TECHNICAL NOTE TN767 / July 2024

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Management & Selection of Rams for Efficiency

Rams play an essential role in the business success of any breeding sheep flock. The following guide aims to aid ram management decisions including feeding management, condition scoring, selection of both maternal and terminal rams, pre-buying considerations, sale day and health.


Image by Kirstyn Blackwood

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Section 1 – Economic and general management

Economics

How many lambs a ram leaves in his lifetime determines the return on his purchase cost. The table below shows effects of the number of mating seasons and ewes per ram mated on cost per lamb born assuming a 150% lambing percentage and a £800 ram.

Lifetime (mating seasons)	**No. ewes mated per season per ram (lambing at 150%)**			
	40	60	80	100
1	13.33	8.89	6.67	5.33
2	6.67	4.44	3.33	2.67
3	4.44	2.96	2.22	1.78
4	3.33	2.22	1.67	1.33

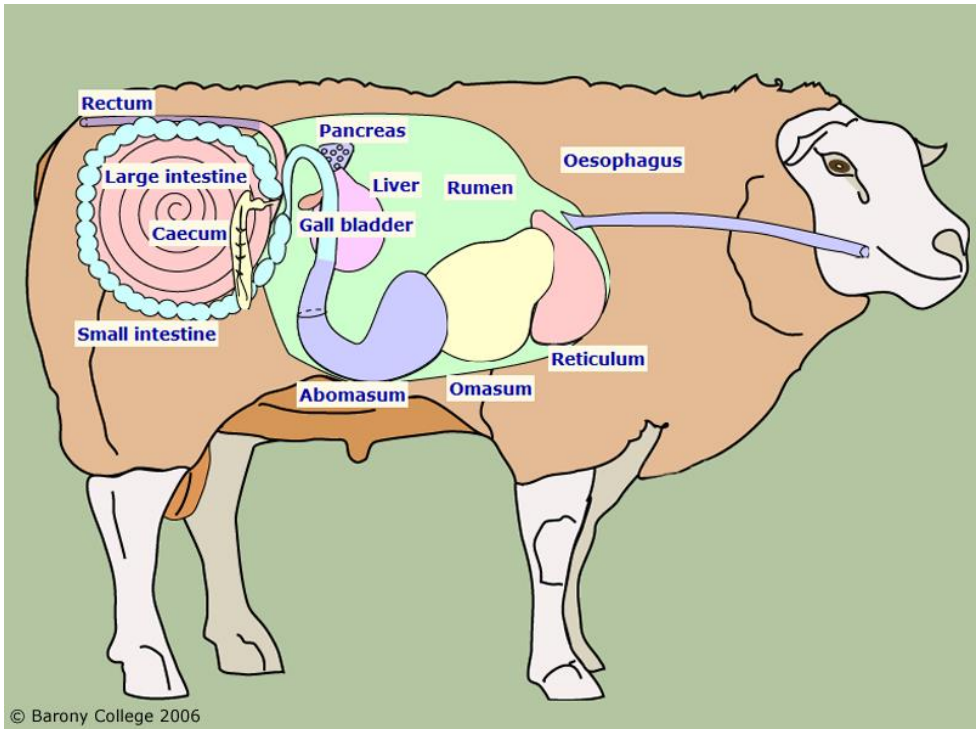
The potential saving in ram costs per lamb born are around £5 where rams are able to mate 100 ewes per year for 4 years compared to 40 ewes per year for 2 years.

The number of ewes a ram can mate depends on how many ewes he is allocated. A typical ram to ewe ratio for lowland flocks is 1:40. However if rams are young or the environment is more rough hill ground then the number of ewes per ram should be lowered. The number of ewes per ram should also be lowered when teaser tups have been used due to the increased number of ewes cycling, usually 1:25-35. Some prolific, grass-reared breeds can be worked at 1:80, provided the ram is not over-fat and has good legs and feet.

Feeding Rams for breeding:

The ram sales and tupping time are undoubtedly the most prominent periods in the ram's calendar, however effective management necessitates all year-round attention. The ram accounts for half of the flock but can often be forgotten throughout the year. Nutrition is a key part of the success of the ram and their fertility status; therefore, it is vital to feed rams to their nutritional requirements to maximise growth potential without compromising longevity.

Rumen Function and nutritional terms:



Overview of ruminant digestive system

Optimal rumen function is fundamental to the health and productivity of the ram. The ram relies on the microbial population within the rumen to break down the feed that it ingests, to provide the majority of its energy and protein needs. More information on the role of the rumen microbes and digestion can be found in the guide to ruminant nutrition and forage analysis.

Terms used in ruminant nutrition and referred to in this guide include:

- Dry matter (DM) - refers to the feed component that remains after the removal of water.
- Metabolisable energy (ME) - is the amount of energy in the feed available minus the energy lost in the faeces and urine.
- Metabolisable protein (MP) - ruminant protein requirements are expressed as MP. This is made up of two sources: microbial protein (made by the rumen bugs and forms the greatest proportion) and digestible undegradable protein (DUP), which is protein that bypasses the rumen and is absorbed in the small intestine.
- Rumen pH – the rumen uses several homeostatic mechanisms to maintain a fairly neutral pH of around 6.5 - 7. Providing fibre in the ration is vital to promote saliva production and maintain an optimal pH.

Therefore, it is important for any ration to be balanced to meet the ram's requirements and optimise rumen function.

Ration formulation based on requirements:

For the first 150 days, up to weaning, feeding must allow full expression of growth potential. Milk, creep feed and high-quality forage are important ingredients of the diet. Growth rates of up to 500 g/day are feasible and can average 400 g/day, so typically a ram should weigh 60 kg at 20 weeks (scanning weight) in August. A terminal sire ram born in mid-March should weigh around 100 kg (breed dependent) by sale in mid-September at 550 days of age.

Subsequent increase in weight totalling 40 kg to reach target weight at sale can be quite moderate, averaging about 100 g/day for 400 days. The ME requirements in Table 1 should be achievable without the need for high levels of concentrate feeding. Good grass management, forage analysis and formulating a well-balanced

ration are key to meeting growth targets. During housing it is also important to ensure good feed access and removal of old feed material.

Table 1. Energy requirements for rams brought out to be used as shearlings:

Period (days)	Target weight at end of period (kg)	Daily gain (g/day)	Metabolisable energy (ME) (MJ/kg DM)	Feeding Notes
Birth – Back fat scanning (140 days)	60	400	22.8*	Grass & Milk base of diet. Provide *ad lib* high energy, 18% protein creep feed depending on grass management availability. Ensure trace elements are supplemented, especially cobalt.
Scanning – housing (110 days)	75	100	15.3	Concentrate feeding may be required depending on grass availability/quality.
Housing – turnout (150 days)	85	80	17.7	Analyse silage/hay and supplement if required.
2nd summer grazing – midsummer (90 days)	95	110	20	Grass should be sufficient – monitor grass height. Supplement with trace elements.
Preparation for sale (60 days)	100	85	19	Avoid excessive feeding of concentrates, no more than 0.5kg per feed.

Notes: *Requirement is based on 30kg lamb

Table 1 shows the highest requirements for growth are from birth – scanning. This is because ram lambs are at their most efficient, with a feed conversion ratio of 4:1, meaning they can convert 4 kg of feed into 1kg of liveweight. As lambs age this decreases to around 12:1. Up to weaning the ration will be based on grass and milk predominantly, alongside a high energy, 18% creep feed available *ad lib* if grazing is insufficient or ewes and lambs are beginning to compete for resources. At weaning lambs should be put onto best pasture available, depending on the grass cover at this point the level of concentrates offered could be reduced. Ensure trace elements are supplied if concentrates are reduced as grass alone will generally not meet requirements, particularly for cobalt.

After scanning rams should have reached a target weight of 60kg. At this point feed conversion efficiency reduces and grass quality deteriorates putting less pressure to achieve a high growth rate, with a modest target of an average of 100g/day until sale. The amount of supplementation required will be dependent on grass management.

At housing, a growth rate of around 80 –100g/day should be easily achieved on forage. However, if and how much supplementation is required will depend on the quality of the forage available, therefore ensure you have analysed the silage or hay to feed to requirements accurately.

During the ram's 2nd summer grazing, grass alone is sufficient to meet their full requirements for energy and protein. A trace element supplement should also be provided. In the 2 months prior to sale concentrates can be fed but it is advisable not to feed more than 0.5 kg per feed of concentrate to reduce the acid load on the rumen.

Feeding mature rams

Mature rams have moderate energy and protein needs for maintenance, table 2 shows the requirements for maintenance of rams at 80 kg and 100 kg mature weight. Feeding hay of average quality (around 8.5 MJ of ME/kg DM and 10% CP) fed *ad lib* will be sufficient to meet these requirements. A hay analysis from a reputable lab will ensure that forage alone is sufficient, if the quality is less than stated above then supplementation with concentrate will be required.

Table 2: Energy requirements of mature rams maintaining body condition

Ram weight (kg)	Metabolisable energy (MJ/day)	Feeding notes
80	12.3	*Ad lib* average hay (8.5 ME, 10% CP), during housing/winter when grass availability is limited. Ensure good feed access.
100	14.6	

Spring grass meets their full requirements for energy and protein but as the grazing season progresses grass quality falls and rams may lose condition. Low stocking rates result in stemmy pastures of lower digestibility but frequent mowing where possible will help maintain pasture quality into August. If rams condition score is less than 3.5 at mating, on grass alone then up to 0.5kg of concentrates/day should be provided. It takes 8 weeks to produce sperm, so rams must be inspected 12 weeks before turnout to ensure they have sufficient time to gain condition and treat any ill health.

Practical feeding guidelines:

To avoid the problems caused by sub-acute acidosis do not exceed 40% of concentrates in the total dry matter of the ration. Where concentrates are fed follow these guidelines:

- Feed grain whole and do not exceed 0.5 kg per feed
- If processing grain, avoid over processing a light crack is sufficient for mature rams
- Provide long roughage to encourage the flow of saliva. Saliva contains sodium bicarbonate which acts as an important buffer
- Replace up to 30% of starchy cereal with a digestible fibre source such as sugar beet pulp, soya hulls or roots
- Feed forage *ad-lib* as hunger increases variation in intake at the trough
- Allow enough trough space so all can eat together (roughly 1.5 x ewe trough space allocation).
- Ensure there is always access to clean water
- In a total mixed ration use ingredients that are not separated easily
- Allow the rumen time to adapt to changes in the ration by building them up over 2-3 weeks
- Excessive concentrate feeding should be avoided, some studies have shown that in cases where lambs have been fed a predominately concentrate-based ration that the rapid growth can lead to a reduction in bone density. This can leave concentrate fed lambs prone to joint defects which manifests as lameness or wobbly walking.

Body Condition Scoring (BCS):

Body condition scoring is a simple, effective management tool to evaluate body reserves of adult sheep. A body condition scoring guide is available here:fas.scot/downloads/tn702-body-condition-scoring-mature-sheep/. Body condition scoring is a physical rather than visual examination of sheep, scored on a scale of 1-5. A unit of body condition equates to around 12% of the mature sheep's liveweight. Therefore, a 100 kg ram

would need to lose or gain 12 kg to move a condition score. This level of weight loss/gain takes management and time.

A pre-mating check should be carried out 8-12 weeks prior to being introduced to the ewes. This should include checking the rams condition score, feet, teeth, testicles and general health. This will allow sufficient time to change the ration, if required, to achieve target body condition at mating.

Rams can lose up to 15% of their body weight during the mating period. If rams condition score is less than 3.5, 6 weeks pre mating on grass alone then up to 0.5kg of concentrates/day should be provided. This will increase energy, allow for body condition recovery, testicular growth and semen production. It takes 8 weeks to produce sperm, so rams must be inspected 12 weeks before turnout to ensure they have sufficient time to gain condition and treat any ill health.

Over-fat rams (BCS >4.0) can also be an issue as they may be too heavy for some ewes, as well as having a reduced libido and be lazy to mate. In addition, fat in the scrotal neck can increase the temperature of the testes, reducing semen quality.

When the rams are in with the ewes, it is good practice to change the colour of the raddle every 7-10 days, starting with a lighter colour e.g. yellow, then change to red. This will give you essential information when ewes are batched for housing. However, ill-fitted keel harnesses can cause slow to heal brisket sores that reduce condition, therefore keep an eye out for any sores. Keel paint is another alternative which may be preferable if you are finding issues with raddles.

Once the ram is removed from the ewes, he will need care and attention, particularly those that are below body condition score 3.0. Ideally, he should be taken indoors or to a sheltered field and offered concentrate feed (up to 0.5kg per day) alongside good quality forage. Severe loss of condition during the mating period of up to two units of condition endangers ram welfare and may predispose rams to respiratory disease and other infections. Good foot care is also essential, as this can often be an underlying cause of condition loss.

Frequent body condition scoring with appropriate feeding:

- Minimises welfare problems
- Reduces losses
- Maximises longevity and mating success

Table 3: Target scores for rams

Period	Score	Notes
Pre-mating/ mating	3.5 -4.0	Prior to mating, depending on grass availability supplementation may be required to meet target.
Post-mating (Winter)	3.0	Provide good quality forage, supplementation may be required depending on forage quality. Rams below 3.0 will require supplementation.
Summer	3.0	Grass and a mineral/vitamin supplement should be sufficient. May require supplementing towards the tail end of summer as grass growth declines.

Nutrition related health disorders in rams.

Risk management of urinary caliculi (gravel)

Concentrate-fed ram lambs are prone to the precipitation of mineral elements in their urine. The precipitate takes the form of crystals that block the urethra, thus restricting the passage of urine out of the bladder.

Minimising the risk of urinary caliculi in concentrate fed rams involves careful diet formulation. Avoiding excess magnesium intakes by limiting inclusion rates of feeds with magnesium content over 0.4% and adding ammonium chloride to the diet can reduce the pH of the urine, thereby reducing the tendency for crystal formation are key to reducing the risk. Protein sources such as rapeseed meal and feed by-products such as wheat feed, maize gluten and molasses are high in magnesium, as shown in Table 4.

Table 4: Variation in magnesium content of common feeds fed to rams

Feed Source	% magnesium in DM
Maize gluten	0.52
Wheatfeed	0.52
Rapeseed meal	0.47
Molasses	0.44
Maize distiller grains	0.37
Hipro Soyabean meal	0.34
Wheat distiller's grains	0.26
Sugar beet pulp	0.21
Barley/Wheat/Oats	0.1 - 0.3

Guidelines to prevent urinary caliculi:

Dietary factors that cause a high incidence of calculi in lambs:

- High levels of concentrate feeding – availability of P is high from concentrates
- Low forage intake – high forage diets reduce the availability of P
- High P (over 4.7 g/kg DM) in the diet.
- High Mg (over 2.5 g/kg DM) in the diet.
- A low ratio of Ca:P (less than 1.5:1) in the diet. A high Ca:P reduces the absorption of P so reduces urinary excretion.
- Low water intake – increases the concentration of minerals in the urine
- Genetics - there is a genetic difference in the efficiency of absorption of P in sheep, with Blackface and Texel breeds absorbing more P from their diet than other breeds. This means that these breeds also excrete more P in their urine and therefore are more at risk from developing calculi.

Measures to avoid urinary calculi in lambs:

- Feeding diets, and ingredients, low in P (less than 4.6 g/kg DM) and Mg (less than 2.3 g/kg DM).
- Feeding diets high in Ca
- Maintaining a high ratio of Ca:P. This ratio should be at least 2:1 but preferably nearer 3:1.
- Provide rock salt
- Always maintain an adequate supply of clean water
- Making the urine more acid by including (0.5%) ammonium chloride in the diet. Crystals are less likely to start growing if the urine is acid rather than alkaline.

Acidosis

Concentrates contain a high level of readily available carbohydrates in the form of starch, therefore consuming large quantities can lead to a rapid decrease in the pH of the rumen fluid (<5.5). Highly processed (ground, milled), energy-rich cereal grains (barley, wheat, maize) are the components of concentrates with greatest effects. The mechanisms used to maintain the rumen pH can become overwhelmed, leading to rumen acidosis. In extreme cases this can cause damage to the papillae that line the inside of the rumen wall. As a result, bacteria can enter the blood stream leading to liver abscesses and sudden death.

Section 2 – Ram management for longevity

Mating management and grazing risks

Rams serving 100 ewes should be used in groups of at least three rams along with mature ewes. They need to be stocked reasonably heavily at over 25 ewes/ha on saved grass. Move the mating group to a fresh field when half the sward height on offer has been removed by grazing. Normal ratios are recommended for rams used on an open hill. Prior to mating the rams should be looked over by a vet as many potential reproductive problems can be detected by physical examination and, if unsure, a vet can take a semen sample for analysis.

Red clover

There has been historical concern regarding the impact of feeding pasture high in red clover on the fertility of ewes and rams. This is due to the concentration of formononetin which is a Phyto-oestrogen that can inhibit ovulation in ewes. There is very little evidence to suggest an impact to ram fertility from feeding high red clover swards with research dating as far back as 1946 suggesting there to be no negative impact on male fertility (Marley *et al,* 2011). Plant breeders have been actively reducing the concentration of formononetin in red clover varieties with the risk to fertility thought to have reduced for ewes, and some field studies such as those ran by ADAS in 2022 suggest potential benefits. However, advice would remain to avoid grazing ewes on dominant red clover swards (>30% red clover inclusion) for 45 days pre and post mating to avoid any potential risk.

Sewage pellets

Research at MLURI and SAC has found that in sewage sludge pellets there are chemicals, each benign within its own EU safety limit, but as a cocktail, they act as endocrine disrupters. Through foetal programming, they can have lifetime effects on ram behaviour and reduce the number of Sertoli cells in the testes that connect and nurse the sperm-producing cells. Whilst sewage sludge-treated pastures grow a lot of grass and are safe for finishing animals, they are best avoided by the ram breeding flock.

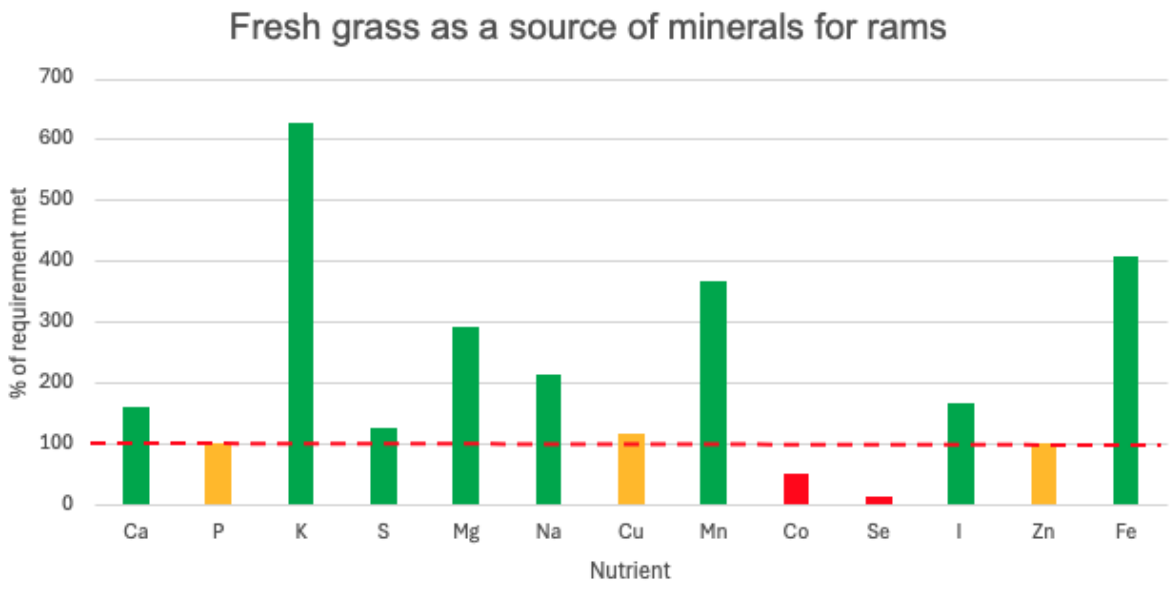
Multi-species swards for rams

Grazing high nutritional value multi-species swards (MSS) can offer an excellent alternative to concentrate feeding. There has been an increase in the use of MSS over recent years due to the many benefits they provide. MSS contain three or more species from three plant groups: grasses such as perennial ryegrasses, legumes such as clover and herbs such as chicory and plantain. Grazing high nutritional value multi-species swards (MSS) can offer an excellent alternative to concentrate feeding, while increasing lamb growth rates.

For more information on MSS go to: fas.scot/downloads/grazing-for-profit-and-biodiversity-multi-species-swards/

Trace element problems

Figure 1: Typical analysis of fresh grass as a source of minerals



Note: Mineral content of grass is based on average figures and will not be the same for every farm depending on soil type, management and diversity of the sward

Grass is likely to be low in the trace elements cobalt and selenium, and occasionally there are deficiencies of zinc and copper. This is illustrated by figure 1 which shows there is a shortfall of cobalt and selenium, and copper and zinc are marginal. Rams have high nutritional requirements for zinc, cobalt and selenium.

Requirements for zinc are affected by ram liveweight, growth rate and diet composition, with those on a more concentrate, cereal rich diet possibly benefiting from a higher level of zinc than a grass/silage-based diet. This is due to the lower availability of zinc in cereal diets and higher antagonism. Zinc is critical for sperm health and fertility in rams, however exceeding requirements has not been found to improve sperm numbers. Rams may also benefit from added PUFAs (poly unsaturated fatty acids, as found in fish oils for example) and vitamin E, which are low in mature grass.

Rams can be prone to copper accumulation and toxicity, often due to high levels of concentrate feeding, with Texels and Lleyns being susceptible breeds. Molybdenum and sulphur exert antagonistic effects on copper availability. Copper levels must be kept below 15 mg/kg as fed in complete feeding stuffs, take technical advice on copper levels when home mixing.

Trace elements, minerals and vitamins can be provided by proprietary supplements. MSS tend to have higher levels of trace elements and minerals compared to a perennial ryegrass sward. However, studies from SRUC have shown that mineral levels fluctuate throughout the growing season. Therefore, it is advised that a fresh grass sample is taken during the growing season when the pasture is most representative of what your lambs are grazing, early morning is often a good time. Your local adviser can organise this and advise on the need for supplementation.

To identify any deficiencies blood sampling can be done by your vet 10-12 weeks prior to tupping. If deficiencies are detected discuss supplementation with your vet or nutritionist. Note if you suspect a copper deficiency blood is not the most accurate measure of copper accumulation.

For more information regarding trace element requirements of sheep please refer to the FAS trace element supplementation in sheep flocks fact sheet.

Section 3: Purchase and Selection

Ram Purchase

When buying a ram, it is important to balance the quality element he will bring to his future offspring with the quantity of live lambs produced. A ram with good carcass traits will make progeny sell well at live auction but may also bring undesirable traits into the breeding flock such as poor lambing ease or a reduction in milk subsequently increasing labour. Many breeds of ram have changed shape over the last 30 years with legs shorter, conformation blockier and bones thicker and many new breeds also introduced into the breeding system. These changes brought about by selection for genes affecting bone morphogenesis may reduce the ease with which lambs are born in some breeds.

Image by Kirstyn Blackwood

Selecting maternal breeds on shape is very risky as the maternal component of lambing ease is likely to be affected by this. The easiest lambing ewes have a large pelvis and the right pelvic angle, this is not readily observable so you cannot breed for it by looking at the ram. This is where maternal EBVs are useful as it combines milk production (8-week weight) and lamb-rearing ability.

Selecting a maternal sire

Image by Daniel Stout

The main purpose of a maternal sire is to breed female progeny for flock replacement. Many maternal traits such as lambing ease, prolificacy, milking ability and vigour are not easily identified by assessing the ram on carcass and appearance alone.

A maternal sire's genetics will remain with the flock for years to come through his daughters so making the right decision at purchase is crucial for future success of the breeding flock. In order to aid decision making estimated breeding values (EBVs) can prove a useful tool to indicate the breeding merit of a maternal sire. Note: EBVs can only be used to compare rams within a single breed not across breeds. The weighting of each EBV at selection may depend on flock goals. For example, if we are looking to reduce ewe mature size

but also ensure lambing ease, we may look for a ram with a negative value for mature size but positive for lambing ease and maternal ability.

Desirable maternal traits to look out for include:

Index	Indicator
Maternal Ability	Ewe's milking ability and ability to wean heavier lambs
Litter Size	Ewe prolificacy
Mature Size	Mature ewe weight
Lambing ease (%)	Direct – Potential for a lamb to be born without assistance
Lamb Survival	Ability of the lamb to survive post birth.

For more information of EBVs please refer to the FAS – Using estimated breeding values in sheep guide.

One of the most important factors when choosing any ram is lamb survival, if survivability is poor, we do not have a lamb to grow the flock or sell. Some of the main causes of mortality around lambing include hypothermia and dystocia (difficult births). Selection for heritable traits such as lambing ease, lamb vigour, and suckling ability can be beneficial to increasing survival in the flock.

Selecting a terminal sire

Terminal sire selection will focus heavier on carcass traits and less on the mothering ability to select a ram that will produce profitable lambs for slaughter. Therefore, we are ideally looking to purchase a sire to the flock that will produce lambs with high growth rates and a good balance of lean muscle and fat in the carcass. A ram that produces offspring that is effective at converting forage to meat efficiently is also highly desirable.

Some of these carcass traits can be more visible compared to maternal traits. However, care must be taken to select a terminal ram in good condition due to genetic capability rather than a high level of feeding which may promote higher levels of fat rather than lean muscle. It is important that the ram is fit for purpose

(condition score 3.5-4.0) and is ready to work when he arrives. For grass-based systems a small positive in fat depth may be beneficial to help lambs reach finishing spec sooner. However, care must be taken to avoid lambs grading high for fat which may result in penalties at sale.

Desirable growth and carcass terminal EBVs include:

Index	**Indicator**
Eight Week Weight (kg)	Early growth potential
Scan Weight (kg)	Growth potential up to scanning (17-21 weeks old)
Muscle Depth (mm)	Depth of muscle across the loin
Fat Depth (mm)	Fat cover across the loin

Pre Buying Checks

Teeth

Shearling rams should have two broad incisors that meet the hard pad at right angles and are not sloping forwards. You should also check that the ram does not have any jaw abnormalities, gaps or molar abscesses.

Toes

A good breeding ram should be sound on all four feet with good locomotion, no interdigital growths. Legs should all be correct without any bone abnormalities.

Testicles

All rams should have two testicles that of are even size that move freely in the scrotum. Ideally they should feel firm not solid, are free from any hard lumps and have an epididymis the size of a table tennis ball at the base.

Measuring the scrotal circumference is a good indicator of male fertility and serving capacity. It is also correlated with early maturity of female offspring. Rams with a greater scrotal circumference are more likely to leave ewe lambs that will breed in their first year. The target scrotal sac circumference is as below:

Maturity / Size of Ram	Target scrotal sac circumference (cm)
Lowland Mature	36 - 38
Hill Mature	34 - 36
Lowland Shearling	32 - 34
Hill Shearing	30 – 32
Lowland Lamb	30
Hill Lamb	28

For more information on ensuring rams are fit for breeding please refer to the tupping toolkit.

Navigating Sales

Direct from Farm/ On Farm Auction

Many sheep producers are now opting to buy rams directly from the breeders in a private sale or at a growing number of on-farm auctions. This comes with many benefits to the buyer and allows the seller to sell rams directly from the farm in a more “natural state” than required for sale through an auction market or society sale often without the need for much additional feeding or dressing.

Benefits of buying directly from the breeder:

+ Increased knowledge of how the ram has been produced and the type of farm he has been bred on
+ Reduced risk of disease due to less mixing of sources at sale.
+ Often sold in their “working clothes” rather than hard pushed.

Risks of buying directly from the breeder:

- No option to compare rams from different breeders.
- Price must be negotiated often before larger sales have occurred to gauge the market.

Auction

Auction sales still remain a popular way to sell male breeding stock with sales starting late August and continuing to early October.

Benefits of buying via auction:

+ Offer a large selection of breeders to select a ram from within a single breed.
+ Will often include multiple breeds in one sale meaning if you are buying more than one breed they can be bought in a single day.
+ Prices can determined via market demand.

Risk of buying via auction:

- Increased risk of buying in disease due to the mixing of rams from multiple sources.
- Rams should be dressed to society guidelines, take care to inspect rams before buying to ensure imperfections have not been hidden remember: Teeth, Toes, Testicles!

Purchase checklist

To ensure you are buying the correct ram for the job you intend for him to do, the following checklist can be used to ensure all questions have been asked, for more information and questions to ask the breeder please refer to the FAS: Ram Selection Factsheet.

- ☐ **Teeth**
- ☐ **Toes**
- ☐ **Testicles**
- ☐ **Health Status**
- ☐ **Estimated breeding values (EBVs) meet breeding goals.**
- ☐ **Feeding: Grass based Vs Concentrate**
- ☐ **Conformation**
- ☐ **Reputable Breeder**
- ☐ **Fits the system: hill, upland or lowland**

Post sale Biosecurity

To prevent any unwanted disease being brought into the flock, and therefore any unwanted post buying costs, biosecurity post sale is of upmost importance. Try as much as possible to buy from flocks of known health status and use a quarantine health plan with your vet. Typically, the health plan will recommend that:

- New sheep to the flock are kept separate from the existing flock by at least 2 metres (no nose-to-nose contact).
- Quarantine for at least 28 days.
- Use separate handling facilities.
- Equipment should be sterilised in between groups of sheep.
- Fully disinfect protective clothing between groups and preferably have separate PPE for quarantine use.

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Production of this Technical Note was funded by the Scottish Government as part of its Farm Advisory Service.