COMPARISON OF THE SIROLAN FLEECESCAN AND OFDA2000 FOR ON-FARM TESTING OF FIBRE DIAMETER

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SUMMARY
This paper reports the results of a comparison trial between the on-farm testing technologies, Sirolan FLEECESCAN and OFDA2000, and commercial laboratory testing for the measurement of Mean Fibre Diameter (MFD) of individual animals. The trial was conducted on a commercial property at Mingenew, Western Australia, using the same 99 ewe hoggets. The 95% confidence limit for the measurement of a greasy staple from the hipbone using the OFDA2000 was 0.57 μm. For the FLEECESCAN, the 95% confidence limit for the measurement of the MFD of a whole fleece was 0.88 μm. A comparison in the ranking of fleeces on MFD was made between the on-farm tests, and an accurate and precise estimate based on 8 individual measurements per fleece in the laboratory. The FLEECESCAN was found to be the best instrument for ranking fleeces on MFD, whereas, the OFDA2000 had a similar precision to conventional laboratory testing. The results confirm that the on-farm testing technologies are sufficiently precise to be used as a tool for ranking sheep on MFD.

Keywords: fibre diameter, OFDA2000, Sirolan FLEECESCAN, on-farm testing

INTRODUCTION
The commercialistion of two new technologies now provides wool producers with the opportunity to measure the mean fibre diameter (MFD) of fleeces from individual sheep on-farm. The Sirolan FLEECESCAN (Hansford 1999) is designed to core and measure a fleece after shearing whereas the OFDA2000 (Brims *et al*. 1999) measures a staple from a sample site either before or after shearing. The information provided by these new technologies is currently being used by producers for the selection of animals for breeding and/or the splitting of a clip into marketable parcels based on MFD. Previous work has reported the accuracy of the FLEECESCAN (Hansford, 1999) and the precision and accuracy of the OFDA2000 (Baxter 2001; Behrendt *et. al*. 2001; Peterson and Gherardi 2001), although there has been no comparison of the two technologies when measuring the same fleeces. For the selection of animals under commercial measurement conditions, the precision of an instrument is more important than its accuracy, however for the splitting of lines precision and accuracy is important. This paper reports the relative precision of both the FLEECESCAN and OFDA2000 in measuring the MFD of individual fleeces on-farm and compares these estimates with those of a commercial laboratory.

MATERIALS AND METHODS
OFDA2000 Measurements
The trial was undertaken on a random sample of 99 Australian Merino Society ewe hoggets on a commercial property at Mingenew (Western Australia). From 60 of the sheep, 20 g wool samples were removed with electric shears from 8 different sites around the animal. These sites were the midside (left and right), hipbone, shoulder (left and right), wither, mid-back and rump. Only a midside and hipbone sample were taken from the remaining 40 sheep. From the 20 g sample, three staples were chosen from the hipbone sample and one staple was chosen from the midside sample. Each staple was individually prepared (3 to 4 micro-staples per staple) and measured in the yards with the OFDA2000 so that there were 3 individual tests from the hipbone and 1 test from the midside for each animal. The remainder of the 20 g samples was sent to Australian Fibre Testing, a commercial laboratory situated at York, Western Australia. These samples were aqueous scoured, minicored and measured with a Laserscan for MFD under standard laboratory conditions (20°C & 65% RH).

For the OFDA2000 measurements, a grease test was performed on the staples from 30 sheep by scouring the staples in an ultrasonic bath filled with a solvent of 90% hexane and 10% alcohol. Staples were then dried for 5 minutes at ambient environmental conditions and re-measured with the OFDA2000 with the grease correction factor (GCF) turned off. The mean difference in fibre diameter between the greasy and clean staples was 0.8 micron (19.9μm-19.1μm). The GCF, and the MFD at which the GCF was calculated (19.9 µm) were entered into the OFDA2000 software (v4.21). The automatic humidity correction was also used for all measurements in the field.

FLEECESCAN measurements

The same 100 ewe hoggets that were measured prior to shearing using the OFDA2000 were shorn the next day. Immediately after skirting, the fleece was cored once and the core sample was measured by the FLEECESCAN. This process was repeated another two times for each fleece with the fleece being taken out of the coring chamber and turned around between cores.

Data analysis

The MFD results from 99 hoggets were used to assess the precision of tests from the FLEECESCAN and OFDA2000. The values of precision were based on 3 repeat core measurements on each fleece (FLEECESCAN) or 3 different staples taken from the same 20 g sub-sample of the hipbone (OFDA2000). The precision of the two systems was not directly comparable because the value for the FLEECESCAN was for testing a fleece whereas, the value for the OFDA2000 was for testing a sample site (hipbone). Measurements from the 99 sheep were split into three micron groups (<19, 19 to 20 and >20 µm) to investigate any changes in the level of precision relative to MFD. A comparison of the FLEECESCAN and OFDA2000 with laboratory measurements was also undertaken on the first set of 60 hoggets. The 60 sheep were ranked on their MFD measurements and their relative rankings were compared using different methods of measurement. The sheep were ranked from 1 to 60 based on their MFD measurement from lowest to highest. The ranking of the 60 sheep based on the range of MFD measurements from each instrument was regressed against their ranking based on the MFD of the 8 sample sites. The standard error of the fitted line was then used to estimate the error in ranking animals. For example, a 95% CL of ±17 for the laboratory midside test meant that an animal ranked as 40 out of 60 would have a 5% chance that its true ranking would be less than 23, or greater than 57. Statistical regression analysis was performed on the relationship between on-farm testing and laboratory measurements using the software package Genstat for Windows 5.0. The IWTO guidelines for calculation and reporting of statistical data (IWTO-0 Appendix B) were used where applicable. The variance components were estimated from a Restricted Mean Likelihood (REML) model.

RESULTS

Precision of OFDA200 and FLEECESCAN

There was a significant difference (P<0.001) in MFD of 0.31 µm between the two instruments (Table 1). The variance between sheep was the same for both machines (P = 0.177), but the variance between replicates was significantly different (P<0.001), (Table 1). There appeared to be no difference in 95% CL's between micron classes for either instrument.

Table 1. The precision of measuring one greasy staple from the hipbone using the OFDA2000, and that for measuring a a single core from a fleece using the FLEECESCAN. Values in brackets are standard errors.

		Micron Class			
		<19	19-20	>20	Pooled
OFDA2000	No. Sheep	31	39	29	99
	Mean	18.25	19.47	21.00	19.54
	Variance between sheep	0.404 (0.113)	0.057 (0.019)	0.836 (0.231)	1.535 (0.223)
	Variance between reps	0.104 (0.018)	0.073 (0.012)	0.081 (0.015)	0.085 (0.008)
	95% CL (between reps)	0.63	0.53	0.56	0.57
FLEECESCAN	No. Sheep	46	30	23	99
	Mean	18.23	19.43	20.95	19.23
	Variance between sheep	0.437 (0.105)	0	0.572 (0.198)	1.463 (0.219)
	Variance between reps	0.178 (0.026)	0.218 (0.032)	0.201 (0.043)	0.200 (0.020)
	95% CL (between cores)	0.83	0.91	0.88	0.88

Comparison between OFDA2000, FLEECESCAN and laboratory

The MFD between animals ranged from 16.4 to 23.2 µm (measured in laboratory). The OFDA2000 measured significantly finer (0.2 µm, P<0.05) than the laboratory measurements for the hipbone but was not significantly different (P>0.05) to laboratory measurements on the midside**.** There was no significant (P>0.01) difference in the ability of the FLEECESCAN or OFDA2000 to estimate the MFD of the whole un-skirted fleece (Table 2).

Table 2. Statistical data for linear regressions and difference (ie. OFDA2000 minus Lab) vs. average (ie. combined mean of OFDA2000 and Lab) plots when comparing various systems of MFD measurement. Values in brackets are standard errors

X vs. Y	Linear Regression	Diff. vs. Average
OFDA2000 (1 staple hip) vs. Laboratory (8 sites), n=60		
r^2	0.80 (0.54)	NS
Slope	1.03 (0.04)	NS
Intercept	-0.23 (0.75)	NS
FLEECESCAN (1 core) vs. Laboratory (8 sites), n=60		
r^2	0.83 (0.54)	0.08
Slope	1.16* (0.04)	0.16$^+$(0.04)
Intercept	-3.05 (0.75)	

*slope significantly different to 1 (P>0.05); $^+$difference significantly different to 0 (P>0.05); NS = not significant.

The ability of the FLEECESCAN and OFDA2000 to rank sheep improved as the number of measurements increased (Table 3). The ranking based on the average of three core tests using the FLEECESCAN best matched the ranking based on the average MFD of the 8 sample sites. The ranking based on one core test using the FLEECESCAN was marginally better than a midside test conducted in the laboratory.

Table 3. Correlation coefficients (with standard errors) between the rankings of 60 sheep based on the MFD of 8 sites (Laboratory), versus the ranking of sheep based on a range of MFD measurements undertaken on-farm or in the laboratory

Comparative Measurement	r^2 (s.e.)	95% CL
Laboratory (midside only)	0.75 (8.70)	17.0
FLEECESCAN (1 core test)	0.79 (8.07)	15.8
FLEECESCAN (mean of 3 core tests)	0.88 (6.10)	12.0
OFDA2000 (hipbone, 1 staple)	0.72 (9.29)	18.2
OFDA2000 (hipbone, mean of 3 staples)	0.74 (8.80)	17.2
OFDA2000 (midside, 1 staple)	0.74 (8.97)	17.6
OFDA2000 (mean of mid and hip, 1 staple each)	0.79 (8.09)	15.9

Variation at sites across a fleece

The average difference between midside and hipbone sample sites was 0.45 µm for OFDA2000 measurements of greasy staples, and 0.5 µm for the laboratory measured samples. Of the sites measured, the shoulder was the finest sample site (Table 4). There was a 1.1 µm difference between the finest and broadest (rump) sample site. Of all the sites, the midside had the strongest correlation with the average MFD of the 8 sites.

Table 4. The average MFD of 60 animals tested at each sample site by the Laserscan under laboratory conditions. Correlations are shown between the MFD at a site, and the combined average MFD of the 8 sample sites.

Site	MFD (um), variance in brackets	Correlation coefficient (r^2) with MFD of 8 Sites (s.e. in brackets)
Shoulder	18.85 (1.36)	0.75 (0.58)
Shoulder (2nd)	18.91 (1.37)	0.75 (0.58)
Midside	19.04 (1.29)	0.83 (0.49)
Midside (2nd)	19.17 (1.48)	0.83 (0.43)
Wither	19.27 (1.40)	0.80 (0.53)
Middle Back	19.56 (1.28)	0.79 (0.52)
Hipbone	19.74 (1.54)	0.83 (0.51)
Rump	19.94 (1.42)	0.79 (0.54)
Mean	19.32	

DISCUSSION

The results of this study show that the level of precision for the on-farm testing of MFD using the FLEECESCAN and OFDA2000 was similar to that for conventional laboratory testing of a mid-side sample. Accordingly, both the FLEECESCAN and OFDA2000 can be used for the ranking of sheep within flocks on-farm. The level of precision of both the FLEECESCAN and OFDA2000 improved as the number of cores or staples increased respectively. This indicates that in the case of the FLEECESCAN, further improvements could be made to the sampling technique. Observations of the FLEECESCAN coring head during operation suggest that coring could be improved by presenting more compressed fleece to the coring head. In the case of the OFDA2000, there is the opportunity to measure more staples from the same site. However, better precision was achieved by testing a staple from both the midside and hipside rather testing the same number of staples from one sample site. By testing staples from more than one sample site, some of the variance in fibre diameter between sites can be accounted for, leading to better test precision.

The level of precision for the OFDA2000 in this study was better than previously reported. The mean 95% CL for testing a single greasy staple was 0.57μm, which was lower than reported estimates of 1.2μm (Peterson and Gherardi 2001), 1.1μm (Baxter 2001) and 0.7μm of Behrendt et al. (2001). It is likely that the 95% CL's depend on the variation in fibre diameter between sites within a fleece. The small range in fibre diameter between sites (1.1 μm) within the fleece of the Australian Merino Society sheep in this trial could have contributed to the lower 95% CL's. Furthermore, the very low grease correction factor of 0.8 μm for this flock may have also contributed to the reduction in the 95% CL. Since the precision estimates are dependent on these factors, this estimate for a sample site is of little practical use when attempting to report a standard 95% CL for a test. However, the relative 95% CL's for ranking fleeces shown in Table 3 are far more useful. Since there was little difference in ranking precision between the laboratory and the OFDA2000 for either midside or hipbone sampling, one would be confident in using OFDA2000 for animal selection.

Other than the whole fleece, the midside was found to be the best sampling site for ranking animals on MFD. The midside is the site that is considered to be most representative of the whole fleece (Newton-Turner 1956; Dunlop and McMahon 1974; Hansford 1992). However, in our study, the hipbone was only slightly less precise than the midside. Furthermore, the hipbone was the next best sample site when compared to the other sampling sites in this study (Table 4). Several commercial operators have reported that they prefer the hipbone as a sample site since it is easier to find and access. The results of the trial suggest that there is only a small penalty in test precision when sampling the hipbone and the use of this site is justified given the opportunity for increased sampling error due to incorrect site selection and ease of sampling this site.

There is another potential source of error for the estimation of MFD using the OFDA2000. Staples are measured greasy and despite the use of a grease correction factor, this value can not account for the natural variation in the grease factor between sheep. However, the grease correction factor for individual sheep is only necessary if an accurate estimate of MFD is required. It is not practical to measure the grease correction factor of all sheep and if better test precision is required, it is better (but more costly) to measure the MFD of scoured staples. This study demonstrates that it is unlikely that the expected improvements in test precision would provide significant improvements in the ranking of sheep since the precision of both OFDA2000 and commercial laboratory testing were already similar.

ACKNOWLEDGEMENTS
We would like to thank Alan Heitman and Chris Richardson (Australian Merino Society) for initiating the trial and providing sheep and infrastructure, Bill Johnston (Interactive Wool Group) for OFDA2000 measurement, and Lorraine Hewitt (Australian Fibre Testing) for the preparation of FLEECESCAN data. We acknowledge the technical support of Stewart Gittins and Grant Doncon.

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