The heritability of loose wool bulk and colour traits and their genetic and phenotypic correlations with other wool traits

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ABSTRACT

The heritability of loose wool bulk and yellowness (CIE Tristimulus value Y-Z) and the genetic and phenotypic correlation of these with other wool traits were determined from data obtained on ewe hoggets born in 1979 and 1980 in the strains trial at Rotomahana. Heritability estimates were 0.41 ± 0.09 and 0.13 ± 0.06 for loose wool bulk and yellowness respectively. The correlations indicated that selection for loose wool bulk while not changing greasy fleece weight would reduce clean fleece weight and increase the amount of grease/suint in the fleece. Staple length would decrease and the wool would become finer.

Selection for a low Y-Z value (white wool) would reduce both clean and greasy fleece weight and decrease the amount of grease/suint in the fleece. Staple length would decline and the wool would become finer.

Selection for greasy fleece weight would have little effect on loose wool bulk and only a minor effect on yellowness.

INTRODUCTION

The value of wool for carpet manufacture is affected by both its loose wool bulk (Carnaby and Elliott, 1980) and its colour. Bulky wools give a carpet better cover while yellow wools are less versatile for dying.

The majority of New Zealand crossbred wools are suitable for carpet manufacture and are considered to be among the best of their type available to the world carpet industry to improve both yarn strength and blend colour and to achieve good spinning performance (Ince, 1979). However New Zealand crossbred wools lack bulk (Carnaby and Elliott, 1980) due to their fibre-crimp characteristics and it would therefore be desirable to improve bulk. Although the colour of New Zealand crossbred wools is considered to be good, further improvement would also be desirable.

To date no information has been available regarding the heritability of loose wool bulk or colour traits for Romney crossbred sheep nor genetic correlations of these with other wool traits. This paper reports such data.

EXPERIMENTAL

Data were obtained from ewe hoggets born in 1979 and 1980 in the Strains comparison trial underway at the Rotomahana Research Station. Rams from 1 Coopworth and 5 strains of Romney (Ruakura High Fertility and 4 strains A, B, C and D), were single sire mated to randomly allocated commercial Romney ewes. Each source was represented by 5 sires each year. An additional 12 Romney and 5 Border Leicester rams were selected at random from the ram breeding industry and were similarly single sire mated each year. Numbers of ewe hoggets by strain and year class was, on average, 88 (range 65 to 115).

The ewe progeny of these matings were managed together from birth onwards. Prior to shearing and fleece weight recording at approximately 14 months of age all hoggets were wool sampled on the right midside and the sample measured for: staple length and total crimps on the greasy sample and yield of clean wool; fibre diameter-FFDA (Lynch and Mitchie. 1976); loose wool bulk (Dunlop *et al.*, 1974) and the CIE Tristimulus colour values X, Y and Z.

The CIE Tristimulus values represent the extent to which white light is reflected by a wool in the red (X), green (Y) and blue (Z) areas of the colour spectrum. All 3 values are required to express the true colour of a wool but because of the range of colours of New Zealand wools the X and Y values are almost identical. The Y-Z value is a good indicator of the extent of yellow discolouration (Edmunds, 1977). A low Y-Z value indicates a white wool, while a high value indicates that the wool is yellow.

Data were analysed by mixed model least square analysis of variance procedures. Genetic parameters

TABLE 1 Least square means for fleece weight, loose wool bulk and yellowness.

	Greasy fleece wt (kg)		Loose wool bulk (cm^3/g)		Yellowness (Y-Z)	
	1979	1980	1979	1980	1979	1980
Industry Romney	3.2	3.9	19.4	21.6	2.4	3.5
Ruakura HF	3.1	3.7	21.5	22.6	2.2	3.2
Romney A	3.3	3.8	20.1	20.9	2.5	3.2
B	3.1	3.9	20.1	20.9	2.5	3.3
C	3.1	4.0	19.7	21.0	2.4	3.5
D	3.2	3.7	18.9	20.0	2.3	3.3
Coopworth × Romney	3.5	4.4	19.7	20.2	2.4	3.3
Border Leicester × Romney	3.5	4.3	18.7	20.1	2.4	3.5
SD	0.5		2.6		0.8	

SD = Standard deviation of pooled data.

were estimated by pooling sires within strains and years.

RESULTS AND DISCUSSION

Least square means for greasy fleece weight, loose wool bulk and yellowness for each strain in each year are shown in Table 1. The Coopworth and Border Leicester crosses had the heavier greasy fleece weights in both years than Romneys ($P < 0.01$) which is in agreement with results of Hight *et al.* (1975).

The Ruakura High Fertility strain had the highest loose wool bulk in both years ($P < 0.01$). Carnaby and Elliott (1980) have shown that loose wool bulk and yarn bulk are highly correlated but have stated that a difference of at least 15% in loose wool bulk is required to produce detectable differences in yarn bulk. In 1979 therefore wool from the Ruakura High Fertility strain would have produced yarn of detectably higher bulk than the Border Leicester.

Differences in yellowness (Y-Z value) between the strains were small, with values being approximately 1 unit higher in 1980 than in 1979. Recent evaluation trials undertaken by the New Zealand Wool Board (M. K. Corrigan, pers. comm.) indicate that the differences in yellowness between style grades are of the order of 1 to 1.5 Y-Z units. The 1980 wools were therefore approximately 1 style grade lower than those of 1979.

The heritability estimate for greasy fleece weight, loose wool bulk and yellowness were 0.62 ± 0.11, 0.41 ± 0.09 and 0.13 ± 0.06 respectively. The estimate for loose wool bulk is high and is similar to that reported by Watson *et al.* (1977) for resistance to compression for the Australian Merino. The heritability of yellowness is low.

Genetic and phenotypic correlations between wool traits and greasy fleece weight, loose wool bulk and yellowness are shown in Table 2. These estimates indicate that selection for loose wool bulk would reduce clean fleece weight while leaving greasy fleece weight unchanged probably from increasing the amount of grease/suint in the fleece. Staple length would also decrease and the wool would become finer. Similar results were reported by Watson *et al.* (1977) for the Merino.

If mass selection was applied to a large population using 5% of males with the highest loose wool bulk (Table 3), loose wool bulk would increase by about 1 cm^3/g in 1 generation or require about 3 generations for a 15% increase to occur. This would be accompanied by a reduction of approximately 0.05 kg of

TABLE 2 Genetic (g) and Phenotypic (p) correlations between wool traits.

	Greasy fleece		Bulk		Yellowness	
	g	p	g	p	g	p
Greasy fleece weight			-0.06	-0.03	0.49	0.23
Clean fleece weight	0.95	0.91	-0.23	-0.23	0.30	0.22
Yield	-0.25	-0.09	-0.83	-0.49	-0.55	-0.01
Staple length	0.32	0.29	-0.67	-0.50	0.36	0.17
Fibre diameter	0.55	0.41	-0.13	0.01	0.53	0.14
Bulk	-0.06	-0.03			-0.04	-0.11
Yellowness	0.49	0.23	-0.04	-0.11		
Total crimps	0.03	0.01	0.57	0.45	-0.48	-0.14

clean wool per generation, currently worth about 20 cents. At present there appears to be little if any premium paid at auction for loose wool bulk (New Zealand Wool Board classing trials, L. Wiggins, pers. comm.) and it would therefore not be to the breeders advantage to select for loose wool bulk.

TABLE 3 Direct and correlated responses from 1 generation of selection.

Trait selected	Selection response: Greasy fleece wt (kg)	Clean fleece wt (kg)	Bulk (cm^3/g)	Yellowness (Y-Z)
Greasy fleece weight	0.34	0.25	0.08	0.12
Bulk	0.02	-0.05	1.10	-0.01
Yellowness (downwards)	-0.07	-0.04	0.02	-0.11

Selection for whiteness, i.e. reduced Y-Z values, would reduce both clean and greasy fleece weights (Table 3). Using the same selection procedure as above in which rams with a low Y-Z value were selected would result in the reduction in greasy fleece weight of 0.07 kg with a reduction in the Y-Z value of 0.1 Y-Z units. Again it would not be to the breeders advantage to select for whiteness.

The only wool trait included in the Sheeplan selection index for crossbred sheep is greasy fleece weight which is the major factor influencing gross returns from sale of wool in such flocks. At least for the present there is no economic reason to include either loose wool bulk or yellowness as selection criteria in the index.

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