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RELATIONSHIPS BETWEEN LAMBPLAN EBVS FOR RAMS AND POST WEANING PERFORMANCE OF THEIR CROSSBRED PROGENY

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SUMMARY
LAMBPLAN calculates estimated breeding values (EBVs) for animals based on their measured performance and that of their relatives in industry flocks. Some 72 rams with LAMBPLAN EBVs were independently progeny tested in the Maternal sire Central Progeny Test (MCPT). Post weaning weight, carcase fat and eye muscle depth of their first cross progeny and second cross progeny of the first cross ewes were recorded. The correlations between the ram LAMBPLAN EBVs and their first cross progeny performance were positive and generally moderately high (0.5 – 0.6) for all traits and LAMBPLAN EBV analyses. The correlations for second cross progeny performance were positive although generally lower (0.3 – 0.5) than for first cross progeny. Regressions of progeny performance on LAMBPLAN EBVs quantified the possible response from selection and indicated higher than expected response in fat depth. The results clearly show that use of LAMBPLAN EBVs for selection of maternal sire rams will result in improved growth and carcase performance of crossbred progeny.
Keywords: Sheep, selection, correlation, breeding values

INTRODUCTION
The advent of genetic evaluation programs has helped Australian sheep breeders to make significant improvements in the genetic progress of their flocks. Terminal sire breeders have embraced genetic evaluation and have made considerable genetic improvement since the launch of LAMBPLAN, the Australian genetic evaluation program for meat sheep, in 1989 (Banks 1994). The same level of genetic improvement has not been seen in the maternal breeding sector (Banks 2002), which prompted the initiation of the Maternal sire Central Progeny test (MCPT) in 1997. The MCPT evaluated the first and second crossbred progeny of maternal and dual purpose sires and the scope for genetic improvement in the maternal sector (Fogarty *et al.* 2001). Since establishment of the MCPT, there has been an increase in awareness and uptake of genetic improvement in the maternal sector. Most of the maternal sire rams have LAMBPLAN information that is based on their own and relatives performance in industry flocks which is independent of their progeny performance in the MCPT. This paper reports the relationships between LAMBPLAN estimated breeding values of the rams and the performance of their first and second cross progeny for growth, fat and muscle.

MATERIALS AND METHODS

Animals. EBVs for the rams were from three LAMBPLAN analyses (the Border Leicester, Maternal and Terminal reports calculated in September 2004). These analyses included varying records for the rams including their own, progeny and relatives data but did not include MCPT data. The Maternal report is an experimental across-breed analysis which is not yet published by LAMBPLAN. Of the 91 rams progeny tested in the MCPT, 72 had LAMBPLAN EBVs, with 57 in the Border Leicester report, 69 in the Maternal and 60 in the Terminal reports and 50 sires were common to all reports. The rams were mated to base ewes (mainly Merinos) to produce first cross progeny over 3 years at Cowra, NSW, Hamilton, Vic, and Struan, SA. Three sires were used in all sites and years to provide genetic links. The rams with LAMBPLAN EBVs were from breeds including: Border Leicester (18), East Friesian and crosses (12), Finnsheep and crosses (6), Coopworth (9), White Suffolk (7), Corriedale (5), Booroola Leicester (5) with 10 rams from other breeds. The first cross progeny were grown out, wethers were slaughtered and ewes retained and mated to terminal sire rams for 3 years to produce second cross slaughter lambs. The first cross ewes born at Struan were transferred to Rutherglen, Vic, for joining. First cross ewes at Hamilton were joined in autumn, whereas ewes at Rutherglen were joined in spring and ewes at Cowra were split into spring and autumn joining groups. Further information relating to the design and management of the MCPT and the genetic merit of sires and source of the base ewes can be found in Fogarty *et al.* (2005). The progeny performance traits included post weaning weights of first and second cross ewes and wethers recorded between 4 and 6 months of age, and fat depth (GR) and eye muscle depth measured at the 12^{th} rib of first cross wethers and second cross lamb carcases.

Statistical analysis. Mixed linear models were used to generate sire deviations for all 91 rams for post weaning traits from the MCPT first and second cross lambs. The data consisted of 5868 post weaning weight records from first cross progeny, and 8559 records from second cross progeny. Fixed effects included in the model for first cross lambs were site (Cowra, Hamilton, Struan), year (1, 2, 3), sire breed (1 to 8), type of birth and rearing (11, 21, 22, 31, 32, 33), dam source (1-10), and sex (male, female). Age of the lamb was fitted as a linear covariate to post weaning weight, and hot carcase weight was fitted as a linear covariate to fat and eye muscle depth. Fixed effects included in the model for the second cross lambs were site (Cowra, Hamilton, Rutherglen), season (autumn, spring), grand sire breed (1 to 8), type of birth and rearing (11, 21, 22, 31, 32, 33), dam parity (1, 2, 3), and sex (male, female), with age of the lamb fitted as a linear covariate for post weaning weight, and hot carcase weight fitted as a linear covariate to fat and eye muscle depth. All significant ($P<0.05$) two way interactions between the fixed effects were included. Random effects included in both models were sire, dam and dam by year interaction.

The ram LAMBPLAN EBVs were correlated with the sire deviations calculated from the first and second cross MCPT progeny. Correlations were estimated applying a multivariate restricted maximum likelihood procedure using ASReml (Gilmour *et al.* 2002). Three sires had EBV accuracies of zero for fat and eye muscle depth and were not included in the analysis. The number of sires, range of EBVs and their accuracies are shown in Table 1. Regression coefficients to quantify the response from selection on LAMBPLAN EBVs were obtained by adding the appropriate LAMBPLAN EBV to the above models as a linear covariate.

Table 1. Number of rams, range of EBVs, mean (standard deviation) of accuracies (%) from the Border Leicester, Maternal and Terminal LAMBPLAN analyses for post weaning weight (Pwwt), fat depth (Pfat) and eye muscle depth (Pemd) and MCPT progeny sire deviations

Analysis	Rams	Pwwt (kg)		Pfat (mm)		Pemd (mm)	
	(n)	EBV	Accuracy	EBV	Accuracy	EBV	Accuracy
LP Border Leicester	57	-2.6 9.8	66 (24)	-1.3 0.9	59 (25)	-1.3 1.2	59 (25)
LP Maternal	69	-1.6 9.1	75 (21)	-1.4 1.1	68 (21)	-2.1 1.4	68 (21)
LP Terminal	60	-3.8 11.1	70 (28)	-1.8 1.1	59 (28)	-2.0 1.3	62 (29)
MCPT first cross	72	-6.5 4.7	-	-5.7 3.1	-	-1.9 2.0	-
MCPT second cross	72	-2.5 3.4	-	-1.2 1.3	-	-0.7 0.9	-

RESULTS AND DISCUSSION

The LAMBPLAN EBVs of rams are independent of the performance of their first and second cross progeny tested in MCPT. The correlations between LAMBPLAN EBVs and first cross performance were positive and generally moderately high (0.5 – 0.6) for all traits (Table 2). The correlations for the Border Leicester LAMBPLAN EBVs tended to be lower and less consistent across the traits (especially for Pemd, 0.25) than for the other LAMBPLAN analyses. As well as being from independent data sources, fat and eye muscle depth traits are measured in live animals using ultrasound to derive EBVs whereas the progeny performance was measured on carcases. There were more sires with Maternal EBVs (69) than Terminal (60) or Border Leicester (57), which is reflected in the standard errors of the correlation estimates. The correlations between LAMBPLAN EBVs and second cross progeny performance were positive, although generally lower (0.2-0.5) than those for first cross progeny. This is expected due to the reduced genetic contribution of the sires as they only contribute a quarter of the genes to the second cross progeny. The correlations for the carcase traits (Pfat and Pemd) were higher than for post weaning weight.

Table 2. Correlations (± s.e.) between ram LAMBPLAN EBVs (Border Leicester, Maternal, Terminal analyses) and their first and second cross progeny performance in MCPT for post weaning weight (Pwwt), fat depth (Pfat) and eye muscle depth (Pemd)

		Border Leicester	Maternal	Terminal
First cross	Pwwt	0.42 ± 0.11	0.50 ± 0.09	0.48 ± 0.10
	Pfat	0.50 ± 0.10	0.65 ± 0.07	0.53 ± 0.10
	Pemd	0.25 ± 0.13	0.50 ± 0.10	0.50 ± 0.10
Second cross	Pwwt	0.15 ± 0.13	0.22 ± 0.12	0.20 ± 0.12
	Pfat	0.47 ± 0.11	0.33 ± 0.11	0.15 ± 0.13
	Pemd	0.27 ± 0.13	0.28 ± 0.11	0.29 ± 0.12

There was little effect on the correlations by only including rams with EBV accuracies greater than 30%, although the correlations were generally higher for rams with accuracies greater than 50%. Correlations between first and second cross progeny performance for all 91 sire deviations in MCPT were also calculated and were positive and moderate to high (post weaning weight 0.49, fat depth

0.47, eye muscle depth 0.33). This indicates that the relative performance of the sires from their first cross progeny is carried through consistently to their second cross progeny.

The regression of progeny performance on a ram's LAMBPLAN EBV quantifies the possible response from selection of rams on EBVs (Table 3). The expected value for each of the regressions was calculated as for correlated responses using genetic parameters from Safari *et al.* (2005). The expected values do not take into account the possibility that the genetic correlations between purebred and first and second cross performance may be less than unity but do account for differences in the variance of the traits and data sets (Fogarty *et al.* 1997). The regressions for fat are considerably higher than expected for first and second cross progeny for the three LAMBPLAN EBV analyses. The regressions tended to be higher for the Border Leicester and Maternal than the Terminal EBVs.

Table 3. Regression coefficients (± s.e.) of first and second cross progeny performance on ram LAMBPLAN (Border Leicester, Maternal and Terminal) EBVs for post weaning weight (Pwwt), fat depth (Pfat) and eye muscle depth (Pemd)

	Trait	Border Leicester	Maternal	Terminal	Expected
First cross	Pwwt (kg/kgEBV)	0.24 ± 0.11	0.37 ± 0.11	0.15 ± 0.09	0.40
	Pfat (mm/mmEBV)	1.25 ± 0.39	1.28 ± 0.39	0.54 ± 0.42	0.30
	Pemd (mm/mmEBV)	0.28 ± 0.35	0.74 ± 0.32	0.17 ± 0.30	0.28
Second cross	Pwwt (kg/kgEBV)	0.16 ± 0.11	0.23 ± 0.11	0.15 ± 0.08	0.20
	Pfat (mm/mmEBV)	0.84 ± 0.20	0.77 ± 0.20	0.39 ± 0.23	0.15
	Pemd (mm/mmEBV)	0.38 ± 0.16	0.51 ± 0.14	0.32 ± 0.12	0.14

CONCLUSIONS

The results clearly show that the use of LAMBPLAN EBVs for selection of maternal sires will result in improved performance of crossbred progeny. Rams with higher EBVs for growth and carcase traits produced better performing first cross progeny, and the superior merit of these sires was consistently passed on to the second cross progeny of their daughters.

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