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The Relationship between New Zealand Merino Fleece Measurement Produced at NZPAC Ltd and their Corresponding Core Test Results

By

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SUMMARY

In October 1999, the New Zealand Product Advancement Centre (NZPAC) Ltd, a wholly owned subsidiary of Merino New Zealand Ltd, began operations into testing individual New Zealand Merino fleeces on a production-line basis. Each fleece was objectively measured for fineness and fineness distribution using Sirolan-Fleecescan technology and assigned to specific lots based on these results and subjective measurements of staple length, staple strength and colour.

Overall, the fleece results (ie. the calculated MFD) of Merino lots classed at NZPAC were very similar to core-test measurements produced under controlled laboratory conditions. 85% of fleece results from NZPAC were within ±0.3µm of the certified Laserscan MFD, while 97% were within ±0.5µm. Considering the precision limits of a Laserscan core test result (around ±0.35µm for a 20µm sample), these results suggest that lots can successfully be created at NZPAC to satisfy MFD requirements of contract specifications.

While there was no overall relative bias between fleece and core-test measurements, significant differences between MFD results were detected for ultra-fine and coarse Merino lots. Fleece results for ultra fine lots were approximately 0.2µm finer than the corresponding certified MFD measured under controlled laboratory conditions. For lots with a mean fineness greater than 22µm, the certified MFD result was around 0.4µm finer than that predicted by the individual fleece data. This bias in results at the extremes of the diameter range is due to the precision in the fineness measurements of the individual fleeces that will result in a small but significant proportion of the fleeces in the finest and coarsest diameter bins being incorrectly classed.

The subjective estimates for length, strength and colour, classed categorically rather than to an absolute value, were relatively successful in differentiating fleeces of various characteristics. Differentiation of length appeared to be performed relative to the average length of the flock being processed, resulting in the lengths of the ‘short’ lines of some flocks being similar to ‘medium’ length lots of other grower clips. Almost all ‘tender’ lines classed at NZPAC were less than 28N/ktex, indicating separation of fleeces on strength was performed well. Lots separated for colour were infrequently different to main lines due to the difficulty in estimating how poor-coloured fleeces will react during scouring.

This report compliments RWG 04, which examines the relationship between the core test measurements from Airflow, Laserscan and OFDA of lots classed at NZPAC. These two reports can be used together to assist processors who may wish to purchase lots classed at NZPAC of the relationships they can expect between fleece and core test measurements and between core test measurements of MFD performed by different instruments.

INTRODUCTION

What is NZPAC and Why was it Formed?

The New Zealand Product Advancement Centre (NZPAC) Ltd is a centralised testing, classing and packing facility of individual Merino fleeces on a production-line basis. A wholly owned subsidiary of Merino New Zealand Ltd, NZPAC was developed to increase the level of grower feedback on the content and preparation of their clip. It was also felt that this system, where all classing would be performed both objectively and by a very small but highly skilled and dedicated team of employees, would reduce the variability in clip preparation discovered by processors of New Zealand Merino wool.

Merino farmers in New Zealand currently receive little commentary on the processing and preparation of their wool, and it is difficult to determine where improvements can be made to increase returns. The NZPAC system provides maximum feedback on numerous issues of a grower's clip, while also allowing for efficient and effective benchmarking to occur between growers.

Merino New Zealand executives and overseas processors also determined that a chain was required that could link consignments back to individual lots and their respective growers. This could assist mills who discovered a particular grower's clip or type of wool processed well and would allow duplication of that processing over successive seasons. Alternatively, they can also identify the origins and attributes of poor-processing wool. While this would only be possible for consignments where all fleeces have been processed through NZPAC, this has tremendous research and marketing potential when exclusive suits or exquisite knitwear can be linked back to particular farms. In summary, a NZPAC system provides the ability to explore and define the total attributes of the New Zealand Merino clip.

The NZPAC Operation in the Inaugural Season

Growers using NZPAC to class their wool played a significant role in preparing their wool for classing at NZPAC. For the first season of NZPAC operations, each fleece was fully skirted and rolled as currently performed in most sheds. The fleece was then given an identification tag corresponding to the individual animal which was placed with the fleece before being pressed.

The rolling of the fleeces was critical to the NZPAC system for two reasons. Firstly, it allowed fleeces to be clearly separated from each other when the bale was re-opened at NZPAC. Even for small hogget fleeces that were heavily pressed, very few problems were encountered when this was performed to NZPAC instructions. Secondly, incorrect rolling increased the potential to lose or mix identification tags.

Before being classed at NZPAC, growers were invited to discuss with NZPAC staff the distribution of lines they would like to prepare. Historical data from each grower's clip was generally used to establish these lines, with a total of sixteen bins (lines) available to growers this season. One line was commonly used to separate tender fleeces, while another was frequently established to remove fleeces with extensive colour deficiencies. Many growers also set bins for fleeces classed as short and/or long. The remaining lines were separated into half-micron or one-micron categories covering the fineness range of the clip.

Upon arrival at NZPAC, each fleece was identified with its tag number and weighed. The whole fleece was then minicored (randomly over the fleece) and the snippets prepared for fineness measurement using the Sirolan-Fleecescan testing system incorporating a snippet-washing and drying device and Laserscan instrument. The coring and snippet preparation systems are a modified version of that trialed in-shed recently in Australia.[1] While the sample was being prepared, the fleece was placed on a conveyor system leading to the classer.

Electronic photocells at the beginning and end of the conveyor system were used to identify when fleeces are placed onto, and fall from, the belt. The system is designed so that the belt will only move when a fleece has been placed on the conveyor, and the Laserscan measurements are automatically brought up on a monitor in front of the classer when a fleece falls to them from the conveyor.

The classer's role was to make a visual appraisal of those parameters (ie. length, strength and/or colour) requested by the grower. If a fleece was classed as tender, of poor colour, or a particular length (unusually long or short), the classer would assign it to those differentiated bins accordingly. If no "subjective" measurement of the fleece was determined (ie. it is of medium length and sound strength), the fleece was classed purely on its fineness result and assigned to its appropriate bin accordingly. The classer could not overwrite the fineness measurement of the fleece at any time.

Once the subjective appraisals have been made, the fleece was then placed on a second conveyor. This system links the classers' appraisal with the fineness measurement of Laserscan and sweeps the fleece from the belt into the appropriate bin. The main computer system stores the data on each fleece and what bins they are assigned to.

The Advantages of NZPAC

The NZPAC system offers several advantages to the grower to increase their revenue. As all classing is performed at NZPAC, the classer in the shearing shed is purely limited to a supervisory role. Similarly, mustering of the flock is only performed once, as opposed to mid-side sampling where an additional pre-shearing step is required. Both factors will reduce on-farm costs.

The greatest advantage provided by NZPAC is in the objective measurements that are performed and the feedback to growers they can provide. Classing for fibre diameter using the Laserscan instrument drastically reduces the errors caused by the inefficiencies of subjective assessment[1], and the NZPAC system provides arguably a more accurate estimate of fineness than mid-side sampling as snippets are cored from all regions of the fleece.

This system effectively identifies the finest fleeces within a flock to enable an increased proportion of ultrafine bales and thus improve returns to the grower. It also provides an opportunity to create lines specifically to meet contract requirements, and unlike mid-side sampling where most growers will only test hoggets, the NZPAC system allows the whole flock to be tested as handling of the sheep is only performed once.

The use of the Sirolan-Laserscan system and balance to measure the fineness and greasy weight of fleeces provides the main variables in establishing an economic value of each sheep, but this is extended further in the NZPAC system by providing subjective measurements of length and strength. This allows those fleeces that are short (or long) and/or tender, that only contribute to the variability of the final lot, to be separated from the rest of the clip to produce a more consistent end product.

NZPAC provides a comprehensive report back to growers using the extensive inventory of measurements on each animal. This report details the range of fineness values and weights within the flock, an estimate of the individual economical value of each animal using the actual prices paid for their wool (this takes into account the effects of length, strength and colour), and a complete database of the objective measurements of their flock. It also indicates the bin each fleece was assigned to at NZPAC with the core test results for each lot. Equally important, the NZPAC report identifies where improvements can be made in the shearing and in-shed preparation of their wool.

All this information can be used to assist the grower in specific breeding strategies, particularly if all sheep are tested, in improving the genetic composition of their clip.

Future Developments

In its first season of operation, NZPAC was a Research and Development program developed to answer two questions. Firstly, could such an operation achieve its primary objectives of reducing the variability found in New Zealand Merino consignments while remaining technically sound and improving returns to the grower, and secondly, could an operation like NZPAC be commercially viable in the future? While this report concentrates on the technical aspects of the NZPAC operations, it is important to consider the future developments that NZPAC are considering.

Improvements to the existing NZPAC system will transpire as more objective measurements are determined throughout the production-line operation. This may be difficult to perform while maintaining high levels of technical performance as most fibre tests are carried out under strictly controlled laboratory conditions and problematical in adapting to a production-line environment. Additional measurements on-line will however allow lots to be constructed to processor's individual requirements for numerous characteristics. This will further result in more consistent lots being available and may also provide exclusive premiums to growers, as each fleece will satisfy the constraints of the contract rather than merely the 'average' for the lot.

While the development of further on-line objective measurements will be beneficial to growers and processors alike, NZPAC is also investigating additional aspects critical to this system. One such component important to grower feedback is the identification of individual fleeces. While the procedure used in the inaugural season was slow, manual, and prone to several potential errors, the use of transponder technology in-shed and at NZPAC is currently being examined. This would significantly reduce the error rate associated with identification and ensure growers are receiving the correct information on their animals.

MATERIALS AND METHODS

An extensive range of fleeces characteristic of the New Zealand Merino clip were measured through the NZPAC system in its first season. This covered a complete range in fineness from 14µm to 24µm. Clips of both Saxon and Merryville Merino (the two major bloodlines of New Zealand Merinos) were processed. 600 snippets were measured on each fleece for fibre diameter and diameter distribution.

Over 60,000 fleeces were tested between October 1999 and February 2000. This encompassed approximately 1000 bales, and over 160 tonnes of New Zealand Merino wool. This represents approximately 2.5% of the total New Zealand Merino clip.

This report examines the relationship between the fleece measurements of lots produced at NZPAC using the Sirolan-Fleecescan technology with their corresponding core-test results measured at the New Zealand Wool Testing Authority laboratory in Napier. Both fleece and core test samples were measured by Laserscan. The relationship between core test results by Airflow, Laserscan and OFDA are shown in report RWG 04 of this meeting.

Fleece results, as referred to throughout this report to indicate the average MFD for the lot using the data from individual fleeces, were calculated using the following combination function:

$$D = \frac{\Sigma \left(M_i / (D_i\,(1+C_i^2)\right)}{\Sigma \left(M_i / (D_i^2\,(1+C_i^2)\right)}$$

Where: D = the Mean Fibre Diameter for the Lot (ie. the 'Fleece result')

M_i = the greasy weight of fleece *i*

D_i = the mean fibre diameter of fleece *i*

C_i = the coefficient of variation of fleece *i*

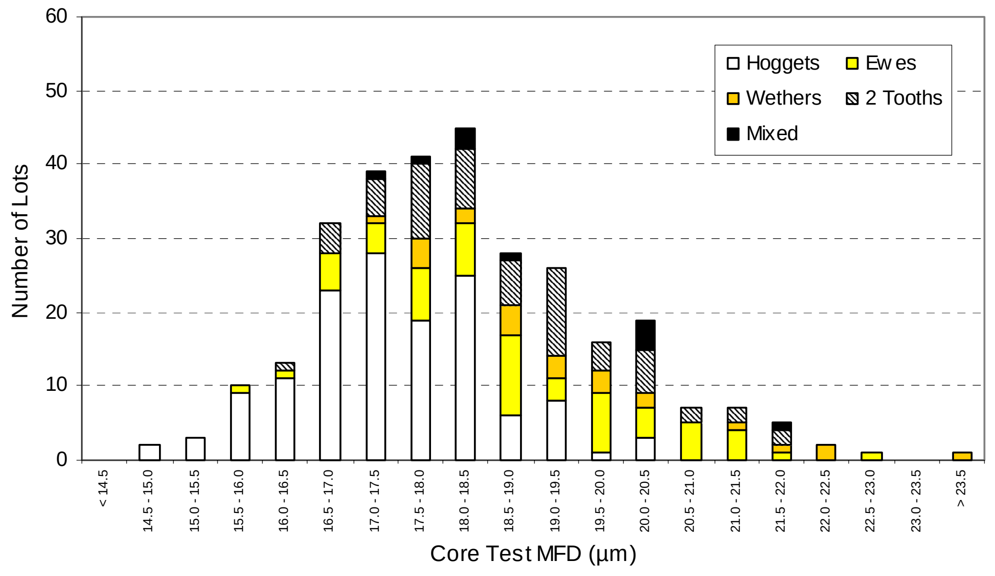
Note: This equation is a variant of that published in Section 6.2 in IWTO-31. No provision was made in the above equation for the wool base of individual fleeces. As no objective measurement of wool base was performed at NZPAC, this was assumed constant for each of the fleeces in each lot. It was therefore removed from the calculation formulae.

RESULTS AND DISCUSSION

Before analysing the data, a thorough examination of the fleece and sale lot data was performed. A number of lots could not be correctly matched with their fleece data, which is likely to be due to problems encountered at the beginning of the project when some fleeces were assigned to incorrect bins. Some growers also changed the parameters of the bins soon after classing started, which caused confusion as to the final destination of those fleeces classed prior to the change. Lots where the certified and bin weights differed by 10% were removed from the analysis.

The distribution of lots produced at NZPAC in its inaugural year, as certified by Laserscan MFD, is shown in Figure 1. This has been separated into the different wool types that were classed throughout the project. The mixed lines represent one grower who processed their ewes, wethers and rams together. As could have been expected, the majority of finer lines comprised hogget wool, while older-aged sheep characterised most of the coarse lots.

Figure 1. Distribution of Lots Classed at NZPAC



The Technical Performance of NZPAC

The technical performance of NZPAC was analysed by comparing the objective measurements produced on the fleeces in NZPAC with their corresponding certified test results. These core test measurements were performed by the New Zealand Wool Testing Authority Ltd in Napier, and conducted in accordance with the Laserscan Test Method (IWTO-12) and associated regulations. To ensure no possible bias in comparing fleece and core test results, measurements at NZWTA were carried out with no prior knowledge of the fleece measurements of the lots being tested.

A summary of the relationship between fleece and core-test results for mean fineness (MFD) is shown in Table 1. It is evident that, on average, the fleece measurements produced by the NZPAC system and core test measurements provided very similar results over the whole range of Merino wools tested.

Table 1. Summary of Lots Produced at NZPAC in 1999/2000

Core Test MFD Range (µm)	Number of Lots	Average Fleece MFD (µm)	Average Core Test MFD (µm)	Fleece MFD - Core Test MFD (µm)
14.1 - 15.0	2	14.46	14.60	-0.14
15.1 - 16.0	13	15.59	15.72	-0.13
16.1 - 17.0	45	16.51	16.65	-0.14
17.1 - 18.0	80	17.54	17.58	-0.03
18.1 - 19.0	73	18.54	18.50	0.04
19.1 - 20.0	42	19.53	19.49	0.05
20.1 - 21.0	26	20.58	20.41	0.17
21.1 - 22.0	12	21.59	21.49	0.10
22.1 - 23.0	3	22.69	22.47	0.22
23.1 - 24.0	1	23.81	23.80	0.01
Average	297	18.309	18.307	0.002

Figure 2 presents the distribution of differences between the fleece and core test measurements. It was clear that the majority of fleece results were within 0.3µm of the certified core test result. This is further illustrated by the cumulative frequency distribution of these differences shown in Figure 3.

The graph confirms that 85% of the fleece results of lots produced at NZPAC were within ±0.3µm of the Laserscan core test result, while 97% were within ±0.5µm. Considering the precision limits of a Laserscan core test result (around ±0.35µm for a 20µm sample), these results suggest that lots can successfully be created at NZPAC to satisfy MFD requirements of contract specifications.

Figure 2. Distribution of Differences between Fleece and Core Test Results of Lots Classed at NZPAC

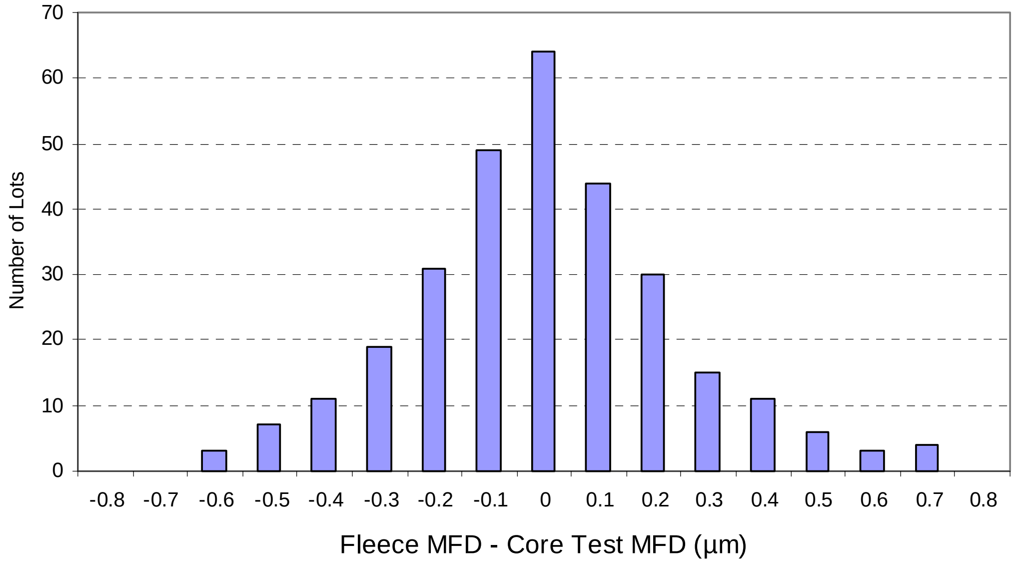
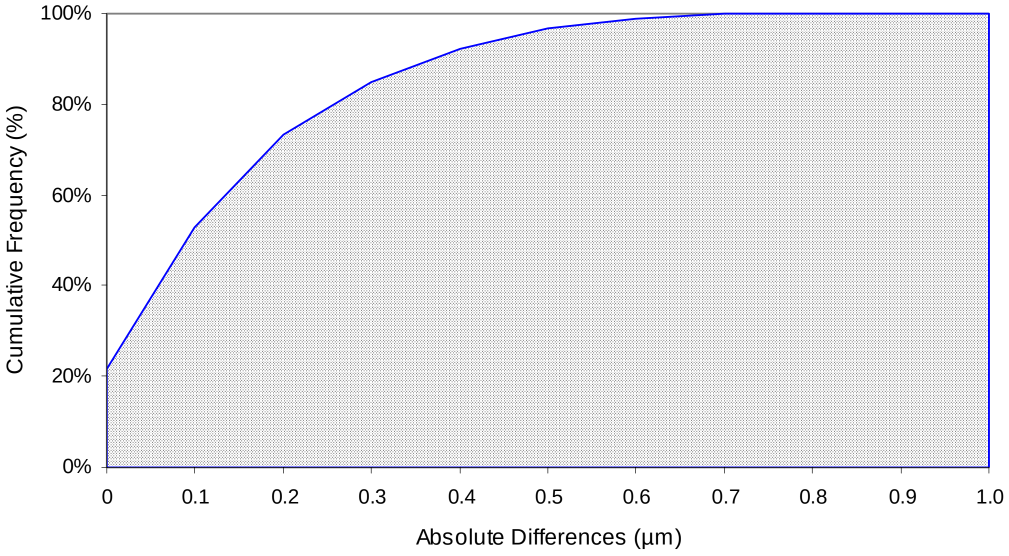


Figure 3. Cumulative Frequency Distribution of Difference between Fleece and Core Test MFD Results of Lots Classed at NZPAC



There is evidence from Table 1 that results at the very fine and coarse ends of the Merino diameter ranges may be slightly biased. This is confirmed in Figure 4, which shows the differences between fleece and core test measurements over the Merino diameter scale.

Summary statistics for the comparison of the fleece and core test results are presented in Table 2. While this showed there was no overall bias between the results, the regression analyses in Table 3 revealed a highly significant level dependent bias. Fleece results for ultra fine lots were approximately 0.2µm finer than the corresponding certified MFD measurement. Similarly, the trend between fleece and certified diameter results showed that for lots with a mean fineness greater than 22µm, the certified MFD result could expect to be around 0.4µm finer than that predicted by the individual fleece data.

Figure 4. Comparison of Fleece and Core Test Fineness Results for Lots Classed at NZPAC

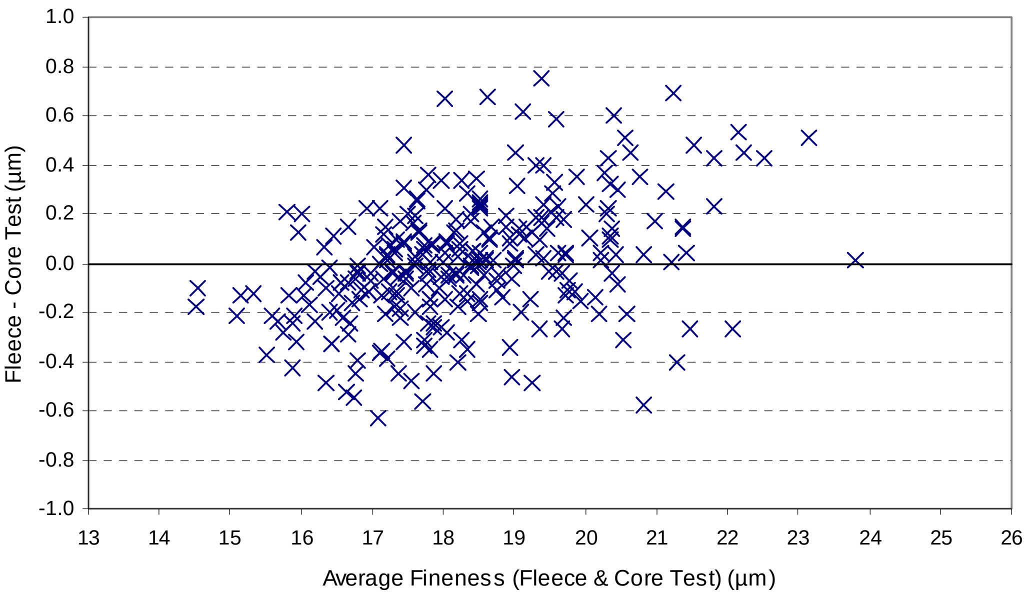


Table 2. Summary Statistics for Certified and Predicted Mean Fineness of NZPAC-Classed Lots

	Fleece MFD	Core Test MFD	Difference	Average
Number of Lots	297	297	297	297
Mean (µm)	18.309	18.307	0.002	18.308
Standard Deviation (µm)	1.616	1.518	0.243	1.563
Standard Error (µm)	0.094	0.088	0.014	0.091

Table 3. Summary of Statistical Data from Regression Analyses

Regression Type	Estimated Slope	SE of Slope	t-value of slope	Significance level
Geometric Mean	1.0641	0.0088	-7.2841	***
Difference versus Average	0.0625	0.0083	7.5244	***

This bias in results at the extremes of the diameter range is likely to be caused by the precision in fineness measurements of the individual fleeces at NZPAC. If we assume that the precision of diameter results from the NZPAC system is similar to that of regular fleece testing methods[2], and the diameter range of fleeces within a flock is normally distributed, a small but significant proportion of the fleeces in these “extreme” diameter bins will be incorrectly classed.

This will effect the finest bin with a number of “coarser” fleeces (for example, with a “true” diameter of 15.5µm) being classed into the 14.1-15.0µm bin. However because the flock will contain only a very small number of fleeces below the lower diameter limit (if any), the proportion of incorrectly classed fleeces either side of the diameter limit will not be the same. This will result in the core test measurement almost always measuring coarser than the fleece result for the finest line. The opposite trend will occur for the coarsest line, where a disproportionate number of fleeces with a true diameter finer than the lower bin limit will be incorrectly classed. This will clearly not effect lines closer to the flock average to the same degree.

The Differentiation of Subjectively-Measured Characteristics in NZPAC

To compliment the objective measurements provided by the Sirolan-Laserscan instrument, experienced classers were used to assess fleeces for the characteristics of length, strength and colour. Rather than estimating the absolute value of each of these parameters, fleeces were simply classed as short, medium, or long in length, and sound or tender in categorising strength. Fleeces that appeared an ‘off-colour’ were assigned to the colour line.

Fleeces that were classed as average length, sound strength and of good colour were assigned to main lines differentiated solely on fibre diameter. A classer could not override the fibre diameter estimate provided by Laserscan.

While some growers decided to class their flocks purely on fibre diameter, a significant number chose to identify and extract the fleeces which added variability to their main lines. Several growers created two ‘short’ and ‘long’ lines (usually split at a diameter level near the flock average) to retain the benefit of identifying and separating finer fleeces. Similarly, the majority of growers elected to remove tender fleeces from their main lines to ensure only sound-strength wool were being assigned into them.

The differentiation achieved for short, long, tender and off-colour lines for the clips processed through NZPAC in its inaugural season is summarised in Table 4. These results indicate that all four parameters were successfully separated from the main lines of clips, with highly significant differences produced for each of them. Each parameter is examined separately below.

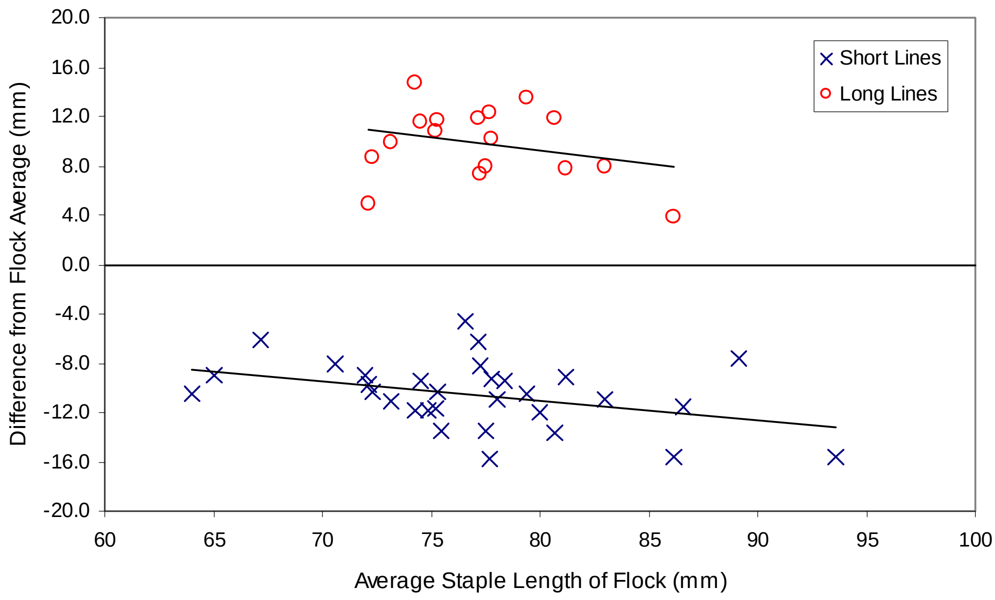
Table 4. Summary of Differentiation of Lots for Length, Strength and Colour at NZPAC

Measurement		Number of Differentiated Lots	Average of Differentiated Lots (SD)	Average of Main Lines (SD)	Difference	Significance
Staple Length (mm)	Short	31	66.4 (6.0)	77.0 (6.5)	10.6	***
	Long	17	87.2 (4.1)	77.4 (3.8)	9.8	***
Staple Strength (N/ktex)		17	24.2 (3.7)	37.4 (3.2)	13.3	***
Colour (Y-Z units)		23	-0.7 (0.8)	-1.4 (0.4)	0.7	***

1. Staple Length

The differentiation attained in mean staple length for short and long lines produced at NZPAC is shown in Figure 5. The average staple length of each flock was calculated as the mean of the respective main lines and those classed as tender and off-colour (ie. all lines apart from those categorised as 'short' or 'long'), using the certified lot results produced by ATLAS at NZWTA Ltd. It was evident for both short and long lots that fleeces that differed from the average flock length were successfully removed from main diameter-classed lines. Staple length measurements of 'short' lines were approximately 6-16mm shorter than the average flock length, while lots categorised as 'long' were approximately 7-14mm longer than main lines.

Figure 5. Differentiation in Staple Length Achieved by NZPAC



The trends of Figure 5 indicate that the differentiation of short lines was more successful when the average staple length of a flock was relatively long (ie >85mm). The opposite applies for long lines which show a greater difference to the average flock length for shorter-length wools. However the magnitude of this differentiation suggests that short and long lines were classed relative to the average length of the particular flock being processed, rather than to an absolute value. For example, the trendline in Figure 5 suggests a 'short' line for a flock with an average staple length of 85mm would measure approximately 74mm. This would clearly be assigned to a 'medium' length (main line) lot for the majority of other clips processed through NZPAC.

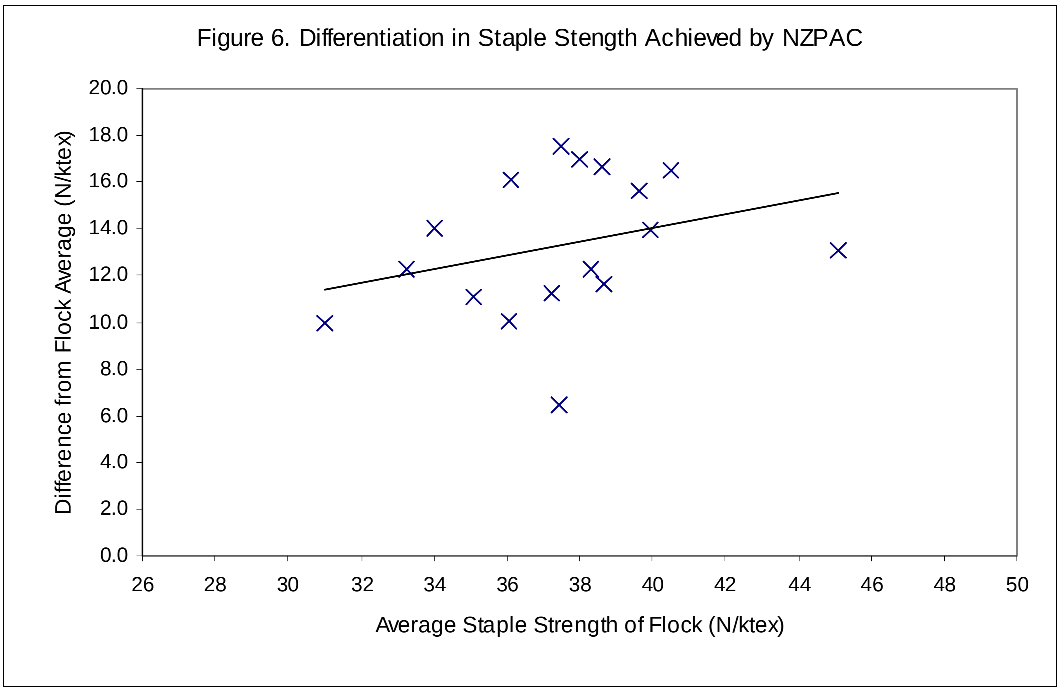
Unless lines are being constructed to pre-determined length restrictions, the fleeces assigned to many of the short and long lines were perhaps unnecessarily being classed into such lots. While this categorisation will reduce the overall variation in length within a line, it is a question that needs to be posed to the processor as to "how much variation is acceptable?"

2. Staple Strength

The differentiation achieved at NZPAC for mean staple strength is illustrated in Figure 6. The average staple strength of each flock was calculated as the mean of all the lines from the particular clip involved, excluding the 'tender' line. As occurred for length results, measurements from ATLAS were taken from grab samples from each lot.

For most flocks processed through NZPAC, the classing (or removal) of the tender fleeces appeared to be successful. The average difference in strength between the tender and main lines was 13.3N/tex, with only one clip exhibiting a tender lot less than 10N/ktex weaker than the average flock strength.

The results for staple strength suggest the differentiation between tender and main lines was performed towards a reference value rather than relative to the strength of the clip being classed. While it may have been unintentional, ninety percent of tender lots measured less than 28N/ktex, while one lot measuring 32N/ktex was the tender line of a clip with an average staple strength of more than 45N/ktex. With the average strength of the total New Zealand Merino wool clip being approximately 41N/ktex[3], the differentiation achieved by NZPAC subjectively for staple strength measurement was exceptional.

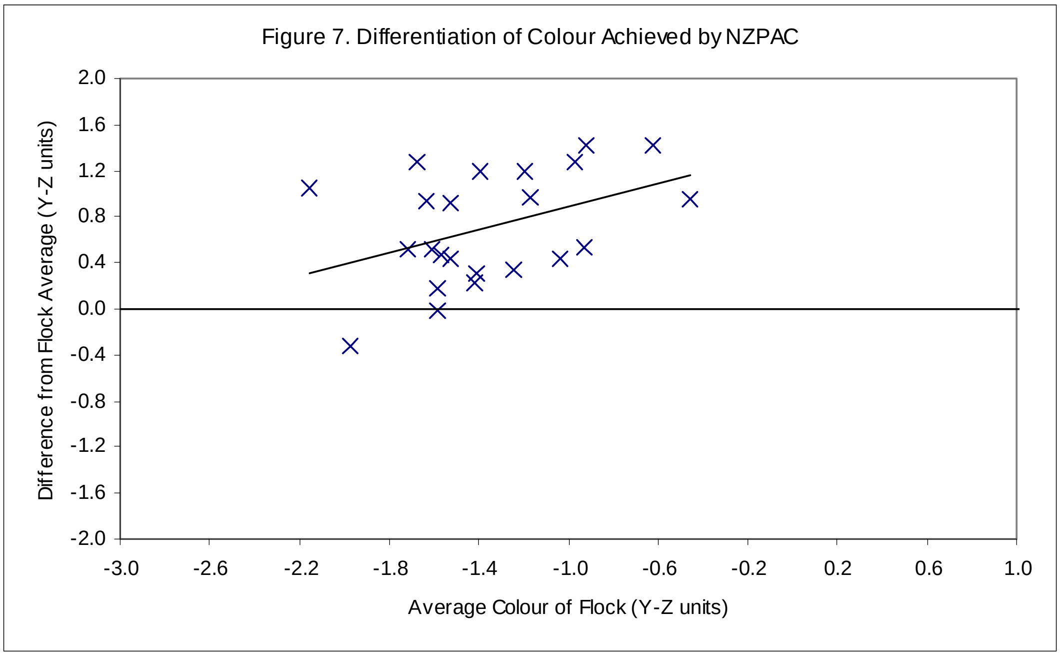


3. Colour

The differentiation of poor colour lines was possibly the least successful of the subjective measurements performed at NZPAC. The average difference between off-colour and main lines was approximately 0.7 units. However this may be considered beneficial depending on the yellowness level required to satisfy contracts.

The differentiation achieved for colour is presented in Figure 7. While most off-colour lots were between 0.4 and 1.2 units higher in Y-Z than each respective flock average, the inclusion of several of these lots into main lines would have made little difference to the average colour of the clips. It was evident however that the differentiation in colour improved as the yellowness of clips increased. Indeed for flocks with an average Y-Z of greater than -1.0 units, the separation of an off-colour lot with a yellowness measurement level above 0.0 units may be quite advantageous. However for clips with an average Y-Z lower than -1.5 units, it is probably of no advantage to separate fleeces of poor visual colour.

With 12 of the 23 clips showing differences between the off-colour and main lines of 0.5 units or less, this report suggest that successfully separating fleeces based on visual colour is very difficult, particularly when the average clip colour is very good. This is likely to be due to difficulties in estimating how poor-coloured fleeces will react during scouring.



In general, the subjective assessments of length, strength, and to a lesser extent, colour, when classed categorically, were successful in differentiating fleeces of various characteristics. Differentiation of length appeared to be performed relative to the average length of the flock being processed, rather than to a stipulated length. For clips of an average staple length of 85mm, this differentiation lead to ‘short’ lines of approximately 75mm, which was nearer the average length for several other flocks classed at NZPAC. A similar effect was seen for ‘off-colour’ lines, although this is partly due to the difficulty in estimating the scourability of poor-coloured fleeces.

While this differentiation would have reduced the variability within each lot (particularly for length), it may be more appropriate in future to establish absolute limits (ie. an actual value) before processing through NZPAC. This form of classing would also be more suitable for lines being created to satisfy contracts which stipulate specific limits.

Clearly if NZPAC were to provide objective measurements for these characteristics as well as the fineness and fineness distribution information currently provided by Laserscan, highly consistent lines (ie. low within-lot variation for each characteristic) could be produced. While the superiority of such lots in terms of processing performance would need to be researched, there is potential for these wools to attract significant premiums for growers.

CONCLUSIONS

The fleece results (ie. the calculated MFD) of Merino lots classed at NZPAC in its inaugural year were very similar to core-test measurements produced under controlled laboratory conditions. 85% of fleece results from NZPAC were within ±0.3µm of the certified Laserscan MFD, while 97% were within ±0.5µm. Considering the precision limits of a Laserscan core test result (around ±0.35µm for a 20µm sample), these results suggest that lots can successfully be created at NZPAC to satisfy MFD requirements of contract specifications.

While there was no overall relative bias between fleece and core-test measurements, significant differences between MFD results were detected for ultra-fine and coarse Merino samples. Fleece results for ultra fine lots were approximately 0.2µm finer than the corresponding certified MFD measured under controlled conditions. For lots with a mean fineness greater than 22µm, the certified MFD result was around 0.4µm finer than that predicted by the individual fleece data.

This bias in results at the extremes of the diameter range is due to the precision in the fineness measurements of the individual fleeces at NZPAC. As such, a small but significant proportion of the fleeces in the finest and coarsest diameter bins will be incorrectly classed. This will cause the MFD estimate of the fleece results to be finer than the 'true' MFD of the finest lot (in this instance indicated by the core test result), and conversely, the core test measurement of the coarsest bin to be finer than the fleece result.

To compliment the objective measurements of MFD and diameter distribution, subjective assessments were also used to categorise fleeces for length, strength and colour. Rather than estimating the absolute value of each of these parameters, fleeces were simply classed as short, medium or long in length, and sound or tender in categorising strength. Fleeces that appeared an "off-colour" were assigned to the colour line.

In general, these subjective estimates of length and strength were relatively successful in differentiating fleeces of various characteristics. Differentiation of length appeared to be performed relative to the average length of the flock being processed, rather than to a stipulated length, while almost all 'tender' lines classed at NZPAC were less than 28N/ktex. Lots separated for colour were infrequently different to main lines due to the difficulty in estimating how poor-coloured fleeces will react during scouring.

ACKNOWLEDGEMENTS

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