NIR MEASUREMENT OF RAW WOOL MID-SIDES FOR MEAN FIBRE DIAMETER AND YIELD

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Wool producers can test wool on-farm for mean fibre diameter (MFD) but there are no on-farm methods for estimating wool yield (YLD) and hence clean fleece weight. Previous studies have shown that it is possible to measure YLD using near infrared spectroscopy (NIR) for estimates of clean fleece weight (Keogh and Roberts 1985). However, modern NIR technology uses quicker and more accurate scanning with changes to sample preparation and presentation increasing the potential for on-farm use. An initial study (unpublished) using an NIR sample transport module (STM) across a wide sample range provided acceptable calibration and cross-validation statistics while a round trial showed the NIR STM method to be more precise (95% confidence limit) than conventional methods for YLD (± 3.0% *v* ± 5.0%), but worse in precision for MFD (± 2.9 µm *v* ± 1.4 µm). Given the reasonable agreement of NIR results with fleece testing laboratories, a new trial was conducted to evaluate the potential on-farm use of NIR technology.

Two Foss-NIRSystems model 6500 spectrophotometers were used in this study. One was equipped with a remote reflectance probe (RRP) and the other with a sample transport module (STM). New calibrations were generated for MFD and YLD over a selected set of 102 greasy wool mid-side samples. The trial assessed the accuracy and precision of both instruments to determine confidence limits for MFD and YLD measurements. The results were also compared with OFDA2000 measurement and conventional laboratory-based testing for YLD and MFD (by Sirolan-Laserscan) as the reference method.

The calibration and validation statistics for the STM and RRP are reported in Table 1. The RRP is a smaller hand held device attached to a bench-mounted NIR instrument. The sampling area (40 mm x 40 mm) is substantially smaller than that of the STM (20 mm x 45 mm). It was therefore expected that the calibration, validation, precision and correlation statistics would all be poorer for the RRP than the STM (Tables 1and 2).

Table 1. Calibration and cross-validation statistics for Sample Transport Module (STM) and Remote Reflectance Probe (RRP) NIR testing on all samples (n=102, No scatter correction; 0,0,1,1 math; using 1108-2492,8 region for MFD but 708-2492,8 for Yield)

Type	Trait	SEC	R^2	SECV	1-VR	SD	N
STM	MFD	0.88	0.79	0.97	0.74	1.93	100
	Yield	1.72	0.75	1.94	0.68	3.42	98
RRP	MFD	0.92	0.69	1.01	0.63	1.66	95
	Yield	1.95	0.66	2.02	0.64	3.35	99

SEC = standard error of calibration, SECV = standard error of cross-validation, 1-VR = 1-variance ratio (i.e. r^2 in cross-validation), SD = standard deviation of values across the population, N = number of samples

Table 2. The precision for testing a single sample for mean fibre diameter and yield using different measurement systems and the correlation between each test method and the conventional laboratory based testing method (n=102, Sample Transport Module (STM) and Remote Reflectance Probe (RRP))

	Precision (95% Confidence Limit)		Correlation Coefficients (s.e.)	
Fibre Test Method	**Mean Fibre Diameter(µm)**	**Yield(%)**	**Mean Fibre Diameter(µm)**	**Yield(%)**
Laboratory Test	± 0.6	± 3.1	N/A	N/A
OFDA2000	± 1.0	N/A	0.96 (0.58)	N/A
NIR STM	± 1.1	± 2.5	0.89 (0.96)	0.84 (1.93)
NIR RRP	± 2.0	± 3.0	0.84 (1.13)	0.81 (2.13)

The NIR STM was correlated to the laboratory method and had similar precision to the OFDA2000 for MFD testing. Both NIR systems were correlated to the laboratory yield measurement but were more precise. The NIR methods showed lower correlation coefficients and level-dependent bias but this was expected given the narrow sample set used for calibration in this study. The NIR RRP technology shows potential for development into an on-farm instrument but both NIR systems require further research and development on sample presentation, calibration and hardware design.

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