BREEDING ALPACAS TO IMPROVE FLEECE QUALITY

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Over the 16 years I have owned AAFT, there are two questions I seem to be asked by alpaca breeders on a relatively regular basis.

The first question is 'what fleece qualities should I be breeding towards'. The second question that is asked is 'why can't I see any improvement in the quality of my fleeces'. It seems wise to cover both these potentially vexing issues in this paper.

Before embarking on a discussion on what fleece traits are most desirable, we cannot avoid the provocative topic of whether desired fleece traits for the commercial fibre market are the same as the desired traits for winning show ribbons. While diplomacy might not be one of my strengths, I'll venture forth and state that they can be quite different.

Let me provide two examples. I have seen considerable emphasis with huacaya judging around the world, place varying degrees of importance upon crimp definition even though virtually all commercial fleece processors pay no, or very little attention to crimp. Further, the same issue applies to the emphasis on twisted lock structure when judging suris. Any commercial fibre processor of suri will tell you that suri fleeces with twisted lock structure are an absolute nightmare to process. In saying that, I am pleased to see some movement towards open lock structure in some countries.

While I will leave it to the various alpaca associations to reconcile the issue of commercial versus show fleece traits, I will concentrate on the pursuit of desired traits for the commercial fibre market. My final comment on this matter is that if one pursues ribbon winning fleece traits over commercial fibre traits, then this surely is a case of putting the cart before the horse, although I am well aware that show ribbons often sell alpacas. We now move on!

During 2004 and 2010, AAFT conducted commercial market analysis to determine key demand drivers for alpaca fleece. This was carried out in 2004 as a prelude to the recording breaking 'ultrafine bales' scheme, and 2010 as a prelude to the fleece marketing scheme of Premium Alpaca.

Firstly, there is the good news. Luxury garment manufacturers considered alpaca fibre possessed clear opportunities in 'high end' luxury goods due mainly to its soft handle and it's welfare and environmental credentials. Of particular note was the strong desire expressed by some mills to use alpacas' natural colours for eco friendly garment manufacturing.

But then came the bad news. The market feedback from those who had used alpaca fibre was that it contained too many coarse fibres, too much variation over individual fleeces and between fleeces within consignments, and had issues with contamination and irregular fleece length.

In almost all cases, the incidence of coarse fibres was stated as alpaca's greatest problem. In some instances, some fashion label mills stated they would love to use alpaca, but only after the issue of coarse fibres had been resolved.

The other point from the market analysis was that fibre diameter was clearly the single most important determining factor for processing performance. In 2004, the demand with regard to alpaca fibre was 'lower the micron the better'. In 2010, the demand was generally towards averages of 19 to 23 microns. Limitations in volume and processing difficulties caused the micron bar to be raised.

While the market analysis has given us a hint as to what fleece traits to breed towards, we will now turn our attention towards developing effective breeding programs so that we might pursue such traits through genetic improvement.

When creating a set of breeding objectives, we need to address five basic principles.

Firstly, an effective breeding program needs to meet our consumers' demands. If our aim is to win show ribbons, then our breeding program needs to treat judging criteria as our consumers' demands. If we wish to pursue the commercial fleece market, then we need to listen to what the commercial mills require.

Secondly, any trait included as a breeding objective, must possess a high degree of heritability. Heritability is the degree to which a trait possessed by a parent, will be passed on to the offspring. In other words, the higher the heritability, the greater we are able to predict the trait will be passed on to the cria. If we use traits with low heritability, then our breeding program is based on nothing more than luck.

Thirdly, an effective breeding program should not focus on more than, say, three fleece traits. Two is ideal. If we disperse the genetic improvement over too many traits, the net improvement for any one of the traits will be to such a small degree, any improvement with that trait will be insignificant. I should add that we do not ignore all the other traits as we might decide not to use a breeding male because of extremely low density – the point in all this is that we are prioritising. There needs to be a focus.

Fourthly, breeders need to appreciate that genetic improvement will take two or three generations before it will be observable. Some alpaca breeders change their breeding programs before they give their current program a chance to realise any benefit. If the traits you have focused upon are highly heritable and you are choosing your breeding alpacas wisely, the genetic improvement will accumulate, although at first it might not be evident. This also highlights the fact that breeders need to ensure their breeding programs have been well thought out as it takes many years to identify and resolve any problems.

Lastly, to ensure breeders are in fact making progress, breeding programs need to be monitored through the use of objective measurement. Relying on subjective estimates and memory will never be an effective method of finding out if you are moving forward, backwards or treading water.

We will now try to align the above 5 principles for an effective breeding program with the information we gained from our commercial market information. By aligning

our breeding program with the market analysis, we will have already addressed the first principle of meeting our customer's needs.

As mentioned, our analysis found the fibre markets clearly place fibre diameter as a key demand driver. In all cases, it was at the top of their list.

Average diameter of an individual fibre is measured in microns. One micron equates to one millionth of a metre. The lower the diameter (lower the micron), the softer the fibre feels to the touch. Fibres used to manufacture 'next to skin' wear have very low microns as it is important the fabric or yarn feels comfortable on the skin. On the other hand, carpets use fibres of higher microns as the 'handle' of the carpet is not so important.

Lower micron fibres feel softer as they are more flexible, and that the minute scales protruding from the fibre are smaller as the diameter becomes thinner.

Given the softer, more luxurious, softer handling products sell for higher prices per kilo than coarser products, low micron fleeces usually command higher prices when sold to processors. In 2005 when AAFT was involved in fleece consigning, we sold 26 micron fleeces for $5 per kilo while 17 micron fleeces sold for up to $80 per kilo.

As a guide, alpaca fleeces from 2 to 4 year old alpacas are normally about 20 to 26 microns at a point located at the centre of the body mass. This point is normally referred to as the 'midside'.

While fibre diameter is critical for processing performance, the other important thing to note with fibre diameter is that it has been found to be the fleece trait with the highest level of heritability. In other words, fibre diameter is clearly a fleece trait that is most expected to be passed on from parents to offspring. This then addresses the second principle of a breeding program.

Drawing again from our market analysis, the other fleece criteria that is most on commercial fleece processors mind is the issue of coarse fibres, or more to the point, how do we breed out the coarse fibres.

To place the issue of coarse fibres found on alpacas into perspective, the fibre bundles on an alpaca will vary by about 26 microns, whereas a merino sheep will vary by about 15 microns. For example, an alpaca midside fibre sample with average of 22 microns will may have fibres between 14 microns and 40 microns, whereas a sheep with midside sample averaging 22 microns will likely have a range of 16 microns to 32 microns (the distribution is normally skewed towards the coarse fibres).

The simplest method of identifying alpacas that might achieve genetic improvement towards reducing coarse fibres, is to select on 'standard deviation of fibre diameter' (SD). SD is a common statistical term used to describe the degree of variation in any sample. Plainly speaking, SD tells us how far we need to travel from the sample's average in order to capture two thirds of the total variation.

For example, if a midside sample has a test result of average fibre diameter of 20 microns with an SD of 4 microns, then technically, two thirds of the fibres in the sample are from 16 microns up to 24 microns. The fact with alpaca fibres, however, is

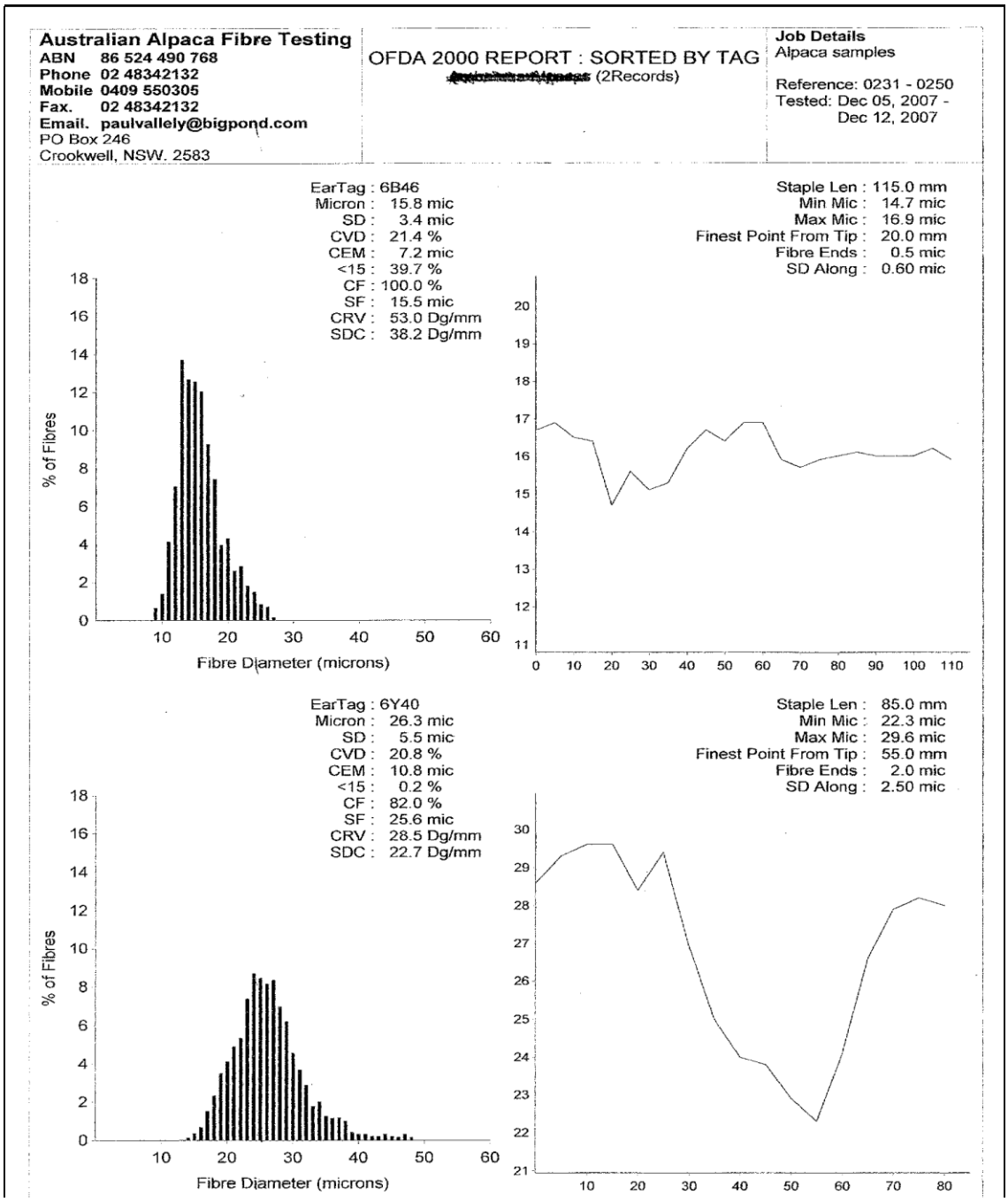
that the coarse fibres tend to skew off from the average more so than the finer fibres. As a consequence, lowering the variation of the diameter of fibres tends to have greater impact on reducing the number of coarse fibres than finer fibres.

The benefit of breeding for low SD, is that fleeces with low variation in diameter are generally superior in terms of processing performance compared to high variation fleeces. Further, alpacas with low variation in fibre diameter tend to allow greater predictability when breeding for fibre diameter. In fact a saying amongst fibre producers is that you need to get your SD's under control before you get your microns under control. Low variation fleeces also tend to possess more alignment of fibres due to the fact that fibre growth rate is correlated to fibre diameter – the more uniform the growth rate, the more aligned the fibres.

A major advantage with SD is that it also has a very high level of heritability compared to other fleece traits, and therefore, providing sound opportunities for genetic improvement. In other words, breeding for SD also achieves the second principle for breeding programs.

To help illustrate what we are trying to achieve by focusing on fibre diameter and SD, the following pair of histograms will assist. The histograms (bar graphs) on the left side of the test reports show the distribution of fibres according to their individual microns. The vertical axis indicates the percentage of fibres within the sample that tested with the relative micron (on the horizontal axis).

The top midside sample shows the alpaca has a low average fibre diameter of 15.8 microns with a low SD of 3.4 microns. The bottom histogram shows this alpaca has a high average fibre diameter of 26.3 microns resulting in a much harsher feeling fleece than the first alpaca. Further, the SD of 5.5 microns shows the alpaca has far too many coarse fibres. This would make the fleece feel even harsher. It is worth noting that if the second alpaca had the same micron, yet much lower SD, the fleece would not feel as harsh.



Finally, if your breeding objectives focus on fibre diameter (microns) and SD (fibre diameter variability), then we address the third principle of breeding programs in that we are concentrating our efforts on just two key fleece traits. As we gain observable genetic improvement in these traits, we might adjust our focus to include other traits, such as reducing the variation of fibre diameter over the fleece. In fact many breeders include this trait in their initial breeding program.

To those who are just starting out with breeding alpacas, I suggest you try to keep things as basic and simple as possible. Genetic improvement can be a very complex, protracted and challenging pursuit at the best of times. Seek as much information as possible before you start out, but apply wisdom when selecting the source of your information.