RESPONSES TO SELECTION FOR RESISTANCE AND SUSCEPTIBILITY TO FLEECE ROT AND BODY STRIKE IN MERINO SHEEP

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SUMMARY

After 17 years of selection, responses in disease and production traits in lines of Merino sheep selected for increased (Susceptible line) and reduced (Resistant line) expression of body strike and fleece rot were estimated. The Susceptible and Resistant lines differed significantly in both natural and artificial expressions of fleece rot and body strike. The lines diverged at annual rates of 2.8% for natural fleece rot incidence and 0.4% for natural body strike incidence. Similar divergence rates were observed for the artificial expressions of these traits. Selection resulted in unfavourable correlated responses in greasy and clean fleece weights, a favourable correlated response in fibre diameter and little evidence of correlated responses in yield and body weight.

Keywords: Merino sheep, selection, fleece rot, body strike, production traits.

INTRODUCTION

Cutaneous myiasis, blowfly strike, in Merino sheep is of major concern to the Australian wool industry. This concern not only arises from the costs of lost wool production, animal losses and the application of preventative treatments (M^{c}Leod 1995) but reflects consumer fears over possible chemical residues in wool fibre and its by-products (James 1990). Chemical methods to control blowfly strike also could have potential problems of pesticide resistance, occupational exposure to pesticides and the accumulation of chemicals in the environment.

A long-term strategy to reduce blowfly strike in sheep is selection for reduced susceptibility to blowfly strike and fleece rot, a superficial bacterial dermatitis and major precursor of body strike. Selection could be used independently or as part of an integrated pest management program, which could include biological, chemical and immunological methods. The ability to alter the susceptibility of sheep to body strike and fleece rot has been demonstrated in divergent lines selected for increased (Susceptible line) and reduced (Resistant line) expression of body strike and fleece rot, described by M^{c}Guirk *et al.* (1978). Differences between the lines in fleece rot and body strike incidences were observed in both a low risk (Raadsma 1991a) and a high risk environment (Raadsma 1991b). Differences between the lines in production traits are yet to be studied. This paper reports further on the divergence between the Susceptible and Resistant lines achieved in expression of body strike and fleece rot, as well as the correlated responses in wool production traits.

MATERIALS AND METHODS

The Resistant and Susceptible selection lines (M[c]Guirk *et al.* 1978) were established to assess the ability of direct selection to alter resistance to fleece rot and body strike. The selection criteria used within the lines varied across years and included natural expressions of fleece rot and body strike and artificial expressions of fleece rot and body strike following fleece rot induction (Raadsma *et al.* 1988). The selection lines were established by selecting rams from the Trangie Fertility flock and ewes from the Trangie Selection Demonstration flock. The lines were closed to ram introductions in 1980 and a minimum of five rams per line have been used at mating. Ewe numbers within each line were allowed to reach a ceiling of about 175 ewes per line. Group matings of rams occurred from 1976 to 1982. Single-sire matings occurred in all other years.

Observations on rams, ewes and wethers born between 1977 and 1991 are reported in this study. The disease traits were fleece rot and body strike incidences, assessed following the methods of Raadsma *et al.* (1988) and recorded as categorical traits where unaffected animals had scores of 0. The traits were recorded following natural challenge between birth and 13 months of age (natural fleece rot incidence, NFR, and natural body strike incidence, NBS) and following fleece rot induction, described by Raadsma *et al.* (1988), at 14 months of age (artificial fleece rot incidence, AFR, and artificial body strike incidence, ABS). Production traits recorded on the animals at 15-16 months of age were greasy fleece weight (GFW), clean fleece weight (CFW), yield (Y), fibre diameter (FD) and body weight (BWT). Least squares procedures (REG, Gilmour 1993) were used to analyse the data. Fixed effects (year, sex, age of dam, birth-rearing type, age at observation and month of shearing), selection line and selection line X year were fitted in models for each trait. Annual responses in the traits for each selection line were estimated as the regression of the deviation between the Susceptible and Resistant line-year means on year of selection.

RESULTS

Mean values of NFR, NBS, AFR and ABS were 23.5%, 5.8%, 50.5% and 3.5% respectively. The Susceptible line had higher incidences of NFR (37% versus 10%), NBS (8% versus 3%), AFR (63% versus 38%) and ABS (5% versus 0%) than the Resistant line (Table 1). Line differences were significant for all production traits except BWT. Means for GFW, CFW and FD were all greater in the Susceptible line than the Resistant line.

For NFR, the annual divergence between the Resistant and Susceptible lines increased with time (Figure 1). A deviation to this trend occurred for 1990-born animals where the average incidence was low compared with other years due to unfavourable rainfall conditions for fleece rot development. Significant rates of divergence between the selection lines were observed for NFR, NBS and AFR (Table 1) but not for ABS (P=5.8%). Annual response rates in divergence between the lines for the disease traits were all positive: 2.8% for NFR, 0.4% for NBS, 2.3%

Table 1. Means (± standard errors) and annual responses of disease and production traits in the Susceptible and Resistant selection lines

Trait	Records	Selection line means[A]		Annual responses[B]
		Susceptible	Resistant	
NFR	3339	0.37 ± 0.01^{a}	0.10 ± 0.01^{b}	0.028 ±0.004***
NBS	3339	0.08 ± 0.00^{a}	0.03 ± 0.00^{b}	0.004±0.001**
AFR	2870	0.63 ± 0.01^{a}	0.38 ± 0.01^{b}	0.023±0.002***
ABS	2870	0.05 ± 0.00^{a}	0.00 ± 0.00^{b}	0.005±0.002
GFW(kg)	3408	3.67 ± 0.01^{a}	3.50 ± 0.01^{b}	0.015±0.004**
CFW(kg)	2797	2.65 ± 0.01^{a}	2.50 ± 0.01^{b}	0.013±0.003**
Y(%)	2799	70.15 ± 0.10^{a}	69.60 ± 0.10^{b}	0.053±0.041
FD(μ)	2801	20.87 ± 0.03^{a}	20.49 ± 0.03^{b}	0.040±0.011**
BWT(kg)	3173	43.59±0.10	43.58±0.10	0.001±0.018

[A] Means with different letters differ significantly.
[B] *** P<0.001; ** P<0.01; * P<0.05.

for AFR and 0.5% for ABS. Divergence rates between the lines were positive and significant for GFW (0.015 kg per year), CFW (0.013 kg per year) and FD (0.040 μ per year). Annual responses in Y and BWT were positive but not significant.

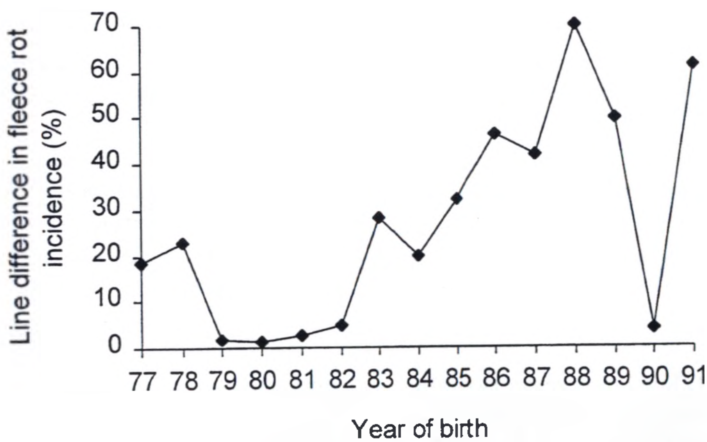

Figure 1. Differences in line-year means (Susceptible - Resistant) for natural fleece rot incidence (%).

DISCUSSION

Selection on susceptibility to body strike and fleece rot of Merino sheep has yielded responses in both the natural and artificial expressions of fleece rot and body strike. Similar response rates were observed in both fleece rot traits and these responses were substantially faster than in body strike. Responses of slightly more than 1% per generation would be expected when the selection objective was reduction of fleece rot susceptibility alone (Atkins unpublished data). Our result of a 1.4% annual change in NFR shows that faster gains in fleece rot can be achieved, presumably through greater selection accuracy brought about by including a number of highly correlated expressions of the trait. The responses observed here need further investigation to identify base population heritabilities and the genetic relationships among the component traits.

Selection for reduced susceptibility to body strike and fleece rot has been accompanied by unfavourable correlated responses in greasy and clean fleece weights, a favourable correlated response in fibre diameter and little evidence of correlated responses in yield and body weight. The regression of standardised divergence in a correlated character (here a production character) on standardised divergence in the directly selected character (assumed to be natural fleece rot incidence) has an expectation of (h_2/h_1*r_G) where h_1 is the square root of heritability of natural fleece rot incidence, h_2 is the square root of heritability of the correlated production character and r_G is the genetic correlation between the characters. Using literature values of heritabilities, the realised genetic correlation estimates were about +0.2 between fleece rot incidence and greasy and clean fleece weights and about +0.1 between fleece rot incidence and fibre diameter. Further study of the genetic relationships between fleece rot incidence and production traits, as well as body strike incidence and production traits, are needed to be confident about predictions of selection response. If the favourable genetic correlation with fibre diameter and unfavourable ones with greasy and clean fleece weights of natural fleece rot incidence are confirmed, then little useful change in fleece rot incidence will occur in breeding programs designed to increase fleece weight and reduce fibre diameter. Effort will then be needed in such breeding programs to alter the genetic susceptibility of Merinos to fleece rot.

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