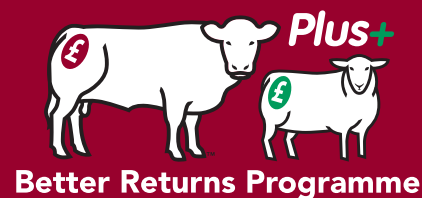


Breeding Female Replacements for the Suckler Herd



Information compiled by Samuel Boon, Signet Breeding Services



Key messages

- + Most factors affecting suckler cow performance can be influenced by their genes
- + Set breeding goals to change the traits that will increase the financial returns to the business
- + Bull selection is the most efficient way to create genetic change within a suckler herd
- + Finding a bull with the right genes is as important as finding one of the right breed
- + Dairy genetics still have a marked impact on the UK's suckler herd, but this is decreasing
- + EBVs provide the best indication of an animal's genetic merit
- + The average stock bull spends six years in the breeding herd, leaving four calf crops behind him. With the right management many could work for longer
- + The best breeding plans are worthless unless the cow produces a live calf
- + Commercial suckler herds should aim for an average calving interval of 365 days, with 90% of the herd calving within ten weeks
- + Optimum cow size for any herd depends on available resources, particularly feed
- + To make fast, reliable and more predictable genetic gain in maternal traits, commercial producers should consider widely-used bulls, with the right balance of EBVs, with high Accuracy Values
- + Most commercial cattle breeding programmes take ten to fifteen years to reach maturity. It is important to think how changes in breeding policy now might influence future profitability

Keywords:

Breeding suckler cow replacements, heifers for suckler herds, bulls for suckler herds, efficient suckler cows, improving maternal traits in suckler herds, EBVs and Breeding Indexes

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Introduction

As the beef industry starts to plan for a new period of economic, political and environmental change, the running of efficient, productive cows that thrive within the farm's unique environment, while making the most of the available resources, has never been more vital.

Most factors that affect suckler cow performance are influenced by their genes, so breeding (or buying-in) the right type of heifer for the herd is the best way to secure a more profitable future.

Selecting a bull that will deliver good maternal traits such as milk and ease of calving, as well as carcase output, is increasingly important. Using tools such as Estimated Breeding Values (EBVs), takes some of the guesswork out of breeding decisions, helping deliver female replacements that will be fit for purpose for many years to come.

Breeding strategies such as crossbreeding can also help produce robust cows that will produce strong and healthy offspring.

There is still much debate in the UK and abroad about aspects such as the optimum size a suckler cow should be. This BRP+ document examines some of these issues in more detail, so that producers can develop the right female replacements for their herds, their farms and their end markets.

What can we change in our suckler cows?

Most factors affecting suckler cow performance can be influenced by their genes.

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Herd management policies do have an impact on performance, but the upper limit is set by the genetic potential of the animals.

Maternal breeding strategies are complex. The ideal genetic makeup of a suckler cow depends on more traits than cattle destined for slaughter.

Profitable suckler cows need to:

- + Reach puberty at the desired age and calve without difficulty
- + Wean a calf annually which fits market requirements
- + Adapt to the resources on the farm – its management and environment
- + Have low annual maintenance costs
- + Have a long, productive life

In the UK, the emphasis has traditionally been placed on optimising carcase output at least cost, whilst considering ease of calving as a trait of the sire.

This may have been appropriate when a large proportion of the genetics within the beef sector came from the dairy herd. However, as the proportion of beef breed genetics used on suckler cows increases, so does the requirement to select for maternal traits.

Traits influencing longevity and fertility, which have a massive impact upon herd profitability, must now be considered. Due to their low heritability however, their improvement without using a sire selection strategy based on Estimated Breeding Values (EBVs) is nearly impossible.

Figure 1 shows those traits expressed by the cow and passed to her calf over which there is some control when using EBV-based sire selection.

Figure 1: Traits passed from cow to calf which can be influenced when EBVs are used to aid sire selection

Maternal traits

Fertility traits – age at first calving, calving interval, scrotal circumference

Ease of birth – maternal calving ease

Milk production

Temperament

Cow mature size/efficiency

Longevity



Carcase traits

Ease of birth – calving ease, birthweight, gestation length

Calf survival

Calf growth rate

Carcase conformation

Meat eating quality - intramuscular fat/marbling

Set breeding goals to increase herd profitability

A herd's physical performance significantly affects profitability, either through reduced input costs or increased output.

Breeding strategies must focus on traits that can enhance herd profitability. The starting point is to examine current performance of the herd.

To identify areas for improvement:

- + Compare the herd's physical performance to national figures, eg length of calving season; calves sold/100 cows mated; growth rate and conformation of calves sold for slaughter
- + Calculate the cost of production
- + Compare herd financial output against AHDB Beef & Lamb Stocktake figures

Set breeding goals to change the traits that will increase the financial returns to the business.

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Use cows that are adapted to the farm

One of the strengths, or perhaps weaknesses of the UK beef herd, is the diversity of breeds which have adapted to perform in a range of different situations.

No single breed is ideal for every environment.

Table 1 shows the importance of matching cows with the right genetics to where they live. In a harsh environment with limited feed availability the priority is to produce a hardy, easy-calving cow that is not too large. When feed is plentiful, more focus can be placed on milk and carcase traits and cow mature size can increase.

But note: regardless of the environment, there is no role for difficult calving breeds.



It is important to match cow-type to the environment in which they live

Table 1: Matching genetic potential for different traits to feed availability. Data adapted from work by Spangler, 2007

Traits	Feed availability		
	High	Medium	Low
Milk	M-H	M-H	L-M
Mature size	M-H	M	L-M
Ability to store energy*	L-M	M-H	H
Resistance to stress#	M	M	M
Calving ease	M-H	M-H	M-H
Lean meat yield	H	M-H	M

* Ability to store fat and regulate energy requirements with changing (seasonal) availability of feed

Physiological tolerance to heat, cold, parasites, disease and other factors.

L = low, M = medium, H = high

Breeding female replacements



Producing home-bred replacements greatly reduces the threat to herd health status

Before deciding whether to breed female replacements, producers need to know if it is more cost effective than buying them in.

Several factors that affect a herd's financial performance will influence this decision (Table 2).

Table 2: Issues to consider when deciding whether to breed or buy-in replacement heifers

	Home-bred	Buy-in
Impact on replacement costs	Depends on relative market prices for breeding stock and slaughter animals	
Control over breeding merit of cow	High with EBV-based sire selection	Very little
Control over replacement costs	Greater control	Limited and may fluctuate
Extra resources needed eg land and labour	Yes	No
Threat to herd health status	Greatly reduced – a closed herd can be run	Significant risk – where females are brought in

Retaining home-bred replacement females should not be a reaction to high heifer/cow prices or low calf prices. It should be a planned approach to ensure productive heifers enter the herd which are of the right breed or cross, with the desired breeding potential and health status.

Producers considering breeding their own replacements must:

- + Assess the financial implications of keeping home-bred females
- + Establish performance-based breeding goals
- + Select stock sires based on EBVs to improve economically important traits
- + Capitalise on hybrid vigour
- + Set up simple recording systems to identify animals to keep or cull

It is essential to:

- + Plan a breeding strategy that will deliver females that are more productive
- + Avoid 'negative selection' by keeping poor performing, less saleable females for breeding

Which breed?

Variation within a breed is usually as great as between breeds. In many cases finding a bull with the right genes is as important as finding one of the right breed.

Finding a bull with the right genes is as important as finding one of the right breed.

However, breed differences do exist and should be taken into account. For example there would be less concern over a bull with poor genes for milk production in a breed like the Simmental, compared to other continental breeds.

Do not assume every bull in an easy-calving breed will produce females that will give birth easily. In every breed there are problem bulls. It is important to see a bull's breeding values for birthweight and calving ease before purchase.

Suckler breeds in the UK

Dairy genetics still have a marked impact on the UK's suckler herd, but this is decreasing.

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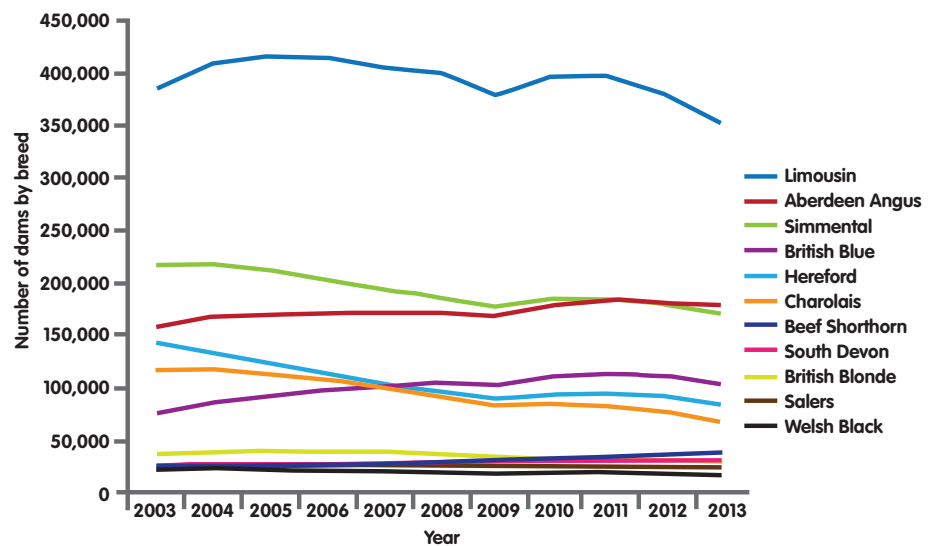
The influence of different breeds can be seen in data supplied by the British Cattle Movement Service (BCMS) showing the breed of the dam of cattle registered over the past decade.

Figure 2 shows the dominance of the Limousin breed and an increase in the relative influence of Aberdeen Angus and British Blue genetics, at the expense of Simmental and Hereford.



Limousin is the dominant beef breed in the UK

Figure 2: Number of non-dairy breed dams producing calves each year (breeds with over 15,000 recorded dams per year)



Many numerically small breeds have much to offer the beef industry and their importance may change in future. However, the challenge for these breeds is often a lack of choice when selecting bulls and poor availability of performance records. Some breeds do not engage in performance recording, so in these breeds bull selection is a gamble. Numerically large breeds tend to offer a greater choice of genetics.

Bull selection – take a long-term view

Bull selection is the most efficient way to create genetic change within a suckler herd.

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Compared to cows, bulls contribute vastly more progeny during their lifetime and through the availability of EBVs, their breeding merit is generally better known.

It is easier to obtain elite genetics through the purchase of bulls or use of artificial insemination (AI), than it is when buying cows. Also, if a mistake is made a bull can quickly be replaced, unlike cows.

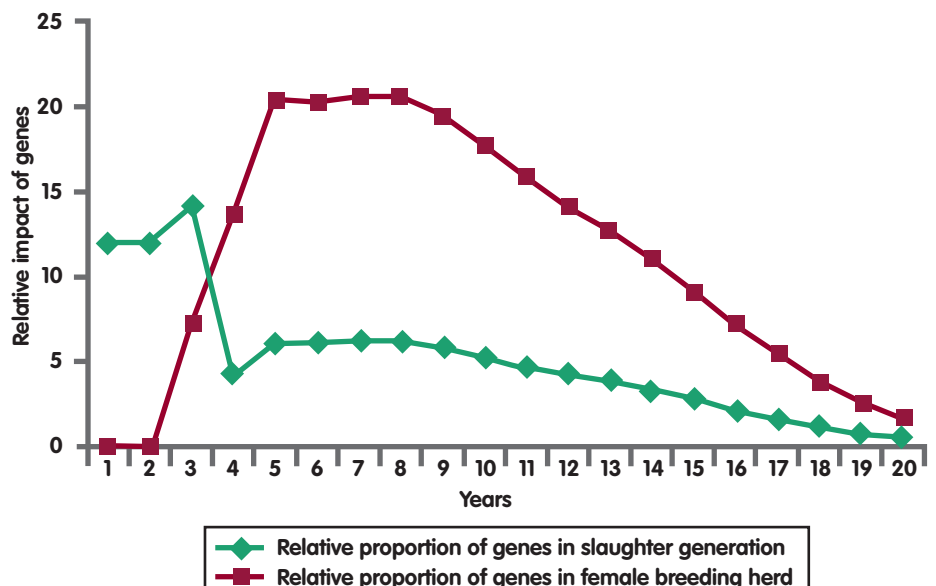
Genetic improvement can create a cumulative and permanent lift in herd performance, but it can take several years for this improvement to be realised.

Figure 3 shows how the genes from a bull used for three years firstly influences the genes in the slaughter generation, then through his daughters, he starts to influence the female breeding herd.

A bull's maternal genetics will not start to be expressed significantly until five years after his arrival, but will continue to have a big impact on the herd long after he has gone.

Breeding improvement takes time. Sires selected today need to create animals that will be in demand by the market in ten year's time.

Figure 3: Impact of maternal sire's breeding potential in a herd



Selecting the best bulls

Whilst the appearance of a bull is influenced by many factors, including how he has been reared and his health; the only way attributes can be passed onto the next generation is through his breeding potential.

The best way to assess this within a breed is to collect a wide range of measurements or performance records, on as many animals as possible, then to have this data analysed to identify the animals with the highest genetic merit.

The best approach to this is the use of Best Linear Unbiased Prediction (BLUP) analyses to produce EBVs. These can predict an animal's genetic potential and how a bull's offspring will perform.

In the UK it is thought that over 1000 pedigree herds are involved in performance recording, so most commercial producers have good access to recorded breeding stock.

Two approaches to the production of EBVs have been developed by ABRI/Breedplan and Signet. Each organisation works with different breeds, but both analyse data in a similar way and information on most traits is available from either. EBVs cannot be compared between breeds.

Table 3: Breeds covered by ABRI/Breedplan and Signet

ABRI/Breedplan	Signet
Aberdeen Angus	British Blonde
Beef Shorthorn	Highland
British Blue	Lincoln Red
Charolais	Red Poll
Hereford	Stabiliser
Red Ruby Devon	Sussex
Saler	Limousin (via breed society which uses Signet-style breeding values)
Simmental	
South Devon	

Bear in mind that:

EBVs provide the best indication of an animal's genetic merit.

- + EBVs provide the best indication of an animal's genetic merit
- + An animal's breeding potential is only half the story and will only be realised under the right stock management

Traits assessed through performance recording

A range of EBVs is available for bull buyers to scrutinise, although not every trait is assessed for every breed.

Table 4: The influence of key EBVs on animal performance

EBV	Attributes	Influence on performance
Birthweight (kg)	Enables bulls to be selected that will produce smaller calves	Ease of calving
Calving Ease – Direct	Identifies bulls whose progeny will be born without assistance	
Calving Ease – Maternal/ Daughters	Identifies bulls whose female progeny will calve without assistance	
Gestation Length (days)	Enables producers to shorten gestation length	
Age at First Calving	Identifies female breeding lines that are reproductively active and capable of conception at an early age	Fertility
Scrotal Circumference (cm)	Increasing scrotal circumference in males enhances reproductive performance in male and female progeny	
Calving Interval (days)	Enhances reproductive success within the herd	
200 Day Milk (kg)	Identifies female breeding lines that will produce more milk and therefore wean heavier calves	Milk production
200 Day Weight (kg)	An indication of breeding potential for growth to 200 days of age	Calf growth rate
400 Day Weight (kg)	An indication of breeding potential for growth to 400 days of age	
Muscle Depth/ Area (mm/cm ²)	Assesses muscle depth/area across loin	Carcase conformation
Fat Depth (mm)	Assesses fat depth across the loin	
Mature Size (kg)	Estimates cow size at maturity	Efficiency
Docility	Indicates genetic influences on temperament in youngstock at around 400 days of age	Ease of management
Longevity	Estimates how long cows will be reproductively active in the herd	Productive lifespan

Interpreting genetic information

Estimated breeding values are expressed in real units of measurement, so a 400 Day Weight EBV of +48 means the bull has the genetic potential to be 48kg heavier at 400 days than a bull with an EBV of 0. On average his calves would be expected to be 24kg heavier, as half the genetics come from the bull and the other half from the dam.

To understand how this bull compares to the rest of the breed, the buyer must compare his figures to the Breed Benchmark. This is a table showing the EBVs achieved by the Top 50%, 25% and 10% of animals of the breed.

Breeding Index

A Breeding Index is calculated to rank animals for a specific breeding goal, taking into account all the individual EBVs that influence it. Typical Breeding Indexes are shown in Table 5.

Table 5: Typical Breeding Indexes produced by Signet (top) and ABRI (bottom)

Calving Value (Signet)	Female progeny have less cases of difficult calvings
Beef Value (Signet)	Slaughter animals have increased carcase value
Maternal Value (Signet)	Female replacements have superior genetics
Maternal Production Value (Signet)	Profitable bulls for producing female replacements and cattle for slaughter
Terminal Sire Index (ABRI)	Profitable terminal sires conferring superior calving and carcase traits to their progeny
Self-Replacing Index (ABRI)	Profitable bulls for producing female replacements and cattle for slaughter

Accuracy Values

Every EBV and Breeding Index is accompanied by an Accuracy Value. These show how similar an animal's EBVs are to its true breeding value, indicating how much is known about the animal's genetic merit when the predictions were made. Breeders can use Accuracy Values to assess the likelihood of an animal's EBVs changing over time.

Finding breeding information

The first place to look for information is on the Internet. Nearly all performance-recorded cattle have EBVs that can be quickly accessed online either through the breed society website or via Signet's website www.signetfbc.co.uk. Smartphones will also show this data, so EBVs can even be assessed in the middle of a field.

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Information on EBVs is usually printed in sale catalogues and most breeders with high genetic merit stock will print EBV charts and display them at sales.

Lists of leading sires and promising young bulls can often be obtained via breed societies and these provide another useful starting point when sourcing bulls.

When buying semen, most breeding companies will have an online presence where the bulls' EBVs can be viewed quickly and easily.

Interpreting a breeding chart

Breeding Values are often shown graphically, with the centre of the graph representing the average performance of the population of bulls of each particular breed. Bars to the right tend to indicate superiority for any given trait – although bigger is not always best when selecting a maternal bull (see page 15).

Ensure stock bulls have a long working life

Selecting the right bull to breed female replacements can be highly cost effective, but the value of his genetics can only be exploited if he has a long and productive working life.

The average stock bull spends six years in the breeding herd, leaving four calf crops behind him. With better management many could work for longer. Many bulls have considerably shorter working lives.

The average stock bull spends six years in the breeding herd, leaving four calf crops behind him. With better management many could work for longer.



A bull fit and ready to work

When selecting a bull ensure he is:

+ Assessed to optimise fertility

There are a number of steps a bull buyer can take to minimise the chance of purchasing a bull with poor fertility. These include checking:

- Testicle size and tone
- Structure of sheath and penis
- Semen quality
- Bull behaviour – such as libido and serving capacity
- Structural soundness

There is no single strategy that will guarantee the fertility of a stock bull, but this checklist can help avoid problem animals. If producers are concerned about a bull's fertility they should consult the vet.

+ Structurally sound

For a bull to actively seek out cows for mating and mount them, he needs to be physically fit and have free movement. Bulls with sub-optimal locomotion tend to be sub-fertile and require culling at a younger age. So check:

- Leg conformation – particularly the hind limbs
- Foot structure – including the angle of the feet
- Locomotion – avoid bulls that under or overstep or show discomfort

Faults in young bulls tend to get worse with age, leading to arthritis and premature culling.

+ Fit for purpose

Overfed young bulls tend to be less fertile in early life and work for shorter periods than those that have been raised fit for purpose. Talk to the breeder about the way the bull has been reared and managed and seek out bulls that will suit the system at home. Discuss with the vendor how he should be looked after to avoid checks in growth and performance.

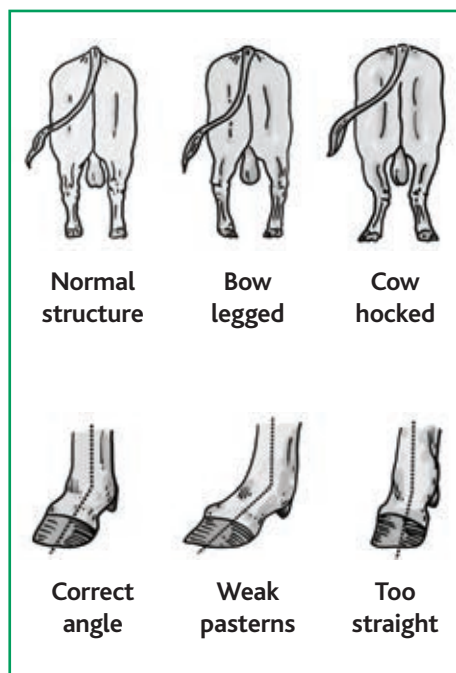
+ Good temperament

Beef cattle require more frequent handling these days, at a time when labour levels on farms are reducing. The importance of working with bulls with sensible and reliable temperaments cannot be underestimated.

+ High health status

Bull breeders should be in a health scheme and able to explain what diseases they are testing for and which ones are covered by vaccination

For more information read the AHDB Beef & Lamb publication **Fit for purpose bulls**.



Hind limb structure

Important breeding traits

Ease of calving

The best breeding plans in the world are worthless unless the cow produces a live calf.

The best breeding plans in the world are worthless unless the cow produces a live calf.

A critical factor influencing calf survival is the ease with which they are born. Difficult calvings reduce herd profitability due to veterinary costs, the potential loss of the cow or calf and reduced cow fertility at future matings. They also tend to result in longer calving intervals which dramatically affect herd profitability.

Aim to produce heifer calves that will be easily born and calve freely when retained as female replacements.

Do not confuse 'Calving Ease – Direct', which is the ease with which a calf is born, with 'Maternal Calving Ease', which is how easily cows give birth. There is a mild antagonism between the two and both should be taken into account when buying a sire to breed female replacements.

The challenge for bull buyers is that breeders tend to pay less attention to calving traits than they do to carcase traits. In many breeds the genetic potential for calving ease has worsened over the past 20 years. Commercial bull buyers now need to look more carefully at EBVs for calving traits, particularly when selecting bulls to mate to heifers or smaller framed, native breeds.

Growth rate

Selecting bulls with high 200 and 400 Day Weight EBVs will result in heavier calves at weaning and slaughter. This increases the weight of cattle sold, improves production efficiency and influences the timing of cattle sales.

Cattle with high growth rates make more efficient use of feed, so feed costs per kilogram of liveweight gain are reduced, as is the time taken to reach slaughter.

However, selecting for high growth rate alone can increase birthweights, leading to calving problems and increased cow mature size, which on some systems might reduce herd efficiency. For this reason do not select on growth rate EBVs alone.

Carcase quality

Carcases that meet market specifications optimise profit potential. Selecting bulls with the right EBVs for Muscle Depth/Area and Fat Depth will enhance carcase conformation.

There is an acknowledged link between extreme muscling (particularly in the hindquarter) and calving problems and this must be taken into account when retaining female replacements.

Extreme muscling is often linked to the presence or absence of certain major genes such as those influencing Myostatin expression, which is known to cause calving problems, although the impact can be breed specific. However, this is not always the case, the F94L gene present in some Limousin and South Devon cattle, is not thought to have an important influence on calving.

Estimated Breeding Values for Muscle Depth/Area assess muscling across the loin, one of the more financially rewarding parts of the carcase. Selecting for this trait has an indirect influence on muscling in the hind-quarter. If done in combination with calving trait EBVs, well-muscled, easy-calving breeding lines can be identified.

Australian work¹ with Aberdeen Angus cattle showed that the visual selection of cattle for increased muscularity in this non-continental maternal breed, did increase muscling in the carcase, without compromising calving ease or influencing calf growth rates to weaning.

The Fat Depth EBV influences how quickly cattle can be finished for slaughter and the weight to which carcasses can be taken without attracting a fatness penalty. Using sires with negative Fat Depth EBVs will reduce the likelihood of overfat carcasses – a risk most commonly associated when finishing heifers.



Extreme muscling in bulls can be linked to calving problems in the cows they mate with and their daughters

¹ Factsheet: Muscularity and a Productive Breeding Herd, The Cooperative Research Centre for Beef Genetic Technologies

When selecting bulls with high EBVs for muscling and growth rate that are to be mated to cows of similar genetic merit, a slightly positive fat depth EBV may be required. This will ensure adequate finish is laid down in progeny sent for slaughter, particularly under extensive, low input systems or where there is a payment ceiling on carcase weight.

Genetically lean maternal lines have also been shown to have poor fertility under harsh, nutritionally restrictive environments.

Early fertility



Calving heifers early increases the number of calves they can have over their lifetime

It is common UK practice to calve heifers at two, two-and-a-half or three years of age.

Calving at a younger age under appropriate management, increases the number of calves raised during a cow's lifetime and she will be more profitable.

To achieve this heifers must be reproductively active early enough to calve at two years. The key factors influencing age at puberty are body condition score and liveweight.

Producers calving heifers early should pay careful attention to pre-mating and pre-calving nutrition and select easy-calving bulls. To ensure high conception rates, heifers should have reached two thirds of adult weight before mating. Breed can influence age of puberty, with native breeds tending to reach puberty earlier than continental ones. Within every breed there is genetic variation that can be exploited.

Producers can select bulls using the Age at First Calving EBV. There is also a relationship between a bull's scrotal circumference and the age at which his female progeny will reach puberty. Using bulls with superior scrotal circumference EBVs will enhance female fertility traits.

Fertility and longevity traits

Commercial suckler herds should aim for an average calving interval of 365 days, with 90% of the herd calving within ten weeks.

Commercial suckler herds should aim for an average calving interval of 365 days, with 90% of the herd calving within ten weeks.

Long calving intervals result in:

- + Less calves produced in a cow's lifetime
- + Extended calving periods requiring the retention of staff
- + Difficulties in batching cows and calves into similar management groups

To tighten calving intervals, producers should use bulls with short Calving Interval EBVs.

Estimated Breeding Values for longevity identify breeding lines that will have a longer working lifetime. Although the genetic variation observed in this trait tends to be small, the economic impact of even a small change in longevity can be significant.

The challenge in using these EBVs is they tend to have low heritability, compared to a trait like growth rate. Within breed variation tends to be low as are the Accuracy Values associated with these traits, making genetic progress slow.

An alternative approach to enhancing low heritability traits is by crossbreeding and exploiting hybrid vigour (see page 22).

Milk production

Optimising a cow's milk production gives newborn calves a good start in life and has a major influence on how well they grow. Producers can enhance the milking ability of cows retained within the herd by selecting beef sires with superior 200 Day Milk EBVs, or selecting heifers whose breed makeup contains dairy genetics.

In terms of biological efficiency, the production of milk comes at a cost which must be balanced against any gains achieved in calf growth rate.

An efficient suckler cow manages to conceive quickly while producing a lot of milk to feed her calf, and repeats this cycle several times throughout her lifetime.

An efficient suckler cow manages to conceive quickly while producing a lot of milk to feed her calf, and repeats this cycle several times throughout her lifetime.

However, a cow that channels a significant amount of energy from what she eats to produce milk, will probably lose body condition. This is likely to override her ability to get back in calf and her efficiency will drop. The degree to which this 'sacrifice' of body condition arises depends on feed availability.

The importance of milk

The importance of milk production can be seen in a study carried out in Ireland in 2013 which compared four strains of cow, producing their second calf which were reared under identical conditions.

Weaning weight was closely aligned with their genetic potential for milk production and this gain was maintained throughout the life of the progeny. The dairy cross breeding line lost more body condition and gained less liveweight than the beef-bred strains.

Increased performance was not due to extra feed intake, as the dairy cross breeding line actually ate slightly less feed than the three beef-bred strains. Clearly the dairy-bred cows were using feed resources in a different way to those selected for beef production.



Optimising a cow's milk production gives calves a good start in life

Table 6: Performance results of a dairy-bred breed compared to three beef breeds

	Limousin X Holstein/ Friesian	Limousin X Simmental	Charolais X Simmental	Limousin X Charolais
Average body condition score at mating	3.3	3.3	3.2	3.2
Average body condition score at weaning	2.8	3.2	3.2	3.2
Change in weight from mating to weaning	-1kg	+67kg	+56kg	+45kg
Milk yield at 120 th day of lactation (kg/day)	8.8	6.6	6.6	5.7
Weaning weight (kg)	317 (highest)	283	284	265 (lowest)
Slaughter weight (kg)	649 (highest)	627	636	606 (lowest)

(Minchin and McGee, Teagasc 2013)

The benefit of superior calf growth rates from dairy cross cows would be negated if it came at a cost to fertility, but in this work this was not the case. This may be due to the ability of dairy breeds to remain reproductively active at lower body condition scores than beef breeds.

The emphasis placed on milk production will vary depending on the genetic merit of the cows in the herd, eg producers would not select for this trait when breeding replacements out of dairy bred cows.

The importance a producer places on milk production depends on the value placed on calf weight gain to weaning. If calves are sold at weaning, this growth has a higher value to the business than a herd finishing calves for slaughter, where weight gain may be achieved more cheaply at a different stage in the animal's life. Milk also has greater importance in systems feeding little or no creep feed.



Smaller cows with lower feed requirements can be more fertile under harsh conditions

Cow mature size

Selecting cattle to improve calf growth rates will usually lead to an increase in mature cow size. Where feed is plentiful and feed costs are low, this may be desirable.

However, where feed supply is limiting, a smaller cow with lower feed requirements can be an advantage. Smaller-framed animals are more likely to retain a higher body condition score under harsh conditions and may be easier to get in calf.

Table 7: The potential advantages and disadvantages of breeding smaller cows

Potential advantages	Potential disadvantages
✓ Lower feed costs	✗ Lower cull cow value
✓ Higher stocking rates	✗ Lighter-weight calves
✓ More fertile under harsh conditions	✗ Potential for more calving problems
✓ Easier to outwinter/cheaper to house	
✓ Potential to reach puberty earlier	

Producers can use the Cow Mature Size EBV to modify increases in the animal's size. This generally means selecting breeding stock with superior EBVs for 200 Day Weight, but lower Mature Size EBVs.

Optimum cow size for any given herd depends on available resources, particularly feed.

Optimum cow size for any given herd depends on available resources, particularly feed.

Net feed efficiency

Beef production is a relatively inefficient process, with only 6% of feed inputs resulting in protein deposition in the end product. Seventy to seventy-five per cent of feed energy is used to maintain the breeding cow, compared to 5-10% for gestation, 10-15% for lactation and 10-15% for the growth of the cows and calves (Peter Parnell, The Maternal Journal, September 2008).

Studies have shown considerable variation exists in the feed requirements of cattle expressing similar levels of production.

Net Feed Intake (NFI) measures how much more or less an animal eats compared to expected feed requirements for its size and growth rate. It is a measure of feed efficiency that is genetically variable, heritable and does not tend to be unfavourably correlated to other traits of importance, such as carcase attributes or maternal performance.

The benefits of having cattle with low NFI are:

- + Lower feed inputs per animal
- + Higher stocking density possible as feed requirement per animal falls
- + Reduction in greenhouse gas emissions per kg of bodyweight

Estimated Breeding Values are not currently available for this trait in the UK, but work is being undertaken to measure feed intake in cattle to assist their development in the future.



Stabiliser breeders measuring feed intake

Breeding for efficiency

Biological and economic efficiency are related, but are not always the same thing.

Biological and economic efficiency are related, but are not always the same thing.

For example medium size cows may be biologically more efficient than larger-framed cows. However, the latter may be more efficient economically if the additional supplementary feed required to maintain their body condition and fertility, is more than rewarded by the extra value of the weight of their larger-framed calves, plus their eventual cull value.

Measures of efficiency vary within the production chain. Suckler producers try to optimise the weight of calf sold per cow without encouraging calving or fertility problems. Beef finishers are simply looking at the conversion of feed into meat.

Smaller-framed cows may be biologically efficient, but their calves may be heavily discounted when sold as stores and will therefore lose out on economic efficiency.

Biological efficiency

Biologically efficient cows:

- + Calve at a young age
- + Are highly fertile and calve regularly
- + Calve without assistance
- + Live a long time
- + Have low maintenance requirements
- + Rear a heavy weight of calf

The ability to reproduce has the biggest influence on biological efficiency. Cows use the energy in the feed they eat in the following order – maintenance, growth, lactation and then reproduction. When feed resources are scarce reproduction is the first trait to suffer.

Table 8: A comparison of high and low maintenance cattle

High maintenance cattle	Low maintenance cattle
High milk production	Low milk production
High visceral organ weight	Low visceral organ weight
High body lean mass	Low body lean mass
Low body fat mass	High body fat mass
High output	Low output
High input	Low input

Ritchie 2001

Low maintenance cattle tend to be the least productive cattle. They have low energy requirements because they do not produce particularly high outputs. Low maintenance alone does not lead to greater biological efficiency.

Low maintenance cattle tend to be the least productive cattle. Low maintenance alone does not lead to greater biological efficiency.



At high feed intakes continental cattle exploit the surplus energy to grow more quickly

Matching animal efficiency to the production system

Animal efficiency is heavily dependent on the interaction between an animal's genes and the environment. Some breeds are more efficient in one environment than another.

Cow efficiency should be considered within the context of the whole beef production system, taking into account farm resources, business objectives and the end market.

The interaction between nutrition and genetics in determining biological efficiency is most clearly seen in data from the Meat Animal Research Centre (MARC) in America. Nine breeds of cattle were assessed (three British and six continental) under two very different levels of feed energy intake.

At lower feed intakes, breeds like the Red Poll and Aberdeen Angus excelled, because they were able to maintain body condition and had high conception rates.

At higher feed intakes the continental breeds exploited the surplus energy in terms of milk production and growth, whilst the smaller framed breeds could not convert this energy into milk. These cows simply became fatter, which is an inefficient use of energy.

The challenge of increasing calf growth rates

Improvements in calf growth rate EBVs tend to be associated with increases in cow mature weight and these animals tend to have higher maintenance requirements. In establishing optimum performance, producers need to assess the feed and other costs of increasing the mature size of their cows, relative to the financial benefits of increasing calf growth rates.

Cow weight to calf weight ratios

On an individual animal basis, cow weight to calf weight ratios are not good measures of efficiency.

When comparing two cows and their calves on the same farm, this ratio can be highly misleading because:

- + They assume similar levels of feed intake. However this will vary with body condition score, age, stage of production, forage quality and environmental stress
- + They ignore the importance of reproduction. A 15kg calf weight advantage is of little consequence if the cow fails to calve again promptly the following year
- + The cow with the heavier calf probably produced more milk and may have a higher energy requirement when dry
- + Under nutritionally challenging conditions the cow with higher milk production is more likely to fail to re-breed
- + Cow age has a major impact on cow weight. Young cows often look more efficient as they are smaller than old ones

At a herd level the ratio between the weight of calves weaned per 100 cows relative to the weight of cows exposed to the bull, is a better indicator of efficiency, as it takes into account reproductive performance.



A 15kg calf weight advantage is little use if the cow fails to conceive again promptly

Case Study: Stabiliser Data



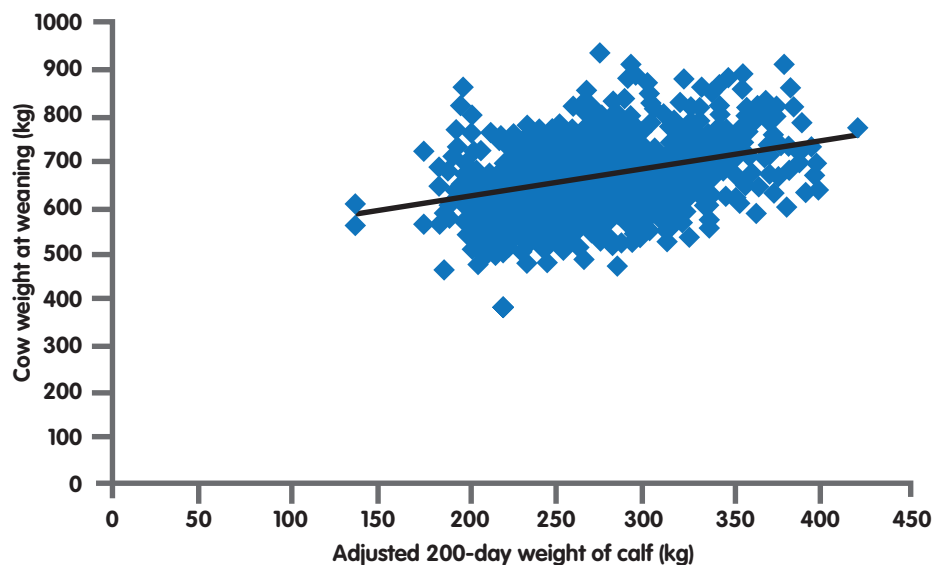
Trials show tremendous variation between cow weights at weaning and calf weights at 200 days in three Stabiliser herds

Case Study: Stabiliser cow and calf weights

This data shows the weight at weaning of Stabiliser cows on one farm, Givendale in Yorkshire, plotted against the 200-day weight of their calves.

While there is a relationship between cow and calf weights, there is also tremendous variation between animals; with clear examples of cows 100kg lighter than their contemporaries producing a similar weight of calf. This work was repeated twice more using other large Stabiliser herds. In each case large amounts of variation in the relationship between cow weight and 200-day adjusted calf weight were noted.

Figure 4: Stabiliser cow weight vs 200-day adjusted calf weight



Improving efficiency through selective breeding

Getting rid of inefficient cows is an ineffective breeding policy.

Getting rid of inefficient cows is an ineffective breeding policy.

The performance of an individual cow has a small impact on the herd and 'efficiency', which is relatively hard to measure, is influenced by many low heritability traits. It also takes at least two years to replace cows with potentially more efficient heifers. So it is difficult to generate change at herd level by culling individual cows. Change can be generated much quicker through bull selection.

Selecting more efficient bulls

Selecting within a breed those sires predicted to have fast growing progeny, using 200 Day Weight and 200 Day Milk EBVs, but whose daughters have lower overall maintenance requirements (using Cow Mature Size EBVs), will deliver greater biological efficiency.

The use of EBVs influencing ease of calving, reproduction and longevity will also help.

Exploiting breed differences

Crossbreeding programmes enable producers to take advantage of breed differences and complementarity, as well as exploiting hybrid vigour.

By using a two-breed crossing programme, producers can select cow breeds with a high reproductive rate, longevity and optimal levels of milk production while producing slaughter calves from easy-calving bulls, with superior genes for growth and carcase traits. This exploits the best attributes of each breed in the right way and is a much better strategy than the less biologically efficient use of slower growing, smaller-framed sires on very large-framed cows.



Two-breed crossing exploits the best attributes of each breed

When trying to optimise animal attributes – bigger is not always better.

Selecting heifers for breeding

By the time a heifer calf is born, its genetic merit is fixed. All that can be done to enhance its performance is to manage it in a way that enables these genes, however good or bad, to be expressed in the best way.

However, breeders can still generate some genetic change within their herds, when deciding which heifers to retain for breeding and which to cull.

Productive heifers should be:

- + Produced by parents with a track record of high performance
- + Well grown for their age so they breed easily
- + Structurally sound, with good feet, jaw and teat placement
- + Quiet in temperament
- + Not twinned to a bull calf as this will probably make them infertile (a freemartin)

Horned or polled

The presence or absence of horns is influenced by genetic variation associated with a single gene. Polling is a dominant trait. Cows carrying one copy of the 'polling gene' will be polled, but may produce horned offspring if mated to a horned bull (50% horned offspring), or a polled bull only carrying one copy of the gene (25% horned offspring).

To guarantee calves do not have horns, one parent, usually the sire for ease of management, must carry two copies of the gene influencing polling. Many breeds have polled strains and breeding hornless calves should be an economic and welfare consideration in any breeding plan.

The genes influencing scurs – partial or deformed horns in livestock, are different to those influencing polling/true horns – but behave in a similar manner.

The size of the pelvic area

Calving difficulty is an economic and welfare problem, which can increase in frequency when heifers are calved at two years of age. One reason is the potential mismatch between the size of the calf and the size of the mother's birth canal (pelvic area).

Calf birthweight is reasonably heritable and the selection of easy-calving sires provides the most efficient way to reduce the occurrence of difficult calvings.

It is possible to measure internal pelvic height and width and hence predict area, using a pelvimeter. Measures taken on heifers can be used to predict their ability to calve a certain weight of calf without assistance.

Bigger is not necessarily better, as heifers with larger pelvic areas are often no easier calving than average animals, as larger framed animals tend to have bigger calves. However, some studies have shown it to be a useful culling tool for removing heifers with very small pelvic areas. Note this approach will lead to the loss of a number of false positives, ie heifers with small pelvic area that would have gone on to calve easily.



A pelvimeter can predict a heifers ability to calve a certain weight of calf without assistance

Image courtesy of www.bovine-elite.com

Ways to enhance low heritability traits

Many of the important traits influencing beef production have low heritability and the EBVs produced tend to have low Accuracy Values. This makes it difficult to select superior young bulls with confidence.

Work at the Scottish Agricultural College (SAC) funded by Quality Meat Scotland (QMS), has shown that maternal trait EBVs with high Accuracy Values predict financially important differences in daughter performance well.

However, sires in the study with high Accuracy Values tended to be between 15-20 years of age, so had left the farm or were only available via AI.

This work highlighted the difficulty in identifying young bulls with high Accuracy Values for maternal traits which are gender limited in expression and tend to show up late in the animal's life.

Despite these difficulties, the SAC research showed that pedigree breeders and commercial producers can enhance maternal traits using high EBV young bulls. However, they should be aware that individual herd results could be variable.

To make fast, reliable and more predictable genetic gain in maternal traits, commercial producers should consider widely-used AI bulls, with the right balance of EBVs with high Accuracy Values obtained by measuring many daughters.

To make fast, reliable and more predictable genetic gain in maternal traits, commercial producers should consider widely-used AI bulls, with the right balance of EBVs with high Accuracy Values obtained by measuring many daughters.

The availability of sexed semen to ensure a higher proportion of heifer calves are born from planned mating will also help if it is available from the right bulls.

Genomic selection

Conventional genetic selection programmes have focused on measuring specific attributes relating to an animal's performance, such as growth rate and using statistical packages to predict the animal's breeding merit. These predictions take into account knowledge of its performance as well as the performance of its relatives.

Genomic approaches go a step further – rather than trying to predict which genes an animal has for a given trait using measurements of performance – genomic breeding values use information about the actual genetic variation observed in the animal's DNA. This approach can lead to more informed estimates of genetic merit. Maternal traits are the perfect candidate for genomic selection. They tend to have a high economic value, but are more difficult to record and take a long time to evaluate accurately.

The science of creating genomic breeding values is progressing quickly. When using genomics to enhance maternal performance be aware that they:

- + Will not replace the need for bull breeders to collect accurate measurements
- + Are most accurate when validated against a dataset of animals closely related to the animal being genotyped, ie of the same breed and evaluated in the same country under the same conditions
- + Will only be possible if new measurements are taken on a numerically robust set of animals
- + Need to be used in conjunction with existing EBV-based information

Selection focused predominantly on single genes, eg polling/colour/muscling, will lead to slower overall genetic progress, as other important traits may be ignored.

Hybrid vigour

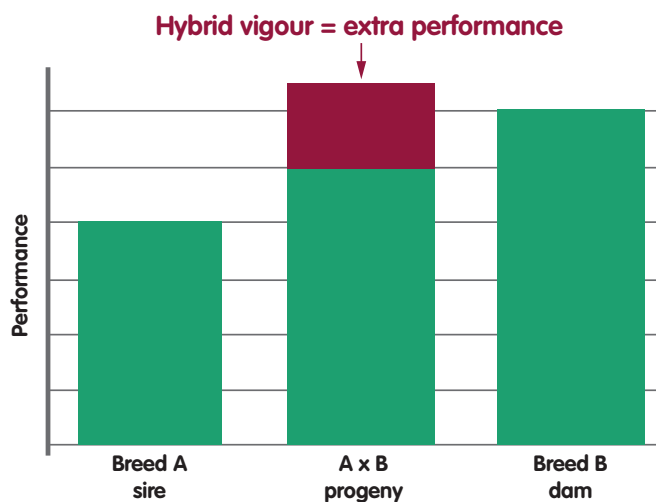


Many low heritability traits can be improved greatly by crossbreeding

Many low heritability traits that are difficult to enhance by within-breed selection, can be improved greatly by crossbreeding. This allows farmers to exploit what is known as hybrid vigour.

Hybrid vigour arises where the performance of a crossbred animal is over and above the average performance of its two parents.

Figure 5: The effect on animal performance of crossbreeding



Most traits are influenced by hybrid vigour, but some of the ones most significantly improved include:

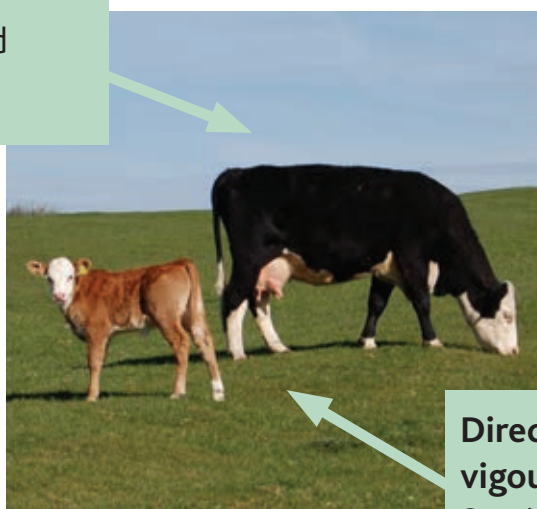
- + Cow fertility
- + Calf survival
- + Disease resistance
- + Longevity

These traits have a major impact on herd productivity.

When designing a crossbreeding strategy, producers need to consider whether they are seeking to optimise hybrid vigour in the breeding cow, its offspring or both.

Maternal hybrid vigour

Fertility and longevity



Direct hybrid vigour

Survival, growth and carcass characteristics

Breeding strategies

Producers considering breeding their own heifer replacements need to consider whether these are to be purebred or crossbred.

Advantages of a purebred herd:

- + Simple
- + Financial returns from purebred sales
- + Greater uniformity amongst breeding stock

Advantages of a crossbred herd:

- + Exploitation of hybrid vigour to gain better performance
- + Wide access to different genetics
- + Faster rates of genetic change

There are many ways to build hybrid vigour into a breeding programme, either using crossbred heifers from the dairy industry, developing two or three-way rotational crosses (where a different breed is used over successive generations), or the exploitation of multi-breed composite strains.

Economic, genetic and logistical reasons will dictate which is the most suitable strategy for any particular farm. Simple strategies are more suitable for small herds.

Planning a breeding programme

Most commercial cattle breeding programmes take ten to fifteen years to reach maturity. It is important to think how changes in breeding policy now might influence future profitability.

Most commercial cattle breeding programmes take ten to fifteen years to reach maturity. It is important to think how changes in breeding policy now might influence future profitability.

It is also crucial to consider the requirements of the end market, now and in the future, whether this is for slaughter animals or breeding stock.

Figure 6: Steps for developing a breeding plan for a suckler herd

Step 1 Define system parameters	Step 2 Establish breeding goals	Step 3 Make breeding decisions	Step 4 Action
Market Farm <ul style="list-style-type: none"> • Land • Labour • Forage • Housing • Herd dynamics 	Cow Calf	Bull selection (EBVs) Hybrid vigour Breed differences	Implement plan Monitor change

Examine the constraints in which the enterprise has to operate:

- + How many different bulls/mating groups can be run on the farm?
- + Can replacement heifers be overwintered?
- + What are the farm factors that will influence herd management and feed availability over the next ten years?



Research which EBVs can be helpful when selecting a bull

Set breeding objectives for the cow and calf and determine how they will be achieved:

- + Which traits are required in the male or female breeding lines?
- + Which EBVs can be used to aid bull selection?
- + Are any traits antagonistic to each other?
- + Can variation between breeds be exploited?
- + Which breeds should be used and what are their strengths and weaknesses?
- + Does the programme exploit hybrid vigour – particularly within the female breeding line?



Which traits are required in the female breeding line?

By the end of the plan a producer will know:

- + What type of bulls are required
- + Which breed of bull is to be mated to each group of cows
- + How many animals of each breed or cross will be on hand within a given year
- + If records need to be kept on cow performance to identify the best performing cows in the herd. These animals can then be preferentially mated to produce the next generation of heifers

As a final step consider how to measure and monitor improvements in herd performance to ensure the breeding plan is working or whether it needs modification.

For more information:

For more information contact: Better Returns Programme

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