FLEECE MARKERS FOR FIBRE DENSITY AND LENGTH

by Dr Jim Watts *19 December 2006*

The Huacaya alpaca shown in Figure 1 has a high density of fast growing fibres. It is capable of producing high fleece weights of fine diameter wool.

High levels of fibre density and length are identified visually in Huacaya alpacas as animals that grow long thin staples with deep crimp (high crimp amplitude) and bold crimp (low crimp frequency). These primary fleece markers are reinforced by such fleeces being soft handling and lustrous.

The question that arises immediately is:

Why are these fleece traits reliable indicators of high fibre density and length?

To understand why, it is necessary to examine the patterning or arrangement of wool follicles in the skin. Fibres grow from wool follicles. Follicles are arranged as a cluster or follicle group, about 0.5 to 1.0 millimetres in diameter. Follicle groups occur as repeating units, much like 'bricks in a wall', over the entire wool bearing skin surface of the alpaca. Figure 2 is a diagrammatic representation of a follicle group.

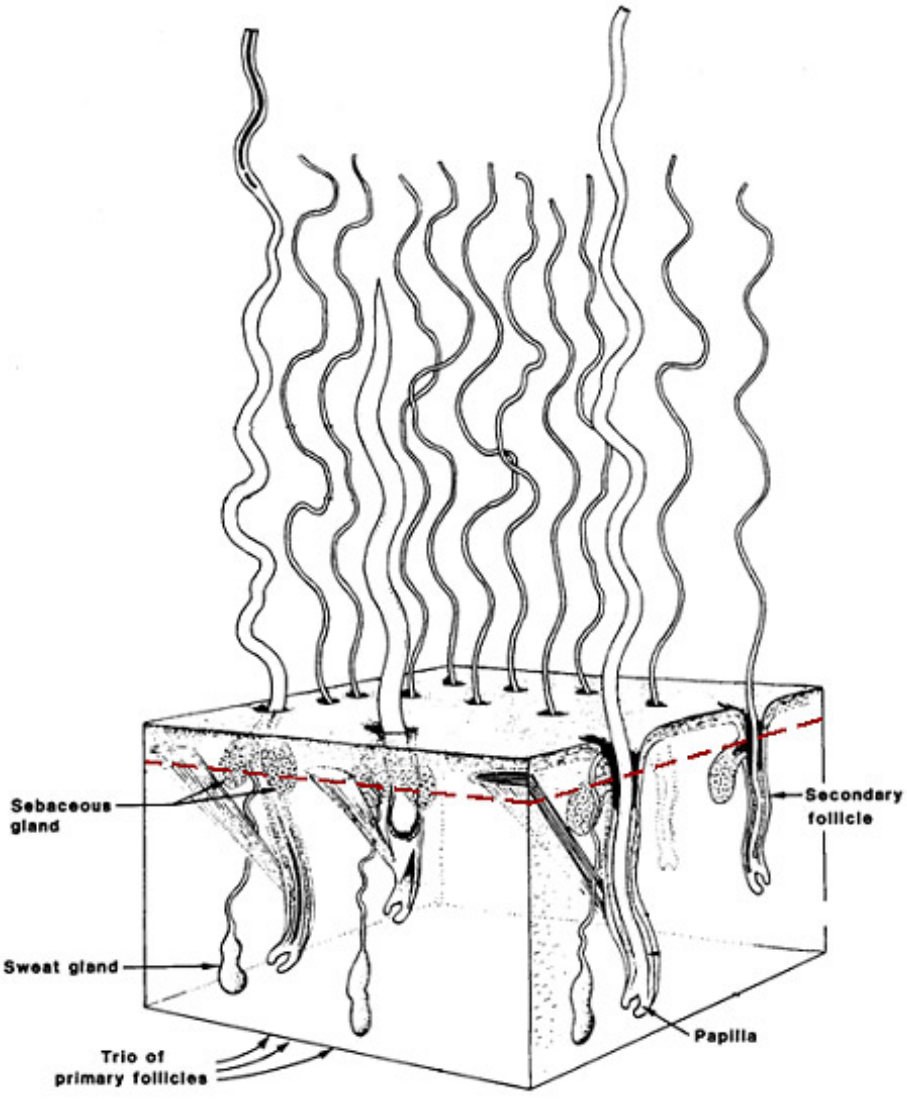

Figure 1. A Huacaya alpaca of measurably high levels of fibre density and fibre length

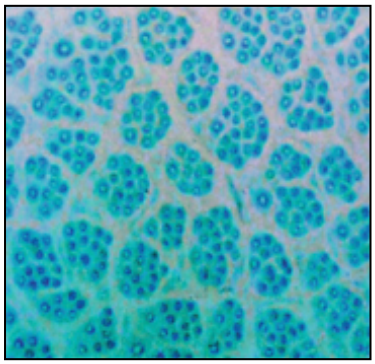

Figure 3. Follicle groups, follicles and fibres in a horizontal skin section from a high density alpaca (x 50 magnification: Nile blue sulphate stain).

Figure 4. Fibre bundles in a Huacaya fleece.

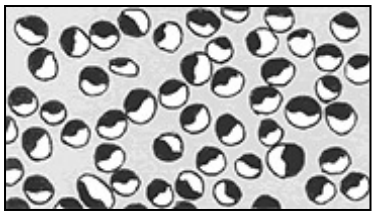

Figure 5. Cross-sectional view of crimping fibres from the fleece of a high density fleece. The orthocortex is the shaded area; the paracortex the white area.

Figure 2. A follicle group and its associated fibres and glands. The dotted line indicates the preferred plane of sectioning for preparing a horizontal skin section to measure follicle density.

For a particular alpaca, the number of follicles in a follicle group is more or less constant but varies widely (from about 15 to 50) between alpacas. Generally, the more follicles there are in a follicle group, the closer the follicles are packed to each other and the higher the fibre density is going to be. Figure 3 shows a magnified view of follicle groups in a horizontal skin section from an alpaca with a high follicle density of 89 follicles per square millimetre.

Note the oval shaped follicle groups and how closely the follicles are packed together within the follicle groups. The distances between the follicles within the follicle groups are much less than the distance between the follicle groups. Consequently, in a high density animal like this, the fibres tend to grow into the fleece from each follicle group as a highly aligned and separate cluster of fibres. These distinct clusters of fibres emerging from follicle groups are called 'fibre bundles'. The fibre bundles (Figure 4) are no more than 1.5 millimetres wide, the maximum diameter of a follicle group.

Note in the skin section of the high density alpaca (Figure 3), how fine and uniform in diameter and circular in shape the fibres - shown as white dots within the blue rings in Figure 3 - are.

High follicle density reshapes the fibre.

In Figure 5, which is a magnified view of the tracings of the cross-sections of fleece fibres from a high density animal, note that the fibres consist of more or less equal amounts of orthocortical ('soft keratin') proteins and paracortical ('hard keratin') proteins arranged as hemi-cylinders. It is this bilateral segmentation of orthocortex and paracortex that gives the fibre its cylindrical shape and allows the fibre to crimp deeply.

The hard keratin bends the fibre causing the soft keratin side of the fibre to buckle as it descends into the crimp wave (Figure 6). The fibre twists on its axis 180 degrees throughout the crimp wave with the hard keratin side forcing the fibre to ascend from the crimp trough. If the fibres consist of equal halves of orthocortex and paracortex, it is able to maximise crimp depth.

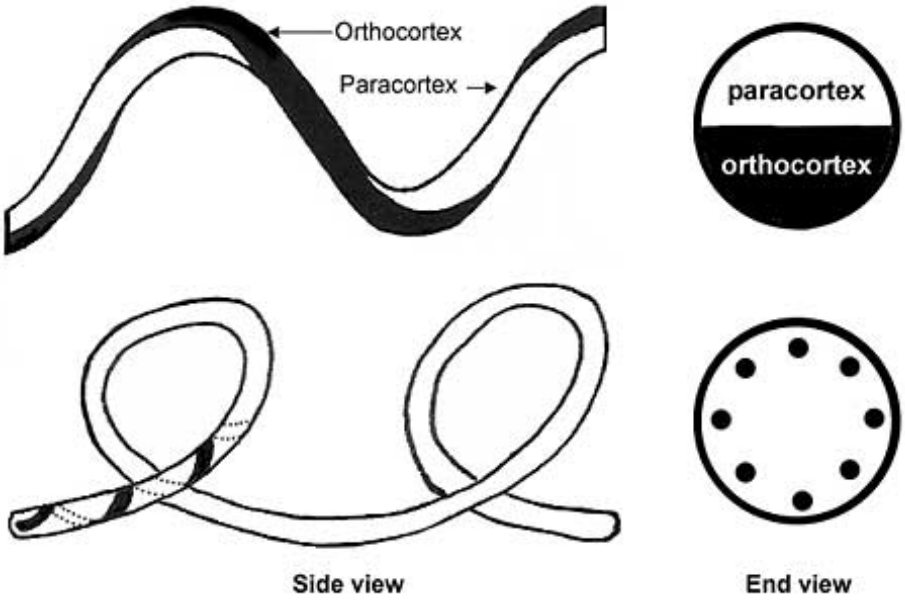

Figure 6. Top: The crimping action of the Huacaya fibre (left) which is deepest when there is a bilateral segmentation of orthocortex and paracortex (right) within the fibre.
Bottom: The coiling or twisting action of the Suri fibre is thought to be most pronounced when the orthocortex is arranged as outer concentric rods in a matrix of paracortex.

Now let us assume that the maximum crimp depth possible occurs when a crimp wave forms a half circle. This equates to the ratio of the fibre length to the staple length being about 1.50 to 1, or in other words, a fibre that is 50% longer than the staple length.

The Huacaya alpaca has, on average, a fibre length to staple length ratio of about 1.10 to 1 (mean fibre length is 10% greater than the staple length) with the best measured individual being about 1.35 to 1 (mean fibre length is 35% greater than the staple length). We can expect that as we select alpacas for higher density, the more likely we are to reach that magical ratio of 1.50 to 1.

Clearly, breeding thin stapled alpacas with deep crimp is an indirect indicator of high fibre (follicle) density and length and an important way of increasing fleece weight, reducing fibre diameter and improving fibre quality.

When bold crimp (low crimp frequency) is superimposed on a deeply crimped (thin stapled) fleece, the fibres become even longer and the fleece weight higher.

The Huacaya fibre crimps, on average, about every 16 days. Bold crimp signifies that the wool has grown a greater distance in the 16 days it takes to form a crimp wave than wool of higher crimp frequencies. The fibre scales, already flat and smooth (a density effect), now become longer. Garments made from these fibres with long flat scales have less contact points with the human skin and these contact points are hardly detectable. Consequently, the garments have a sensual softness to it, especially if it is light weight.

The same principles apply to Suri alpacas. However, the fibre bundles in high density Suris can only be seen shortly after emerging from the skin into the fleece. The unique twisting or coiling action of Suri fibre (see Figure 6) wraps the fibre bundles into a long thin staple with pronounce coiling where the fist coil is formed (Figure 7).

Figure 7. The long thin staple of pronounced and free coiling indicates high levels of fibre density and fibre length in Suri alpacas.

The best sites on the Suri alpaca's body to look for this distinct staple formation is on the neck and rump, that is, away from body sites such as the saddle where the flat and non-coiling appearance of staples can be simply due to the animal's rolling behaviour.

Also, because the Suri fibres twist rather than crimp, the fibres are tucked away into the body of the staple. This makes it hard to detect 'guard hair' and therefore difficult to select against it simply on a visual assessment of the fleece. Compounding this difficulty is that the Suri, unlike the Huacaya, appears to grow fibre intermittently or seasonally rather than continually throughout the year, and a considerable proportion of the fibres may be shorter than the staple length. Short 'guard hair' (or long 'guard hair') can be present and difficult to detect unless close fleece inspection on fibres withdrawn from the basal (not the tip end) of the staple. Skin tests will identify and quantify the presence of such fibres with certainty.