

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](#).



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/>

Effect of selecting Perendale hoggets for loose wool bulk on fleece characteristics and wool end-product performance

R.M.W. SUMNER, D.C. MADDEVER¹ AND J.N. CLARKE²

MAF Technology, Whatawhata Research Centre, Private Bag, Hamilton, New Zealand.

ABSTRACT

Two lines of Perendale sheep selected for and against loose wool bulk as yearlings at hogget shearing were established at Whatawhata Research Centre in 1987. Each line consists of approximately 100 mixed age breeding ewes.

At ewe hogget shearing in 1989 loose wool bulk of the selection lines differed by $5.2 \pm 0.8 \text{ cm}^3/\text{g}$. The lines were of a similar live weight with a similar greasy and clean fleece weight. Wool from the lines was of a similar mean fibre diameter, brightness and yellowness. The high bulk line wool was $4.5 \pm 1.2\%$ lower yielding and $23 \pm 5 \text{ mm}$ shorter than the wool from the low bulk line.

Fleeces from the selection lines, were regrouped to provide 3 distinct lots with respect to loose wool bulk to evaluate end-product performance. Core bulk of the lots was 31.2, 28.0 and $23.4 \text{ cm}^3/\text{g}$ for the high, medium and low bulk lots respectively. Each lot was processed into loose wool batting, carpet (woollen), knitting yarn (semi-worsted) and cloth (worsted). Significant differences in yarn properties and product performance attributable to the achieved differences in bulk were obtained.

The results provide an indication of the wide range of wool products that can be made and the long term performance benefits that can be achieved through selection for loose wool bulk.

Keywords Perendale, selection, loose wool bulk, fleece characteristics, wool product performance.

INTRODUCTION

Bulk has been identified as a characteristic of importance to both carpet and hand-knitting yarns through imparting a fullness to the yarn with improved insulation (Elliott *et al.*, 1986). Yarn bulk is strongly correlated with the bulk of loose wool before processing (Elliott *et al.*, 1986). Loose wool bulk can be measured for either individual sheep or lots of unprocessed wool (Bedford *et al.*, 1977).

Trials have shown loose wool bulk to be strongly inherited (Sumner *et al.*, 1989) with the Perendale having the bulkiest wool of the common crossbred wool breeds in New Zealand (Carnaby and Elliott, 1980). To test the hypothesis that either a single gene, or relatively few genes, may be involved in the genetic control of bulk, lines of Perendale sheep have been selected for and against loose wool bulk at Whatawhata Research Centre since 1987. Subsequently these will be interbred and the variation in their progeny evaluated. With the establishment of these lines it will also be possible to evaluate realised heritability estimates and correlated

selection responses.

Early trial work evaluating the processing implications of bulk used wools obtained from wool stores with no knowledge of the on-farm management system under which the wool was grown. Wool obtained from the Whatawhata bulk selection lines provide a unique resource to evaluate the end-product performance of wools grown under the same conditions which differed only in loose wool bulk.

This paper reports the fleece characteristics of ewe hogget wool following 2 years selection for and against bulk as well as end-product performance of the resulting wool when processed into a wide range of wool products where bulk is known to be of significance.

EXPERIMENTAL

Flock Establishment

A flock of approximately 200 Perendale breeding ewes has been maintained at Whatawhata Research Centre

¹ Wool Research Organisation of New Zealand, Private Bag, Christchurch, New Zealand.

² MAFTechnology, Ruakura Agricultural Centre, Private Bag, Hamilton, New Zealand.

since 1970. During this time the flock has been used for an evaluation of on-farm management procedures such as time and frequency of shearing (e.g. Sumner and Scott, 1990).

From 1970 to 1984 and in 1986, 4 rams were leased annually from different breeders and joined with the whole ewe flock. In 1985, the ewe flock was used for an assortative mating programme to evaluate the inheritance of loose wool bulk (Sumner *et al.*, 1989). Subsequently in 1987, high and low loose wool bulk lines of ewes were established by selecting the existing flock on the basis of the loose wool bulk of a mid-side hogget fleece sample. Four pairs of half-sib high and low bulk rams were selected for use in 1987 from within 3 industry flocks on the basis of the bulk of a mid-side hogget fleece sample. The rams were the progeny of an assortative mating programme within the industry flocks (Sumner *et al.*, 1989). Thereafter the flock was closed.

Flock Management

Both lines have been grazed together and treated similarly at all times except over mating when the ewes were synchronised by use of a progesterone impregnated controlled internal drug release device CIDR (Carter Holt Harvey, Hamilton, New Zealand) and single-sire joined for 2 cycles to 1 of 5 rams selected on a within family basis. The ewes in each family have been re-randomised annually to minimise inbreeding. Lambs were individually identified at birth and ewes culled at 5 years-of-age.

Lambs were weighed and shorn in December and again as hoggets in the spring. The ram hoggets were shorn in late August and the ewe hoggets shorn in mid-October. Individual greasy fleece weight was recorded at hogget shearing and a mid-side fleece sample taken for measurement of washing yield, staple length, mean fibre diameter (Lynch and Michie, 1976), loose wool bulk (Bigham *et al.*, 1984) and brightness and yellowness (Hammersley and Thompson, 1974). Replacement ewes and rams used for breeding have been selected solely on loose wool bulk of the mid-side hogget fleece sample.

Processing Evaluation

In 1989, 57 ewe hogget fleeces representing all the ewe

hogget fleeces available that year were individually bagged at shearing. These were later regrouped to provide 3 approximately equal distinct lots of high, medium and low bulk wool based on the mid-side sample measurement (Table 2). The high and low bulk lots were compared entirely of fleeces from the high and low bulk selection lines respectively while the medium bulk lot contained fleeces from both the high and low bulk selection lines.

The 3 lots were blended, scoured and subsampled for the measurement of core bulk (NZS DZ 8716), fibre length after carding (NZS DZ 8719), mean fibre diameter (IWTO-28-61(E)) and brightness and yellowness (NZS 8707:1984). Each lot was then divided into 4 sub-lots for processing into loose wool batting, carpet (woollen yarn), knitting yarn (semi-worsted yarn), and cloth (worsted yarn). Due to the relatively small quantities of wool in each sub-lot processing performance was not able to be assessed. Aspects of the performance of the end-products produced were evaluated using a range of testing techniques. This paper reports preliminary data of some of the key measurements.

TABLE 1 Mean values for live weight and fleece characteristics of each selection line at ewe hogget shearing in 1989.

Characteristic	Selection line		
	High bulk	Low bulk	SED
Number of hoggets	28	29	-
Live weight (kg)	40.7	40.6	1.2
Greasy fleece weight (kg)	3.0	3.1	0.2
Yield (%)	67.7	72.2	1.2
Clean fleece weight (kg)	2.0	2.2	0.2
Staple length (mm)	108	131	5
Fibre diameter (μm)	32.2	31.0	0.6
Loose wool bulk (cm^3/g)	29.1	23.9	0.8
Brightness (CIE Y)	51.0	49.6	0.8
Yellowness (CIE Y-Z)	6.5	6.7	0.3

RESULTS AND DISCUSSION

Fleece Characteristics

Fig. 1 shows the mean loose wool bulk at ewe hogget shearing in 1985, 1986 and 1987 before the lines were established and in 1988 and 1989 after the lines were

established. The graph shows the magnitude of the difference in loose wool bulk achieved through selection for and against bulk in a single flock.

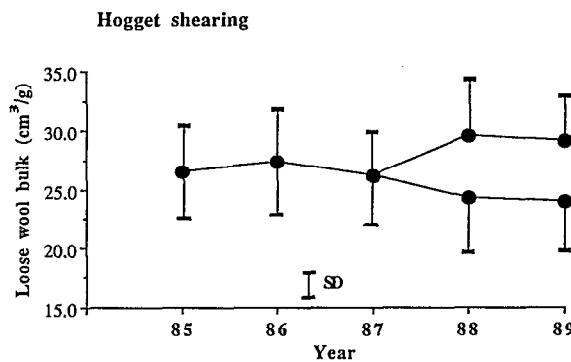


FIG 1 Mean and standard deviation for loose wool bulk of the Perendale flock at ewe hogget shearing. Selection lines for and against loose wool bulk were established prior to joining in 1987.

Mean values for live weight and fleece characteristic data at ewe hogget shearing in 1989 are given in Table 1. The apparent trends are in line with expectations (Bigham *et al.*, 1983). The high bulk line wool had a lower yield and a shorter staple length as a combined effect of both staple structure and increased crimp (Stobart and Sumner, 1991). Live weight, greasy and clean fleece weight, fibre diameter, brightness and yellowness have to date not been significantly affected by selection for loose wool bulk.

TABLE 2 Objective description of the wool processing lots.

Description	Wool Lot			95% confidence interval
	High bulk	Medium bulk	Low bulk	
Allocation criterion (cm³/g)	>30	25-30	<25	-
Number of fleeces	15	26	16	-
Approximate clean weight (kg)	18	34	21	-
Core bulk (cm³/g)	31	28	23	2
Barbe fibre length (mm)	82	87	91	5
Below 40 mm (%)	14	16	15	5
Below 140 mm (%)	96	88	84	5
Fibre diameter (μm)	33.0	31.0	32.2	0.7
Brightness (CIE Y)	56	56	58	2
Yellowness (CIE Y-Z)	7.0	5.0	6.5	0.8

Contrary to price trends in the early 1980's (Bigham *et al.*, 1983), the mean relative economic value for clean fleece weight, staple length and loose wool bulk during the last 5 years (Maddever, 1991), suggest equivalent net returns/hogget/yr would presently be achieved for both lines of wool.

End-product Performance

The objective description of the wool processing lots selected for bulk is given in Table 2. The lots showed a clear distinction in bulk. Within the sensitivity of the tests the lots were similar in fibre diameter and colour. There was however a trend for the high bulk lot to have less long fibres and hence a lower mean fibre length after carding. This is likely to be partly accounted for by the apparent shorter length of more highly crimped fibres.

The first performance characteristic tested was felting (IWTO-20-69), a measure of the extent of fibre entanglement with agitation in water (Table 4). The highly crimped high bulk wool showed a reduced propensity to felting with the straighter fibres of the low bulk wool being the most prone to felt (Elliott and Lohrey, 1983).

One sub-lot of each bulk type lot was carded into a batt and made into mini quilts. Each quilt was subjected to various loadings after dry cleaning (Table 4). The thickness of battings under both a low and high load generally increased with wool bulk, indicating improved body cushioning in under-body products, such as futons, mattresses and pillows and a greater warmth or insulative value in duvets (Watt, 1988).

Table 3 gives the yarn bulk (Ross *et al.*, 1977) for the yarns spun on the woollen, semi-worsted and worsted system from each of the bulk type lots. There was a clear trend for the yarns spun from high bulk wool to be more bulky. It is not however valid to compare between spinning systems as the yarns were spun to different counts to meet the requirements of the end-products produced from each yarn type.

Samples of tufted carpet produced from the woollen yarn were subjected to appearance and wearability tests (Table 4). Thickness loss during the Tetrapod simulated wear test (IWS TM 237) decreased with increasing wool bulk. Carpet wear performance as indicated by the WIRA abrasion test (IWS TM 122)

TABLE 4 End-product performance measurements.

Product	Processing route	Measurement	High bulk	Wool Lot Medium bulk	Low bulk	95% confidence interval
Loose wool	Scoured	Felt density (g/cm ³)	0.06	0.11	0.15	0.02
Batt	Carded	Thickness (mm)				
		1g/cm ² load	69	70	51	8
		5g/cm ² load	45	39	35	5
Carpet	Woollen	Thickness loss (%) WIRA abrasion (rubs)	18 12329	19 12176	22 11410	4 1000
Knitted panel	Semi-worsted	Shrinkage (%)	31	44	55	12
Cloth	Worsted	Koshi (firmness)	7.2	6.7	6.6	0.1
		Numeri (sleekness)	4.1	4.8	4.9	0.3
		Fukurami (fullness)	4.7	5.2	5.1	0.2

increased slightly with increasing wool bulk.

TABLE 3 Yarn bulk (cm³/g).

Spinning system	Count	Wool lot			95% confidence interval
		High bulk	Medium bulk	Low bulk	
Woollen	R600/2	14.3	12.6	11.3	0.5
Semi-worsted	R440/4	15.9	14.2	12.4	1.5
Worsted	R83/2	8.6	8.0	7.5	0.5

The semi-worsted yarn was hand-knitted into panels and subjected to a severe washing treatment. Panels produced from high bulk wool showed less shrinkage than the panels produced from the medium and low bulk wools (Table 4). These results are in good agreement with the feltability tests referred to earlier (Table 4). The basis of this effect is most likely to be shrinkage associated with felting of the yarn structure.

Japanese researchers have been instrumental in developing sophisticated objective evaluation procedures for textiles which allow comparisons of subtle differences based on sets of subjective assessments.

(Kawabata, 1980). The winter weight apparel worsted spun cloths processed in this trial were evaluated by such procedures. The measurement differences (Table 4) were slight and probably indistinguishable to the average consumer. The finer yarn, higher twist and tighter fabric construction of worsted fabric tend to suppress the effects of differences in wool bulk, so that by comparison with the other products evaluated, the worsted fabrics cannot be expected to show bulk-related differences in product performance as clearly. Nevertheless, the trends expected as bulk increases of greater firmness, less sleekness and greater fullness were found for firmness and sleekness. The trend for fullness was contradicted by an anomalously low fullness value for the high bulk sample.

These data highlight the significant difference in wool product performance achievable through selection and sorting for loose wool bulk within a single flock of Perendale sheep. While it is not normal mill practice to process straight lines of wool, as carried out in this trial, the results indicate the magnitude of trends achievable through adjustments to blend components. These advantages are already well appreciated by processors, in subjective rather than objective terms. Thus with increased awareness of wool core bulk measurements now being available, it is anticipated that the price

differentials for wool bulk (Maddever, 1991) will stabilise at or above the levels applicable during the last 2 seasons. This will have the effect of encouraging more woolgrowers to consider bulk as an important fleece characteristic, which, when combined with suitable wool handling procedures in the shearing shed, will be an economically worthwhile selection criteria.

ACKNOWLEDGEMENTS

To Mrs M.L. Scott, Messrs G.J. Poff, A.W. Richards, I.R. McMillan, R.M.A. Goodwin and I.W. Kitney for management and care of the Perendale sheep flock, Misses R.D. Winter and P.M. Speedy for measurement of fleece samples, Mr P.R. Marshall and Miss A.D. Kellick for handling of sheep and fleece data, many staff at WRONZ, particularly Mrs H.M. Ingham, for technical assistance and Mr J.D. Watt for professional advice.

REFERENCES

- Bedford, J; Ross, D.A.; Carnaby, G.A.; Lappage, J. 1977. WRONZ fibre bulkometer instruction manual. WRONZ.
- Bigham, M.L.; Meyer, H.H.; Smeaton, J.E. 1983. The heritability of loose wool bulk and colour traits and their genetic and phenotypic correlations with other wool traits. *Proceedings of the New Zealand Society of Animal Production* 43: 83-85.
- Bigham, M.L.; Sumner, R.M.W.; Cox, N.R. 1984. The measurement of sources of variation of loose wool bulk in Romney, Coopworth and Perendale breeds. *New Zealand Journal of Experimental Agriculture* 12: 23-28.
- Carnaby, G.S.; Elliott, K.H. 1980. Bulk : A wool trait of importance to the carpet industry. *Proceedings of the New Zealand Society of Animal Production* 40: 196-204.
- Elliott, K.H. 1986. The ability of the WRONZ automatic bulkometer to rank wools for lustre. *WRONZ Report No. R 135*.
- Elliott, K.H.; Lohrey, P.J. 1983. The loose wool felting properties of a range of New Zealand wools. *Wool* 7 (4): 21-25.
- Elliott, K.H.; van Luijk, C.J.; Carnaby, G.A. 1986. Loose wool bulk measurement : Application to the processing and product performance of New Zealand wools. In *Presentation on Specification of New Zealand Scoured Wool*. Proceedings 55th Annual Conference International Wool Textile Organisation June 1986, Ostende, Belgium.
- Hammersley, M.J.: Thompson, B. 1984. Wool colour measurement. *WRONZ Communication No. 24*.
- Kawabata, S. 1980. *The standardisation and analysis of hand evaluation*. Textile Machinery Society of Japan, Osaka.
- Lynch, L.J.; Michie, N.A. 1976. An instrument for the rapid automatic measurement of fiber fineness distribution. *Textile Research Journal* 46: 653-660.
- Maddever, D.C. 1991. Relative economic values of wool processing parameters. *Proceedings of the New Zealand Society of Animal Production* 51: 333-337.
- Ross, D.A.; Carnaby, G.A.; Palmer, D.G.; Lewis, W.J.; Seed, D.P.; Cooper, J.C.; Narsian, M.G. 1977. Bulk. Part II. The measurement of yarn bulk. *WRONZ Communication No. 52*.
- Stobart, R.H.; Sumner, R.M.W. 1991. Bulk and its structural basis : A review. *Proceedings of the New Zealand Society of Animal Production* 51: 339-345.
- Sumner, R.M.W.; Scott, M.L. 1990. Effect of shearing once-yearly in January, once-yearly in July or twice-yearly in January and July on ewe performance. *Proceedings of the New Zealand Society of Animal Production* 50: 329-334.
- Watt, J.D., 1988. New bedding products from New Zealand wool. *Wool* 7(9): 47-48.