RuSource
the rural information network

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Briefing 1196

Improving sheep through genetics

Summary

The challenge is to speed the uptake of genetically superior recorded animals and exploit new technologies to provide animals fit for purpose. The performance of recorded animals offers benefits over average animals in terms of growth rates, carcase quality and maternal ability. New technologies used for example to breed for worm resistance can further develop sheep.

This paper is summarised from Chapter 8: "*Improving the UK sheep industry over the next decade, through genetic improvement" taken* from the report of The Royal Agricultural College and Rumenco 100 Club Annual Fellowship in Beef and Sheep by Nick Allen Sector Director, EBLEX. Further chapters are summarised in other papers. The full report is at:
http://www.eblex.org.uk/documents/content/publications/p_cp_rac_sheep_report_281010.pdf

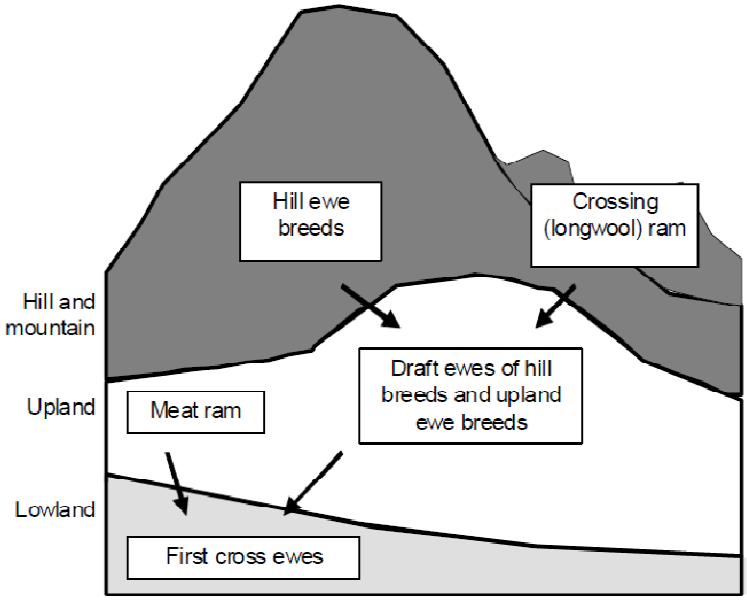
The UK's unique stratified breeding structure

The UK sheep industry is often criticised for having a plethora of breeds and crosses. In truth, this is the down to the varied terrain and climate in which breeds have evolved. It is characterised by a stratified three-tier breeding structure related to the altitude and quality of grazing.

The two components which affect the efficiency of meat production most are the reproductive performance of the ewe and the growth and carcase characteristics of the lamb. Consequently, specialised sire and dam breeds or crosses are often used. The dam breeds, where ewe reproductive traits are most important, are generally kept in low input/low output systems (e.g., Swaledale) and the sire breeds, which are bred for growth and carcase characteristics are usually reared on better land (e.g., Texel).

Stratification exploits both breed complementarity and heterosis. The production of crossbred ewes from hill breeds by crossing with longwool rams results in ewes with higher prolificacy and bodyweight than their pure-bred mothers and maximises heterosis for maternal traits, survivability etc. The use of terminal sire meat breeds on the crossbred ewes then provides the means to tailor the slaughter lamb carcases to meet the requirements of the market.

Figure 8.1: Stratification of the UK sheep industry



Value of recording to commercial producers

Commercial sheep producers can enhance the productivity and profitability of their flocks through the use of recorded rams.

In Terminal Sire breeds, rams with high scan weight Estimated Breeding Values (EBVs) can be used to increase carcase weights or to cut the number of days taken for lambs to reach slaughter weight, reducing costs of production. Rams with high muscle depth EBVs will enhance carcase conformation gradings, whilst those with low fat depth EBVs can be used to produce leaner carcases. This benefit is worth an extra £2.50 to £3.00 per lamb.

In maternal breeds, increases in the number and weight of lambs weaned can be worth over £600 per ram during its working lifetime.

Within-breed selection

Although the majority of slaughter lambs in Britain are cross-breds, the pure-bred flocks have an essential role to play in the production of high genetic merit breeding stock for use in commercial flocks. Selection within breeds involves comparing animals of the same breed and mating the preferred animals to produce the next generation. Selection “by eye” can be misleading so recording schemes use both performance and pedigree records to identify animals with high genetic merit for traits of interest (e.g., growth, litter size etc) to disentangle the effects of genes and the environment on performance.

Analysis of Results: Best Linear Unbiased Predictor (BLUP)

BLUP is a statistical procedure which has been used in the UK dairy industry since the early 1970s and in the sheep, pig and beef industries since 1990/91. It is used to work out how much of an animal’s performance is due to the effect of its genes and how much is because of non-genetic factors. The outputs are a series of Estimated Breeding Values (EBVs) for traits of economic importance.

Estimated Breeding Values

EBVs predict the superiority or inferiority of the genes an animal possesses for each trait measured. EBVs of animals in the same flock or recording scheme can be directly compared and they can also be compared across time, allowing genetic trends to be monitored. They cannot be compared across breeds. They are produced for a range of traits, although not every value is available for every breed.

Breeding indexes

EBVs are usually presented for each trait measured which allows breeders to decide how much emphasis they wish to place on each trait in selection. However, they can also be combined into a multi-trait selection index for a specific breeding objective, or set of objectives. Economic weightings relevant to current market conditions may be used to ensure each trait is given the appropriate amount of emphasis in the index.

Table 8.2: Recorded flock numbers- Signet's Performance Recording Scheme

Breed	Number of Signet Recorded Flocks (June 2010)	Av. Flock Size (ewes) (where known)
Texel	149	51.0
Suffolk	71	54.9
Lleyn	49	170.8
Charollais	48	71.4
Hampshire Down	46	24.8
Scotchblackface	28	144.7
Dorset	20	144.9
Shropshire	18	35.6
Bluefaced Leicester	16	37.2
North Country Cheviot Park	16	69.4
Welsh Mountain	16	186.6
Beltex	14	31.6
Wiltshire Horn	14	38.5
North Country Cheviot Hill	9	105.7
Southdown	7	44.3
Beulah	6	119.7
Meatlinc	6	167.5
Five or less flocks = Hardy, Speckle, Easycare, Bleu de Maine, Border Leicester, Ile de France, Vendeen, Zwartbles, Composite, Romney Marsh, South Welsh Mountain, Berrichon Ducher, Charmoise Hill, Colbred, Leicester Longwool, Oxford Down, Rouge de L'Ouest, Ryeland.		

Across-flock evaluations

UK breeding flocks are generally small by comparison to countries like New Zealand where breeding companies run large recorded flocks, making faster genetic gains. The UK industry has therefore developed ways to link flocks within breeds or groups. Sire Referencing Schemes, where rams are used across members' flocks, allows their progeny to be used as a benchmark against which all other lambs are compared. By linking the flocks in this way, the size of the population from which replacements can be objectively selected is enlarged.

Use of technology to aid sheep improvement

New techniques for measuring sheep have dramatically increased the accuracy of sheep breeding programmes. These include:

Ultrasound scanning – for fat and muscle depth.

Computed tomography – CT produces images of the body cross-sections, using low-dose X-rays. Images are high resolution, allowing detailed measurements of the body to be made. Computer image analysis identifies areas of fat, muscle and bone, and from these measurements body composition, and hence carcase composition, can be predicted with 97% to 98% accuracy.

The use of CT has enhanced our understanding of the relationship between on-farm ultrasonic measurements and lean and fat in the carcase. This has improved the efficiency with which superior animals can be identified using on-farm ultrasound.

Breeding for worm resistance

When infected with worms, lambs raise an immune response to fight the infection and some lambs are better at this than others. Worm resistance has a genetic component, it is moderately heritable and so it can be improved through breeding and a commercial service is now available to assist producers through the production of FEC (Faecal Egg Count) EBVs.

Table 8.3: EBV traits

EBV	Trait	Raw Data
Litter Size	Prolificacy	This trait is defined as the total number of lambs born alive and dead when pregnancy reaches full term.
Lambing Ease	Ease of Lambing	Lambing ease score (1-5)
Birth Weight	Size at birth	Birth weight in kilograms
Maternal Ability (kg)	Maternal ability of ewe relates to milk production	The component of a lamb's growth to eight weeks of age that is influenced by the ewes breeding potential for milk production.
Eight Week Weight (kg)	Growth rate to 8 weeks of age Maternal ability of ewe	Weight at 8 weeks of age. To achieve an adjusted 8-week weight lambs must be weighed between 42 and 84 days of age.
Scan Weight (kg)	Growth rate to 21 weeks of age	Weight at scanning time, when lambs are 21 weeks of age.
Muscle Depth (mm)	Carcase muscling	Measured at 21 weeks of age by a Signet-approved technician. Ultrasound measurements at the third lumbar vertebra.
Fat Depth (mm)	Leanness	Measured at 21 weeks of age by a Signet-approved technician. Three ultrasound measurements taken at the third lumbar vertebra.
Carcase Lean Weight (kg)	Muscle yield	Quantity of muscle tissue in the carcase assessed using Computed Tomography (CT) image analysis of breeding stock at 21 weeks of age.
Carcase Fat Weight (kg)	Leanness	Quantity of fat in the carcase assessed using CT image analysis of breeding stock at 21 weeks of age.
Gigot Muscularity (mm)	Carcase shape	Thickness of the muscle tissue in the gigot assessed using CT standardised to a fixed femur length.
Mature size (kg)	Ewe efficiency	Ewe liveweight at first mating.
Faecal Egg Count (FEC)	Worm resistance	Faecal samples are taken from lambs at 21 weeks of age and submitted for laboratory analysis to measure the worm egg count in the sample.

Alan Spedding, 22 December 2010

RuSource briefings provide concise information on current farming and rural issues for rural professionals. They are circulated weekly by email and produced by Alan Spedding in association with the Arthur Rank Centre, the national focus for the rural church. Previous briefings can be accessed on the Arthur Rank Centre website at http://www.arthurrankcentre.org.uk/projects/rusource_briefings/index.html

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If you would like to be put on the list for regular briefings or have any other queries about the service contact alan.spedding@btopenworld.com .