms in the gastrointestinal tract of animals lay eggs which are passed out with the faeces. The eggs hatch within approximately two weeks and the larvae migrate onto pasture and are ingested by grazing animals. Ingested larvae undergo further development in the gastrointestinal tract before maturing to adult worms approximately three weeks later. Occasionally, larval development can be arrested (hypobiosis). The main gut worm species which infect cattle in Ireland are *Ostertagia* and *Cooperia*. *Ostertagia* is the main species associated with disease while the less pathogenic *Cooperia* species is the main contributor to faecal egg counts. Ostertagiosis is primarily a disease of first season grazing cattle and is generally a bigger problem in dairy calf-to-beef than in suckler beef systems. Disease is more common in the second half of the grazing season due to the build-up of larvae on pasture over time.

The development of anthelmintic resistance

There are currently three classes of anthelmintics available for the treatment of gut worms in cattle, benzimidazoles (white drenches), levamisoles (yellow drenches) and macrocyclic

lactones (clear drenches). In species such as sheep and horses the widespread use of wormers has resulted in the emergence of anthelmintic resistant worms. Anthelmintic resistance has been a problem in sheep production for some time and has recently been detected in cattle. Effective detection and prevention methods need to be put in place to ensure that anthelmintic resistance does not become a problem for cattle producers. As in sheep, anthelmintic resistance in cattle is usually measured using a faecal egg count reduction test. A fully effective anthelmintic dose reduces egg count to zero after administration. If the egg count reduction is less than 95%, then anthelmintic resistance is present. A major limitation of the egg count reduction test is its expense and its relatively low sensitivity. Additionally, very few beef farmers are carrying out faecal egg counts. Therefore, anthelmintic resistance is only detected when there are production losses from the failure of anthelmintic treatment. By this stage the treatment has failed and that particular anthelmintic product is no longer effective on that farm. New anthelmintic drugs take many years and are costly to develop. Thus, early methods of anthelmintic resistance detection are required so that its occurrence can be prevented and the lifespan of the existing anthelmintic drugs can be prolonged.

Molecular tests for anthelmintic resistance detection

At Teagasc Grange and Athenry we are working with other European researchers on strategies to mitigate the risk of anthelmintic resistance. This work includes the development of molecular markers of anthelmintic resistance. Currently, we are using sheep worms as models of cattle worms due to the similarity of sheep and cattle worms and the ease and lower cost of working with sheep than cattle. Worms resistant to the white drenches (benzimidazole) have been isolated from four sheep farms in Ireland. Resistant worms of the *Teladorsagia* (*Ostertagia*), *Cooperia* and *Trichostrongylus* species were identified. The DNA sequence of the beta-tubulin gene from these worms has been determined and a mutation has been found which is responsible for their resistance to the white drenches. Additionally, worms that are resistant to ivermectin (macrocyclic lactone) have also been isolated from a farm in Ireland. These worms are of the *Teladorsagia* (*Ostertagia*) species. The genome of these ivermectin-resistant worms is currently being analysed by next-generation sequencing technology in order to identify potential molecular markers associated with the ivermectin resistance. The detection of molecular markers will allow the development of rapid and inexpensive tests for anthelmintic resistance in worms.

Conclusions and implications

Good gut worm control is currently dependent on the availability of efficacious wormers. However, worms that are resistant to the available wormers are emerging. Sensitive, inexpensive tests are required in order to detect resistant worms and implement strategies that prolong the life of the current anthelmintics. A molecular marker of white drench resistance has been identified. Work to identify a marker of clear drench resistance is on-going.

Preventing animal diseases

Improving diagnosis of Johne's disease

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Summary

- Johne's disease in cattle is caused by a bacterial infection of '*Mycobacterium avium* sub-species *paratuberculosis*', which is more commonly referred to as 'MAP'. Johne's disease can cause significant economic losses via reduced milk yield, increased susceptibility to other diseases, and poor feed conversion and reproductive efficiency.
- It is difficult to get an estimate of the true prevalence of MAP because the performance of current diagnostics are poor, with enzyme-linked immunosorbent assay (ELISA) sensitivities only in the region of 30%, and as MAP infected cattle irregularly shed bacteria in their faeces.
- Our research is employing advanced genomics and proteomics approaches to identify novel host and pathogen targets to improve future diagnosis of MAP in Irish cattle.

Background and current diagnostics

A recent study by Animal Health Ireland and other stakeholders found herd prevalence for Johne's disease to be 31% for dairy herds and 18% for beef herds, although test sensitivity was limited. As the 5th largest exporter of beef in the world, the increasing focus on animal health and welfare will herald a new impetus in the control of infectious diseases in general and MAP in particular. Current tools are not sufficiently powerful to perform early and specific diagnosis of MAP with ELISA sensitivities currently in the region of 30%. While faecal culture is the gold standard for diagnosis, it cannot be used during the long sub-clinical phase of the disease, and even clinical animals only shed intermittently.

Research initiatives

Our research program is using a variety of new technologies to contribute toward understanding infection with MAP in cattle, and thereby identify targets for improved diagnosis. Technological developments now mean that it is possible to assay the blood (and milk) from MAP infected animals with superior resolution for proteins that will differentiate between infected and healthy animals. Our research is using new technologies to identify specific and sensitive markers that may be used to reliably detect MAP infection in both clinical animals that are not shedding the bacteria and in subclinically-infected cattle. Antigens (proteins/carbohydrates) from the Irish strains of MAP will be profiled against cattle sera to detect novel targets which may form the basis for new diagnostics. One of the key novel aspects of our research programme is the use of a dialysis membrane to culture the bacteria in the intestine of cattle before analysis. It is hoped that these conditions will mirror the natural environment of the bacteria and therefore allow the identification of markers that will have more success in the diagnosis of MAP infection.

Conclusions

Mycobacterial diseases are a major impediment to the economic sustainability of both the animal and agri-food sectors of the economy. Utilising technological advances to profile host and pathogen interactions will ultimately allow the identification of diseased animals with superior resolution. Although in its early stages, these complementary research strategies will contribute toward a comprehensive understanding and long-term control of MAP infection in Irish dairy and beef herds.

Preventing animal diseases

Nanovaccines – novel approach for the control of bovine respiratory disease (BRD) in calves

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Summary

- Mortality in young calves can often be as high as 10%, and viral pneumonia is an important component of the respiratory disease complex.
- The success of vaccination is often limited as the vaccine can be neutralised by maternal antibodies.
- Our research has developed a novel nanoparticle vaccine (nanovaccine) against bovine parainfluenza type 3 virus (BPI-3V) in calves.

Background

Clinical investigations have established the importance of viruses such as respiratory syncytial virus (RSV) and parainfluenza type 3 virus (PI-3) as primary lung pathogens in many bovine respiratory disease (BRD) outbreaks, with other viruses such as infectious bovine rhinotracheitis (IBR), and bovine viral diarrhoea virus (BVD) also often involved.

Research initiatives

This research investigated a novel, slow-antigen releasing, intranasally delivered, nanoparticle vaccine (nanovaccine) against bovine parainfluenza type 3 virus (BPI-3V), an important pathogen associated with bovine respiratory disease (BRD) in cattle. The nanoparticles which contain the viral antigen are made at AFBI, Stormont, N. Ireland. The immune responses to the nanovaccine (BPI-3V) were first assessed in a mouse model as a 'proof of principle' study at AFBI before commencing calf immunisation studies at AFBI and Teagasc, respectively. The nanoparticles – which are microscopic in size, tiny enough to be used in a nasal spray – attach themselves to the lung of the calf and deliver a vaccine to stimulate a localised immune response at the very core of the respiratory system. The slow release single treatment protects the lungs of the calf during the most vulnerable months of its life.

The immune responses to the BPI-3V nanovaccine were compared with those induced by a commercially available BPI-3V vaccine in artificially reared dairy calves with pre-existing maternal antibodies, and that had been challenged with a 'field' strain of BPI-3virus. Calves administered the BPI-3V nanovaccine had significantly greater and sustained immune responses than calves that received the commercial vaccine, even in the presence of maternally derived antibodies. In a follow-on study, the impact of weaning stress on the immune response of beef calves to the BPI-3V nanovaccine, and to a commercial vaccine, was also investigated. The findings indicated that immunising calves 4 weeks prior to weaning resulted in greater immune responses than in calves immunised 1 week before weaning for both vaccine treatments.

Conclusions

This is the first project of its kind to develop and assess the immune response to a viral nanovaccine in calves. Our research has shown that the nanovaccine containing BPI-3V against BRD in calves provides long-lasting protection against viral challenge. It works in calves with pre-existing maternal antibodies and requires the administration of a single intra-nasal dose.

Enterprise Ireland presents innovations in agricultural technology

Kevin Mitchell

Enterprise Ireland is the government organisation responsible for the development and growth of Irish enterprises in world markets. We work in partnership with Irish enterprises to help them start, grow, innovate and win export sales on global markets.

Enterprise Ireland is a national and global organisation with a national network of nine regional offices throughout Ireland and over 30 international locations, facilitating access to more than 60 countries worldwide.

Today we have five companies who offer potentially game-changing technologies. Each of these companies, although in different stages of development, has been invited to exhibit at this event due to the innovative nature of their solutions.

Livestock Internet Services

Tim Harty
www.livestock.ie

Livestock Internet Services (LIS) or Livestock.ie is an online cattle mart which offers farmers the ability to source the exact type of livestock they are looking for, or to find suitable buyers for their stock. Livestock.ie is a trusted online platform that will enable buyers and sellers complete sales/purchases efficiently and save on cost.

Services offered by LIS include:

- Livestock broker
- Provide current market information
- Financial and documentation transfer
- Request transport permits
- Dept. of Agriculture, Food and the Marine application scheme assistance
- Board Bia Quality Beef Assurance scheme assistance

Gavico

Peter Young
www.boviminder.com

BoviMinder is a complete herd health system that monitors your herd 24 hours a day. Using an ear tag that accurately measures the animal's temperature every 15 minutes, the system alerts farmers immediately to a rise or fall in an individual animal's temperature.

Using temperature the BoviMinder can identify:

- Common illnesses such as metritis, grass tetany and milk fever, allowing farmers to treat stock sooner
- When a cow is in heat or due to calve

Using web-based technology it alerts farmers to a change in temperature via their phone, laptop or computer, and also helps identify the potential reason for that change in temperature. The system can be used indoors and at grazing, and does not require broadband coverage.

Herdwatch

Fabien Peyaud
www.herdwatch.ie

Herdwatch is a Mobile Herd Manager for beef and dairy farmers, available on smartphones, tablets, laptops and PCs.

With Herdwatch, farmers can:

- Register calves in seconds from any compatible mobile device
- Download their herd details directly from Dept. Agric., Food and the Marine
- Stay compliant by recording remedies / dosing on-the-go
- Record inseminations, pregnancy scan results and weights, which are automatically transferred to ICBF.
- Feed purchases recorded in the format required for Bord Bia compliance.

Herdwatch is the result of two years of research and development by FRS Network (Farm Relief Services), a farmer-owned co-operative, and is fully approved by the Department of Agriculture, Food and the Marine.

Monford Ag Systems

Steven Lock
www.grassometer.com

The GrassOmeter brings precision farming to the grassland farmer. Its unique Map – Measure – Manage system tracks grass growth, enabling accurate field level grazing and management decision making.

Measurements are captured automatically through the device (worn on your boot or mounted on a stick) and uploaded instantly via your phone to the web. Data can be shared and benchmarked, linked with other data and compared historically and contemporaneously to enable farmers to get the most from their grass.

Keenan inTouch

Andy Warnes
www.keenansystem.com

Keenan's inTouch service includes market leading feed processing technology, 24/7 animal nutrition management & support linked to the world's largest animal feed database. Using this cost effective but extensive service we enable improvements in rumen health and productivity that deliver increased profits in the form of feed conversion efficiencies and measurable improvements in output product quality. Farmers have achieved 2 kg a day live weight gain with finishing beef cattle.

Keenan inTouch was recently announced as the winner of the Agri-food category in the Irish Times InterTradeIreland Innovation awards for 2014.

Technology Village:

Sustainable farm environment

Proving Irish beef production's "green credentials"

Donal O'Brien and Kevin McNamara
Teagasc Animal & Grassland Research and Innovation Centre, Moorepark, Fermoy, Co. Cork

Summary

- A central requirement within the Food Harvest 2020 report targets is that beef output is increased in an environmentally sustainable manner.
- Life cycle assessment (LCA) is the preferred tool to assess the environmental sustainability of grass-based beef farms.
- The development of a sustainability assurance scheme using LCA models will demonstrate our green credentials, which will potentially offer increased future market returns for Irish beef.

Introduction

The main priority of the Food Harvest 2020 report is to achieve substantial growth using increased levels of technology ("Smart") in a sustainable manner ("Green") building on an umbrella brand ("Brand Ireland"). To fulfil this ambition, Irish beef producers will need to continue improving the environmental efficiency of their ruminant production systems, which are amongst the best in Europe for key environmental indicators e.g. greenhouse gas (GHG) emissions. This research aims to further improve grass-based beef producer's environmental performance through the development of a farm sustainability assurance scheme with Bord Bia. Additionally, the methodology used will be internationally standardised. This will facilitate benchmarking of our national environmental performance globally, thus underpinning Ireland's "green credentials".

Measuring environmental sustainability

Important environmental performance measures of beef production systems include GHG emissions, trans-boundary and eutrophic emissions, biodiversity, and energy and water consumption. Life cycle assessment (LCA) models are the preferred tools to assess the various components of the environmental sustainability of grass-based beef production systems. This is mainly because they are relatively inexpensive and accurate. In addition, using a holistic approach such as LCA avoids simply shifting problems along the food chain or from one environmental impact to the other; this is "pollution swapping". For example, it is reported that methane production by cattle can be reduced by increasing the ratio of concentrates over roughages in the diet. However, the net GHG benefit depends on whether the increase in GHG emissions related to the production and transport of additional concentrates is greater than emissions avoided by feeding more concentrate.

Teagasc Grange have previously developed LCA models for beef production systems, which are internationally standardised, but these LCA's are limited to gaseous emissions. In order to develop LCA models for measuring biodiversity, water consumption and non-renewable energy use, field work is being carried out on representative grass-based beef farms. As part of this work, monitoring equipment was installed on-farms to meter water and energy use, and habitat surveys are being conducted to measure biodiversity. Additionally, detailed data are being collected on several farm factors, including livestock movements, milk and meat production, grazing season length, machinery, fuel usage and fertiliser application. This information is primarily collected electronically via for instance national databases (e.g. ICBF Herd plus system) and by farm technicians using web-based farm survey tools.

Sustainability assurance

Once the LCA models are developed they will be implemented as part of the Bord Bia quality assurance scheme and will provide scientific integrity around sustainability farm audits (Figure 1). The LCA models will benchmark the environmental performance of farms and will be used as a basis to develop decision support tools to aid producers improve the sustainability of their beef farming enterprise. In conjunction with Bord Bia, a sustainability assurance scheme will be developed that will include data capture, model development and data storage. In addition, the scheme will generate farm sustainability reports to disseminate environmental results and advice to beef producers.

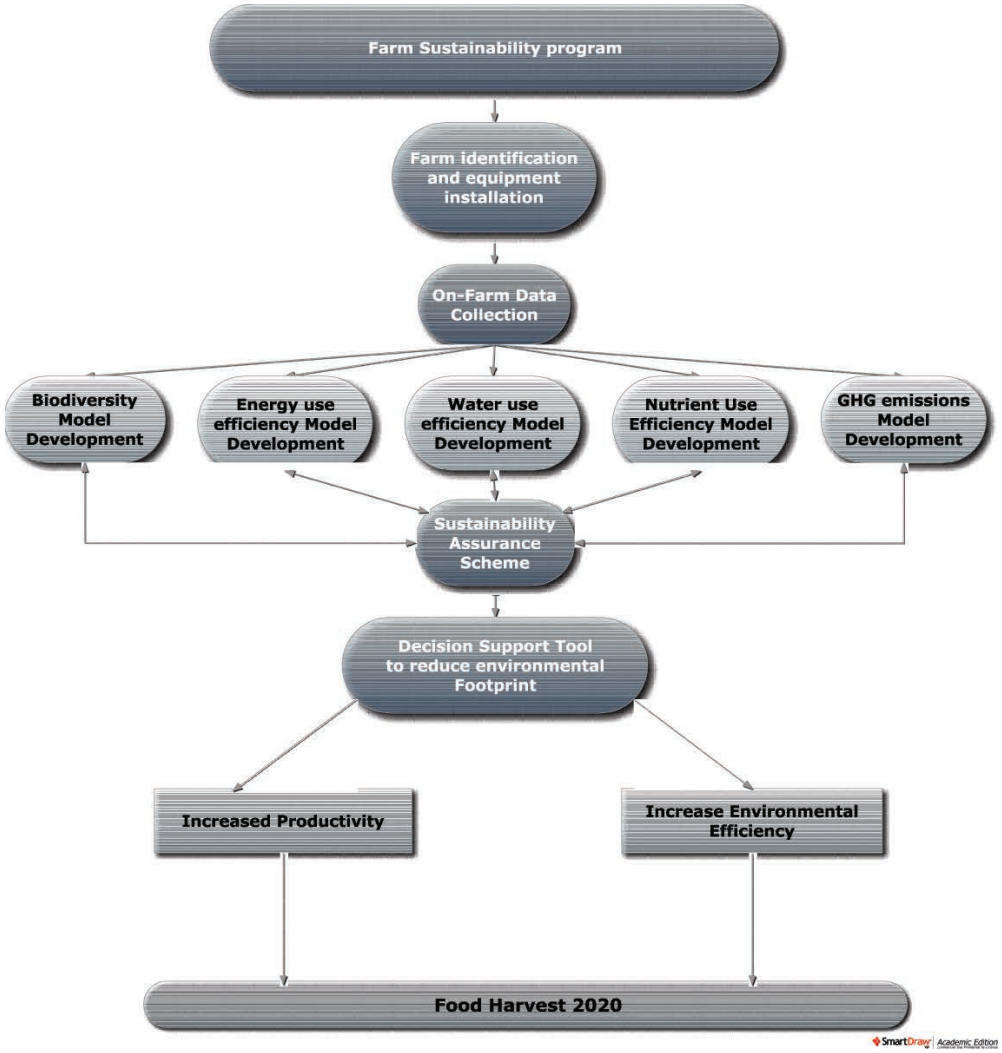


Figure 1 — Flow diagram of the development of a sustainability assurance scheme

Conclusion

The development of a sustainability assurance scheme via LCA will demonstrate our green credentials, which potentially offers increased future market returns for Irish beef products. Furthermore, the decision support LCA tools developed from this research will assist farmers to continue improving their environmental performance.

Greenhouse gas emissions from beef cattle systems

Gary Lanigan and Pat Murphy
Teagasc, Johnstown Castle Environmental Research Centre, Wexford.

Summary

- Irish beef production is one of the most carbon-efficient in Europe but the sector faces challenges to limit greenhouse gas (GHG) emissions.
- Reducing emissions per unit beef depends on increasing production efficiency.
- Reductions in finishing times, extending the grazing season, improving genetic merit and adoption of sexed semen will increase production efficiency and reduce methane emissions.
- Optimising the timing/method of slurry application, adoption of clover into pastures, and changing mineral fertiliser type will reduce nitrous oxide and nitrogen loss in general.
- Good pasture management (fertiliser and liming) will improve carbon sequestration, offsetting GHG emissions.

Greenhouse gas emissions from the beef sector

Food Harvest 2020 envisages a 20% increase in beef value and global beef demand is expected to rise by 30% by 2050. However, future opportunities for the sector are occurring within an EU policy context wherein Irish greenhouse gas (GHG) emissions must be reduced by 20% on current levels, despite agriculture currently comprising one-third of national GHG emissions. Over 80% of emissions occur on-farm and consist of methane from enteric fermentation (45%) and manure management (15%), while nitrous oxide (23%) mainly arises from fertiliser/manure and animal excreta deposition on soils. Conversely, grasslands and forests sequester CO_2 from the atmosphere, offsetting some of these emissions.

Despite the large proportion of national emissions contributed by Irish agriculture, the EU estimate Irish beef production to be the fifth most carbon efficient in Europe. With the roll-out of the Origin Green initiative, there is a growing impetus to further improve production efficiency, which will also reduce the carbon footprint of beef. Currently, the carbon footprint of our beef ranges from 16.7 kg GHG per kg beef live weight (suckler/weanling systems) to <10 kg GHG per kg beef liveweight for dairy beef.

Reducing methane emissions

As enteric methane accounts for half the total GHG emission from beef production, strategies which result in reductions in enteric fermentation emissions result in considerably lower system level emissions. The use of an Economic Breeding Index (EBI) selection of cow breed, based on a combination of fertility and production performance, already reduced emissions per kg production in the dairy sector and the Eurostar system offers similar potential for the beef sector. The reduction in beef finishing times by attaining high average lifetime daily gains can result in 15-18% lower emissions per kg of beef carcass produced for both steer and bull systems. High average lifetime daily gains are also compatible with high production efficiency and profitability.

Extending the grazing season (i.e. increasing the number of days that animals spend at grass outdoors) can also reduce emission intensities by reducing the quantity of stored manure, and by directly lowering enteric methane emissions if cattle ingest higher quality feed.

The roll-out of sexed semen offers the opportunity to increase carbon efficiency as the sexing of semen allows dairy farmers to maintain a 23% replacement rate while only inseminating less than 30% of cows with exclusively female dairy semen – leaving the remaining 70% of cows to be served by beef bulls, thus ensuring more efficient beef production with a lower carbon-footprint.

Intensification of production (i.e. increasing stocking rates) up to 2.2 livestock units per hectare has been shown to increase carbon efficiency on-farm as it can increase resource efficiency, increase carbon sequestration in pastures by optimising grass growth (see below) and freeing up land for alternative use (forestry etc.).

Nitrous oxide mitigation and carbon sequestration in pastures

Shifting fertiliser type from CAN to urea combined with the use of urease and nitrification inhibitors, and matching fertiliser application to sward demand can substantially reduce N loss (ammonia, leached N and nitrous oxide emissions). The use of clover reduces nitrous oxide by reducing the need for mineral fertiliser and can reduce emissions by 15-20%. In addition, the timing and application technique for land-spreading slurry and the use of chemical amendments can reduce both ammonia and nitrous oxide from urine deposition and slurry.

As well as reducing greenhouse gases, Irish beef production can offset emissions as production is pasture-based. Grassland sequesters carbon dioxide (CO_2) from the atmosphere during photosynthesis and there is a net 'sink' of approximately 1-3 tonnes of CO_2 per hectare per year in Irish grasslands. This can reduce the carbon footprint of beef production by 20-30% and improved management (optimal N and P fertilisation and adequate liming) can further enhance uptake. In addition, the planting of hedgerows has been shown to make a significant contribution to increasing carbon sequestration.

Reducing emissions on-farm: the role of the Carbon Navigator

Teagasc have been central to Bord Bia's carbon footprint certification of Irish beef production as part of the Origin Green initiative, and has developed the Carbon Navigator to allow farmers make on-farm decisions that will improve both farm efficiencies and the Carbon footprint. The Beef Carbon Navigator is an advisory tool aimed at improving the carbon efficiency of Irish agricultural output and improving the sustainability credentials of produce. The approach taken in the Carbon Navigator is to provide an analysis of performance relative to other farmers with regard to a number areas where emissions reductions can be achieved, to provide an opportunity to set targets for improvement in these indicators and to incentivise the achievement of these targets by demonstrating the combined benefits in terms of emissions reductions and improvement in income. It uses a "distance to target" approach which aims to incentivise the achievement of outcomes. The Beef Carbon Navigator will be used with beef discussion groups and individual beef farmers in the coming years and is a critical component of industry initiatives to improve and verify the sustainability of our beef production systems.

The Agricultural Catchments programme

Ger Shortle
Teagasc, Johnstown Castle Environment Research Centre, Wexford

Summary

- The Agricultural Catchments Programme is an essential part of Ireland's Nitrates and Water Framework Directive compliance, and works in partnership with farmers.
- Average nitrate and phosphorus levels are generally low to moderate by international standards but improvement is needed to achieve water quality targets.
- Lag times of 5 to 20 years are expected between the implementation of the regulations at farm level and improvement in water quality.
- Farmers have an opportunity for a financial and environmental benefit ('win/win') if they can improve nutrient management on their farms.
- Effectively communicating the science behind the regulations to farmers should improve understanding of the benefits and uptake of measures.

Introduction

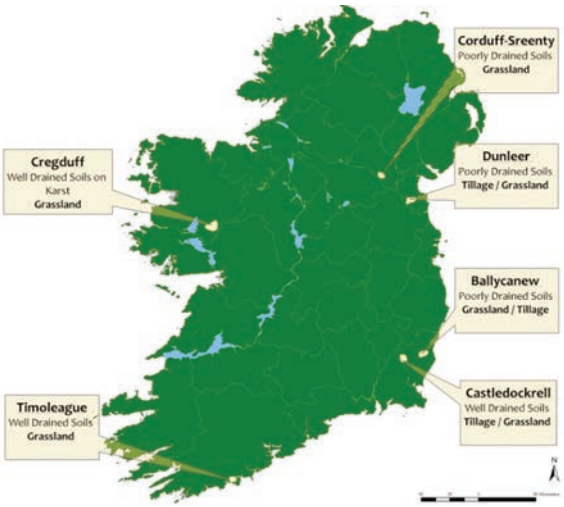
The Agricultural Catchments Programme (ACP) is an advisory/research programme working in partnership with farmers to help meet Ireland's water quality challenges. The ACP was established to test the effectiveness of the Good Agricultural Practice (GAP) measures or 'Nitrates Regulations'. Measuring the effectiveness of Ireland's derogation, that allows farmers to stock land at up to 250 kg of organic nitrogen per hectare, is also part of the ACP's work. ACP is also working to support the Food Harvest 2020 aims of producing knowledge which enables farmers to grow output in a sustainable way and delivering both high quality food and a high quality environment. The scientific evidence produced by the ACP is also needed to support Irish agriculture in meeting the requirements of the Water Framework Directive (WFD). This 'umbrella' directive incorporates the Nitrates Directive and is focussed on achieving good ecological quality in all waters. It requires member states to have individual management plans for each river basin. There are eight river basins in the island of Ireland (seven wholly or partially in the republic). The next round of preparing new plans begins in 2015 and these plans can include additional farming measures to address specific local water quality issues.

Operating the Agricultural Catchments Programme

The ACP operates in six catchments (clearly defined areas drained by a stream or spring) where farming is the main land use. Each catchment was chosen to represent a specific combination of landscape, soils and farming. The map shows the location of the six catchments. They are all intensively farmed but vary greatly in the type of farming carried on in them. Two are predominantly tillage (Castledockerell and Dunleer) while the rest are almost completely grassland. The Timoleague catchment is dominated by dairying while the other grassland catchments have mixtures of beef, sheep and dairy farming.

There are over 300 farmers with land in the catchments and their support and co-operation are essential to the success of the programme. We depend on the farmers for access to their land so that we can monitor soils, surface water, groundwater and the weather. We also gather essential information on how they farm and their economic performance. By building up this detailed information over many years we can learn how farming impacts on water quality and how the regulations impact on farming. This

knowledge enables us to help farmers improve their returns while reducing nutrients lost to water. The scientific approach taken by the ACP is the same in each catchment and is based on the concept that nutrients can only be delivered to water following a series of steps which begins with the *sources* of nutrients (soil, manure, fertilisers); if these are *mobilised* they must then follow a *pathway* before *delivery* to the water and only then may have an *impact* on water quality. Each step must be completed for a water quality impact to happen and by improving our understanding of each step we can find ways to interrupt the process and reduce the risk to water from farming.



Summary of the main ACP findings to date

- Average nitrate levels in the streams and groundwater in all six catchments are well below the WHO drinking water limits.
- Phosphorus levels in the streams were low to moderate by international standards, however, three streams had levels above the Irish environmental quality standard.
- There are some indications of recent water quality improvement, likely due to farmers adopting better management practices.
- Lag times of five to 20 years can be expected between changes in farm management and changing soil phosphorus and groundwater nitrate levels i.e. the GAP measures need time to work.
- There is scope to improve nutrient management on farms – this will produce a 'win-win' – better farm profitability and better water quality.
- Farm management practices need to be tailored to suit the soil types to be effective in reducing the risk of nutrient loss.
- There is growing acceptance of the environmental benefits of the GAP measures but scepticism remains around certain measures, especially, "calendar farming".
- Improved communication of the science underpinning the measures would help to improve farmers understanding of the rationale that they are based on.

More information at **www.agcatchments.ie/agcatchments**.
The ACP is funded by the Department of Agriculture, Food and the Marine.

Ten tips to improve biodiversity on your farm

Catherine Keena
Teagasc, Kildalton Agricultural College, Piltown, Co. Kilkenny

Summary

- The marketing of Irish beef relies on our 'green' environmental image. This involves farming in harmony with nature or biodiversity.
- Biodiversity includes: native Irish flora (trees, flowering plants, ferns, mosses and lichens), native Irish fauna (birds, bats, amphibians, fish and invertebrates), and the habitats in which they exist such as hedgerows, watercourses and field margins.
- Managing existing habitats is most important. The following ten tips will improve biodiversity on your farm and live up to the green image of our beef industry.

1. **Leave a whitethorn tree in every hedge**
   Allow individual whitethorn trees mature and flower within routinely trimmed hedgerows to provide pollen for bees and other insects and haws as food for birds.
2. **Allow routinely trimmed hedgerows grow taller**
   Birds only nest in hedgerows over 1.4m high which provide cover from ground and overhead predators. Side trim hedges to a triangular shape with a wide base, with the peak cut to prevent the hedges escaping into individual mature trees. A diversity of hedgerow types is ideal, with some routinely trimmed and others allowed grow into mature relict hedgerows which are side-trimmed.

3. **Clean watercourses in an environmentally friendly way**
   When cleaning a channel, remove only vegetation and silt material from the open channel. Do not remove stone or gravel. Place spoil along the bank outside the bank-full line, spreading thinly. Retain bank slopes intact with a margin of vegetation. Leave a buffer length of 20m at the downstream end of a drain discharging in to a river to act as a silt trap. For least disruption to fish, plan work during July-Sept. Fish and their spawning grounds are protected under the Fisheries Acts (1959 – 2010). In-stream works should not be carried out without prior consultation and approval of Inland Fisheries Ireland. www.fisheriesireland.ie
4. **Replace drinking points with alternative water supply**
   Replace drinking points with piped water. Where piped water is not available, consider installing a nose pump. Access by livestock to watercourses, even to a well-managed drinking point, destroys vegetation and causes siltation which clogs up gravel. Fencing and providing alternative supplies of water prevents fouling with pathogens and prevents the escape of nitrogen and phosphorus to water.
5. **Allow birds and bats nest in buildings**
   Swallows return from Africa to the same farmyard each year. Never interfere with existing bird nests or bat roosts. Any renovation works or disturbance should be undertaken outside the breeding season. Do not block entrances to buildings where

birds are nesting or bats are roosting. Create new entrance holes and access points to older and derelict buildings to make them more accessible. Erect nest boxes for birds and bat boxes inside or outside farm buildings. Take care when using rodenticides – follow CRRU (Campaign for Responsible Rodenticide Use) code: **www.thinkwildlife.org**

A nesting pair of barn owls can catch up to 1500 rodents each year

6. **Identify and control invasive species**
   Invasive plant species such as Japanese knotweed, Giant hogweed and Himalayan balsam are not native to Ireland and spread rapidly, threatening native species and damaging habitats such as watercourses margins. Prevent their spread to or from your land and control or eradicate if already present. Take care not to introduce aquatic invasive plants if planting ponds or reedbeds with oxygenating plants. Invasive New Zealand flatworms devour earthworms and impact soil quality. For further information and to report sightings of invasive species: **http://invasives.biodiversityireland.ie**
7. **Plant native hedgerows**
   Hedges give the Irish landscape its distinctive character and provide shelter. For stock-proof hedges, plant seven whitethorn plants per metre into cultivated or disturbed ground, in a double staggered row. Include some holly, blackthorn, spindle, guelder rose, and hazel to increase its wildlife value. Prune plants back to 100 mm above ground level to encourage dense growth where required at ground level. Leave an occasional whitethorn unpruned to grow into a tree. Cut a strip of used silage plastic 1.2 metres wide and roll it up. Push the pruned shoots through the plastic. Hold down the plastic using gravel or by pushing the edges into the ground. Fence out rabbits and hares if necessary using two strands of electric wire: 150 mm and 450 mm above ground level.
8. **Plant native trees**
   Plant bare-rooted two year old whips during the dormant season – avoid exposure to air. There is usually no need to stake whips (large trees do require staking). Place a tree guard around each tree and fence off livestock as necessary. Keep a 1 metre diameter around the tree weed-free. Choose from our twenty or so native tree species.
9. **Grow a crop for wildlife**
   Growing crops for wildlife and leaving them un-harvested over winter provides seed food through the winter for seed-eating birds. A mix of oats and linseed sown each year is recommended. Cereals suit yellowhammer. Linseed suits finches, linnet and skylark. Crops provide refuge for hares, mice, voles, owls and kestrels.
10. **Leave field margins and grassy areas**
    Field margins, corners and grassy farm roadways are valuable *provided* fertilisers or sprays are not applied which encourage aggressive plants such as nettles, thistles and docks and that the vegetation is cut or grazed after flowering in August every few years. These areas provide space for broad-leaved plants, traditional grasses, beetles, butterflies, bank voles, mice, shrews linnet and meadow pipit.

Cross-compliance and farm inspections

Tim Hyde
Teagasc, Athenry, Co. Galway

Summary

- All farmers must comply with the cross-compliance regulations. These include public health, animal and plant health, animal welfare and environmental standards.
- Farmers must maintain all their land in Good Agricultural & Environmental Condition.
- All fields declared for SFP must be grazed, topped or cropped every year.

Introduction

Some 1350 farmers, or 1% of Single Payment Scheme (SPS) applicants, are inspected each year for all cross-compliance requirements. In addition, 5% of farmers who have cattle are inspected under Cattle Identification and Registration requirements, and 3% of farmers who have sheep are inspected. Failure to comply with cross-compliance or Good Agricultural & Environmental Condition (GAEC) regulations will lead to penalties being applied to all direct payments (called non-compliance).

The Dept. Agric., Food and the Marine (DAFM) may give no notification, or up to 14 days, depending on the regulations being inspected. Notification is given only "where such notice does not jeopardize the objective of the inspection". It is important that all records as required are maintained and available for inspection. Further information is available in the Teagasc cross-compliance workbook or www.agriculture.gov.ie.

Nitrates Directive top tips

- In REPS, silage bales may not be stored more than 2m high (not a cross-compliance requirement). Effluent leaking from bales, if not collected, will incur a penalty. Silage bales cannot be stored within 20m of any dry drain, stream or river.
- Do not store waste silage or farmyard manure in a silage pit. Rain coming off silage plastic is clean (provided no FYM is put on top of the plastic) and can be diverted to clean water outlets, but preferably not directly to streams/watercourses. When covering a silage pit, extend plastic over the effluent collection channels. Direct rain coming off the plastic to a clean water outlet. Where the pit is opened at the high end, direct rain on the plastic away from the feed face to the clean water system. Rain on self-feed silage areas must be collected with the manure. The face of the silage pit must be kept clean. If the silage apron is regularly cleaned, the rainwater runoff will be regarded as clean water.
- Set aside a concrete-floored area for farmyard manure (FYM) from calving pens, calf houses and waste silage. Rainfall onto FYM is a problem – if collected, there must be storage for 16/18/20/22 weeks and no spreading during the closed period.
- FYM cannot be stored in a heap in fields during the closed period. FYM cannot be stored on hardcore but may be allowed to build up under cattle in loose houses. FYM cannot be stored within 20m of any surface water (rivers/streams/drains).
- Runoff rainwater need not be collected from yards to which stock do not have access. Mixing with water from soiled areas is a common problem leading to penalties, increased storage requirements and elevating spreading costs. If rainfall on yards is mixing with slurry/faeces, this material cannot be spread during the closed period.

- Cattle crushes and farm roads should be scraped, and solids collected and stored. The rainfall runoff will be classed as clean water and will not require storage. Rainfall on roadways along which cattle are moved does not have to be collected. However, the last 100m should be regularly scraped. Do not allow run-off flow directly into a stream. Ensure roadways are sloped towards the field where run-off can filter through the soil.
- If slurry is moved off any farm in 2014, record this and notify DAFM by 31 Dec. 2014.
- A 2m uncultivated and unsown zone for tillage crops is required alongside surface waters identified on the 6" OSI map (1:10560) (see **http://maps.osi.ie/publicviewer**).
- Organic fertiliser setback distances from surface waters have been increased from 5m to 10m during the 2 weeks before and after the closed period.

Good Agricultural and Environmental Condition (GAEC) top tips

- All continuous tillage soils (≥6years) must be soil organic matter (SOM) tested.
- Removal of hedgerows/ditches is not permitted unless a similar length is replaced elsewhere on the holding in advance of the removal.
- Trimming of hedgerows can only be between 1st September and 28th February.

Common reasons for penalties under Statutory Management Requirements (SMR9) cross-compliance

- Exceeding the maximum individual and/or maximum total dose for a pesticide
- Poor/incomplete record keeping e.g. mixing up rates, not recording all applications
- Mixing up products and PCS numbers for similar products
- Failure to record all products used e.g. half cans in-store, but no purchase record.
- Using products in a knapsack sprayer when not authorised on the product label.

General cross-compliance tips

- All farmers involved in spraying need to be aware of the Sustainable Use Directive
- Prevent contamination of all stored feedstuffs during the winter months.
- Burning agricultural waste such as hedge/bush cuttings must be notified in advance to your local authority Environment Section. Burning of growing vegetation is illegal between 1st March and the 31st August.
- Sheep dip facilities need to be leak proof. Draining pens need to be concreted and sloped into collection tank.
- Ensure oil and fuel tanks are in working order and bunded to contain leaks.
- Don't locate outdoor feeding points within 20m of rivers/streams, or on rock.
- No application of non-selective herbicides or ploughing permitted after 1st Dec.
- Where land is ploughed or a non-selective herbicide is applied between 1st July and 30th November, an acceptable green cover must emerge within 6 weeks.
- Grassland cannot be ploughed between 16th October and 30th November.
- Late harvested crops (e.g. maize, potatoes, veg.) do not require a green cover.

Conclusion

Farmers need to know the requirements for cross-compliance. Teagasc provides advice to farmers to meet the required standards. A self-assessment booklet is available at **http://www.teagasc.ie/publications/view_publication.aspx?PublicationID=1896**.

Hazardous waste collection gives farmers peace of mind

Tim Hyde and Mark Gibson
Teagasc, Athenry, Co. Galway

Summary

- In November 2013, Teagasc, in association with the EPA, DAFM and local authorities, operated a farm hazardous waste collection pilot scheme involving six 'bring-centres' across the country. The campaign prompted an enormous response, with over 95 tonnes of hazardous waste collected from 864 farmers. An expanded campaign will be run in 2014 in eight locations across the country. The objectives were/are to:
- Get a better understanding of the quantities and types of hazardous waste that are stored on Irish farms.
- Facilitate the removal of hazardous wastes from farms and ensure that their recovery and disposal complies with national and European waste legislation.
- Make recommendations on how best to deliver an affordable and suitable national farm hazardous waste collection scheme.
- Pool resources and collective expertise of the various agencies and departments.

Introduction

What are hazardous wastes on farms which farmers can bring to these collection days?

Waste types collected during the pilot scheme
Waste engine and hydraulic oil, brake fluids, coolants and antifreeze
Oily containers, oily filters, rags, cloths, empty grease guns
Waste paints (including solvent and chromate based paints)
Unused, de-regulated, partially used pesticides and biocides including herbicides, fungicides and insecticides (sprays/chemicals).
Obsolete, unused or partially used veterinary products including tubes, syringes, empty dose packs, empty sheep dip packs, etc. Used Veterinary needles
Aerosol cans and empty silicone guns
All batteries including tractor, car, electrical fence, AA batteries, etc.
Waste electrical and electronic equipment (equipment that requires a battery or plug to operate), bulbs old TVs; computer monitors; fridges, freezers, drills, saws, etc.

Farmers were charged €2/kg to dispose of their hazardous waste. Since there is a market for waste oil, farmers were not charged for its disposal. All farmers were issued with a receipt of payment and were then posted a certificate of disposal which could be kept on record for cross-compliance or quality assurance purposes.

During the campaign, all wastes were weighed and categorised (Figure 1). By far the largest volume of waste was waste oils, which accounted for 66% of the total collected. It was evident that farmers had no easily accessible route to dispose of waste oils even though they have value. Pesticides contributed 15% of the total waste collected followed by paint (7%) and veterinary medicines (5%). The six bring centres were geographically spread across the country. Nearly 5 tonnes of veterinary medicines (unused, partially used and

out-of-date medicines, sheep dips, dose packs, syringes, mastitis tubes, etc.) were collected. Smaller quantities of other hazardous wastes, 3.5 tonnes in total, were collected which included out-of-date liquid fertilisers, contaminated empty containers, corrosives such as acids, biocides, aerosols, sharps, adhesives, anti-freeze, grease cartridges, creosote, brake fluid, etc.

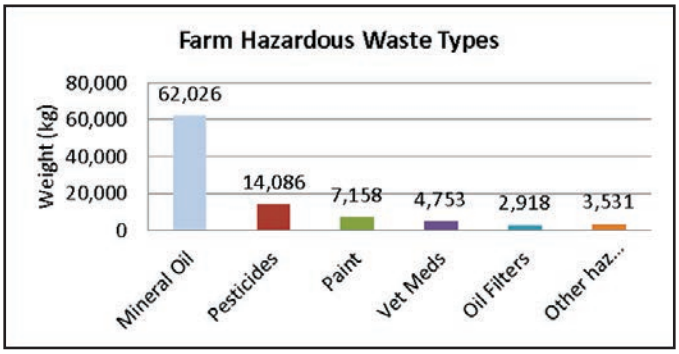


Figure 1 — Farm hazardous waste types and quantities collected (kg)

This pilot scheme indicated that there was/is hazardous waste on farms (both legacy and current) which posed a potential risk to the environment. The pilot scheme supported many existing national legislative and policy requirements, and contributed to Ireland's green credentials as a primary food producer.

This initiative clearly demonstrated the benefits of inter-agency collaboration and active stakeholder engagement resulting in real on-the-ground environmental protection. The absence of a suitable and affordable national scheme for the management of farm hazardous waste has been clearly identified. Farmers were supportive and appreciative of the initiative. Farmers want to manage these wastes in accordance with the relevant legislation and have demonstrated this by their participation in the pilot scheme and also by their willingness to contribute financially to the safe disposal of the hazardous waste. The issue is not so much a "willingness to pay" problem, but one of access and convenience.

Each of the bring-centres also collected WEEE (Waste Electronic and Electrical Equipment) and batteries. Electrical and Electronic Equipment (EEE) often contain hazardous components and substances which can be damaging to the environment and have adverse effects on human health. In total total, 22 tonnes of WEEE was collected.

Next steps

1. Eight bring-centres will be operated by the project team in November 2014.
2. The provisional list of locations are Donegal, Mayo, Cork, Waterford, Wexford, Dublin, Cavan and Offaly. Farmers will be issued with a certificate of disposal.
3. Teagasc will use its advisory service and discussion groups to disseminate information and to publicise the being-centres.
4. Other organisations such as IFA, ICMSA, Bord Bia and the Agricultural Consultants Association will be contacted to assist in publicising the campaign

The pilot campaign has highlighted the need for a suitable and affordable national scheme for the collection of farm hazardous waste, It provided relevant information and expertise on how best to develop such as scheme though a producer responsibility initiative.

Technology Village:

Exploiting grass on Irish beef farms

Teagasc grass and clover breeding programme

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Summary

- Teagasc has been breeding grass and clover varieties for Irish farm systems for over 50 years.
- Our goal is to breed new improved varieties of perennial ryegrass and white clover that offer high yields of quality forage over a long grazing season.
- Twenty-five perennial ryegrass and nine white clover varieties have been commercialised to date.
- Teagasc has entered into a new partnership with Goldcrop Ltd., an Irish seed and inputs company, to support the breeding programme and commercialise all new Teagasc varieties.

Introduction

Grassland is Ireland's greatest renewable feed resource and provides the main feed for ruminant livestock. Perennial ryegrass and white clover are the key components of the most productive swards. Changing climate, pests, diseases and farming practices (as dictated by economic and national policy shifts), and increasing animal demand from grassland, mean that new varieties are continually required in order to optimise the performance of our grassland. Breeding is the science, art and business of producing new varieties for the benefit of mankind. Forage grass and clover have been subjected to relatively little formal breeding. Genetic variation within and among populations is still extremely high, showing no signs of decreasing. There is no sign that the genetic progress achieved during the past 50 years of forage breeding will not continue for at least the next 50 years. Harnessing the power of modern technologies such as genomic selection may further accelerate genetic improvement.

History

The science of forage breeding in Teagasc began in the early 1960's at the Oak Park Research Centre, Carlow. Initially, there was a broad remit including (i) research on breeding methods, (ii) agronomic evaluation of species, varieties within species and mixtures (at the time there was no organised trial system in Ireland in which all new varieties were assessed) and (iii) breeding new varieties. In the mid-1980's major changes were made to the programme. It was decided that going forward the programme would concentrate primarily on the breeding of new varieties and that the programme would become commercially orientated. An exclusive commercial agreement with DLF-Trifolium of Denmark to propagate and market all new Teagasc varieties was entered into in 1992. To date, the programme has bred and commercialised 25 perennial ryegrass varieties and 9 white clover varieties.

In 2013, the Teagasc breeding programme entered a new chapter in its history signing a new 10 year commercial agreement with Goldcrop Ltd., an Irish seed and inputs company with headquarters in Carrigtwohill, Co. Cork. Goldcrop offer financial and technical support to the breeding programme. In return, Goldcrop have exclusive world-wide rights to commercialise and market all new varieties that emerge from the programme.

Breeding goals

Our emphasis is on breeding improved varieties of perennial ryegrass and white clover for Irish farmers. Our goal is to increase the profitability and sustainability, and reduce the environmental cost, of animal production from grassland in Ireland. The main plant traits for genetic improvement are: (i) spring and autumn growth, (ii) quality, particularly at mid-season, (iii) sward persistency and density and (iv) disease resistance. The perfect variety should provide sufficient yield to match the animal feed demand curve over the entire season. In other words, it would offer significantly higher spring and autumn yields than is currently achieved. It would also provide additional yield during the mid-season that could be conserved for use during the winter when grazing is not possible. We want a grass variety that heads only once in a compact period of time. The variety must head if we are to produce seed for resale. For the rest of the year we want a leafy, highly digestible sward. We want a variety that produces a dense sward with no bare ground and that will persist indefinitely. Finally, we want a grass variety resistant to rust. Rust is not a major disease problem in Ireland at present but it is predicted to get worse in the future.

The Teagasc perennial ryegrass breeding programme focusses equally on diploids and tetraploids, and primarily on later heading cultivars (i.e., late intermediate and late maturity groups). The white clover breeding programme focusses primarily on medium leaf size varieties.

Varieties

In 2014, farmers may choose among nine perennial ryegrass and three white clover varieties bred by Teagasc. All varieties are included on the 2014 Grass and Clover Recommended List of Varieties for Ireland. Teagasc perennial ryegrass varieties include: *KINTYRE*, top yielding late tetraploid; *GLENVEAGH*, late diploid with the highest sward density of all recommended varieties; MAJESTIC, late diploid with excellent all round performance; CARRAIG, intermediate tetraploid with the highest spring yield and ground cover of all tetraploid varieties; *SOLOMON*, highest spring yielding intermediate diploid. Teagasc white clover varieties include: *CHIEFTAIN* and *AVOCA*, best yielding medium leaf size white clover varieties on the Recommended List.

The 2014 Grass and Clover Recommended List of Varieties for Ireland is available at the following website: **www.agriculture.gov.ie/publications/2014/**.

Forthcoming Teagasc varieties, currently undergoing seed increase and with predicted release dates in 2015-2016, include *GLENROYAL* (late diploid perennial ryegrass), *SOLAS* (late tetraploid perennial ryegrass) and *BUDDY* (medium leaf white clover).

Conclusions

Breeding offers a relatively low cost means of improving the profitability, sustainability and productivity of Irish grassland. The Teagasc forage breeding programme continues to develop improved varieties of grass and clover for Irish farmers. Farmers may currently choose among nine perennial ryegrass and three white clover varieties bred by Teagasc for reseeding. A number of other new varieties are currently undergoing seed increase for future release. The future of forage breeding is bright, limited only by human imagination, ingenuity and available funding.

Grassland reseeding on drystock farms

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Summary

- Reseeding is one of the most cost effective on-farm investments
- There is little difference between reseeding methods
- When reseeding in spring, there is no loss in dry matter production in the establishment year compared to permanent pasture
- Management after reseeding is just as important as decisions made at sowing

Introduction

Many farms in Ireland have swards that cannot grow enough grass during the year, especially in spring and autumn. This is mainly due to the absence of productive perennial ryegrasses in pastures. Economically, pastures with a low proportion of perennial ryegrass are costing farmers up to €300/ha/year due to a loss of dry matter (DM) production and reduced nitrogen use efficiency during the growing season. If the cost of reseeding is estimated at approximately €700/ha, the increased profitability of the reseeded pasture would cover this cost in just over two years. This means reseeding is one of the most cost effective on-farm investments.

Reseeding methods

How paddocks are prepared for reseeding comes down to soil type, amount of underlying stone and machine/contractor availability. There are essentially two methods of preparing the seedbed. The most common method is ploughing; however in many areas this is not possible because the ground is too stony, soil too shallow or topography is too steep. Technical advances, such as minimal cultivation techniques, enable reseeding to be carried out without ploughing. Recent studies have compared four methods of reseeding, namely (1) direct drilling, (2) discing followed by one-pass sowing, (3) power-harrowing followed by one-pass sowing, and (4) conventional ploughing, seed-bed preparation and sowing. The outcomes of the studies were assessed in terms of the effects on DM production, sward establishment and sward persistence. While all having different modes of action, each of the full sward renewal methods evaluated performed satisfactorily. It can be concluded that, on balance, each of the sward renewal methods evaluated were as effective as the conventional 'ploughing' method of grassland reseeding. The length of the study (2.5 years) may be too short to fully evaluate the lifetime performance of the swards, but after 24 months of establishment, prevailing grazing management is more likely to influence DM production than the reseeding method.

Timing of reseeding

Most reseeding in Ireland is completed in the autumn. This may make sense from a feed budget point of view but it does have some negative consequences. Conditions deteriorate as autumn progresses – lower soil temperatures can decrease seed germination and variable weather conditions reduce the chances of grazing the new sward. The opportunity to apply a post-emergence spray for weed control is also reduced as ground conditions are

often unsuitable for machinery to travel. With this in mind, if planning to reseed, the spring period should be considered for at least a proportion of the area, with any reseeding in autumn to be completed as early as possible. As part of the two studies investigating reseeding methods described above, the effect of reseeding timing was investigated over a two year period. Swards were established in both autumn and spring. The autumn-sown reseed in its first year of production out-yielded an old permanent pasture control sward by 958 kg DM/ha (11,326 versus 10,368 kg DM/ha). In Year 2, this difference increased to 2410 kg DM/ha (12,749 versus 10,339 kg DM/ha). For the spring-sown reseed there was virtually no difference in DM production in the establishment year (swards yielded 9700 kg DM/ha), while in Year 2 this difference increased to 2033 kg DM/ha in favour of the reseeded swards. A key finding from this study was that there was no loss of production in the establishment year when reseeding in the spring period. It could be concluded from the study that, irrespective of timing of reseeding, the swards required time to settle and allow perennial ryegrass hierarchy establish, and then the advantage to reseeding *per se* became apparent.

Management of reseeds

When reseeding, ensure that grass varieties from either of the Irish (Republic or Northern) recommended lists are used. These varieties have been trialled and tested under Irish conditions. Teagasc recommendations are to sow 35 kg/ha to ensure good establishment of the sward. It is also advised to sow a minimum of 3 kg of each variety within a mixture. Prior to reseeding, the old sward should be killed off using glyphosate. It is vitally important that soil fertility is at recommended levels to ensure high performance from reseeded swards. Soil samples should be taken from the freshly cultivated soil for analysis so as to gauge the level of nutrients required. The best time to control docks and all other weeds is after reseeding. By using a post emergence spray, seedling weeds can be destroyed before they develop and establish root stocks. The post-emergence spray should be applied approximately 6 weeks after establishment, just before the first grazing takes place. Care needs to be taken when grazing newly reseeded swards. The sward should be grazed as soon as the new grass plants roots are strong enough to withstand grazing (root stays anchored in the ground when pulled). Early grazing is important to allow light to the base of the plant to encourage tillering. Light grazing by animals such as calves, weanlings or sheep is preferred as ground conditions may still be somewhat fragile, depending on the establishment method used. The first grazing of a new reseed can be completed at pre-grazing yields of 600-1000 kg DM/ha. Frequent grazing of the reseeds at light covers (<1400 kg DM/ha or less than 10 cm) over the first year post establishment will have a beneficial effect on the sward. The aim is to produce a uniform, well tillered, dense sward. If possible newly reseeded swards should not be closed for silage in their first year of production as the shading effect of heavy covers of grass will inhibit tillering of the grass plant resulting in an open sward which would be liable to weed ingress.

Conclusion

The timing of reseeding will be influenced by feed budgets and weather conditions. There is little difference between reseeding methods once a firm, thrash-free seed bed is established. Many management factors affect the success of newly sown swards. Good management after sowing is as important as decisions around timing and methods.

The Pasture Profit Index

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Summary

- The Pasture Profit Index applies monetary values to each grass variety based on its seasonality of dry matter production, quality, persistency and silage dry matter production
- The generated sub-indices within the Pasture Profit Index will identify the most suitable varieties for individual systems
- A prototype of the Pasture Profit Index with rankings for individual varieties was released in 2014. It contains approximately 50% of varieties on the 2014 Recommended List, and as more varieties have a Pasture Profit Index value applied, the rankings of cultivars may change

Introduction

The seasonal nature of ruminant production in Ireland influences the traits of importance for grass-based production systems. Varieties that provide higher dry matter (DM) production in spring and autumn support the extension of the grazing season. As a result the costs of production are reduced. There is a greater economic benefit to these varieties compared to those which provide higher DM yields during the main grazing season, when there is already surplus grass in the system. Quality and persistency are also two important traits which will influence the value of a cultivar to a grazing system. The objective of the Pasture Profit Index (PPI) is to simplify the selection of grass varieties, by applying economic values to the traits of importance within a grass based production system, and from this farmers can identify the suitability of varieties to their particular grazing system.

Development of the Pasture Profit Index

The Pasture Profit Index was developed to rank perennial ryegrass varieties on their economic contribution to a farm system. The index applies economic values to the traits of importance for a grass-based ruminant production system. Economic values were derived by simulating a physical change for each trait using the Moorepark Dairy Systems Model. The difference between the net margin per hectare, before and after the change was simulated, was divided by the change in the trait of interest to calculate the economic value for a unit change in that trait. Table 1 presents the calculated economic value for each trait within the Pasture Profit Index. These economic values are then applied to the performance of individual varieties to determine the total economic merit of a variety.

Application of the Pasture Profit Index

Economic values will be applied to data generated within the DAFM trials to calculate the total economic merit of a variety. The performance of each variety relative to a base within each trait will be determined to quantify the benefit which can be achieved by selecting varieties based on their economic merit relative to the base.

Table 1 — Economic values (€ per ha/year) for traits within the Pasture Profit Index.

Seasonal DM yield[1]			Quality[2]				Persistency[3]	Silage[1]	
Spring	Mid season	Autumn	April	May	June	July		1st Cut	2nd Cut
0.16	0.04	0.11	-0.001	-0.008	-0.010	-0.009	-67.23	0.04	0.03

[1]per kg DM increase; [2]per unit change in DMD; [3]per year loss in persistency

Table 2 presents the PPI Prototype – with varieties which have a PPI value assigned to them and the sub-indices which indicates the performance of each variety within the traits of importance. Not all varieties on the 2014 Recommended List have a PPI value as not all varieties have frequent cutting data available. The sub-indices present the opportunity to select varieties for specific purposes. For example, if selecting a variety for intensive grazing, the emphasis would be placed on seasonal DM yield and quality with less importance placed on the silage performance of the variety. On the other hand, if selecting a variety specifically for silage production, then greater emphasis would be placed on the silage sub-index. Using a mixture of the most appropriate varieties is recommended to create the optimum sward. As not all varieties currently on the 2014 Recommended List have a PPI value available it is strongly advised to use the Recommended List when selecting varieties for reseeding this year. In 2015 and 2016 the PPI will have a greater proportion of varieties from the recommended list and so can be used as a tool for variety selection.

Table 2 — The Pasture Profit Index – 2014 Prototype (as not all varieties on the Recommended List have a PPI value, this is a prototype of how the PPI will look)

Variety details				PPI details	PPI Sub-Indexes (€ per ha per year†)					
					DM yield					
Rank	Variety	Ploidy	Heading date	Total €/ha per year†	Spring	Summer	Autumn	Silage	Quality	Persistency
1	Dunluce	T	29-May	226	53	52	61	11	50	0
2	AberMagic	D	30-May	185	66	59	87	-3	21	-45
3	Magician	T	21-May	173	61	40	46	16	11	0
4	Trend	T	24-May	160	42	54	35	24	5	0
5	Navan	T	6-Jun	147	20	52	60	-5	27	-7
6	Aspect	T	5-Jun	138	34	52	33	-4	31	-7
7	Delphin	T	1-Jun	117	23	51	30	7	6	0
8	AberCraigs	T	4-Jun	92	1	46	22	4	19	0
9	Twymax	T	6-Jun	89	-4	55	23	2	29	-17
10	Glencar	T	2-Jun	78	25	43	31	5	4	-29
11	Tyrella	D	3-Jun	48	47	28	24	-11	-10	-29
12	Portstewart	D	5-Jun	44	3	38	21	-13	-5	0
13	Mezquita	D	6-Jun	30	16	37	8	-9	-22	0
14	Malambo	D	10-Jun	22	5	39	17	-9	-13	-17
15	Denver	D	2-Jun	14	3	38	9	-5	-30	0
16	Soriento	D	3-Jun	8	3	32	6	-7	-27	0

†Economic values are rounded to the nearest whole Euro

Conclusion

The PPI will simplify the selection of grass varieties at farm level. The total PPI value will indicate the overall value of a variety, however the sub-indices will indicate where a variety is performing well and hence varieties should be selected accordingly to ensure the optimum varieties are used to meet the individual farm requirements. Not all varieties on the 2014 Recommended List have a PPI value. Over the next two years more varieties will have a PPI value and hence the true rankings of more varieties will be identified.

White clover for beef systems

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Summary

- The price of fertiliser nitrogen has doubled in the last decade
- Clover fixes nitrogen from the air and thereby reduces fertiliser costs
- White clover is the most suitable clover for grazing in Ireland
- White clover can supply 50-150 kg N/ha each year on most farms
- Clover needs good grassland management and works best in a paddock system
- Guidelines are provided for establishing and maintaining clover in swards

Introduction

Fertiliser nitrogen (N) price has doubled in the last decade and each 1 kg fertiliser N now costs an average of just over €1. White clover has rhizobia bacteria in its roots that "fix" nitrogen from the air, and this can supply 50-200 kg N/ha per year. Increasing the clover content in grassland can result in increased herbage production and quality (Table 1).

Table 1 — Herbage production, herbage quality and nitrogen (N) fixation from grass and clover plots with zero fertiliser N input at Teagasc Solohead research farm in 2009.

Annual sward clover content (%)	0	15	20	25	30	35
Tonnes herbage DM produced/ha	7.4	9.4	9.8	10.5	11.0	11.1
Crude protein content (% of DM)	21	23	23	24	24	25
Organic matter digestibility (%)	77	79	79	80	80	80
N fixed (kg/ha)	0	89	108	144	160	187

Establishing white clover on your farm

Oversowing: The cheapest way to introduce white clover on your farm is to oversow (broadcast) it on existing grassland using a fertiliser spreader, slug pellet applicator or similar machine during late spring:

1. Get a soil test. The ideal soil fertility for clover is the same as for grass: soil P and K index of 3 and a pH of 6.0 to 6.8. However, clover is not tolerant of low pH.
2. Get weeds such as docks under control before introducing clover. Herbicides that don't kill clover are usually quite expensive.
3. Seed-to-soil contact and high soil moisture are essential. Ideal conditions are an open sward (e.g. after first cut silage) where soil moisture is likely to remain high for the next 4-6 weeks.
4. Oversow 5 kg white clover seed/ha. This can be achieved with a fertilizer spreader by mixing the seed with a zero-N fertilizer (e.g. 0:7:30). The seed and fertilizer will separate out during motion, and should therefore be mixed regularly during the oversowing.
5. Do not apply fertilizer N for the remainder of the year. This may result in lower herbage production from this area during the year of sowing, but is essential for the establishment of the clover.

6. Graze tight late into the following autumn, and graze again in early spring. Do not let heavy covers of grass shade out the newly-established clover during the winter.

Reseeding: Reseeding is a more expensive option but might be recommended to establish more productive perennial ryegrasses on old grassland. The above principles for oversowing clover also apply to establishing clover in a reseed.

Grazing management of white clover

Beef farmers should achieve better success with oversowing and maintaining clover if a paddock system is used. The recommended grazing management for white clover is very similar to the recommended best practices for perennial ryegrass. However, there are certain management practices that promote clover in grassland:

1. Only apply fertiliser N in spring. Excessive use of fertiliser N reduces clover's natural N fixation and can deplete the clover from the sward. Therefore, total fertiliser N use on grass-clover swards should be kept to less than 100 kg per ha in spring, with no fertiliser N applied after April.
2. Graze tight. A post-grazing height of 4 cm is beneficial to herbage production from grass-clover swards. It is particularly important in late autumn and in spring.
3. Extend the grazing season as much as possible. The ground cover by clover in a good grass-clover sward typically reaches a peak of 50-60% each autumn and declines to less than 10% each winter and spring. Therefore, leaving a heavy cover of herbage throughout the winter and spring can shade out clover. Extend the grazing season as much as possible with early turnout and late housing. Use the Teagasc autumn and spring rotation planners to achieve this.

Teagasc research has found clover to be very suitable for building covers in autumn (as long as there is a tight grazing before closing the paddock for winter) and it can also do well after a silage harvest, as long as there is at least one grazing in spring.

Bloat

Clover has an excellent feeding value, and livestock show high intakes and performance when grazing clover-rich herbage. However, clover can cause bloat (a potentially fatal condition). That said, Solohead Teagasc Research Farm has used clover for the last 10 years and has yet to encounter a case of bloat. However, the following points should be observed:

1. Don't put very hungry (e.g. fasted) livestock straight onto clover-rich sward.
2. Introduce livestock gradually to clover-rich swards. Livestock that are not used to clover are at a higher risk of bloat.
3. Be extra careful when livestock are moved from a grass-only sward (particularly a poor quality one) onto a clover-rich sward.
4. If the sward has a high content of clover (> 50%), consider increasing roughage by providing straw or allowing pre-grazing herbage mass to increase.
5. If in any doubt, provide an anti-bloat additive in the feed or water.

For more information on clover, please see the following Teagasc booklets:

1. *A guide to the management of white clover in grassland.*
2. *Using clover to cut costs on dairy and beef farms.*

Both of these booklets can be downloaded from the following website:
http://www.agresearch.teagasc.ie/moorepark/publications/publications_d.asp

PastureBaseIreland – national grassland database

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Summary

PastureBaseIreland is an online grassland management application tool which stores grass data recorded by famers in a centralised grassland database.

- PastureBaseIreland includes a user-friendly decision support tool to increase the precision of grassland management.
- The data stored by PastureBaseIreland in the centralised database will facilitate future research with an increased understanding of the range of factors that affect grass growth on farms in Ireland.
- It is anticipated that PastureBaseIreland will result in the development of more robust grass growth models, more accurate grass cultivar evaluation and an increased understanding of the factors affecting grass growth at farm level.
- PastureBaseIreland is designed to allow the use of data directly from commercial software.

Introduction

The future of an efficient low cost production system will depend on increasing the utilisation of grazed grass. On many beef farms some form of grassland measurement is being completed. Historically this immensely valuable information was not centrally collated and stored in a way that it could be used for research. The development of PastureBaseIreland (PBI) which incorporates both a decision support tool to increase the precision of grassland management and a database to store all of the grassland data in a standard format is an important step to advance grassland research, with an ultimate aim of developing grassland technologies that are more robust for the future The data captured through this process will significantly increase the understanding of the factors affecting grass growth, grass utilisation, cultivar evaluation and numerous other grassland related components.

PastureBaseIreland

PBI was launched in January 2013 with an extension, advisory, training and research focus. The database stores all grassland measurements in a common structure. This will facilitate the quantification of grass growth and dry matter (DM) production (total and seasonal) across different enterprises, grassland management systems, regions and soil types using a common measurement protocol and methodology. PBI has a number of reports that allow farmers to make day to day management decisions (grass wedge, rotation planners and budgets) and allows farmers to evaluate medium to long term performance from the farm (distribution of growth and paddock summary reports). The reports can also be used to benchmark farms across enterprises and regions. Background data such as paddock soil fertility, grass cultivar, aspect, altitude, reseeding history, soil type, drainage characteristics and fertiliser applications are also recorded. PBI will also for the first time link grass growth on farms to local meteorological weather data.

Both nationally and internationally there is a lack of historical data on grass growth. This has had implications for grassland technology adoption on farms and resulted in a

poor understanding of grass growth in many countries. Many grass growth models are based on limited data and are in effect limited in their ability to predict grass growth at farm level.

Grass variety evaluation

A long term on-farm grass cultivar trial has been setup by Teagasc Moorepark. There are currently 76 farms on the trial. However, over the coming years it is hoped over 100 farms will participate in the trial (the project is funded by Germinal Ireland and UK, Goldcrop, Barenbrug, Dairygold and Glanbia). Adopting on-farm grass cultivar evaluation will quantify the lifetime performance of the grass cultivar. Data from commercial farms is required for the development of the Pasture Profit Index. Pasture persistency and longevity are key traits within the index, the measurement of these traits needs to be over a long term period in grass evaluation protocols. The development of PBI will give researchers immediate access to the performance of cultivars on commercial farms.

Advisory and educational requirements

The Teagasc agricultural colleges are using PBI as a grassland management decision support tool for both their dairy and drystock enterprises. This will ensure that there is a common use of decision support tools across all Teagasc farms. Advisors for the first time will have direct access to grassland data from all Teagasc research farms. This innovation will provide reliable grass growth rates to the advisory service across soil types and regions. Advisors will have easier access to their clients grazing data, as they will be fully integrated users on the system. This will allow them to generate grassland reports for individual farms and larger reports to include all farms in a discussion group.

Compatibility with commercial company software

Over the past number of years the number of commercial grassland management decision support packages has increased dramatically. It is anticipated that in the future PBI will have the capability to accept data entered on these packages. Incorporating these data will increase the value of the database and will ensure that all potential data sources are being used to increase the sustainability of grass based dairy, beef and sheep farms. Teagasc in conjunction with the commercial software providers is currently developing strategies to facilitate the flow of data into PBI.

Conclusion

The development of PBI both as a decision support tool and a grassland database is a hugely significant step for the future of grassland production systems in Ireland. PBI has the potential to add significant value to the data collected by individual farmers and will ultimately result in significant advancement towards gaining a greater understanding around grass growth in Ireland.

Drainage of heavy wet soils

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Summary

- The first step to diagnose a drainage problem is to excavate several soil test pits on your farm within problem and non-problem areas.
- Two main types of drainage system exist: a groundwater and a shallow drainage system.
- There is no one size fits all solution to land drainage in Ireland. The design of the system depends entirely on the drainage characteristics of the soil.

Introduction

The objective of any form of land drainage is to remove excess water from the soil, to lower the watertable, and to reduce the period of waterlogging. Land drainage is an effective tool to lengthen the growing season, the grazing season, the utilisation of grazed grass by livestock and the accessibility of land to machinery. It is one of a suite of measures to increase productivity on Irish farms. A number of drainage techniques specific to Ireland have been developed to suit our different soil types and high rainfall conditions. Broadly speaking, there are two main categories of land drainage:

- **Groundwater drainage system:** A network of deeply installed piped drains exploiting permeable layers.
- **Shallow drainage system:** Where the permeability (the ability of the soil to allow water to move through it) of the soil is low at all depths and needs to be improved.

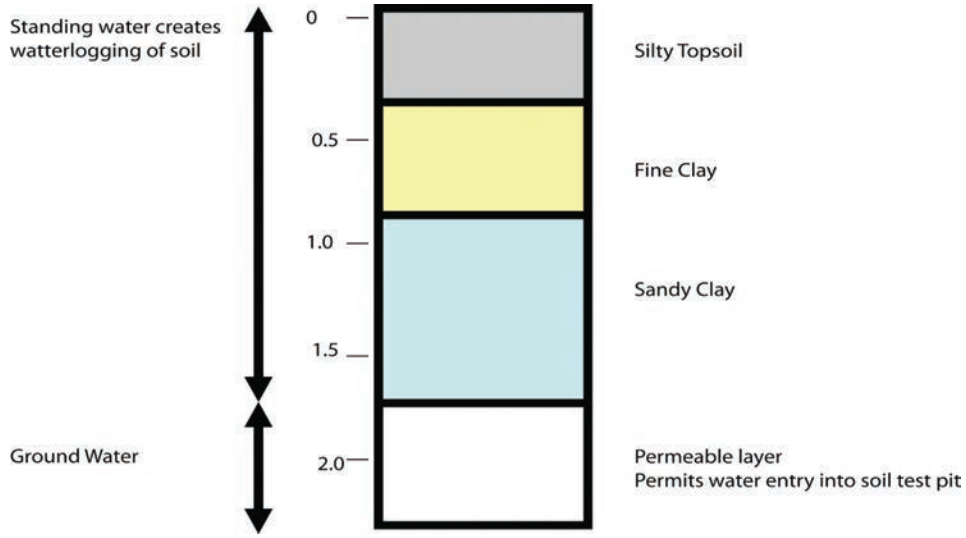

Figure 1 — A typical heavy wet soil profile (depth in metres). If a free draining layer (called "permeable layer" here) is present at any depth then a groundwater drainage system is the most appropriate solution, if not then a shallow drainage system is required.

A number of soil test pits (at least 2.5m deep) should be excavated within the area to be drained. The soil test pits should be dug in areas that are representative of the area as a whole. As the soil test pits are dug, the faces of the pits are observed, soil type should be established and the rate and depth of water seepage into the soil test pit (if any) recorded. Visible cracking, areas of looser soil and rooting depth should be noted as these can convey important information regarding the drainage status of the different layers. The depth and type of the drain to be installed will depend entirely on the interpretation of the characteristics revealed by the test pits. Also walk the length of any open drains on site to look for consistency of the permeable layer. Researchers in Teagasc are now developing techniques outlined in the new "Teagasc Manual on Drainage" to diagnose and pick a suitable technique to eradicate your drainage problems.

Groundwater drainage system

In soil test pits where there is strong inflow of water or seepage from the faces of the pit walls, layers of high permeability are present. If this type of scenario is evident on parts of your farm it would be best to focus on these areas first as the potential for improvement is usually very high. Under these circumstances the use of a piped drainage system is advised. The installation of a piped drain at the depth of inflow will facilitate the removal of ground water assuming a suitable outfall is available. Conventional piped drains at depths of 0.8 to 1.5m below ground level have been successful where they encounter layers of high permeability. However, where layers with high permeability are deeper than this, deeper drains are required. Deep piped drains are usually installed at a depth of 1.5-2.5m and at spacings of 15-50 m, depending on the slope of the land and the permeability and thickness of the drainage layer. Piped drains should always be installed across the slope to intercept as much groundwater as possible, with open drains and main piped drains running in the direction of maximum slope.

Shallow drainage system

Where a soil test pit shows little ingress of water at any depth a shallow drainage system is required. These soils with no obvious permeable layer and very low hydraulic conductivity are more difficult to drain. Shallow drainage systems are those that aim to improve the capacity of the soil to transmit water by fracturing and cracking it, these include mole drainage and gravel mole drainage. Mole drainage is suited to soils with high clay content (>40%) which form stable channels. Mole drains are formed with a mole plough comprised of a torpedo-like cylindrical foot attached to a narrow leg, followed by a slightly larger diameter cylindrical expander. The foot and trailing expander form the mole channel while the leg creates a narrow slot that extends from the soil surface down to the mole channel depth.

The success of mole drainage depends on the formation of cracks in the soil that radiate from the tip of the mole plough at shallow depth. Gravel filled moles employ the same principles as ordinary mole drains but are required where an ordinary mole will not remain open for a sufficiently long period. This is the case in unstable soils having lower clay content or where stones are present. The mole channel is formed in a similar manner but the channel is then filled with gravel which supports the channel walls. The gravel mole plough carries a hopper which controls the flow of gravel. During the operation the hopper is filled using a loading shovel or alternatively a belt conveyor from an adjacent gravel cart. Gravel moles require a gravel aggregate within the 10-20 mm size range to ensure they function properly.

Teagasc manual on drainage – A best practice manual for Ireland's farmers

This was published in 2013 and has all the tips needed to carry out a drainage campaign. In addition there is a booklet version free of charge on the Teagasc website at — **www.teagasc.ie/publications**

Fertiliser advice for beef systems

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Summary – 5 targets for soil fertility on your farm

- Soil test the whole farm to know soil fertility levels.
- Apply lime to acidic soils to increase the pH.
- Use the soil index in each field to guide fertiliser P and K and slurry application.
- Apply slurry in spring to fields with high P and K requirements (i.e. where there were low P and/or K values in a soil test, and/or where cut for silage) to maximise its nutrient value.
- Use bagged fertilisers that are correctly balanced in N, P, K and S for the needs of each field.

Introduction

Productive soils are the foundation of any successful farm. The demand within intensive grazing systems for high grass growth rates over an extended grazing season represents an increasing demand on soil fertility levels. The ability of soils to maintain a supply of nutrients in the appropriate quantities for grass growth is a key factor in determining how productive a field or farm can be. Fertiliser costs account for approximately 20% of the total variable costs on farms, but can provide good value for money when used correctly. However, fertiliser application rates that are either too low, too high, or not in balance with other soil fertility factors will give lower responses. With soil phosphorus (P) and potassium (K) levels declining on many farms in recent years, the importance of soil fertility management has increased.

Soil fertility management – 5 steps to follow

1) *Soil test*

A soil test will indicate the background soil fertility levels of pH, P and K, and also Mg and trace elements where required. The role of soil analysis has taken on a new dimension in recent years within the Nitrates regulations, with soil testing now being associated more with bureaucracy and regulation than with good farming practice. However, it is important to remember that the primary function of soil testing on the farm should be to improve soil fertility information and to plan fertiliser applications.

Have soil samples taken for the whole farm. It can be organised through your local Teagasc advisor at a cost of €25 per sample. Unless you know what is in the soil, it is impossible to know how much fertiliser it needs. Thus, by undertaking soil analysis and using the results, the fertiliser programme can be tailored to the needs of the soil and the farm. Repeating soil analysis over time is also critical to monitor soil fertility.

2) *Apply lime*

Soil pH is the first thing to get right. The release of nutrients from the soil and the response to applied fertilisers will be reduced where the soil pH is low (or too high). Apply lime as required based on the soil test result, to increase soil pH up to the target pH, which is 6.3 for grassland. It is important not to apply more than 7.5 t/ha of lime in a single application, as it can affect trace element availability in soils if applied in excess. Apply 7.5 t/ha immediately and the remainder after two years where more than 7.5 t/ha is required.

3) *Target Index 3 for P and K*
Soil analysis is designed to estimate the P and K that is present in the soil in a plant-available form. Aim to have soil P and K in Index 3 in all fields where high levels of production of quality grass is the target. High fertility soils (Index 4) are a resource and should be utilised. Low fertility soils (Index 1 or 2) need to be nourished. For soils in Index 3 the fertiliser program should be designed to replace the nutrients being removed, thus maintaining the soil fertility level. Advice for P and K for beef grassland is shown in Table 1. The P advice rates should also be adjusted to account for the P applied in slurry or coming onto the farm in concentrate feeds. Each tonne of concentrate feed is assumed to contribute 5 kg of P.

Table 1 — Simplified P & K requirements for grazed and cut swards in beef systems.

Soil Index	Grazed swards				Silage swards	
	Farm stocking ate (LU/ha)				Cut Once	Cut Twice
	< 1.0	1.0-1.5	1.5-2.0	>2.0		
P advice (kg/ha)						
1	24	27	30	33	+20	+30
2	14	17	20	23	+20	+30
3	4	7	10	13	+20	+30
4	0	0	0	0	0	0
K advice (kg/ha)						
1	65	70	75	80	+120	+155
2	35	40	45	50	+120	+155
3	5	10	15	20	+120	+155
4	0	0	0	0	0	0

4) *Slurry*
Slurry is a valuable source of P and K, and typically contains 0.6 kg m^{-3} of P and 3.6 kg m^{-3} of K. The P and K fertiliser values of slurry can be highly variable, usually due to dilution with water. While slurry can be more difficult to manage than chemical fertiliser, it can be a very cost effective resource to increase fertility levels. Target slurry applications to fields that have high P and K requirements (fields with P and K Index 1 or 2). Apply in cool and moist weather conditions (e.g. in spring) to maximise N recovery. Many beef farms with lower stocking rates will be able to import manures and slurries from other farms. Cattle and pig slurry brought into the farm is a cost effective way of increasing soil fertility and should be considered where possible.

5) *Fertiliser products that give a balanced nutrient supply*
Make sure the fertiliser compound is supplying nutrients in the correct balance for the crop, the soil, and to complement other fertilisers being applied. If one nutrient is deficient, no amount of another nutrient will overcome this. For example, if a field is deficient in K, then excess N application will not be fully utilised. Consider straight K or NK fertilisers where P usage is restricted. Other nutrients such as sulphur can play a very important role in a balanced fertiliser programme and should also be applied on lighter soils that are freely drained and have lower organic matter contents.

Conclusions

Implementing these steps for soil fertility management will go a long way to ensuring that the production potential of the farm is being realised, and that fertiliser inputs are being utilised as efficiently as possible.

Controlling docks in grassland – an integrated pest management approach

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Summary

- Docks continue to be the main weed in Irish grassland capable of halving grass production.
- Seedling docks readily establish during reseeding **but** rarely establish in existing grass swards.
- The best post-emergence herbicide (Doxstar) following reseeding gave 91% control that lasted for four years.
- The best dock herbicide (Forefront) in established awards gave 81% control after 2 years.
- High rates of recovery of mature dock plants were recorded following the application of some herbicides (Eagle and Prospect) to established swards.
- Recovery of dock numbers was primarily from regeneration from existing rootstocks.

Introduction

Broadleaved dock is a very common weed in intensively managed Irish grassland. High chemical fertiliser inputs, land spreading of organic manures and grass-silage making are associated with higher dock population densities. At low populations, docks are of little consequence to grass production but once numbers increase, docks reduce both the productivity of the sward and the intake of grazing animals. In intensive grassland, the control of docks is almost exclusively by selective herbicides. Nevertheless, control can often be poor and generally short-term with further applications required within a number of years. The objective of this study was to compare the effectiveness of a number of herbicides applied either (i) at the post-emergence seedling stage following reseeding or (ii) to mature established swards.

Experiment layout

A dock control experiment was conducted in Kildalton College from 2010-2013. The field was reseeded in October 2009 and herbicide treatments were randomly assigned. Dock herbicides were either applied at seedling stage (April 2010) or mature stage (April 2012) and the effects (numbers, grass and dock herbage yields) were monitored for 4 years after reseeding. The experiment area was cut for silage twice and grazed three times each year as part of the college dairy herd area.

Results

Table 1 shows that herbicide application at the seedling stage is substantially more effective than herbicide application at the mature stage and the effect lasted for at least 4 years. The excellent initial control of seedlings was due to their lack of regeneration capacity and underdeveloped root. Table 1 also shows that the effect of the seedling spray is consistent over time which is due to the competitive grass sward out-competing any subsequent dock seedlings that may arise. Table 2 shows that treating mature docks with herbicide reduces their number initially but, depending on the herbicide used, some dock

plants had the capacity to recover over time. Of herbicides applied to established swards, Forefront gave the best long term control during the study. The recovery of dock numbers following herbicide application to established swards was from the regeneration from rootstocks and not from new seedlings establishing in the sward.

Table 1 — The effect of herbicide treatments on dock numbers per m² over 3 seasons.

Herbicide applied	Application date	Stage of dock growth at application	2010/11	2011/12	2012/13
Untreated			4.66	3.77	4.67
				After herbicide application	
Alistell	April 2010	seedling	1.88	1.47	1.90
Legumex + Triad	April 2010	seedling	1.38	1.15	1.35
CMPP	April 2010	seedling	1.25	1.44	1.43
Doxstar	April 2010	seedling	0.87	0.34	0.42
				Before application	After application
Eagle	April 2012	mature	5.09	3.49	2.71
Prospect	April 2012	mature	4.53	3.60	2.26
Doxstar	April 2012	mature	4.71	3.30	1.54
Forefront	April 2012	mature	5.48	4.39	0.89

Note: Eagle, Prospect, Doxstar and Forefront were applied to mature dock plants in April 2012

Table 2 — The evolution in numbers of individually marked docks following herbicide application to mature docks in established swards.

	April 2012	Sept 2012	April 2013	Sept 2013
Before herbicide application		After herbicide application		
Untreated	10.6	9.9	9.5	9.2
Eagle	10.5	7.4	8.5	7.8
Prospect	11.4	4.9	8.3	7.8
Doxstar	10.3	2.4	4.6	4.5
Forefront	10.6	1.5	2.9	3.4

Conclusions

Docks continue to be a problem in intensive grass leys and can significantly reduce grass yields. Dock seeds readily germinate and establish in reseeded leys due to lack of competition from the establishing grass seedlings. However, dock seedlings are far less likely to dominate in established grass swards due to competition from the sward. A well-targeted post emergence spray following reseeding can give very effective control of docks that will persist for at least four years and should be considered an essential component of the reseeding operation. The efficacy of this spray is due to it being applied onto susceptible dock seedlings and thereafter the competitive grass ley prevents dock seedlings from establishing. Where docks are established in mature grassland, Forefront offers the best control option. Some regeneration from rootstocks can occur and repeat applications may be necessary. Where clover is important, the clover-safe options for post-emergence application following reseeding offers greater and longer lasting dock control than the clover-safe options applied to established swards.

Technology Village:

Supporting beef systems

G€N€ Ireland® Maternal Beef breeding programme

Andrew Cromie

Summary

- ICBF are working in conjunction with industry partners to increase genetic gain in pedigree and commercial beef herds through the G€N€ IR€LAND (GI) Maternal beef breeding programme.
- There are two main objectives to the GI Maternal programme:
  1. To identify and progeny test the top maternal bulls within each breed.
  2. To facilitate, promote and reward pedigree breeders that record high quality data through the Herd Data Quality Index (HDQI).
- There are benefits to joining the programme for both pedigree breeders and commercial beef suckler farmers.

ICBF are working in conjunction with industry partners to increase genetic gain in pedigree and commercial beef herds through the G€N€ IR€LAND (GI) Maternal beef breeding programme which was established in late Autumn 2012. 220 pedigree beef herds consisting of 6500 pedigree females are currently involved as well as approximately 700 commercial suckler herds which use the semen from the new bulls.

There are two main objectives to the GI Maternal programme.

1. To identify and progeny test the top maternal bulls within each breed.
2. To facilitate, promote and reward pedigree breeders that record high quality data through the Herd Data Quality Index (HDQI).

Each bull that gets accepted into the programme will have 1000 semen straws collected. 500 semen straws will be used in commercial suckler herds to progeny test the bull. The progeny test involves collecting information such as calving ease, docility and carcass traits on commercial sons and daughters of the bull in order to increase the reliability of the bull's index. The remaining 500 semen straws will be stored until the bull is proven. At this stage the semen will then be distributed for use in elite matings to herds that have signed-up to the programme. Only bulls that excel in the programme will have their semen disseminated to pedigree herds.

In 2013, the programme purchased 25 bulls, which is a major step forward for Irish beef breeding. The first semen was available from these bulls through the 2014 Spring G€N€ IR€LAND progeny test programme. All purchased bulls have undergone a rigorous selection process which involves; (i) the bull having met various genetic index and ancestry criteria, as defined by each breeding programme group and (ii) the bull (and his dam) having passed a visual inspection, as carried out by independent ICBF linear scorers. In

addition, bulls are only considered if the herd is a signed up participant of the G€N€ IR€LAND Maternal beef breeding programme. Only bulls that have passed all three criteria are then considered for potential purchase.

Once purchased, the bulls are health tested on-farm, after which they are sent to one of the partner AI companies involved in the G€N€ IR€LAND programme. Following semen collection the bulls are either sold on to one of the partner AI companies and/or sold for commercial/pedigree breeding.

What are the benefits of joining the programme?

Pedigree breeders benefits

As part of joining the voluntary programme, breeders will be able to avail of the following services and information:

- Potential to have a bull purchased by the programme.
- Allocation of stored semen from G€N€ IR€LAND (GI) AI bulls to your herds. A marketing stamp to allow promoting as a "G€N€ IR€LAND bull breeding herd".
- Mating advice on all breeding females in the herd with particular emphasis on elite cows to produce bulls required for the GI beef breeding programme.
- Assessment of information quality and quantity using the Herd Data Quality Index report. Also, advice on how you can improve the index for your herd.
- Promotion of the herd to pedigree and commercial herd owners through the ICBF website, herdbooks and various forms of media.

Commercial suckler farmer benefits

- Access to the best new maternal beef bulls in Irish AI
- Free weight recording
- Satisfies BTAP option
- Potential to sell progeny to Tully Beef Test Centre

Who to contact?

If you have questions on any aspect of the G€N€ IR€LAND® Maternal beef breeding programme, please do not hesitate to contact your herdbook office or the ICBF HerdPlus office at 1850 600 900. We would be delighted to handle your queries. More information is available on the ICBF website at **www.icbf.com**

Beef market outlook and desired carcase specifications

Joe Burke
Sector Manager – Beef & Livestock, Bord Bia

Summary

- To-date in 2014, finished cattle prices in Ireland have fallen by between 7% (steers) and 14% (young bulls) compared to last year.
- UK and European cattle prices are also well below last year's levels.
- Beef demand has been impacted by falling consumption in key export markets.
- More than ever, producers need to focus on what the market is looking for.
- Animals which meet the desired carcase specifications, in terms of age, weight, fat class and QA-status, will realise significantly higher prices.

Introduction

While weather conditions were more favourable than in recent years, the spring of 2014 has been disappointing for beef producers. At the time of writing, the average price paid for R3 steers by Irish meat plants is equivalent to €3.99/kg (incl. VAT). This represents a decline of almost €0.50/kg on the equivalent price this time last year. Prices paid for other classes of animals have fallen more sharply: especially young bulls and cull cows.

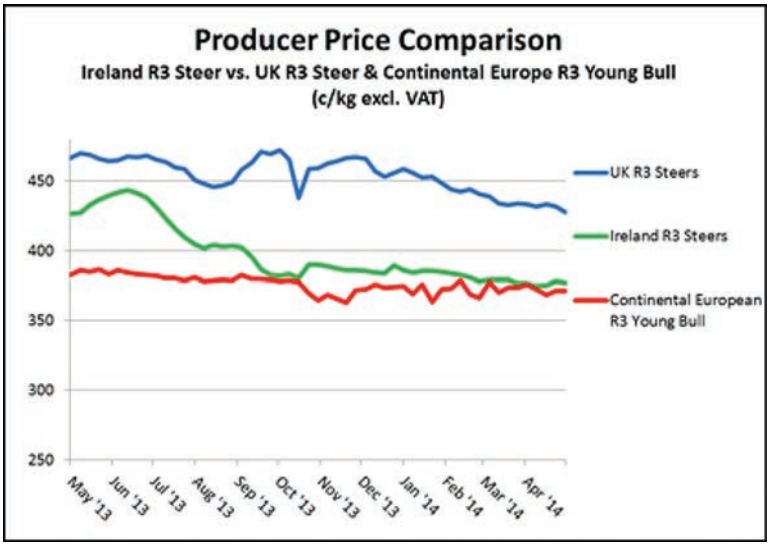
Ireland a major exporter

Ireland is the largest net exporter of beef in the EU and the northern hemisphere, with over 470,000 tonnes traded in 2013. Since almost 90% of our national production is exported, returns to the sector are directly linked to the demand for beef across the major international markets.

The UK market accounted for 250,000 tonnes, or 53%, of Irish beef exports in 2013. Other exports focused on Continental EU countries, including France, the Netherlands, Italy, Sweden and Germany. Non-EU markets accounted for just 1% of the overall volume.

Producer price comparison

Within these export markets, Irish beef tends to compete with local domestic production, followed by imports from other EU counties or elsewhere. Therefore, it is



worthwhile to compare Irish producer prices with the prevailing cattle prices in the UK and across Continental Europe.

Challenges to beef demand

Although the UK remains the highest-priced beef market in Europe, the graph shows that finished cattle prices there have fallen by more than €0.30/kg since the beginning of the year. Similarly, Continental European prices remain below last year's levels.

Within the EU, beef consumption declined by 2.1% in 2013, which is partly attributable to the difficult economic situation across many member states and the resulting impact on consumer spending power. Although beef consumption rates are expected to recover slightly this year, retail sales of beef in the UK and other EU markets have been disappointing to-date.

Customer requirements

Irish beef is now listed with more than 75 multiple retail chains across EU markets, a higher number than beef of any other origin. The feedback that Bord Bia continually gets from customers is that they put a real value on prime steer and heifer beef coming from our sustainable, grass-based production systems.

On the other hand, young bull beef is viewed by many as a more 'commodity' type product. Therefore, the number of market outlets available for beef from young bulls is limited. Producers intending to finish young bulls should consult well in advance with their intended meat plant, to ensure they meet customer requirements.

In the case of the UK retail sector, processors are only permitted to supply beef from carcases which meet the following requirements:

- Steers or heifers of less than 30 months of age (**Age limit for some is 36 months*.)
- **Or** alternatively: Young bulls of less than 16 months of age
- From Quality Assured farms
- Carcase weights of between 280 and 380 kg
- Carcase conformation of 'O=' or better
- Fat class of 2+, 3, 4- or 4=

Carcases which meet the above requirements are also likely to satisfy the specifications for other valuable outlets including quick-service restaurant chains (McDonalds & Burger King) along with premium retail and foodservice customers.

Promotion

Ireland is well positioned to capitalise on opportunities which will arise as European production contracts further, and as exciting new markets develop further afield, such as China, Japan and the United States. We need to consistently deliver what the market wants, in terms of specification, Quality Assurance and grass-based farming methods which are also looking after the environment and the animals' welfare.

Prime Irish beef consistently scores top marks for eating quality in international taste tests. The Origin Green Sustainability Programme is now central in Bord Bia's overseas promotion of Irish beef as a natural and premium product. In the Netherlands and Germany, recent promotional campaigns have been successful in driving consumer awareness and building the position of Irish beef as the premium beef of choice at retail and food-service level. Further promotions are planned throughout the year with key customers across 14 European markets.

The Chefs Irish Beef Club is a further promotional initiative, involving more than 70 chefs of Michelin Star standard or equivalent across six of our most valuable markets: Belgium, Britain, France, Germany, Netherlands and Switzerland. These chefs passionately endorse and promote Irish beef as a world-class premium product.

Beef quality attributes – consumer perspectives and market opportunities

Maeve Henchion and Virginia Resconi
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Summary

- The growing demand for beef globally is good news for the Irish beef industry. However consumption per per capita is declining in some markets.
- In such markets (e.g. European markets), quality will become an increasingly important factor affecting consumer choice.
- Misalignment between consumers' expected and experienced quality may result in consumer disappointment.
- Establishing relevant and effective quality signals for consumers (e.g. based on information on how the meat was produced or processed) could offer advantage in the market place, and some of these could be incorporated into the genetic breeding index for beef.

Introduction

Total beef consumption increased globally by 18% between 1990 and 2009. This was in response to a growing population and rising income levels in some regions including Asia, Latin America and the Middle East. However consumption per head decreased by almost 8% in the same period, mainly in some countries with developed economies (e.g. the EU) as a result of lower rates of income growth, declining and aging populations, as well as increased health and dietary awareness. Quality-related issues will become increasingly important in these markets in the future.

Quality from a consumer perspective

Quality can be identified as a measure of degree of excellence or as a measure of fitness for purpose. However when examining quality from a consumer perspective, consumer perceptions of quality are as important as actual objective measurements, and one has to be concerned with the emotional as well as the functional dimensions of quality. In practice, this means being concerned with not just factors such as breed, muscle colour and fat level but what academics call "credence" attributes which relate to sustainability, environmentally friendly, health, etc. These credence attributes of quality cannot actually be experienced by consumers when eating meat but they are nonetheless potentially important influences of consumer choice. Consumers need to believe information provided to them about such attributes through information presented on packaging, or through other signals.

Important quality attributes

A systematic review of the literature about quality attributes of importance in beef from a consumer perspective, consistently highlights the importance of tenderness, juiciness and flavour. These are fundamental quality attributes that highlight the importance of sensory characteristics for consumers. Intrinsic signals consumers use to infer these attributes when buying meat include meat colour, fat levels and fat structure/type (marbling/rim fat).

According to a Teagasc survey, Irish consumers mainly select beef according to its redness. However, apart from dark firm and dry beef, which is a problem usually associated with animal stress, colour is poorly related to tenderness or juiciness. Therefore, the signals consumers use to infer expected quality may not be strongly related to actual experienced quality, and could result in consumer dissatisfaction.

Other extrinsic signals consumers use to infer quality are origin and place of purchase. Typically, European consumers believe meat produced in the home market is better than imports, and independent butchers offer better quality meat than supermarkets. Consumers are becoming more open to the use of other extrinsic cues, e.g. labels, brands, due to the shortcomings of intrinsic cues such as colour as a predictor of experienced quality.

In addition to sensory attributes, the literature highlights the increasing consumer emphasis on health, sustainability and the environment. Meat products that can deliver on these credence attributes are likely to be successful in the market place. Whether they result in a higher price is another matter. Nonetheless, the challenge is to identify signals that communicate these attributes, and to use trusted channels and agents to communicate about them.

Opportunities for the future

Sensory aspects will continue to be the main factor influencing choice for most consumers. Due to the dysfunctional link between some intrinsic cues and quality there is potential to use extrinsic cues, e.g. quality labels, to infer eating quality. These may be based on supply chain systems that identify and control production and processing factors that affect eating quality, e.g. the Australian PACCP (palatability assured critical control point) system.

Sustainability, and in particular the carbon footprint associated with beef production, may provide opportunities for the industry to promote systems (such as grass-based systems) that have lower emissions. However, the extent to which consumers (as opposed to taxpayers through government subsidies/taxes) will pay for this is not yet clear. Bord Bia through its Origin Green programme believes sustainability credentials are very important in terms of marketing to the trade.

Market opportunities and threats linked to health should be further explored. Red meats have been identified as good sources of high-quality protein and nutrients. However, they have also been associated with certain illness such as cancer and heart disease. Developing healthier alternatives that do not compromise on taste, e.g. through genetics or the application of novel production/process technologies, could provide opportunities.

Conclusions

Teagasc is aware of the evolving demands of consumers relating to quality and has at least two beef research projects that have a strong market focus. These include:

- BreedQuality (led by Donagh Berry) which is seeking to identify important quality attributes from a consumer perspective with the ultimate aim of integrating them into the genetic breeding index for beef, and
- GrassBeef (led by Aidan Moloney) which is seeking to quantify the benefits associated with grass-based beef systems from a nutrition perspective and to determine the best way to use this information to address consumer needs.

Mannion et al, 2000

Grazing infrastructure and farm buildings on drystock farms

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Summary

- A rotational grazing system is essential in ensuring the availability of leafy high digestibility grass at all times.
- A good farm roadway and water supply allows great flexibility in grazing management.
- Expenditure on farm buildings is, by its nature, a long-term capital investment which needs careful planning both from a financial and a technical point of view.

Introduction

Finding the correct balance in providing much needed grazing infrastructure, animal housing and associated facilities and justifying the expenditure is a challenge facing many drystock farmers.

Grazing infrastructure

It is important to maximise the intake of grazed grass and keep the feeding of concentrates low. The aim is to match herd feed requirements with the grass growing season. Practice grass budgeting to identify, and respond promptly, to shortages or surpluses and plan closing dates to ensure adequate spring grass is available at turnout. A high rate of liveweight gain during the grazing season is important. Rotational grazing, feed budgeting, grazing to a predetermined residual sward height and reseeding of non-productive pastures ensure that leafy high digestibility grass is available at all times. A proper grazing infrastructure is central to optimising grazing management practices and animal performance at pasture. Rotational grazing can be in the form of a paddock system, with fixed or flexible paddock sizes, or via the existing field structure.

Farm roadways

Farm roadways have advantages on beef farms as well as dairy farms. They provide machinery access to silage fields, thus confining tractors and heavy trailers to the roadway avoiding compaction and rutting across paddocks. They facilitate easy access to handling facilities, speeding up the job and saving on labour. This is particularly important with suckler cows if using AI. A farm roadway makes it easy to practice short duration early grazing in Spring. This increases grass utilisation, reduces winter feed costs and will remove the cows from the calves for a period, which improves the onset of heat.

Construction costs can vary, from €15 to €30 per metre, depending on the cost of materials, the width and depth of material. and the method of construction. Narrow tracks are a cost effective way (€6 to €8 per metre) to improve access to paddocks, particularly on heavy land.

Water supply

Livestock can survive for a reasonable period of time without feed but they will not survive for long without water. Check water supply regularly. Do not leave animals without drinking water for more than 24 hours. Suckler cows in milk and finishing cattle on high concentrate diets should never be left without drinking water. Daily water consumption by

different types of stock is as follows: lactating dairy cows 60-100 litres, dry cows 40-55 litres, 300 kg beef cattle 20-25 litres, 600 kg beef cattle 35-60 litres and beef cattle finished on dry ration 70 litres.

Are flow rates and pipe sizes adequate? Are water troughs big enough and correctly located? Provide a trough volume of about 6 litres and a flow rate of 0.15 litres per minute per suckler cow or 500 kg beef animal.

Farm buildings

Expenditure on farm buildings is, by its nature, a long-term capital investment which needs careful planning both from a financial and a technical point of view. Good workmanship and correctly specified materials are also essential if structures are to stand the test of time and prove good value for money.

Factors for success include:

- Prioritise investments for maximum benefit. Arguably, grazing infrastructure and works that protect your single farm payment (e.g., slurry storage, silage facilities) should be prioritised.
- At grass, animals have ample space, feed, air, water, and light available to them in abundance. These simple basics are often taken for granted and it is very seldom that all can be found together during the housing period. Do not compromise on any of these design features, especially lying space, feed space and ventilation requirements.
- Assess existing facilities to ensure they are fit for purpose and take steps to correct any deficiencies.
- Modifying existing housing can reduce expenditure. For example, building a new slatted tank beside or in an existing building, or conversion of existing sheds to a different use like calving facilities or a calf house. Ideally there should be few compromises and existing facilities should be in good condition.
- Create a financial plan that identifies how you will pay for the building. Ensure that the proposed structure is affordable; otherwise it will have negative financial implications for your farm business.
- Get accurate costings. Shop around and get itemised quotations. These outline exactly what is being costed and allows like-with-like comparisons to the same specification.
- Virtually all new farm buildings will require planning permission. The planning application process is a real cost to the project, which includes a planning fee, a fee for the drawings and perhaps a development contribution. Banks require confirmation of planning permission for loan drawdown.
- Ensure that the building will be fully compliant with the requirements for storage of slurry, storage of effluents, etc.
- Any infrastructure development, from planning to completion, always takes longer than expected, so allow extra time.
- Don't be tempted to add on additional work that is not included in the plan.
- When choosing the site consider whether there is scope for future expansion.
- The DAFM specifications should be adhered to for all farm buildings. Failing to do so is a recipe for disaster. Compliance with the specifications is mandatory for grant aid and cross-compliance.
- It is expected that grants will be available for animal housing, slurry storage and silage pits, etc., from early next year. Grants, capital allowances, interest relief and VAT refund all help to make on-farm capital investment affordable.
- Health and safety in design, construction, day-to-day use and subsequent repair and maintenance are important for any farm construction project.

Safety and health on beef farms

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Summary

- Farm accidents and ill-health cause tragedy, suffering and long-term disability. They also have the potential to jeopardise a person's capacity to farm effectively and hence maintain their farm income. Therefore it is in everyone's best interest to give practical safety and health management adequate attention.
- In 2014 to-date, there has been a major upsurge in farm workplace deaths, with 12 deaths confirmed by late May.
- Farmers have been identified as an occupational group who have a high level of ill health. The data available suggest they need to give more attention to maintaining their health, and this includes regular medical check-ups.
- Injury to the spine and back is a major cause of occupational ill-health among farmers. As spinal injuries are difficult to resolve, attention should be paid in particular to minimising heavy lifting and, when lifting, to do so correctly.
- Personal protective equipment such as gloves, goggles, helmet, face mask, etc., should be used as required.

Introduction

Farming is one of the most dangerous work sectors in Ireland. Typically about a third of all workplace deaths occur in the sector but to-date in 2014, over 50% of workplace deaths have taken place on farms. Childhood deaths are particularly tragic and in recent years there has been a significant increase in the occurrence of these fatalities. Farm accidents occur at the high level of 2000 per year where serious injury requiring hospitalisation takes place. These can lead to permanent disability and impede a person's capacity to farm effectively. Farmers have also been identified as an occupational group who have high levels of preventable ill health, so far more awareness of health promotion practices are needed among the farming community.

Teagasc and the Health and Safety Authority operate a Prevention Initiative to assist farmers to effectively manage farm safety and health. This initiative is run in association with the farming organisations represented on the Farm Safety Partnership.

Legal duty to complete a risk assessment

All workplaces including farms have a legal duty to conduct a risk assessment to ensure that work is carried out safely. A comprehensive risk assessment document has been prepared for use by farmers and includes a comprehensive list of possible farm hazards to be considered. The requirement to conduct a risk assessment replaced the requirement to prepare a safety statement for farms with three or less employees, which are estimated to make up about 95% of farms nationally.

Preventing machinery accidents

Machinery related deaths make up 46% of all farm deaths. With vehicles, being crushed (67%) is the most frequent cause of death followed by falling from the vehicle (12%), overturning (11%) and being struck (10%). With machinery, being crushed (47%) or struck (20%) are the most frequent causes of death followed by PTO (17%) and machine

entanglement (13%) and other (3%). Most fatal accidents occur due to people being crushed or struck, and safety vigilance is especially needed in proximity to moving vehicles. Entanglement fatalities and deaths are particularly gruesome and occur most frequently with machine use in a stationary position such as a vacuum tanker or slurry agitator, where contact can occur between the person and the PTO.

Preventing accidents with cattle

On Irish farms, deaths due to interaction with livestock make up 16% of deaths and 26% of farm accidents. Bulls account for 37% of fatal accidents, followed by cows (33%), horses (17%) and other cattle (13%). While bull attacks are still the most frequent cause of livestock deaths, the percentage of cow attacks causing death has doubled in the last decade. Farmers are advised to keep bull temperament under constant review, have a ring and chain fitted, keep a bull in view and always have a means of escape or refuge. New calving pens which minimise the risk of a cow attack around calving will be on display. Breeding for docility will also be considered at the event.

Preventing deaths with slurry

Farm deaths associated with slurry and water account for 11% of farm deaths with the majority of these being drowning. Particular care is needed when slurry access points are open and physical guarding needs to be put in place. Access points for slurry tanks need to be covered or fenced when they are not in use as other persons not aware of the hazard could fall in. Slurry gases are a potentially lethal hazard on cattle farms. Hydrogen sulphide is released when slurry is agitated and in calm weather it can readily be present at lethal levels. The key controls are to pick a windy day for agitating, evacuate all persons and stock from housing and open all doors and outlets. A range of other gases including methane, ammonia and carbon dioxide are released when slurry is agitated or due to fermentation in partially emptied tanks. Never have an ignition source near a slurry tank due to the methane explosion risk. Never enter a tank due to the risk of asphyxiation due to lack of oxygen or poisoning.

Farmers health

A recent Irish study has indicated that farmers (16-64 years age range) have a 5.14 higher 'all cause' death rate than the occupational group with the lowest rate. The major causes where death rates are excessive include cardiovascular disease (CVD), cancers and injuries. A further Irish study indicated that 59% of farmers had a medical health check in the last year compared to 74% for the general population. Among farmers, despite 60% being classified as overweight or obese just 27% believed that they were too heavy. Low back pain (LBP) was the most prevalent physical complaint occurring in 28% of farmers. As LBP-associated disability can lead to on-going pain and reduced capacity to be physically active, it has been shown to be associated with other conditions including CVD. Farmers should pay attention to risk factors for LBP including body weight, devising farm systems which minimise manual handling and using the correct techniques for this farm work.

Personal protective equipment such as gloves, goggles, helmet, face mask, etc., should be used as required.

Notes

Notes

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