LIFETIME WOOL. 11. PROGENY GENOTYPE BY ENVIRONMENT INTERACTION USING THE REACTION NORM MODEL

K.V. KONSTANTINOV[A]*, M. FERGUSON*[A] *and B. PAGANONI*[B]

[A] Primary Industries Research Victoria, Department of Primary Industries, Hamilton, Vic 3300
[B] School of Animal Biology, University of Western Australia, 35 Stirling Hwy, Crawley, WA 6009

The effect of genotype by environment (G x E) interactions in the Merino sheep industry can be severe. Sheep are exposed to different climatic conditions, within and between years, and different management systems that create different production environments for economically important wool traits. The Lifetime Wool project is developing profitable ewe management guidelines for woolgrowers across Australia. The plot-scale experiments were conducted in 2 different environments with a minimum of 40% genetic linkage to allow for corrections due to environment if it was necessary (Thompson and Oldham 2004). The reaction norm model (Kolmodin *et al*. 2000) describes the phenotype expressed by a genotype as a function of the environment. This study sought to test the ability of the reaction norm model to quantify G x E in Merino sheep in the Lifetime Wool project.

The data were analysed using the following model:
$y_{ijk} = \mu + f_k + bX_{ij} + s_{a_l} + s_{b_s} X_{ij} + e_{ijk}$, where y equals a vector of observations (wool production traits); μ is the overall mean; f is the vector containing fixed effects (sex, birth type dam age); b is the fixed coefficient of regression of y on X_{ij} ; s_{a_l} is the random intercept of the reaction norm of sire *I*, also called level; s_{b_s} is the random linear coefficient of random regression of y on X_{ij}; X_{ij} is the production environment defined as a deviation of the contemporary group mean from the population mean; and e is the vector of residuals. The contemporary group was defined as the group of all animals sharing the same year, site, plot and level of feed on offer. The relationship matrix used was based on sire-maternal grandsire. All calculations were performed using ASREML software (Gilmour *et al*. 2000).

Table 1. Estimates of reaction norm components from univariate analyses.

Progeny Trait	Variance (level)	Cov (level,slope)	Variance (slope)	Cor (level,slope)	Var (residual)
Clean fleece wt	0.008 ± 0.00002	0.007 ± 0.00004	0.03 ± 0.0003	0.44 ± 0.34	0.18 ± 0.00009
Greasy fleece wt	0.01 ± 0.00004	0.005 ± 0.00004	0.02 ± 0.0003	0.32 ± 0.34	0.28 ± 0.0002
Staple strength	6.3 ± 7.3	0.4 ± 0.3	0.1 ± 0.01	0.43 ± 0.56	48.8 ± 20.2
Staple length	15.3 ± 18.4	1.4 ± 1.4	0.2 ± 0.08	0.88 ± 0.59	85.9 ± 32.2
Birth weight	0.006 ± 0.0002	0.002 ± 0.00001	0.009 ± 0.00001	0.30 ± 0.48	0.47 ± 0.0002
Liveweight at 12 months	1.4 ± 0.3	0.02 ± 0.0002	0.02 ± 0.00007	0.11 ± 0.30	16.8 ± 0.43

Table 1 shows the estimates of the parameters of the reaction norm model for some of the wool production traits. For most of the traits included, the variances of the level and slope were significant but the covariance between the level and the slope was insignificant despite the low standard errors. This resulted in genetic correlations between level and slope with very high standard errors. These preliminary results should be viewed as indicative only since the amount of the available data did not permit more comprehensive analyses. Nevertheless, the results indicate that the reaction norm model is suitable for quantification of G x E in Merino sheep data. Reaction norms for all available sires could be calculated and used for specific matings in specific environments that potentially will reduce the bias from possible G x E.

KOLMODIN, R., STRANDBER, G.E., MADSEN, P., JENSEN, J. and JOJANY, H. (2000). *Acta Agric. Scan. Sect. A. Anim. Sci.* **52**, 11-24.
GILMOUR, A.R., CULLIS, B.R., WELHAM, S.J. and THOMPSON, R. (2000). 'ASREML – Reference Manual..' (NSW Agriculture: Orange.)
THOMPSON, A.N. and OLDHAM, C.M. (2004). *Anim. Prod. Aust.* **25**, (This proceedings).

Email: Kon.Konstantinov@dpi.vic.gov.au