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Implementing selection and optimising flock structures in Merino flocks

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Abstract

Optimum flock structure and selection practices can improve the profitability of commercial Merino flocks. This report describes several programs that have been developed by the Sheep CRC to facilitate prediction of the potential effects of alternative flock structures and selection practices. These programs include programs that predict the effects of on-farm fibre measurement, terminal sire mating, proportion of wethers in a flock, simultaneous assortment and lamb growth rate.

Introduction

The Sheep CRC has developed software programs that can be used to optimise aspects of flock structure and genetic selection for enterprises in which measurements of the performance of individual animals are conducted. These programs predict short-term phenotypic outcomes and long-term genetic outcomes of alternative management strategies for meat and wool production from specific groups of animals. Two programs (terminal sire mating calculators I and II) deal with flock structure, two combine aspects of flock structure and selection (on-farm fibre measurement calculator and wether calculator) and others deal with selection strategies for improving profitability (simultaneous assortment, and the use of selection and net returns in lamb production systems).

Effect of terminal sire mating on flock structure

Two programs were developed to predict the change in flock structure that would result from mating a proportion of ewes of a self-replacing Merino flock to terminal sires (http://www.sheepcrc.org.au/flock_structure.php). One program estimates the maximum percentage of the ewe flock that could be mated to terminal sires without long-term effects on flock structure and the other predicts the effect that exceeding the maximum would have on flock structure. These programs were developed in response to the practice of mating terminal sires to Merino ewes, which has increased because of high meat prices. Curtis and Croker (2005) estimated that at least 20% of Australian sheep producers mate 50% of their Merino ewe flock to terminal sires. Our program indicates that the maximum proportion of the average Merino ewe flock (number of lambings = 5, weaning percentage = 77%, mortality up to one year of age = 5%, hogget culling = 10%, adult mortality = 5%; Curtis and Croker, 2005) that could be mated to terminal sires without long-term effects on flock structure is 35%. If the percentage of ewes mated to terminal sires is less than 35% for three consecutive years, Merino sires can subsequently be used to re-establish the original flock structure within one year, but it would take five or seven years to re-establish the original flock structure if 50% or 60%, respectively, of ewes were mated to terminal sires for three years (Fig. 1). The number of ewes available decreases slightly during the third year when more than 35% of ewes are mated to terminal sires, resulting in deficits of replacement Merino ewes in subsequent years. If the same number of ewes is to be mated each year,

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consideration should be given to retention of a greater proportion of older adult ewes, reduction of selection pressure on replacement ewes or purchase of replacement ewes. However, these alternative strategies may have financial effects and may retard genetic progress.

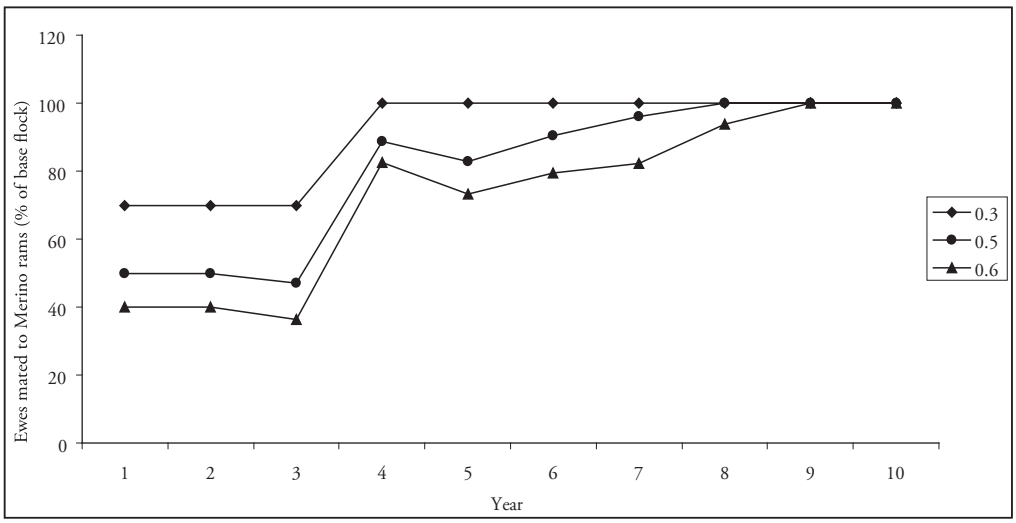

Fig. 1. Simulation of recovery of ewe numbers from mating a percentage of a self-replacing Merino flock to terminal sires for three years. It was assumed that ewes were mated for five years and 5% of adult ewes died, 77% of lambs born were weaned and 15% of lambs died or were culled from weaning to one year of age.

Depending on the relative prices of meat and wool, breeders who have mated non-Merino rams to Merino ewes may decide to develop composite flocks for dual purposes or meat production. However, further research is required on how to make the best use of available breeds and sires for various production environments.

On-farm fibre measurement calculator

The on-farm fibre measurement program estimates the profitability of using fibre diameter measurement for clip preparation and replacement ewe selection (http://www.sheepcrc.org.au/articles.php3?rc=170). On-farm measurement of fibre diameter can improve profitability in commercial flocks (Atkins and Semple, 2003; Atkins et al., 2004; Brien, 2005). The effect of clip preparation on profit varies according to the mean fibre diameter of the flock and market conditions. The effect of using fibre diameter measurements for selection of replacement ewes is greater than that of market conditions because the benefits of selection are cumulative. Atkins et al. (2004) estimated that selection can result in an additional profit of $5 per ewe joined per year. The benefit of using fibre diameter measurement for clip preparation is greatest for fine- to medium-wool flocks, and the benefit of using fibre diameter measurement for selection decisions is greatest for fine-wool flocks.

Wether selection

The wether program was developed to predict the economic consequences of the proportion of wethers in flocks of various mean fibre diameters and with various assumptions about the value of the meat of surplus sheep. Wether flocks are kept for wool production in many Merino enterprises and as a means of managing risk because the number of wethers can be adjusted according to market or

climatic conditions without loss of genetic resources. Furthermore, the relatively high resistance of adult wethers to internal parasites enables them to be used to control internal parasites.

There is no economic benefit in retaining all wethers produced (Richards et al., 2005). However, wethers can make a positive economic contribution if only those that have the best fibre diameter or the best combination of fibre diameter and fleece weight are retained. In fine-wool flocks, a high proportion of wethers (up to 50% of the number of breeding ewes) is beneficial when the value of hogget meat is low. As the value of meat increases, the benefit of high numbers of wethers is reduced. However, the wether flock should be equivalent at least 10% of the size of the ewe flock. Although factors such as ease of management may influence the size of the wether flock, selected wethers will always be more beneficial than unselected wethers.

Simultaneous assortment

Simultaneous assortment refers to selection of groups of animals for specific uses with the intention of increasing their value (Richards and Atkins, 2004). Currently, most Merino breeders only select sheep for wool attributes and often fatten those that are surplus to the wool flock for sale to meat markets. Old, surplus Merino ewes are also mated to meat-breed sires to produce crossbred lambs. Cull groups formed for specific purposes result in superior income when the culls are of limited merit for the alternative market. For example, selection of wool sheep according to fibre diameter results in culls that have greater fibre diameters than the flock average but average body weights. An alternative is to use a simple algorithm for simultaneous assortment that would result in selection of animals with low fibre diameter, albeit not as low as possible, which could be retained for the wool flock, and animals with a body weight greater than average, which could be sold as meat.

Simultaneous assortment can be used for two purposes. Firstly, it can be used for the phenotypic assortment of Merino lambs for meat production from lambs or hoggets or for lifetime wool production. Secondly, breeding ewes can be assorted into mating groups for the production of meat or wool. This contrasts with the common practice of mating animals of surplus age groups to meat sires, which equates to random allocation and does not result in a selection advantage. Dual selection of ewes for mating to wool or meat sires would result in better overall meat and wool production. Joint selection for meat (body weight) and wool (fibre diameter) results in 70–85% of the selection advantage of single trait selection (Richards and Atkins, 2004).

Opportunities for selection in meat production systems

Selection opportunities for meat production are more limited than for wool production simply because meat lambs are kept for a much shorter period. However, the use of individual animal measurement enables producers to monitor growing animals and match groups of animals to the requirements for various markets. Performance monitoring also enables sire genotypes to be evaluated.

Two programs were developed to predict the consequences of selection and changes in flock structure for lamb finishing systems: one is for analysing the performance of groups of lambs in the feedlot or under other finishing systems, and the other is for predicting turn-off time from growth rate. They can also be used to devise strategies for ensuring that lambs are finished for the most profitable time and for selection of appropriate animals.

Calculating net returns from selected groups of lambs

A program was developed to simulate various scenarios for lamb production and to identify factors that contribute to variation in net returns. Live weight, carcass data and meat prices are used to estimate returns for animals fed concentrate diets or pasture prior to marketing. Fig. 2 shows an example of the variation in net returns of lambs finished using grain. Although the average return was

$4.30 per head, 22% of lambs had negative net returns. This program can be used to identify and discard animals that cannot be finished profitably.

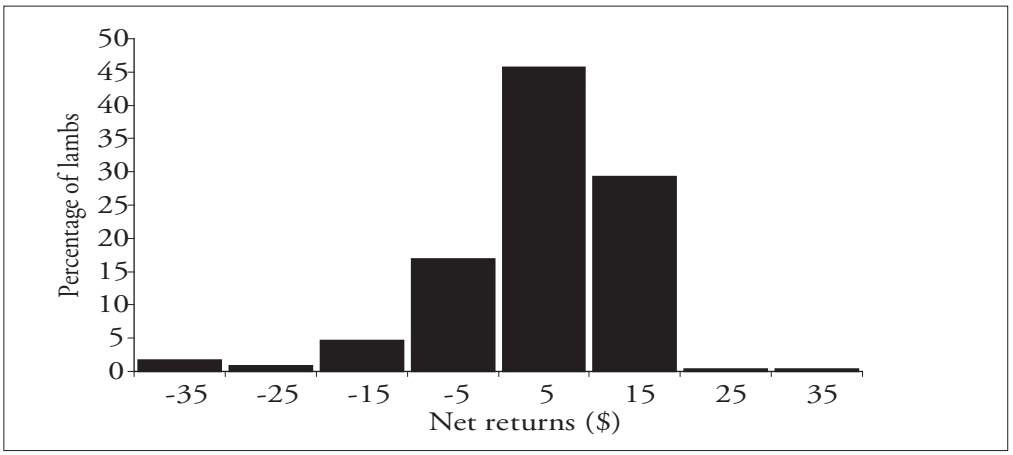

Fig. 2. Frequency distribution of lambs according to net return from grain finishing for a flock of animals in which the average net return was $4.32 per head.

Lamb growth predictor

The lamb growth predictor is useful for making management decisions from liveweight records. The number of animals that will exceed a target weight on a date in the future can be predicted; conversely, the date on which a defined number of animals or percentage of the flock will reach a target weight can be predicted. Such information would facilitate forward planning for transport or slaughter bookings. The program can also be used to predict whether animals that do not reach a target weight by a specified date should be sold at that point or retained.

Future developments

- Most commercial producers cull ewes on the basis of age, but the development of technology for automated recording of information on individual animals will enable returns to be increased by culling on the basis of performance. The appropriate culling strategy will depend on factors such as genetic progress at the ram source, the use of measurements for selection of the ewe flock, reproduction and mortality. These factors require investigation in order to develop optimum strategies.
- More widespread measurement of individual animals among commercial flocks represents an opportunity for ram breeders to obtain progeny test data from their clients. Identification of the progeny of individual sires is difficult when multiple sires are used in a flock, but this will be viable if the cost of DNA analysis decreases. This information would be valuable for selection for traits that are hard to measure in ram breeding flocks, particularly carcass traits and those related to disease resistance.
- To date, the work we have done on flock structures and selection has focussed on wool and meat production traits. A future challenge is to develop strategies for decision-making using data on disease resistance traits for which the Sheep CRC has developed efficient diagnostic techniques.
- Some of the programs described in this article are under development. The integration of these Sheep CRC technologies into practical decision support systems that can be used by

producers and their advisors is in progress.

Conclusions

The Sheep CRC has developed a series of software programs to improve the profitability of sheep producers by optimising flock structures and selection strategies. The key results to date have been as follows.

- Varying proportions of Merino ewes can be mated to terminal sires in a sustainable manner depending on reproduction rate.
- On-farm fibre measurement can be used to reliably increase profit under appropriate market conditions and to devise optimal selection strategies and flock structures.
- Wethers selected on the basis of performance can constitute a profitable component of Merino flocks.
- Simultaneous assortment can be used to improve the merit of animals chosen for meat or wool production.
- Considerable variation exists in the growth rate of lambs, which can be used to optimise the profitability of meat enterprises.
- Procedures and software have been developed to implement these selection practices.

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