

New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website www.nzsap.org.nz

[View All Proceedings](#)

[Next Conference](#)

[Join NZSAP](#)

The New Zealand Society of Animal Production in publishing the conference proceedings is engaged in disseminating information, not rendering professional advice or services. The views expressed herein do not necessarily represent the views of the New Zealand Society of Animal Production and the New Zealand Society of Animal Production expressly disclaims any form of liability with respect to anything done or omitted to be done in reliance upon the contents of these proceedings.

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](http://creativecommons.org/licenses/by-nc-nd/4.0/).



You are free to:

Share— copy and redistribute the material in any medium or format

Under the following terms:

Attribution — You must give [appropriate credit](#), provide a link to the license, and [indicate if changes were made](#). You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

NonCommercial — You may not use the material for [commercial purposes](#).

NoDerivatives — If you [remix, transform, or build upon](#) the material, you may not distribute the modified material.

<http://creativecommons.org.nz/licences/licences-explained/>

Live weights, fleece weights and wool characteristics of screened high fleece weight and randomly selected Romney ewe hoggets

H. HAWKER AND R.P. LITTLEJOHN

Invermay Agricultural Centre
Ministry of Agriculture and Fisheries, Mosgiel

ABSTRACT

Fleeces from 28 000 Romney ewe hoggets in 14 mobs on 7 farms were weighed. Within each mob the top 1% on hogget fleece weight (High) and a random 1% (Random) were identified, midside sampled and weighed off-shears. Subsequently the top 0.6% on hogget fleece weight from each mob and a random 0.3% were transferred to Woodlands Research Station and managed as one flock for the next year.

At hogget shearing (9 months fleece) the 14 High sub-groups had on average 1.08kg higher fleece weights (greasy) and 0.83 kg higher clean fleece weights than the Random sub-groups. There was a close between sub-group relationship between greasy fleece weight and live weight with the High hoggets having 0.78 kg heavier fleeces at the same live weight. The High hogget sub-groups had a higher mean live weight (+ 3.9kg), fibre diameter (+ 2.7 μ m), staple length (+ 13 mm) and staple strength (+ 0.34 g/tex). The High and Random hoggets did not differ in loose wool bulk or colour. Most of the variation between or within mobs in clean fleece weight was accounted for by variation in fibre volume.

During the 2-tooth year the differences in fleece weight and live weight persisted. At shearing in March (4 months fleece) and December (9 months fleece) the High ewes had a 0.38 and 0.62 kg higher mean greasy fleece weight, respectively, than the Random ewes. The High ewes were 4 to 5 kg higher in live weight than the Random ewes at each weighing. The number of lambs born per ewe joined was higher for the High ewes (1.34 v 1.12), the advantage being largely attributable to these ewes' higher live weights.

Keywords Romney; selection; high fleece weight; screening; live weight; fibre characteristics; staple strength.

INTRODUCTION

There is little information available to allow prediction of the response to selection for fleece weight in a flock established by an intensive initial screening for high fleece weight. Depending on the number of genes involved and whether the response is consistent with the normal additive model of inheritance, the response may be greater or less than that typically observed in a flock selected initially from a random base population.

Phenotypic and genetic correlations between wool characteristics are usually similar (Elliott *et al.*, 1979b). Circumstantial evidence obtained from longwoolled breeds suggests that responses to selection for fleece weight are attributable to responses in fibre volume, i.e. there may be little genetic variation in the size of the follicle population (Elliott *et al.*, 1979b; Blair *et al.*, 1985).

A high fleece weight Romney flock has been established at Woodlands Research Station by screening ewe and ram hoggets from the industry on hogget greasy fleece weight. In this paper the live weights, wool production and wool characteristics of the high fleece weight and random ewe hoggets from each screened mob are described and information on 2-tooth production presented. Specific objectives are:

- i. To establish the contribution of live weight to the fleece weight advantage of the high fleece weight hoggets.
- ii. To examine the contribution of the components of

fleece weight to the differences between the 2 groups.

- iii. To estimate the phenotypic relationships between wool production and characteristics in the 2 sub-flocks to see if these are consistent with established relationships.
- iv. To estimate the advantage in ewe fleece weight accruing from screening on hogget fleece weight.

MATERIALS AND METHODS

Animals and Records

The fleeces (excluding bellies) from 28 000 untagged Romney ewe hoggets in 14 management mobs of between 940 and 4140 hoggets on 7 farms (selected primarily on large flock size) in West Otago and Southland were weighed at shearing in October-November 1984. The hoggets on each farm had previously been shorn as lambs in late January-early February. Within each of the 14 mobs the top 1% on hogget greasy fleece weight (HFW) and a random 1% (which excluded animals in both the top and bottom 1%) were identified and midside samples collected from their fleeces. The live weights (LW) of these hoggets were recorded off-shears. Subsequently the identified hoggets were subsampled such that the best 0.6% on HFW from each mob were selected to form the screened high fleece weight flock, while a random

0.3% (i.e. 30% of the random 1%) were selected to form a contemporary control flock.

The selected animals were transferred to Woodlands Research Station in January 1985 when they were 16 months old, and subsequently managed as one flock. Greasy fleece weights (GFW) were recorded at 2-tooth shearing on 5 March. On 10 April live weights were recorded and the ewes single-sire joined to Romney rams for 35 days. After the first 17 days of joining ovulation rates were determined by laparoscopy. The lambing performance of each ewe was recorded. Live weights of the ewes were recorded at weaning on 2 December and on 7 January, 1986. GFWs were recorded at shearing on 16 December.

Wool Measurements

Depending on mob size there were between 10 and 41 hoggets in the top 1% on HFW from each management mob and the same numbers in the random 1%. These sub-groups are subsequently referred to as High and Random, respectively. The 570 midside samples were measured for yield at 16% regain to determine clean fleece weight (CFW). Staple length, mean fibre diameter by the airflow method, and staple strength by Instron tensile strength tester were also measured on each midside sample. Loose wool bulk, brightness (tristimulus value Y) and yellowness (tristimulus values Y-Z) were measured on composite sub-samples from each of the 28 sub-groups.

Statistical Analyses

Hoggets

The distribution of HFW in each mob was tested for skewness as a deviation from normality. Differences in each variable between mobs and between the High 1% and Random 1% of hoggets were tested by analysis of variance. Two series of regression relationships were calculated.

- i. Between sub-group regressions were calculated using the sub-group means for each variable. Slopes and intercepts for the High and Random hoggets were compared.
- ii. Within sub-group regressions were calculated using the data from individual hoggets within each sub-group. Slopes and intercepts for the High and Random hoggets were compared.

Ewes

Live weights, GFW and ovulation rates were examined by analyses of variance and regression, as appropriate. Ovulation rate data were pooled across mobs of origin and regression equations calculated for the High and Random sub-flocks.

RESULTS

Hoggets

Mob mean HFW prior to selection varied from 2.04 to 3.45 kg. The standard deviation increased with mean HFW from 0.26 to 0.42 kg, but the coefficient of variation varied independently between 12.1 and 15.0%. The distribution of HFW in each mob showed significant positive skewness which could indicate non-additive genetic variation in fleece weight. The *absolute* selection differential of the High 1% varied with mob mean HFW from 0.8 to 1.2 kg (mean 1.08 kg) while the *relative* selection differential varied from 2.9 to 3.3 standard deviations. Each Random 1% and the final 0.3% selected had means and standard deviations of HFW similar to those of the source flock.

Mean LW of the Random hoggets varied between sub-groups from 23.8 to 41.5 kg. Within each mob the High hoggets had a higher mean LW than the Random hoggets (Table 1), the difference varying from 1.4 to 9.4 kg. The *between sub-group* relationship between HFW and off-shears LW is shown in Figure 1. There was no difference in slope between the High and Random hoggets, each extra kg in LW being associated with an extra 75 (SE 7) g of fleece. The intercept was 0.78 (SE 0.09) kg higher for the High hoggets.

The *within sub-group* relationships for the High and Random hoggets differed in both slope and intercept, the equations being, respectively;

$$\text{HFW} = 3.61 + 0.0033 (\text{SE } 0.0041) \text{ LW}$$

$$\text{HFW} = 1.64 + 0.0329 (\text{SE } 0.0049) \text{ LW}$$

The equation for the Highs is difficult to interpret because of the restricted distribution of fleece weights (top 1% of each mob). Using the Random equation it can be calculated that the 3.9 kg higher mean LW of the

TABLE 1 Live weights, wool production and wool characteristics of High fleece weight and differences between High and Random ewe hoggets*.

	High	Difference (High-Random)	SED
Live weight (kg)	35.5	3.9	0.54
Greasy fleece weight (kg)	3.78	1.08	0.03
Clean fleece weight (kg)	3.03	0.83	0.02
Yield (%)	80.7	-0.8	0.4
Staple length (mm)	149	13	1.9
Mean fibre diameter (µm)	35.8	2.7	0.25
Staple strength (g/tex)	2.63	0.34	0.11
Bulk (cm ³ /g)	20.2	0.0	0.5
Brightness (Y)	61.5	-0.5	0.6
Yellowness (Y-Z)	3.3	0.4	0.5

* Means and SED calculated from sub-group means (14 mobs; High and Random sub-groups within each mob; 10-41 hoggets/sub-group; N = 570).

High hoggets (Table 1) accounts for only approximately 14% of their higher mean HFW.

Hogget fleece weights and wool characteristics are summarised in Table 1. Mean yields of the fleeces from the Random hoggets varied from 75 to 86%, with only one sub-group below 79%. Mean yields were higher for the Random hoggets in 12 mobs but the average difference (0.8%) was small. As a result, the relative advantages of the High over the Random hoggets in greasy and clean fleece weight were similar (40 v 38%, respectively). Between sub-groups, yield was not significantly associated with any other variable. Within sub-groups, yield and CFW were closely associated (53% of variance accounted for), with a higher slope for the High hoggets due to their restricted fleece weight distributions.

Mean fibre diameters (FD) of the Random hoggets varied from 31.1 to 35.5 μ m and mean staple lengths (SL) from 108 to 156 mm. The High hoggets had higher mean FD (range +0.8 to +4.7 μ m) and SL (range +2 to +24 mm) than the Random hoggets in each mob. The relative advantage of the High hoggets in fibre cross-sectional area (i.e. 0.25 (FD²)) and in SL (17 and 10% respectively) accounted for most of the 38% advantage in CFW. This was confirmed by between and within sub-group regressions; fibre volume (area x length) in each case accounting for 87% of the variation in CFW.

Mean staple strength (SS) of the Random hoggets varied from 1.8 to 3.4 g/tex, being higher for the High hoggets in 11 of the 14 mobs. There were significant between and within sub-group relationships between SS and CFW, with no difference between the Highs and Randoms. The between sub-group relationship was

$SS = 1.1 + 0.52$ (SE 0.12) CFW (38% of variance accounted for)

Both between and within sub-groups the components of CFW (viz. FD, SL and fibre volume) were no better as predictors of SS than was CFW itself.

There was no difference in bulk between the High and Random hoggets (Table 1). Between sub-groups, bulk was negatively associated with fleece weight and the other wool characteristics, but none of the relationships were significant. There was a significant between sub-group relationship between the 2 components of colour, viz.

Brightness = 63.6 - 0.59 (SE 0.14) Yellowness
which accounted for 40% of the variance in brightness. Thus the sub-groups with the whitest wool also tended to have the brightest wool.

Ewes

The initial difference in LW between the High and Random hoggets persisted through the 2-tooth year (Table 2). At hogget shearing the High hoggets were on average 14% heavier than the Random hoggets. From

April to January (1986) the relative advantage was 8%, with the High ewes having a higher mean LW in January in 12 of the 14 mobs. Between mob of origin differences in LW also persisted through the 2-tooth year but by January they were only significant relative to the within sub-group SED.

Differences between the mobs in mean ovulation rate were not significant. The proportion of ewes with multiple ovulations increased with increasing pre-joining LW more rapidly for Random than for High ewes. The 0.14 higher mean ovulation rate of the High ewes was consistent with their 4.5 kg higher mean pre-joining LW.

The pooled number of lambs born/ewe joined was 1.34 and 1.12 for the High and Random ewes, respectively (difference non-significant), with no significant differences between the mobs. Number of lambs born did not significantly affect subsequent live weights in December or January or GFW in December.

The mean HFW of the High hoggets was 41% greater than that of the Random hoggets. Substantial advantages in GFW persisted through the 2-tooth year (Table 2), viz. 17% in March and 21% in December. At December shearing there were significant differences of up to 0.7 kg in GFW between sub-groups (cf. differences of up to 1.9 kg at hogget shearing).

There were significant between and within sub-group relationships between GFW and LW in December. The equations for the High ewes were:

Between sub-groups:

$GFW = 1.5 + 0.034$ (SE 0.003) LW (79% of variance accounted for)

Within sub-groups:

$GFW = 2.1 + 0.026$ (SE 0.003) LW (45% of variance accounted for)

The slopes for the High and Random ewes were not significantly different, but the High ewes consistently had a 0.45 (SE 0.05-0.08) kg higher intercept. The higher live weight of the High ewes accounted for approximately 20% of their higher GFW.

Wool characteristics measured on core samples from the High and Random ewes' fleece wool are shown in Table 2. Unlike the hoggets, mean yield was slightly higher for the High ewes, but like the hoggets there was little difference in brightness or yellowness. The 4% higher FD of the High ewes was about half the advantage observed with the hoggets and is therefore consistent with the differences in fleece weight observed at each age.

DISCUSSION

Screening of ewe hoggets on high GFW has resulted in a ewe flock with a large advantage in GFW relative to the random flock, with most of this advantage independent of live weight.

The persistence of the fleece weight advantage is consistent with the known high repeatability of GFW (Elliott *et al.*, 1979a; Lewer *et al.*, 1983b), but some of

the advantage in HFW is clearly not maintained. Because the hoggets were unrecorded and therefore environmental effects were unknown, selection would to some extent have favoured older and heavier hoggets within each mob. However with longwoolled hoggets previously shorn as lambs environmental effects are generally small (Elliott *et al.*, 1978, 1979b; Baker *et al.*, 1979) and thus are likely to have had little effect on the repeatability of GFW. Differential phenotypic responses during the hogget and 2-tooth years and possible changes with age in the genetic variance of GFW may account for the narrowing of the initial gap in GFW between the High and Random ewes.

In studies where between mob differences in fleece weight and live weight have been due solely to differences in feeding level, a slope of 0.1 kg GFW/kg LW has been recorded (Hawker, 1981; Sumner *et al.*, 1981). In the present study (Figure 1) the slope was 0.075, indicating that the relationship is due largely to a common response of wool and body growth to average feeding level through the hogget year.

TABLE 2 Live weights, wool production and wool characteristics of High fleece weight and differences between High and Random ewes*.

	High	Difference (High-Random)	SED
Live weight (kg) in			
April (19 months)	56.3	4.6	0.7
December (27 months)	62.0	4.9	1.0
January (28 months)	55.0	4.2	1.0
GFW (kg) in			
March	2.59	0.38	0.03
December	3.61	0.62	0.05
Wool characteristics in December+			
Yield (%)	78.8	1.7	n.a.
Mean fibre diameter (μ m)	37.9	1.6	n.a.
Brightness (Y)	59.0	-1.5	n.a.
Yellowness (Y-Z)	5.5	-0.5	n.a.

* Means and SED calculated from sub-group means

+ Measured on core samples.

The lower slope of the within sub-group relationship between HFW and LW (0.03) indicates that while phenotypically bigger hoggets tend to grow more wool the two variables are to a substantial degree independent. This relationship is consistent with typical estimates of 0.4 for the phenotypic correlation between HFW and LW (Elliott *et al.*, 1979b; Baker *et al.*, 1979; Lewer *et al.*, 1983a). It is of interest that after nearly a year of common grazing, during which compensatory growth occurred, the between and within sub-group relationships between GFW and LW have merged considerably.

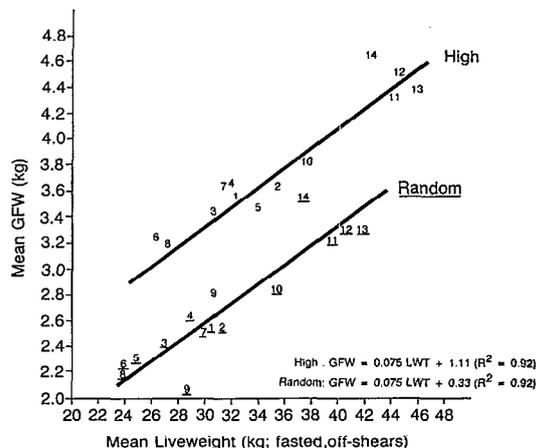


FIG. 1. Relationship between mean greasy fleece weight and mean live weight for screened high fleece weight and randomly selected Romney ewe hoggets from 14 mobs.

The modest phenotypic relationship between GFW and LW has on the one hand allowed the selection of a group of sheep with "bona fide" superior wool production, but on the other hand has resulted in the High ewes having consistently higher mean LW. The relative HFW and LW of the progeny of the High and Random ewes will be of considerable interest.

With only small differences in yield between the High and Random hoggets or ewes the High's advantage in GFW is clearly due to an increased production of clean wool. The close between sub-group relationships between CFW and its components were expected—nutritional differences between mobs are reflected in differences in the diameter and length of the wool fibres grown and therefore in differences in CFW. That both the difference in CFW between the High and Random hoggets, and the within mob variation in CFW, can be largely attributed to changes in fibre volume is consistent with other evidence that there may be little genetic variation in longwoolled breeds in the size of the follicle population (Elliot *et al.*, 1979b; Blair *et al.*, 1985).

The higher staple strength (SS) of the High hogget fleeces is consistent with the positive phenotypic and genetic correlations between SS and fleece weight observed elsewhere (Bigham *et al.*, 1983). SS reflects fibre dimensions at the point of minimum growth and because minimum and average fibre dimensions are associated, and average fibre dimensions determine CFW, then SS and CFW are positively associated.

CONCLUSION

A high fleece weight Romney flock has been established by selecting the hoggets with the highest fleece weight from a number of mobs. The fleece weight advantage has persisted in the ewe flock and is largely independent of live weight. The higher fibre diameter, staple length and in particular staple strength associated with high fleece weight should result in processing and therefore price advantages. The flock will be used as a gene pool for high fleece weight and to investigate its inheritance and biology.

ACKNOWLEDGEMENTS

We wish to thank R.N. Andrews and M. Barber for assistance with hogget fleece weighing and data collection, K.J. Knowler and C.D. Mathieson for flock management and the owners and/or managers of the mobs sampled for their enthusiastic co-operation.

REFERENCES

- Baker R.L.; Clarke J.N.; Carter A.H.; Diprose G.D. 1979. Genetic and phenotypic parameters in New Zealand Romney sheep. I. Body weights, fleece weights, and oestrous activity. *New Zealand journal of agricultural research* **22**: 9-21.
- Bigham M.L.; Sumner R. M. W.; Hawker H.; Fitzgerald J.M. 1983. Fleece tenderness—a review. *Proceedings of the New Zealand Society of Animal Production* **43**: 73-78.
- Blair H.T.; Garrick D.J.; Rae A.L.; Wickham G.A. 1985. Selection responses in New Zealand Romney sheep. 2. Selection for yearling greasy fleece weight. *New Zealand journal of agricultural research* **28**: 257-264.
- Elliott K.H.; Bigham M.L.; Sumner R.M.W.; Dalton D.C. 1978. Wool production of yearling ewes of different breeds on hill country. *New Zealand journal of agricultural research* **21**: 179-186.
- Elliott K.H.; Rae A.L.; Wickham G.A. 1979a. Analysis of records of a Perendale flock. I. The phenotypic relationships of hogget characteristics to lifetime performance. *New Zealand journal of agricultural research* **22**: 259-265.
- Elliott K.H.; Rae A.L.; Wickham G.A. 1979b. Analysis of records of a Perendale flock. II. Genetic and phenotypic parameters for immature body weights and yearling fleece characteristics. *New Zealand journal of agricultural research* **22**: 267-272.
- Hawker H. 1981. Effect of liveweight of hogget and ewe on wool production. *Proceedings of the Sheep Farmers' Conference, Gore, 4 March 1981*. pp.11-25.
- Lewer R.P.; Rae A.L.; Wickham G.A. 1983a. Analysis of records of a Perendale flock. IV. Estimates of genetic and phenotypic parameters for mature ewes. *New Zealand journal of agricultural research* **26**: 309-314.
- Lewer R.P.; Rae A.L.; Wickham G.A. 1983b. Analysis of records of a Perendale flock. V. Repeatabilities and genetic correlations between ages. *New Zealand journal of agricultural research* **26**: 315-319.
- Sumner R.M.W.; During C.; Webby R.W. 1981. Effect of grazing management on hogget fleece characteristics. *Proceedings of the New Zealand Society of Animal Production* **41**: 128-132.