Resistance and susceptibility to fleece yellowing and relationships with scoured colour

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ABSTRACT

A predictive test for susceptibility to fleece yellowing, which has a high heritability (0.5), is described.

In a flock of Corriedale ewes 2 lines, selected entirely on the basis of the predictive test, demonstrated predicted levels of fleece yellowness when conditions promoted high levels of discolouration.

Assessed greasy and measured scoured wool yellowness were not highly correlated. The yellowness value of scoured wool of highly resistant (HR) fleeces was always low; that of highly susceptible (HS) fleeces was variable and often high. The yellowness value of HS fleeces increased on storage of greasy fleeces.

There was a negative correlation between yield and susceptibility, which was not strong enough to use for predictive purposes.

HR and HS Corriedale ewes, thoroughly washed and then housed to eliminate weather effects, showed striking differences in yield % (83 *v* 61), wax % (16 *v* 25) and suint % (5 *v* 29) respectively.

Pilocarpine hydrochloride was administered to the housed sheep to determine whether fleece yellowing and related faults were caused by excessive sweating. Results were variable.

Keywords Wool; fleece yellowing; prediction; grease; suint; heritability; correlations; scoured colour.

INTRODUCTION

Yellow discolourations of wool vary with fleece structure (Lipson, 1978) and with year, season and time of shearing (Chopra, 1978; Wilkinson, 1981; Sumner, 1983). Greasy fleece yellowness has a medium to high heritability (Chopra, 1978; James *et al.*, 1984). The heritability estimate is likely to be incident dependent (Atkins *et al.*, 1980; McGuirk and Atkins, 1984). The heritability of scoured colour is low (Jackson, 1973; Chopra, 1978; Bigham, 1983, pers. comm.). The relationship between greasy yellowness and scoured colour has been reported as weak (Clark and Whiteley 1977) and as strong (Chopra, 1978).

Breeding for whiteness of wool is made difficult by the highly variable incidence of fleece yellowing and the lack of a clear association between susceptibility to yellowness and assessed or measured wool and fleece characteristics.

Incubating wool samples to predict susceptibility to yellowness and related faults (Wilkinson, 1981) has been found useful as an indirect selection method.

MATERIALS AND METHODS

Sheep

Incubation tests were performed on midside fleece samples from Merino and Corriedale ram hoggets and on Romney ewe hoggets from the Rotomahana strains comparison trial (M. Bigham, pers. comm.). Twenty mixed age Corriedale ewes, selected solely on the incubation test for susceptibility to fleece yellowing, were run together to provide fleece samples for basic studies. Some of these sheep were thoroughly washed and then housed for 9 months.

Incubation Test

The procedure described by Wilkinson (1981) was modified by using larger and more frequent additions of water during incubation. Yellowness was scored by assessing the colour of a 60% ethanol wash after 5 days incubation. Low scores were given to resistant wools and high scores to susceptible wools (range 1 to 10).

Scoured Colour

Y-Z yellowness values were recorded on a Hunterlab D25-2 colour/difference meter. Higher values indicate greater yellowness.

Storage Colour

Greasy wool samples from the 20 Corriedale ewes were stored for 18 months in a standard atmosphere. Scoured colour was measured before and after storage.

Grease and Suint

Greasy samples were fractionated using distilled Shell X4 commercial hexane for grease (wax) extraction.

Induction of Sweating

Pilocarpine hydrochloride was administered daily for 14 days to some housed sheep as a subcutaneous injection of 0.73 mg/kg live weight.

RESULTS

Relationships between Predicted Susceptibility to Fleece Yellowing and Some Fleece Characteristics

Phenotypic correlations

Relationships between susceptibility and fleece weight and yield were unstable in small flocks. Analyses of data from larger flocks showed that susceptibility was, in general, positively correlated with greasy fleece weight, negatively correlated with yield and either negatively or not correlated with clean fleece weight (Table 1).

TABLE 1 Phenotypic correlations between susceptibility to fleece yellowing and greasy fleece weight (GFW), yield and clean fleece weight (CFW).

Breed	Sheep	GFW	Yield	CFW
Merino	363	0.155**	-0.141*	0.107^{NS}
Corriedale	225	0.176*	-0.340***	0.021^{NS}
Corriedale	107	-0.074^{NS}	-0.194*	-0.185^{NS}
Corriedale	390	0.149**	-0.211**	-0.002^{NS}
Romney	361	-0.013^{NS}	-0.552***	-0.261***

Heritability and genetic correlations

Predictive tests were conducted on fleece samples from 361 ewe hoggets in 38 sire groups from the Rotomahana strains trial. The heritability of the predictive test was 0.51 ± 0.10 and there were strong negative genetic correlations of susceptibility with GFW (-0.412, SD 0.353), yield (-1.00, SD 0.543) and with CFW (-0.715, SD 0.352) (M.L. Bigham, pers. comm.).

Scoured Colour and Storage Colour

The yellowness values of scoured wool before and after storage of greasy wool samples from Corriedale ewes were low for the resistant group and generally high for the susceptible group (Table 2). Comparisons of initial greasy colour against scoured colour before and after storage gave r^2 values for the resistant group of 0 and 29.4% and for the susceptible group of 69.1% and 22.9% (B. Batchelar, pers. comm.).

The greasy fleece colour of these sheep observed throughout a number of years was generally similar in autumn and winter. Susceptible fleeces discoloured in spring and summer and, in 1 year of the last 3, all developed fleece rot.

TABLE 2 Mean yellowness values (Y-Z) of scoured wool from 10 resistant and 10 susceptible fleeces before and after 18 months storage in the greasy state.

	Resistant		Susceptible	
	Before	After	Before	After
Mean	1.30	0.67	4.9	5.11
SD	0.56	0.88	2.47	4.10

Grease and Suint

Fleece samples from housed resistant and susceptible Corriedale ewes were fractionated to provide yield, grease and suint values. Resistant fleeces were high yielding and low in suint, whereas susceptible fleeces were low yielding and high in suint (Table 3). Resistant fleeces remained white, susceptible fleeces became grossly discoloured.

Pilocarpine hydrochloride did not significantly increase suint content or decrease yield of midside greasy fleece samples.

TABLE 3 Group mean values (%) for sample yield, grease and suint from 5 resistant and 4 susceptible housed Corriedale ewes (clean conditioned basis, standard deviation in brackets).

	Resistant			Susceptible		
	June	July	August	June	July	August
Yield	83.1 (2.4)	82.1 (2.6)	84.3 (3.4)	62.1 (5.5)	62.7 (6.0)	60.0 (7.9)
Grease	17.8 (5.3)	19.4 (5.1)	16.0 (4.8)	23.5 (7.7)	25.0 (8.2)	26.7 (11.7)
Suint	4.0 (1.8)	5.1 (1.3)	5.5 (2.0)	26.9 (4.5)	28.3 (9.0)	33.8 (9.6)

DISCUSSION AND CONCLUSION

Because of the strong influence of climatic factors, of shearing time and frequency and of fleece characteristics on the reaction of the fleece to environmental challenge, direct selection against fleece yellowing is not generally successful. A number of fleece characteristics have been related to yellowing but they are not suitable for indirect selection because the relationships are unstable (Wilkinson, 1981, 1982).

Successful prediction demands an index that is highly inherited and strongly related to the trait, that can be scored at any time and has a wide range of expression and that is simple and inexpensive (McGuirk and Atkins, 1980; Wilkinson, 1981).

The incubation test is shown in this report to satisfy these criteria. The suint fraction of greasy fleeces is clearly related to susceptibility. Fleeces resistant to yellowing and related faults, as determined by the predictive incubation tests have a high clean weight, scour white and store well. The prediction is highly inherited.

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