The importance of 'precision' in wool testing

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There are differences in precision between the different machines used to test wool fibre diameter. These differences can impact on your ability to select the best sheep in your flock, especially when selecting a few animals from a large mob of sheep. If you are selecting rams for breeding, then test precision is important. If you are selecting ewes for a commercial flock (for example, culling 500 sheep from a mob of 2000) then test precision is less important.

A plethora of information about methods of testing wool has been published recently, in both the scientific and popular rural press. This has been summarized to provide recommendations about which equipment is appropriate for different situations.

In summary, there are not large differences in precision of fibre diameter testing between the types of equipment available. This was the finding of a recent study by The Australian Wool Testing Authority (AWTA) that compared results from the Fleecescan, OFDA2000 and laboratory testing.

However, another study indicated that, for sheep flocks with a lower variation for fibre diameter between sheep, 'test result precision' would be more important to accurately rank animals according to their fibre diameter. Fine wool flocks tend to have lower variation in fibre diameter between sheep within the flock, compared to medium wool flocks, and so a precise fibre measurement test would be more important for these flocks.

Accuracy vs. Precision

Accuracy and precision are two different estimates of the performance of a test.

Accuracy is the ability of a test to predict the true value of whatever is being measured (ie. the test value is the true value). For example, consider using a tape measure to measure the length of a piece of wood. If the measurements printed on the tape, are derived from a measurements standard agency, and the tape is lined up correctly with the wood, the measurements will be accurate.

Precision is the ability of a test to provide a repeatable result. That is, a precise test will continually give the same answer each time the test is completed on the same sample. For example, if the measurements on our tape are incorrectly printed, but the tape is always correctly lined up on the wood, repeated measurements will always be the same, that is, the measurement will be precise.

Another important concept is **bias**, which is a systematic sampling error. A biased result will give, on average, a higher (or lower) estimate of the true value for all samples that are tested. For our tape measure example, if the tape is printed so that 1mm is actually 0.9mm, then the result will always have a bias, as the measurements you obtain will always be higher (in this case) than the real measurement. In this situation, bias can also be introduced by not placing the tape directly at each end of the piece of wood.

For a test to be accurate, it must be both precise and free from bias.

A testing regime may have a high precision, but have some bias. This is adequate if the test is required for ranking purposes. However, if the test is required to predict actual values, this needs to be accounted for when you are using the results of that test.

If you are using individual measurements for sheep selection, the precision of the test is important. In this case, you are only interested in finding out, and correctly ranking, which animals are the finest in the mob.

The effect of precision on ranking sheep for selection

Putting all this information together, what does this really mean for you as a sheep breeder?

To predict the difference in fibre diameter you are likely to achieve using different testing equipment I used estimates for precision published by AWTA for the OFDA2000, the Fleecescan and laboratory testing, and estimates for visual classing from a separate study.

I have also taken into account the lower levels of variation in fibre diameter that we have observed within fine-wool flocks.

Table 1: Correlation (%) between the test result and the 'true' fibre diameter for different equipment

	Fleece Scan	Labor-atory	OFDA 2000	Visual
17µm	92%	89%	85%	23%
19µm	93%	91%	88%	25%
21µm	94%	92%	90%	28%

The correlations between the 'true' result and the results from different testing equipment for different fibre diameter categories are shown in Table 1.

This table also includes the correlation of visual assessment of fibre diameter against the true values. For example, visual classing in a 19µ flock will achieve only a 23% correlation with the 'true' fibre diameter, whereas all the testing instruments are vastly superior with an 88-93% correlation. The correlations for the machines are slightly lower in the 17µ flock, meaning that woolgrowers will be less able to rank sheep accurately for fibre diameter in a fine-wool compared to a broad-wool flock.

Table 1 also shows that the Fleecescan test was more precise than the laboratory test. This is more to do with how the fleece is sampled, rather than the equipment used to obtain the result.

Most errors associated with fleece testing result from how the fleece is sampled, rather than the equipment that is used to test the sample. The Fleecescan actually "mini-cores" the fleece, while the OFDA2000 uses a single staple, and the recommended laboratory tests use a midside sample.

The implications of using different instruments

The higher the precision of the instrument you are using, the more likely you will select the 'correct' animals.

Table 2 shows you the effect of different selection levels and test precision on the selection differentials achieved. For example, if you select 75% (cull 25%) of a 19µ mob of sheep on fibre diameter alone, the selected sheep would be 0.3µm lower if the test was 100% accurate.

If you use the Fleecescan, you would expect the average of the selected mob to be 0.28µm lower, so you are loosing some of the benefit.

When using the OFDA 200 there will be a 0.26µ drop – not a great deal of difference for a one-off selection. In other words, the cost of selecting some 'wrong' sheep is not going to be high in a situation where relatively high percentages of the mob are being selected (or conversely, where only a low percentage is culled).

Genetic effects

However, it is important to consider the contribution of these small differences on genetic improvement over time. Not all this superiority will pass on to the progeny, in fact, only just over half this superiority passes onto the progeny. Therefore, the effect of a 0.2µm loss in accuracy will result in about 0.1µm loss in genetic gain per generation.

Given that genetic improvement is permanent and cumulative, this may have a small effect over time, if you are using the equipment to select ewes for your commercial flock. it is likely to have a much larger effect if you are selecting rams to breed rams and ewes for your flock.

More precision helps ram selection

Test precision is far more important when you are selecting a few animals from a large number. For example, with ram selection when selecting a small proportion, say 10 out of 1000, test equipment with higher precision will give an improved result. This is important information to ram breeders, particularly in finer flocks.

Using the equipment for clip preparation

While precision is important than accuracy for selecting sheep, accuracy is more important when using equipment for clip preparation. In this situation, you want to accurately predict the lines of wool you are creating.

The effect of using different testing equipment on the returns you generate through clip preparation is dealt with in the "Classer" Program at www.mackinnonproject.com.au.

Key Points:

- ***All methods of FD testing are adequate when a large percentage of animals are selected from target mobs.***
- ***For selecting rams, use a test with higher precision, such as Fleecescan or laboratory test.***

Table 2. The effect of different wool testing equipment on selection differentials for fibre diameter in a Merino flock

Micron of flock	Proportion of sheep selected:	Actual fibre diameter difference of selected sheep (µm)				
		True FD difference	Fleece Scan	Laboratory	OFDA2000	Visual
17µm flock	5%	-2.4	-2.21	-2.14	-2.04	-0.55
	50%	-0.3	-0.28	-0.27	-0.26	-0.07
19µm flock	0.5%	-4.7	-4.37	-4.28	-4.14	-1.18
	5%	-2.7	-2.51	-2.46	-2.38	-0.68
	50%	-1.0	-0.93	-0.91	-0.88	-0.25
	75%	-0.3	-0.28	-0.27	-0.26	-0.08
21µm flock	5%	-3.0	-2.82	-2.76	-2.70	-0.84
	50%	-1.2	-1.13	-1.10	-1.08	-0.34

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