THE RELATIONSHIPS BETWEEN CRUTCH COVER SCORE AND PRODUCTION AND EASY CARE TRAITS IN MERINO SHEEP

D.H. Smith[1], E. Safari[2], F.D. Brien[1], K.S. Jaensch[1] and R.J. Grimson[1]

[1] South Australian Research and Development Institute, Roseworthy, SA, 5371
[2] School of Biological Science, Flinders University, Bedford Park, SA, 5001

SUMMARY

A preliminary study of the relationship between crutch cover score, measured at hogget and adult age, and production and easy care traits found moderately negative phenotypic correlations between hogget score and hogget fibre diameter and body weight, and a moderately positive phenotypic correlation with hogget face cover. Genetic correlations between hogget crutch cover score and hogget fibre diameter, staple strength, staple length and body weight were moderately to strongly negative and strongly positive for coefficient of variation of fibre diameter and face cover. Correlations with hogget fleece weight, yield, neck and body wrinkle were not significantly different to zero. Heritability of crutch cover score at both ages was high. Strategies to eliminate the need for mulesing by placing selection emphasis on decreased hogget crutch cover should result in genetic gains in hogget performance for body weight, staple strength, staple length and to a lesser degree plainness but attention should be paid to fibre diameter to prevent it from increasing. Better estimates of the genetic correlations between hogget crutch cover score, other hogget traits and adult traits are needed to predict future hogget and adult flock performance, however our preliminary results suggest that selection to reduce hogget crutch cover should give minor gains in adult body weight and reproductive performance, with negligible impact on adult fleece weight in the current flock.

INTRODUCTION

James (2006) argued that breeding sheep resistant to flystrike provides the best long term alternative to surgical mulesing as long as those sheep are then managed within a best practice integrated pest management program**.** Murray *et al.* (2007) demonstrated that selection of Merino ewe lambs for low wrinkle, dag and urine score and high breech bareness can be as effective as mulesing in preventing breech blowfly strike. Edwards *et al.* (2009) concluded that crutch cover score was moderately to highly heritable, irrespective of the age at measurement. They also concluded that the genetic correlation with economically important traits, other than weight of belly wool and skirtings, was low however they did not attempt to define the relationship between hogget score and adult performance.

Breeding sheep that are less susceptible to breech strike, when un-mulesed, will involve placing increased selection emphasis on easy care traits such as reduced breech wrinkle, and decreased breech and crutch cover. The effect of this emphasis on current and later age production is of considerable interest to producers. This preliminary study examines the phenotypic and genetic correlations of crutch cover score with production and easy care traits in Merino sheep.

MATERIALS AND METHODS

Data. Mulesed ewe hoggets from SARDI's five South Australian Merino Selection Demonstration Flocks were scored for crutch cover at hogget shearing (16-18 months of age). The ewe hoggets represented 87 sires. The scoring system for crutch cover is described in Edwards *et al.* (2009) where 1 = bare, 5 = woolly, and conforms to the scoring system described in the AWI Visual Sheep Scores guide (2007). Unskirted greasy fleece weight including belly wool was recorded at shearing. Yield, fibre diameter, coefficient of variation of fibre diameter, staple length and staple strength were measured on mid-samples taken prior to shearing. Body weight, face cover score (1 = open, 5 = muffled), neck wrinkle score (1 = plain, 5 = wrinkled), and body wrinkle score (1 = plain, 5 = wrinkled) were recorded 10-14 days after the hogget shearing. Adult crutch cover score, weight of belly wool, skirted and unskirted greasy fleece weight, fibre diameter, coefficient of variation of fibre diameter, and body weight were also recorded at shearing in 2009 for ewe hoggets retained as breeding ewes. Records were also available on number of lambs weaned during 2008 and lifetime number of lambs weaned per lambing opportunity. Summary statistics are given in Table 1.

Table 1. Summary statistics for production and easy care traits

Trait	N	Mean	S.D.	Range
Hogget				
Clean fleece weight	875	4.1	1.1	1.6 - 7.1
Greasy fleece weight (unskirted, including belly)	875	5.7	1.5	2.4 - 10.0
Fibre diameter	875	19.5	2.0	14.9 - 27.1
Yield	875	70.7	4.6	57.3 - 82.7
Coefficient of variation for fibre diameter	875	21.5	3.0	13.6 - 31.5
Staple strength	875	27.7	12.3	5.1 - 79.0
Staple length	875	102.2	19.7	63.4 - 156.5
Body weight	875	43.3	6.2	19.5 - 63.5
Face cover score	873	1.8	0.6	1 - 4
Neck wrinkle score	876	2.5	0.8	1 - 5
Body wrinkle score	876	1.5	0.6	1 - 4
Crutch cover score	865	3.3	0.8	1 - 5
Adult				
Weight of belly wool	401	0.4	0.1	0.0 - 0.7
Skirted greasy fleece weight (not including belly)	403	5.7	0.9	3.9 - 8.5
Unskirted greasy fleece weight (not including belly)	402	6.5	0.9	4.7 - 9.4
Fibre diameter	403	20.9	1.8	16.5 - 26.9
Coefficient of variation for fibre diameter	403	16.7	1.8	12.6 - 22.2
Body weight	403	70.5	7.8	49.7 - 93.2
No. of lambs weaned 2008	430	1.3	0.7	0 - 3
Av. no. of lambs weaned per lambing opportunity	769	1.0	0.5	0 - 2.5
Crutch cover score	400	2.8	0.9	1 - 5

Statistical analysis. Variance components were estimated with ASREML software (Gilmour *et al.* 2006). The model included birth type (single or multiple), rearing type (raised as a single or multiple), age of dam (2 to 7 years), birth year (2004 or 2005), flock (measured performance, classer assessment, elite wool, fibre meat plus, and control) as fixed effects and a direct animal genetic component as a random effect. For the analysis of adult ewe crutch score reproduction status (number of lambs weaned in 2008) was fitted as another fixed effect in the model. Phenotypic and genetic correlations were estimated from bivariate analysis of hogget crutch cover score with hogget and adult traits.

RESULTS AND DISCUSSION

The distribution of hogget crutch score was 0.5%, 17.1%, 38.3% 37.9% and 6.2% for scores 1 to 5 respectively. For adult crutch score the values were 10.5%, 23.8%, 44.0%, 20.8% and 1.0%.

Only flock and birth year were significant ($P<0.05$) for both hogget and adult crutch scores. However for adult crutch score, flock and birth year became non-significant after the inclusion of the number of lambs weaned in 2008 in the analytical model. Type of rearing and year of birth were the only significant fixed effects for face cover score, while type of birth, flock and year of birth were significant for both wrinkle scores. A significant ($P<0.05$) flock by year of birth effect was observed only for body wrinkle score.

Estimated heritabilities were 0.54 ± 0.11 and 0.48 ± 0.18 for hogget and adult crutch scores, respectively. The high heritability estimates for crutch score in hogget and adult are similar to those found by Edwards *et al.* (2009), but slightly higher than those reported by Scobie (2007). Estimated heritabilities for face cover, neck and body wrinkle scores were 0.38 ± 0.10, 0.33 ± 0.10 and 0.34 ± 0.11, respectively which agree with those reported by Mortimer *et al.* (2009).

Phenotypic and genetic correlations between hogget crutch cover score and hogget traits are shown in Table 2. Moderately negative phenotypic correlations were found between hogget crutch cover score and hogget fibre diameter and body weight, and a moderately positive phenotypic correlation with hogget face cover. The genetic correlations had high standard errors but suggest a moderate to strong negative relationship with hogget fibre diameter, staple strength, staple length and body weight and a strong positive relationship with coefficient of variation of fibre diameter and face cover. Correlations with hogget fleece weight, yield and neck and body wrinkle were not significantly different to zero. Edwards *et al* (2009) also showed negative, albeit weaker, correlations with fibre diameter but slightly positive correlations with greasy fleece weight.

Table 2. Correlations (± s.e.) between hogget crutch cover score and other hogget traits

Traits	Phenotypic	Genetic
Clean fleece weight	0.01 ± 0.04	-0.12 ± 0.19
Greasy fleece weight	0.02 ± 0.04	-0.03 ± 0.18
Fibre diameter	-0.20 ± 0.04	-0.37 ± 0.15
Yield	-0.00 ± 0.04	-0.11 ± 0.17
Coefficient of variation of fibre diameter	0.17 ± 0.04	0.58 ± 0.21
Staple strength	-0.16 ± 0.04	-0.27 ± 0.16
Staple length	-0.16 ± 0.04	-0.27 ± 0.15
Body weight	-0.32 ±0.03	-0.51 ± 0.12
Face cover score	0.29 ± 0.03	0.61 ± 0.14
Neck wrinkle score	0.13 ± 0.04	0.23 ± 0.19
Body wrinkle score	0.07 ± 0.04	0.18 ± 0.19

The phenotypic correlations between hogget crutch cover score and adult traits are shown in Table 3. There were insufficient records on adult animals to provide meaningful estimates of genetic correlations between hogget crutch score and adult traits. At the phenotypic level, hogget crutch cover score appears to be moderately and positively correlated with adult belly wool weight, only weakly correlated with adult unskirted greasy fleece weight but uncorrelated with skirted fleece weight. Slightly unfavourable phenotypic correlations between hogget crutch cover and adult fibre diameter are evident in the data but the relationship with body weight and lifetime reproductive performance is slightly favourable.

Table 3. Phenotypic correlations (± s.e.) between hogget crutch cover score and adult traits

Traits	Phenotypic
Weight of belly wool	0.39 ± 0.05
Skirted greasy fleece weight (not including belly)	0.01 ± 0.05
Unskirted greasy fleece weight (not including belly)	0.10 ± 0.05
Fibre diameter	-0.13 ± 0.06
Coefficient of variation for fibre diameter	0.25 ± 0.05
Body weight	-0.17 ± 0.05
No. of lambs weaned 2008	-0.04 ± 0.05
No. of lambs weaned per lambing opportunity	-0.10 ± 0.05
Adult crutch cover score	0.57 ± 0.04

In conclusion, these preliminary results indicate that selection for decreased hogget crutch cover may result in genetic gains in hogget body weight, staple strength, staple length and plainness but attention needs to be paid to fibre diameter to prevent it from increasing. Such selection on hogget performance should also lead to minor current flock gains in adult body weight and reproductive performance, with only slightly unfavourable impacts on adult fleece weight. Notwithstanding, precise estimates of genetic correlations are needed between hogget crutch cover and wrinkle scores with later-age productivity before robust selection indices incorporating visual traits can be offered to industry. More exact estimates should be possible by combining our data with that available in other datasets ie the Falkiner Sheep Genome flock, the Adelaide University Calkookera flock and the Breeding for Breech Strike Resistance project. In the interim any independent culling level method used to select sheep with more resistance to flystrike, as described by Greeff *et al.* (2008), should be structured to allow sufficient selection pressure to be placed on production traits, especially fibre diameter, to ensure present production levels are maintained.

ACKNOWLEDGEMENTS

The SA Selection Demonstration Flocks (SDFs) received major funding support from Australian Wool Innovation and SARDI. We acknowledge Dr. Raul Ponzoni as the founder of the SDFs. Following the conclusion of the project in July 2006, funding for several projects through the Sheep CRC has enabled a percentage of the SDF ewes to be retained.

REFERENCES

Edwards, N.M., Hebart, M.L. and Hynd, P.I. (2009). *Anim. Prod. Sci.*,**49:**56

Gilmour, A. R., Cullis, S. J., Welham, S. J., and Thompson, R. (2006) ASReml User Guide. New South Wales Agriculture, Orange, Australia.

Greeff, J. C., Karlsson, J. E., Slocombe, S., Jones, K. and Underwood, N. (2008) *Agribusiness Livestock Updates, Perth, W.A. 1-2nd July, 2008.*

James, P.J. (2006) *Aust. J. Exp. Ag.* **46**:18

Murray, B., Karlsson, J. and Greeff, J. (2007) *Agribusiness Livestock Updates, Perth, W.A. 24-25th July, 2007.*

Mortimer, S.I., Robinson, D.L., Atkins, K.D., Brien, F.D., Swan, A.A., Taylor, P.J. and Fogarty, N.M. (2009). *Anim. Prod. Sci.* **49**:32

Scobie, D.R., O'Connell, D.O., Morris, C.A. and Hickey, S.M. (2007). *Aust. J. Agric. Res.* **58:**161

Visual Sheep Scores Guide. Australian Wool Innovation (2007). www.wool.com.au/publications.