On Farm Testing of FibreLux Micron Meter and OFDA2000 Compared to Sirolan Laserscan

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ABSTRACT

Previous testing of the FibreLux Micron Meter (FL), a recently developed instrument for on-farm testing of mean fiber diameter (MFD), by this lab was done in the lab and was not compared to a reference method. This study compared the FL to the OFDA2000 in an on-farm test and to the Sirolan Laserscan (SL, a reference method) in the lab. Comparison between the FL and the OFDA2000 was similar to the previous study. In both studies, the average MDF was 0.2 µm greater on the OFDA2000 than the FL and the correlation between the two instruments was similar (r=0.9). When validated against the SL reference method, the OFDA2000 was better than the FL. Comparing the OFDA2000 to the SL, MFD did not differ, geometric slope did not differ from unity, while both statistics differed for the FL compared to the SL. Both alternative methods did show a level bias but in different directions. Compared to the reference method, the OFDA2000 was shown to be superior to the FL. However, because of the difference in cost for the two instruments, we recommend the FL to help growers improve the quality of their clip by selecting replacements with finer wool, and to add value to their clip by classifying fleeces into appropriate lots.

Key words: wool, fiber diameter, FibreLux, OFDA2000, Sirolan laserscan

1. Introduction

The FibreLux Micron Meter was previously validated against the OFDA2000 (Walker et al. 2018) for the measurement of mean fiber diameter (MFD) by measuring wool staples on both instruments in the laboratory. However, this research was lacking because these two instruments were designed for on-farm use and that study was conducted in the laboratory. Furthermore, the OFDA2000 is not a reference method for measuring MFD and thus in the previous study, the comparison of methods was between two alternative methods.

The objective of this study was to compare the FL to the OFDA2000 in an on-farm test and to compare both instruments to the Sirolan Laserscan (SL), which is an official reference method for measuring MFD.

2. Materials and methods

Wool samples for this study were obtained chute side from 214 Rambouillet or Rambouillet x Merino ewes prior to shearing. A 5 x 5 cm mid side sample was collected from each ewe using electric shears and placed in a labelled paper bag. In the barn, staple fibers were teased apart by hand, producing a loose array of individual fibers. The prepared staple was then placed on an OFDA2000 slide. The entire length of the staple was measured on the OFDA2000. After the sample had been measured on the OFDA2000, the entire sample was removed and combed to

align its fibers to fit into a FL slide. Combing resulted in the loss of some fibers from the sample. The base end of the staple was placed on the top end of the slide and excess staple tip was trimmed off. Thus, only the middle portion of the staple was measured. The sample was kept separate from the rest of the side sample for later measurement in the lab by a SL. In the lab, staples were cut into 2 mm snippets using a twin-bladed guillotine and measured on the SL. Snippets measured on the SL included the 25 mm measured on the FL as well as the 40 mm held by the FL slide that are not measured. Thus, the portion of the staple measured on the SL was longer than measured on the FL but not the full staple measured on the OFDA2000.

2.1. *Statistical Analysis*

Estimates of MFD by the FL and OFDA2000 (alternative methods) were compared to the SL (reference method) following the IWTO-0 Appendix B (2002) procedure for comparison of methods. For comparison to previous work (Walker et al. 2018), FL (alternative) was compared to OFDA2000 (reference) using the same procedure. To compare MFD between the two alternative methods, data were analyzed using the GLM procedure of SAS (Version 9.4) where alternative method was fit as a fixed class effect, the sample's MFD measured with the alternative method was fit as a linear covariate, and the sample's MFD measured on the SL was the response variable. Fisher-z test was used to determine if the strength of the correlation between the two alternative methods with the reference method was equal (Weaver and Wuensch, 2013). The distribution of the errors of the two alternative methods to the reference method was tested using Kolmogorov-Smirnov test Daniel (1978) using the NPAR1WAY procedure using SAS (Version 9.4).

3. Results

Descriptive statistics are shown in Table 1. Mean fiber diameter was 18.83, 18.63, and 18.46 as measured on the SL, OFDA2000, and FL, respectively. MDF measured on the FL compared to the SL was finer ($P = 0.017$), while MDF was similar ($P=0.152$) between OFDA2000 and the SL as was MDF of FL and SL ($P=0.26$). The geometric regression of OFDA2000 and FL with the SL is shown in Table 2 and Figure 1. Both alternative methods were significantly correlated ($P<0.001$) with the SL and the correlation with the SL was greater ($P<0.001$) for the OFDA2000 ($r=0.91$) than the FL ($r=0.82$). The slope of the geometric regression for the OFDA 2000 ($\beta=0.95$) did not differ from one ($P=0.20$) but was greater than one ($P=0.01$) for the FL ($\beta = 1.16$). The difference versus average regression indicated that error did not vary ($P=0.09$) as MFD changed for the OFDA2000 but the FL underpredicted fine fibers and overpredicted coarse fibers ($\beta = 0.16$; $P=0.01$). The distribution of residual SL differed ($P<0.001$) between the OFDA2000 and the FL (Figure 2). Eighty-two percent of the samples measured on the FL were within ±0.8 µm of the MFD measured on the SL, which is the accuracy of the FL specified by the manufacturer. For the OFDA2000, 97% of the samples were within ±0.8 µm of the MFD measured on the SL.

Table 1 Summary statistics for the comparison of mean fiber diameter (MFD) measured on the Sirolan Laserscan, OFDA 2000, and FibreLux.

	Laserscan	OFDA2000	FibreLux
Number of Observations	214	214	214
Mean MFD (μm)	18.83	18.63	18.46
Standard Deviation (μm)	1.41	1.48	1.72
Standard Error (μm)	0.10	0.10	0.12
Pr > t $\bar{x}_{FL}$ or $\bar{x}_{OFDA} = \bar{x}_{SL}$		0.152	0.017
Pr > t $\bar{x}_{FL} = \bar{x}_{OFDA}$			0.26

Table 2 Geometric mean regression for Laserscan (reference method) to OFDA2000 and FibreLux (alternative method) using IWTO-0 Appendix B methods for all samples.

Statistic		OFDA2000	FibreLux	Fl vs OFDA200
N		214	214	214
Estimated Slope		0.95	1.16	1.21
Standard Error of Slope		0.04	0.06	0.05
Significance of Slope:	t-Value	1.30	-2.56	3.95
	Significance	0.20	0.01	<0.01
Significance of Correlation:	*R-Value*	0.91	0.82	0.87
	t-Value	31.54	20.77	26.24
	Significance	< 0.001	<0.001	<0.001

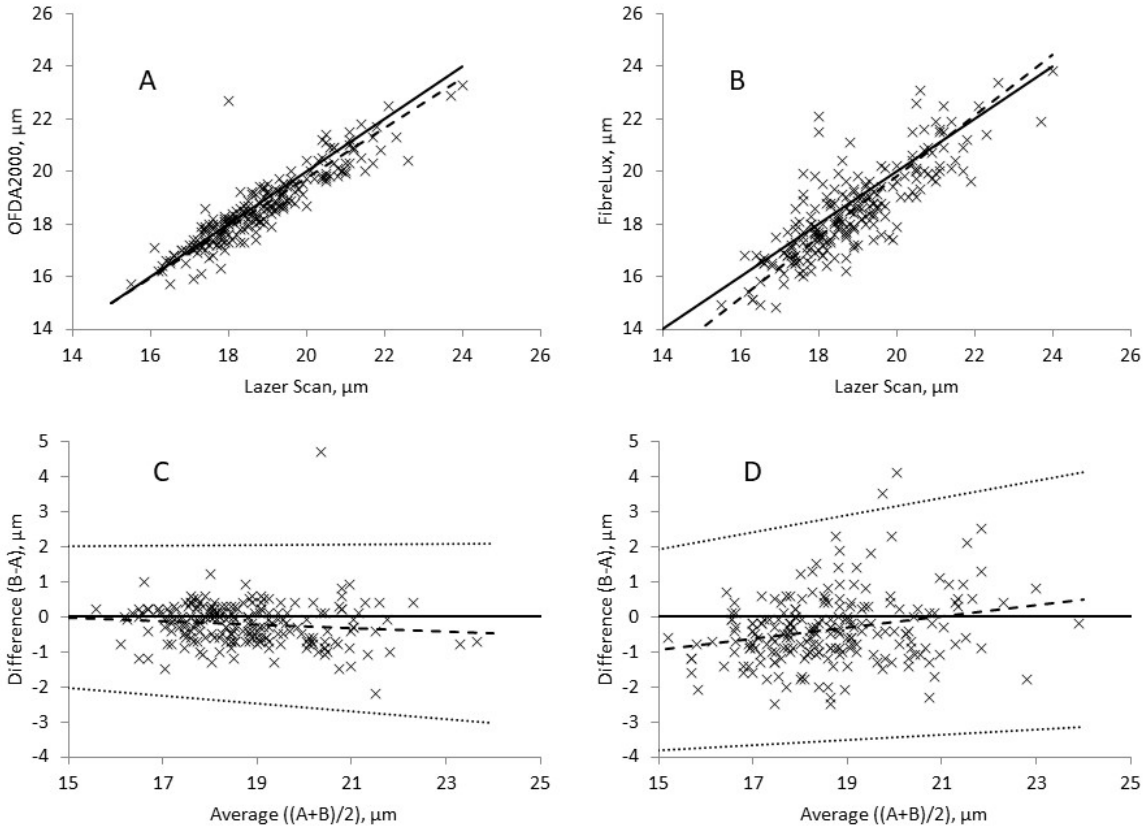

Figure 1. Scatter plot of geometric mean regression OFDA2000 on Laserscan A and FibreLux on Laserscan B, the solid line is the 1:1 line and dashed line is the regression line. Difference (alternative method B – reference method A) versus average of both methods.

Table 3. Regression of residuals of alternative minus reference method regressed on average alternative and reference method for Laserscan (reference method) and OFDA2000 or FibreLux (alternative method) using IWTO-0 Appendix B methods for all samples.

Statistic		OFDA2000	FibreLux	Fl vs OFDA200
N		214	214	214
Estimated Slope		-0.05	0.16	0.21
Standard Error of Slope		0.03	0.04	0.04
Significance of Slope:	t-Value	-1.69	3.69	5.84
	Significance	0.09	0.01	<0.01
Significance of Correlation:	*R-Value*	0.17	0.32	0.37
	t-Value	2.47	4.87	5.84
	Significance	< 0.01	<0.01	<0.01

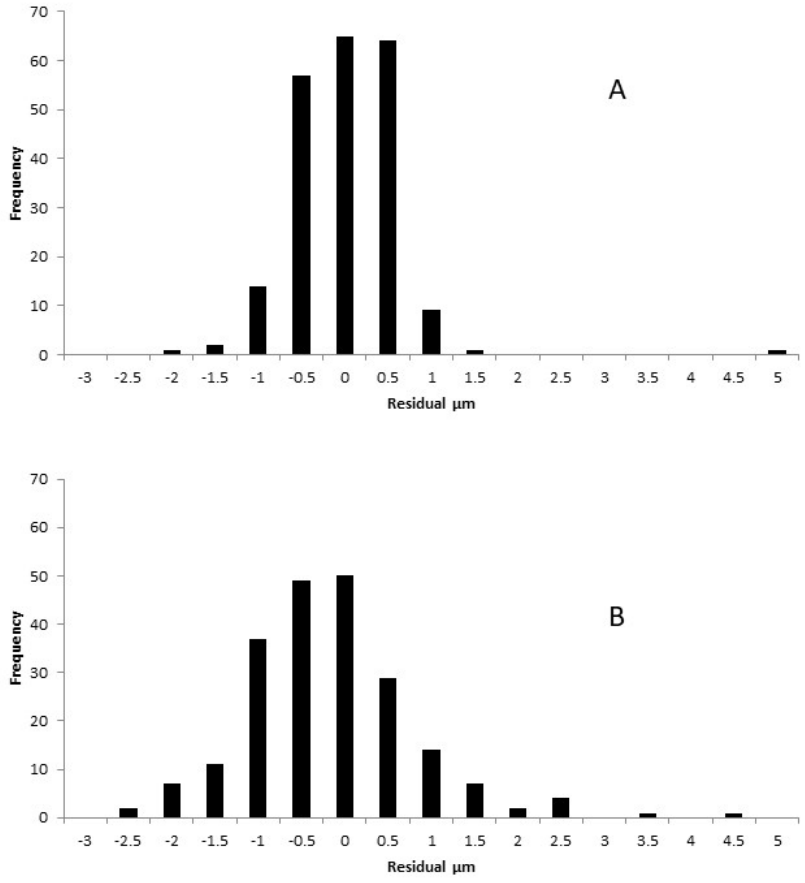

Figure 2. Frequency distribution of difference of OFDA2000 (A) and FibreLux (B) compared to Laserscan.

4. Discussion

Compared to previous research comparing the FL to the OFDA2000 at this location (Walker et al. 2018), the results from this study are similar. In both studies, the average MDF was 0.2 µm greater on the OFDA2000 than the FL and the correlation between the two instruments was similar (r=0.9). There was a level dependent positive bias in both studies when comparing the FL with the OFDA2000. All measurements in the 2018 study were done in the lab, while in the present study, measurements on the OFDA2000 and FL were done on-farm at a pace that equaled the time required to obtain the side sample.

When validated against the SL reference method, the OFDA2000 was better than the FL. Comparing the OFDA2000 to the SL, MFD did not differ, geometric slope did not differ from unity, while both statistics differed for the FL compared to the SL. Both alternative methods did show a level bias but in different directions. The results of the validation of the OFDA2000 to a reference method found in this study were similar to previously reported validations of the OFDA2000. Behrendt et al. (2002) reported correlation between the OFDA2000 and a reference method of 0.94 compared to 0.91 for this study. Likewise, Marler and Baxter (2004) reported that MFD values for the OFDA2000 were 0.17 µm less than measured on the SL compared to 0.20 µm for this study and neither differed from the whole fleece MDF. Although they did not compare these measurements directly, because the two measurements did not differ from the whole fleece MDF it can be assumed that, like this study, the OFDA2000 and SL measure of MDF did not differ.

5. Conclusions

This study validated our previous lab-based research with an on-farm test and compared the two alternative methods (OFDA2000 and FL) to a reference method (SL), which was not done previously. Compared to the reference method, the OFDA2000 was shown to be superior to the FL. However, because of the difference in cost for the two instruments, we recommend the FL to help growers improve the quality of their clip by selecting replacements with finer wool, and to add value to their clip by classifying fleeces into appropriate lots. This is supported by our knowledge that several producers have purchased this instrument and are using it for selecting replacement ewes and creating wool lots with higher value. In contrast, in the U.S. the producers are only using the OFDA2000 when assisted by university personnel.

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