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Measurement and selection options for wool and meat production in commercial sheep flocks

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Abstract

Performance measurements in commercial sheep flocks can improve production in the short-term, contribute to genetic gain and can be used to target specific markets and implement precision management. The benefits of performance measurement for enterprises that produce wool, prime lambs or both are discussed. Measurement of fibre diameter may increase income from wool, and measurement of liveweight may increase income from meat; additional benefits can be realised from other performance measurements.

Introduction

Typical commercial sheep production systems are low-input enterprises. Ram purchases dictate the genetic composition of flocks and animals of various ages and genders are usually managed as single flocks. Cost reduction has been mainly achieved by manipulating stocking rate. Increased measurement for selection and management can improve productivity and profitability. The potential benefits of measurement-based systems are examined for a Merino flock in which wool is the main product, a flock in which crossbred lambs are produced for the prime lamb market and a dual-purpose Merino flock in which both wool and crossbred lambs are produced. A companion paper (Kelly et al., 2006) describes some decision aids and operational tools that allow these benefits to be extracted under commercial conditions.

The costs and benefits of measurement and selection

The genetic effect of replacement ewe selection is limited by restricted selection differentials, low selection accuracy and a small effect relative to that of ram purchases. However, developments in data collection, analysis and production systems necessitate a re-evaluation of the costs and benefits of measurement and selection. Recent advances that may reduce costs associated with measurement include on-farm fibre measurement systems (AWI, 2006), walk-through weighing and radio frequency identification of animals. These technologies enable selection decisions to be made immediately, eliminating the need for permanent identification of individual animals or for accumulation of data for subsequent decisions and obviating the need for re-mustering. Software programs for the analysis of data during data collection have been developed (James, 2002) and applied to sheep systems (Atkins and Semple, 2003). Automatic drafting facilitates immediate application of selection decisions.

In addition to genetic gain, other means of improving the flock using measurement should be considered. These include current generation gains, increasing net income by selecting groups of animals for high-value markets and reducing costs by selecting groups of animals for low-value markets. Application of precision management to selected groups of animals exploits variation in value or extracts response in sub-groups of animals within the flock to tactical treatment.

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Merino wool production

On-farm measurement of fibre diameter for selection and clip preparation

The benefit of on-farm measurement of fibre diameter of hogget or yearling ewes in a self-replacing flock with a mean fibre diameter of 19 µm is shown in Fig. 1.

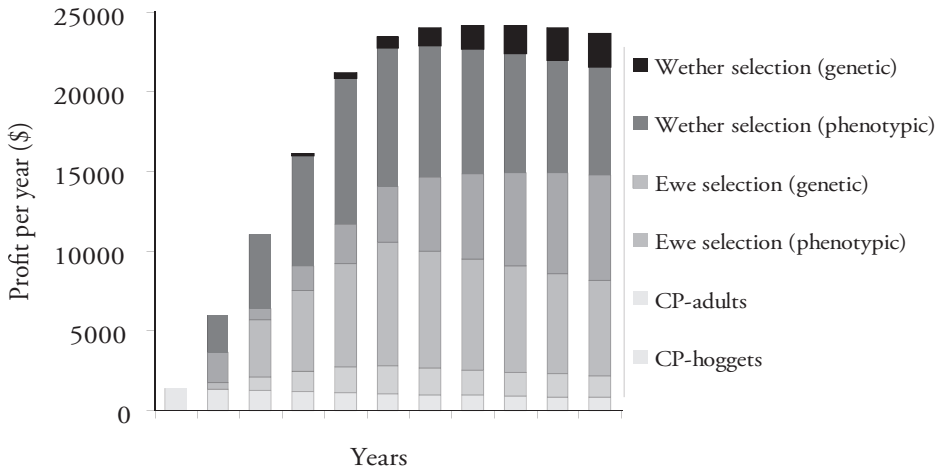

Fig. 1. Effects of selection for fibre diameter in a Merino flock with an initial mean fibre diameter of 19 µm on profit. A 5% annual discount rate was assumed.

Culling of animals with high fibre-diameter wool will have an immediate effect on the mean fibre diameter of the flock; this is also the largest of the short- and long-term effects. Retention of ewes with fine wool will influence the genetic merit of their progeny but the initial effect is relatively small, and it takes time for benefits to accumulate. The effectiveness of using fibre diameter measurements for clip preparation depends on non-linearity in the price relationship with fibre diameters. The value of clip preparation can therefore vary greatly between years depending on the market value for wools of differing diameter. In the example presented in Fig. 1, the value of clip preparation for wool from hoggets and adults is less then $2500 per year, but it can range $1000 to over $6000 per year depending on market conditions. The benefits of applying on-farm measurement of fibre diameter to selection of wethers are mainly derived from current generation improvement and clip preparation (Fig. 1). The benefit may be considerably greater for wethers than for ewes because the intensity of selection is often greater for wethers than ewes.

Age structure

Most selection decisions are made after the first shearing; selected animals are retained until they are culled from the flock at a predefined age. A better method of culling is to vary the time that individual animals are allowed to remain in the flock according to their financial and genetic contributions to the flock. This culling system works well when culling is based on fibre diameter because the repeatability and heritability of this trait is high. A flexible culling policy is useful in drought situations.

Mating allocation

Measurement of fibre diameter makes it possible to mate ewes selected for fine wool to sires with superior breeding values for other traits such as staple strength. An example of the use of measurements for mating allocation is described in the section on dual purpose production systems.

Optimising the size of the wether flock

It is of interest to determine the relative value of wethers for wool production or sale for meat. Richards and Atkins (2005) showed that in the absence of selection among wethers, there is little economic benefit in retaining adult wethers for wool production. Fig. 2 shows the optimum percentage of wethers relative to the size of the breeding ewe flock for a flock with a mean fibre diameter of 19 µm for various values of surplus animals sold for meat. Although the optimum decreases as the value of surplus animals increases, a selected wether flock provides economic returns, even at high prices for surplus animals.

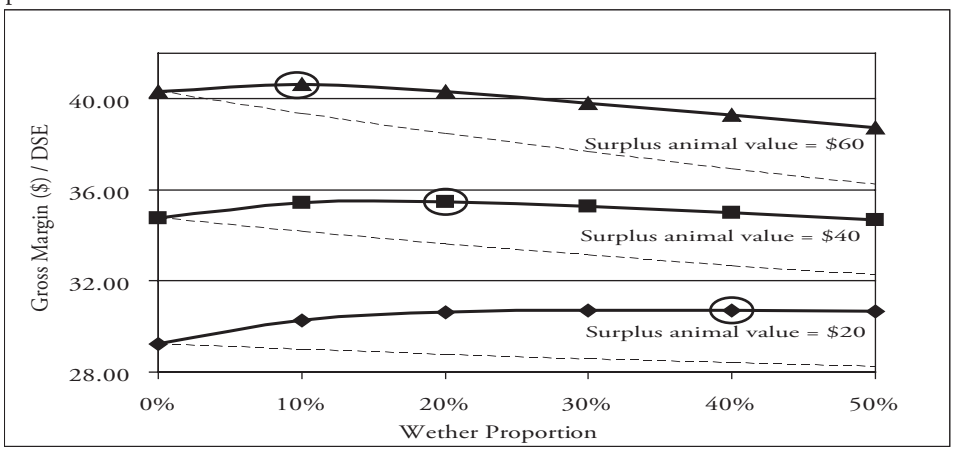

Fig. 2. Optimum percentage of adult wethers relative to the size of a breeding ewe flock and the influence of wether selection on gross margins in a Merino flock with a mean fibre diameter of 19 µm. Optima are indicated by circles; the dashed lines indicate gross margins after random selection of wethers and the solid lines indicate gross margins after selection of wethers for fibre diameter.

Prime lamb production

Repeated measurement of liveweights of lambs during growth can be used to monitor growth, predict future weights and predict dates on which animals will attain slaughter weights. Variation in growth rate between animals is considerable. In the example shown in Fig. 3, in which the mean post-weaning growth rate of crossbred lambs grazing pasture was 237 g/d, the growth rate of the best third was 295 g/d and that of the lowest third was 178 g/d. Additional information such as sire breeding values for fat and muscling may facilitate phenotypic prediction of carcase values of lambs.

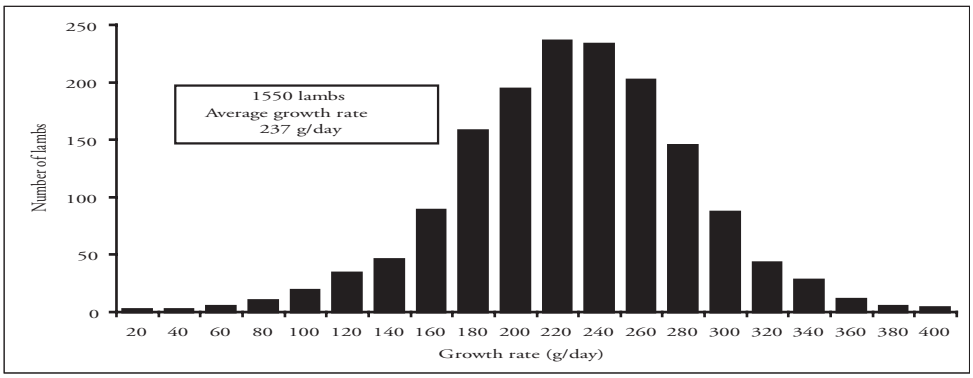

Fig. 3. Distribution of post-weaning growth rates of crossbred lambs grazing pasture.

Placing an economic value on individual breeding ewes within the lamb flock is feasible but of limited accuracy with current technology. The value of a ewe will be largely determined by the growth and carcass traits of her progeny, which are not easily identified in a commercial flock, and her reproductive performance, a trait with a low repeatability. However, knowledge of the past and current reproductive performance of individual ewes will enable more effective nutrition to be applied to groups of ewes.

Dual-purpose animals for meat and wool production

An increasingly common practice in Merino flocks is to mate a proportion of the flock to Merino sires to maintain the breeding ewe flock for a wool production and to mate the remainder to a terminal sire of another breed to produce crossbred lambs for slaughter. This system can realize the benefits discussed for meat and wool systems, but a number of issues need to be considered.

The proportion of ewes that can be mated to terminal sires is influenced by the price of meat relative to that of wool, flock structure, ewes required to sustain the wool flock, and the ability to finish lambs for slaughter.

On-farm measurement of both body weight and fibre diameter of ewes at hogget age can be used to determine which ewes should be mated to Merino sires and which should be mated to terminal sires. Animals could be sorted according to both traits into two groups that have different degrees of merit for both wool and meat (Richards and Atkins, 2004). For example, Table 1 shows the impact of dividing a single group of animals into two sub-flocks, one a better wool group (1.5 µm finer in fibre diameter but smaller animals) and the other a better meat group (broader in fibre diameter but 6 kg larger compared to the alternate group). The other benefit of this assortment is a reduction in variation for both traits when dividing the whole mob into two groups. If the proportion of animals to be mated to terminal sires alters in the subsequent year, re-allocation can be based on the information gained during the previous year. Additional data on fleece weight or reproduction rate can be used to improve the accuracy of the assortment process.

Table 1. Impact of simultaneous assortment for fibre diameter and body weight in Merinos (SD: standard deviation).

		Whole Drop	Better Wool	Better Meat
Fibre diameter (µm)	mean	20.38	19.63	21.11
	SD	1.2	0.93	0.95
Body weight (kg)	mean	51.6	48.89	54.24
	SD	4.84	4.21	3.85

The purchase of Merino or terminal sires requires careful consideration. The long-term effects of selecting larger animals, which have greater reproduction rates, for the meat enterprise may require that emphasis be placed on body weight for both ram and ewe selection in Merinos.

Conclusions

There are many opportunities for producers to use measurement of individual animals to improve profitability through selection, targeted marketing and precision management. However, many of these benefits are incremental and rely on re-using information on multiple occasions. Therefore, in order to extract maximum benefits, the cumulative benefits arising from several potential changes should be considered. There are many means of implementing precision selection and management, which vary from simple real-time options to complex electronic recording and drafting systems.

Furthermore, software programs have been developed to facilitate decision-making (Kelly et al., 2006).

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