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Using genetic variation for greater profit

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ABSTRACT

Over 20 years ago, cooperative group breeding schemes screened large gene pools to establish ram breeding flocks. This process invariably exploited differences between animals within a breed and not differences between animals regardless of breed. This paper describes the establishment and operation of Landcorp Farming Limited's Lamb Supreme (LS) terminal sire breeding programme and presents results of a comparative slaughter trial for discussion.

In 1989 and 1990 Landcorp screened a total of 3,685 ewe hoggets from 501,000 animals. The progeny from 3 years' matings of these screened-in ewes constituted the nucleus flock of the LS programme. The progeny of rams from this flock mated to commercial Romney ewes were compared with straightbred Romneys (R) in a slaughter trial in three slaughters from January to May 1994.

At the three slaughter dates, LS lambs had heavier pre-slaughter live weights and carcass weights than R lambs and were no fatter when adjusted to the same mean carcass weight. Net returns averaged more per LS cross lamb than per straightbred R lamb.

Keywords: Breeds; utilisation; synthetic; sheep; terminal sire.

INTRODUCTION

Sheep breeds in NZ differ in performance in traits of major economic importance: reproduction, wool production and lean meat production. The NZ sheep industry in general is not well structured functionally to exploit breed differences effectively. Certainly there is some degree of specific crossing, such as the use of Romney rams over Perendale ewes to increase fleece weights, or the mating of terminal sire breeds such as the Suffolk or Poll Dorset to maternal breeds such as the Romney or Coopworth for slaughter lamb production. However, there are other avenues for exploiting breed differences. This paper considers some of these avenues, with particular emphasis on Landcorp Farming Limited's derivation of a synthetic terminal sire line called Lamb Supreme.

Breed utilisation

Expansion of superior breeds has been a common method of breed utilisation. Grading up to the superior breed is relatively efficient since it uses the reproductive ability of the (adapted) breed being displaced. The alternative of expanding the superior breed by culling fewer animals in that breed is less effective. However, replacement as a means of utilising breed differences does not exploit heterosis in individual or maternal performance (heterosis is the average improvement in performance in the crossbred progeny over the average of the straightbred parental breeds).

Specific crossbred combinations make maximum use of breed differences in superiority, but their use is limited when reproduction rate is low because of the high proportion of straightbred matings required to produce replacements for the crossbred matings. The two-breed cross fully exploits heterosis for individual performance in such traits as growth and carcass composition, with the most obvious example being the crossing of specialised terminal sire breeds over maternal breeds for slaughter lamb production. Essentially the maximum use of heterosis comes from the mating of a straightbred (eg terminal) sire breed over a crossbred dam (eg Finn x Romney, Border x Dorset, etc). Such a cross fully exploits heterosis for maternal productivity in the crossbred dam, and heterosis for individual performance in the three-breed crossbred progeny.

Apart from these specific crosses, rotational crossbreeding options are available. Less than maximum use of heterosis occurs and in addition, fluctuation in breed composition can occur between generations, resulting in considerable variation among ewes and lambs in performance levels. This fluctuation can be reduced if the breeds used in the rotation are similar in performance characteristics, but then this restricts the degree to which breed differences in economic traits can be exploited. Increasing the number of breeds in the rotation increases the proportion of maximum potential heterozygosity, but also increases the complexity of the mating system in practice.

The development of synthetic breeds offers much the same opportunity as rotational crossbreeding for retaining a high proportion of heterosis in individual and maternal performance traits. In practice the management of a synthetic is simpler than crossing each generation to maintain the desired breed combination and proportion of heterosis. This assumes that there is no serious loss from random recombination of favourable gene combinations that were maintained by selection in the parental breeds (Dickerson, 1973).

In general, lower reproductive rates favour rotational crossing or synthetics since the costs of maintaining straightbred populations for specific crossbreeding systems are greater. When there are large breed differences in performance, specific crossing offers more advantages than rotational crossing or synthetic breeds. When individual or maternal trait heterosis is large it is more appropriate to develop crossbreds or synthetics than to maintain purebreds. If recombination loss is important, then crossbreeding is more appropriate than developing a synthetic.

Lamb supreme programme

Screening large gene pools to exploit differences among animals within a breed captured the imagination of commercial sheep breeders and producers over 20 years ago. However, screening large gene pools to exploit differences among breeds has rarely been given serious consideration by the industry. Landcorp Farming Limited established its Lamb Supreme terminal sire breeding programme from such a basis. As described by Nicoll *et al.* (1992), a total of 3,865 ewe hoggets were screened on liveweight from a pool of 501,000 sheep over two years (1989 and 1990). The sheep were run on Huirimu (North Island) and Kepler Stations (South Island), and the progeny resulting from three years of matings of these screened-in ewes to rams of several breeds (including Romney, Wiltshire, Poll Dorset, Coopworth and Texel), formed the Lamb Supreme flock. The screened ewes were removed from the programme and since that time, the (interbred) replacements for the Lamb Supreme flock have been selected on an Animalplan index using liveweight and ultrasound estimates of fat depth, eye muscle depth and (more recently) eye muscle width.

One of the features of the Lamb Supreme programme is that at no stage have there been any conscious decisions on maintaining specific breeds. Replacement selections have been based solely on performance and structural soundness. A second feature of the programme has been the intense screening from a wide genetic resource and the wide selection of sire breeds in the initial matings to establish the Lamb Supreme flock programme. Both features indicate that in effect, the Lamb Supreme programme is developing a synthetic terminal sire, based on wide initial sampling and subsequent selection on performance and functionality.

To assess the progress to date, a comparative trial was conducted from 1994. In January, 350 Romney x Romney (R) and 350 Lamb Supreme x Romney (LS) short-scrotum lambs were identified from a commercial flock. No birth data were available. The R and LS sires of these lambs were considered typical of those routinely distributed to and used on Landcorp Farming Limited stations in the 1993/94 season. On 19 January, 50 lambs from each group were randomly drafted and slaughtered at a commercial slaughter premises. Pre-slaughter liveweight, hot carcass weight, carcass GR depth and export grade were recorded. The same information was collected at subsequent drafts on 29 March (n=100) and 27 May (n=180). The results are shown in Table 5.

At the three slaughter dates, LS-sired lambs had heavier pre-slaughter weights than R-sired lambs (differing by +2.3, +2.0 and +2.9kg respectively; $P<0.05$), and heavier carcass weights (differences of +1.0, +1.6 and +2.2kg; $P<0.05$). Carcass GR depths in LS-sired lambs were significantly greater at each of the three slaughter dates than in R-sired lambs (+0.88, +1.47 and +1.39mm; $P<0.01$). Net returns per lamb were greater in LS-sired lambs than in R-sired lambs by a range of $2.66 to $3.36 across the three slaughter dates.

The greater GR depths of the LS-sired compared with the R-sired lambs were a reflection of their heavier carcass weights (Table 6). Using the within-genotype regression equations of GR on carcass weight, and the pooled mean

TABLE 5: Data (mean (SE) from Lamb Supreme- (LS) and Romney-sired (R) lambs slaughtered in January, March and May 1994.

		Number	Liveweight (kg)	Carcass wt (kg)	Dressing % (%)	GR (mm)	Net Return ($/lamb)[1]
19 January:							
	LS-sired	50	28.8 ± 0.6	11.6 ± 0.3	40.3	3.72 ± 0.21	29.69
	R-sired	50	26.5 ± 0.6	10.6 ± 0.3	40.0	2.84 ± 0.16	27.03
	Difference (LS-R)		+2.3*	+1.0*	+0.3	+0.88**	+2.66
29 March:							
	LS-sired	100	36.1 ± 0.5	14.6 ± 0.3	40.4	4.61 ± 0.21	41.81
	R-sired	100	34.1 ± 0.4	13.0 ± 0.2	38.1	3.14 ± 0.16	38.45
	Difference (LS-R)		+2.0**	+1.6**	+2.3	+1.47**	+3.36
29 May:							
	LS-sired	180	38.5 ± 0.4	15.7 ± 0.2	40.8	5.30 ± 0.19	42.71
	R-sired	179	35.4 ± 0.4	13.5 ± 0.2	38.1	3.91 ± 0.15	39.38
	Difference (LS-R)		+2.9**	+2.2**	+2.7	+1.39**	+3.33

[1] Includes wool returns and levies
* $P<0.05$; ** $P<0.01$

TABLE 6: Regression relationship between GR and carcass weight (CW; kg) Estimated GR depth (mm) at the same mean carcass weight for Lamb Supreme - (LS) and Romney-sired (R) lambs slaughtered in January, March and May, 1994.

Date (Mean CW)	Regression of GR on CW	SE of coefficient	Estimated GR
19 January (11.13 kg)			
	$GR_{LS} = 0.36CW - 0.47$	± 0.079***	3.54
	$GR_{R} = 0.27CW + 0.03$	± 0.068***	2.98
29 March (13.20 kg)			
	$GR_{LS} = 0.57CW - 3.53$	± 0.062***	4.00
	$GR_{R} = 0.60CW - 4.47$	± 0.067***	3.50
27 May (14.09 kg)			
	$GR_{LS} = 0.61CW - 4.02$	± 0.064***	4.57
	$GR_{R} = 0.53CW - 2.93$	± 0.055***	4.51

*** $P<0.001$