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Refining and fine tuning your sheep breeding program

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As any breeder knows, there are many issues to settle in running a breeding program. Decisions need to be made about breeding objectives, characters to select for, selection index, logistics, costs, and so on.

Developing a program largely involves applying genetic theory to sheep breeding (see Farmnote 4/2003). As well, attention to the details of your program may be well worthwhile by improving your rate of gain. These gains are permanent and cumulative; small gains can soon magnify.

Every commercial sheep breeder or ram breeder has specific issues to deal with, and needs to be met. All have different views of the industry, its future, the future farm system and what sheep should look like.

This farmnote assumes that your aim in breeding sheep (selection and mating) is to improve productivity and product quality, with a view to improving your profitability as rapidly as commercially practical using genetic means. If you are breeding rams for sale and use in other flocks, we assume that you aim to pass this on to your client. If you are buying rams we assume that you expect to buy this genetic progress.

Your breeding objective

The first step in any journey is to decide where you are going! In sheep breeding, regardless of whether you use classing, performance recording, or a combination of both, your direction is mapped out by your breeding objective (see Farmnote 4/2003). This determines what it is about the flock that you wish to change, the relative importance of these traits and where change is to be directed.

What is a breeding objective?

A breeding objective is a guide to help select animals that will increase flock profitability. It is a description of where you hope to see your flock in terms of production at some time in the future. It is essential to have a long-term breeding objective because sheep breeding is a slow process and is not helped by changing objectives. Your objective helps you to:

- set long term production goals;
- make faster progress towards your goals;
- set a steady breeding direction for your flock;
- provide a basis to measure change against.

Your breeding objective should provide a description to guide your:

- choice of ram source;
- selection of rams;
- choice of ewes as replacements and culls;
- traits to be improved which dictate the choice (if any) of characters to select for;
- selection index.

A breeding objective can be based on a production target and/or your assessment of future markets for wool and meat.

It includes a list of traits that are to be improved by selection or culling. These traits should be heritable and contribute to flock profitability. The cost of assessing traits also needs to be considered. This will help you to decide whether to include the traits being targeted (direct selection criteria) or to use different (indirect) selection criteria.

A breeding objective should be:

- profit driven;
- long-term;
- well defined;
- measurable;
- achievable and practical;
- related to a specific period of time.

The program should also be realistic and focus on traits that will improve the profitability of the flock. In Merino sheep breeding, the three most important traits are body weight, fleece weight and fibre diameter, which account for 90 per cent of the value of the wool clip. For sheep meat production, ewe reproduction rate, lamb growth rate and fat depth are the most important traits.

Traits to include in your breeding objective should be:

- definable and inexpensive to measure or assess;
- of economic importance by increasing returns or decreasing costs;
- heritable: under genetic control and inherited from the parents;
- variable: with a range in performance for each trait.

Objective measurement is important in your breeding objective but you can include visually assessed traits that are important to you by scoring or culling for them.

Industry has different opinions about breeding objectives. The following are examples of traditional objectives:

- Upstanding sheep with deep bodies and well-sprung ribs, with stylish, white, waterproof wool.
- Big sheep with good neck extension, that stand well on their feet and with legs covered with good performing skin producing shafty, long, white, soft, rich wool.
- Sheep that are free-growing, well-nourished, with good constitution, open draping fronts and deep bodies, and producing excellently styled wool.

The following breeding objectives are examples of more targeted and effective objectives:

- Maintain fibre diameter and body weight while maximising fleece weight.
- Decrease fibre diameter by 1.5 microns and increase staple strength by 2 N/ktex in 10 years while maintaining body weight and maximising fleece weight.
- Increase body weight by 2.5 kg, increase resistance to parasites by 20 per cent and decrease fibre diameter by 0.5 microns while maximising fleece weight in 10 years.
- Maximise fleece weight while maintaining fibre diameter, body weight, style and conformation.

There is no right or wrong breeding objective; it will depend on:

- the environment in which your flock is run;
- your assessment of market signals;
- your prediction of the factors that will determine the future value of your wool clip and surplus sheep.

Members of the WADA Sheep Genetics Team can assist you with formulating a breeding objective (contact the Katanning Office, phone 98213333).

Choosing your selection criteria

Your breeding objective identifies traits that you wish to change. Some traits are easily measured, for example, liveweight. Other traits cannot be measured easily and you need to measure another indicator trait instead. Selection criteria are the measures you can use to assess the traits identified in your breeding objective when selecting animals. They may be the same or different from the traits in the breeding objective. If the trait is different, the indicator trait must be strongly linked to the breeding objective trait, and is usually easier or cheaper to measure.

So, in choosing the selection criteria, consider:

- ease and practicality of measurement;
- cost of measurement;
- degree of relationship (genetic correlation) with the trait in question.

For example, if your breeding objective includes increasing staple strength you may choose to measure coefficient of variation of fibre diameter, which is much cheaper to measure than staple strength but strongly correlated genetically.

If your breeding objective includes increasing carcass leanness, then you may choose to measure fat depth at the GR site by ultrasound, as it is difficult and impractical to measure the fat content of the whole body.

Which selection method to use

Visual selection

'Classing' is the general term for selection on the appearance of the animals. This was the traditional method until the arrival of cost effective measurement techniques. However, many traits and selection criteria can still only be assessed by visual methods, and today a combination of measured information and visual assessment is commonly used.

Independent culling level

Many characters lend themselves to independent culling levels, where a standard is set for each trait. An animal is kept if it meets or exceeds the set standard, but culled if it falls below it. The method is widely used in practice, particularly in culling for faults. It can also be used for measured traits.

Selection index

A selection index is usually a more efficient method. It is a method of considering all of an animal's attributes against your breeding objective and combining the information into a single figure. Since some traits are worth relatively more, either in terms of the genetic gains you can make or in their potential to increase profit, a weighting factor can be calculated for each trait.

The Estimated Breeding Value (EBV) (see Farmnote 4/2003), for each trait is multiplied by the weighting factor and then combined to give a total score for the animal, which is its index value.

Combining important traits with the correct emphasis on each allows you to select superior animals and make progress across all the traits in your breeding objective. It allows you to apply the same strategy year after year.

Nevertheless, an index is only an aid to selection because it allows animals to be ranked. It should not be used as a means of paper selection without attention to other important non-measured or visual traits such as conformation.

Your fleece testing laboratory may be able to offer you access to a choice of standard selection indexes. Members of the DAWA Sheep Genetics Team can assist with creating a selection index (contact the Katanning Office, phone 98213333). For a fee you can use Lambplan or Merino Genetic Services, which offer a variety of off-the-shelf selection indexes.

Selection on the animal's own records plus relatives (pedigree) records: BLUP analysis

The most efficient selection method is to include pedigree record information with the animal's own records. This improves the accuracy of selection. Then the data are analysed by a statistical method called Best Linear Unbiased Prediction (BLUP). The addition of pedigree information is particularly useful for traits of low heritability, and where the trait is expressed in only one sex (such as reproductive rate).

Mating plans

Corrective mating

In an attempt to improve the degree of uniformity within the flock, corrective mating has been common practice in the stud industry, where sires are often chosen that excel in the weak points of the females. But this technique does not normally lead to genetic improvement but only allows animals to breed back to the average of the flock.

Inbreeding

Inbreeding arises as a result of common ancestry in small, closed flocks and it is cumulative. Where animals are intensively selected on pedigree information, a certain amount of inbreeding is unavoidable. Inbreeding depression is mainly seen in the "fitness" traits, in particular in reproduction, but also in growth rate and disease resistance. To minimise inbreeding the population may need to be enlarged or have new outside rams introduced.

Line breeding is commonly used in the stud breeding industry and is where animals are mated to keep their offspring closely related to an ancestor. It is a form of inbreeding and any form of inbreeding is undesirable.

Benchmarking

Benchmarking, the process of evaluating your product against an industry standard, is a very effective management tool.

What is genetic benchmarking?

Genetic benchmarking compares the performance of an individual animal, flock or ram source against an industry standard. It can be used very effectively to improve your flock performance and profitability. After determining the relative performance of your current ram source, you can select an alternative if necessary and choose superior rams from that source.

There is a great deal of opportunity available, depending on the performance of your current ram source. Wether trial analyses suggest a variation of 60 per cent between poorest and best performing ram sources.

Benchmarking will also help you to clearly define an effective breeding objective. Establishing the standard of your flock or individual animals helps direct flock improvement in the right direction and focuses on measurement.

How do you go about it?

The simplest form of benchmarking flock performance is to "look over the fence" and compare your flock with your neighbour's. Of course, this is of limited value because there are many management and environmental differences between the two flocks, which will bias the genetic comparison.

Fairer comparisons are designed to remove the management and environmental effects, leaving fewer biasing factors to distort the comparison. For example, running flocks, or samples of flocks, together means that they experience the same management and environment and thus removes these biasing effects.

What are the industry benchmarks?

Industry benchmarks include:

Benchmark	**Audience**	
	Commercial breeder	Ram breeder
Wether trials (Farmnote 75/2002)	✓	?
Ewe trials	✓	?
Western Australian combined wether trial analysis results	✓	?
Merino Bloodline Performance results	✓	?
On-farm ram source comparisons	✓	✓
Progeny tests (Farmnote 58/93)		✓
Central Test Sire Evaluation (Merino Superior Sires)		✓

Choosing a ram source

Now that you have set your flock breeding objective and benchmarked your current performance, you need to evaluate the breeding progress of alternative ram sources. You can then select the ram source that will deliver the best combination of high performance now and the possibility of long-term genetic gains in productivity.

The first task in choosing a ram source is to ensure that its breeding objective is compatible with yours. There is no point in using a ram source that is not aiming for the same result that you are because you will end up somewhere other than where you intended.

You should inspect the sheep (for example, one of the ram breeder's commercial flocks) to ensure that they are the type of animal and have the type of fleece that you are aiming to produce. Better still, inspect a commercial flock in your district that has been buying rams from the potential ram source for at least five years.

The Western Australian combined wether trial data and NSW bloodline analysis provide a useful guide to potential ram sources. To use this data you will need to have some idea of where your flock productivity sits in relation to those reported in these analyses (see Benchmarking).

If you are a ram breeder you may be able to make use of the ram progeny test data from the various CTSE (Central Test Sire Evaluation) centres such as published in Merino Superior Sires (www.mss.anprod.csiro.au) or in the publications of Merino Genetic Services of Meat and Livestock Australia (MLA). This provides comparable productivity information on the rams that have been progeny tested and semen may be available from any ram of interest. However, it gives no indication of flock performance or ranking.

Selecting rams

Whether you are a commercial breeder or a ram breeder the principles are the same. If you are using measurement, *beware of considering only the individual's measurement.*

For example, if your flock is 21 microns and you are looking to reduce the micron to 20 microns, don't simply buy 20 micron rams. A 20 micron ram in one flock may have a very different effect on the genetics of your flock to a 20 micron ram from another flock. Rather, consider the animal's performance in relation to the mean of the mob from which the individual came. The best way of doing this is to express its productivity or value as a **deviation from the mean;** that is, the difference between the animal's actual value and the average for all the animals from that drop or mob. For example, if the mob or drop average for liveweight was 40 kg and two individuals were 38 kg and 43.5 kg, then the respective deviations would be –2 kg and +3.5 kg.

Animals that have been progeny tested are generally offered with their progeny test information presented in this logical manner, but many rams presented for sale are presented with raw data and seldom is the flock average provided.

Selecting ewes

A decision support tool (see Farmnote 8/2003) enables wool growers to assess whether it is profitable to use in-shed fleece measurement (fleece weight and/or fibre diameter) in selecting replacement ewes. It can be accessed on the Department of Agriculture web site at: www.agric.wa.gov.au/programs/wool/fleece/index.htm

The calculator works because sheep that perform better by producing more and finer wool than their contemporaries will tend to continue to perform better during their lifetime in the flock. The results depend on:

- the size of the breeding ewe flock;
- the number of replacement hogget ewes available;
- the average fleece weight;
- average fibre diameter; and
- clean yield of hogget and mature ewes in the flock.

Total measurement cost and a discount rate (to account for inflation) is also required as these are specific for each flock.

As the reproductive rate increases the number of ewe replacements increases allowing for a greater culling rate. This results in selecting on measured characters being more profitable (or less of a loss). However, it is generally only profitable if selection is based on both fibre diameter and fleece weight measurements, and then only at higher reproductive rates and/or lower measurement cost. As the measurement cost increases, the profitability decreases, becoming a financial loss exercise at lower reproductive rates. Invariably the early measurement costs are not recouped for several years of selection.

Total Genetic Resource Management (TGRM)

TGRM is a tool available to Lambplan clients to assist with mating decisions. It enables breeders to capture both immediate and long-term benefits by optimising mate allocation decisions. These include maximising progeny index value in the next generation at the same time as minimising inbreeding. The output from a TGRM run includes:

- the list of sires chosen for breeding and the number of times each ram is to be used; and
- the full mating list, indicating which rams should be mated to which ewes and the predicted index and EBV values for the resultant progeny.

Contact the WADA Sheep Genetics Team through the Katanning Office (phone 98213333) to find out who your local TGRM operator is.

Further reading

Farmnote 4/2003. *Genetics for sheep breeders*. David Windsor. Department of Agriculture.

Merino Breeding & Selection - a commercial focus. NSW Agriculture and Woolmark Company. 1999.

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