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

Textile Evaluation of Texel Wools

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ABSTRACT

While the main focus in the breeding of Texel sheep in New Zealand has been selection for superior meat production there are significant qualities in the wool which make it a highly desirable fibre. Texel, Texel X Romney and Romney wools are evaluated to determine their relative attributes as textile fibres in wool products where good length and high bulk are considered important. Evaluation involved examining the value of good length bulky wool in the current wool market, spinning semi-worsted yarns, manufacturing carpets and sample bedding products. All three lines performed as expected from the measured fibre chatacteristics.

Core bulk of the scoured wool for Texel, Texel X Romney and the Romney were respectively 32.9 cm^3/g, 29 cm^3/g and 25.7 cm^3/g. Based on an average market value of 450 c/kg clean and 1991/92 relativities, the premium for bulk of these long good colour wools is 10 c/kg/unit. The high bulk wools gave improved spinning performance 44.4, 52.9 and 73.3 end breaks per 100 spindle hours at 5000-6000 rpm for the Texel, Texel X Romney and Romney lines respectively. Improved abrasion resistance of carpet made from the Texel and Texel-cross was attributable to different pile weight and yarn bulk values. Samples evaluated indicate Texel sheep produce wools with similar textile properties to New Zealand crossbred wools but with higher bulk. The Texel breed should be monitored for its suitability as a source of genetic material to increase bulk in New Zealand wools. Lack of quantitative knowledge of the change in fleece weight and carcass returns from the introduction of the Texel genetic influence into Romney stock prevents assessment of their economic benefit to the New Zealand farmer.

Keywords: Wool, Texel, bulk, fleece characteristics, wool product performance, relative economic values.

INTRODUCTION

New Zealand crossbred wool has been criticised for lack of bulk especially in semi-worsted spun yarn. Previous reports to the Society indicated that wool from Texel sheep have higher bulk, lower fleece weights, good strength and colour compared to most of the crossbred wool grown in New Zealand (Wuliji *et al.*, 1990; Dobbie *et al.*, 1991; Newman and Paterson 1991). These reports also indicate that Texel sheep when compared to down breeds used as terminal sires in New Zealand, have similar bulk, higher fleece weights, and a longer staple length. A report on the relative economic value (REV) of the wool fibre parameters important for processing (Maddever *et al.*, 1991) showed there were significant premiums for colour and bulk in New Zealand wool auctions.

Processing studies have shown bulk to be an important property for the carpet industry (Carnaby and Elliott, 1980). The New Zealand Wool Board (1992) estimates that 45% of the New Zealand wool clip is used in carpet, of which a significant proportion is made from semi-worsted spun yarn. Large quantities of New Zealand wools are manufactured in Europe into plain shade and printed tufted carpets. A further significant use in terms of quantity of New Zealand wools is in face-to-face Wilton carpet manufacture, where the fibre properties are critical because spinning is close to the lower limit of number of fibres in the yarn cross-section. Use of wool fibre from New Zealand crossbred sheep in bedding products is hampered by its lack of resistance to compression and ease of fibre migration. These two characteristics are both associated with lack of bulk.

Texel sheep in New Zealand were released from quarantine in late 1991 with the New Zealand Texel Sheep Society basing their introduction, as in Europe, on survival and vigour of lambs, growth rate and ability of both crossbred ram and ewe lambs to grade to heavy weights compared to those of traditional breeds (NZ Farmer, 1992). However the importance of the fibre from both purebred Texels and their crosses should not be overlooked.

MATERIALS AND METHODS

Three lines of wool were collected by AgResearch Invermay at 1991 shearing. Fleeces were chosen randomly from a flock of Romney ewes (53kg), 1/2 Texel 1/2 Romney ewes (44kg), and as there was no Texel ewe fleece available, 13 month's growth of Texel ram (30kg) fleeces were substituted. Since the three lines of wool came from different production backgrounds a comparison of fibre properties for breeding purposes is not valid and was not considered. What this trial attempted to do, is evaluate the market value and textile performance of the wools chosen, relative to the measured fibre properties (Carnaby *et al.*, 1985 and 1988).

At shearing all fleeces were midside sampled and fleece characteristics, namely yield, bulk, staple length, staple strength and fibre diameter were individually tested. The wool was scoured in the WRONZ mini bowl scour and randomly

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sampled and tested for: core bulk (NZS D-8716), fibre diameter and medullation by projection microscope (IWTO-28-89(E)), yellowness and brightness (NZS 8707:1984), fibre length after carding (NZS 8719:1992) and felting propensity (IWTO 20-69). The value of the fibre was examined in light of an updated analysis based on New Zealand Wool Board's auction data analysis reported previously (Maddever *et al.*, 1991). Premiums for fibre properties that are expected to be produced by the Texel breed were investigated.

Each line of wool was split into two lots per line - one lot for loose stock dyeing and the other for carding in the natural state. Random samples were taken after dyeing to measure core bulk and fibre length after carding to check whether dyeing had caused any differences in these fibre properties. The second lot was carded and spun into a yarn before hank dyeing. Approximately 300g of scoured undyed loose wool from each line was independently carded into a bat on a small sample card. Each bat was cut and made into two mini-quilts and all six were contained in separate cotton duck covers and measured for compression recovery, drycleaned twice and re-measured.

Carded sliver was sampled after three gillings for measurement of sliver cohesion on an Instron tensile tester. This test involved loading the Instron with sliver at a gauge length of 50mm and stretching at 250 mm/min. Ten samples of each line were stretched to break.

The stock-dyed (Goblin Grape shade) loose wool was spun into a R540/2 yarn which was tufted into carpet. The natural loose wool was spun into R210/3 yarn with an end break count to check the performance of the three lines. The yarn was dyed (Raphael Red shade) and two ends were slightly twisted together to produce a 420 tex yarn for carpet tufting. This procedure enables a tufting machine to produce a texture resembling the face-to-face Wilton texture. Samples from each line and both colours were tested for yarn bulk (WRONZ destructive channel bulk method), strength and extension (ISO 2062E), linear density (BS 2010:1963), both singles and folded twist (BS 2085:1973) and evenness (IWTO 18-67(E)). Carpets from both colours were tested for shorn pile weight (IWS TM 234), pile thickness (IWS TM 142), abrasion resistance (IWS TM 122), weight loss by abrasion (IWS TM 283), dynamic loading (IWS TM 123), and Hexapod wear thickness and texture and colour change (IWS TM 247).

RESULTS AND DISCUSSION

Wool Properties

Greasy wool fibre properties from the fleeces used in this trial with the exception of loose wool bulk showed considerable overlap between breeds.(Table 1).

Scoured wool properties (Table 2) were within the limits expected from the greasy wool measurements. The diameter discrepancy can be attributed to the medullation (measured only on the scoured sample) because it reduces the fibre diameter in the airflow measurement (van Luijk, 1984), thus giving a false impression of the diameter of the greasy wool. Discrepancies in the comparison of the bulk values can be predicted with the equation:

$$\text{core bulk} = 0.746 \times (\text{loose wool bulk}) + 7.78 \quad (\text{adjusted } R^2 = 88.6\%)$$

(Sanderson and Burling-Claridge,1990). The Romney fibre was significantly poorer in colour than the other two lines. These scoured wool properties determine the value and the processing performance of the fibre.

TABLE 1: Mean and std.dev. of greasy wool fleece characteristics.

Fibre Property	Texel	Texel-cross	Romney
Number of fleeces	10	12	15
Yield (oven dry, %)	65.8 ± 4.3	70.0 ± 4.1	65.2 ± 4.1
Fibre diameter (airflow, µm)	35.4 ± 2.3	36.4 ± 1.8	36.6 ± 2.2
Loose wool bulk (cm³/g)	32.7 ± 2.2	27.5 ± 2.0	23.9 ± 2.2
Staple length (mm)	124.4 ± 20.1	152.6 ± 19.5	142.9 ± 16.1
Staple strength (N/ktex)	14.4 ± 5.0	11.2 ± 5.2	13.1 ± 6.6
Position of break -(distance) from tip (%)	68 ± 5.6	72 ± 6.4	67 ± 11.8

TABLE 2: Scoured loose wool fibre properties

Fibre Property	Texel	Texel-cross	Romney	95% CI
Fibre diameter, PM (µm)	39.8	34.9	36.2	0.7
Medullation, PM (%)	16.0	8.1	2.8	5.0
Brightness (Y)	63.1	62.3	56.7	2.0
Yellowness (Y-Z)	4.4	3.9	7.0	0.8
Core bulk (cm³/g)	32.9	29.0	25.7	2.0
Barbe (mm)	108.4	107.6	111.0	5.0
Short fibre (%<40mm barbe)	5.7	7.6	10.0	5.0
Long fibre (%<140mm barbe)	76.6	72.8	66.8	5.0
Sliver strength (gf/ktex)	29.1	20.3	16.4	3.0
Felted ball density	<0.07	0.09	0.09	0.02

Market Value

The price paid for wool of high bulk,good colour and length can be determined by analysis of New Zealand Wool Board auction data. Earlier analysis (Maddever *et al.*, 1991) has been modified in light of the changing market. It appears that while the premium for measured wool brightness continues to increase, yellowness premiums are more volatile. However, the indicated premiums for predicted bulk and length continue to rise (Table 3).

Texel wool is similar to down wool of which a little over 0.3m kg was sold through auction in the 1991/92 season. These down wools averaged a diameter of 32µm, yellowness of 4.4, brightness of 59, barbe length of 70mm, bulk of 33cm³/g and an 11% price premium over crossbred shears with similar properties, but a bulk of 23cm³/g. Now, since this price premium represents an REV for bulk in these wools of 5 cents/unit change/clean kg, there must be other regions where the premium is considerably higher than the average of 8.0 indicated in Table 3. Close examination of the 1991/92 season's auction data shows, in the region of long wools (over

TABLE 3: REVs (cents/unit change/clean kg) based on an average price of 450 cents/clean kg.

Fibre property	Previously Reported av.	89/90	New analysis 90/91	91/92
Bulk	6.4	6.2	7.1	8.0
Yellowness (Y-Z)	-6.5	-2.0	-2.7	-6.6
Brightness (Y)	4.3	5.6	7.5	6.1
Carded length (mm, barbe)	0.3	0.6	0.7	0.7
R^2 for fitted model(%)	89.3	91.8	92.6	91.6

100mm barbe), there is a premium for bulk of 10 cents/unit change/clean kg (WRONZ unpublished data). This premium for bulk indicates the Texel and Texel cross lines used in this trial would be worth 72c/clean kg and 33c/clean kg more respectively than the Romney wool for the improved bulk alone and 126c/clean kg and 85c/clean kg more respectively when all four property differences are taken into account (based on a market value of 450c/clean kg.)

Processing performance

The stock-dyed half of each line showed expected reductions in length (Holmes-Brown *et al.*, 1982) but produced no significant change in fibre property relativities, compared to before dyeing, between the 3 lines of wool.

The property of sliver cohesion is a secondary parameter used as a performance indicator. Work at WRONZ has shown sliver cohesion can be predicted from the scoured wool properties. Wools with high sliver strength are easier to process due to the better cohesion between fibres (WRONZ unpublished data) and the results shown in Table 2 clearly indicate an expected improved performance for Texel because they are higher bulk lines.

Bedding product

Felted ball densities were similar for the Romney and Texel-cross lines but were significantly lower for the high bulk Texel wool. This lack of felting would be expected to improve the performance in bedding products. Thicknesses under small compressional forces were measured on the mini-quilts. Texel and Texel-cross samples were more down-like with a loftier appearance, and the same weight of wool made up a thicker quilt: 96mm for the Texel, 86.5mm for the Texel-cross and 70mm for the Romney. After two drycleanings the mini-quilts under 80gf/cm² compression measured 17, 14, and 12.5mm, respectively for the Texel, Texel-cross and Romney lines. The higher volume to weight ratio of the bulky wools makes them more suitable for bedding uses.

Carding and Spinning

Although the Texel line had a higher level of medullation, which is usually associated with an increase in card waste, its higher level of bulk and sliver strength (Table 2) and low medulla diameter to fibre diameter ratio, may be the reason for it having the lowest carding waste level. The Texel line recorded 1.1% carding waste, while the Texel-cross line had 1.4% and the Romney line 2.3% carding waste.

While spinning the natural undyed fibre it was found that the end-breaks per 100 spindle hours were 44.4 for the Texel, 52.9 for the Texel-cross and 73.3 for the Romney line at a normal spindle speed of 5000-6000rpm. Results for the measured properties of strength, extension, linear density, singles twist, folded twist and evenness, showed no significant difference between the three lines. Only yarn bulk was found to be different (Table 4).

TABLE 4: Yarn Bulk (cm³/g)

Yarn colour	Texel	Texel-cross	Romney	95% CI
Goblin Grape	9.7	8.3	7.3	0.2
Raphael Red	11.3	10.2	9.2	0.2

Carpets

Carpets were tufted with no difficulties and a range of samples were performance tested. When assessing the performance of carpets it is important that similar constructions are involved. Current theory of carpet wear (Tandon *et al.*, 1990), in the absence of differing intrinsic strengths of the fibre and with similar pile thicknesses and yarn twist levels, abrasion resistance is linearly related to the pile weight. Both colours of carpet had small differences between lines and these could be attributed to the different pile weight and bulk values (Table 5). The increase in abrasion resistance found for the Texel and Texel-cross lines was greater than that attributable to the pile weight alone and is believed to be one of the benefits of greater bulk. The Raphael Red carpet test results showed no surprises and because the pile weights were highly different (possibly due to the non-standard production technique used to simulate a face-to-face Wilton with a tufted carpet) making interpretation more difficult, their results are not reported here.

TABLE 5: Goblin Grape Carpet Performance Test Results (mean of 5 samples)

Property	Texel	Texel-cross	Romney	Std error
Shorn pile wt (g/m²)	1023	986	994	10
Pile thickness (mm)	6.9	7.0	7.1	0.1
Pile wt density factor	152,000	141,000	140,000	5,000
Hexapod thickness loss (%)	19.6	22.0	23.3	2
WIRA abrasion Rubs to end point	12,850	10,050	9250	1,000
Rate of wt loss (mg/1000 rubs)	38	38	42	2
Dynamic loading % thickness loss (2000 cycles)	30	36	38	2

There were no visual effects of the medullation content in the Texel lines indicating low medulla diameter to fibre diameter ratios. Dark fibre, pigmented or stained fibre contents were not measured but there was no visual effects of these observed in any of the lines.

CONCLUSION

This study did not look at wool grown under similar circumstances but these samples of Texel and Texel-cross wools performed as expected on the basis of their measured fibre characteristics, relative to other New Zealand crossbred wools. The extra bulk in the Texel wools gave expected processing and end-product performance advantages over the lower bulk Romney line. Texel sheep with their higher bulk wool compared to most New Zealand crossbred wool, have a potential future role in beneficially increasing the bulkiness of our crossbred clip without deleteriously affecting any other characteristics of manufacturing significance. However the overall economic implications for a woolgrower switching to Texel or Texel-cross wool are dependent not only on the value and size of the fleeces but meat production and farm management considerations. The effect of expected lighter fleece weights also needs to be compared to the higher "calculated" 85c-126c/clean kg premium for long, high bulk, good colour wools grown by these animals.

ACKNOWLEDGEMENTS

For wool supply we wish to acknowledge AgResearch Gore, Mr M Gorden at Winton and Mr A McGregor at Ohai properties. Messrs R. N. Andrews and P. Turner for fleece character measurements, and many staff at WRONZ, particularly Mrs K.E.E Ridgen for technical assistance, Mr. M. Woods for data analysis and Mr J.D. Watt for professional advice.

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