Reproductive performance and liveweight in Romney sheep selected for fleece weight and a control flock

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ABSTRACT

A high fleece weight Romney breeding flock (HFW) and a contemporary random control flock (RC) has been established at MAF Technology Woodlands Research Station by the intensive screening of ewe and ram hoggets from commercial flocks. This paper summarises production traits including reproductive performances, liveweight and fleece weight of the ewe flocks over the 7 years.

The ovulation rate and number of multiple births per ewe lambed were higher for HFW than RC ewes 1.84 vs 1.75 (SE 0.02, $p<0.01$) and 0.62 vs 0.56 (0.02, $p<0.05$). Number of lambs born per ewe joined, number of lambs reared per ewe lambed, the number of lambs weaned per lamb born and number of lambs weaned per ewe joined in HFW were 1.49 (SE 0.02), 1.37 (0.02), 0.84 (0.01) 1.20 (0.02) respectively, which were not significantly different compared with RC. The joining live weight was significantly ($P<0.001$) higher in HFW (65.4kg;SE 2.4) than in RC (61.3 kg; 2.4). The greasy fleece weight averaged 4.55 kg (SE 0.21) for HFW and 3.87 kg (0.21) for RC. This represents an average advantage of 17.6% ($P<0.001$) to HFW over 7 production years. The results indicate that the single trait selection for fleece weight will be associated with increases in other important productive traits in long wooled sheep.

Keywords Romney, ovulation, fleece weight, selection, lambs.

INTRODUCTION

Reproductive performance is an important efficiency factor determining profitability in the sheep industry. It is also a major limitation to genetic gains in breeding for any particular trait such as carcass or fleece production.

A high fleece weight Romney selection flock (HFW) and a contemporary random control flock (RC) were established at Woodlands Research Station in 1984 by intensively screening ewe and ram hoggets from industry flocks on hogget greasy fleece weight (Hawker and Littlejohn, 1986). The preliminary results of production and wool characteristics from the hogget progeny in the flocks were presented by Hawker *et al.*, (1988) and Wuliji *et al.*, (1991). This paper reports the reproduction, live weight and adult fleece weight performances in ewe flocks during the period from 1985 to 1991.

MATERIALS AND METHODS

Animal Management

The selected HFW and RC mature ewes were run together during the year as one mob, except during mating and lambing periods. The average stocking rate was 17 ewes/ha on a predominantly rye grass/white clover pasture. Each year ewes were joined for two cycles (35 days), in single sire groups in April, and lambed in these separate sire groups in September. Lambs were tailed at two weeks of age and weaned in late November. Any ewe that returned to service from single sire joining was re-joined to a blackface ram and the progeny discarded from the trial. Mature ewes were shorn in early December and culling and replacements were made subsequently. Routine husbandry practices, such as drenching, dipping and vaccination, were carried out simultaneously for all animals in both flocks. Over the last three years the flock age structure has been maintained in 5 age groups with an average of 35%, 30%, 18%, 11% and 6% as 2, 3, 4, 5 and 6 year olds, respectively, while a few older ewes were also kept from special family lines.

Data Recording and Analysis

The data presented in this report consist of 2185 records from 1985 to 1991. The live weights were recorded at pre-joining in April (JLW), wintering in July (WLW) and shearing in December (SLW). The reproductive performances were measured as ovulation rate (OR), number of lambs born/ewes joined (LBEJ), number of lambs reared/ewes lambed (LREL), number of ewes with multiple births/ewes lambed (MBEL), number of lambs reared/lambs born (LRLB), number of lambs weaned/lambs born (LWLB) and number of lambs weaned/ewes joined (LWEJ). The OR was determined by laparoscopic counting of corpora lutea in each ewe after one cycle of mating. Greasy fleece weight (GFW) of ewes was recorded at each shearing.

The data was statistically analyzed by least-squares analysis of variance. Models included year, flock and age of ewe, with older ewe classes (6 and above) combined. When checking first order interactions for significance a significant year x age interaction was found for GFW and the live weight measurements. This interaction could be largely accounted for by a year of birth effect, so this was added to the models for these traits.

RESULTS AND DISCUSSION

The OR of ewes was significantly ($P<0.001$) higher for HFW than for RC (Table 1). There were, however, no significant differences for LBEJ, LREL, LWEJ or LWLB between the flocks. The advantage of higher OR was not shown in subsequent reproductive measurements and this was partially due to a higher barren rate in HFW. This may coincide with reluctance to cull HFW ewes for poor reproductive record and the higher ratio of older ewes kept for special family lines in the flock.

TABLE 1 The reproductive performance of HFW and RC averaged over 7 consecutive production years

Flock	n	OR	SE	LBEJ	SE	LREL	SE	MBEL	SE	LWLB	SE	LWEJ	SE
RC	662	1.75	0.02	1.47	0.03	1.35	0.03	0.56	0.02	0.86	0.01	1.21	0.03
HFW	1523	1.84**	0.02	1.49^{ns}	0.02	1.37^{ns}	0.02	0.62*	0.02	0.84^{ns}	0.01	1.20^{ns}	0.02

*: P<0.05; **: P< 0.01; ns: non significant.

The ratio of MBEL was significantly (P<0.05) higher in HFW than in RC, this difference contributed to the significant difference in lambs born/ewe lambed (HFW: 1.65 vs RC 1.59, P<0.05). The OR was relatively stable in the consecutive production years (Table 2) ranging from 1.73 to 1.87 corpora lutea per ewe. However, LREL was significantly lower (P<0.05) for the 85, 86 and 87 production years compared with other years. The MBEL was significantly lower (P<0.05) in the 1986 production year than all other years. The analysis for age groups showed that OR was significantly (P<0.01) higher for 4 or 5 year olds compared with younger ewes. The LBEJ, LREL, LWLB, LWEJ and MBEJ performances increased up to 4 year old and then gradually decreased. These results agree very closely with previous investigations in Romneys (McDonald and Ch'ang 1966; Kelly *et al.*, 1978; Baker *et al.*, 1987; Hight and Jury 1970; Davis *et al.*, 1987), which mostly revealed that the reproductive performances rose to a peak at 4 to 7 years old. In this study, the peak was at 4 to 5 years old. Increasing lambdrop with increasing pre-joining live weight has been demonstrated in many studies in New Zealand. In their review, Allison and Kelly (1978) reported a 1.5 to 3.5% increase in multiple births per kg live weight increase; while a study in the US showed that pre-mating live weight had a significant but small effect on both OR and litter size with estimated increases of 5% and 3%, respectively, per 10% live weight increase (Nawaz and Meyer 1991).

Kelly and Johnstone (1982) showed that there was an increase of 0.61 - 0.69 lambs born per ewe lambing, and of 0.52 - 0.57 lambs tailed per ewe joined, for every increase in number of ovulations. The corresponding results for this study (due to the flock differences in OR) are an increase of 0.68 and a decrease of 0.17 respectively.

Kelly *et al.*, (1983) demonstrated that low and high live weight ewes on differential feeding levels resulted in a mean OR 0.34 higher for high liveweight groups than low liveweight groups, and 0.27 higher for high compared with the low nutritional status. Furthermore, Thompson *et al.*, (1985) noted the OR was related to sequential liveweight changes, with an average 0.12 increase per 100g/day liveweight change. However, the responses declined with extended periods of feeding, and such response is likely to be confounded with breeding seasonality.

Hight and Jury (1970) noted that age differences resulted in changes in the percentage of ewes lambing, lamb survival to weaning and particularly in the proportion of multiple births. They showed a significant age and year effect on MBEL which was lowest in the 2 year old and markedly increased in the 3-5 year old groups. This is similar to the results of the present study. The results we present here show higher performances across production years and age groups than the Romney strain in their study.

The data confirm that the reproductive performances achieved in these breeding flocks at Woodlands are comparable to those of Romney strains selected for reproductive performances or in group breeding schemes, during the last 15-20 years, cited by Baker *et al.*, (1987). This suggests that selection for fleece weight in long wool sheep is positively associated with liveweight and reproductive traits.

The JLW, WLW, SLW and GFW were significantly (P<0.001) heavier in HFW than in RC by 6.7%, 6.9%, 6.3% and 7.6% respectively (Table 3). The differences are similar to that reported by Wuliji *et al.*, (1991) for hoggets indicating that differences in ewe hogget performance are sustained through to adult performance.

The live weight and fleece weight means for the production years and age groups are given in Table 4. The JLW was significantly (P<0.05) higher for the production years 1987, 1988

TABLE 2 Reproductive performances for each production year and age group

	n	OR	LBEJ	LREL	MBEL	LWLB	LWEJ
Production Year							
85	293	1.75^{a}	1.43^{ns}	1.19^{a}	0.55^{b}	0.74^{a}	1.07^{a}
86	288	1.78^{ab}	1.47^{ns}	1.26^{a}	0.45^{a}	0.87^{bc}	1.23^{a}
87	297	1.77^{a}	1.46^{ns}	1.24^{a}	0.63^{bc}	0.76^{a}	1.07^{a}
88	311	1.82^{ab}	1.48^{ns}	1.48^{bc}	0.64^{bc}	0.91^{cd}	1.26^{b}
89	320	1.73^{a}	1.50^{ns}	1.51^{c}	0.58^{bc}	0.94^{d}	1.27^{b}
90	349	1.87^{b}	1.52^{ns}	1.40^{b}	0.65^{c}	0.84^{b}	1.24^{b}
91	327	1.82^{b}	1.50^{ns}	1.41^{bc}	0.62^{bc}	0.89^{bc}	1.29^{b}
SED		0.05	0.06	0.06	0.05	0.29	0.07
Age Groups							
2	779	1.68^{a}	1.33^{a}	1.23^{a}	0.46^{a}	0.86^{ab}	1.09^{a}
3	621	1.73^{ab}	1.48^{bc}	1.43^{c}	0.63^{b}	0.87^{ab}	1.25^{b}
4	377	1.86^{c}	1.63^{d}	1.47^{c}	0.66^{b}	0.88^{b}	1.37^{b}
5	238	1.90^{c}	1.59^{cd}	1.37^{bc}	0.62^{b}	0.83^{ab}	1.26^{b}
6+	170	1.79^{bc}	1.38^{ab}	1.27^{ab}	0.57^{b}	0.81^{a}	1.04^{a}
SED		0.05	0.06	0.06	0.05	0.03	0.07

abcd: Means with different superscripts differ significantly at P<0.05. ns: non significant.

TABLE 3 The average live weights and fleece weight in HFW and RC in 7 consecutive production years

Flock	n	JLW	SE	WLW	SE	SLW	SE	GFW	SE
RC	662	61.3	2.4	68.5	3.4	65.0	2.9	3.87	0.21
HFW	1523	65.4***	2.4	73.2***	3.3	69.1***	2.9	4.55***	0.21

***: P<0.001.

and 1990. There were significant year to year differences in the live weights, especially for SLW. These differences may be partially explained by the pastoral dry matter production rate variation in years, and also by animal management and weighing time variation from year to year. Ewes at least 4 years old were significantly heavier (P<0.05) than younger ewes, with 3 year olds significantly (P<0.05) heavier than the 2 year olds. The GFW production was relatively stable although production in 1991 was significantly lower (P<0.05) than the previous three years due to drought conditions. After adjusting the 2 year old GFW to 12 months production (actual GFW is for 10.5 months) in line with the other age groups, the only significant age effect on GFW was that 2 year olds produced less than 3-5 year olds (P<0.01). GFW peaked at age 3-5 and slightly decreased at age 6 or more. The GFW results show an age gradient difference that is comparable to a Romney flock studied in Canterbury (Wright and Stevens,1953) and a Hill Country situation in the North Island studying long wool breeds such as Coopworth, Perendale, Cheviot and Romney cross (Bigham *et al.*, 1978). A similar age and production performance relationship was also demonstrated in Merino breeds, where greasy and clean fleece weights reached a peak at 3½ years, then declined (Brown *et al.*, 1966).

TABLE 4 The live weights and fleece weight for production year and age group

	n	JLW	WLW	SLW	GFW
Production Year					
85	293	60.6^{a}	75.9^{c}	72.0^{bc}	4.08^{ab}
86	288	60.4^{a}	72.3^{ab}	72.0^{bc}	4.23^{ab}
87	297	66.0^{bc}	75.6^{c}	65.5^{ab}	4.32^{abc}
88	311	66.4^{bc}	73.4^{bc}	62.7^{ab}	4.40^{bc}
89	320	60.3^{a}	66.0^{a}	73.4^{c}	4.51^{c}
90	349	67.3^{c}	n/a	65.4^{b}	4.23^{b}
91	327	62.4^{ab}	61.8^{a}	58.4^{a}	3.69^{a}
SED		2.8	3.4	3.3	0.24
Age Groups					
2	779	57.3^{a}	56.6^{a}	59.3^{a}	$4.10\#^{a}$
3	621	60.6^{b}	65.5^{b}	65.0^{b}	4.44^{b}
4	377	64.7^{c}	73.1^{c}	68.4^{c}	4.42^{b}
5	238	66.3^{c}	77.2^{d}	70.7^{c}	4.44^{b}
6+	170	67.8^{c}	81.8^{e}	72.0^{c}	4.19^{ab}
SED		2.2	2.7	2.7	0.20

^{abcde}: Means with different superscript differed significantly at P<0.05.
n/a The winter live weight in 1990 was accidentally lost;
#: 2 year olds carried 10′ months fleece at the December shearing (3.59 kg) so the fleece weight adjusted to 12 months.
+: The 6, 7 and 8 year olds were combined as 6 plus group.

CONCLUSION

The data analysis of the HFW trait selection trial at Woodlands demonstrates that selection on fleece weight will increase economic return by improving wool weight production, ovulation rate and market live weights. As the fleece weight is highly associated with other major productive traits, namely ovulation rate, lambs born/ewe lambed rate and live weight, these traits can be achieved indirectly in selection for fleece weight in long wool sheep, further improving profitability of the industry in the future.

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