RESPONSES OF MATURE BREEDING EWES TO SELECTION FOR MULTIPLE REARING ABILITY

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INTRODUCTION

Fluctuations in the ratio between wool and meat prices have resulted in the shifting of the emphasis between the two products during selection. This resulted in distinct changes in the South African Merino industry over the last two decades. The breeding strategy was adapted to enable an improved meat production capability (Olivier, 1999). The implications of this strategy on other traits contributing to the lifetime income from ewes have not been studied yet. The purpose of this study was to compare the performance of breeding ewes from two lines divergently selected for multiple rearing ability for traits of economic importance.

MATERIAL AND METHODS

Two lines of Merino sheep were divergently selected from the same base population since 1986 (the High [H] and Low [L] line respectively), using maternal ranking values for lambs reared per joining. Details of the replacement policy can be found in Cloete and Scholtz (1998). The H line was augmented by 28 ewes born to a multiple ovulation and embryo transfer program (Cloete *et al*., 1998). The performance of these ewes was similar to that recorded in the H line, and they were treated as one group. The lines were run at the Elsenburg Agricultural Centre as a single flock, except during joining in single sire groups. Details of the experimental site and husbandry practices are in Cloete and Scholtz (1998). The animals were maintained on irrigated kikuyu, dryland lucerne and medic pastures, as well as occasional small grain fodder crops and stubbles. Nutrition was mostly adequate throughout the year, and supplementary feeding was rarely needed. The ewes were shorn within 3-4 weeks of the commencement of lambing. Data included 1848 annual reproduction records of 638 ewes (aged 2 to 7 years) from 1993 to 2001. Reproduction traits included number of lambs born (NLB), number of lambs weaned (NLW) and total weight of lamb weaned (TWW). The latter trait was recorded as defined by Olivier (1999). Live weight at joining (LW) and annual greasy fleece weight (GFW) were also recorded. Mean fibre diameter (MFD) was recorded in 454 ewes from 1997 to 2001, resulting in 1027 repeated records. ASREML (Gilmour *et al*., 1999) was used to estimate variance components in single-trait analyses. Direct additive genetic effects and permanent environmental ewe effects were computed. A random effect of service sire was included in the analyses for reproduction traits. A cubic spline (Gilmour *et al*., 1999) was used to model changes in production with age. The interaction of selection line with the linear and curvilinear components of the spline was fitted initially, and retained in the final analyses where significant.

RESULTS

Heritabilities obtained for the reproduction traits were below 0.10 (Table 1). In the case of LW and GFW, h^2 approached 0.50 while it was as high as 0.66 for MFD. Estimates of c^2 were roughly 0.12 for the reproduction traits, between 0.20 and 0.27 for LW and GFW, and 0.06 for MFD. Service sire effects were low, contributing ≤3% to the overall phenotypic variance.

Table 1. Variance components and ratios for traits of economic importance in mature breeding ewes

	Variance components				Variance ratios		
Trait	σ^2_a	σ^2_{pe}	σ^2_{sire}	σ^2_p	h^2	c^2_{pe}	c^2_{sire}
NLB	0.0365	0.0522	0.0033	0.4304	0.085±0.039	0.121±0.041	0.008±0.009
NLW	0.0232	0.0533	0.0060	0.4272	0.054±0.033	0.125±0.038	0.014±0.010
TWW	10.836	19.804	5.257	173.43	0.063±0.035	0.114±0.038	0.030±0.013
LW	14.548	8.023	n.a.	30.175	0.482±0.073	0.266±0.067	n.a.
GFW	0.3107	0.1368	n.a.	0.6780	0.458±0.067	0.202±0.060	n.a.
MFD	1.9076	0.1820	n.a.	2.8750	0.664±0.084	0.063±0.074	n.a.

σ^2_a – Direct additive variance; σ^2_{pe} – Ewe permanent environmental variance; σ^2_{sire} – Service sire variance; σ^2_p – Phenotypic variance; h^2 – Heritability; c^2_{pe} – Ewe permanent environmental variance ratio; c^2_{pe} – Service sire variance ratio; n.a. – Not applicable

The reproduction traits NLW and TWW increased with age to reach a maximum by 4 to 5 years, followed by a decline (Figure 1). Statistical evidence suggested that the form of the curve did not differ between selection lines (P>0.05). The main effect of selection line was, however, highly significant (P<0.001). Overall, NLW (estimated at the average age of 3.9 years) was 41% higher in H line ewes than in L line ewes, when expressed relative to the latter (1.171±0.042 vs. 0.831±0.051 respectively). The corresponding difference for TWW amounted to 49% (25.2±08 vs. 16.9±0.0 respectively).

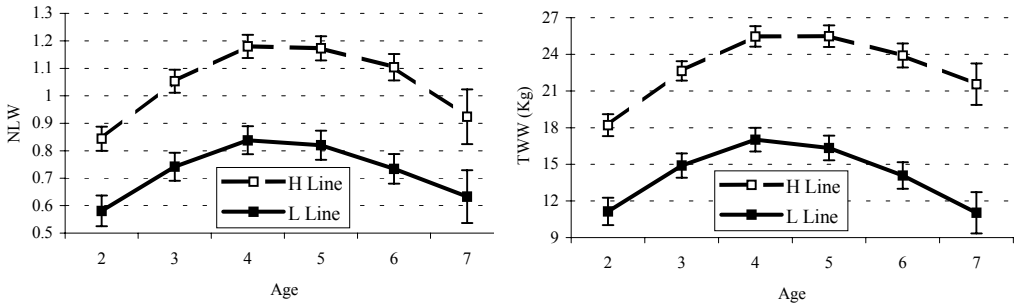

Figure 1. Age trends in the reproduction traits number of lambs weaned (NLW) and total weight of lamb weaned (TWW) in the H and L lines. Vertical bars upon the lines represent standard errors

When GFW and LW were considered, the curves derived for the two lines were found to differ (P<0.05). Ewes in the L line generally had a higher (P<0.05) GFW than H line contemporaries (Figure 2). Ewes in the H line produced 4.7% less wool than L line contemporaries at 2 years of age, expressed relative to the latter. Corresponding figures amounted to 5.4% at 3 years, 6.5% at 4 years and 6.1% at 5 years. No significant difference in GFW was observed between H and L line ewes of 6 years and older. Ewes in the H line were heavier (P>0.01) than L line contemporaries at 2 years of age (42.5±0.5 vs. 40.4±0.6 kg respectively. This line difference was reduced to a tendency (P<0.10) at 3 years of age. No line difference occurred at later ages. In general, MFG increased with an increasing ewe age. Trends did not differ between the two lines. The overall rate of increase in MDF was 0.46±0.06 μm per year. Overall least squares means for MFD were 22.7±0.2 for the H line and 22.5±0.2 for the L line (P>0.05).

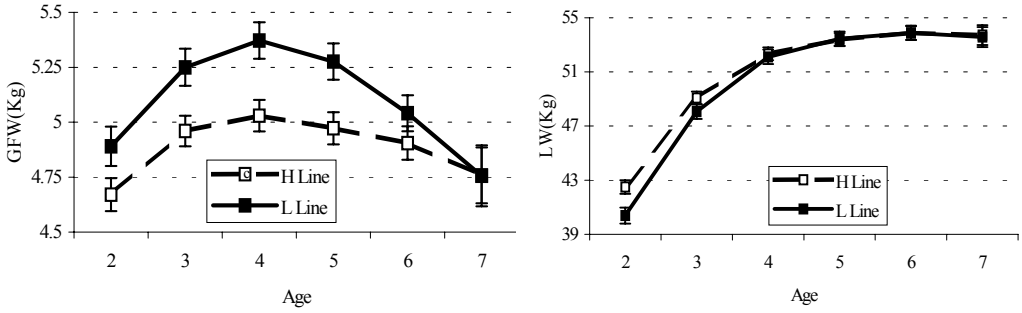

Figure 2. Age trends in greasy fleece weight (GFW) and live weight at joining (LW) in the H and L lines. Vertical bars upon the lines represent standard errors

DISCUSSION

The h^2 estimate for NLB in Table 1 accorded with estimates in the literature (0.06 – Brash *et al*., 1994a; 0.03 – Brash *et al*., 1994b; 0.07 to 0.12 – Bromley *et al*., 2000). In the case of NLW, h^2 was estimated at 0.054. Comparable estimates in the literature were 0.06 (Brash *et al*., 1994a), 0.03 (Brash *et al*., 1994b), 0.03 to 0.07 (Bromley *et al*., 2000) and 0.04 (Swan *et al*., 2001). Our estimate for TWW accorded with those of Bromley *et al*. (2001), ranging from 0.02 to 0.11. The h^2 estimate for LW was consistent with that of 0.46 reported by Swan *et al*. (2001). Estimates for the h^2 of fleece weight ranged from 0.47 to 0.55 in the studies of Bromley *et al*. (2000; 2001), which accorded with our estimate of 0.458. Estimates of c^2_{pe} for the reproduction traits in our study were approximately 0.12 in all cases. Corresponding estimates reported by Bromley *et al*. (2000) ranged from 0.01 to 0.07. Swan *et al*. (2001) reported a c^2_{pe} estimate of 0.09 for NLW. The latter study also reported a c^2_{pe} estimate of 0.13 for LW, which was somewhat lower than that reported in this study. Bromley *et al*. (2000) reported c^2_{pe} estimates ranging from 0.08 to 0.17 for GFW in four breeds. Our corresponding estimate was 0.20. Repeatability (the sum of h^2 and c^2_{pe}) was 0.727 for MFD in this study. Murray *et al*. (2001) reported a corresponding estimate of 0.74. Our estimate for c^2_{sire} was 0.03 for TWW. Bromley *et al*. (2001) reported c^2_{sire} estimates ranging from 0.00 to 0.03.

The general trends with an increase in age were consistent with those reported by Brash *et al*. (1994a). The H line had an advantage (P<0.001) relative to the L line with regard to lamb output, as reported previously (Cloete and Scholtz, 1998). Selection for TWW in the United States led to similar benefits (Ercanbrack and Knight, 1998). Ewes in the L line had a higher (P<0.05) GFW than H line contemporaries at ages from 2 to 5 years. This line difference could be attributed to the stress associated with an increased reproduction rate, since genetic trends for fleece weight in the two lines showed no evidence of a genetic difference (Cloete and Olivier, 1998). The reason for the decline in GFW of L line ewes relative to H line ewes at ages >5 years is unclear at this stage. At 2 years of age, H line ewes were heavier (P<0.05) than contemporaries in the L line. This line difference was consistent with genetic trends in the two lines, where H line progeny became heavier and plainer relative to the L line (Cloete and Olivier, 1998). The difference, however, declined at later ages, and L line ewes were as heavy as H line contemporaries from 4 years of age. This result could be ascribed to the drain of a higher reproduction rate on the reserves of H line ewes.

CONCLUSIONS

Estimated parameters were consistent with literature values cited. The study demonstrated that fairly high levels of reproduction was attainable in pasture fed sheep selected for multiple rearing ability. The higher lamb output was associated with reductions in fleece weight in the H line. This response could be accounted for by the higher lamb output of H line ewes. The detrimental effect of reproduction on fleece traits are well known (Murray *et al*., 2001). The initial advantage of H line ewes for LW was cancelled by 4 years of age, and would not be reflected as an additional benefit when ewes are cast for age. Since MFD is the single most important determinant of wool price, it is mentionable that was similar between lines.

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