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Progeny test of selected lean and fat rams

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ABSTRACT

The fat thickness over the 12th rib was measured ultrasonically on 41 Coopworth ram lambs (7 months of age, 34 to 57 kg live weight). Four of the 7 fattest and 4 of the 7 leanest were selected on the basis of their deviations from the overall fat thickness—live-weight relationship. Ten to 12 male progeny of each of these rams generated from Perendale ewes were slaughtered at 4 to 7 months of age and 4 parameters of carcass fatness measured. The difference between the progeny of the 4 lean sires and that of the 4 fat sires was significant for 2 fat measurements, namely C ($P < 0.05$) the backfat thickness over the 12th rib, and S2 ($P < 0.01$) a fat depth in the shoulder region. Differences in GR and total chemical fat failed to reach significance. The data indicate that selection of sires on the basis of backfat thickness could be an effective means of reducing carcass fat thickness in lambs.

INTRODUCTION

Excessive fat on the carcasses can be a major problem in marketing of New Zealand export lamb (Frazer, 1982). Therefore the use of genetically leaner rams as sires of lambs for export would be an attractive proposition. The recent development in ultrasonic equipment designed to measure backfat thickness in the live animal (Jensen, 1977; Gooden *et al.*, 1980) may soon enable selection of such rams. The present experiment was designed to obtain some preliminary information on the likely success of such a strategy.

EXPERIMENTAL

Sire Selection

Ram lambs generated from 2 flocks of Coopworth ewes were used for the experiments. Ewes and rams for the original 2 flocks designated "low fat" and "high fat" were selected in January 1979 on the basis of backfat thickness measured ultrasonically using the Danscanner (Jensen, 1977; Bass, 1979). However, due to problems with the use of the Danscanner on sheep and with the interpretation of the photographic scans, it is now considered most unlikely that these initial selections were significantly different in backfat thickness.

In April 1980, 41 of these Coopworth ram lambs (7 months of age, live weight 34 to 57 kg, mean 42.2 ± 4.6 kg, SD) were screened for backfat thickness using the Danscanner. By then most of the problems with the operation of the instrument on sheep and the interpretation of scans had been overcome, mainly by ensuring very good contact between the instrument head and the back of the sheep (J. J. Bass, unpublished). For the scan, 2 photographs were taken on each side in the vicinity of the 12th rib.

Fat thickness was measured over the middle of the eye muscle and the mean of the values from the 4 photographs was taken as the fat thickness.

Regression equations relating ultrasonic backfat thickness (y, mm) to live weight at screening (LW, kg) for each flock of rams were then derived. There were no significant differences between the equations for the 2 flocks and the pooled regression therefore was derived:

$$y = 0.116 LW - 0.75 \quad (r = 0.51, S_{y.x} = 0.93, n = 41)$$

The deviation of the actual backfat thickness from that expected from the pooled equation was calculated for each ram lamb. The mean values for

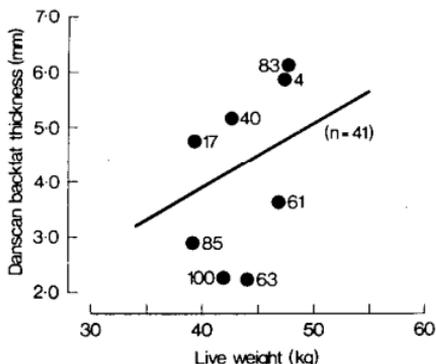


FIG. 1 Regression relationship between Danscan backfat thickness and live weight for the 41 ram lambs. (●) the 4 fat and the 4 lean rams selected for progeny testing.

TABLE 1 Pooled regressions for each carcass parameter on cold carcass weight.

	C (mm)	GR (mm)	S2 (mm)	Fat (kg)	Length (m)
Coefficient	0.288	1.026	0.413	0.411	0.0122
Intercept	1.77	1.21	0.454	0.468	0.0108
Sy.x	0.823	1.84	1.07	0.347	0.0148
Correlation (r)	0.518**	0.686**	0.547**	0.896**	0.815**

the 2 flocks were very similar and there was no significant difference between them.

Progeny Test Procedures

Eight ram lambs were selected for progeny testing (Fig. 1). The 4 lean rams (61, 63, 85, 100) and one of the fat rams (83) were chosen from the "low fat" flock while the remaining 3 rams were chosen from the "high fat" flock. Therefore it is considered possible but most unlikely that in the selection of the rams for progeny testing there was an element of 2-phase selection. In effect, 4 of the 7 fattest and 4 of the 7 leanest rams from the total flock of 41 were chosen for progeny testing.

Thirty mixed-aged Perendale ewes were allocated at random to each ram. After 17 days of mating all ewes were boxed together and run as a single mob thereafter. Lambs were identified at birth. At weaning, the ewe lambs were sold and ram lambs retained.

Twelve ram lambs per sire (only 10 available by 2 sires) were selected at random from those present at weaning in December and allocated to one of 3 slaughter dates, 23 February, 24 March or 14 April. After slaughter the following measurements were recorded: cold carcass weight (CCW), fat thickness C (Palsson, 1939) and S2 (Kirton *et al.*, 1967), GR

(tissue thickness at a point 11 cm from the midline in the vicinity of 12th rib; Fraser, 1976) and carcass length (distance from the neck to the crutch). The left side of the carcass was ground and subsamples analysed for water by freeze drying and chemical fat by Soxhlet extraction with petroleum ether.

Biometrical Analyses

Data were analysed by linear regression of each parameter (C, GR, S2, fat, length) on CCW for the progeny of each sire. Comparisons between the progeny of the various sires were analysed by covariance procedures (Snedecor and Cochran, 1967). A comparison of the progeny of the group of lean sires against the group of fat sires was performed using a variance-covariance matrix procedure (P. D. Johnstone, pers. comm.).

RESULTS

There were no significant differences between any of the sire groups in regression slopes for any parameter regressed on CCW. Therefore the pooled regressions were derived for each parameter (Table 1). The adjusted mean values for the progeny of each sire at a CCW of 13.5 kg were calculated and are presented in Table 2. The mean values for the progeny of the lean and fat sires are also presented.

TABLE 2 Adjusted mean values for the progeny of each sire for each carcass parameter at a cold carcass weight of 13.5 kg and the overall means for the progeny of the lean and fat sires used.

Sire	Progeny	CCW (kg)	Adjusted mean values				
			C (mm)	GR (mm)	S2 (mm)	Fat (kg)	Length (m)
Lean							
61	12	13.38	1.74	5.95	3.05	3.06	0.718
63	12	14.13	2.01	5.48	2.66	2.75	0.704
85	10	13.39	1.98	7.16	2.95	2.77	0.702
100	12	12.98	2.00	6.03	2.92	2.66	0.708
Fat							
4	12	14.11	2.12	7.29	4.38	2.87	0.705
17	10	12.71	2.23	6.51	2.93	2.79	0.704
40	12	12.95	2.64	6.94	3.81	3.08	0.702
83	12	14.33	2.26	6.70	3.24	2.95	0.704
Means							
Lean		13.47	1.93	6.16	2.90	2.81	0.708
Fat		13.53	2.31	6.70	3.59	2.93	0.704
Overall		13.50	2.12	6.43	3.24	2.87	0.706

TABLE 3 Deviations of the adjusted mean values from the overall mean for each sire for each carcass parameter and the overall means for the progeny of the lean and fat sires used.

Sire No.	Danscan C deviation (mm) ¹	Progeny: deviations of adjusted means				
		C (mm)	GR (mm)	S2 (mm)	Fat (kg)	Length (m)
Lean						
61	-1.05	-0.38	-0.48	-0.19	0.19	0.012
63	-2.1	-0.11	-0.95	-0.58	-0.12	-0.002
85	-0.9	-0.14	0.73	-0.29	-0.10	-0.004
100	-1.8	-0.12	-0.40	-0.32	-0.21	0.002
Fat						
4	1.1	0	0.86	1.14	0	-0.001
17	0.9	0.09	0.08	-0.31	-0.08	-0.002
40	0.95	0.52	0.51	0.57	0.21	-0.004
83	1.4	0.14	-0.36	0	0.08	-0.002
Means						
Lean	-1.47	-0.19	-0.28	-0.35	-0.06	0.002
Fat	1.09	0.19	0.27	0.35	0.05	-0.002
		*	ns	**	ns	ns

1. Calculated from the equation in the text: $y = 0.116LW - 0.75$.

Table 3 presents the deviations of the adjusted mean values from the overall mean for the progeny of each sire. From Tables 2 and 3 it is apparent that the progeny of the lean sires tended to have less fat than those of the fat sires with the difference in the 2 fat thickness measurements, C and S2 being significant ($P < 0.05$ and $P < 0.01$). The differences in GR, chemical fat and carcass length failed to reach significance.

A summary of the differences between the progeny of the lean and fat sires is given in Table 4. The differences in the carcass measurements as proportions of the residual standard deviation (SD) calculated from the pooled regression are also given. The differences between the 2 groups of progeny range from 0.30 to 0.65 SD compared with a difference of about 2.8 SD between the 2 groups of sires.

TABLE 4 Differences between mean Danscan C for lean and fat sires used and for carcass parameters for their progeny.

	Difference ¹ Fat-Lean	Sy.x	D/Sy.x
Sires			
Danscan C (mm)	2.58	0.93	2.78
Progeny			
C (mm)	0.38	0.82	0.46
GR (mm)	0.55	1.84	0.30
S2 (mm)	0.70	1.07	0.65
Fat (kg)	0.11	0.35	0.32
Length (m)	0.004	0.015	0.27

1. Difference between fat and lean sire groups calculated as (Fat sire mean - Lean sire mean), e.g., for carcass C: $0.19 - (-0.19) = 0.38$

DISCUSSION

The ultrasonic backfat thickness on the live animal should be equivalent to that of measurement C on the carcass. Therefore the regression of the mean deviation for the progeny of each sire (y) on the sire's own deviation (x , mm) is of interest namely:

$$y \text{ (mm)} = 0.123 x + 0.023 \quad (r = 0.66^*, \text{ Sy} \cdot x = 0.124, n = 8)$$

The significant regression relationship indicates that the selection of sires on the basis of backfat thickness measured ultrasonically could be expected to assist in reducing backfat thickness of carcasses produced. Published estimates of the heritability of backfat thickness in sheep are in the order of 0.2 to 0.5 (Botkin *et al.*, 1969; Bowman and Hendy, 1972; Cotterill and Roberts, 1976; Wolf *et al.*, 1981). The effectiveness of the selection reported in this paper would tend to support such estimates of heritability and to suggest that significant progress in selection can be made.

While the reduction in backfat thickness is of importance, the effectiveness of selection in reducing overall carcass fatness also needs to be considered. Generally those lambs sired by the lean rams were leaner than average for the other parameters measured while those sired by fat rams were fatter than average. For deviations in both GR and S2, 6 of the 8 sire groups exhibited changes in the same direction as the change in carcass C, while for chemical fat 5 out of 8 were in the same direction. In the lean groups, the progeny of sires 63 and 100 were leaner than average for all 4 parameters and in the fat group the progeny of sire 40 were fatter than average for all 4 parameters. Recent work by Wolf *et al.*

(1981) has indicated high genetic and phenotypic correlations between subcutaneous fat depth and other fatness characteristics.

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