THE EFFECT OF STANDARDISING FIBRE DIAMETERS TO A COMMON GENETIC VARIANCE ON GENETIC PARAMETERS FOR MICRON BLOWOUT

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SUMMARY

Micron blowout (MB) calculated as the difference between fibre diameter records taken at different ages can produce 'biased' heritability and genetic correlation estimates due to a scale effect. Standardisation of the fibre diameter records to a common genetic variance removed the scale effect, and as a consequence changed the heritability and the genetic correlation estimates. It is recommended that heritabilities and genetic correlations involving MB be calculated after standardising the fibre diameter measurements to a common genetic variance.
Keywords : Micron blowout, scale effect, heritability, genetic correlation

INTRODUCTION

Age change in fibre diameter, commonly referred to by Merino breeders as 'micron blowout', has been measured by the difference between records taken at different ages (eg. Cottle *et al.* 1995). James (1998) shows that using this method to measure micron blowout could result in a non-zero heritability value due to a difference in the genetic variance between the ages in question. That is, the non-zero heritability value could reflect only a scale effect and not imply that the trait was affected in part by different genes at the two ages.

In this paper we estimate the heritability of micron blowout among several ages with and without standardising the fibre diameter measurements to the same genetic variance. We also examine the genetic correlation of characters measured on young rams with micron blowout with and without standardising the fibre diameter measurements to the same genetic variance.

MATERIALS AND METHODS

Measurements were made on fleece samples taken from the ram and the ewe progeny of the Turretfield Merino Resource Flock (Ponzoni *et al.* 1995) and also on skin samples taken from the ram progeny of the same flock. The ram progeny were sampled at 10 and 16 months of age, and the ewe progeny were sampled at 16, 28 and 40 months of age. Micron blowout (MB_M) was calculated as the difference between the fibre diameter (FD) records measured at two different ages. The FD records were then standardised to a common genetic variance as follows: $FD_S = (FD_M - FD_A) / \sigma_{GFD}$, where subscripts S,M and A stand for standardised, measured and average, respectively, and σ_{GFD} is the genetic standard deviation of FD_M. These standardised fibre diameter records were then used to calculate a standardised value for micron blowout (MB_S).

Heritability estimates were obtained for both MB_M and MB_S between the various ages. Similarly, genetic correlations between secondary follicle diameter (SECD16) and both MB_M and MB_S were estimated. These were compared with estimates for the genetic correlation between micron blowout and FD (taken from the ram progeny at 10 and 16 months of age). The heritability and the genetic correlation estimates were calculated using ASREML (Gilmour *et al.* 1998). An animal model was fitted to the data, which included the fixed effects of stud, year, age of dam, type of birth and rearing class (for both the ram and the ewe data) and type of lamb birth and rearing class (for the ewe data only). Day of birth was fitted as a linear covariate.

RESULTS

Standardisation resulted in a uniform genetic variance estimate for the fibre diameter measurements at different ages (Table 1) and it did not alter the heritabilities or the genetic correlations for the fibre diameter measurements. Minor discrepancies can be attributed to rounding.

Table 1. Genetic variances, heritabilities and genetic correlations for fibre diameter

		FD10(rams)	FD16(rams)	FD16(ewes)	FD28(ewes)	FD40(ewes)
σ^2_G	M	1.22	1.96	1.85	2.12	2.31
	S	1.0	1.0	1.0	1.0	1.0
h^2	M	0.52(0.078)	0.62(0.080)	0.71(0.058)	0.73(0.058)	0.67(0.061)
	S	0.52(0.078)	0.62(0.080)	0.71(0.058)	0.73(0.058)	0.67(0.061)
Rams	$FD16_M$	0.95(0.023)				
	$FD16_S$	0.94(0.025)				
Ewes	$FD16_M$	0.99 (0.039)	0.95 (0.042)			
	$FD16_S$	0.99 (0.039)	0.95 (0.042)			
	$FD28_M$	1.00 (0.040)	0.97 (0.038)	0.96(0.014)		
	$FD28_S$	1.00 (0.041)	0.95 (0.040)	0.95(0.016)		
	$FD40_M$	0.96 (0.049)	0.89 (0.051)	0.89(0.024)	0.94(0.016)	
	$FD40_S$	0.99 (0.048)	0.92 (0.050)	0.90(0.024)	0.94(0.016)	

The heritability value for micron blowout measured at the different ages was low to moderate (Table 2). When the variance of fibre diameter was standardised in the ram data, the heritability estimate for micron blowout decreased to 60 per cent of the value prior to standardisation. In the ewes the decrease was less noticeable.

Table 2. Heritability for MB_M and MB_S, in rams and ewes

		Rams	Ewes		
		10 to 16 mo.	16 to 28 mo.	16 to 40 mo.	28 to 40 mo.
h^2	MB_M	0.17 (0.054)	0.16 (0.047)	0.28 (0.056)	0.19 (0.050)
	MB_S	0.10 (0.048)	0.15 (0.046)	0.26 (0.055)	0.19 (0.050)

The genetic correlation between the micron blowouts measured at different ages was not consistent (Table 3). In some instances the sign of the correlation changed after standardisation. Secondary follicle diameter measured in ram skin samples had a moderate to high genetic correlation with micron blowout measured on ewes at the different ages. In comparison, FD (measured on rams at 10 and 16 months of age) had a greater genetic correlation with micron blowout between 16 and 28 months, but lower between 16 and 40, and between 28 and 40 (FD10 only) (Table 3). Standardising to a common genetic variance decreased the genetic correlation. The decrease was greater for the genetic correlation between FD and micron blowout, compared with the genetic correlation between SECD16 and micron blowout. Also in two instances (FD10 and FD16 with MB_S 28 to 40 months) the sign of the genetic correlation was reversed.

Table 3. Genetic correlations among micron blowouts, and between both ram secondary follicle diameter and fibre diameter records with ewe micron blowout

		Rams	Ewes		Rams		
		MB_M	MB_M	MB_M	SECD16	FD10	FD16
		10 to 16	16 to 28	16 to 40			
16 to 28	MB_M	0.34 (0.21)			0.41 (0.19)	0.48 (0.15)	0.54 (0.14)
	MB_S	-0.13 (0.27)			0.28 (0.20)	0.28 (0.17)	0.37 (0.15)
16 to 40	MB_M	0.04 (0.18)	0.64 (0.11)		0.51 (0.15)	0.28 (0.13)	0.23 (0.12)
	MB_S	0.09 (0.22)	0.86 (0.05)		0.37 (0.16)	0.02 (0.14)	0.00 (0.13)
28 to 40	MB_M	-0.25 (0.20)	0.01 (0.20)	0.79 (0.08)	0.38 (0.18)	0.03 (0.16)	0.15 (0.11)
	MB_S	0.26 (0.24)	0.06 (0.22)	0.65 (0.11)	0.27 (0.18)	-0.20 (0.15)	-0.31 (0.14)

DISCUSSION

James (1998) showed that the genetic variance of micron blowout could be non-zero (resulting in a non-zero estimate for the heritability of micron blowout) if the genetic variances for the fibre diameter records differed between the two ages. The non-zero heritability value would then reflect only a scale effect, and would be a 'biased estimate' of the heritability of micron blowout.

After standardising the ram data to a common genetic variance (ie. removing the scale effect, Table 1) the heritability for micron blowout decreased to a value of approximately 60 per cent of what it was before standardisation. This indicates that the heritability, to a large extent reflected only a scale effect. The greatest decrease was obtained when the difference in the size of the genetic variances of the two fibre diameter measurements in question was greatest (MB10-16). By contrast, after standardisation of the female data, the heritability value for micron blowout remained approximately equal to the heritability value estimated prior to standardisation. This suggests that different genes affect the expression of FD at different ages. Although standardisation of the female data did not greatly alter the estimate of the heritability of micron blowout, the genetic correlation between the micron blowout records was not consistent across successive shearings (Table 3). This suggests that sheep that were determined to have a propensity to "blow" at one shearing, may behave differently at the next shearing, and that micron blowout may not be a consistent phenomenon.

Standardisation of the fibre diameter measurements also decreased the magnitude of the genetic correlations, and in some cases changed its sign (Table 3). A similar result was reported by Hickson *et al.* (1995), and Hill *et al* (in press) explained the result. The results in Table 3 suggest that the ram skin character (SECD16) may be a better indicator of future ewe micron blowout performance compared with ram FD measurements at 10 and 16 months. However preliminary analysis has shown that the heritability of secondary follicle diameter was moderate [0.28 (0.066)] whereas the heritability of fibre diameter recorded at 10 and 16 months is high (0.45 and 0.59, respectively)

(Ponzoni *et al.* 1995). As the value of an indirect indicator is a function of both the heritability estimate and the genetic correlation between the indicator trait and the trait itself, the often stronger and more consistent genetic correlation between SECD16 and MB may not be sufficient to conclude that secondary follicle diameter was a better indicator of future ewe micron blowout performance compared with fibre diameter.

CONCLUSION

The present study illustrates how the estimation of the heritability of micron blowout as the difference in fibre diameter measurements between different ages can lead to 'biased' heritability estimates. The bias will be greater the greater the between age difference in genetic variance. The genetic correlation estimates are also influenced by the correlation between the indicator trait and the two intervening fibre diameters. As a consequence, predictions of genetic change in micron blowout should be based on heritabilities and genetic correlations obtained after standardising the fibre diameter measurements to a common genetic variance.

SECD16 may be a better indicator of future ewe micron blowout performance than ram fibre diameter measurements. However, the cost of measurement of SECD16 should be taken into consideration in any practical recommendation.

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