Using OFDA2000 and FLEECESCAN to Prepare Lots for Sale and Sheep Selection: A Case Study.

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Summary
Traditionally, fleece testing using midside samples has been conducted in a laboratory, commonly using the Airflow, SIROLAN-LASERSCAN or OFDA100 instruments. A new generation of testing technologies has recently allowed testing to be performed on-farm, in a classing race (OFDA2000) or during shearing (SIROLAN-FLEECESCAN). Commercial usage has determined each system's costs and practical advantages/ disadvantages, but little information is available that evaluates their precision limits or technical performance.

Based on a fine-medium Merino flock, this study compares the performance of OFDA2000 operated in a race prior to shearing with FLEECESCAN operated in a central store. A further comparison is made with snippets sampled by FLEECESCAN but tested under standard laboratory conditions (referred to as LAB LASERSCAN). OFDA2000 and FLEECESCAN results were used to allocate fleeces to four Mean Fibre Diameter (MFD) categories and two "Elite" classes. It was stipulated by the classer that Elite fleeces be ≤19.0 µm and Semi-Elite fleeces be ≤20.0 µm. The average fleece MFDs for all sale lots were compared to their corresponding IWTO Coretest results. Both OFDA2000 and FLEECESCAN were able to class fleeces into four distinct diameter categories. However, in this trial, the OFDA2000 results exhibited a coarse bias that resulted in the allocation of fewer fleeces to Elite classing lines. This highlighted the importance of measurement accuracy when classing to a micron cut-off.

The ranking of a single trait, MFD, was used to compare the testing technologies. When selecting a large proportion of a flock, e.g. retain 65%, the three systems had 85-90% of sheep in common. However, when selecting a tail of the distribution, e.g. retain 5%, the systems only had 40 - 50% of sheep in common. This highlighted the importance of measurement precision. In these circumstances, it is advisable to use the test system with the best precision and if possible, further improve the precision through testing more samples (for FLEECESCAN) or more sites (for OFDA2000).

The following comments/recommendations are based on the results of this trial. Both OFDA2000 and FLEECESCAN testing facilitated the differentiation of fleeces into four MFD categories. As the different test systems do not rank animals in the same order and/or may have different biases, in a commercial situation it is not recommended that comparisons of results from different test systems be made. For example, do not make decisions about sheep tested using OFDA 2000 with sheep tested using FLEECESCAN. High levels of accuracy are required in order that specific clip preparation strategies involving micron cut-offs can be achieved, for example, preparation for a contract with defined MFD categories. Under these circumstances, it is essential that a close relationship between the test system and Coretest results be assured.

Introduction

Traditionally, fleece measurement involves the testing of sub-samples, often sourced from the midside, within a laboratory environment (Morgan 1990; Cottle *et al.* 1996). More recently, a new generation of testing technologies has facilitated fleece testing either on-farm or in a wool store. The OFDA2000 (Brims *et al.* 1999; Baxter 2001; Petersen and Gherardi 2001) is generally used pre-shearing in a race, while the SIROLAN-FLEECESCAN system (Hansford 1999; Knowles 2000; Humphries *et al.* 2001) is usually operated at shearing in the shed but may also be operated post-shearing at a central store.

Although fleece testing systems have operated commercially for some time, little information is available that compares their precision limits or performance. This information is important due to the impact both the precision and accuracy of a measurement may have on its fitness for purpose, that is, its success in achieving desired outcomes in clip preparation and sheep breeding. Therefore, in addition to cost and convenience, performance should also be considered when choosing a testing system.

Recently, a theoretical study (Marler 2001) and subsequent practical experimentation (Marler *et al.* 2002) quantified the major factors that contribute to the successful application of fleece measurement to sheep breeding and clip preparation. Specifically, these are the precision of the measurement and the variation between sheep within the flock being tested. The different instruments and procedures contribute significantly to the precision of the measurements (Marler *et al.* 2002). The variation within a flock for Mean Fibre Diameter (MFD) is

mostly determined by the genotype and average MFD of the flock, in conjunction with the selection pressure that has previously been placed on MFD for that flock.

This paper summarises the performance, recently reported in detail (Hansford *et al.* 2002), of three fleece testing systems in terms of clip preparation and sheep selection:

- OFDA2000 system operated in a race pre-shearing;
- SIROLAN-FLEECESCAN/LASERSCAN system operated in a central wool store; and
- SIROLAN LASERSCAN Laboratory measurement of snippets taken using FLEECESCAN sampling.

Materials and Methods

Source Material

Two thousand four hundred sheep were selected at random from a flock of approximately 5,000 fine-medium wool, 15-month old, ewe hoggets, grown in the Riverina region of New South Wales. All sheep were tested using three commercial systems: OFDA2000 in a race pre-shearing, SIROLAN-FLEECESCAN located in a wool-store and a SIROLAN-LASERSCAN operated under commercial laboratory conditions, thus enabling a comparison of the individual results regardless of the test methodology. These hoggets were shorn with 11 months wool growth. Bellies and skirtings were removed.

Clip Preparation

The sheep were randomly allocated to two equal groups to assess the ability of the systems to class a clip into distinct diameter categories. One thousand two hundred sheep were allocated to clip preparation categories using OFDA2000 operated on-farm pre-shearing, and a further 1,200 fleeces were allocated to categories based on tests performed post-shearing by SIROLAN-FLEECESCAN located in a central wool store.

For OFDA2000, to determine the Grease Correction Factor, 30 greasy samples were tested with the grease correction factor set at zero. The same samples were retested after scouring in an ultrasonic bath using a 20% solution of isopropyl alcohol in industrial grade hexane. For the 30 samples, the average MFD was 20.9 µm greasy and 19.5 scoured, giving a grease correction factor of 1.4 µm. In combination with the MFD of the 30 fleeces and operator's assessment of the wool market at the time of shearing (August 2001), four diameter categories were determined. They were: ≤18.6 µm, 18.7 – 19.7 µm, 19.8 – 20.5 µm and ≥ 20.6 µm.

Forty fleeces were used to estimate the MFD of the 1,200 fleeces allocated to FLEECESCAN classing. This average result was finer than that produced by the OFDA2000. Therefore, to facilitate a valid comparison, four diameter categories with the same range between categories as used for OFDA2000 classing were determined for FLEECESCAN classing. The diameter categories were: ≤17.4 µm, 17.5 - 18.5 µm, 18.6 - 19.3 µm and ≥19.4µm.

In addition, a commercial decision was taken to identify and class out Elite and Semi-Elite fleeces based on visual appraisal of the fleeces, particularly for crimp and greasy colour. However, to be allocated to these extra visual clip preparation categories, the classer also deemed it necessary that the fleeces be ≤19.0 µm for Elite and ≤20.0 µm for Semi-Elite. These micron cut-offs were the same for classing by both OFDA2000 and FLEECESCAN.

Sheep Selection Analysis

The application of fleece testing measurements to sheep selection is via ranking. It is recognised that a number of traits are generally utilised in a sheep selection program, however for this trial, to compare the test systems only one characteristic is used. This evaluation was based on two scenarios. The first scenario assumes the selection of a superior group. In this instance, 5% (or 113 of 2,260) of the sheep are retained. The second scenario assumes the selection strategy is used to cull inferior animals, with the intention in this instance being to retain 65% (or 1,469 of 2,260).

Results and Discussion

Evaluation of Fleece Classing

Table 1 compares the mean values obtained through commercial classing, with Coretest results. Note, fleece numbers differ from initial trial numbers due to loss of samples and/or results. Hence, for a valid comparison fleeces are only included if results exist for all three test systems. The mean results for OFDA2000, FLEECESCAN and LAB-LASERSCAN for both clip preparation strategies demonstrate the consistency of the three test systems. Across all fleeces, Table 1 shows that, on average, the OFDA2000 instruments tested approximately 0.8 µm coarser than the Coretest MFD, while the FLEECESCAN and LAB-LASERSCAN were respectively, 0.4 µm and 0.2 µm finer than the Coretest MFD. Regardless of these biases, both OFDA2000 and FLEECESCAN were able to successfully differentiate the clip into four MFD categories. The small differences

between the Coretest results and both FLEECESCAN and LAB-LASERSCAN are consistent with previous studies (Knowles 2000; Humphries et al. 2001).

Table 1: Comparison of Coretest MFD and Average MFD of Fleeces for FLEECESCAN (n= 1138) and OFDA2000 (n=1122) Clip Preparation Categories tested by OFDA2000, FLEECESCAN and LAB-LASERSCAN.

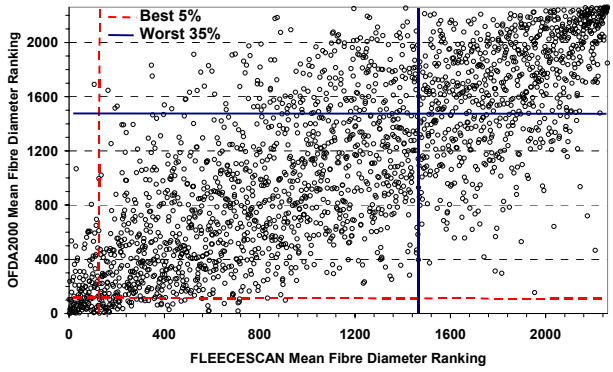
MFD Classed Category	Greasy Fleece Wt (kg)	Coretest MFD (µm)	OFDA2000 MFD		FLEECESCAN MFD		LAB-LASERSCAN MFD	
			Average MFD Fleeces (µm)	Fleeces minus Coretest (µm)	Average MFD Fleeces (µm)	Fleeces minus Coretest (µm)	Average MFD Fleeces (µm)	Fleeces minus Coretest (µm)
FLEECESCAN Clip Preparation Categories								
Elite	385	**18.1**	19.0	-0.9	17.6	0.5	17.9	0.2
Semi-El	1102	**18.9**	19.7	-0.8	18.4	0.5	18.6	0.3
≤17.4 µm	326	**17.4**	18.3	-0.9	16.7	0.7	17.2	0.2
17.5-18.5	553	**18.7**	19.4	-0.7	18.1	0.6	18.4	0.3
18.6-19.3	587	**19.4**	20.2	-0.8	18.9	0.5	19.1	0.3
≥19.4 µm	1235	**20.2**	21.3	-1.1	20.3	-0.1	20.3	-0.1
Mean	**4188**	**18.8**	**19.7**	**-0.9**	**18.3**	**0.4**	**18.6**	**0.2**
OFDA2000 Clip Preparation Categories								
Elite	120	**17.5**	18.3	-0.8	17.2	0.3	17.5	0.0
Semi-El	536	**18.2**	18.9	-0.7	17.9	0.3	18.2	0.0
≤18.6 µm	391	**17.9**	17.9	0.0	17.1	0.8	17.4	0.5
18.7-19.7	699	**18.4**	19.2	-0.8	18.2	0.2	18.4	0.0
19.8-20.5	857	**19.5**	20.2	-0.7	19.0	0.5	19.1	0.4
≥20.6 µm	1477	**20.5**	21.5	-1.0	20.0	0.5	20.3	0.2
Mean	**4080**	**18.7**	**19.3**	**-0.7**	**18.2**	**0.4**	**18.5**	**0.2**

There are reported instances where the various test systems produce results that are in good agreement with the subsequent Coretest (e.g. Brien *et al.* 2001; Humphries *et al* 2001). Equally, there are cases where a bias has been found (e.g. Esperance Wool Exporters 2000; Behrendt *et al.* 2001; Sommerville 2001). In this trial, the coarse bias exhibited by the OFDA 2000 resulted in the allocation of fewer fleeces to Elite classing lines, which included micron cut-offs. As it is currently not known how to anticipate potential biases, caution is required when clip preparation strategies involving fleece measurement are used, for example, to meet a contract with micron cut-offs (defined MFD categories).

Comparison of Rankings determined by Three Test Systems

A single selection criterion of low MFD was used to compare ranking. The two sheep selection scenarios were: retain 5% of superior animals (or 113 from 2,260 sheep) and retain 65% of flock after culling inferior animals (or 1469 of 2,260 sheep). In Figure 1 compares these two selections strategies.

Figure 1: Comparison of the Ranking of Sheep Based on OFDA2000 and FLEECESCAN MFD Results



To give these rankings a mathematical perspective, three statistics were extracted from the datasets. Table 2 presents, for the three technologies and the two sheep selection scenarios, the following data:

- Total number of sheep selected when two different test systems are used to rank sheep.
- Number of sheep ranked that are common to the two test systems.
- Percentage sheep ranked that are common to the two test systems.

Table 2: Comparison of Sheep Selections made using MFD Rankings based on Measurements by OFDA2000, FLEECESCAN and LAB-LASERSCAN (n = 2,260)

Sheep Selection Strategy	Statistics	Total number of Sheep to be selected from the 2,260	Comparison of Technologies		
			OFDA2000 & FLCSCN	OFDA2000 & LABLAS	FLCSCN & LABLAS
Retain 5%	Total Sheep Selected	113	174	177	158
	Number Sheep in Common		52	49	58
	% of Sheep in Common		46	43	51
Retain 65%	Total Sheep Selected	1469	1689	1687	1632
	Number Sheep in Common		1249	1251	1306
	% of Sheep in Common		85	85	89

For the first scenario (retain superior 5%), only 40 – 50% of the rankings were common to both systems, while in the second scenario (cull inferior 35%) this increased to 85 – 90% of the rankings. These results highlight the risk involved when keeping or culling animals at the extremes of a distribution. That is, the precision of a measurement is most important at extremes of the population. In these circumstances, it is advisable to use the test system with the best precision and if possible, further improve the precision through testing more samples (for FLEECESCAN) or more sites (for OFDA2000).

Conclusions

This study highlighted the different effects on clip preparation and sheep selection of measurement accuracy and measurement precision. OFDA2000 and FLEECESCAN results were used to allocate fleeces to four MFD categories and two "Elite" classes. It was stipulated by the classer that Elite fleeces be ≤19.0 µm and Semi-Elite fleeces be ≤20.0 µm. The MFD calculated for all sale lots was compared with the corresponding Coretest results. Both OFDA2000 and FLEECESCAN were able to class fleeces into four distinctive diameter categories. However, in this trial, the OFDA2000 results exhibited a coarse bias that resulted in the allocation of fewer fleeces to the Elite classing lines. This highlights the importance of measurement accuracy when classing to a micron cut-off; in this instance, the Coretest results set the standard.

The ranking of a single trait, MFD, was used to compare the testing technologies. When selecting a large proportion of a flock, e.g. retain 65% of sheep, the three systems had 85 - 90% of sheep in common. However, when selecting a tail of the distribution, e.g. retain 5% of sheep, the two systems only had 40 - 50% of sheep in common. This demonstrates the importance of measurement precision. Precision is largely a function of the sampling and measurement procedures employed by each testing technology, as well as the number of samples and/or sites tested.

References

Brims, M.A., Petersen, A.D. and Gherardi, S.G. (1999). *IWTO T&S Committee*, Florence, Report RWG 04.
Baxter, B.P. (2001). *Wool Tech. Sheep Breed*. **49**(2), 133.
Behrendt, R. Ferguson, M and Gloag, C. (2001). *Proc. Assoc. Advmt. Anim. Breed. Genet*. **14**, 281.
Brien, F.D, Ferguson, M.B. and Konstantinov, K. (2001). *Proc. Assoc. Advmt. Anim. Breed. Genet*. **14**, 277.
Cottle, D.J., Almeida, C.D., Baxter, B.P. and Petrie, D.J. (1996). *Wool Tech. Sheep Breed*, **44**(4), 295.
Esperance Wool Exporters (2000) *Wool Market Link Project Report*. Esperance Wool Exporters Pty Ltd,
Hansford, K.A. (1999). *Wool Tech. Sheep Breed*. **47**(1), 19.
Hansford, K.A., Marler, J.W. and McLachlan, I.M. (2002). *IWTO T&S Committee*, Barcelona, Report CTF 09.
Humphries, W., Vuckovic, L., Aspros, W.A. and Higgerson, G.J. (2001). *IWTO T&S Committee*, Shanghai, Report CTF 04.
Knowles, D.G. (2000). *IWTO T&S Committee*, Christchurch, Report RWG 03.
Marler, J.W. and Couchman, R.C. (2001). *Wool Tech. Sheep Breed.* **19**(4), 311.
Marler, J.W. (2001). *IWTO T&S Committee*, Nice, Report CTF 04.
Marler, J.W., Hansford, K.A. and McLachlan, I.M. (2002). *IWTO T&S Committee*, Barcelona, Report CTF 08.
Morgan, P.D. (1990). *Wool Tech. Sheep Breed*. **38**(1), 21.
Petersen, A.D. and Gherardi, S.G. (2001). *Wool Tech. Sheep Breed*. 49(2), 110.
Sommerville, P.J. (2001). *Australian Wool Testing Authority Ltd Newsletter*, September 2001, Melbourne, Australia.