Animal & Grassland Research & Innovation Programme

Teagasc National Beef Conference

'Applying Technologies to Sustain Profitability'

Tuesday, 13th October

Hodson Bay Hotel, Athlone, Co. Westmeath

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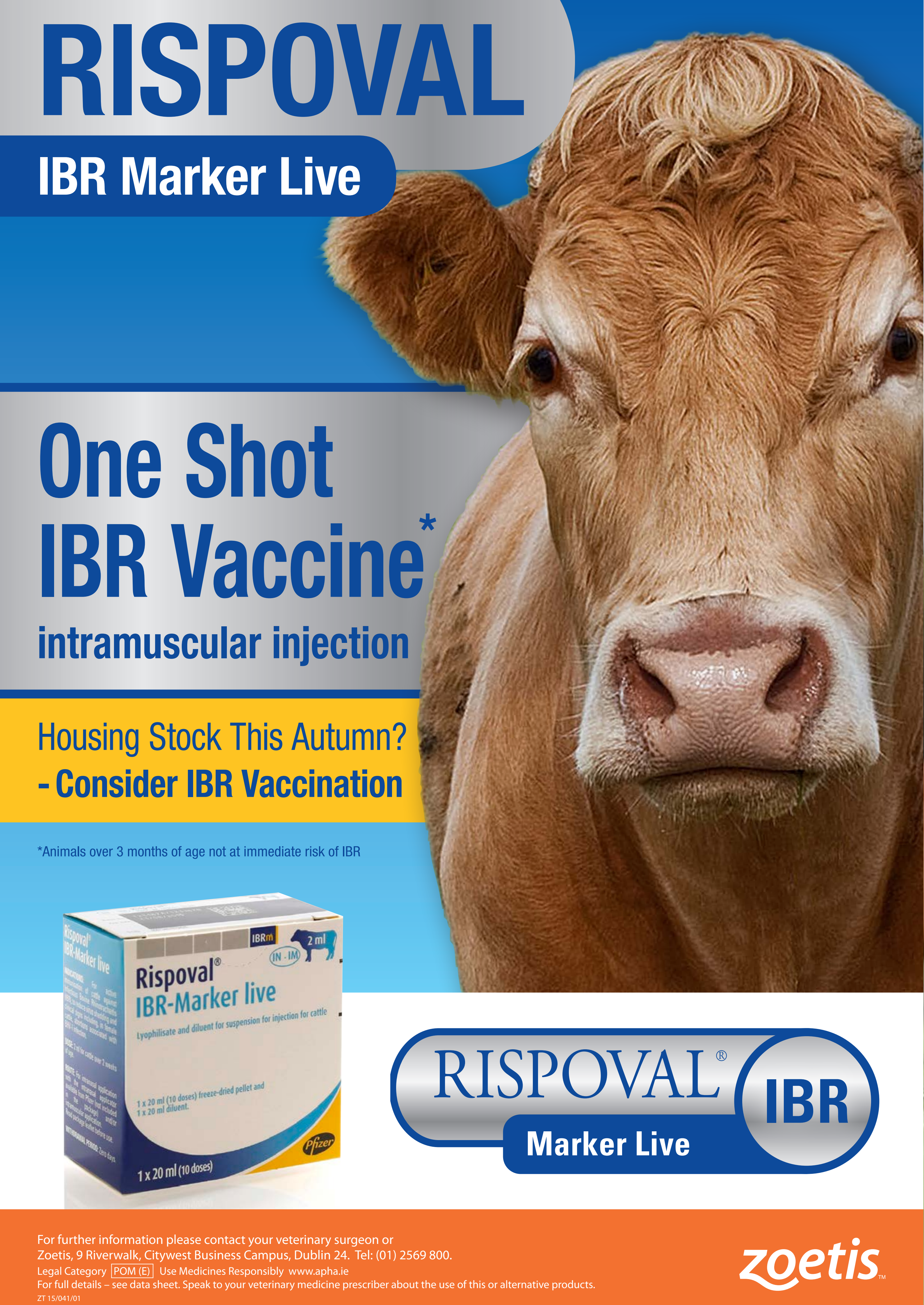

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Teagasc National Beef Conference 2015

‘Applying Technologies to Sustain Profitability’

Compiled and edited by:
Padraig O’Kiely & Loreto Ferguson, Teagasc.

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8:30pm	Close of Conference

Foreword

You are all very welcome to the Teagasc National Beef Conference for 2015. The aim of the conference this year is to focus on those technologies that best offer our beef farmers and the beef industry in general the most profitable and sustainable future going forward. All of the beef research that Teagasc is involved in, and all of the advice that we provide to beef farmers, is based on returning the best possible economic outcome, while at the same time encouraging technologies which are sustainable in the long-term. Each of the papers at the conference fit into these criteria.

With the launch of the new Beef Data and Genomics Programme many of the suckler farmers who are participating in the scheme are now looking to see how they can improve their own herds over the coming years. The first session of the conference looks at some of the practical technologies that can increase the genetic gain in the national beef herd through the use of Artificial Insemination and by selecting replacement stock based on their breeding values that the new replacement indices now deliver. We also look at how the Teagasc demonstration herds, both Derrypatrick in Grange and Newford, are currently using these tools now and into the future.

Whilst the average price of beef has risen over the last number of years so too have the input costs on Irish beef farms, resulting in only a small increase in profitability per hectare on many farms. The second session of the conference examines how beef farmers who are finishing cattle can optimise the performance of their finishing systems to leave them with a greater return. With feed costs accounting for a large proportion of overall costs on farms maximising the amount of grass in the lifetime diet of our cattle has to a priority. How this has been achieved both in research trials and on farms is covered in detail along with other important areas that will increase the returns for farmers.

The new knowledge transfer groups being launched as part of the Rural Development programme, are an ideal opportunity for beef farmers to come together as a group to learn how best to implement practices on their farms that will make them more profitable. I would encourage all beef farmers to join these groups as there is clear evidence that participation in discussion groups benefits all those involved and is one of the best methods for keeping up to date on the latest developments that are of value. Teagasc will be committing resources over the coming years to ensure the success of these groups.

Finally I would like to thank all of our speakers and to thank Zoetis for, once again, sponsoring our conference. A significant amount of time and effort goes into organising an event of this size and I want to thank all of my colleagues who have worked to make it a success. I hope you enjoy listening to the different papers, that you participate in the discussions around them and can take home some of what you have heard to improve your own beef enterprises over the coming months and years.

Professor Gerry Boyle

Teagasc Director

Optimising the usage of AI in the beef suckler herd

M.H. Parr[1], M. G. Diskin[2], F. Randi[1,3] F. Lively[4] and D. A. Kenny[1]
Animal and Bioscience Research Department, Teagasc, Animal & Grassland Research and Innovation Centre, [1]Grange, Dunsany, Co. Meath; [2]Athenry, Co. Galway. [3]School of Agriculture and Food Science, University College Dublin, Belfield, Dublin 4. [4]Agri- Food and Biosciences Institute, Large Park, Hillsborough, Co. Down

Summary

- Only 23% of beef calves are born to an AI sire.
- The better the heat detection rate and the prevailing herd fertility, the more cows that will be pregnant at the end of the breeding season.
- Maximize heat detection rates by visually observing the herd on a frequent basis. There should be particular emphasis on early morning and late evening observations combined with a further observation during the middle of the day.
- Use heat detection aids as much as possible to find cows in heat.
- Breed replacements from within the herd using high reliability maternally tested sires.
- Oestrous synchronisation and fixed time AI can be used as a management tool to reduce calving interval and increase AI usage.

Introduction

In Ireland, only about 23% of calves in beef herds are bred by artificial insemination (AI). Such low usage of this well tested and effective technology most likely reflects the difficulty and labour requirements for heat detection and assembly of cow(s) for insemination. It also reflects the effects of land fragmentation on beef farms. Despite this, it is well acknowledged that AI allows access to genetically proven sires for terminal, maternal and ease of calving traits, thereby facilitating greater genetic progress and ease of management. Additionally, semen used in AI is consistently monitored for fertility and is generally of very high quality. It is collected from bulls tested clear of transmissible diseases. With natural service bulls, although the reported incidence of sterility is generally low (<4%), subfertility, at a consistent level of 20-25%, is a much more common issue. Furthermore, use of AI avoids the necessity to maintain a bull(s) on the farm, which is always a potential hazard. Indeed, data from the Central Statistics Office show that there were 26 fatalities on Irish farms (13% of total farm fatalities) due to livestock between 2005 and 2014, of which seven people died as a result of being attacked by a bull.

Unlike dairy farmers, many beef farmers have no defined policy for producing quality female replacements, with the result that many beef cow herds have become almost pure-bred with a consequent loss of hybrid vigour. This can lead to a decline in cow fertility and calf vitality and survival, as well as a decline in cow milk production and calf performance. The importance of quality replacement heifers in beef herds is becoming increasingly recognised. One of the primary objectives of the recently introduced Beef Data Genomics Programme (BDGP) is to improve the genetic merit of the national beef herd, particularly for maternal traits. It is envisaged that AI will be increasingly used to produce higher genetic merit (4 and 5 star) female replacements. The successful use of AI is primarily dependent on the accuracy of heat detection. The main objective of this paper is to discuss the main issues around use of AI and provide some practical recommendations to improve the efficiency of its use in beef herds.

Breeding and the establishment of pregnancy

Once oestrous cycles have commenced it is the combined effect of heat detection efficiency (submission rate) and conception rate that determines the compactness of calving and ultimately the pregnancy rates after a short defined breeding period (see Table 1). In summary, the better the heat detection rate and the prevailing herd fertility, the more cows that will be pregnant at the end of the breeding season.

Where an active, fertile bull(s) is used, it is expected that all cows and heifers in heat should be mated and, therefore, under such circumstances, compactness of calving and pregnancy rate will be solely the function of bull fertility. For herds using AI, accurate detection of heat is of paramount importance to achieving good success.

Oestrous behaviour

Currently, detection of standing oestrus (heat) is the best indicator of ovulation (release of an egg from the ovary) in cattle and is the best predictor of when to inseminate an animal. In cattle the duration of the oestrous cycle normally varies from 18-24 days with some evidence of the cycle being, on average, 1 day shorter in heifers. For heifers it would appear that the duration of standing oestrus varies from 12 to 14 hours (Diskin, 2008). For beef cows, managed under confined conditions, indoors, the average duration of standing oestrus has been reported to be less than 8.5 hours however, there is significant variation around this average value which would appear to be largely dependent on the size of the sexually active group and prevailing underfoot surface conditions. In the absence of a bull or other aids to assist with identification of females in heat, detection requires the cow or heifer to express behavioural oestrus and secondly for the herdsperson to detect it. Both the duration of standing oestrus and intensity of its expression are affected by a range of environmental factors including under foot surface type, size of the sexually active group and the presence of a bull. The more important factors are briefly discussed here.

Housing arrangement

For satisfactory expression of heat, cows must have adequate space to allow cow-to-cow interaction. If the stocking density indoors is too high the expression of the signs of heat are reduced, consequently making detection more difficult. Also, under high stocking density, it is likely that there will be an increase in the erroneous identification of cows in heat. Additionally, cows dislike being mounted while standing on concrete and have a preference for softer underfoot surfaces such as grass, earth, woodchip 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 beef cows or heifers in heat simultaneously has a major impact on overall heat activity and on the average number of mounts received per cow. The number of mounts received 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 in heat on any given day is less, thus, making heat detection more difficult as the breeding season progresses.

It is suggested that about 10% of the reasons for failure to detect heats are attributable to "cow" problems and 90% to "management" problems. The latter includes too few observations per day for checking for heat activity, too little time spent observing the cows or observing the cows at the wrong times such as at feeding time. A major reason for failure to detect heat is that those involved in heat detection do not adequately appreciate the signs of heat. To optimise heat detection both the primary and secondary signs, must be clearly understood.

Maximizing heat detection rates

To maximize heat detection rates, it is important to visually observe the herd on a frequent basis with particular emphasis on early morning and late evening observations combined with a further observation during the middle of the day. It is well acknowledged that the longer spent with the herd during each observation period the more cows that are detected in oestrus. The widely accepted laborious, repetitive nature of heat detection has focused research efforts on developing technologies to improve detection rates and/or reduce the labour and commitment involved in observation.

Aids to heat detection

Due to the time consuming and monotonous nature of heat detection, it is strongly advised that one or more technologies to aid with identifying cows in heat be adopted for as long as AI is being used. Some of the more common aids with direct application to beef cows are summarised in Table 1. In a US-based study with beef cows and heifers, no difference was recorded in the accuracy of three oestrous detection methods (eight times daily observation, oestrous alert scratch card-type patches and teaser bull with a deviated penis) and all were greater than 90%.

Teaser bulls

Active vasectomised teaser bulls fitted with a chin-ball marking harness are useful for identifying cows either coming into or already in heat. Vasectomy should be carried out 40-60 days prior to introduction to the herd. Vasectomy can be performed on one testis (unilaterally) with the other testis removed or the cord crushed with a burdizzo. The cost of the vasectomy varies from €90-120 per bull. Many herd owners 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. Bulls should be fitted with a chinball harness 2-3 weeks before turn out with the herd. The marker colour should be changed every three weeks to identify repeat heats. Teaser bulls require the same management as entire bulls and should be either castrated or disposed of after one season.

Timing of insemination

For beef cows the average interval from the onset of heat to ovulation is about 31 hours, and somewhat shorter for beef heifers (~27.4 hours). However, all studies that have measured this report significant variation between animals around these average values. In practice, the exact time of heat onset is rarely known and combined with the known inter-animal variation in timing of ovulation it is not practical to recommend an exact timing for insemination. Consequently, the well-established and recommended 'am-pm' rule still stands; in other words animals seen on heat for the first time in the morning should be inseminated that evening and those seen in the evening should be submitted for AI the following morning.

Strategies to facilitate assembly of animals for AI

Poor farm layout, inadequate facilities and lack of labour availability, combined with the difficulty of removing an individual cow(s) (and her calf) from the herd for AI, all mitigate against the use of AI. It is important that the paddock or field layout is conducive to the removal of a cow from the herd. In Teagasc we have found that the use of a temporary fence, ideally electric, to funnel cows towards the gate and roadway is an excellent way of easily removing an individual cow from the herd for AI. This simple and inexpensive approach is currently used on many farms. Obviously, good handling facilities in the yard or pen are essential for the proper restraint of the animal and fundamental to the successful placement of semen by the AI technician.

Accurate breeding records

Good breeding records are an integral part of breeding management and are always the first port of call in the investigation of a herd infertility problem. Records should include calving date, calving difficulty or problems related to calving, heat and breeding dates, sire used and scanning results (where available). During the breeding season it is important to regularly monitor heat detection efficiency (submission rate) and, particularly, identify and possibly treat any cows that are calved more than eight weeks and not yet inseminated. Submission rate is calculated as the proportion of cows calved at the beginning of the breeding season that are intended for re-breeding and that are submitted for insemination. A submission rate of at least 80% should be achieved in the first 21 days of the breeding period. A submission rate of less than 80% indicates a problem with heat detection and diagnosis of this problem at such an early stage allows corrective action be taken before much of the breeding period has elapsed.

Oestrous synchronisation for beef cows

Measures to control the oestrous cycle, or synchronised breeding regimens, have been commercially available for more than 25 years. In recent years a number of alterations have been made to previously used regimens and some new protocols have been developed. The following section will give a brief overview of recently developed regimens for use in beef cows and replacement heifers.

Practical requirements of a synchronisation regimen

- High proportion of cows must ovulate in a timely manner to allow fixed-time AI
- Be capable of inducing heat in cows that are anoestrus.
- Require a maximum of three assemblies.
- Be cost effective
- Be capable of inducing normal fertility

As an alternative to heat detection and inseminating only cows observed in heat, GnRH could be administered 72 hours after PRID or CIDR removal, with all cows inseminated once at this time (72 hours). The overall proportion of treated cows becoming pregnant would expected to be slightly greater following a fixed-time AI as opposed to inseminating at observed heats only. While this option eliminates the need for heat detection the extra dose of GnRH would cost €5-6 per cow as well as an extra handling of cows. One management option might be to synchronise all cows and breed once by AI to high genetic merit maternal sires followed by the use of natural service to pick up repeats. This should provide sufficient high genetic merit replacements females and, for large herds, reduce the number of bulls required.

Results from ongoing Teagasc studies

A series of large scale on-farm synchronization studies for FTAI were conducted by Teagasc in 2014 and 2015 and involved 74 beef cow herds all over the island of Ireland. The trials were run in both autumn- and spring-calving herds with cows (n=2205) calved ≥35days enrolled in the studies. Three different synchronization protocols were compared, which included the protocol outlined in Table 2 and as well as two minor variations of this. All cows were subjected to FTAI, 72 hrs after PRID removal. Overall average herd pregnancy rates ranged from 50-70% in these trials.

Success rates with synchronisation treatments

The expected conception rates vary from 30- 75%, with an average of 50-55% of cows becoming pregnant. Cows that fail to become pregnant to the synchronized breeding, that repeat and are re-inseminated usually have normal fertility (65-75% conception rate) at the repeat heat. It is best that:

- Cows are in a moderate BCS score (2.5 –3.0) at time of treatment. It is equally important that cows are a minimum of 35 days calved at the time of PRID or CIDR insertion and are on a good plane of nutrition (plentiful supply of grass) for a minimum of 3-4 weeks prior to, during and after treatment.
- Synchronization should only be used in herds where the levels of management and in particular heat detection skills are high in order to detect heats and particularly repeat heats. Alternatively, a bull should be turned out with cows following the synchronized AI.
- It is vitally important that high fertility semen is used and the competence of the inseminator is high. Semen must be thawed carefully (15 seconds in water at 35^{O}C) and inseminated into the cow within 1-2 minutes of thawing. The correct site for semen deposition is in the common body of the uterus. Each straw should be thawed separately.

The advantages and disadvantages of heat synchronization in beef cows are summarised in Table 3.

Synchronisation regimens for replacement heifers

As the vast majority of replacement heifers should be cyclic there is a reduced requirement for incorporating an exogenous source of progesterone in the regimen for heifers. Consequently, prostaglandin-based regimens are the methods of choice for use on replacement heifers. A common regimen used for heifers involves two administrations of prostaglandin (PG) at an 11-day interval. All heifers can be inseminated twice on a fixed-time basis at 72 and 96 hours after the second administration without any heat detection or, alternatively, heifers can be checked for heat after the 2nd prostaglandin administration and inseminated on the basis of a detected heat. A more cost effective regimen involves good heat detection initially carried out for six days and all heifers detected in heat would then be inseminated. On the 6th day all heifers not yet detected in heat are injected with prostaglandin. About 90% of the injected heifers will respond to the prostaglandin and show heat 2-4 days after injection and should be inseminated as normal. Using this protocol, drug use, semen costs and veterinary costs are minimised. Conception rates to prostaglandin-induced heats are normal. Heifers should be bred to easy-calving sires.

Sexed semen

It is expected that sexed semen will become more widely available in the next number of years. Currently, conception rates are 10-15 percentage points below those achieved with conventional frozen-thawed semen. Current recommendations are that sexed semen should only be used in replacement heifers which are normally highly fertile (expected conception rates of 65-75% to a single service using frozen-thawed semen). Even at a conception rate of 50%, the use of sexed semen to produce high genetic merit female replacements may be worthwhile provided the premium on the sexed semen is not excessive.

Summary

It is strongly recommended that beef farmers should develop a specific breeding programme to produce quality herd replacements. At least half of the herd should be bred to produce such replacements and the remainder bred to terminal beef sires. For most herds this inevitably means the use of AI unless herd size is big enough to justify more than one breed of natural service sire. This will remove much of the risk associated with the production of replacement heifers. AI should always be used at the beginning of the breeding season when heat detection is easier. Heat detection is critical to the success of AI and the use of a teaser bull is strongly recommended. For beef cows progesterone-based synchronisation combined with fixed time AI may be worth considering.

Table 1. Different oestrous detection aids for use in beef cows / heifers; mechanisms of action, relative cost and usefulness

Aid	Mechanisms of action	Relative cost[1]	Usefulness and remarks
Teaser bulls	Yearling bulls can rendered sterile by vasectomy, epididyectomy, or incapable of mating by penile deviation. Bulls seek out cows/heifers in oestrus.	***	Start with yearling bulls. Vasectomy or epididyectomy needs only be performed unilaterally with the other testis castrated. Penis deviation requires more extensive surgical preparation. Teaser bulls are particularly useful when fitted with a chin ball harness. However, they require the same maintenance and safety precautions as an entire bull. Risk of disease spread and variation in libido are drawbacks.
Tail paint or chalk	Water-based paint or chalk is applied to the animals tailhead. When the animal in heat is mounted by a herd mate the paint of chalk is rubbed off by the friction between the brisket and tailhead.	*	Requires repainting / chalking at 7-10 day intervals which requires animal assembly. Can be removed by cows rubbing against low hanging branches, etc. Works well early in the season when oestrous activity is high. Best to remove any loose hair or dirt from tail head prior to application
Heat mount detectors	The detector is a pressure sensitive device with a built-in timing mechanism. It is glued onto the tail head. Pressure from the brisket of a mounting animal requires approximately 3 seconds to turn the detector from white to red. This timing mechanism helps distinguish between true standing heat versus false mounting activity.	*	False activation particularly in cows indoors or by rubbing against branches / trees giving rise to false heats. Can be lost when cows are moulting. Best to remove any loose hair or dirt from tail heat prior to application. Duration of use probably 3-4 weeks before replacement is required.
"Scratch card–type" mount detectors	These scratch card type patches either with (self-adhesive) or spray glue are glued onto the cow's tail head. The surface coating is removed by the friction of the brisket of the mounting animal revealing an underlying shiny bright surface.	*	Similar to ink based detectors above in that false activation particularly in cows indoors or by rubbing against branches / trees giving rise to false heats. Can be lost when cows are moulting. Best to remove any loose hair or dirt from tail heat prior to application. Duration of use - 3-4 weeks. Must be warmed before application

[1]More stars indicate higher cost

Table 2. Recommended synchronisation regimen for beef cows 35 – 70 days (or longer) calved at time of treatment

Day	Action
Day 0, am (Monday)	PRID or CIDR insertion + GnRH at insertion
Day 7, am (Monday)	PRID or CIDR removal + prostaglandin + 400 iu eCG i.m. at time of removal (Ideally tail paint cows or affix heat detection patches to cows)
Day 8 (Tuesday)	Cows will start to show standing heats late pm and through the night. Record cows in heat and active
Day 9 (Wednesday)	Most heats expected. Inseminate all cows observed in heat in the evening of Day 9 and on Day10. Heat check cows and record all cows active or in heat (if required). Alternatively, inseminate all cows at 72 hours following progesterone insert removal and administer GnRH to cows not yet observed in heat.
Day 10 (Thursday)	Continue heat detection and inseminate cows observed in heat. Alternatively, inseminate all cows not observed in heat at 72 hours post CIDR or PRID removal and administer GnRH (optional) to these cows at time of insemination.

Notes

- All drugs are Prescription Only Medicines (POMs) and are under veterinary control.
- Dosage of drugs: will vary according to drug and drug formulation.
- Inadvertent administration of prostaglandin to a cow/heifer during the first 3-4 months of pregnancy will cause abortion.

Table 3. Advantages and disadvantages of heat synchronization in beef cows

Advantages	Disadvantages
Can be used to facilitate AI and the use of genetically superior bulls or to introduce bulls with high breeding values for maternal traits to produce replacement heifers	Costs around €25-35 per cow treated + Veterinary call out fees and AI costs.
With fixed time AI most cows can be bred on an appointed day. There may be savings on insemination fees as a result.	Repeated collecting and handling of cows
For larger herds the requirement for a number of natural service bulls is reduced	Achieving good conception rates requires good management and attention to detail
Can be used to induce heat in anoestrous cows. While the conception rate achieved at the induced heat in such cows is generally low (30-50%), fertility at subsequent repeat heats is normal (55-70%)	Does not eliminate the need for heat detection. Cows returning to service must be detected in heat and re-inseminated. Alternatively, a bull can be used to breed cows returning to service.

Farmer perspective: My experience of using AI

Mr. Artie Birt
Portaferry, Newtownards, Co. Down.

Introduction

Alongside my wife Julie and father Arthur (senior) we farm on 100 hectares of free-draining grassland near Newtownards, Co. Down. The farm lies on the shores of Strangford Lough and varies from sea level to 250 ft above sea level. Our grazing season typically runs from mid-February to early November. We normally have approximately 32 inches (81 cm) of rainfall annually which is below the national average of 40 inches (100 cm).

Breeding Plan

Our average calving interval on the farm is 375 days. We presently run 180 spring-calving cows, composed of approximately 50% Simmental and 50% Limousin crosses. We use Charolais as a terminal sire to make the best use of hybrid vigour. We keep approximately 40 replacement heifers per year, which are bred on the farm. All heifers are bred at between 13 and 15 months of age (weighing 380-400 kg) to easy-calving Simmental or Limousin AI. The duration of the breeding season for heifers is 7 weeks, whilst the cows have a 9 week breeding season. All calves are either kept for replacements or slaughtered before 24 months of age. We use two stock bulls (Simmental and Charolais) on the farm. However, in recent years we have put greater emphasis on the use of AI in the herd. Since I started using AI, I have seen benefits in the form of:

- Availability of top maternal and terminal sires beyond which I could purchase as stock bulls.
- Greater choice of easy-calving sires for heifers.
- Enhanced maternal traits in heifers and cows.
- Reducing my requirement for stock bulls to two (previously seven bulls).

In 2014 and 2015, we signed up to the Teagasc-run research project, in conjunction with AFBINI, which aimed to develop a fixed-time AI (FTAI) protocol for suckler cows. Eighty-one and 68 spring-calving cows were enrolled over the two years, respectively. Cows that we enrolled on the programme were brought in to the collection area on three occasions for the programme, and this significantly reduced the amount of heat checking I had to carry out for at least 16 days until repeat heats were due again. Following scanning we had 55 cows (68%) and 49 cows (72%) pregnant across 2014 and 2015, respectively.

Will I use heat synchronisation/FTAI on my cows in the coming years? Yes. The synchronisation programme was very beneficial as it reduced the time required for heat detection, allowed me to shorten the interval between calving and conception and also have a more compact calving period. Cows which repeated were either re-inseminated to a terminal sire (mainly Charolais) or allowed run with the stock bulls.

When carrying out routine AI on the farm I generally use tail chalk/paint as a heat detection aid. I find it cheap, but very effective at identifying cows in heat. Cows are checked twice daily for at least twenty minutes, and if there are any signs of heat or chalk removal, the cows are brought to the collection yard and are monitored further. All inseminations are undertaken in the morning by a commercial technician.

Calving the synchronised cows

Calving takes place indoors between February and April and is a very busy time on my farm. My day begins at 5 am and finishes at about 11 pm. We have twelve calving boxes, and all cows and calves are turned out to grass after calving, weather depending. I dedicate all my time around calving time to the cows and their new-borns. Other work on the farm is carried out by a hired farm worker or a contractor. The 55 cows that calved this spring following synchronisation, did so over approximately 24 days despite all being inseminated on the same day and with semen from the same sire. The greatest number of cows that we calved on any one day was seven. Prior to calving all cows are fed 20 kg grass silage (70% DMD), 2 kg straw and pre-calving minerals, between 7 and 8 pm daily before calving. To date this approach has been very successful at reducing the number of cows calving during the night/ early morning.

Conclusion

The use of artificial insemination has been very beneficial in my herd, especially for producing top quality replacement heifers. Using AI has allowed me to use easy calving high genetic merit sires on all my heifers, which are calving down by 24 months of age. Using tail chalk/ paint has increased my heat detection rates, but has also saved me time and money by finding cows in heat. Most importantly I would recommend spending time with the cows especially at breeding and calving to maximise the number of cows in-calf at the end of the breeding season and subsequently live calves on the ground.

Performance of high and low replacement index cows across a range of commercial suckler beef herds

Nóirín McHugh[1], Andrew Cromie[2], Ross Evans[2], Thierry Pabiou[2]
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Summary

- The ideal suckler cow requires low labour input, efficiently produces a good quality weanling and goes back in calf year on year.
- The €uro-star replacement index is a profit-based index which should be used to identify the ideal cow for your production system.
- Performance from commercial herd data shows that cows with high replacement indexes consistently outperform cows with lower indexes.
- Performance was also superior in progeny from cows with higher replacement indexes.
- The economic benefit of using a five star replacement index cow over a one star cows is as much as €172 per calving event.

Introduction

The ideal suckler cow for Ireland, irrespective of coat colour, is a cow that efficiently produces a good quality weanling from grazed grass, requires low labour input and continues to go back in calf year on year. A robust reliable cow will ensure that profits are maximised from suckler herds irrespective of external market forces. Accurate genetic evaluations are key for the identification of the ideal suckler cow for grass based production systems. However, the identification of the ideal cow is dependent on robust genetic evaluations that accurately reflect on-farm performance. Research to date has focussed on the assessment of the genetic evaluations for individual traits using data from the national database. Results from this analysis have shown that differences in genetic merit at the individual trait level for traits such as calving interval, weaning weight and milk yield are reflected in differences in animal performance. However replacement females are generally purchased based on the overall replacement index rather than on individual trait ranking, therefore a key question for the industry is – do cows with superior replacement indexes have superior performance compared to cows with low replacement indexes? In this paper we will evaluate the usefulness of the €uro-star replacement index to select the ideal suckler cow for Ireland.

Replacement Index- A tool to identify the ideal suckler cow

The ICBF beef €uro-star system was introduced to Ireland in 2007 and is calculated for each animal based on individual animal performance records (such as calving surveys, weights, carcass data) and all ancestry records (i.e. sire and dam). Economic values are thereafter applied to these genetic evaluations to generate a combined index value. A comprehensive review of the €uro-star replacement and terminal indexes was undertaken earlier this year and, after consultation with industry, the decision was taken to change the definition of the replacement index from an index constructed at the sire level to breed daughters to an index constructed at the cow level. This resulted in greater emphasis being placed on the maternal or female expressed traits. This has resulted in greater weighting on traits such as maternal calving difficulty, milk yield, cow maintenance costs, calving interval and cow survival, and less weighting on progeny carcass traits (i.e. terminal traits). Table 1 highlights the relative weighting placed on the trait groups within the new replacement index. Currently 71% of the index is weighted towards traits of the cow and the remaining 29% is weighted towards calf or progeny traits.

Table 1. Relative weighting (%) of all traits included in the replacement index.

	Trait	Relative weight (%)
Trait of the cow	Age 1st calving	6%
	Maternal calving difficulty	6%
	Maternal weaning weight	18%
	Calving interval	9%
	Survival	8%
	Heifer feed intake	8%
	Cow feed intake	6%
	Cow docility	3%
	Cull cow weight	7%
Trait of the calf	Calving difficulty	7%
	Gestation	2%
	Mortality	1%
	Docility	1%
	Feed intake	4%
	Carcass weight	10%
	Carcass conformation	3%
	Carcass fat	1%

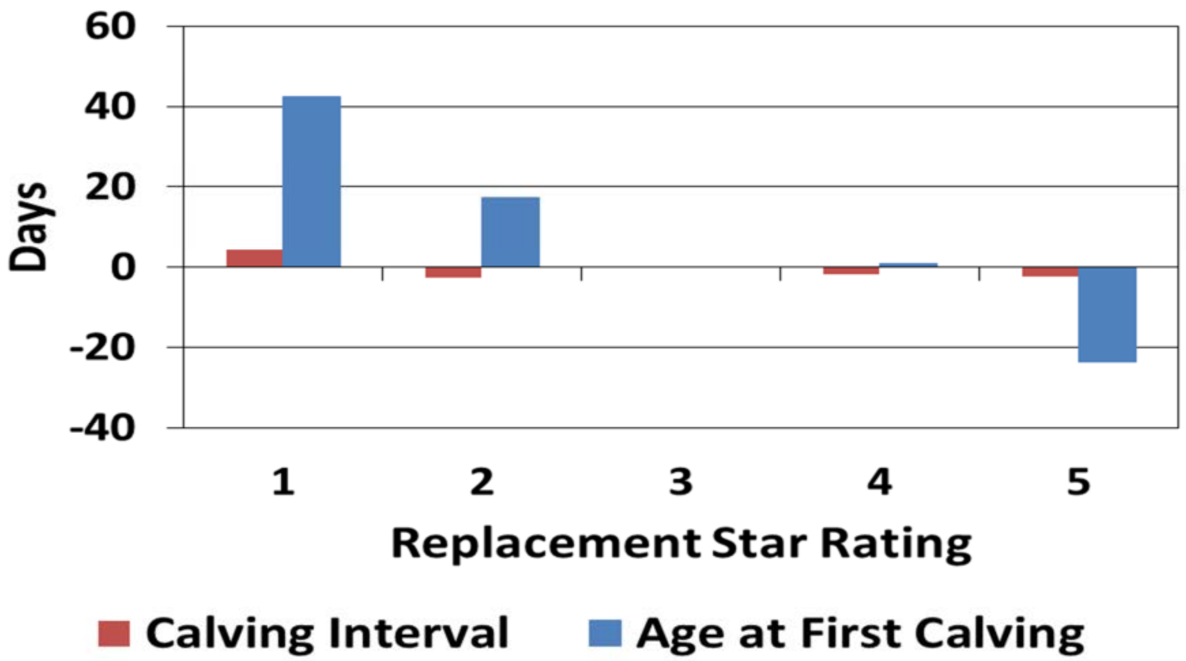
Does the Replacement Index work?

The accuracy of the ICBF replacement index can be tested by comparing the genetic index of the cow with her own performance and the performance of her progeny. In the current paper data were available from 34 spring calving commercial suckler herds that are participating in a weight recording initiative undertaken by Teagasc in conjunction with ICBF. The purpose of this initiative is to demonstrate the performance differences in high versus low replacement index cows through the collection of high quality data such as weight records on cows and calves prior to weaning. As part of this initiative weight information was collected on all cows and calves over the summer months and this will be undertaken over the next three years.

The weight information, as well as data on calving, fertility and other calf performance traits for the last five years (2010 to 2015) on 25,155 cows and their progeny, were used to assess the usefulness of the replacement index in detecting differences in performance between cows within the 34 commercial herds. For the analysis cow traits were adjusted for cow parity and contemporary group effects. For the progeny traits all models were adjusted for dam parity, calf sex, calf age sire effect and contemporary group.

Cow traits

Across all the cow traits, cows with higher replacement indexes had superior on-the-ground performance compared to cows with low replacement indexes. Five star replacement index cows calved for the first time on average 66 days earlier than one star cows (Figure 1).



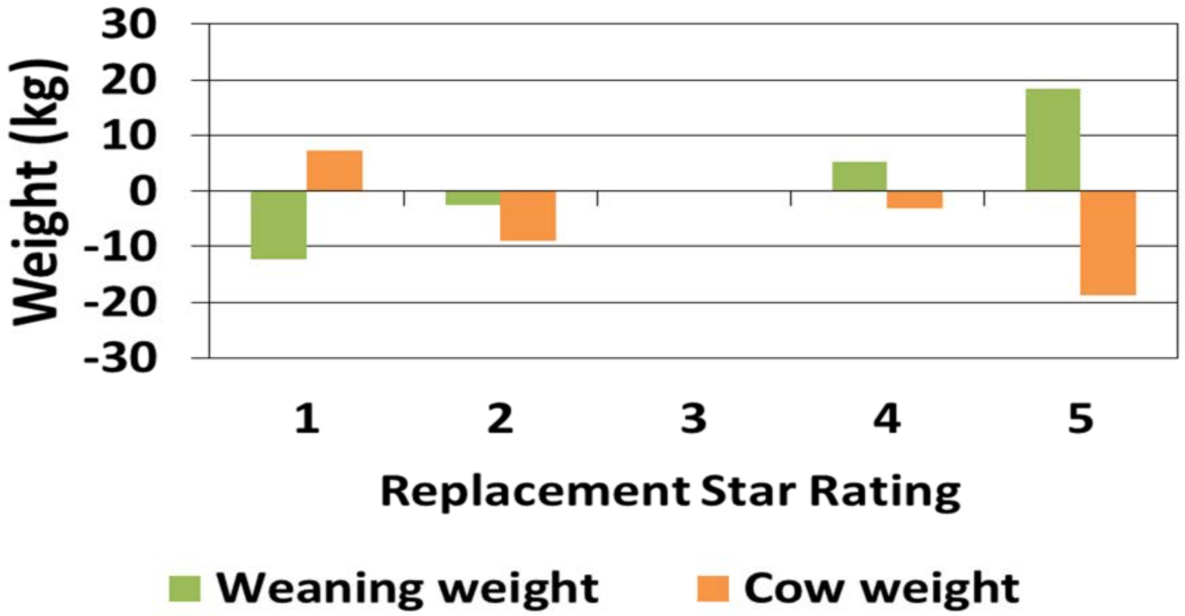


Figure 1. Mean on-farm performance of cows differing in Replacement Index star ratings for the respective traits of calving interval, age at first calving (measured in days) and weaning weight and cow weight (measured in kg). For all traits three star cows were centred to zero.

Cows with high replacement indexes also maintained a tighter calving interval (371 days for five star cows) compared to cows with low replacement indexes (378 days for one star cows). Cows with high replacement indexes were also more likely to survive to a subsequent calving (81%) compared to one star cows (73%).

Although cows with high replacement indexes were on average lighter than cows with low indexes (Figure 1), five star replacement cows on average weaned heavier calves (30 kg heavier) compared to one star cows. Cows with high replacement indexes were also more likely to produce more calves over their lifetime (+1.18 calves), experience less difficulty at calving (-0.27) and have lower levels of calf mortality (-3.92%) compared to cows with low replacement indexes (Table 2). These results indicate that selection of cows for favourable high replacement indexes will result in favourable improvements in cow performance.

Table 2. Average on-farm performance of cows differing in Replacement Index star ratings for number of calving events, calf mortality (%) and calving ease score (score 1 to 4) [values within parentheses are standard errors]

Replacement Index star	Number of calvings	Calf mortality	Calving ease score
1	3.44 (0.09)	13 (3)	1.50 (0.07)
2	3.86 (0.10)	13 (3)	1.38 (0.07)
3	3.97 (0.09)	12 (3)	1.30 (0.07)
4	4.25 (0.09)	10 (3)	1.29 (0.07)
5	4.63 (0.07)	8 (3)	1.23 (0.07)

Calf traits

Progeny from cows with high replacement indexes were also more likely to outperform their contempories from cows of low replacement index throughout their lifetime. Weanlings from high replacement index cow had higher growth rates to weaning (1.21 kg/d for progeny from 5 star cows) compared progeny from low replacement index cows (1.07 kg/d for progeny from 1 star cows). The superior performance of the progeny of high replacement index cows was also reflected in slaughter performance, with progeny from high replacement index cows slaughtered at an earlier age and at heavier carcass weights compared to progeny from low replacement index cows (Table 3). No statistically significant differences were detected in carcass conformation of the progeny of cows of varying star ratings but the conformation tended to be higher for progeny of cows with lower stars for the replacement index (Table 3).

Table 3. Average on-farm performance of the progeny of cows differing in star ratings for the Replacement Index for age at slaughter (days), carcass weight (kg) and carcass conformation score (score 1= P- to score 15 = E+) [values within parentheses are standard errors].

Replacement Index star	Age at slaughter	Carcass weight	Carcass conformation
1	629 (5.78)	341 (4.52)	9.07 (0.16)
2	625 (5.81)	344 (4.55)	9.09 (0.16)
3	630 (5.73)	350 (4.48)	9.16 (0.16)
4	632 (5.62)	352 (4.39)	9.09 (0.16)
5	626 (5.58)	355 (4.36)	9.05 (0.16)

What's it worth?

An estimate of the additional profit that could potentially be generated from the use of high replacement index cows can be derived based on the economic values assigned to each of the aforementioned traits. The economic values are calculated from the Grange Beef Systems model and are currently used in the €uro-star index construction. Based on the current results from the 34 commercial herds the additional benefit of using five star replacement index cows was €172 per calving event over the use of one star replacement index cows. It should be noted that information on certain traits included in the replacement index (i.e. feed intake and cow and weaning docility scores) were not available in the current study therefore the additional benefit from the use of high replacement index cows may be higher than calculated here. These results however do highlight the importance of genetic indexes on herd performance and profitability.

Conclusions

Genetic evaluations remain an important tool for beef farmers to make more informed breeding decisions on the selection of the ideal cow for increasing farm performance and profitability. Results from the analysis of commercial herd data show that the benefits of genetic index can clearly be realised at farm level. Research will continue to focus on the continual improvement of the national genetic evaluations to ensure that production and profitability gains are maximised for the beef industry.

Teagasc beef suckler demonstration farms - Past, present and the next steps

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Summary

- The value of beef and cattle output in 2014 for Ireland was €2 billion, representing 30% of total agricultural output, and it was the second largest agricultural sector.
- At farm level an improvement in profitability will necessitate the adoption of key technologies which include more compact calving, higher stocking rates, increased numbers of high maternal genetic index replacements, high quality pasture management and low cost labour-efficient farm infrastructures.
- Both the Derrypatrick herd and the Newford herd are centred around high grass growth and high grass utilisation.
- The Derrypatrick and Newford farms have grown 12.9 and 9.1 tonnes grass dry matter/ha, respectively, up to 30th September this year.
- Both farms aim to finish carcasses according to market specifications predominantly from a grazed grass diet with minimal input of concentrates.

Background

The value of beef and cattle output in 2014 for Ireland was €2 billion, representing 30% of total agricultural output, and it was the second largest agricultural sector. However, profitability at farm level is extremely low with the majority of beef farmers making a net loss when farm support payments are excluded from income. Despite these present challenges, the outlook for the Irish beef sector in the medium term is positive due to projected significant growth in world demand for meat products based on increasing world population and a return to improved global economic circumstances. At farm level an improvement in profitability will necessitate the adoption of key technologies which include more compact calving, higher stocking rates, increased numbers of high maternal genetic index replacements, high quality pasture management and low cost labour-efficient farm infrastructures. In the past, demonstration farms have been used to transfer key technologies to farmers with two examples being the Greenfield dairy farm in Co. Kilkenny and the Derrypatrick beef suckler farm in Grange, Co. Meath. In the past number of years Teagasc's BETTER programmes in beef and sheep have also used commercial farms to good effect to demonstrate best practice. Demonstration farms have also played an integral role in the technology transfer process in other countries such as New Zealand and Scotland.

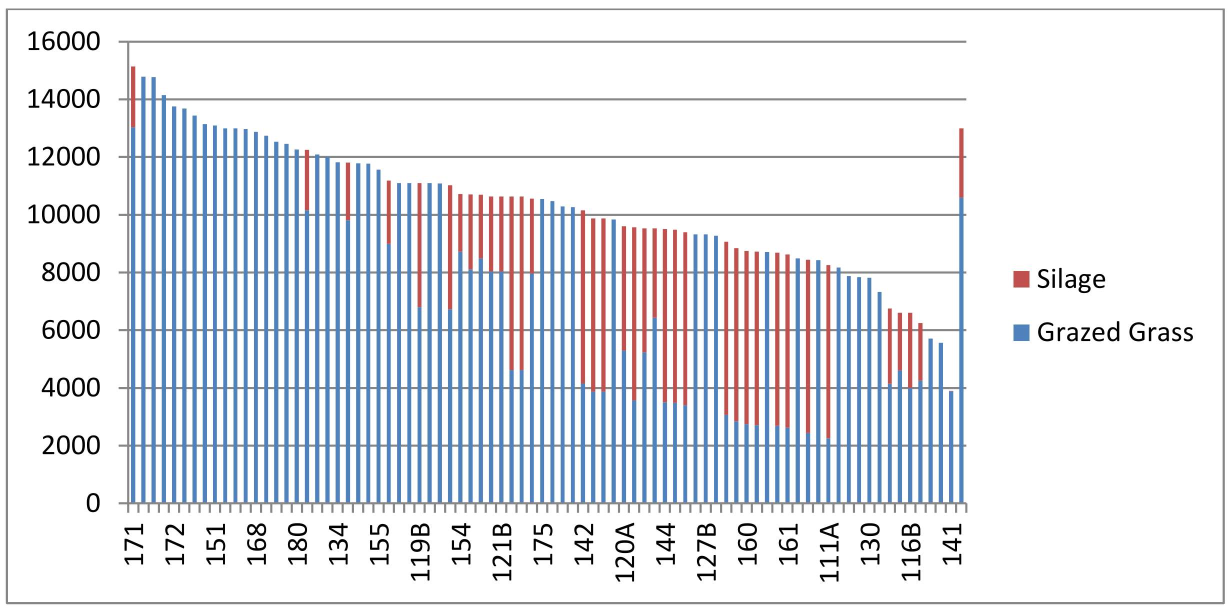
The Derrypatrick farm

The Derrypatrick farm is a suckler beef systems research farm established at Teagasc, Grange, Dunsany, Co. Meath in 2009 for the purposes of research demonstration to Irish beef producers. The farm size is 65 ha and all of the land is situated in one block with a good network of roadways servicing 79 grazing divisions or paddocks. While most of the farm is free-draining, some of the land area is heavy in nature and difficult to graze very early or late in the year. Perennial ryegrass dominates much of the swards and 12 ha (30 acres) were reseeded during the summer of 2015 with monocultures of Abergain, Glenveagh, Abergreen and Aberchoice sown at the rate of 35 kg/ha. It is envisaged that in the future 10% of the land area will be reseeded each year. Soil fertility is medium with the most recent soil samples (taken in 2013) showing that 10% of the farm was Index 3 or higher for phosphorus (P) and 46% of the farm Index 3 or higher for potassium (K). The pH of the Derrypatrick farm was 5.8 in 2013. These soil fertility issues have been addressed over the past two years and the farm is due to be soil sampled again during the winter of 2015.

Derrypatrick grass growth 2015

The Derrypatrick system is based around high grass growth and high grass utilisation. Figure 1 summarises the grass growth for the Derrypatrick farm for the year to date (28/09/2015). So far, the farm has grown 12,992 kg dry matter (DM), with 10,593 kg DM/ha of this coming from grazed grass and 2,398 kg DM/ha coming from conserved grass silage. On average, each of the 79 paddocks was grazed 4.9 times – this includes the silage fields. The most productive paddock on the Derrypatrick farm has grown 15.1 tonnes DM/ha so far this year while the most unproductive paddock has grown just 3.8 tonnes DM/ha. This demonstrates the wide variance between paddocks on the same farm and next year's focus will be on upgrading lower yielding paddocks (towards the right of Figure 1) to ensure that they grow more grass through increasing soil fertility or reseeding.

Figure 1. Derrypatrick grass yields for each paddock up to 30 September 2015 – yield is in kg DM/ha



Financial performance

One of the objectives of the Derrypatrick herd is to demonstrate systems of production which generate high levels of profitability. A target gross margin in excess of €1,000 per hectare was set at the initiation of the project in 2009. Two key principles for achieving targets set for the Derrypatrick herd are:

1. Output of beef per hectare must be high. This is achieved through high output per livestock unit and a high stocking rate. High beef output is also extremely important in driving profitability.
2. It is imperative that this output is generated within cost-efficient systems of production, which means that a high proportion of lifetime daily gain is achieved from grazed grass. Currently it is estimated that, on average, grazed grass constitutes 49% of the total feed budget on Irish suckler calf-to-beef farms and total herbage utilised is less than 5 t DM/ha. This is considerably lower than targets set for the Derrypatrick herd, where grazed grass is estimated to account for ~65% of the total feed budget and herbage utilised is ~11 t DM/ha. For bull and heifer progeny in the Derrypatrick herd, approximately 50% and 70%, respectively, of slaughter weight will be achieved from grazed grass.

The farm system

In 2013, a decision was taken to change the breeding programme from the original cow breed type comparison study to a study comparing early- *vs.* late-maturing breed sires. In 2013, the replacement policy also changed with half of the replacements now being sourced from the dairy herd as Limousin X Holstein/Friesian while the other half are sourced from suckler herds as heifers that are ranked high on the Replacement Index – they are predominantly Limousin- and Simmental-crossbred heifers. All heifers are served to either an easy-calving Aberdeen Angus or Limousin bull and all replacements calve at 24 months of age. All replacements are purchased at 8-12 months of age with no replacements bred on the farm (in order to maximise the number of animals finished, thereby providing more carcass data for the breed comparison). An objective for the Derrypatrick herd over the next four years is that all cows will be 4 or 5 star on the Replacement Index scale.

Table 1. Replacement Index of the Derrypatrick beef suckler herd

Star rating		Value (€)
★	n=13	€13.50
★★	n=13	€44.60
★★★	n=11	€64.60
★★★★	n=14	€86.50
★★★★★	n=19	€127.50
2016 replacements		€100.80
All cows		€73.60

The calving period is from 18th February to 30th April and calving in 2016 will take place over an 11 week period (Table 2). The six week pregnancy rate in the Derrypatrick herd in 2015 was 82.5% with an overall pregnancy rate of 96% (two cows and two heifers were scanned as non-pregnant). Seventy-one mature cows and 26 maiden heifers will calve down in 2016.

Table 2. Breeding and calving dates for the Derrypatrick herd in 2015/16

Cows	Start	End	Days	Weeks
Breeding	08/05/2015	20/07/2015	73	11
Calving	18/02/2016	30/04/2016	73	11
Heifers				
Breeding	14/05/2015	28/06/2015	45	7
Calving	27/02/2016	12/04/2016	45	7

Terminal sires used are Charolais, Aberdeen Angus and Limousin. The herd is divided evenly between early-maturing sire (Aberdeen Angus) and late-maturing sires (Charolais and Limousin). All animals are brought to finish, with half (n=25) of the male progeny being finished as bulls under 16 months of age (13 late-maturing and 12 early-maturing). The remaining male calves are finished as steers at 18-22 months of age. Heifers are finished at 17-22 months with about 75% of the heifers being slaughtered off grass in September/October. Many of the early maturing heifers will be slaughtered off grass without any supplementation while the late maturing heifers will receive some concentrates at grass 6-8 weeks prior to slaughter. The typical carcass weights expected from this system are: under 16 month old bulls 360-420 kg, heifers 250-350 kg and steers 300-400 kg.

Table 3. Derrypatrick sales performance for 2015

Animal type	Weight (kg)	Confirmation	Fat	Carcass	Kill out %	Euro/ kg	Value (€)
Cull cows (20)	805	R=	4-	430	50.8	3.79	1633
AA bulls (10)	665	R+	3=	380	57.2	4.35	1655
CH bulls (13)	664	U-	3-	395	59.5	4.41	1741
AA steers (7)	644	R=	3+	360	55.9	4.17	1501
AA heifers (20)	569	R-	4-	309	54.2	4.20	1296

AA=Aberdeen Angus; CH=Charolais

The majority of the cull cows (n=13) were finished off grass, with cows getting concentrates from 9th September until slaughter on 29th September. Concentrates were fed to cows and calves to aid the weaning process. Six Aberdeen Angus heifers and four Aberdeen Angus steers were slaughtered directly off grass with no concentrates fed to them. Late maturing heifers (n=25) have recently been split into two groups with 15 heifers destined for slaughter off grass and the remainder to be housed for indoor finishing. All steers and heifers for finishing at grass were started on concentrates on 9th September and are currently being offered 5 kg/head/day. The late-maturing heifers, which are predominantly Charolais-sired, currently weigh 563 kg, while the late-maturing steers currently weigh 610 kg (30/09/2015). The projected gross and net margins for the Derrypatrick herd for 2015 are presented in Table 4. It is apparent that the margin achieved is largely due to the high level of output (24% greater than the top third of the Teagasc eProfit Monitor farms). The gross margin is the best measure of technical efficiency and is projected to be close to €1300/ha for the Derrypatrick herd in 2015. When full costs are considered (including overheads and facilities costs) net margin is expected to exceed €600/ha.

Table 4. Projected Derrypatrick profit analysis compared to the average and top third of the 2014 eprofit monitor farms

	Derrypatrick estimate	Average eprofit monitor	Top 1/3 of eprofit monitor
Physical			
Farm size (ha)	65	44	48
Stocking rate (LU/ha)	2.7	1.7	2.2
Liveweight produced (kg/LU)	362	324	360
Liveweight produced (kg/ha)	977	561	775
Financial(€/ha)			
Gross output	€2277	€1242	€1831
Variable costs	€1004	€710	€865
Gross margin	€1273	€532	€966
Fixed costs	€652	€526	€652
Net profit excl. premia	€621	€6	€314

LU = Livestock unit

Derrypatrick herd - The 5 year targets

1. Achieve a gross margin in excess of €1500/ha and a net margin in excess of €1000/ha.
2. All paddocks on the Derrypatrick farm had Index 3-4 for P and K and a pH above 6.2.
3. Grow 15 tonnes grass DM/ha.
4. Achieve high utilisation and at least 250 days at grass.
5. Become one of the highest Replacement Index herds in the country.
6. Achieve the best possible breeding and fertility targets.
7. Produce carcasses according to meat industry specifications predominantly off grazed grass.
8. Incorporate a clover research trial on the Derrypatrick farm.
9. Incorporate a breeding comparison trial within the Derrypatrick herd.
10. Host every Knowledge Transfer (KT) discussion group in the country within the next 5 years.

The Newford farm - a Dawn Meats/ Teagasc partnership

One of the key recommendations arising out of the Food Harvest 2020 report was for Teagasc to set up a stand-alone demonstration herd in the west of Ireland. It was felt that a demonstration farm was needed in the west in order to demonstrate to farmers the key technologies that drive profitability in a suckler herd. The model of the Newford herd is that a commercial interest operates the farm, owns the animals, employs the labour, with Teagasc providing expert advice, and Teagasc has full access to all data for analysis and dissemination purposes. A management team consisting of personnel from both Teagasc and Dawn Meats have responsibility for decision making and long term objectives while Dawn Meats have employed a full time farm manager who through the direction of the management team for the project has full responsibility for the day to day running of the herd. This project is also supported by McDonald's Global Sustainability Team and demonstrates their ongoing commitment to Verified Sustainable Beef Production.

The key objectives of the project are:

- To establish a 'stand-alone' 100 cow spring-calving suckler unit, to demonstrate the most innovative technologies in beef production to improve productivity and profit levels on Irish farms.
- To transfer knowledge on the efficient operation of a grass-based suckler farm onto a greater number of beef farms.
- To demonstrate the potential of a moderately large suckler beef farm to provide a viable family farm income when operated to the highest level of technical efficiency.
- To develop and demonstrate world-best practice in suckler beef farm systems in terms of management and environmental and animal welfare sustainability while setting new benchmarks for achievable performance.
- To provide additional training and educational opportunities for advisors and suckler beef farmers.
- To operate an efficient and well organised business unit.

The farm

The farm is located at Newford, Athenry on a stand-alone unit close to the Teagasc Mellows Campus, Athenry. Farm size is 55.8 ha (138 acres) and it is split into three blocks. Much of the land is free-draining with about 8 ha (20 acres) requiring drainage works to be carried out. Ten hecares (25 acres) of the farm were reseeded in October 2014 and a further 9 ha (17.5 acres) were reseeded this spring/summer. In the forthcoming years it is envisaged that 10% of the land area will be reseeded each year. Monocultures of grass varieties such as Glenveagh, Abergain, Aberchoice and Abergreen have been sown and their performance will be analysed over the duration of the project. Soil fertility is quite good with the average pH of the farm being 6.14. Ninety-seven percent of the farm is at Index 3-4 for phosphorus and 51% of the farm is Index 3-4 for potassium. Cattle will be housed in slatted accommodation during winter months with straw-bedded loose housing being used to house some of the weanlings. Sheds were converted in spring 2015 to calving pens and loose pens for cows at calving time.

The farm system

The farming system will be a suckler-to-beef steer and heifer system with steers finished at 20-24 months of age and heifers finished at 20-22 months of age. It is projected that heifers will be finished at 320 kg carcass weight and steers will be finished at 350 kg carcass. The farm will be stocked at 200 kg organic nitrogen/ha or 2.7 LU/ha. The system is projected to deliver a gross margin in excess of €1000/ha. Cow type is early-maturing (Angus/Hereford) crossbreds from the dairy herd with high Terminal Index bulls being used to produce progeny for slaughter. Replacements will continue to be sourced from the dairy herd for the duration of the project. The option of replacement heifers being purchased as calves, contract reared and then brought back onto the farm close to calving at 24 months of age is currently being considered. While some may question this replacement strategy and cow type it is important to be cognisant that with the expansion in the dairy herd this type of replacement will be more readily available for suckler farmers and this demonstration farm will be able to exhibit their suitability or non-suitability to a suckler-to-beef system. This replacement system will also allow the farm generate maximum output/ha, while keeping the system simple with a minimum of stock groups grazing on the farm. In 2016, calving will take place from 20th February to 30th April. As the farm is managed by one labour unit, calving difficulty is an extremely important consideration when selecting terminal sires and a limit of <6% calving difficulty was set. Other criteria for AI sires were 5 stars on the terminal index, greater than 25 kg extra carcass weight and greater than 40% reliability.

Figure 2. Calf liveweight performance (kg/day) in the Derrypatrick and Newford herds

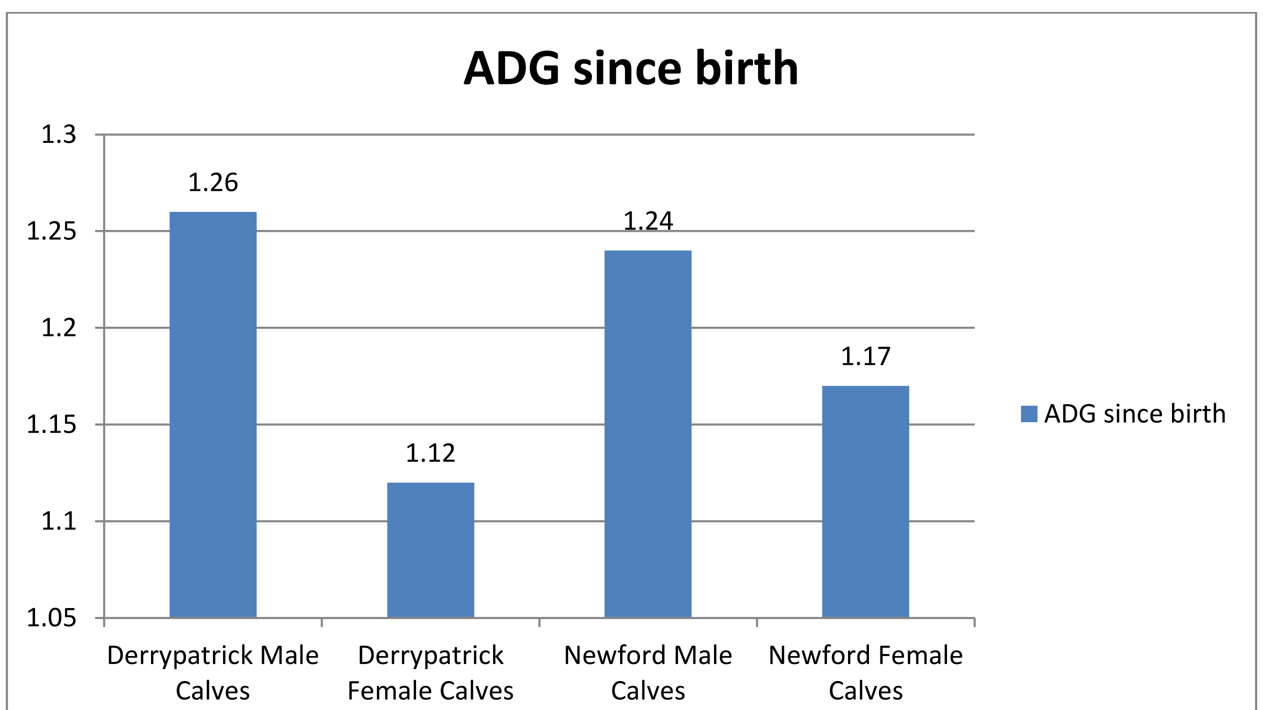


Figure 2 summarises the calf performance on both the Derrypatrick and Newford farms for 2015 to date. Calf performance targets are 1.25 kg/day for male calves and 1.1 kg/day for female calves.

Figure 3. Newford grass yields for each paddock up to 30 September 2015 – yield is in kg DM/ha

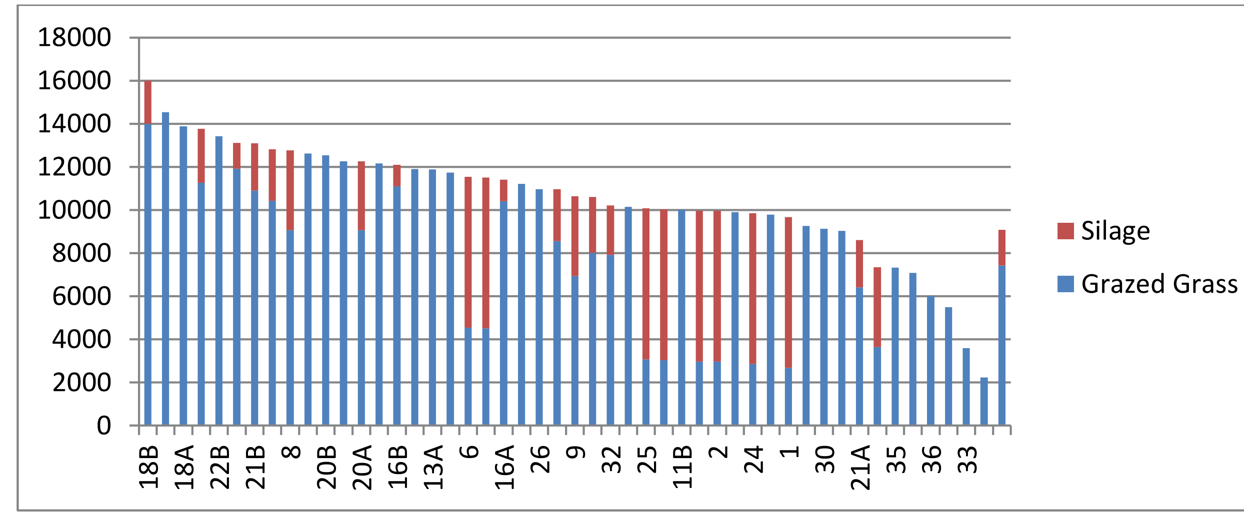


Figure 3 summarises the grass growth for the Newford farm for the year to date (up to 30/09/2015). To date the farm has grown 9076 kg DM/ha with 7426 kg DM/ha of this coming from grazed grass and 1650 kg DM/ha coming from removal for silage making. There are 48 paddocks on the farm and on average each paddock was grazed 5.3 times since the start of the year, including the silage fields. Paddocks 18-22 were reseeded in October 2014 and have grown the most amount of grass in 2015, with paddock 18B growing 16 tonnes DM/ha to date. The worst paddock on the farm has grown just 2.2 tonnes DM/ha and has already been reseeded this year. Next year's focus will be on the lower yielding paddocks (towards the right side of Figure 3) to ensure that they grow more grass through increasing soil fertility or reseeding with perennial ryegrass.

Data collection, reporting and visits

Both farms operate in a completely transparent manner with all measurements and data being made available to visiting groups, other interested parties and the farming public. Weekly farm notes are currently being uploaded on the website (http://www.teagasc.ie/beef/derrypatrick-herd/ and http://www.newfordsucklerbeef.ie so farmers can keep track of progress and management changes on the farms. Both herds are also open to the public for pre-arranged farm tours and open days will be arranged on a regular basis. Anyone interested in further information on either farms should contact Adam Woods at adam.woods@teagasc.ie

Planning to profit from beef production – principles and guidelines

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Summary

- Irish beef production systems are predominantly pasture-based due to the natural comparative advantage of Ireland to grow grass.
- Spring-calving systems predominate to optimise efficient use of grazed grass.
- Within these spring-calving systems, achieving good herd reproductive performance and a high proportion of lifetime carcass gain from grazed grass are the key profit drivers.
- In contrast to the relative uniformity of the cow-calf phase of production, there are a myriad of weanling-to-beef systems operated.
- To provide guidance to beef farmers, Teagasc have developed a set of Beef Production Guidelines covering the 14 most common beef production systems from weaning to slaughter for suckler and dairy origin cattle.

Introduction

Beef production is the most widespread farm activity in Ireland with approximately 70% of the 140,000 Irish farms having a beef cattle enterprise (CSO, 2012). Just over 1.7 million cattle were slaughtered in 2014 producing 585,000 tonnes of beef (DAFM, 2015). The output value of the cattle sector was €2 billion, representing 28% of total gross output from the agri-food sector. Ireland is also one of the largest net exporters of beef in the world with greater than 90% of total production exported. Thus, it is apparent that the Irish beef industry plays a critical role in the wider Irish agri-economy.

Irish beef production systems are predominantly pasture-based. This is due to the natural comparative advantage of Ireland to grow grass with the grass growing season and grass dry matter (DM) yield ranging from approximately 250 days and 11 t DM/ha in the north-east to 330 days and 15 t DM/ha in the south-west, respectively (Brereton and Keane, 1995). Consequently, grazed grass is the cheapest ruminant feed available for Irish farmers (Finneran *et al.*, 2012) and production systems which maximise the proportion of lifetime daily gain derived from grazed grass are usually the most profitable (Crosson *et al.*, 2006).

There are a myriad of production systems which are operated by Irish suckler beef farmers and many alternative sale options within these systems. The differing background and type of animals (e.g. suckler or dairy origin, gender, breed, etc.) gives rise to a huge number of possible system permutations, and furthermore, farm-specific factors influence the suitability of a given farm to a particular production system. For example, facility and labour constraints are important considerations, particularly for more intensive production systems. To provide some guidance to beef farmers with respect to production system blueprints, Teagasc have developed a set of Beef Production Guidelines (Teagasc, 2015). The 14 most common beef production systems from weaning to slaughter are covered. The suckler cow-calf stage of production and the rearing (up to 10 weeks of age) stage for dairy-bred beef systems are not considered in the Guidelines since it is assumed that they are relatively constant for the respective suckler and dairy beef systems.

Given the importance of the suckler cow-calf phase of production in determining whole farm profitability for suckler systems, the first objective of this paper is to outline the profit drivers for Irish suckler calf-to-weanling production systems (a subsequent paper by O'Riordan *et al.* (2015 – this proceedings) will address key technologies underpinning profitable weanling-to-beef production systems). The second objective of this paper is to provide an introduction to the Teagasc Beef Production System Guidelines that have been recently published (Teagasc, 2015).

Profit drivers of suckler calf to weanling production systems

Grazed grass, grass silage and concentrate are the primary feed inputs on beef farms, and collectively account for over 70% of direct costs. For example, within grass-based, suckler calf-to-beef steer systems on research farms, about two-thirds of the feed consumed annually is comprised of grazed grass, with the remainder made up of grass silage (27%) and concentrates (7%). However, when this feed budget is expressed in terms of cost (land charge included), the outcome is very different, in that grazed grass makes up only 44% of total feed cost, whereas grass silage accounts for 39% and concentrates accounts for 17% of total feed costs (O'Kiely, 2014). As the major feed costs on beef farms relate to indoor (winter) feeding small improvements in feed (cost) efficiency at these times has a relatively large influence on farm profitability. Consequently, the economic sustainability of 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 (O'Kiely, 2014).

There are a number of components of beef production systems which determine the extent to which production from grazed grass, and hence profitability, are maximised.

1. ***Achieving a long grazing season***
   In order to maximise profitability of suckler systems, a long grazing season with a corresponding short indoor winter feeding period is desirable. Previous research showed that increasing the grazing season length from 6 to 9 months increased profitability over 2-fold (Crosson *et al.*, 2009). Longer grazing seasons increase profitability by replacing more expensive grass silage and concentrates with grazed grass as well as reducing slurry handling costs. However, turnout of livestock to pasture has to be delayed until grass growth begins and grazing conditions are adequate. Thus, early turnout to pasture is dependent on location and year to year weather variation. Grassland management and grazing infrastructure also play a pivotal role. Where grazing conditions are difficult, restricted/"on-off" grazing, whereby animals are given limited access time to pasture daily, may be used (Gould *et al.*, 2010, 2011). Given the significant annual variation in possible turnout dates for a given site, a sufficient buffer of winter forage - usually grass silage - of suitable quality is critical.

2. ***Calving compactly in early spring***
   To facilitate early turnout to pasture for suckler beef cow production systems, calving in early spring (February/March) is essential. In general, mean calving date should coincide with the start of the grass growing/grazing season (Crosson and McGee, 2015). Cows should calve compactly so that the number of "late calvers", with corresponding later turnout dates, are minimised. There are also health risks (mixing of calves of different ages and levels of disease exposure), marketing difficulties (selling uneven batches of calves) and management/labour challenges (for example, repetition of

husbandry tasks such as disbudding and castration as calves reach suitable ages on different dates) with protracted calving seasons. Compact calving requires high levels of breeding management and having a fertile cow herd. Beef cow fertility, and more specifically the interval between successive calvings, plays a key role in compact spring-calving cow-herds (Crosson and McGee, 2012a).

3. ***Efficiently providing cow replacements***
   It has been shown that the annual cost of keeping suckler cows ranges from €550 to €700 per head with a large component of this range being due to the cost of providing replacement heifers. Herd reproduction performance, specifically the age at which heifers calve for the first time, the interval between successive calvings and the rate of survival of cows in a herd, largely determines suckler cow replacement costs. Age at first calving is the most important factor controlling the cost of rearing a suckler cow replacement; Crosson and McGee (2012b) showed that first calving at 24 months of age resulted in a greater number of cows calving, increased output and increased profitability relative to calving at 36 months of age. In the case of longer calving intervals, the likelihood of a cow becoming pregnant and remaining in the herd is reduced, thus increasing the number of replacements required. This is because later calving cows have a shorter duration prior to the breeding season commencing or indeed may even calve during the breeding season. Survival describes the ability of suckler beef cows to remain in the herd over a number of years. Thus, lower values for survival means that a higher number of replacement heifers are required to maintain a suckler herd.

4. ***Mobilising cow body condition***
   For economic reasons suckler cow nutrition generally involves mobilisation of cow body reserves (mainly fat) in winter when feed is more expensive, followed by the deposition of body reserves during the subsequent grazing season when consuming lower cost grass (Drennan and Berry, 2006). Where mature spring-calving suckler cows are in good body condition score (BCS) (~3.0+, Scale 0-5) at the start of the winter their feed energy intake can be restricted such that some of the body fat reserves are utilised to reduce winter feed requirements. This feed energy restriction can result in a feed saving of up to 25%, equivalent to 1.0 to 1.5 tonnes fresh weight of grass silage. However, if cows are not in good BCS at the start of the winter, they cannot be restricted and must be fed to requirements. This particularly applies to first-calvers and old/thin cows. After calving, cows in average BCS can be fed moderate to high digestibility grass silage to appetite for about 4 to 6 weeks, provided they are then turned out onto high quality grazing pasture. The latter is critical for good reproductive performance (Drennan and Berry, 2006). If calved earlier than this and particularly if BCS is low (<2.5), then a higher nutritive value (more expensive) diet is necessary. First-calvers require concentrate supplementation in most cases from calving until turnout to pasture.

5. ***Optimising winter feeding to exploit compensatory growth***
   One approach to reducing the cost of feeding cattle is through optimisation of compensatory growth. Compensatory growth is a physiological process whereby an animal has the potential, after a period of restricted feed nutrient intake, to undergo accelerated growth following re-alimentation, resulting in the animal having a similar liveweight as an animal that never experienced a growth reduction (Hornick

et al., 2000). In practice, exploitation of compensatory growth means animals have a restricted liveweight gain over the more expensive winter feeding period and a subsequent accelerated growth during the summer grazing period whilst grazing high nutritive value and lower cost pasture (Finneran *et al.*, 2012). In a study carried out at Teagasc, Grange (Keane and Drennan, 1994), an inverse relationship was found such that as liveweight gain during the restriction period reduced from 893 to 311 g/day, liveweight gain during the compensation period increased from 470 to 908 g/day. Similarly, McGee *et al.* (2014) found that the liveweight gain responses by continental crossbred weanlings to additional supplementary concentrate offered during the indoor winter feeding period were subsequently largely lost due to subsequent compensatory growth at pasture.

6. ***Producing heavy weanlings with good conformation***
   Liveweight per day of age, produced efficiently, is a key driver of profitability in suckler beef systems (Crosson et al., 2010). Research at Teagasc Grange has demonstrated that cow milk yield is a major determinant of calf liveweight gain pre-weaning (McGee et al., 2005; Murphy et al., 2008). These findings have indicated that the calf daily growth response to each additional kilogram of milk per day is 0.07 kg liveweight. Murphy et al. (2008) found that higher milking crossbred cows with Holstein-Friesian or Simmental ancestry produced heavier weanlings than lower milking beef breed cow types. However, progeny from cows with Holstein-Friesian ancestry had somewhat poorer conformation (muscularity) and were fatter than those from purebred beef breed cows. Carcass conformation is important since it is positively related to the proportion of meat and high-value meat cuts in the carcass, and to carcass value. Given that spring-born weanlings derive most of their non-milk intake from grazed grass, the provision of high quality herbage is also a critical factor influencing pre-weaning liveweight gain. To meet growth potential and weaning weight targets, supplementary feeding of suckling calves can compensate for deficiencies in cow milk supply or where high calf weanling value is expected (e.g. "export" quality weanlings). This supplementary feeding is either in the form of grazed grass ("creep grazing") or concentrates ("creep feeding").

7. ***Operating at high stocking rate***
   Given that land area is the most limiting factor on Irish suckler farms, high levels of profitability per hectare will determine overall farm profitability. Profit per hectare is, in turn, largely dependent on high levels of output per hectare, and thus high stocking rates. Economic analysis of suckler beef production systems at Teagasc Grange has shown that where individual animal performance remains high, stocking rate is the main driver of farm profitability (Crosson et al., 2009). Similarly, Crosson et al. (2010) showed that, where animal performance is constant, each livestock unit increase in stocking rate corresponds to an increase in gross and net margin of €33/ha and €26/ha, respectively, where stocking rate ranges from 1.5 LU/ha to 2.9 LU/ha. Similar to length of grazing season, the appropriate stocking rate is subject to location- and climate-specific factors, however, operating at a relatively high stocking rate is important.

Beef Production Guidelines

The Beef Production Guidelines are based on animal performance levels and physical inputs and outputs obtained from research studies carried out by Teagasc at Grange and Johnstown Castle research centres.

The blueprints follow a standardised format over two pages with seven sections in total:

1. System description. A short description of the production system including herd of origin (suckler/dairy), gender (heifer/steer/bull) and age at slaughter.
2. Typical liveweight and liveweight gain targets at different stages of production.
3. Management guidelines. A general overview of the management required for the respective system.
4. Inputs required. Quantification of grazed grass, grass silage and concentrate feed ration typically consumed.
5. Economics. In this section a "ready reckoner" type table is provided to enable farmers to derive a gross margin per head for the system using cattle, beef and concentrate prices that prevail for that farm at that point in time.
6. Market considerations. An overview of market specification considerations and likely market demand for the respective system.
7. General considerations. Any other considerations that farmers should consider when appraising the suitability of the respective system for their farms e.g. safety issues, variations around liveweight and finishing specifications, facility requirement etc.

An example of the guidelines provided for 24-month steer beef from suckler-bred weanlings is provided in Figures 1 and 2. In the case of the Economics section, default values are provided for a number of the variables (e.g. grass and silage costs). Where farm actual prices are available (e.g. purchased silage) then these values should be substituted for the defaults. There is an onus on users to use prices that are realistic and to complete a sensitivity analysis to ensure that any price changes that might reduce returns (e.g. increase in calf purchase price or reduction in beef price) are accounted for. An example of a sensitivity analysis for the 24 month steer beef (suckler) system is provided in Table 1.

Table 1. Example sensitivity analysis of a production system included in the Beef Production System Guidelines. "Expected" *(€2.50 / kg liveweight for weanlings, €4.00 / kg beef price and, €270 / t for concentrate ration)* and "Lower returns" *(€3.00 / kg liveweight for weanlings, €3.50 / kg beef price and, €300 / t for concentrate ration)* scenarios are for demonstration only.

	Physical inputs & outputs	Expected price scenario	Lower returns price scenario
a. Weaned calf purchase value	290 kg	**€725**	**€870**
b. Carcass value	340 kg	**€1360**	**€1190**
c. Sales – Purchases (b-a)		**€635**	**€320**
Variable costs per head			
Grass	1.9 t DM	€76	€76
Concentrates	0.7 tonnes	**€189**	**€210**
Silage	7.5 tonnes	€225	€225
Veterinary		€30	€30
Transport & Levies		€35	€35
d. Total Variable Costs		**€555**	**€576**
Gross margin per head (c-d)		**€80**	**-€256**

It is clear from Table 1 that although a gross margin of €80 per head is possible if expected prices prevail, this could reduce to a gross loss of €256 if a "lower returns" scenario occurs. It should be noted also that these values do not include an imputed cost for the farmers labour or fixed costs. Fixed costs include items such as machinery repairs and running expenses, lease arrangements, utility (electricity, water) expenses, casual labour, bank loans and interest charges, and, buildings and machinery depreciation. Where a quantifiable change in any of these variables is likely within a production system, then these changes should also be included in the budget.

The Guidelines do not cover all possible production systems – for example, production systems for autumn-born animals (which represent less than 20% of total calvings) are not specifically described. However, the general principles are widely applicable. A brief summary of the systems for suckler bred calves and dairy bred calves are presented in Appendix 1 and 2, respectively.

The Beef Production Guidelines are available from the Teagasc website and can be downloaded at

http://www.teagasc.ie/publications/2015/3712/109311_BeefProdSystemGuide_10_a.pdf

24 MONTH STEER BEEF (SUCKLER)

General overview of the production system described such as source and breed of animal and age at slaughter

1. SYSTEM DESCRIPTION

- Production of spring born continental steers from the suckler herd which are slaughtered at 24 months of age.
- Steers go through a modest store period over the first winter gaining around 0.6kg/day before being turned out to grass for their second grazing year. After housing for the second winter steers are placed on a diet of grass silage and concentrates up to finish.
- Steers on this system are eligible for the Quality Payment Scheme (QPS) provided they are quality assured and fall within the correct conformation and fat classes on the grid.

Liveweight performance targets taken from research studies at Teagasc Grange and Johnstown Castle

2. TYPICAL LIVEWEIGHTS AT DIFFERENT STAGES OF PRODUCTION

STAGE OF PRODUCTION	LIVEWEIGHT (KG)	AVERAGE DAILY GAIN (KG/DAY)
Weaning (Start Weight)	320	1.33
Turnout	400	0.60
Housing (2nd winter)	585	0.90
Slaughter Weight	700	0.95
Carcase Weight (kg)	360-400	

Management guidelines describe feeding and grazing and, other management considerations

3. MANAGEMENT GUIDELINES

- Continental weanlings for this system are on average 320kg at weaning in the autumn.
- Animals will need to achieve a lifetime gain of around 0.90kg/day from birth to slaughter to achieve the targets specified.
- Weanlings are introduced to 1.0 - 2.0 kg of concentrates and good quality silage (72%DMD or better) over the first winter. The target is to achieve a modest weight gain of around 0.60kg/day or 80 kg over the 1st winter.
- Steers are turned out in early spring to achieve a 200 day grazing season and a total weight gain of around 185kg over their second season at grass.
- From housing to slaughter the steers will be on a diet of high quality silage and an average of 5kg/day of concentrate. They will be slaughtered at 700kg liveweight or 395kg carcase.
- Good grazing management will be required to ensure animals achieve good weight gain over their second grazing system.
- In an integrated suckler to beef system a compact calving pattern would be desirable.

Feed inputs and stocking rates based on research studies at Teagasc Grange and Johnstown Castle

4. INPUTS REQUIRED

Concentrates	0.75t DM or 0.87t fresh weight
Grass	2.2t DM
Silage	1.6t DM or 8t fresh weight
Stocking Rate	2.7 animals/ha at 170kg organic N per ha

Figure 1. Example of the Beef Production System Guidelines – first page of the 24 month steer beef (suckler) system

24 MONTH STEER BEEF (SUCKLER)

'Ready reckoner' to enable gross margin analysis

5. ECONOMICS

		€
a. Weaned Calf Purchase Value	320 kg	
b. Carcase Value	395 kg	
c. Sales – Purchases (B –A)		
Variable Costs per Head*		
Grass	2.2 tDM	€88
Concentrates	0.87 tonnes	
Silage	8 tonnes	€240
Veterinary	-	€39
Transport & Levies	-	€40
d. Total Variable Costs		
Gross Margin per Head (C – D) **		

* Variable costs per head do not include interest or mortality costs.
** Subtract estimated fixed costs per head to calculate net margin per head.

Market specifications and demands considerations

6. MARKET CONSIDERATIONS

- Steer beef is seen as being of equivalent quality to heifer beef across many of our markets.
- Steer and heifer beef are the ideal preference for the major UK customers, and similarly across continental Europe these are a point of differentiation, or selling point, against young bull beef, which is widely available and competitively priced.
- Strongest demand is for animals of up to approximately 400 kg carcase weight, which will produce steak cuts of the preferred size for most customers.

General considerations such as key factors underpinning achievement of targets, variations that might arise, safety issues and sale contract/ agreement recommendations.

7. GENERAL CONSIDERATIONS

- The system depends on high quality grass silage being available of at least 70%+ DMD. If silage quality falls below this, higher concentrate levels will be required at both the weanling and finishing phase.
- Good weight gains over the first winter (80kg) are essential to maintain the targets outlined otherwise the finishing period may be prolonged.
- Where silage quality is not adequate producers may opt to feed concentrates *ad-lib* for the final 80-100 days. This will increase the amount of concentrates used and feed costs.
- It is important to slaughter animals as they become fit so that they are not allowed to become over fat.
- Animals are marketed in the spring months when generally demand for steers is good.

Figure 2. Example of the Beef Production System Guidelines – second page of the 24 month steer beef (suckler) system

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Appendix 1. Overview of the suckler weanling to beef production systems described in the Teagasc Beef Production System Guidelines.

System	Suckler Weanling to Beef							
Age at slaughter	Under 16 mo bulls[1]	Under 16 mo bulls[2]	18 – 20 mo bulls	20 mo steers	24 mo steers	28 mo steers	20 mo heifer	24 mo heifer
Weaning weight (kg)	320	320	320	320	320	320	290	290
Weight at turnout (second grazing, kg)	-	-	400	400	400	380	370	370
Weight at housing (second housing, kg)	-	-	535[3]	540[6]	585	575	510[6]	530
Weight at turnout (third grazing, kg)	-	-	-	-	-	630	-	-
Slaughter weight (kg)	700	650	700	590	700	760	565	625
Carcass weight (kg)	400	370	405	320	395	420	310	340
Concentrates fed (t DM/head)[4]	1.4	1.1	1.3	0.5	0.75	0.2	0.5	0.6
Grazed grass fed (t DM/head)	-	-	1.0	2.2	2.2	4.0	1.5	1.9
Grass silage fed (t DM/head)	0.6	0.9	1.1	1.1	1.6	2.1	0.9	1.5
Stocking rate (animal units/ha)[5]	8.4	8.4	4.9	3.9	2.7	2.0	3.9	2.7

[1]Bulls finished on *ad libitum* concentrates over the final 120 days. [2]Bulls finished over a 230 day finishing period fed an average of 5 kg concentrates during this period. [3]Liveweight following 100 d at grass. [4]Including first winter meal consumed. [5]Animal units = weaning to slaughter, assuming 170 kg organic N per ha. [6]Housed in September; where grass supply is adequate may be finished at grass.

Appendix 2. Overview of the dairy calf to beef production systems described in the Teagasc Beef Production System Guidelines.

System	Dairy Calf to Beef					
Age at slaughter	Under 16 mo bulls[1]	18 - 20 mo bulls[1]	24 mo steers[1]	19 mo heifer[2]	23 mo steer[2]	26 mo steer[2]
Weaned calf weight (kg, 70 days)	100	100	90	90	90	90
Weight at housing (first grazing, kg)	250	230	230	200	230	210
Weight at turnout (second grazing, kg)	-	330	310	260	310	280
Weight at housing (second housing, kg)	-	430	490	-	510	450
Weight at turnout (third grazing, kg)	-		-	-	-	490
Slaughter weight (kg)	520	600	620	460	610	610
Carcass weight (kg)	270	320	320	235	310	320
Concentrates fed (t DM/head)	1.9	1.3	0.9	0.4	0.7	0.4
Grazed grass fed (t DM/head)	0.4	1.5	2.2	2.3	2.2	3.7
Grass silage fed (t DM/head)	0.25	0.6	1.2	0.6	1.2	1.4
Stocking rate (animal units/ha)[4]	4.7	3.4	2.2	3.2	2.4	1.95

[1]Based on Holstein-Friesian calves. [2]Based on early maturing beef breed crossbred calves. [2]Housed in September for 60 day finishing period. [4]Animal units = weaning to slaughter, assuming 170 kg organic N per ha.

Feeding strategies to optimise performance from pasture in steer and bull finishing systems

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Introduction

Livestock production accounts for 30% of gross agricultural output and is valued at €2.1 billion (CSO, 2014). Irish ruminant livestock production is largely pasture-based where, collectively, grazed and conserved pasture account for almost 90% of the lifetime feed consumption (O'Kiely, 2014). As grazed pastures are invariably the cheapest feed resource for livestock production (Finneran et al., 2012), much attention has focused on performance at pasture. The national cow herd is predominantly spring-calving and where their progeny (suckler- and dairy-bred) are taken through to slaughter they normally spend two seasons at pasture and in most cases have at least two indoor winter periods. As levels of animal growth in one period of the production cycle can have an influence on gains at a later stage, optimisation of animal performance at the various stages of the cycle is a challenge for producers.

Suckler herd progeny accounted for approximately 45% of the national steer kill (O'Riordan and Cormican, 2015; Table 1). Within the suckler herd, late-maturing breed cows mated to late-maturing sire breeds accounted for 30% of the national steer kill (or 66% of the suckler herd progeny). Early-maturing sires used on late-maturing cows accounted for 3% of the national steer kill (or 7% of suckler slaughterings) in 2013. Approximately 11% of the national steers slaughtered were progeny of early-maturing suckler cows and within this cow type, steers sired by early- or late-maturing breeds accounted for 4% and 7% of the national kill, respectively. Within the young bull category (<24 months of age), progeny of suckler cows accounted for 56% of the bulls produced.

Nationally, mean steer slaughter age is approximately 28 months (Table 1). Progeny from the early-maturing cows, whether sired by early- or late-maturing breed sires had a similar age at slaughter, but the late-maturing crosses had carcasses that were 44 kg heavier. For late-maturing suckler herd, steers sired by late-maturing breeds were one-month older but had carcasses which were 43 kg heavier at slaughter than progeny sired by early-maturing sires.

In an integrated spring-calving suckler calf-to-beef system, progeny spend the first 6–7 months at pasture, are weaned (October/November), and then move to indoor winter accommodation for a 'store' period where they are generally offered an *ad libitum* grass silage diet supplemented with 1-3 kg concentrates/head/day depending on the nutritive value of the silage (Drennan and McGee, 2009). Yearlings return to pasture for a second grazing season from March to November and, in the case of steers, are finally housed for finishing at about 24 months of age on a diet that approximates to a 50:50 grass silage/concentrate mixture. In the case of heifer progeny, the finishing diet may be offered indoors as a silage diet supplemented with concentrates (60:40) or may remain at pasture and receive concentrate supplementation there. In both situations the slaughter age is 20-22 months of age. Such a system is summarised in Figure 1. Steer production predominates but more recently about 25% of the male progeny are finished as bulls that are slaughtered under 16 months or slightly older, but less than 24 months of age (Figure 2).

In practice many weanlings leave their farm of birth during their first year of life and subsequently may move again to other farms before final finishing.

As the effects of pre-weaning performance for suckler calf-to-weanling systems has been addressed in the previous paper (Crosson *et al*., 2015), this paper focuses on post-weaning performance. Firstly, it examines recent results on the effects of weanling winter growth on subsequent performance at pasture, and during finishing and, secondly, it examines the role and response to concentrate supplementation at pasture in spring and autumn and how this influences performance at pasture and during finishing.

Compensatory growth

For economical reasons exploiting compensatory growth is a key goal when feeding weanling/store cattle in winter. Research at Teagasc Grange has determined that the optimum winter growth rate for steers and heifers destined to return to pasture for a second grazing season is in the region of 0.5 kg liveweight/day, if they are to subsequently optimise compensatory growth on cheaper produced grass (Keane 2002; Kyne *et al*., 2001; McGee *et al*., 2014). In other words, there is little point in over-feeding weanlings in winter as, during the subsequent grazing season, cattle that gained less over the winter have the highest liveweight gain at pasture. This ability of "restricted" animals to subsequently compensate at pasture means that at least two-thirds of the winter weight advantage, due to higher levels of supplementation, disappeared by the end of the grazing season. However, unlike steer (or heifer) systems, the optimal growth rate during the first winter for high growth potential young suckler bulls to exploit subsequent compensatory growth at pasture is not clear. Recent research at Grange has addressed this issue.

Effect of weanling winter growth rates on subsequent performance

A number of studies were conducted at Grange to assess the effects of weanling bull winter growth rates on later performance at pasture and during finishing. While at pasture the aim was to set a pre-grazing herbage mass within the range 1200-2000 kg dry matter (DM)/ha and a post-grazing height of approximately 4.5 cm.

The effects of three weanling winter growth rates on subsequent animal performance at pasture and during finishing was recently examined (Marren *et al*., 2013). In this study, 120 spring born Charolais- and Limousin-sired weaned suckled bulls, ~9 months of age, with an average weight of 370 kg and birth date of March 8th, were used. They were placed on: (1) grass silage diet offered *ad libitum* (DMD 731 g/kg) supplemented with 2 kg concentrate (862 g/kg rolled barley, 60 g/kg soya bean meal, 50 g/kg molasses g/kg and 28 g/kg mineral/vitamins) daily, (2) the same grass silage supplemented with 4 kg concentrate daily, and (3) the same grass silage supplemented with 6 kg concentrate daily.

At the end of the 123 day winter, bulls were turned out to pasture for ~100 days, where they rotationally grazed a predominantly perennial ryegrass pasture in group sizes of 20, and stocked at ~6 bulls/ha. Animals were re-housed on 9 July and, over a 3-week period were adapted to an *ad libitum* concentrate diet (same formulation as given above) supplemented with *ad libitum* grass silage. Animals were slaughtered when the group reached a mean liveweight to achieve the target carcass weight of 380 kg.

Weanling liveweights and liveweight gains for the winter, the following grazing period and the finishing period are shown in Table 2 and Figure 3. At the end of the first winter animals supplemented with 4 kg concentrates were 26 kg heavier than those supplemented with 2 kg concentrates, while those supplemented with 6 kg concentrates were 65 kg heavier than those that received 2 kg concentrates. Liveweight change (gut fill loss) immediately (within 2-3 days) post turn-out was greatest for the 6 kg concentrates group, lowest for 2 kg concentrates group and intermediate for the 4 kg concentrates group. This gut fill weight loss meant that the weanlings supplemented with 2 and 4 kg concentrate were now only 16 kg different (not statistically significant). Thus, for an additional 250 kg of concentrates fed (4 kg v 2 kg) animals were 16 kg liveweight heavier, giving an approximate response of 15:1 (not economical with concentrates at €250/t and weanlings €2.60/kg liveweight). The 6 kg supplemented group remained heavier by 47 kg (over the 2 kg supplemented group), giving a production response of ~11:1. Thus, the additional 500 kg concentrates resulted in an extra 47 kg of liveweight (at best breakeven). At pasture, average daily liveweight gain was greatest for animals that received 2 kg concentrates during the winter, lowest for animals which received the 6 kg concentrates, with the 4 kg concentrates group being intermediate. By housing time, there was no difference in liveweight between the 2 and 4 kg concentrates winter supplemented groups, however, the 6 kg concentrates supplemented group were still 32 kg heavier. Thus, there was no additional liveweight response to the feeding 4 kg concentrates compared with 2 kg concentrates. Similarly, the 32 kg liveweight response for the 6 kg concentrates level of feeding (relative to 2 kg concentrates) resulted in a ~15:1 response (not economical). At slaughter, liveweights were not significantly different between the three different first winter feeding levels. There were no significant differences between treatments for carcass weight, kill-out proportion, or carcass fat score.

Another study, with suckler-bred bull weanlings, was undertaken where 3 or 6 kg concentrates were offered as a supplement to grass silage over a 127 day indoor winter period (McMenamin *et al*., 2014). Animals returned to pasture after the winter and were again housed after 98 days for finishing on *ad libitum* concentrates. At the end of the weanling winter phase, animals receiving 6 kg concentrates were 50 kg heavier than those receiving 3 kg concentrate (~10:1 liveweight response). After 98 days at pasture the liveweight difference was reduced to zero. Thus, the liveweight response to the additional concentrates fed during the winter was zero. However, in this study it was found that bulls fed 6 kg concentrates during their first winter were 30 kg heavier at slaughter (13:1 response), resulting in a 20 kg heavier carcass, than animals which received 3 kg concentrates for the first winter.

Maintaining optimum grazing conditions

Planned early turnout of livestock to pasture has been shown to improve farm profitability where cheaper pastures are replacing more expensive winter forage and a further saving in slurry storage and spreading costs are achieved (O'Riordan *et al*., 2011). Subsequently, maintaining pasture quality throughout the season can be a challenge on many beef farms. In grassland management terms, preparation for early turnout and having high quality pastures available in spring starts in the autumn of the previous year. The principles of autumn grassland management with regards to spring grass supply have been well documented (Neilan *et al*, 1997; O'Riordan and Keane, 1997). Once managed properly, pasture quality is invariably high from turnout until early-June. Once grass seed heads appear, sward quality has deteriorated and, if p not correctly managed, can remain sub-optimal. Apart from topping, ensuring animals are offered a pasture where supply is not in excess of 2000 kg DM/ha and paddocks are grazed in an 18-22 day rotation, will aid the maintenance of pasture quality in summer. With control of pre-grazing herbage mass, the extent to which pastures are well grazed (utilised) also has an effect on sward quality. In beef production where individual animal performance is important, a balance is needed between grazing to a low post-grazing sward height to get high pasture utilisation, and not penalising animal liveweight performance by grazing to an excessively low sward height.

The effect of post-grazing sward height on animal performance was studied (O'Riordan *et al*., 2011) where yearling Belgian Blue x Holstein-Friesian and Aberdeen Angus x Holstein-Friesian steers were turned out to pasture in spring and grazed to a post grazing sward height of either 3.5 or 5 cm in a rotational grazing system from mid-March until late October. Live weight gain of steers that grazed to a post-grazing sward height of 3.5 cm was significantly lower than those grazing to 5 cm such that, by the end of the grazing season (late October), those grazing to 3.5 cm were 30 kg lighter. It was concluded that very tight grazing (to a sward height of 3.5 cm) was not recommended. Similarly, in another study, with lactating suckler cows and their calves (Minchin *et al*., 2011), animals grazed to residual sward height of 4.0 or 5.0 cm and it was found that, at the end of the grazing season, cow body condition score gain and calf liveweight gain were lower on the 4.0 cm than on the 5.0 cm sward height. It was concluded that grazing to 4.0 cm had negative effects on the performance of beef suckler calves.

Supplementation at pasture: Spring

A study was undertaken to examine the feeding of two concentrate supplementation levels to suckler weanling bulls during winter (3 or 6 kg/head/day). The animals were subsequently returned to pasture for 100 days where they were offered either zero or 2.7 kg or 5.3 kg concentrates/head/day (McMenamin *et al*., 2014b). Ninety weaned, spring-born Charolais- and Limousin-sired suckler bred bulls, *ca*. 8 months of age (369 kg liveweight) were used. At the end of the grazing period bulls were housed and finished on an *ad libitum* barley-based concentrate diet. The finishing period lasted 76 days followed by slaughter at an average age of ~19 months.

After 100 days at pasture, the zero concentrate supplemented animals were 17 kg and 36 kg lighter than the groups getting 2.7 kg and 5.3 kg supplemented (15:1 and 15:1 liveweight response), respectively (Table 3). The marginal liveweight response for the 5.3 kg allowance over the 2.7 kg allowance was 10:1. During the finishing phase, highest growth rates were seen in the animals that were unsupplemented at pasture. At slaughter, the low and high pasture supplementation levels were 7 kg (35:1 response) and 24 kg (24:1 response) liveweight heavier than the zero supplemented group. The marginal liveweight response for the additional concentrates (5.3 kg v 2.7 kg) was 17 kg (17:1 response). The respective additional carcass weight produced for 2.7 v 0 kg, 5.3 v 0 kg and 5.3 kg v 2.7 kg (fed at pasture) were 6 kg, 20 kg and 14 kg. Kill-out differences were small. Treatment differences observed for carcass weight, slaughter weight, kill-out proportions, carcass conformation and fat scores were not statistically different. Overall, the study concluded that both supplementation during the first winter and at pasture increased animal live weight, however, the scale of the differences were such that the economics of concentrate supplementation were marginal.

In another unpublished study using spring-born suckled bulls that had a 140 day winter as weanlings, animals were turned out to pasture for 200 days. For the first 100 days animals received either grass only or grass supplemented with concentrates which approximated to 50% of the animals daily intake. Supplemented animals grew at 1.69 kg liveweight per day over the first 100 days compared with 1.44 kg/day for the unsupplemented group. Thus, supplemented animals were 25 kg heavier after 100 days (a liveweight response of ~22:1). After 100 days at pasture, half of the zero supplemented animals were offered a concentrate supplement at pasture which approximated to 50% of their daily intake. From day 100 to 200, the unsupplemented bulls grew at 0.92 kg liveweight/day at pasture, while the supplemented group have a daily gain of 1.24 kg/day. After 200 days the bulls were slaughtered and bulls supplemented for the final 100 days at pasture had a carcass weight that was 10 kg heavier than the grass only bulls. This additional carcass weight came from both a higher slaughter weight (+20 kg liveweight) and kill-out proportion (6 g/kg). Comparing bulls that were supplemented throughout the grazing season (200 days of supplementation) with those that were supplemented only for the final 100 days, the fully supplementation group had a carcass weight that was 9 kg heavier. The additional carcass weight came totally from a better kill-out proportion (19 g/kg). The study concluded that the economics of pasture concentrate supplementation (for the conditions prevailing in this study) were, at best, marginal.

In a further supplementation study (Lenehan *et al.*, 2015), 17-month old autumn-born bulls (554 kg liveweight) were turned out to pasture in spring and over the following 90 days received a daily supplement of either zero, 3 kg or 6 kg concentrate per head. The corresponding liveweight gains were 0.90, 1.02 and 1.10 kg/day . At the end of the 90 day grazing period bulls were slaughtered. The liveweight at slaughter, carcass weight, kill-out proportions for the zero, 3 kg and 6 kg supplementation treatments were 635, 648, 664 kg; 367, 367, 387 kg; and 578, 566, 583 g/kg, respectively. Therefore, 270 kg of concentrates were fed (3 kg/day for 90 days) and they resulted in an additional 13 kg liveweight (21:1 response) but no additional carcass. Where 540 kg of concentrates were fed (6 kg/day) and additional 29 kg liveweight (19:1 response) and 20 kg of carcass were achieved compared with the pasture only animals. Offering 6 kg concentrates in contrast to 3 kg concentrates at pasture resulted in an additional 16 kg liveweight (17:1 response) and 20 kg carcass for the higher level of feeding. The lower concentrates supplementation level did not improve kill-out proportion and the higher level of concentrates increased kill-out by 5 g/kg. Carcass fatness was only marginally improved by concentrates supplementation. While at pasture a similar group of bulls remained indoors and were placed on an *ad libitum* concentrate diet where they gained 1.73 kg liveweight per day, and reached a slaughter and carcass weight of 706 and 406 kg, respectively. Carcass fatness was highest on this *ad libitum* concentrate diet.

Supplementation at pasture: Autumn

An earlier study (McNamee *et al.*, 2012) examined the effects of supplementary concentrates in the autumn on performance of dairy crossbred steers finished at pasture or indoors. This study aimed to quantify the response to concentrate supplementation on grass intake and steer performance at pasture in autumn and also to compare steers finished off pasture in autumn or finished indoors during the second winter. In this study, sixty-six spring-born Aberdeen Angus crossbred calves were reared together until July of their second year (approximately 15 months of age) when they were approximately 370 kg liveweight and were then placed on one of three treatments: (1) grazed grass only, (2) grazed grass plus 1.5 kg concentrate (rolled barley), and (3) grazed grass + 3.0 kg concentrate. They were rotationally grazed on predominantly perennial ryegrass swards. After 112 days, half of the animals in each treatment were slaughtered and the remainder were housed in a slatted-floor shed and offered barley-based concentrates *ad libitum* plus ~1 kg/day silage DM until slaughter, 89 days later.

Mean pre-grazing sward height was 10.8 cm and herbage mass was 2,073 kg DM/ha. Mean post-grazing sward heights were 4.71, 4.64 and 4.71 cm for zero, 1.5 kg and 3 kg concentrates supplemented groups, respectively. Animal performance did not differ significantly between the three concentrates supplementation groups (Table 4), except for kill-out proportion, which was lower ($P<0.05$) for the unsupplemented group than for the 1.5 or 3 kg concentrates supplemented groups. Animals subsequently finished indoors had higher carcass weight, carcass fat and conformation score than those finished at pasture. The response to concentrates at pasture for the 1.5 kg and 3.0 kg concentrates supplementation rates were 62 g and 43 g live weight per kg DM, respectively (16:1 and 23:1 liveweight, respectively). These values are much lower than the 101 g (10:1) reported by Keane and Drennan (2008) where Aberdeen Angus crossbred steers were supplemented at pasture with 3.65 kg concentrates daily for 105 days. This partially reflects the higher DMD (760 vs. 695 g/kg) of herbage offered in this study and the substitution rates obtained. Supplementation with 1.5 and 3.0 kg concentrates reduced herbage intake by 0.47 and 0.81 kg DM per kg DM concentrate offered. The response to concentrate supplementation at pasture was poor in this study, partly due to high grass substitution rates. An indoor finishing period after grazing was necessary to produce carcasses of adequate weight, fat cover and quality.

Earlier work at Grange (French *et al.*, 2001) used older late-maturing steers (~570 kg liveweight) to assess the effects of autumn concentrate supplementation at pasture. The pastures used were an 8-9 week old second cut silage regrowth. Pasture was allocated at three allowances (6, 12 and 18 kg DM/head/day) and within each allowance three levels of concentrates were offered (0, 2.5 and 5 kg/head/day). At the low herbage allowance (insufficient pasture to meet the animals requirement) supplementation resulted in a response in the range of 6-8:1 (kg concentrates/kg liveweight gain). At the more generous pasture allowance (12 kg DM/head/day), the liveweight production response was typically 9-10:1. The animal growth response to concentrate supplementation at the highest herbage allowance was generally poorest.

Steers and bulls compared

Bulls are inherently more "efficient" for beef production than steers, upon reaching puberty, due to naturally occurring male steroid hormones. Published comparisons of steers versus bulls are predominantly based on dairy and dairy x beef animals. A review of studies carried out at Teagasc Grange comparing bulls and steers of similar breed, reared under similar management on the same diet and slaughtered at the same age showed that, on average, liveweight gain was 8.4% higher, carcass weight was 9.5 % heavier and lean meat yield was 20% greater for bulls than steers (Fallon *et al.*, 2001). Similarly, data from Hillsborough, Northern Ireland, showed that compared to steers reared in the same way, bulls produced 10% more liveweight, 14% more carcass, 21% better carcass conformation, 20% more lean meat and 17% more saleable meat per kg feed consumed (Steen and Patterson, 1994). Likewise, a review of mainly North American data showed that mean growth rate was 17% higher, carcass fat was 35% lower and feed efficiency was 13% better for bulls than steers (Seideman *et al.*, 1982). Equally, a review of data from mainly continental European countries, illustrated that, on average, intake of bulls was 1% higher, growth was 20% higher, carcass fatness was 27% lower and feed efficiency was 17% better than for steers (Boucque *et al.*, 1992). Differences in favour of bulls are generally more pronounced at higher feeding/feed energy levels and with increasing slaughter weight. It is noteworthy that there is a lot of variation in the magnitude of difference obtained between bulls and steers across the various studies.

In practice, bulls and steers are generally reared in different production systems involving different levels of feeding, particularly in winter, different lifetime ratios of grazing to indoor feeding and different ages and weights at slaughter. This means that the effects of "gender" are confounded with production system factors. The combination of these factors largely determines differences in performance obtained between bulls and steers commercially. Data from Grange clearly show that more "intensively-reared" bulls have a higher kill-out proportion, superior carcass conformation, lower carcass fat score and higher meat proportion than "extensively-reared" steers (Keane and Allen, 1998; Keane, 2003; McGee *et al.*, 2005; Clarke *et al.*, 2009).

In a more recent study at Grange (McMenamin et al., 2015), sixty weaned, spring-born (4 March) Charolais- and Limousin-sired suckler bulls *ca.* 8 months old (363 kg at start) were used to compare steers and bulls in two contrasting production systems. Half of the males were castrated 14 days before the start of the study. Animals were offered grass silage (DMD 688 g/kg) ad libitum plus 3 kg concentrate (862 g/kg rolled barley, 60 g/kg soya bean meal, 50 g/kg molasses and 28 g/kg minerals + vitamins) daily for the first winter, targeting an animal growth rate of ~0.6-0.7 kg/day. First winter duration was 127 days, at the end of which one group of bulls and one group of steers remained indoors on *ad libitum* concentrates while another group of bulls and another group of steers were turned out to pasture for 98 days. Following re-housing the previously grazed animals were gradually adapted (during a 3-week period) to an *ad libitum* barley-based concentrates (formulated as above) plus grass silage diet. Animals were slaughtered at an age of ~19 months.

Apart from liveweight at the end of the first winter, where bulls were only marginally ahead of the steers, and, fatness at slaughter, where steers were fatter, bulls had significantly greater performance than steers for all other variables measured (Table 5). At pasture, bulls grew at ~0.2 kg liveweight gain per day faster than steers and had a similar advantage when finishing indoors. On the 15-point scale, bulls were one score leaner and one score better in conformation than steers.

Conclusions

As most beef cattle destined for slaughter spend at least two seasons at pasture in addition to two winters indoors, the level of animal performance at any stage of the production cycle can have an influence on performance at a later stage in that cycle. In integrated calf-to-beef systems, each stage in the production needs to be optimised. Daily liveweight gains of ~0.5-0.7 kg/day during the indoor winter period seem optimum where animal are returning to pasture for a further grazing season. Animal winter growth will clearly respond to additional supplementary feeding but such gains are invariably diminished during the subsequent grazing season as compensatory growth takes place. Supplementing yearlings at pasture in spring will generally improve performance. However, the additional liveweight gained is often insufficient to meet the input cost of the concentrates. The animal production response to autumn supplementation is influenced by both pasture supply and quality. In times of pasture scarcity or where pasture quality is poor an economical response is likely. However, when well managed autumn pastures are supplemented with concentrates, the production response is often only breakeven in economic terms. So, while kill-out proportion, fat and conformation scores may be increased, the cost of the supplemented concentrates is not always covered by the additional animal gain.

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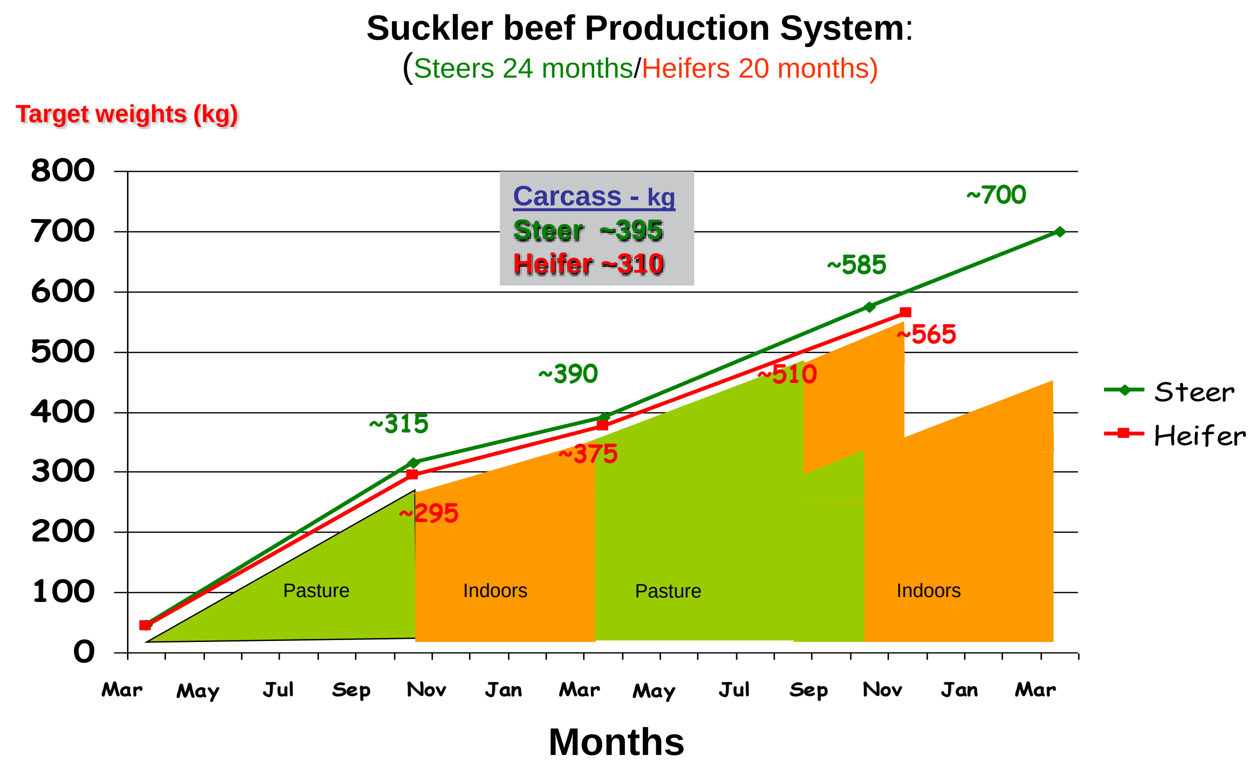

Figure 1. Schematic of suckler calf-to-beef steer and heifer system

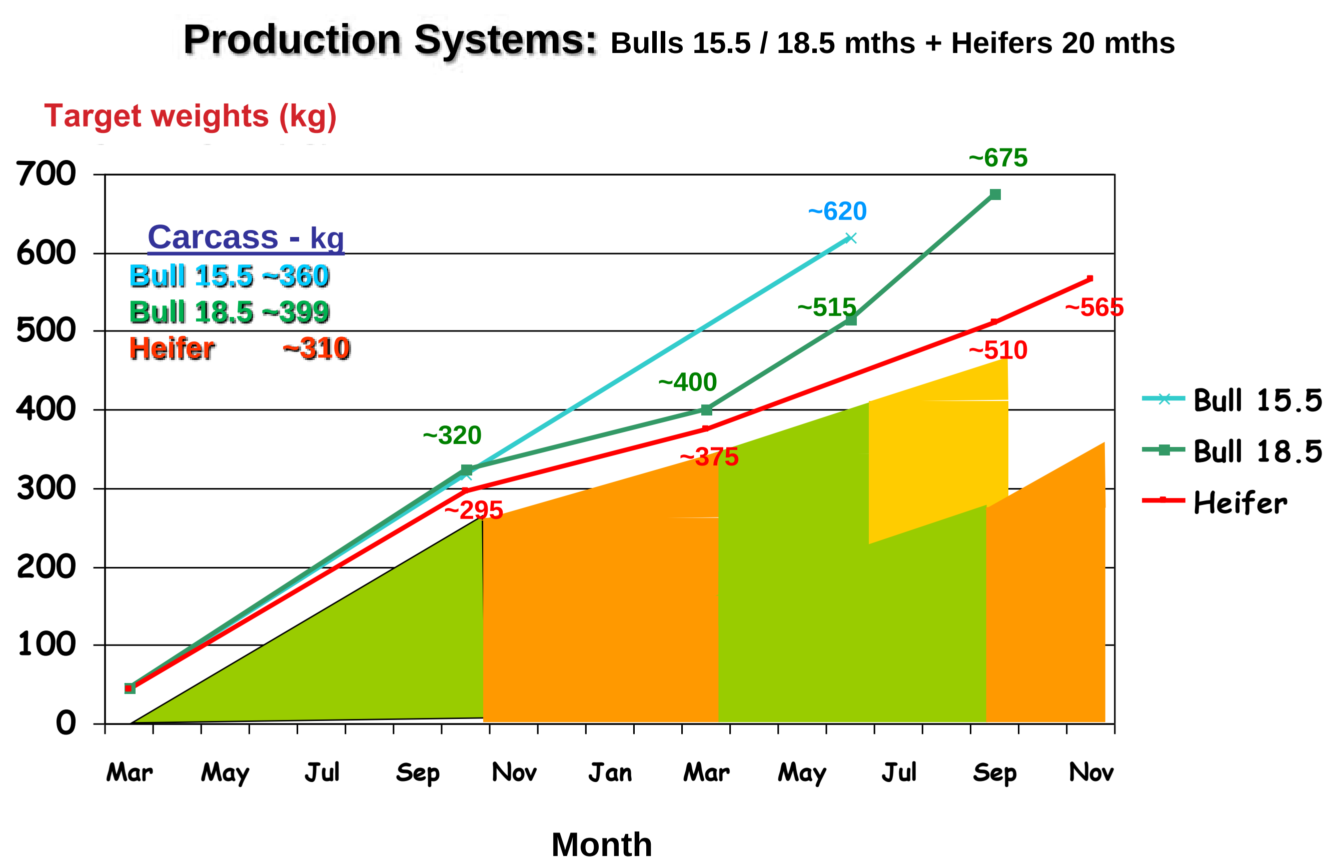

Figure 2. Schematic of suckler calf-to-beef bull and heifer system

Table 1. Age at slaughter and carcass weight of steers slaughtered in Ireland during 2013.

	Dairy dams with progeny sired by			Early-maturing suckler dams with progeny sired by		Late-maturing suckler dams with progeny sired by	
	Dairy	Early-maturing	Late-maturing	Early maturing	Late-maturing	Early-maturing	Late-maturing
Mean age at slaughter (months)	28.3	29.0	29.8	28.9	28.8	28.3	29.3
Mean carcass weight (kg)	325	335	370	341	385	357	400
No. of carcasses (rounded to nearest 1000)	147,000	86,000	44,000	18,000	38,000	14,000	151,000

Table 2. Effect of growth rates during the first winter on live weight and liveweight gains of young bulls.

	Winter supplementation level (kg concentrate/head/day)			
	2	4	6	Sig.
Liveweight (kg)				
Initial weight	370	370	371	NS
Turn-out to pasture	457	483	522	*
Post turnout	446	462	493	**
Gut fill change	-15.4	-20.9	-29.1	*
Housing	554	543	586	*
Slaughter	699	684	683	NS
Live weight gain (kg/day)				
Indoor winter period	0.79	1.01	1.27	*
Pasture	1.20	0.95	1.03	**
Carcass weight (kg)	389	382	378	NS
Kill-out (g/kg)	556	552	553	NS
Conformation (1-15)	9.8	9.4	9.0	*
Fat score (1-15)	6.8	6.5	6.2	NS

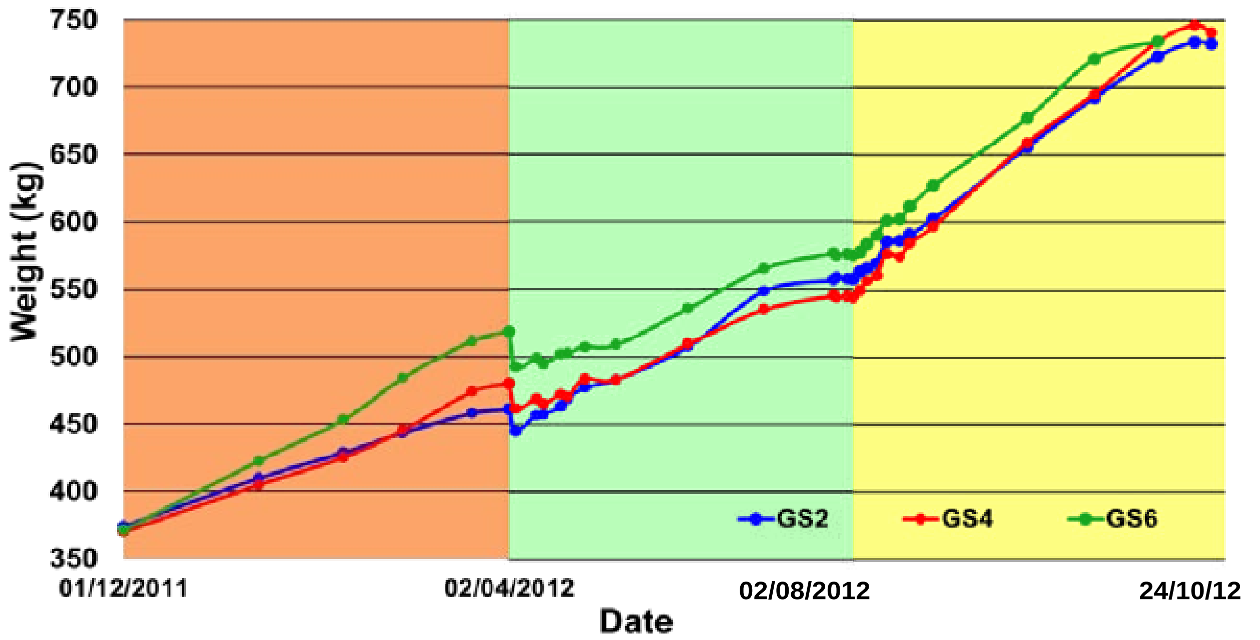

Figure 3. Effect of concentrate supplementation level during the winter on animal weight in winter and subsequently at pasture and during finishing.

Table 3. Effect of winter concentrate level and supplementation at pasture on bull performance.

	Supplementation at pasture (kg/head/day)			
	0	2.7	5.3	Sig.
Live weight gain (kg/day)				
Winter	0.77	0.72	0.72	-
Pasture	1.28	1.33	1.60	***
Finishing	1.83	1.63	1.60	*
Kill-out (g/kg)	574	577	582	NS
Slaughter weight (kg)	718	725	742	NS
Carcass weight (kg)	412	418	432	NS
Carcass fat (1-15)	6.8	7.1	6.6	NS
Carcass conformation (1-15)	10.1	9.7	10.6	NS

Table 4: Performance of steers offered supplementary concentrates at pasture and finished at pasture or indoors

	Supplementation at pasture (kg/d)				Finishing strategy		
	0	1.5	3.0	Sig.	Pasture	Indoors	Sig.
Pasture ADG (kg/day)	0.88	0.88	0.91		0.89	-	
Indoor ADG (kg/day)	1.29	1.13	1.18		-	1.20	
Slaughter weight (kg)	517	518	524		469	570	***
Carcass weight (kg)	252	257	261		233	281	***
Kill-out (g/kg)	487	497	499	*	496	492	
Carcass fat (1-15)	6.3	6.8	7.0		5.5	7.9	***
Carcass conformation (1-15)	5.4	5.6	5.4		5.0	5.9	***

Table 5. Effect of gender (Gen) and diet (Diet) on the performance of suckler bulls and steers

Gender	Bulls		Steers		Significance	
Diet	Grazed	*Ad lib*	Grazed	*Ad lib*	Gen	Diet
Liveweight (kg) adjusted gut fill	438	464	433	468	NS	***
Liveweight gain growing (kg/day)	1.49	1.82	1.28	1.64	**	***
Liveweight gain finishing (kg/day)	1.79	1.33	1.51	0.87	***	***
Slaughter weight (kg)	711	728	651	683	***	NS
Kill-out (g/kg)	571	575	559	560	**	NS
Carcass weight (kg)	406	419	364	382	***	NS
Fat score (1-15)	6.7	7.9	7.9	8.6	*	**
Carcass conformation score (1-15)	9.9	10.2	8.9	9.1	**	NS

Technologies used on the Teagasc/ Irish Farmers Journal BETTER Beef Farms to maximise profit from finishing cattle

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Summary

- Use of innovative technologies by participants of the BETTER Farm Beef Programme has led to increased profitability on farms. The main improvements made were in terms of increasing output, grassland management, and herd health and breeding.
- Intensive grassland management, herd health planning and strict breeding policies have allowed farms to become more profitable and labour efficient.
- Increasing the amount of liveweight gain achieved from grass during the main grazing season significantly reduced the cost of the intensive indoor finishing period.
- Herd health planning, including vaccination policy, played a significant factor in reducing levels of ill-thrift and mortality rates in cattle, and in reducing the labour requirements for handling sick animals.
- Having a tight calving spread reduced labour requirement on all farms. This helped with managing groups of stock for grazing, housing and finishing.

Grassland management

One of the main factors affecting profitability on livestock farms is the quantity of grass utilised in the diet of the grazing animal. The experience of the BETTER Farm Programme has shown a direct correlation between beef output, tonnage of grass grown and profitability on suckler farms. The farms with the greatest levels of profitability typically have a focus on a long grazing season, on targeting an initial turnout date of lighter stock in early February, on a long grazing season (260+ days), and on sequentially closing paddocks in rotation from mid-October to early December. Soil fertility investment, installing paddocks, providing water troughs and reseeding all play an integral part in achieving high levels of liveweight gain at moderate cost. It is important to make use of management tools such as the Spring Rotation Planner and the 60:40 Autumn Planner, and to measure grass growth on a weekly basis with the date being input to PastureBase Ireland. Making top quality silage is an important part of reducing feeding costs. This leads to financial savings due to reduced concentrates being fed, and can be accompanied by increased performance of stock housed over the winter.

Case study: BETTER Farm participant

Donal Scully, Ballyphilip, Banogue, Co.Limerick

Donal Scully runs a 29 hectare suckler-to-finish farm near the village of Banogue in Co. Limerick. Soil type is relatively dry and the farm is capable of carrying a high stocking rate. Farm system comprises 40 suckler cows calving from late June to early September. Progeny are slaughtered as under 16 month old bulls with an average carcass of 420 kg and under 20 month old heifers with an average carcass of 320 kg. To increase output further on the farm 20-25 dairy-continental crossbred heifer calves are purchased to breed as replacements with surpluses sold live as yearling. Every January or February, a further 15 weanling bulls are purchased to slaughter under 16 months of age with his own home reared bulls.

Stocking rate on the farm is high with an average of 2.6 LU/ha recorded on the farm over the last 3 years. This is expected to rise to 2.9 LU/ha for 2015. This requires a high level of skill and management to ensure adequate grass supply (Table 1) and fodder reserves are in place at all times. Gross margin since joining the BETTER Farm Programme has increased from €34/ha in 2012 to €1374/ha in 2014 and is expected to be at similar levels for 2015.

Donal employs the use of all the main grassland management practices encouraged by Teagasc to grow and utilise as much grass as the farm can produce throughout the grazing season.

Table 1. Total grass growth on Donal Scully's farm since 2013

	2013	2014	2015*
Total grass growth (tonne DM/ha)	13.1 T	10.85 T	12.31 T

*To Sept. 21st 2015

Farm layout

Paddocks Donal is a firm believer in having a rotational grazing system in place. The farm is mainly in one block, with 5 hectares located across the main road from the farm yard. Before joining the programme Donal was beginning to install paddocks on the farm and had begun to measure grass. One of the main benefits of having a paddock system in place is the amount of control Donal has in terms of making baled silage from grass that is surplus to immediate requirements, increasing the fertilizer input when grass supply is getting tight or identifying paddocks in need of reseeding. While Donal has 21 fixed paddocks in place, he prefers to use temporary wires to divide paddocks further into 1- 1.5 day blocks for each group of stock and allow 18-21 days for re-growth. At peak times there may be up to 6 different groups of stock on the farm. Having enough divisions is essential to manage grass quantity and quality. It is recommended that at least seven divisions be provided to each group of stock on a farm. This means during peak growth when stocking rate is highest there may be up to 50 paddocks available on the farm. Donal prefers the flexibility of the temporary paddocks as it allows him to remove paddocks easily should a field be designated for silage or reseeding.

Donal uses the leader follower system to help utilise grass. As Donal calves his cows from June to September, with cows weaned in late Spring or early Summer, he therefore has a low demand from cows when they are dry. Priority stock such as yearling bulls and breeding heifers are let graze out paddocks initially, with dry cows used to mop up any remaining poorer quality grass. This allows better utilisation of grass that is grown. It also cuts down on labour by reducing demand for topping. No topping has been carried out on the farm by Donal in the last four years, reducing his labour and diesel bill.

Water supply While most beef farms are guilty of not having enough water troughs to permit having an adequate number of paddocks, another issue is the location of the water troughs. Typically water troughs are located near the gate or the corner of the field. This leads to problems using strip wires or diving paddocks in half. Ideally troughs should be located in the centre of fields and under a central fence wire, allowing the one water trough to service two or even four adjacent paddocks. Donal currently favours using small movable water troughs, especially in his main silage fields which will be divided into 6-8 divisions once the main crop is harvested.

Roadways One of the main investments carried out on the farm since joining the programme was the installation of a central roadway. At a total cost of €4,000 for 400 metres, this investment is considered extremely good value for money by Donal. It facilitates easier movement of stock between paddocks, making it a one man job, allows haulage of slurry across the farm to drier paddocks away from the farmyard in early Spring and allows Donal to continue to use AI on heifers by facilitating segregation of bulling heifers back to yard for insemination.

Grass measurement

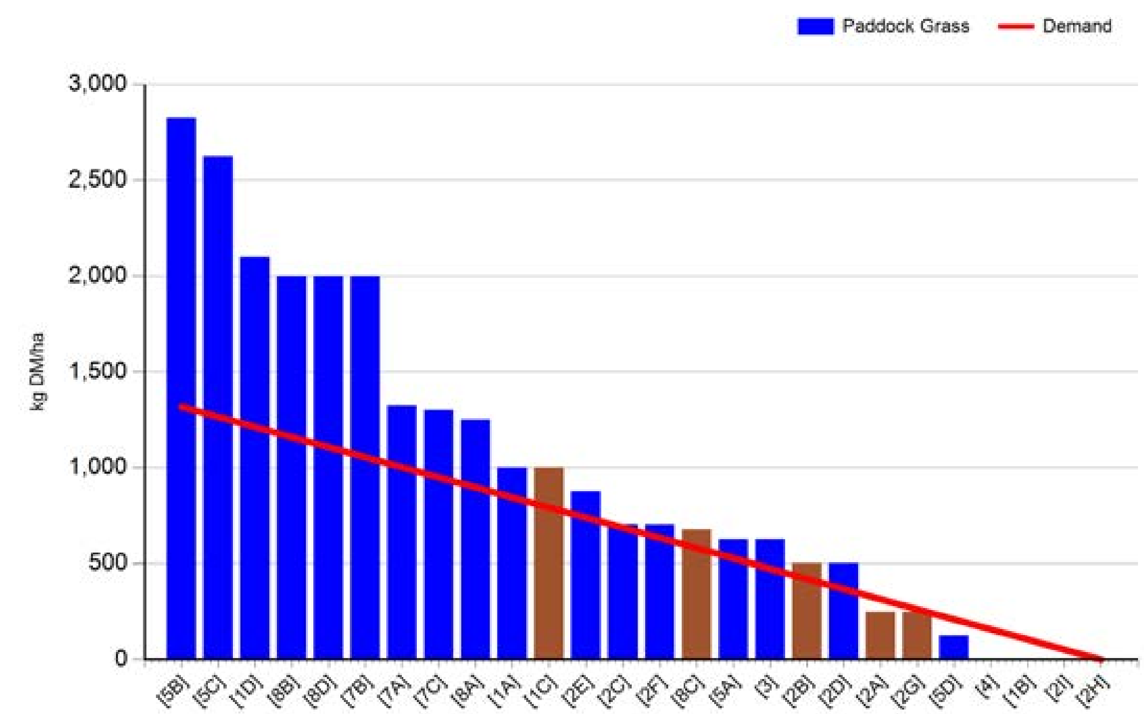
Grass yield is measured on a weekly basis using a plate metre. Donal inputs the grass heights to PastureBase Ireland and assess the grass wedge (Figure 1). During the main grazing season the twin objectives are to provide a constant quality and quantity of grass to stock. The grass wedge is used to help assess when there is too much or too little grass available on the farm. The principle of the grass wedge is that if there are a large number of paddocks with covers over the demand line on the wedge, surplus grass will be taken out as baled silage and if there are too many paddocks with covers under the demand line, then corrective action will be taken in the form of extra nitrogen fertiliser being applied, introducing supplementation in the form of silage or concentrates, or the farm stocking rate must be reduced. Ultimately it allows Donal to be in control of grass on his farm on a weekly basis.

Donal aims to have his cattle graze paddocks with an average cover of 1600-1700 kg DM/ha (10-11 cm). He aims for this slightly higher than recommended cover as he feels that with a higher stocking rate he always needs a higher wedge of grass ahead of stock in case of drought, etc., hitting growth conditions. Donal aims to have his cattle graze paddocks down to 3 cm providing ground conditions allow. The dry cows on the farm from April to July allow Donal to achieve this as they have a lower energy requirement.

In early Spring Donal uses the Spring Rotation Planner and aims to have 60% of the farm grazed by March 20th with the remainder grazed by "Magic Day" which is normally around April 8th. In Autumn, Donal uses the 60:40 Autumn Rotation Planner which means he will start to close paddocks by 15th October and continue to sequentially close paddocks in rotation until 60% are closed by November 10th, and with the remainder by closed by early December.

By following these guidelines Donal is well equipped to have adequate grass supplies for a long grazing season.

Fig 1. Sample grass wedge from Donal's farm



Reseeding and soil fertility

Across all the BETTER Farms reseeding more of the farm regularly is seen as central to achieving more liveweight gain from grass. Some of the older swards on Donal's farm have a low percentage of perennial ryegrass. By measuring grass yield regularly Donal was able to identify poorer performing paddocks and target them for reseeding. The favoured method of reseeding used was two passes of a disc harrow followed by one pass of a power harrow. Seed is then spread with a fertilizer spreader and then rolled and fertilized. Two areas where Donal pays particular attention at reseeding time is seed variety used and timing of post emergence spray to kill new weeds. Grass varieties are all selected from the Department of Agriculture Recommended List. A post emergence spray is applied within 4-6 weeks of reseeding. Soil fertility on Donal's farm is excellent with all soils index 4 for phosphorus (P) and index 3 or 4 for potassium (K). Soil pH averages 6.3. Donal has invested over the last 7-8 years in improving soil fertility and continues to maintain this level of fertility by soil testing every 2-3 years, and fertilizing land accordingly. Since joining the programme an average of 5 hectares per year has been reseeded.

Fertilizer and slurry

Since Donal started inputting grass yield date to Pasturebase Ireland he has recorded an average of 12 tonne DM/ha grown on the farm. To achieve this Donal has an intensive fertilizer plan in place. Slurry is applied on the 16th January each year at a rate of 3000 gallons per acre on silage ground. All grassland gets 23 units of urea in late January and 23 units per acre again 4-6 weeks later as the first round of grazing progresses. Slurry is applied to the rest of the farm at *circa* 2000 gallons per acre by the time silage ground is closed up in early April. Twenty units of nitrogen are applied after each grazing for the rest of the year until September. As the farm runs a very high stocking rate, Donal is reluctant to skip a round of nitrogen even if grass supplies are running ahead of schedule and prefers to take out surplus grass as baled silage for feeding to finishing bulls.

Silage quality

Silage quality on the farm is targeted at achieving a high DMD. Any dip in silage quality below the requirement of the stock means supplementing with additional expensive concentrates, thus increasing the cost of production. Grazing out silage ground well in the spring and late autumn, applying adequate fertiliser to the crop, having a good quality ryegrass sward and targeting an early cutting date all contribute to high DMD silage.

Herd health

Poor herd health effects on the profitability of suckler beef farms manifest themselves through animal mortality, ill-thrift, and the costs of treatment, prevention and labour. A key component of prevention of herd health issues on suckler farms is the identification of management factors that can significantly impact herd health. In Ireland, the national average for calf mortality at birth and 28 days are 4.5% and 5.6%. These values are problematic given that the target is 0.95 calves weaned per female mated.

During Phase 1 of the BETTER Farm Programme, BVD was targeted and from the 14 participants in the programme at the time that used the ear notch test for Persistently Infected (PI) animals, 32 PI's were found and there was 10 PI's found in the worst affected herd.

Phase 2 focused on examining stomach fluke and liver fluke burdens on farms. During 2013, faecal samples were examined on all herds. Herds in the north-west had the largest rumen fluke incidence with 10% of samples showing up as high positive compared to 4% in the south-east. In contrast, 2% of samples in the north-west showed up highly positive for liver fluke while no positive cases were recorded in the north-east or south-west.

Case study: BETTER Farm participant

Michael Dillane, Liscullane, Lixnaw, Co.Kerry

Michael Dillane runs a 95 cow autumn-calving herd on 59 hectares of predominantly very heavy land near Lixnaw in north Kerry. The herd calves from September to January. Previously a weanling producer, predominantly for the export market, Michael has changed to finishing bulls under 16 months and heifers at 16-20 months. An extra 40 cattle between bulls and heifers are purchased for finishing to increase output further. Profitability on this farm has increased substantially since joining the BETTER farm programme. In 2012, the farm had a negative gross margin of -€100/ha. By 2014 this gross margin had improved to €834 and is predicted to increase to over €1300/ha in 2015. One of the reasons for the poor performance prior to joining the programme was the high cost of dealing with herd health issues. In 2012, the farms veterinary bill was €16360. By 2014 the veterinary bill was reduced to €7026 and is expected to remain at similar levels for 2015 and beyond. This is a saving of €9334 or €158/ha for the farm.

Health issues

During the calving period in 2011 and 2012, IBR became an issue. In 2011, 10 calves died from the virus and significant veterinary bills were incurred to try and treat other sick calves. This involved a significant labour input and also lost thrive in calves that survived.

Action taken

A vaccination programme was implemented on the farm. A live vaccine was administered to the cows and a booster vaccine was given every 6 months afterwards. Calves are all vaccinated now at 30 days of age for IBR, Pneumonia and Blackleg. 30 days later calves are vaccinated again for Pneumonia and Blackleg. When calves are being weaned at 8-9 months of age they are vaccinated again with a booster for IBR and Pneumonia. The initial IBR vaccinations are administered intranasally and subsequently by intramuscular injection. While vaccinations are expensive, it should be noted that Mike has very little veterinary call-outs with the majority of the veterinary bills consisting of the cost of buying vaccines.

Mike prevents milk fever and grass tetany by treating with magnesium plus trace elements in the water supply. This ensures that cows get a constant supply of the elements required through the drinking water. The magnesium is supplied by a pump located in the farmyard and flow rate can be adjusted up or down or switched off altogether during low risk periods.

Mike treats with a pour-on for fluke, worms and lice. He feels this is a more suitable method than white drenches as it puts less stress on both farmer and the livestock.

Breeding heifers are treated for Leptospirosis, Samonella and BVD and all are vaccinated twice before breeding begins with the final shot administered 30 days before breeding begins.

Cows and heifers are vaccinated with rotavec corona to prevent scour 30 days before calving.

Breeding and calving health policy

Mike is also tightening up his calving spread from October to April at the start of the BETTER Farm Programme to September to late December. The benefits to this are many, including having a more uniform group of stock in terms of age. This has made it easier for Mike in terms of planning days for jobs such as dehorning, vaccinating, tagging, etc. It also allows Mike focus more on one job at a time such as calving, breeding and turning stock out to grass in spring. Mike has changed from 70% AI on a 70 cow herd to 100% AI on a 95 cow herd. This means focusing on managing the diet and health of the cow at breeding time to ensure onset of heat. Cows are fed 72-75% DMD silage *ad libitum* plus 1-1.5 kg per day of a 16% protein concentrate until they are bred. Cows maintain condition score on this diet. Mike watches for signs of heat in the shed by observing cows 7-8 times per day. He finds this process simple to carry out once cows are housed indoors but much harder to round up cows when they are grazing in a field. Therefore, cows are kept indoors until breeding ends in mid-March. Mike generally finds the last 20% of cows are the hardest to observe in heat. Mike observes cows by walking through the shed at night and looks for a white discharge from the cows. If no heat is observed following this, Mike will serve these cows within 3-4 days once a brown discharge is observed from the cows. This way Mike is able to combat silent heats. In 2013, Mike had a conception rate of 71% to first service using this system and recorded a 368 day calving interval.

Any cows not observed with signs of heat will be synchronised after 2-3 months. The coils will be removed after 10 days and 2 ml of either Estrumate or prostaglandin administered. These cows will be inseminated 3 days later at heat onset. Any cows not scanned in-calf in the required timeframe will be culled.

Since joining the programme, Mike has invested significantly in vaccinations and while this cost is high and will continue on the farm into the future, given the low incidence of animal health issues, low veterinary call-outs and very little set back in animal performance Mike feels it's a necessary cost.

Case study: BETTER Farm participant

James Madigan, Derrynahinch, Ballyhale, Co. Kilkenny

The Madigan farm is located near Knocktopher village in Co. Kilkenny and extends to 64 adjusted ha of grassland. The farm is fragmented into four separate blocks that are all within 1.5 km of one another. The main farm hub consists of 46 ha and is divided by a road. The land is relatively free-draining and has great scope for early turn-out to grass and a long grazing season. James works off-farm full time and therefore labour efficiency and time management are very important in the day to day running of this farm.

James operates a split-calving integrated suckler calf-to-beef system finishing steers and heifers not suitable for breeding. The cow herd has increased from 52 cows in 2010 to 80 cows calved in 2015. James calves half his cows in spring and the other half in the autumn. Cow type is very much focused on good maternal traits (fertility and milk yield) to achieve good reproductive performance and good weight-for-age in their progeny. Cows are bred to either one of two Charolais stock bulls. James has also used A.I. Simmental sires such as ISO and KFY in the past to breed replacement heifers.

James purchases his replacement heifers from a local dairy farm for his autumn calving herd. These heifers are bought in at approximately 450 kg and are Simmental x British-Friesian crossbreds. Sourcing these heifers from the dairy herd gives a good foundation of milk in his herd and from which to breed his own replacements.

Male progeny are castrated between 6 and 8 months of age and are slaughtered at an average of 410 kg carcass weight. The aim is to slaughter the autumn-born steers directly off of grass at 24 months of age and to finish the spring-born steers from the shed at 24 months of age. The heifers not suitable for breeding are slaughtered at 340 kg carcass weight. The autumn-born heifers are finished off grass at 22-23 months of age and the spring-born heifers are finished from the shed at the same age.

James has adopted a very strict culling policy in order to maintain a compact calving period and eliminate animals with poor fertility. The big benefit of compact calving and achieving tight calving intervals has been an increase in the average carcass weights produced and overall output of beef sold.

Breeding performance

A key goal in running an efficient suckler system are good breeding management and herd fertility. As can be seen from Figure 2, James has two defined compact calving periods. This is achieved through a combination of strict breeding policy whereby the bull is left with the cows for a short mating period (12 weeks) and animals not in calf are culled. James splits each herd into two groups of 20 cows during the breeding season giving him more ability to achieve his compact calving. A target for breeding herds is to have 60% of the herd calved down in the first three weeks and 80% calved in the first six weeks. A higher proportion of cows calving in the first six weeks will mean that on average calves will be heavier at weaning, there will be a greater selection of more fertile heifers from which to breed and there should be less disease spread between older and younger calves. In addition to a short breeding season, James maintains it is very important to have the cows in the correct energy balance whereby they are at the correct body condition score and on a rising plane of nutrition prior to breeding. A well planned compact and defined breeding season is essential from a labour efficiency point of view and this is critical for James when working off-farm.

Animal fertility, mortality rate, growth rate and stocking rate are all significant factors affecting farm output and profitability. As can be seen from Table 2, James's mortality rate at calving and 28 days post-calving are well below the national average and hence he is producing over 0.90 calves per cow per year. By having a focussed compact calving period, feeding cows the correct diet pre-calving and having them at the correct body condition score result in an efficient reproduction system. Good herd health and supervision are key management tasks in attaining this high performance. James is very focussed on fertility within the herd and his calving interval has been at 378 days over the last two years which is almost a whole month less than the national average. In the 2014/2015 breeding season, 57 % of the herd calved within 365 days and 20 % of the herd calved between 366 and 390 days. By using the Herd Plus ICBF cow report and reviewing calf performance from previous weighing's James has very accurate farm data to help him make a judgement when selecting suitable autumn-calving cows from which to breed replacements. James uses genetic indices as a key support tool when selecting breeding bulls and herd replacements.

Carcass weights

Since joining the BETTER Farm programme James now weighs his animals regularly to measure and monitor their performance at all stages during the production system. The uniform weights of the calves due to the compact calving makes husbandry management and diet formulation relatively easy as animals are at a similar age and weight for dosing, vaccinating, weaning and finishing. Table 3 shows the liveweights and average daily liveweight gains of his 2013 spring-born steers that were slaughtered in spring 2015 at 25 months of age. The average carcass and live weights of the steers was 418 kg and 760 kg liveweight, respectively. All the steers were killed at two dates within a two week period. The compact calving gives James a great head start as there is not excessive variation in weaning weights. This makes housing animals a lot more simplified in that all animals receive the same diet for the first winter and the finishing period. Also, grassland management is more streamlined as there are less groups of stock on the farm.

Figure 2. Calving patternof James Madigan's cows

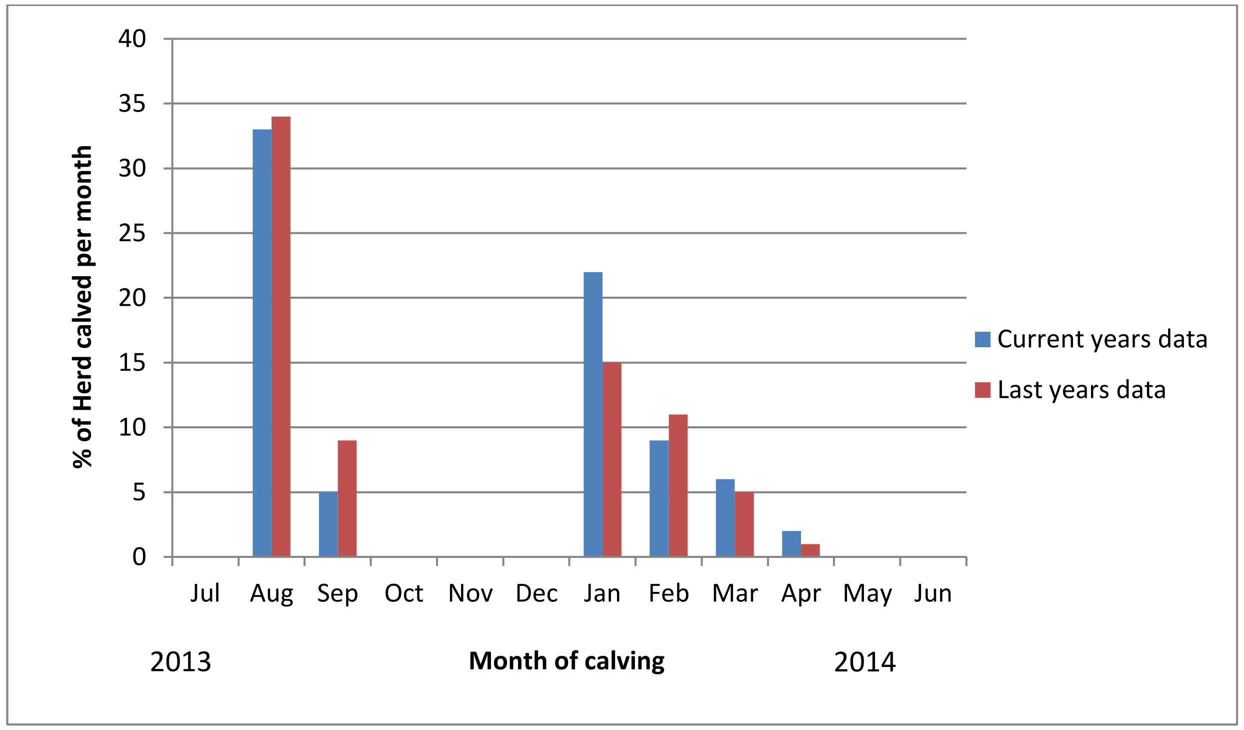


Table 2. Summary of James Madigan's four year calving data

	2011-2012	2012-2013	2013-2014	2014-2015	Current national averages
Total no. of calving's	62	68	74	77	-
No. of cows	40	52	58	62	-
No. of heifers	22	16	16	15	-
Calving interval (days)	368	388	378	378	407
Mortality at birth %	0	1.4	1.3	2.5	4.7
Mortality at 28 days %	0	5.8	3.9	3.8	6
Calves per cow per year	0.97	0.88	0.95	0.97	0.82

Table 3. James Madigan's 2013 spring-born steer live weights and average daily weight gains

Stage of production	Date	Weight (kg)	ADG from last weight (kg)	ADG from birth
Pre-weaning	18/7/13	249	-	1.27
Housing	16/11/13	363	1.00	1.13
Turn-out	1/03/14	413	0.52	0.95
Mid season	28/06/14	535	0.99	0.97
Pre-housing	27/09/14	609	0.82	0.94
Finish	18/02/2015	760	1.06	1.00

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