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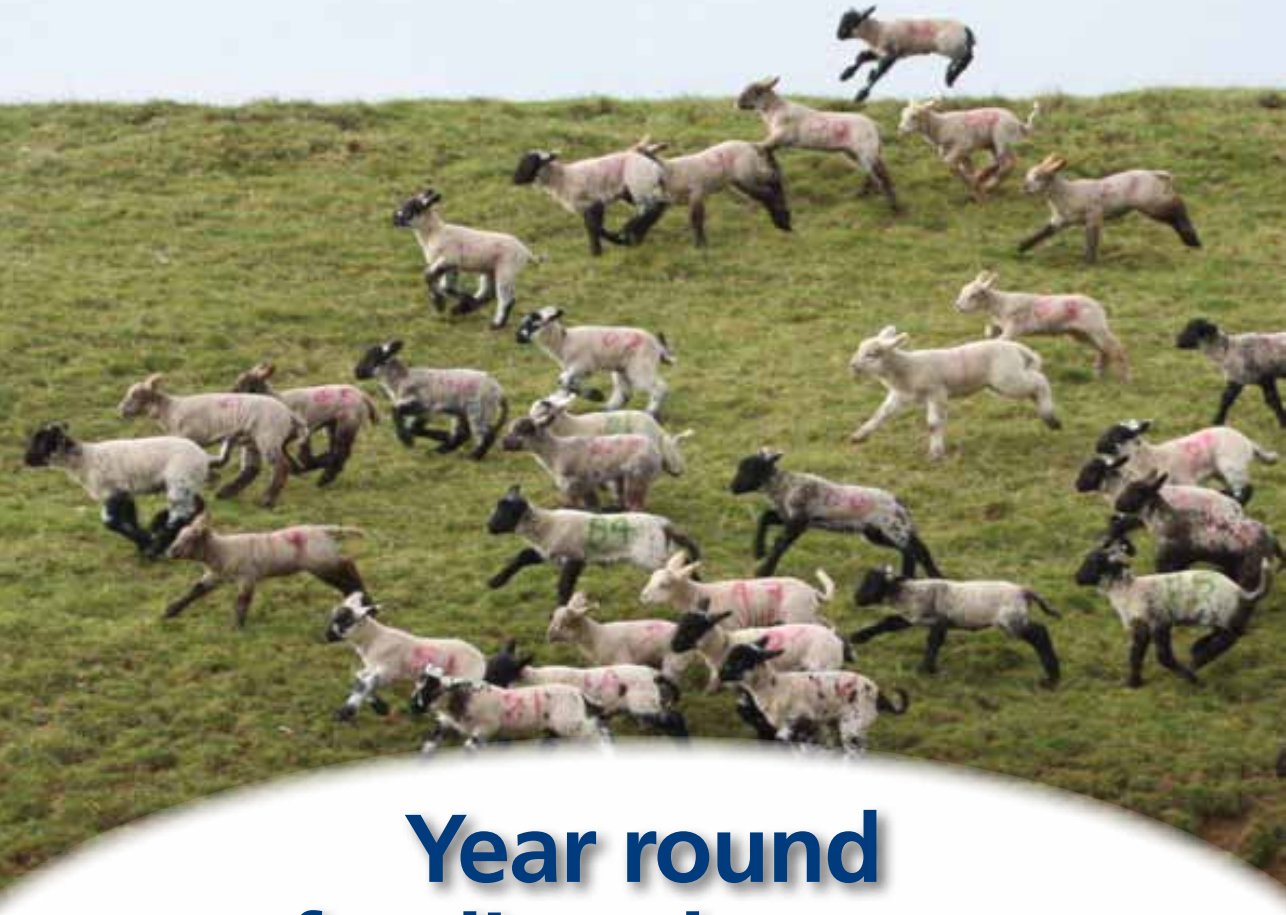

Year round feeding the ewe for lifetime production

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Introduction

Improved prices and better prospects for British lamb have lifted the industry and added value to any technical efficiency. The key to more and better lambs per ewe is proper feeding. We now know that proper nutrition, from as early in life as an embryo or even and egg, can affect a sheep's lifetime performance.

This new, accessible guide pulls together the latest information. It identifies when supplemental strategies and products are most likely to give a return. It is essential information for farmers breeding their own replacements or selling them on.

The idea for this booklet followed an SAC knowledge transfer workshop for the feed industry held in Edinburgh in 2009. It acted as a catalyst and encouraged our sponsors to help us draw this latest knowledge into a blueprint for the industry.

Breeders use EBV's to sell lifetime genetic productivity but to get that lifetime performance sheep must be properly fed. Getting it right benefits those breeding replacements and their clients. While feed can bring out an animal to look it's best for the sale, feeding for performance has beneficial effects for a lifetime.

John Vipond SAC

Making the most of this booklet

This guide is designed for busy farmers.
Each subject area can be read on its own two pages.
The detailed research is on the left and the practical advice is on the right.

Contents

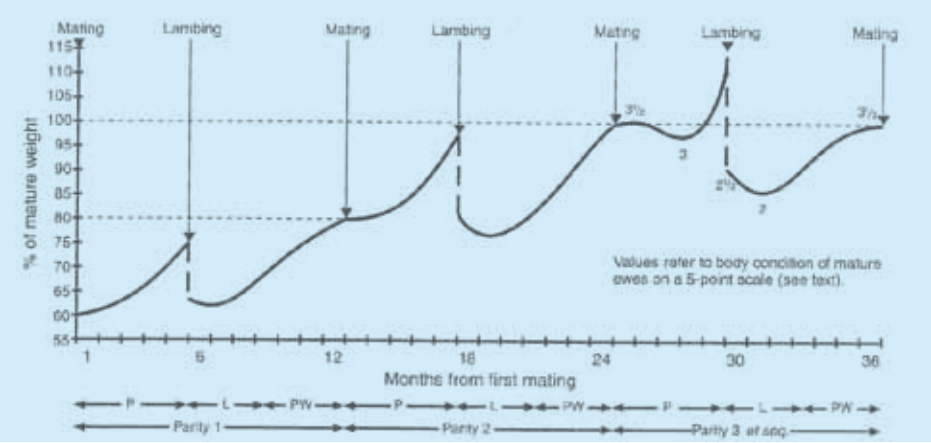
Replacements - practice and diets

Lambing percentage and stocking rate account for most of the variation in gross margin between farms and hence potential profitability. Increasing production from one to two lambs per year reduces the energy requirement per kilo of carcass produced by around 40%. Clearly this contributes to a reduction in costs. A useful target is one kilo of lamb sold or retained per kilo of ewe mated- for example a Mule ewe weighing 75 kg producing on average 1.7 lambs weighing 45 kg each. With the UK average lambing percentage of 110% we are well off target.

- Ewes must be prolific.
- Lambs must be kept alive to sale or retention.
- Ewe liveweight must not be excessive.
- Nutrition is the driver.

Targets for bringing out replacements

Ewe replacements have to be brought out well if they are to be good breeding sheep. Liveweight targets based on reaching 60% of mature body weight (MBW) at mating as a ewe lamb (7 months) or 80% as a two tooth (18 months) have proved useful. The graph below shows condition scores and ewe weights and targets as a percentage of mature weight and the table shows actual weight targets.



Nutrition switches genes on

Sheep show adaptation to famine or periods of plenty by switching genes for growth on or off. Thus what you see when looking at an animal is not just a result of its genetics or nutrition but the interaction between them, with some effects crossing the generations.

Breed	MBW (kg)	Weight At First Mating	
		As Ewe Lamb	At 18 Months
BF/Hill Cheviot	55	33	44
Lleyn	60	36	48
Mule	75	45	60
Continental X	80	48	64

Replacements - practice and diets

Lambs need to grow without check to weaning; a 10% reduction will permanently reduce adult prolificacy. If growth is low due to an upland/hill environment then puberty may not be achieved in the first autumn or reached below target weight. The stress on underweight sheep of pregnancy can result in prolapse, there may be permanent stunting or other long term damage.

Good lowland farms that normally sell finished lambs off grass produce ewe lambs that can be bred in their first year. Quantity and quality of grazing from August is the key. Expect lambs on the best quality grass to gain around 120 – 150 g/d; with high sugar grasses this might increase to 200 g/d and with white clover rich swards 225 g/d. Those holding to first oestrus are preferred as this is a good indicator of further high lifetime performance. If breeding your own, mate 15-20% more ewe lambs than you need, selecting only those holding in the first 17-21 days.

Producing early lambs using supplementary concentrates increases fatty deposition in the udder of ewe lambs compromising their potential future milk yield. In this situation it is better to buy in replacements.

Later lambing and upland farms that produce finished and store lambs off grass are a good source of breeding replacements. These are best left unmated in their first year and need careful management to ensure a target 80% of mature body weight is reached by mating as two – tooths.

Feeding lambs to be mated at 18 months

Crossbred lambs under 30 kg by September are too small for breeding, finish these quickly on concentrates. They may have damaged digestive systems due to coccidiosis. In their first winter lambs chosen as replacements need to gain about 50 g per day- around 5 kg over the winter. If they gain no weight over the winter they are less able to respond to flushing in later life. As a guide, housed hill breed ewe hoggets will need around 135 kg of hay and 25 kg of concentrates for the winter or 300 kg of baled silage at 30% dry matter and 22 kg of mineralised barley or oats.

In the spring shear as early as weather allows and give them access to the best grass available on the farm after shearing when appetite is high – it really is that important to do these replacements well - if left too late the target can easily be missed.

Avoid early checks to growth

Well brought out lambs make better draft ewes

Science of fertility in new breeds

In general, sheep have 2 copies of each gene (alleles) that contributes to their genetic make up. Fertility is generally a polygenic trait, thought to be influenced by hundreds of genes all with a small effect. However scientists have discovered major genes affecting prolificacy. In some cases, there can be graded effects on a trait – for example, a ewe having inherited the 'Booroola' allele for prolificacy from both parents is more prolific than a ewe inheriting it from only one parent, while it in turn outperforms an animal that did not inherit the allele from either parent (i.e., 2 > 1 > 0, representing homozygous carriers, heterozygous carriers and homozygous non-carriers, respectively). The story, however, is not always so simple and a notable exception – termed 'Heterozygote advantage' - is evident in cases of other genes that have major influences on prolificacy in sheep, notably the 'Inverdale'. In this case, ewes that have inherited an allele for prolificacy from one parent only (heterozygous carriers) are more prolific than homozygous non-carriers but, intriguingly, homozygous carriers are infertile. Here, instead of graded effects on a trait, it is a case of 'one is enough but two is too many'– equivalent to a proper dose of medicine being beneficial but double the dose being toxic.

In breeds with prolificacy genes that confer an advantage to heterozygous carriers while at the same time rendering homozygous carriers infertile, careful management of ewe and ram pairings is important, as is screening of ewe lambs for evidence of infertility. The ewe lambs that are congenitally infertile in these instances will not even be marked by a ram because oestrus (heat) does not occur. Among the breeds of sheep noted for Heterozygote advantage-style prolificacy are the Belclare, the Cambridge, the Inverdale X Texel and its cross with the Welsh - the Aberdale. In the Inverdale and its crosses which have been closely controlled and blood typed by Innovis one copy of the gene for high prolificacy will be in all ewes and two copies in none (provided the matings were correct) but in the other breeds the incidence of these genes is unknown, theoretically it will be in around 10-20% of ewes.

At present, the Lleyn breed of sheep is noted for its prolificacy. It gave rise to the 'Belclare' and 'Cambridge' sheep, both of which are composite breeds known to carry more than one major gene affecting prolificacy. So too might the Lleyn as in recent years, 2 of the 3 mutations implicated in the prolificacy of these composite breeds have been identified within the Lleyn breed itself. At least one study demonstrated a 15% incidence of Lleyn ewe lamb infertility consistent with the 'one is enough but two is too many' allele scenario. However it is quite possible many Lleyn flocks contain no major genes for fertility.

New rules for prolific breeds

A "one size fits all" approach to ewe nutrition at mating is not applicable in the light of new information.

Breeds where prolificacy controlled by known major genes	Breeds where prolificacy controlled by many genes
Lleyn, Cambridge, Belclare, Aberdale	Blue Faced Leicester, Finnish Landrace, all other breeds and crosses
Avoid flushing and high feed intake over mating period	Can be treated traditionally

Mating management for new and traditional breeds

Do not flush or feed heavily one month either side of mating

LLeyn *Mate LLeyn ewes on short swards*

Cambridge *High litter size puts pressure on management*

Aberdale *Should be put onto low quality pastures pre-mating, releasing better grass for lamb finishing*

Manage traditionally

Mules *Target condition score 3.5 for mules*

NZ Romney replacements *This breed responds well to flushing*

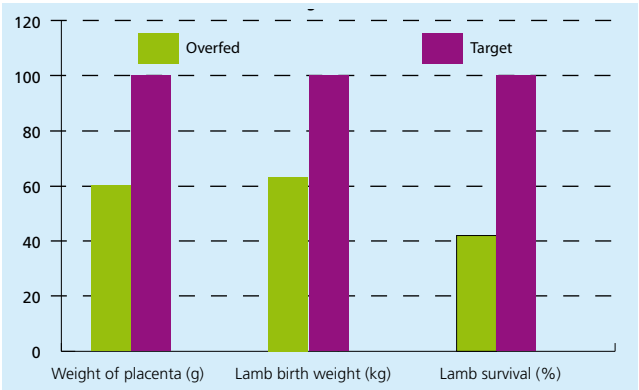
Blackface *Wean in August to allow ewes time to regain condition*

New research on ewe lambs shows that if the target of 60% of mature body weight at the time of mating has not been met, feeding ewe lambs for catch-up growth after mating risks lambs of low birthweight with problems of lack of vigour, limited brown fat reserves and poorer survival.

High daily liveweight gain in ewe lamb pregnancy compromises the birth weights and viability of their offspring - see chart below for overfed (gaining 240 g/d) vs target (gain 80 g/d).

A small ewe lamb invests extra feeding in maternal weight gain, undermining establishment of the placenta. Whilst a smaller placenta may adapt to be more efficient on a per gram basis, it is only a partial recompense and not all genotypes may be capable of this.

Good body condition before mating has been known for many years to encourage the egg producing structures on the ovary (follicles) to develop and sets the potential lambs crop.



For lowland crossbred ewes increasing condition score from 2.5 to 3.5 can increase scanning % by 20 - 40%.

Realising this potential depends on successful implantation of the released egg and development of the placenta. Nutrition affects each stage independently and if inadequate at one stage the damage cannot be undone by heavy feeding later on.

The key hormone influencing the generation, establishment and ultimate competence of the placenta and its ability to support foetal development and lamb birth weight is progesterone. Unless adequate amounts are in circulation in the fortnight immediately following conception, the viability and liveweight of lambs at birth about 5 months later will be compromised. The factors that determine progesterone concentrations are the ewe's ability to produce it from redeployed ovarian tissue at the ovulation site and the rate at which it is lost by breakdown in the liver. High feed intake increases blood flow through the liver. Although ewes with major prolificacy genes ovulate more eggs and should in theory have more progesterone producing sites as a result, they actually have less effective progesterone-producing capacity and flushing them should thus be avoided. Being naturally prolific, they ought not to be 'flushed' because their genetic make-up already predisposes them to release more than enough eggs and flushing destroys the limited progesterone available.

Progesterone also has other roles that make it a key hormone in establishment of pregnancy. As well as facilitating optimal establishment of the placenta, it affects the production of immunosuppressants that are essential for preventing the ewe rejecting her embryo as foreign protein.

Prolific genotypes and low progesterone

In Prolific genotypes, more ovulations occur ***but*** ovulatory follicles are smaller. Total progesterone may be 3 vs 4 ng/ml in young ewes

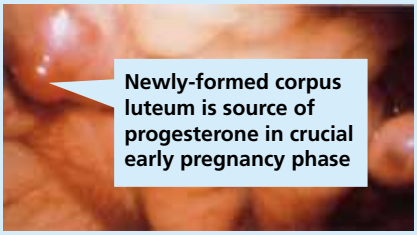


Fig 1. Photograph of ovary with corpus luteum.

First get mature sheep into the optimum condition score for mating. Good management practice is about setting targets for growth and body condition in the months preceding mating so that there is no need for dramatic 'catch-up' feeding or weight gain during the time that ewes are with the rams or in the months that follow.

Achieving condition score targets.

Putting on one unit of condition score adds 13% of liveweight. Thus going from score 2 at weaning to score 3.5 at mating a 65 kg ewe has to put down about 13 kg, mainly as fat.

- The energy content of the weight gain is 24 MJ/kg
- On reasonable diets the efficiency of gain is about 45%, so the ewe needs to eat about 55 MJ per kilo gain – about an extra 700 MJ in total
- Over 10 weeks this is 10 MJ /day – equivalent to 1kg of concentrate/day (as fed) or an extra kilo of DM of best quality grass

To achieve this high intake requires high quality leafy pasture with a 6-8 cm sward height. For thin ewes or if swards are too short (<4 cm) or brown due to drought rather than green or where heavy rainfall interferes with grazing then feed around 0.5 kg/day of cereal/beet pulp mix using a snacker to minimise grazing disturbance.

Flushing traditional breeds that are already sufficiently fit in terms of body condition will not further stimulate the ovaries to release more eggs for fertilization. There is a place for traditional 'flushing' up to ram turnout where adult sheep have missed the condition score target due to bad weather or feed shortage. Specifically avoid flushing and heavy feeding around mating for major gene carriers such as the Lleyn, Cambridge, Belclare and Aberdale.

Missed targets?

Lambs mated at under 60% of mature body size can safely gain up to 80 g/day in pregnancy (4 kg in total), but if they are overfed they direct too much nutrient to their own growth and produce very small lambs at birth.

Supplementary feeding from 5 weeks after mating to lambing (45 kg Mule gaining 80 g/d)

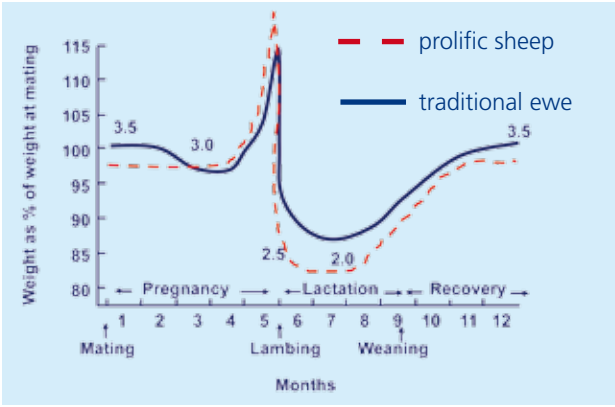
Forage base	(kg /day)
Grazing @2 lambs/ha +storm feeding of hay	0.4
Average silage inside	0.5
Break fed roots and hay	0.4

Condition score ewe hoggets 5 weeks pre-lambing and give twin bearing and thin ones (CS less than 2) an extra 150 g/day of soya or access to buckets (200g/day) designed to increase microbial and digestible undegraded protein supply. Do not allow them to rear twins, cross-foster if possible.

Synchronised and/or superovulated sheep

For ewes being stimulated artificially to produce higher numbers of embryos, nutritional flushing is not applicable. Whether using a single mild stimulus (e.g. low dose of pregnant mares serum gonadotrophin) or stronger (e.g. twice-daily follicle stimulating hormone for a few days), the ovaries of the ewe will be influenced more by the injections than by – in relative terms – the more subtle effects of 'nutritional flushing'. In particular, if synchronisation depends on an intravaginal progesterone-releasing device such as a sponge, then the timing of ovulation depends on a fall in progesterone following device removal. Over-generous feeding while the device is in place would lower progesterone concentrations early due to increased blood flow through the liver and so the 'fall' on removal of the device will be less pronounced. This may limit the subsequent ovulatory outcome. Moreover, quality of embryos generated depends on the calibre of oocytes and this in turn is influenced by the ewe's 'exposure' to adequate progesterone in the week to 10 days prior to ovulation.

Prolific ewes need different treatment



Condition score targets for prolific sheep

Many farmers will be familiar with the idealised pattern of liveweight and condition score change in the stylised diagram above. Mature prolific ewes carrying more than two lambs are unlikely to fit (and ought not be compelled to fit) the classic 'body condition change' pattern (solid line)

A more realistic pattern is indicated by the broken line. Ewes bearing triplets will tend to be heavier pre-lambing and lighter post-lambing. If lamb survival is good (and especially if rearing all 3 lambs) the ewe can also be expected to lose more weight during lactation. Consequently, she will be tupping from a lower body-weight and condition score and faces an uphill struggle to hit conventional targets at tupping. Prolific breeds that produce more than enough eggs can be in optimum condition below condition score 3. Thus the recovery phase can extend into the subsequent pregnancy and by having ewes thinner this will reduce triplets and quads.

Condition score targets

Breed	Weaning	Mating	Mid Pregnancy	Lambing
Lowland breeds	2	3.5	3.0	2.5
Prolific breeds	2	2.5 - 3.0	2.5	2.5

Increases in prolificacy above the ewes' ability to rear them needs to be reconsidered. Triplet and higher order multiple births are generally unprofitable where lambs have to be reared off the dam. We have some way to go before widespread adoption of highly prolific genotypes can be recommended. Controlling the incidence of triplets and quads by nutrition at mating is a good start. Surveys suggest, on average farms, birth type distribution and mortality levels to weaning are:

Singles mortality %	Twins mortality %	Triplets mortality %
5	10	30

Percentage singles	Percentage twins	Percentage triplets	Actual scanning and (lambing) percentage
80	20	0	120 (112)
70	29	1	131 (121)
60	38	2	142 (130)
50	46	4	154 (139)
40	53	7	167 (148)
30	59	11	181 (158)
20	64	16	196 (168)
10	69	21	211 (179)
0	72	28	228 (188)

Above around 170% scanned there is a marked increase in triplets at the expense of singles. Lleyn ewes can achieve over 200 lambs born per 100 ewes easily without flushing. They are well-suited for later-season lamb production when they scan around 10-20 % lower.

Post-mating management

Feed restriction is an effective tool to make the most of limited progesterone available. There is no need to feed for extra lambs after tupping as the energy and protein demands for foetal growth in the earliest weeks of pregnancy are negligible. Recent trials by Innovis on Aberdale (Inverdale Texel X Welsh Mountain) ewes showed grazing on low quality swards of native grasses at a pre-tupping sward height of 8 cm. rather than perrenial ryegrass /clover kept 19 of 26 flocks in the desired lambing percentage range of 160-200%.

However, low food intake, or low quality feed may impair trace element supply which can have important effects on lamb vigour so this needs attention

- Target score at 3-4 weeks pre mating is 2.5 for prolific ewes.
- Hold them at this level to one month post tupping
- Typically sward heights of 4 cm are fine or use mature pasture.
- Supplement mature pasture with trace elements
- Avoid stress from weather or disturbances
- There are no magic bullet feeds, no need for high P or extra protein as DUP
- For mating on forage brassicas allow 50 g/day intake of block with 40 mg/kg Iodine.

Specific effects of cobalt - early stages

Cobalt, through its effect on vitamin B_{12} supply is a key nutrient during oocyte development and for the early foetus. However its effects on lamb vigour at birth are not evident until much later, long after any remedial or compensatory steps can be taken.

In trials involving Scottish Blackface ewes from farms with cobalt-deficient pasture:

- Half were given cobalt bolus (Co+) 30 days before embryo collection / transfer and the remainder untreated (Co-).
- Day 6 embryos from superovulated Co+ or Co- ewes were transferred singly to Co+ or Co- ewes.
- It was found that it was the Co status during embryogenesis that influenced lamb behaviour.

Cobalt given before mating affects lamb behaviour

Cobalt status of embryo donor ewe increased active behaviour of lambs at birth (Mitchell et al, 2007)

Another example - Effects of Co and S deprivation on subsequent development

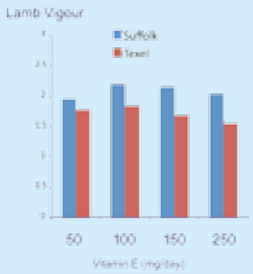
- Two experimental diets were chemically identical, except for their content of elemental cobalt and sulphur, which were reduced in the low diet relative to the control diet
- This was to diminish the capacity of rumen microorganisms to synthesize vitamin B_{12} and sulphur-containing amino acids, respectively.
- Embryo donor ewes were randomly allocated to one of these two experimental diets from 8 weeks before until 6 days after conception.
- There were no effects on pregnancy establishment or birth weight, but the Co and S deprived ewes produced male lambs that in later life had:
  - More fat and lower muscle:bone ratio
  - Altered immune responses to challenge
  - Insulin resistance
  - Elevated blood pressure

Here again long term effects from trace element deficiency in the early stages of egg production and embryonic/foetal development were identified.

Key question:
Does cobalt given before or after mating influence lamb behaviour?

Vitamin E in late pregnancy improves lamb vigour

Although this is accepted a recent trial failed to demonstrate responses to 50-250 mg. supplemental vitamin E in pregnancy. In this case it is possible ewes released vitamen E stored in fat reserves. Since ewe body reserves are unknown it is wise to stay with the recommendation that supplementary feeds in late pregnancy provide 80-100 mg vitamin E/day. If anything the trial increases the relevance of vitamin E supplementation to ewes lambing outside on grass at the lower condition scores needed to avoid oversize lambs and lambing difficulty.



Lamb vigour scores

Vigour scores from lambs sired by Texel rams superior to Suffolk-sired lambs (P<0.001)

No effect of vitamin E

There are many products available but avoid stressing ewes at troughs over mating. Where no extra energy and protein is required e.g. with prolific sheep and well grown ewe hoggs choose straight minerals/mineral blocks or low intake hard licks to supply cobalt (Co) and selenium (Se) - minimum levels in licks with an intake of 30-70 g/day are 6 mg/kg and 3.6 mg/kg respectively. High phosphorous levels are not necessary and in trials there have been no extra responses to digestible undegraded protein so do not buy on this basis. Where scanning % is below target or with thin sheep or where feed supplies at tupping (e.g. late lambing) are sparse /low quality use high energy, high intake (200-300 g/day) type feed blocks. These give a 10-20% increase in lambing percentage. Minimum Co and Se content of these needs to be 1.2 mg/kg and 0.8 mg/kg, respectively.

- Train young sheep to take minerals in the format used
- One site per 30 ewes
- Keep supplies topped up
- Start two weeks before ram turnout and feed for a further month

Trace elements

Where despite having good liveweight gain and condition scanning rates are low and lambing spread out have forage, soils and blood or tissue tests done to identify trace element deficiency. Use all sources of information possible in the supplementation decision. Many commercial companies will test forages for free for major and trace elements which provides a useful starting point. Use the table below to plan tissue sampling and discuss results with your vet.

Trace Element	Clinical signs	When to sample	Number to sample
Copper	Swayback Ill-thrift (uncommon)	• Ewes pre-tupping (useful if results are within or below marginal band) • Lambs at weaning • Cases of ill-thrift	Blood: 7-10 (heparin samples best, clotted OK) Liver: three
Cobalt	Ill-thrift Poor fertility Neonatal losses	• Ewes pre-tupping and pre-lambing • Lambs at weaning • Cases of ill-thrift	Blood: 10 (clotted samples) Liver: three
Selenium	Ill-thrift, poor fertility High barren rate Stillbirths White muscle disease	• Tups and ewes pre-tupping • Ewes pre-lambing • Lambs at weaning • Cases of ill-thrift	Blood: 3 - 5 (heparin samples) Liver: three

Positive results from trials on selenium supplementation pre mating

- Must establish base level using a blood test for glutathione peroxidase well before mating (rams need treatment 12 weeks pre-mating, ewes six weeks).
- Where levels are low significant improvements in reduction in barrenness (-4% Irish studies) and lambs born (+40% - in severe deficiency case in Caithness) Lambs livelier and 0.6 kg heavier at weaning.
- Carryover effects on lambs last weeks – years.
- Can use boluses or injections that last 12 months e.g. Deposel 6 weeks pre mating.
- If you have a selenium deficiency you will most likely already know about it – don't just treat and hope it works!

Undernutrition effects on lifetime performance

In the first half of pregnancy, while various organs and processes are being established in the growing foetus, undernutrition can have a permanent 'programming' effect. Work on hill ewes showed undernutrition of foetal ovaries limited litter size in later life when the foetus became a breeding ewe. In comparison prolific genotypes with the Inverdale gene do not appear to be compromised in this way. Permanent effects from undernutrition on muscle growth, cardiovascular development, endocrine glands (implicated in reaction to stress), the immune system and brain development have been found.

Effects of underfeeding energy and protein on foetal development and mother-offspring interactions

Lamb behaviours at foetal and neonatal stages were studied in underfed ewes using ultrasound and video surveillance of ewes and lambs at lambing. Because of its crucial role in lamb survival the ability of lambs to recognise their mothers was tested at 24 hours old. Results were:

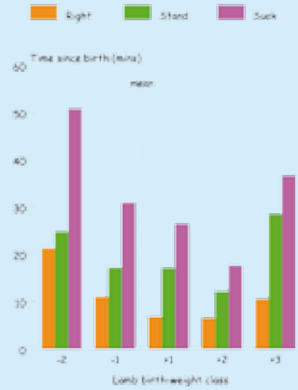
- Reduced foetal growth and birth weight
- Poorer quality of maternal care to their offspring
- Lambs less vigorous at birth with higher mortality
- Reduced birth weight in the Suffolk but not Blackface breeds
- Effects on lamb behaviour and survival in both breeds, with some evidence for a greater effect in Suffolks.
- Underfed ewes groom and bleat to their lambs less immediately after birth.
- Feed restricted ewes scored lower in tests of maternal attachment.

Longer term effects (e.g. on reproduction and health, as well as trans-generational effects) are currently being investigated.

Effects of underfeeding energy and protein on the placenta

In general terms, a moderate mid-pregnancy 'check' in terms of feed intake can actually favour the mature ewe's inclination to invest resources in the placenta with a subsequent pay-off in terms of good lamb birthweights. This capability – absent in the 'need-to-grow' adolescent ewe - could well reflect evolutionary adaptations to cope with winter snowfall scenarios in mid-pregnancy.

Undernutrition and lamb behaviour

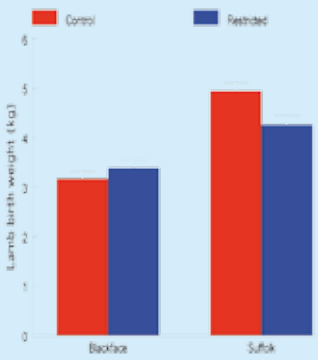


Low birth weight lambs take longer to stand and seek the udder than heavier lambs. Optimal birth weight improves lamb vigour.

Effects of undernutrition - lambs

- Suffolk lambs, lighter at birth
- Lambs less vigorous at birth (e.g. % assisted to suck) and less active during development
- Suffolk ewes and lambs were seen further apart during lactation
- Lambs less able to recognise their mothers in tests

R lambs had higher mortality than C lambs:
19% vs 8%



For the first month after mating and whilst rams are running with the flock aim to maintain body condition and avoid stress. Stress can be caused by sheep fighting for feed from a trough so avoid daily supplementation if possible, also avoid sheep being run to exhaustion as heat stress kills embryos and avoid weather stress by using sheltered fields. Do not gather sheep to the ram, if he is any good he will find them. Severe under-nutrition as shown opposite causes problems but most lowland ewes should have sufficient body reserves to avoid this. Thin hill ewes can be supplemented with a hard type feed block/lick and 0.6 kg of hay in snowy conditions. In stressful conditions they will reabsorb embryos and end up barren despite having been mated.

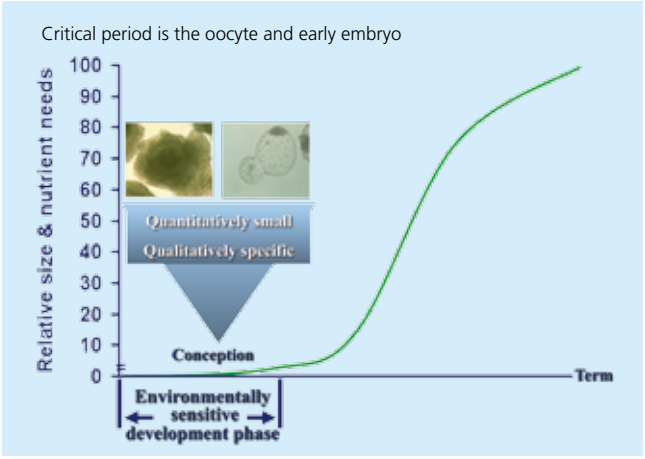
Avoid overfeeding lowland ewes, prolific breeds and ewe lambs by grazing either short leafy swards at around 4 cm or old pasture. However it is important to avoid cobalt deficiency so where this is a known problem ewes should be treated with cobalt bullets or if there are multiple deficiencies use a bolus. Alternatively blocks or licks may suffice but do not rely on oral drenching or the cobalt in a wormer.

Pregnancy timetable for timing of management tasks

Day	Events	Key stages	Management tasks
0	Mating	Pre-implantation	Avoid stress and handling ewes
3	Fertilisation		
15	Migration	Implantation	
34	Implantation		
40	Foetus weighs 5 g	Placental Growth	Embryos now ‘safe’
90	Foetus weighs 700 g		

In the second and third months from mating ewes can be allowed to lose half a body condition score and benefit from mild undernutrition. Ewes can be scanned at 80 days onwards for litter size.

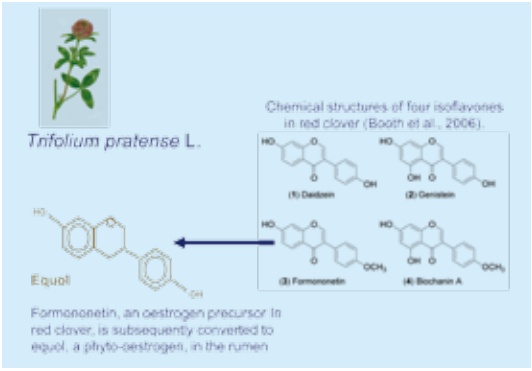
Ewe nutrition affects the developing embryo and placenta



Feeds that can affect breeding efficiency

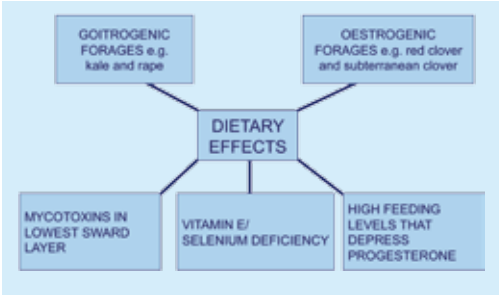
Some feeds for example red clover can impair breeding through the effects of plant secondary metabolites. These are plant components that have chemical structures similar to hormones that control reproduction. Plant breeders are trying to reduce the concentration of formononetin, the major oestrogenic factor in red clover varieties. A practical guide as to whether it is having a biological effect is to check for swelling of the genitalia, for example elongation of vestigial teats on wether lambs (seen at the base of the scrotum)

Red Clover



Forage brassicas contain goitrogens that prevent iodine uptake by the thyroid so where they are fed for long periods supplementation with iodine is beneficial. Another metabolite, S-methyl cysteine sulphoxide may cause haemolytic anaemia. Plant breeders have reduced the concentration of harmful metabolites and judicious use of forage brassicas around mating, where ewes have access to other feeds such as grass, usually avoids problems.

Feeds and feeding that can impair breeding efficiency – low lamb nos.



Chicory is high in trace elements and kills worms and early suggestions are that it is useful for ewes and rams pre-mating

Some plants however may have beneficial effects on reproduction if fed around mating time.

Ewes on chicory

Rams on chicory

Avoiding problems with forages that can impair breeding efficiency

Forage brassicas contain goitrogens that prevent iodine uptake by the thyroid. Other metabolites S-methyl cysteine sulphoxide and glucosinolates may cause haemolytic anaemia and thyroid damage. Symptoms of goitre are swollen thyroid glands in the neck. Anaemic sheep are slow and have pale mucous membranes. In practice just be on the look out for these symptoms as problems are rare. Use kale at least part time for flushing and tupping in later lambing flocks but avoid this for fit ewes and very prolific breeds, targeting leaner ewes and gimmers. Kale made into silage loses its toxicity.

- Ration the crop and introduce it gradually on and off for 3 – 4 days then full time or one day on and one day off, but avoid putting sheep onto frosty kale.
- Have a run back with grass or provide straw.
- Supplement brassica crops fed during tupping or in pregnancy with iodine containing blocks/ buckets or give iodine injections.

Red Clover

Formononetin, an oestrogen precursor in red clover is converted to phyto-oestrogen in the rumen that will disrupt breeding. Swards with over 30% red clover should not be fed to ewes or rams 45 days either side of tupping. Silage made from red clover merely concentrates the oestrogens, thus feeding red clover silage after tupping will result in barren ewes and undersized lambs. However it can be fed safely in the last third of pregnancy. White clover as a grazed crop or silage is safe.

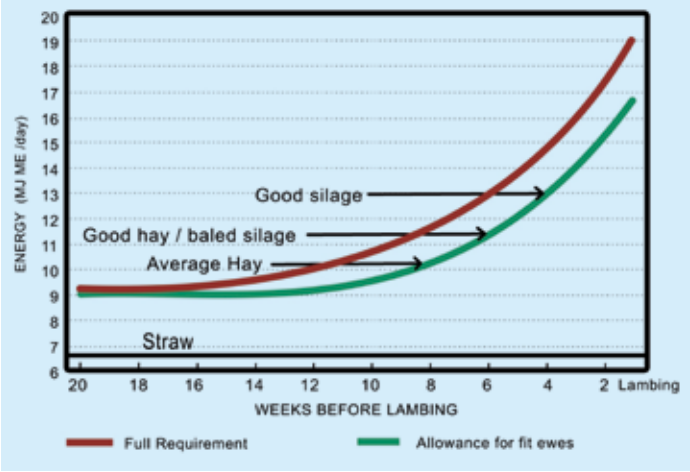
Replacements

Many farmers are moving to rearing their own replacements for a variety of reasons including biosecurity and the need to bring in high performance and easy care traits ignored by many traditional breeders who base sales on looks. They can safely use high performance feeds away from the breeding season. Farmers buying in replacements as ewe lambs or gimmers tend to pay more for the biggest ones; this is not a sensible strategy if the nutritional basis of this has been heavy supplementary feeding just prior to sale. All this does is mask inefficient grazing and/or worm resistance. By bringing out sheep correctly longevity is increased; all farmers agree we need sheep with longer productive lives.

Mule ewes being supplemented on forage brassicas with supplementary iodine

Management changes to feeding arrangements should be based on pregnancy scanning at 80 days and body condition scoring 8 weeks before lambing. Constant CS for a month after mating helps implantation of the embryo. In months 2 and 3 a small loss of condition is acceptable and will ensure optimum growth of the placenta. In months 4 and 5, providing the ewe was in good condition at mating (3.5) and is now around 3, another 0.5 CS units can be lost without affecting foetal growth to achieve a CS of 2.5 at lambing. This CS provides reserves for lactation and insulation but ewes lambing on grass should be in score 2-2.5. to reduce incidence of lambing difficulty.

Energy requirements of pregnant 75 kg twin bearing ewes



Ewes underfed in late pregnancy produce lambs with low reserves of brown fat used specifically for protection against hypothermia, - longer term there are effects on wool follicles reducing wool yield. In late pregnancy due to rumen restriction the ewe adapts by increasing food passage rate and increasing protein absorption by 15%. High energy content of the diet is critical as efficiency falls with lower ME supply. Cereals and cereal by-products are a good source of energy but high levels of cereals, particularly wheat, can cause acidosis so the inclusion of a digestible fibre source, such as molassed sugar beet pulp at around 20% is desirable. Cereals can be fed whole with hay but should be lightly processed with silage. The inclusion of molasses will provide readily available energy, aid palatability and will reduce dust and carry minerals. Protein is required for lamb growth and colostrum yield and quality. Rumen microbes need a sufficient supply of effective rumen degradable protein (ERDP). Also in late pregnancy the concentrate should provide digestible undegradable protein (DUP), which is resistant to breakdown by the rumen microbes and is digested in the small intestine. Hipro Soya is the best protein source supplying 130 g/kg followed by cottonseed meal 110 g/kg, rapeseed meal 57 g/kg. Home grown peas and beans providing around 40 g/kg can be used to provide protein but are less efficient as sources of DUP. Compounds containing supplementary mannan-oligosaccharides increase colostrum quality and protection for lambs against disease.

In late pregnancy rations may be based on straw, average or good quality hay or silage. Hay and silage can be very variable in their nutrient content and thus their adequacy to supply the ewe's needs. Therefore, it is essential to have forages analysed well before this period so that rations can be formulated and the amount and type of supplement required can be estimated. Daily forage dry matter intake (percentage of liveweight) is shown in the table below.

Use these estimates and the graph opposite to estimate supplementary needs. Where each forage crosses the requirement curve shows when to start giving feed supplements. The level can be estimated from the deficit based on the difference between requirement (increases with time) and the supply from the forage e.g. at term a ewe needs 19 MJME /day. Hay provides 7 MJ so the deficit is 19 - 7 = 12 MJ. This requires about one kilo of concentrate dry matter with an energy content of 12.0 MJ/kg. In the final weeks of pregnancy rumen capacity and voluntary intake of roughages decline so concentrates need to be high quality.

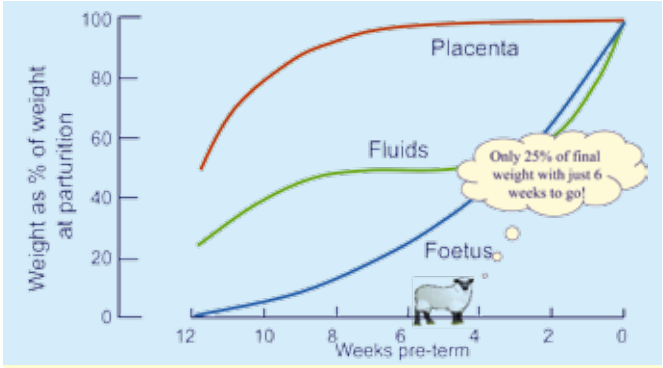
Daily dry matter intakes as % of ewe liveweight by twin bearing ewes in pregnancy and lactation when fed concentrates

	ME	Weeks 12 - 3 pre lambing	Weeks 3 – 0 pre lambing	Weeks 0 – 3 of lactation
		%of LWT	%of LWT	%of LWT
Straw	6.5	1.0	0.8	n/a
Average hay	8.5	1.5	1.1	1.2
Good hay	9.5	1.8	1.4	1.5
Poor silage	9.5	1.4	1.2	1.3
Good silage	10.5	1.6	1.4	1.6

Choosing a compound feed

The minimum metabolisable energy (ME) in a compound should be 12.0 MJ/kgDM and good quality ingredients should be used to achieve this with no reliance on low energy by-products. Any compound with an energy content lower than this is not appropriate since higher levels of feeding will be required which may compromise forage intake. The supplier of the compound should provide, in confidence, a full formulaton and specification of the compound. The protein level declared should be 18%CP, but this gives no indication about the quality of the protein (ERDP and DUP). The formulation will provide this information and will show the source of energy being used – cereals, maize gluten, sugar beet pulp, soya hulls. Avoid formulations with low quality ingredients such as oatfeed, olive pulp, shea nut, cocoa shells or coffee residues.

Feeding the pregnant ewe for viable lambs



Not a time for low quality feeds when intake is constrained

Interpreting forage analyses

The key components of analysis are dry matter (DM), metabolisable energy (ME) and crude protein (CP) and current analytical techniques supply information regarding the degradability of the protein. For silages the intake potential will also be provided with an estimate of the fermentation quality. Ideally samples should be taken from several bales and for pits, cores should be taken at several points across the diagonals of the pit to ensure that the material analysed is representative of the whole. The voluntary intake of precision chopped silage is higher than that of big bale material and ration formulation programs should take this factor into account. Example rations are given opposite.

Assessment of the ration

- Is the ration on paper the same as the ration being fed? Check weigh
- Is the ration being offered actually being eaten? Check wastage, clean out troughs
- Is there adequate trough space for all the ewes to consume their concentrate allowance at the same time?
- A useful check for diet adequacy is a blood sample for the concentration of a compound in the blood called ß-hydroxy butyrate (BOHB).

Whereas in mid pregnancy ewes can adapt to a short severe deficit of energy, in late pregnancy this will result in high BOHB and pregnancy toxaemia (twin lamb disease). Ten ewes should be sampled 4 to 6 weeks before lambing. The target BOHB concentration is 1mmol/l if the ewes have been scanned and foetal numbers are known. If not, the target is 0.8 mmol/l to allow for this uncertainty. If the concentration is 1.6 mmol/l this is a sign of severe energy deficiency and values greater than 3 mmol/l are associated with pregnancy toxaemia. A deficit of energy, as shown by an elevated concentration of BOHB, is associated with reduced lamb birth weight.

The energy deficit can be corrected by feeding more concentrates as shown below.

Correcting an energy deficiency: Concentrate (12.5 MJME/kg DM) required to achieve target BOHB (g/ewe/d)

Actual BOHB mmol/l	1.0	1.5	1.5	2.0	2.0
Target BOHB mmol/l	0.8	0.8	1.0	0.8	1.0
Ewe weight (kg)					
40	95	220	125	290	200
60	145	330	190	440	295
80	190	440	250	585	395

Typical rations for 75 kg housed ewes

Hay to appetite (around 0.86 kgDM/d) with the following concentrate allowances (kg)

	Weeks from lambing			
	8	6	4	2
Singles	0.1	0.2	0.35	0.5
Twins	0.2	0.35	0.5	0.8
Triplets	0.25	0.5	0.7	1.0

Silage to appetite (around 1.0 kgDM/d) plus concentrates (kg)

	Weeks from lambing			
	8	6	4	2
Singles			0.25	0.45
Twins		0.25	0.45	0.6
Triplets	0.25	0.4	0.6	0.8

For ewes below CS 2 and with triplets feed extra concentrates or buckets

Supplements for hill ewes

Evaluation of value for money of supplements given to pregnant hill ewes on indigenous grazing is difficult as deficits are hard to quantify and will include minerals and trace elements. Specifically on heather-dominant hills, extra protein supply in mid pregnancy from feeding blocks increases lamb birth weight. The cost of feeding out the material in time and labour has also to be accounted for as supplements may affect grazing behaviour and hence overall feed intake. Simple comparisons of cost per unit of ME and CP are less relevant than with other classes of stock- see table.

Supplement & typical intake/day	Cost per tonne (£)	Cost per day (p)	Labour cost of feeding	Packaging cost (£/t)	Approx % of energy req.	% of min vit req. met
0.45 kg compound (12.5 ME, 18% CP)	180	8.1	Very high	Bags (£25) Tote (£ 5)	45	70
0.8 kg good quality hay (9.2 MSME)	100	8.0	Moderate	Nil	55	Variable
0.45 kg beet pulp	210	9.4	Very high	Bags (£ 25) Tote (£ 5)	45	20
80 g Hard pour type high energy bucket	618	4.9	Very low	Plastic (£80)	10	90
0.15 kg cold pressed standard feed block	400	6.0	Very low	Bags (£8)	15	100
0.25 kg Cold pressed super energy feed block	430	10.7	Low	Bags (£8)	25	100
0.2 l Urea containing liquid feed	285	7.4	Moderate	n.a.	15	10

Wormy ewes not only produce less milk but also are a major source of infection for their lambs. A combination of high faecal egg count and high faecal output mean one ewe at 300 eggs per gram can produce enough infective larvae to reduce weight gain in 10 lambs or more. Sheep producers can feed high DUP protein in late pregnancy and lactation to reduce worm numbers and eggs deposited onto pasture, thus reducing dependency on wormers and the development of anthelmintic resistance. SAC trials show that to achieve this, protein levels should be ~20% higher than AFRC currently recommends. Increased colostrum and milk production are a bonus and reduce labour costs. For twin-rearing Mules, this means ~170 g metabolizable protein (MP) per head per day during late pregnancy, increasing to ~370 g MP per day during early lactation. The research demonstrated around 10% heavier lambs at birth, 30% increased milk production and a more than 60% reduction in worm burden (Figure 3) with almost 90% reduction in worm egg output (Figure 4). As a result of this, lambs had a temporary lower worm egg output, higher growth rate and higher weaning weight.

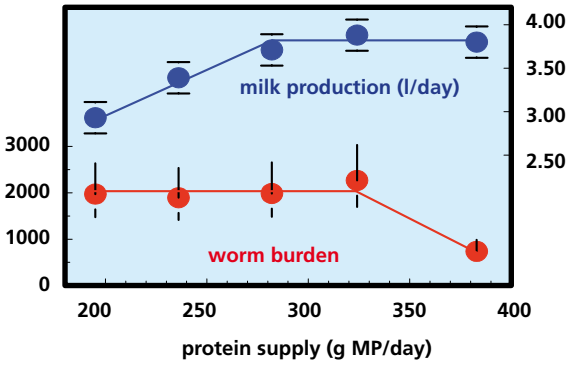


Figure 3

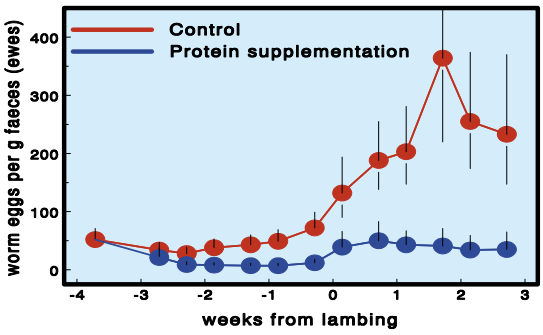


Figure 4

Not all ewes however are equally infective to the pasture. The protein available to ewes is prioritised to body maintenance, reproduction and finally mounting the immune response. Multiple bearing ewes in late pregnancy have to break down body protein reserves to supply glucose to keep their lambs alive. Ewes rearing twins excrete 70-80% more worm eggs than ewes rearing singles, especially if they are in a poor condition. Therefore, it may be worth grazing single rearing ewes separately, and targeting twin-rearing ewes with extra protein. The additional protein needed for multiple–bearing ewes can be fed as 200 g soya per head per day during late pregnancy, increasing to 400 g soya per day during early lactation. Similar effects can be expected from 125 and 250 g/d of protected soya e.g. SoyPass.

Heavier lambs at birth, higher milk production and lower worm egg excretion all contribute to faster growth of lambs, and getting lambs away from the farm early in the season. This usually results in higher prices and better carcass quality. In addition, savings can be made on drenching, reducing development of anthelmintic resistance.

Grazing ewes and lambs on bioactive forage is another approach. Grazing chicory has been shown to improve lamb growth and reduce worm burdens by 40%. In early growing areas turning ewes and lambs onto second year chicory reduces dependence on concentrates for finishing and helps control the effects of worms.

Low labour availability is driving farmers to lambing outdoors, but low losses are a priority and 150-160% lambs sold /ewe mated is a realistic target. One man to 600-1000 ewes at lambing reduces fixed costs and concentrates fed by 20 kg per ewe. A house can be used to rest lambing fields from 12-2 weeks pre lambing. Stocking rate in the house can be 50% higher by winter shearing ewes and cutting out lambing pens.

Grazing

Newly grazed grass not only meets protein and energy needs but sets up ewes to lamb unaided.

- Clear fields 2-3 months pre-lambing to achieve target 6 cm sward height at turnout.
- Turnout at 10 -14 days pre- lambing to allow ewes time to settle and choose a lambing site.
- Stop daily supplementary feeds – these disturb grazing and lambing behaviour.
- Stock lowland twins at 17/ha (range 7- 27), singles at up to 40/ha, half this on upland units.
- Mob size maximum of 120 ewes, unsorted on lambing date.
- Ewes should be lean at turnout - CS 2.0-2.5. As they put on condition pre-lambing, later born singles can be too heavy for an unassisted birth.
- Lamb over 28 days - take rams out to ensure this.

Lambing Management

Research at Greenmount over two years showed outdoor born lambs were heavier at birth, grew faster to six weeks, and had similar mortality to housed lambs except in exceptional weather. An emergency overnight shelter is valuable. Avoiding having to handle outdoor ewes is key:

- Start with lean ewes and a lambing date matched to pasture growth.
- Ewes with plenty of colostrum and used to human contact help.
- Use high maternal EBV ewes and rams.
- Rams need to be selected for easy births and the ability to suck unaided.
- Supplementation with trace elements/vitamins will maximise lamb vigour.
- Problem ewes need to be culled early – big teats, persistent footrot etc.
- A comprehensive health plan should be a working document, not historical.

Ewes lambing on grass have enough colostrum for two lambs but only a proportion have enough for three and the ability to rear them, so expect some cross fostering. Supplemental feeds as buckets or blocks designed for outdoor lambing can improve colostrum supply and lamb survival. Look for mannan oligosaccharides that improve colostrum quality and high trace element/vitamin E content and Megalac for lamb survival. Buckets can be targeted at triplets, underweight twin bearing ewes and gimmers – this avoids having to tube lambs with supplemental colostrum that is expensive and time consuming.

A combination of correct feeding, selection for maternal EBVs and culling ewes that need assistance can reduce interventions to under 10 per 1000 ewes

Rumenco has a complete range of products that fit with enhancing lifetime performance of sheep on UK farms. All products are backed up with extensive research enabling accurate feeding recommendations. Maximising lamb survival, whilst minimising input costs remain key issues on all sheep farms. The introduction of lower labour systems, greater reliance on home produced feeds and increased prolificacy puts greater demands on supplements.

NEW LIFELINE lamb & ewe is the only purpose formulated supplement available in free-access lick and protein formats for both the ewe and unborn lambs. Components include:

MOS **Mannan Oligosaccharides** are carbohydrate components of yeast cell walls that increase the production of immuno-proteins (e.g. antibodies) in ewe colostrum and the increase absorption of colostrum in the newborn lamb to boost immunity.

Selenium + Vitamin E

High levels boost immunity and thrive of newborn lambs encouraging them to stand and suck more quickly than with standard inclusion rates. Lambs have more vitality and "will to live." Selenium can reduce incidence of retained placenta in ewes and it boosts ewe body reserves to promote high milk yield in early lactation.

Lactose & Molasses

These are high-energy sources that increase dry matter intake and stimulate rumen papillae for increased absorption of nutrients across the rumen wall. Lactose is more effective at producing microbial protein than starch and molasses. This protein has a similar amino acid profile to fishmeal that is proven to boost colostrum protein levels. Typical levels of protein in colostrum are 3 – 4%, but this was increased to 13% by use of lactose in trials.

Zinc An extra high level (25%) of protected zinc (chelated) is included to encourage healthy udder, skin and hoof growth and help prevent mastitis..

In a trial carried out by SAC, the results of supplementing late lambing ewes with LIFELINE lamb & ewe were dramatic. The trial involved over 200 Lleyn ewes in two treatments replicated twice. Half the ewes were supplemented with a standard high-energy feed block, fed with grass silage and then turned out to grass. The other half of the flock received LIFELINE lamb & ewe feed block formulated to provide the same intake of energy and protein. 160 colostrum samples taken within 2 hours of lambing were analysed.

IgG levels in colostrum samples at lambing of ewes given LIFELINE and control

	IgG rep1	IgG rep 2	Mean	Level of sig
Lifeline	236.5	220.5	228.5	P<0.01
Control	176.6	189.2	182.9	

LIFELINE

Product formats: Choose the LIFELINE product that best suits your system

Format	Weight (Kg)	Offer rate per ewes	Typical Intake (g/ewe/day)
Bucket or Tub	22.5 & 100	1 bucket for 35-40	80g/ewe at grass and 150g/ewe indoors
Feed block	20	1 block for 35-40	200 - 400g
Protein meal	25 bag	n.a.	200g at lambing

Introduce 4-6 weeks pre-lambing.

Supplement LIFELINE at grass or at housing in addition to the standard feeding programme. It is ideal for mature ewes and particularly valuable for young ewes and ewe lambs, where colostrum yield and quality can be low. When feeding it do not add additional minerals.

An intake of 80-150g/ewe/day of LIFELINE gives best results. This can be achieved by supplementing with a single product or a combination of products. For example, introduce LIFELINE lamb & ewe buckets at 6 weeks pre-lambing followed by LIFELINE protein meal added to cereals at 2 weeks.

Proven in practice

Lamb survival is a key issue on most UK sheep farms and is of increasing importance with recent changes to more prolific breeds and to systems which involve low labour inputs such as outdoor lambing of large flocks.

A 1500 ewe outdoor lambing flock that previously was lambed in the house is now turned out on 1st. April, to lamb from 16th April. Ewes scan 195% rearing 160%. Shorn ewes are housed in pens of 150 with two round bale feeders for silage. Straw bales are put in and spread mainly by the ewes. Typically silages with an ME of 10.5 – 11.0 CP of 110-120 g/kg are used pre lambing.

- Lifeline buckets are fed from 1 month pre turnout, triplets get an additional 0.2kg rolls fed on the floor and from 2 weeks pre- turnout twins also get this- much cheaper and less time consuming. Lifeline buckets are also offered post turnout but intake is lower
- Costs for Lifeline were under £2.00/ewe, with forage costs under £5.00/ewe

Choose from the Rumenco range of products to meet mating needs

To avoid overfeeding of prolific ewes and ewe lambs around mating when high feed intake is counterproductive use Mineral Tab blocks or Supalyx buckets to supply essential cobalt and other trace elements involved in lamb viability through early effects on the embryo.

Supplement Nov /Dec. mated ewes on upland farms when feed intake may be below optimum. Trials on two groups of 200 ewes on three farms where pasture supply was scarce increased scanning from 160 to 176%. Block intake was approx half a block per ewe, a potential return of £650-800 for an outlay on Sheep Super Energy + Fish oil of £550

To avoid undue weight loss in pregnant hill ewes give access to the standard Rumenco High Energy and Protein and avoid lamb mortality.

Essential minerals for sheep

Minerals that are needed by ewes for growing bone and flesh include calcium, phosphorus, potassium, sodium, chlorine, magnesium and sulphur. These are needed in grams /day and are also important for nerve transmission and energy metabolism. Growing and pregnant animals need high levels of calcium and phosphorus for bone development, but these requirements fall in the finishing phase. Important trace elements needed in milligrams or less per day include copper, cobalt and selenium with infrequent deficiencies of iodine, zinc and magnesium. Iron and molybdenum together with the mineral sulphur are antagonistic to copper uptake.

Trace elements are normally involved in the production of enzymes which catalyse reactions, explaining their large effects for the very tiny amount involved. Also some have regulatory roles in switching on genes and iodine affects the formation of hormones such as thyroxine.

When fed a diet with inadequate levels animals become deficient once reserves are used up, then show disorder and finally clinical signs of disease. Minerals, unlike other feed ingredients are not metabolised away to CO_2 and water. They get recycled after use, some are stored and used later. Losses are mainly in the faeces so mineral requirement increases with dry matter intake.

Many farmers will supplement well before disorders or diseases are apparent to counteract potential un-thriftiness or reduced growth and fertility so oversupplementation is widespread. There are good body stores of calcium and phosphorus and most other minerals and trace elements to see sheep through short periods of underfeeding e.g. mid pregnancy or post weaning when low quality diets may be appropriate and demands low. However cobalt levels need maintaining constantly as this is not stored- being used by rumen microbes which then supply the animal with Vitamin B_{12}. Vitamin B_{12} deficiency during egg production and early pregnancy should be avoided as it has long term effects on lamb survival and productivity.

The concentration of minerals in lactation does not necessarily have to be higher as feed intake is high but does so in late pregnancy when intake is constrained. Roundworm infection can seriously impair mineral uptake of phosphorus and this can be exaggerated by low cobalt levels

Supplementation with minerals and vitamins for lamb survival

Trace elements in plants are derived from soil and their availability is therefore based on underlying geology. This varies with location, particularly for cobalt and copper. Selenium is almost universally deficient. Major suppliers of supplements and blocks do regular free testing of forages for clients and using a postcode database can give a general idea of local problems but forage or blood sampling is recommended before supplementing. Compounders include standardised mixes in compounds, blends and balancers for on-farm mixes. At normal feeding levels these will supply sufficient to prevent the known deficiencies. There is increasing evidence for use of Selenium and Zinc in their organic forms, which are more available to the animal.

A good supply of iodine is essential for the newborn lamb to control its body temperature and avoid hypothermia. Selenium is required to assist the metabolism of iodine and along with Vitamin E to protect muscles from damage. Selenium also has a specific role along with iodine in the 'burning' of brown fat to produce heat for the newborn.

Feeding that bit extra

Extra selenium and vitamin E has been shown to increase lamb vigour at birth and is needed with swede based diets and with moist grains (e.g. propcorned barley). Diets high in unsaturated fats increase Selenium and vitamin E requirements. Results from a recent review identifies adding additional Selenium, vitamin E and long chain n-3 fatty acids as found in fish oils - at above normal diet recommendations have the best chance of improving lamb vigour and survival.

Dangers of overdoing it

Although in trials feeding extra long chain fatty acids such as docosahexaenoic (DHA) improves lamb vigour, additions of fish oil a rich source of DHA have been found to reduce ewe colostrum and milk yield. Above 7% oil in the diet rumen function is disrupted. In the past some manufactures of feed supplements used excessive Iodine levels that provided above 10 mg/day (particularly where free access minerals were fed indoors). This was found to interfere with the lambs' ability to absorb antibodies in colostrum. This is a warning to stick to recommended feeding levels and not to overdo it.

Farmers are generally recommended to address energy and protein deficits in diets before resorting to supplementation with Min/Vits as there is widespread overuse. When trace elements are needed without extra energy and protein use mineral blocks and mineral buckets or individual animal treatments.

Specific pasture applications of Cu (optional for sheep pastures where toxicity may be a risk), selenium, copper, iodine, zinc and sodium (as salt) can be useful where grass palatability and trace elements are low, e.g. lighter sandy soils and old pastures. Obtaining cobalt salts for farmer application to pasture is no longer possible due to concerns on safety as there are carcinogenic risks. High circulating urea levels caused by too much rumen degradable protein (or overfeeding urea) can reduce embryo quality.

Grazing animals

Grazers are dependant on plant mineral content, but plants, having no use for iodine, selenium or cobalt can appear healthy despite their tissues being deficient for animals. Thus animals grazing on good quality pastures can still be deficient. Soil acidity can affect mineral uptake, hill reseeds are often copper deficient because molybdenum uptake is much higher at higher pH (above 6.0) and this interferes with copper uptake. High levels of sulphur, and iron are also antagonistic and reduce copper uptake. There are equations to correct for the availability of copper using values shown in a feed analysis. High nitrogen levels can reduce copper and magnesium content but other minerals are not affected. Using high levels of nitrogen suppresses clover which is mineral rich. Water-logged soils are higher in cobalt, but high rainfall reduces selenium content. Generally as plants mature the major minerals, calcium and phosphorus, are reduced, especially after seed fall.

Most soils have higher trace element content than the grass and clover growing on them. Herbs such as chicory and plantain concentrate trace elements and minerals and can be two to four times higher than grass and are useful for correcting moderate deficiency. Outwintered stock on grass may ingest 10 – 15% of their diet as soil which increases the availability of cobalt, iodine and selenium.

Selenium (Se) is a component of many important proteins associated with metabolism. It is involved in competence of the immune system, DNA function, male fertility and the detoxification of harmful molecules. Sheep are adapted to absorb organic Se e.g. Alltech Sel-Plex® as opposed to inorganic Se which is poorly absorbed and stored.

In trials economic responses have been demonstrated to supplemental Sel-Plex® given to pregnant ewes and transferred to their lambs through the colostrum (see Figure 1). The cost at 13 p per animal for an 84 day supplementation increased lamb value by £2.96. The mechanism is understood to be through improved stress resistance and increased ability to withstand disease challenge leaving more energy for growth and gain.

Two other Alltech products Bioplex Zinc ® and Bio-Mos® are also incorporated into ewe feeds and have effects on lamb performance but through different mechanisms. Zinc is involved in the function of the immune system and skin and hoof integrity, providing an effective physical barrier to micro organisms, allowing more energy to be put into growth (see Table 1). Bio-Mos® is derived from yeast and has consistently improved the transfer of immunoglobulin (Ig) to lambs. Key component are mannan-oligosaccharides that improve immune function via increased transfer and absorption of Ig. They also improve gut structure and out- compete harmful bacteria, resulting in improved FCE and faster growing healthier lambs (see Figure 2).

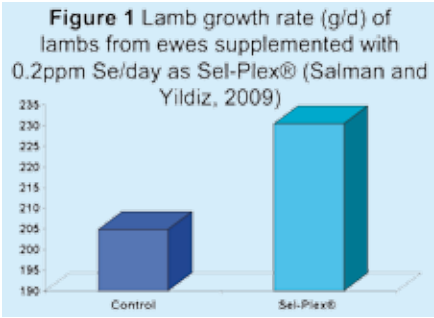


Figure 1 Lamb growth rate (g/d) of lambs from ewes supplemented with 0.2ppm Se/day as Sel-Plex® (Salman and Yildiz, 2009)

Table 1. Effect of ewe supplementation with zinc on lamb performance (adapted from Mackenzie *et al*., 2005)

Liveweight (kg)	Bioplex Zinc®	Zinc oxide
Birth	4.51	4.56
7 days of age	6.36	6.41
14 days of age	8.74	8.43
21 days of age	10.36	9.81
28 days of age	11.96	11.15
Growth rate (kg/d)	0.264	0.232

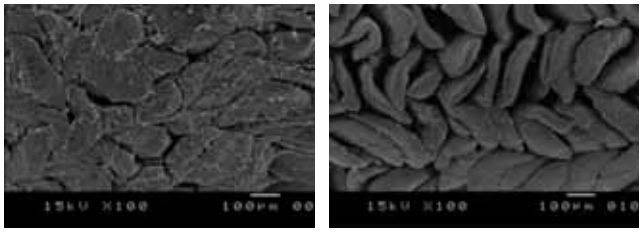
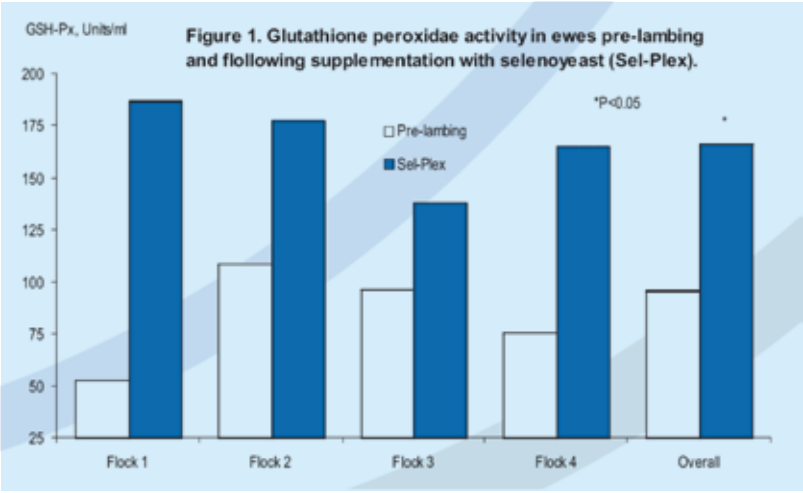


Figure 2 Electron micrograph of the structure of the small intestine without (A) and with (B) supplementation of a mannan-oligosaccharide (Bio-Mos®, Alltech Inc., Nicholasville, KY)

Improving the Selenium Status Of Welsh Ewes

Feed trials on four Welsh farms showed Sel-Plex® increased autumn baseline selenium containing enzyme glutathione peroxidase (GSH-Px) when fed over 12 weeks before and after lambing. Overall levels increased from 100 to 170 units per ml, a significant difference.



Bio-Mos® and UK Lamb Performance

Two hundred lambs from twin-bearing ewes on a farm in the UK were fed ad lib concentrate with or without the additional of Bio-Mos® at 4kg/tonne. Lambs were slaughtered at ~ 12 weeks of age. Performance shown in Table 1 resulted in cost benefits

Table 1 Carcass weight and value from lambs with or without dietary supplementation of Bio-Mos®

		Control	Bio-Mos®	Significance
Kill Out	%	49.4	50.3	p<0.05
Carcass Wt	kg	20.0	20.3	ns
Value	£	46.01	47.00	p<0.05

Bio-Mos® and the growth and health of UK-reared lambs

Further trials have shown addition of Bio-Mos® at 2 kg/tonne to ad libitum lamb creep improved lamb gain in 800 Finn-Dorset lambs by 10% and significantly reduced veterinary treatments and mortality.

Take home messages

- **Year round attention to detail is needed.**

  For example, trace elements from very early in life can have big effects, so relying on pre-lambing supplementation alone is not the answer.

- **Not all sheep are the same**

  A "one size fits all" approach to your sheep is inappropriate as prolific breeds and first time lambers need different management. These should be held in constant condition a month either side of mating.

- **New rules – new practices**

  If holding condition do not undersupply cobalt as this can affect lamb viability through effects on the developing embryo.

- **An 18% CP ewe concentrate is an inadequate description**

  We need to dig deeper than looking just at the crude protein content of concentrates for pregnant sheep. We continue to get basic feeding wrong by underfeeding rumen undegradable protein in late pregnancy.

- **Getting it right saves lives**

  Extra rumen undegradable protein not only improves milk supply and lamb birth weight but also has long term effects on immunity and bonding between the ewe and lamb. Feeding extra to multiple bearing ewes also reduces the worm challenge to their lambs.

  Use this information to update your feeding methods

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