
THE PROCEEDINGS OF THE
NEW ZEALAND SOCIETY
OF
ANIMAL PRODUCTION
VOLUME 62 2002

Mature Merino ewe performance in an ultrafine fibre diameter selected and a control flock

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ABSTRACT

Mature Merino ewe data (1988 to 1995) from 1407 ultrafine (UF) fibre diameter selected and 249 random controls (CF) totaling 3213 and 765 records respectively were analysed. Mean fibre diameter (FD) was significantly ($P<0.001$) lower in UF compared with CF (17.7 µm vs. 20.0 SED 0.04). Mean FD decreased in UF adult ewes by 0.16 µm (±0.02) per year relative to CF. There were no differences for autumn live weight but UF was significantly lower for spring live weight ($P<0.05$) and fleece weight ($P<0.01$) and higher for fleece yield ($P<0.01$) than CF. There were significant ($P<0.001$) age effects for all of these traits. For those ewes born during the project (1990-1994), the number of lambs born per ewe was slightly higher for CF than UF (1.17 vs. 1.14 SED 0.04) but not significant. CF wool had greater tensile strength, bulk and yellow but lower crimp frequency (all $P<0.01$) than UF wool. Selection for ultrafine wool in Merino sheep has shown FD was significantly reduced without negative effect on liveweight and reproduction.

Keywords: Merino; wool; selection; fibre diameter; litter size.

INTRODUCTION

Wool fibre diameter is an important apparel processing characteristic which has a dominant influences on wool prices. Wool processing studies have confirmed the relative importance of fibre characteristics in end products (Hunter *et al*., 1982, 1984; Andrews *et al*., 1985). Whiteley (1987) evaluated and ranked the influence of 13 Merino raw wool characteristics, including fibre diameter, in processing and showed that fibre diameter was the most significant trait of scoured wool, top, yarn and fabric. A number of batch processing trials have been conducted in New Zealand and Japan for Merino wool grown in NZ (Litherland *et al*., 1990; Maddever *et al*., 1994; Wuliji *et al*., 1995a). In these trials New Zealand Merino wool out performed similar categories from other origins, with greater soundness, brightness, evenness of length and strength, and lower crimp and vegetable matter content. For these reasons some wool processors often blend New Zealand Merino wool with wool of other origins to improve the length of tops. Selection for low fibre diameter in Merino sheep has been effective and profitable (Wuliji *et al*., 1990, 1996). However, there were perceptions among breeders that selection for finer wool would also reduce live weight and reproductive performance in Merino sheep. This paper summarises the associated changes in live weight, fleece weight and number of lambs born per ewe joined, in mixed age ewes of an ultrafine fibre diameter selected and a control Merino flock over 8 production years.

MATERIALS AND METHODS

An ultrafine Merino flock was set up by intensively screening the lowest 1% for fibre diameter from commercial flocks and a control flock was drawn from the same resources in 1987. Flock establishment, animal management and preliminary results have been reported (Wuliji *et al*., 1990, 1996). Mixed age ewes of an ultrafine (UF) fibre diameter-selected flock and a random control flock (CF) were recorded for autumn live weight (ALW), spring live weight (SLW), greasy fleece weight (GFW) and clean fleece weight (CFW). A mid-side fleece sample was measured for washing yield (at 16% moisture content), mean fibre diameter (FD), the Commission Internationale de I'Eclairange (CIE) tristimulus values (X, Y, Z and Y-Z), loose wool bulk, resistance to compression (RtC), staple length (SL), staple strength (SS), position of break (POB) and staple crimp frequency (SC). Mean FD was measured using the airflow method. Staple strength and position of break were measured on five staples per fleece sample as procedure described previously (Wuliji *et al*., 1990). The weight ratio of broken base and tip staples were determined as POB (%). Staple length was measured using a staple length tester (Agritest Ltd, Australia) and staple crimp was counted under a fluorescent lighted magnification mirror. Brightness (CIE Y) and yellowness (CIE Y-Z) of scoured wool (Bigham *et al*. 1984) was measured using a reflection colorimeter, resistance to compression using a resistance to compression tester (Australian Standard AS3535-1988), and loose wool bulk using a WRONZ Bulkometer, (Bedford *et al*., 1977). Clean wool traits were measured on wool samples air conditioned at a relative humidity of 65 ± 2% and 20 ± 2°C for 48 hours.

Both UF and CF ewes were joined with rams in each autumn (1988-1995), lambed in spring, and grazed and managed together on flat pastures at AgResearch Tara Hills High Country Research Station. The number of lambs born per ewe lambing (NLB) in the flocks was also compared for production years from 1990 to 1994, including only those ewes born within the flocks. A total of 3978 ewe records, of which 3213 were from UF and 765 from CF were available. Data were analysed by least squares, with age, record year, birth year, flock, flock (record year, and screening-in status as effects. Least squares means are presented from this model, while correlations are presented after adjustment for these effects.

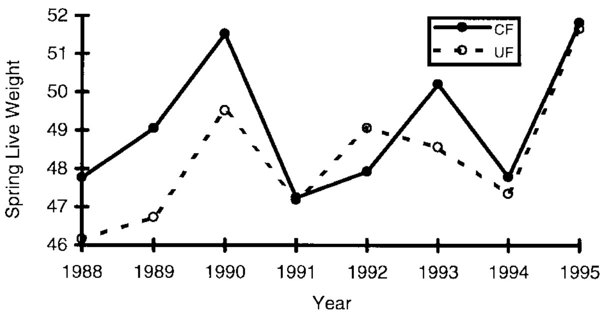
RESULTS

There was no difference between flocks for ALW, however a small but significant SLW advantage was found for the control over ultrafine flock (Table 1). Small but significant flock differences were also found for fleece weight and yield, with ultrafine ewes having higher yield and lower GFW and CFW than control ewes. The SLW by production year is shown in Figure 1. This shows that the flock difference has progressively closed so that SLW was similar in the two flocks by 1995.

TABLE 1: Mean live weight, fleece weight and yield of UF and CF flocks (all traits significantly differ at P<0.001 except ALW; data pooled for 1988-1995)

Group	ALW	SLW	GFW	Yield %	CFW
CF	50.5	49.2	3.98	74.6	2.96
UF	50.3	48.3	3.84	75.2	2.89
SED	0.2	0.2	0.02	0.2	0.02

FIGURE 1: Spring live weight least squares mean by year and flock.

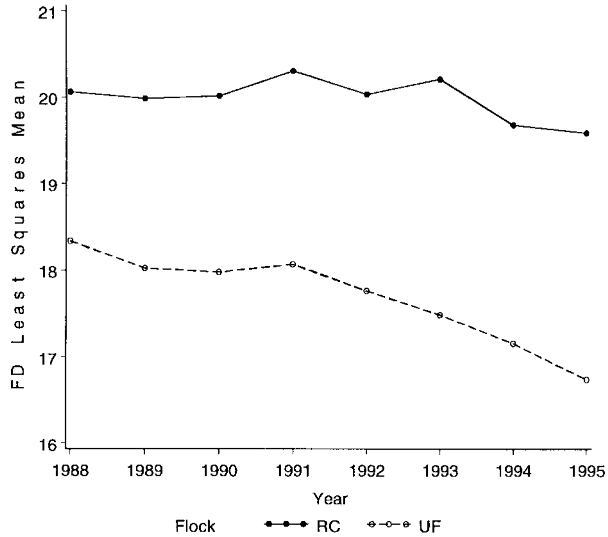


The fibre diameter of the ultrafine ewe flock was significantly (P<0.001) lower than control ewes (Table 2). SL was longer, but not significantly, for UF compared with CF. SS was significantly (P<0.01) higher for CF over UF though the difference was small in magnitude. POB was positioned significantly (P<0.01) more towards the tip of staples in UF compared with CF. SC was significantly (P<0.001) higher for UF over CF whereas bulk and RtC measurements were significantly (P<0.001) higher for CF than UF. It was also found that CF was higher than UF for both CIE Y-Z (by 0.5 units; P<0.001) and CIE Y (by1.6 units; P<0.001). A consistent FD reduction over years (Fig. 2) was achieved for the UF flock. As selection progressed, the fibre diameter difference between ultrafine and control became progressively wider - ultrafine ewes decreased by 0.23 µm per year from their initial flock mean (from 18.3 µm in 1988 to 16.7 µm in 1995) compared to a decrease of 0.07µm per year for control ewes.

TABLE 2: Wool characteristics of mixed age ultrafine (UF) and control (CF) ewes

Group	FD µm	SL cm	SS N/Ktex	POB %	Bulk cm3/g	RtC Kpa/g	SC no/cm	CIE Y	CIE Y-Z
CF	20.0	74.5	23.4	62.6	31.8	11.3	6.3	68.4	1.2
UF	17.7	75.6	22.2	64.8	29.7	9.7	6.7	66.8	0.7
SED	0.04	0.7	0.5	0.8	0.1	0.1	0.06	0.2	0.05

FIGURE 2: Mean fibre diameter of ultrafine (UF) and random control (RC) flock by years



Live weight, fleece weight and wool characteristics by age groups are given in Table 3. The mean ALW, SLW, GFW, and FD were significantly greater in older ewes (except the 2 and 3 year old differences for GFW, CFW and FD). Two year old ewes selected from the ultrafine flock were significantly higher than those screened in from other properties for ALW, SLW, GFW, CFW, yield, CIE Y and Y-Z. Yield appeared to be slightly higher for older ages except 3 year olds. SL was longer with increasing age except for the 4 year old group while there was a significant difference between two year and three year age groups. Though there was difference in SS by age groups but with no clear age trend, 2 year old ewes had stronger staples than older ewes, and there was no age trend for CIE Y either.

The correlations among SLW, CFW and wool characteristics are given in Table 4. They were moderately positive and significant (P<0.001) for SLW with CFW; CFW with yield, FD and SL; SC with bulk and RtC; CIE Y with bulk and RtC; and RtC with CIE Y-Z. They were moderately negative and significant (P<0.001) for CFW with SC; and SL with RtC.

A significantly high correlation (P<0.001) was found for bulk and RtC at 0.80. All other correlations were low although some were significant.

Flock comparisons of NLB by reproductive years is shown in Figure 3. There was no significant difference between flocks and years for NLB, although the overall average was slightly higher for CF.

TABLE 3: Live weight, fleece weight and wool characteristics1 by age groups

Age	ALW kg	SLW kg	GFW kg	Yield %	CFW kg	FD µm	SL cm	SC /m	SS Nktex	CIE Y	CIE Y-Z
2s^A	42.2	40.8	3.46	73.9	2.55	18.5	72.4	6.0	27.1	67.7	0.9
2	48.3	45.7	3.90	75.2	2.92	18.5	73.7	6.2	26.4	66.9	0.5
3	49.5	47.8	3.83	74.2	2.84	18.6	75.8	6.5	21.6	67.6	1.0
4	52.6	51.2	4.01	75.2	3.01	19.0	74.7	6.6	22.0	68.0	1.0
5+	54.3	52.5	4.12	75.7	3.11	19.2	76.6	6.6	20.7	67.6	1.1
SED	0.5	0.6	0.06	0.4	0.05	0.1	2.2	0.2	1.6	0.8	0.2

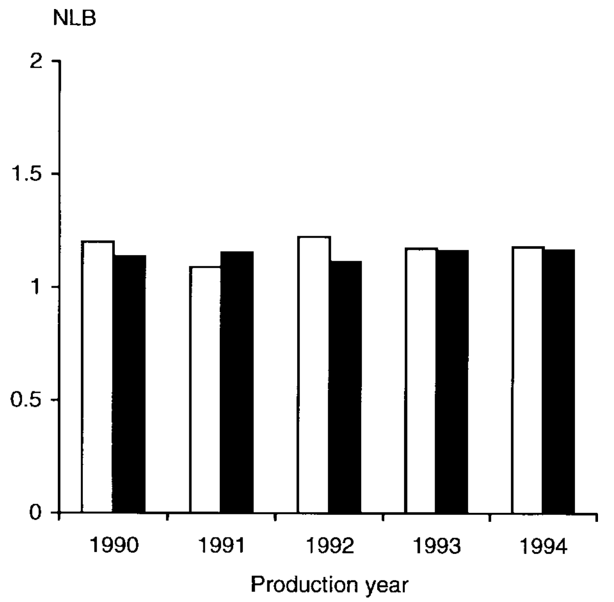
[1] bulk, RtC and POB nod differed by age and not listed; 2s^A: screened in from other properties before first joining.

TABLE 4: Phenotypic correlations of wool characteristics in mature Merino ewes (pooled for flocks)

	CFW	Yield	FD	SL	SC	Bulk	RtC	SS	PoB	Y	Y-Z
SLW	0.39	0.02ns	0.10	0.12	0.05^ns	0.08	0.07	-0.03^ns	-0.02^ns	-0.01^ns	-0.02^ns
CFW		0.33	0.36	0.33	-0.35	-0.16	-0.20	-0.00 ^ns	0.10	-0.02^ns	0.03^ns
Yield			0.10	0.09*	-0.17	-0.06*	-0.15	0.11	0.01^ns	0.10	0.11
FD\				0.08*	-0.21	0.18	0.20	0.14	0.10	0.05*	0.16
SL					-0.17	-0.18	-0.30	-0.02^ns	0.04^ns	0.06^ns	-0.02^ns
SC						0.34	0.44	0.08*	0.05^ns	-0.03^ns	-0.07*
Bulk							0.80	0.02^ns	-0.10	0.46	0.14
RtC								0.08^ns	-0.11	0.33	0.31
SS									-0.02^ns	-0.03^ns	0.06^ns
PoB										0.04^ns	0.08*
Y											0.13

Note: all data were significant at P<0.01 except these denoted with * and ^ns, which are P<0.05 and non significant respectively.

FIGURE 3: Litter size (NLB) of ultrafine (UF () and control (CF () flocks by year.



DISCUSSION

The live weight, fleece weight and wool characteristic differences in flocks were in agreement with previous reports for these flocks (Wuliji *et al.*, 1990, 1996). There were small, but significant, between year FD variations in the control flock, and the suggestion that some, but not all, of the decrease in FD in the UF flock from the early 1990's, was due to non-genetic effects. However, some of the difference can be attributed to the selection strategy. Although CF had slightly higher fleece weights than UF, there was no trend indicating a change in this difference, so that the selection strategy does not appear to be causing a further disadvantage in this trait. Correlations among SLW, CFW and wool characteristics were similar to the previous analysis of these flocks (Wuliji *et al.*, 1990), and agree with Merino literature (Mortimer, 1987). Even though in the pooled data there were significant positive correlations for SC with bulk and RtC, the higher SC in UF than CF, was not associated with higher bulk or RtC. The lower FD of UF flock might have resulted in a lower bulk compared to CF.

The effect of age on wool production and wool traits has been reported (Brown *et al.*,1966; Rose, 1974) where fleece weight has increased from $1^1/_2$ year of age to $6^1/_2$ year of age then declined, while FD has coarsened from $3^1/_2$ -$4^1/_2$ years of age in Merinos. Both greasy and clean fleece weight increased with age in the current trial, with no apparent decline in 5 year and older ewes, but fibre diameter was coarser in ewes over 3 years of age compared with younger ewes. Slightly higher SC and higher CIE Y-Z values were recorded for older age groups.

Wuliji *et al*. (1996) reported the reproduction performance, measured as NLB, as being lower in UF than CF adult ewes, while no such difference was found in the present study. This departure was due to inclusion in the early study of ewes which were artificially bred and where additional wastage occurred, and of inclusion of two year old ewes from other properties. The early studies have shown that within a particular breed of sheep liveweight at ovulation correlates well with ovulation rate (Restall, 1976). The relationship between first joining weight and fertility in Merino ewes has been well known, with about 40 kg regarded as the mating weight for maiden ewes (16-18 months of age). Allison and Davis (1976a,b) investigated the effects of live weight and management on fertility in NZ Merinos, and found that significant differences in levels of barrenness in 16 month old ewes resulted from differences in pre-mating weight, increasing ram: ewe ratios and in mixed age ewes. The current analysis of lambing records of progeny born in the flocks from 1990 to 1994, adjusting for the fixed effects of year and age (2 vs older) and fitting the sire of the ewe as a random effect, shows no significant flock difference in litter size with naturally mated ewes.

Using a simulation model combining AI and an open nucleus breeding scheme, Sherlock and Garrick (1995) suggest that the maximum genetic gain in reduced FD for Merinos is attained by a 60% two tooth ewe replacement policy in the nucleus flock. Reproductive performance and lamb survival rate with this high proportion of the younger ewes might be a disadvantage if there is not a corresponding improvement in lambing/rearing management. The lower reproductive capacity of maiden compared to adult ewes (estimated as -0.16 (SE 0.03) for litter size in this study), and the lower conception rate of artificial insemination compared to natural mating may also have an adverse effect on the flock performance when using strategies which shorten generation intervals. However, it may not be a great concern in the nucleus breeding flock where gains in FD are more important than a minor reduction in NLB. On the other hand, the cast for age ewes from UF, which still consistently grow fleeces with low FD may be used as donor animals in a multiple ovulation and embryo transfer project (Wuliji *et al*., 1995b) to multiply up the elite sheep numbers. These culls from UF could be also kept as ‘dry ewes’ and farmed with a wether flock for speciality fine wool production enterprises in the non Merino farming areas (Litherland *et al*., 1993).

CONCLUSIONS

The fibre diameter difference of 2.3 µm between UF and CF flocks was increased for mixed age ewes. Relative to the control flock, FD selected ewes appeared to improve SLW, and be unchanged in fleece weight over progressive years. Selection primarily for on fine fibre diameter appears not to impede live weight or reproductive traits in Merino ewes.

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