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THE POTENTIAL VALUE OF GENETIC DIFFERENCES IN LIVEWEIGHT LOSS DURING SUMMER AND AUTUMN IN MERINOS EWES DIFFERS WITH PRODUCTION ENVIRONMENT

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SUMMARY

Genotypes that lose less weight during summer and autumn when feed quantity and quality is limiting could potentially be grazed at higher stocking rates and therefore increase farm profitability. To determine the potential value of breeding for reduced liveweight loss during summer and autumn whole farm systems modelling was used to predict potential changes to farm profitability for different sheep production systems in south-west Victoria. Based on the assumptions used, genotypes that lost less liveweight over summer and autumn were more profitable in all of the production systems and pasture system scenarios examined. The improvements in profitability were greater for lamb than wool production systems and for systems based on moderate rather than high performance pasture. The analysis also indicated that the potential value of reduced liveweight loss during summer and autumn depended on whether it was assumed that this was achieved through increased capacity to consume low quality feed or through a lower energy requirement for maintenance. More needs to be known about the potential size of the genetic difference in liveweight loss over summer and autumn between animals and to understand the biological mechanisms responsible for these differences to better define the value of this trait to the whole farm.

INTRODUCTION

The sheep industry faces some significant and uncertain challenges in the short and longer term and many sheep producing regions in Southern Australia are predicted to get drier and the rainfall patterns more variable (Howden *et al.* 2008). To remain viable and optimise stocking rates, it is likely that sheep producers will need to adopt even more flexible production systems and management strategies to deal with larger changes in feed supply between seasons and increased incidence of poor or failed seasons.

Sheep producers across southern Australia, especially those located in more marginal and variable environments, also rank selection and breeding of sheep that are more resilient to sub-optimal nutrition and can survive and produce under these conditions as a priority (Ferguson unpublished data). There is emerging evidence that adult ewes from some sires lose less liveweight during summer and autumn when feed quantity and quality is limiting than ewes from other sires (John *et al.* 2011) and that this trait is moderately heritable in Merinos (Rose *et al*. 2011). The precise mechanisms that may underpin differences in liveweight change during summer/autumn are not known, but it could be due to increased capacity to consume or utilize low quality feed or reduced requirements for maintenance. Importantly, there is considerable genetic variation in both of these traits (Francois *et al*. 2002; Fogarty *et al*. 2009).

In this paper whole farm systems modeling was used to test the hypothesis that genotypes that lost less liveweight during summer and autumn could be grazed at higher stocking rates and therefore enable higher farm profitability. We also reasoned that the economic value of improved resilience would differ for different pasture and sheep production systems.

MATERIAL AND METHODS

The analysis used the Hamilton EverGraze MIDAS bio-economic model calibrated to represent a farm in southwest Victoria (36^{0}58’S; 141^{0}17’E) (Young *et al*. 2004). The total area of the farm was 1000 ha and comprised three land management units: (i) well drained soils at tops of hills (200 ha); (ii) moderately drained loams in the mid slopes (600 ha); and (iii) clay soils in lower slopes that are often waterlogged (200 ha). Two pasture systems and two animal systems were examined to estimate the potential economic value of liveweight loss in summer and autumn in different production systems.

The pasture systems were: a) moderately productive ryegrass grown on all land management units or b) optimum mix of lucerne, fescue and high performance ryegrass grown on appropriate land management units. The system comprising a range of pasture species produced more high quality feed over summer and autumn. The sheep production systems were: a) Wool - self replacing Merino flock selling wethers at 17 months or b) Lamb - a prime lamb producing flock, buying in replacement Merino ewes, mating all ewes to a terminal sire and turning off finished slaughter lambs at 45 kg liveweight. The analysis was based on a dual-purpose Merino genotype which has been described by Thompson and Young (2002) and ewes lambed in July and August. All the flocks were shorn in January and best practice animal husbandry was applied for all ewes and lambs in each system. Prices used in the analysis were based on long term average prices - \$3.25/kg carcass weight for lamb, \$45/head for cast for age ewes, \$65/head for shippers, 1135c/kg for 20um fleece wool and \$250/t for lupins.

To represent genotypes that differed in liveweight loss over summer and autumn, a simulation model that calculates ewe liveweight profiles, metabolisable energy requirements, wool growth and reproductive rate was used to determine how changes to estimates of animal parameter associated with feed-use and metabolisable energy requirements would alter the liveweight profile of the adult ewes. In this paper, the effects of altering parameters to improve the intake of low quality feed or reduce the metabolisable energy required for maintenance are reported. Both of these changes resulted in the ewes getting heavier over a production year if they were grazed in common (Figure 1). However, the grazing management of each genotype was altered such that each genotype followed the same liveweight profile as the standard genotype.

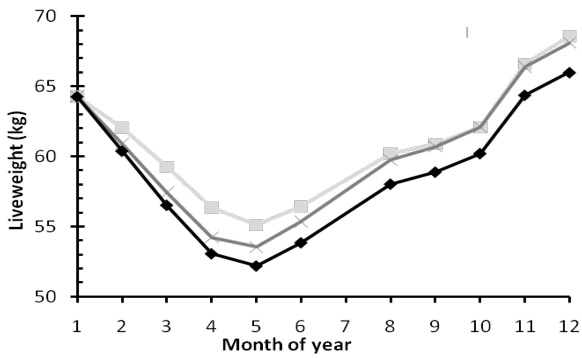

Figure 1. Liveweight profile for standard genotype (◆) and genotypes with either higher intake of low quality feed (■) or lower metabolisable energy requirements for maintenance (x) if the animals start at the same liveweight and are grazed in common.

RESULTS

Animal and pasture system had a significant impact on the profitability of the standard genotype (Table 1). As expected, across both enterprise types, systems based on more productive pastures were much more profitable than those based on poorer pastures (average $132/ha *vs*. $8/ha). The value of pasture improvement was also much greater for animal systems with an emphasis on lamb production compared to wool production. For example, the most profitable lamb system using the standard genotype was $73/ha more profitable than the best wool system, whereas the least profitable lamb system was $60/ha less profitable than the worst wool system.

Genotypes that lost less liveweight over summer and autumn were more profitable in all of the production systems examined and in all cases the benefits were greater for lamb than wool production systems (Table 1). If the reduced liveweight loss during summer and autumn was achieved through increased capacity to consume low quality pasture there was a major genotype by environment interaction, in that the benefits of reduced liveweight loss were greater in the 'moderate' than 'good' pasture system. If reduced liveweight loss was achieved through reduced maintenance requirements the genotype by environment interaction was less evident in the lamb enterprise and did not exist for the wool enterprise.

Table 1. Whole farm profit ($) for different pasture and animal production systems based on a standard genotype and changes in profit for genotypes with increased capacity to consume low quality feed or lower energy requirements for maintenance

Genotype	Wool enterprise		Prime lamb enterprise	
	Moderate pasture	*Good pasture*	*Moderate pasture*	*Good pasture*
Standard genotype	38 000	92 000	-22 000	165 000
Higher intake of low quality feed	+8 800	+700	+77 000	+17 000
Reduced maintenance requirements	+10 500	+11 000	+39 500	+23 000

The optimum management differed for each pasture and animal production system and genotype, and a summary of the stocking rate and supplementary feeding is shown in Table 2. The majority of the benefit from altering genotype resulted from the increase in stocking rate that can be achieved with the new genotype. Having a genotype that loses less weight over the summer period allowed higher grazing pressure to be applied during summer-autumn without increasing the cost associated with supplementary feeding during this period. In environments in which availability of summer feed is restricted this allows increases in stocking rate.

Table 2. Stocking rate (DSE/ha) and grain feeding (kg/DSE; *italics*) for different pasture and animal production systems based on a standard genotype and the change in stocking rate and grain feeding for genotypes with increased capacity to consume low quality feed or lower energy requirements for maintenance

Genotype	Wool enterprise		Prime Lamb enterprise	
	Moderate pasture	*Good pasture*	*Moderate pasture*	*Good pasture*
Standard genotype	8.5 (*1.6 kg*)	12.0 (*0 kg*)	6.7 (*33.3 kg*)	11.0 (*0.9 kg*)
Higher intake of low quality feed	+0.3 (*-0.4 kg*)	+0.1 (*0 kg*)	+1.7 (*-12.5 kg*)	+0.4 (*+0.1 kg*)
Reduced maintenance requirements	+0.4 (*-0.2 kg*)	+0.5 (*0 kg*)	+1.3 *(-2.9 kg*)	+0.5 *(-0.2 kg*)

DISCUSSION

Genotypes that lose less liveweight over summer and autumn due to increased capacity to consume low quality feed or reduced energy requirements for maintenance would be of significant value to sheep production systems. Based on the assumptions used, the value of reduced liveweight loss over summer and autumn was greater for lamb production systems than wool systems. Genotypes that lose less liveweight over summer and autumn could be relatively more important for lamb producers than wool producers because this would allow them to turnoff a higher proportion of their lambs at lower cost. This same logic explains why the value of late season pastures is greater for production systems with a focus on meat production (Masters *et al*. 2006; Young *et al*. 2010).

The analysis also indicates that if reduced liveweight loss was achieved through increased capacity to consume low quality pasture the benefits were greater for systems with poorer pastures. For example, the standard genotype used for lamb production in the 'poor pasture' system was $60,000 less profitable than wool production (-$22,000 cf +$38,000) whereas the Parameter1 genotype was $8,000 more profitable for lamb than wool ($55,000 cf $46,800). Therefore, the emphasis on the liveweight loss trait in breeding objectives is likely to be greater for lamb production systems in more marginal environments.

The majority of the benefit from having a genotype that loses less weight over summer and autumn is from the increase in stocking rate that can be achieved, and increasing stocking rate is a more profitable way to utilise this trait than having fatter animals. With a genotype that losses less liveweight a higher grazing pressure could be applied during summer and autumn without increasing the cost associated with supplementary feeding during this period. For the Hamilton farm of 1000 ha a 0.1 DSE/ha increase in stocking rate is 100 DSE, which equates to $3000/farm if the gross margin is $30/DSE.

The differences in liveweight change between genotypes modelled in this analysis are much smaller than the range evident in the Katanning base flock data (Rose *et al.* 2011) and the Sheep CRC Information Nucleus Flock (John *et al.* 2011). The profit changes from our analysis may therefore be conservative but more needs to be known about the potential size of the genetic difference in liveweight loss between animals and to understand the biological mechanisms responsible for these differences to better define the value of this trait to the whole farm.

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