SELECTION FOR IMPROVED CARCASS COMPOSITION IN SUFFOLK SHEEP

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SUMMARY

For the past 5 years ram lambs in an experimental Suffolk flock have been selected on an index of live weight and ultrasonic fat and muscle depths at 150 days of age. In 1989 lambs from the selection line showed significant responses of about 7.8 and 8.7 per cent in index score for males and females respectively, compared to lambs from a control line. Preliminary results also show responses of about +7.6 g lean and -10.2 g fat/kg carcass weight in the extensively-reared crossbred progeny of high index versus low index sires.

INTRODUCTION

It is likely that returns from lamb production in future will depend, much more than at present, on producing leaner carcasses. In the early 1980s a research project was started at the Edinburgh School of Agriculture (ESA), using Suffolk sheep, to examine the genetic potential for improving carcass composition by within-breed selection in terminal sire breeds. The work commenced with an evaluation of techniques for *in vivo* measurement of carcass composition (Simm, 1987) and derivation of selection indices to incorporate *in vivo* measurements (Simm and Dingwall, 1989). Since 1985 *in vivo* measurement and index selection have been practised in the experimental flock, which now numbers about 220 ewes. This paper reports the interim results of selection.

MATERIALS AND METHODS

Since 1985 ram lambs in the ESA Suffolk flock have been reared on the same performance test regime. This involves creep feeding up to weaning at 56 days of age, followed by performance testing in individual pens, with *ad libitum* access to a high energy (approximately 12 MJ/kg DM), high protein (approximately 180 g/kg DM crude protein) complete diet to 150 days of age. In 1989 ewe lambs were performance tested for the first time under a similar regime except that they were penned in groups of about 10 animals. The aim of this regime is to minimise maternal effects and to maximise variation in carcass composition to facilitate *in vivo* measurement.

At the end of the performance test lambs are weighed on three consecutive days, and ultrasonically scanned with a Vetscan B-mode real time scanner on two (ewe lambs) or three (ram lambs) occasions several days apart. On each scanning occasion, fat depths and muscle depths are recorded at the 13th rib and the 3rd lumbar vertebra. All measurements are adjusted for birth rank and dam age using additive correction factors derived within the flock, and ultrasonic measurements are regressed on age at scanning.

In 1985 ram lambs were selected on an index combining live weight and muscle depth. From 1986 onwards, lambs were selected on the index described by Simm and Dingwall (1989). This index has carcass lean weight and carcass fat weight in the selection goal, with relative economic values of +3 and -1 per kg, respectively. Index measurements are the individual animal's average live weight, muscle depth and fat depth at 150 days of age.

In 1985 about 30 per cent of the ewes were allocated at random, within age groups, to a control line. Six ram lambs with index scores close to the average in that year were also allocated to the control line. The control line is divided into six families with one ram lamb per family moving in sequence to the next family

for mating. The control line ram lambs with the index score closest to their family average are selected for mating in one season only.

Since 1985 the top six ram lambs in the selection line, ranked on index score, have been used for mating for one season only, as long as they are physically sound and eligible for pedigree registration. To reduce inbreeding, a maximum of two sons from any one sire are selected. Until 1989 all physically sound females entered the breeding flock at 18 months of age, replacing ewes drafted on age. In each year index scores are scaled separately for the 2 sexes to have a standard deviation of 40 index points, with a mean of 100 for control line lambs.

As described above, lambs in the ESCA Suffolk flock are reared on an intensive performance test regime. In practice, the plane of nutrition of these animals and the growth rates achieved are similar to those in many UK pedigree Suffolk flocks producing ram lambs for sale. However, most crossbred lambs are reared on grass or forage crops. It is therefore important to check for a possible genotype x environment interaction.

To answer this question, teams of high and low ram lambs, ranked on their index score, regardless of line, have been mated to crossbred ewes on the School farms. The experiment involved 400 Scottish Mule (Blueface Leicester x Scottish Blackface) ewes annually for 3 years. These ewes were mated to 11 high and 11 low index Suffolk ram lambs in each year, in individual mating paddocks. The crossbred progeny were reared on a grass-based finishing system, with weaning at about 14 weeks of age. Within each sire progeny group, lambs were allocated at random to one of three target slaughter liveweights. These liveweights were chosen to give carcass weights spanning the range of those produced in the UK industry (see Table 2). Lambs which failed to reach slaughter weights when grass declined in quality in the autumn were supplemented with concentrates. Lambs were weighed regularly between birth and slaughter. Following slaughter, approximately 20 per cent of carcasses at each weight in each sire group were fully dissected. The remainder had a sample joint dissected (shoulder).

RESULTS

Table 1 shows performance test results for ram and ewe lambs tested in 1989 - the fourth crop of lambs sires by rams who themselves were selected on index score. Compared to control line ram lambs, selection line rams show advantages in live weight, muscle depth and fat depth. Selection line ewe lambs show no advantage in fat depth over control line ewe lambs. This may be partly explained by the greater response in liveweight in females compared to males. The responses in overall index score are similar in the two sexes.

TABLE 1. **Ram and ewe lamb performance test results 1989 (at 150 days of age)**

	Selection Line	Control Line	Difference
Ram lambs			
No.	71	38	
Average live weight (kg)	66.57	64.86	+2.6% NS
Average muscle depth (mm)	30.47	28.86	+5.2% ***
Average fat depth (mm)	7.04	7.57	-7.0% *
Average index score	137	100	+7.8%† ***
Ewe lambs			
No.	84	40	
Average live weight (kg)	57.38	53.52	+7.2% ***
Average muscle depth (mm)	30.00	28.13	+6.6% ***
Average fat depth (mm)	7.00	6.98	0.0% NS
Average index score	136	100	+8.7%† ***

† on the unscaled index
(* = P<0.05, *** = P<0.001)

Young (1989) estimated genetic parameters from these data using restricted maximum likelihood procedures. Apart from the heritability of fat depth, his estimates correspond closely with values assumed in deriving the index (eg. heritability estimates of 0.26 $\pm$ 0.10 for live weight, 0.29 $\pm$ 0.11 for ultrasonic muscle depth and 0.55 $\pm$ 0.11 for ultrasonic fat depth, compared to assumed values of 0.24, 0.22 and 0.23).

Table 2 summarises dissection results from the first year of the progeny test (involving Suffolk rams performance tested in 1986, with crossbred lambs reared in 1987). On average, the progeny of high index sires had carcasses with 7.6 g/kg more lean and 10.2 g/kg less fat than carcasses from lambs sired by low index rams. At the same level of subcutaneous fatness, lambs from the high index sires were predicted to have carcasses about 0.75 kg heavier than those from the progeny of low index rams.

TABLE 2. **Summary of the differences in predicted carcass lean proportion and predicted total carcass fat proportion between progeny of high and low index rams (adjusted to constant carcass weight) †**

Carcass weight (kg)	16.7	19.3	22.3	Average Difference
Difference in predicted lean (g/kg)	+6.3	+8.0	+8.5*	+7.6
Difference in predicted total fat (g/kg)	-9.4*	-10.7*	-10.5*	-10.2

† Prediction based on shoulder joint dissections
(* = $P<0.05$)

DISCUSSION

Interim results from this project show significant responses to index selection for improved carcass composition. At this early stage, responses in components of the index appear to differ between the two sexes. However, responses in overall index score are similar and close to the theoretical maximum for a flock of this size and breeding structure. Early results also show a response in carcass composition in the extensively reared crossbred progeny of high index Suffolk rams.

The scanning procedure and selection index used in the ESA flock have been adopted by the Meat and Livestock Commission (MLC) in their Sheepbreeder recording scheme for pedigree flocks. In 1989 about 260 terminal sires flocks throughout Britain used this scanning and indexing service. In a number of breeds it is the basis for newly established sire referencing schemes.

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