Sheep CRC Practical Wisdom Notes

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Sheep CRC Practical Wisdom
Know it. Do it.

Staple strength—use genetics to make real progress

By Sue Hatcher, NSW DPI

Key points

- Staple strength is important in determining the value of your clip.
- Controlling staple strength by on-farm management techniques is difficult.
- An appropriate breeding strategy allows staple strength and other key price drivers of your wool to be improved.

Introduction

Along with staple length (SL) and fibre diameter (FD), staple strength (SS) is an important predictor of hauteur, coefficient of variation of hauteur and romaine, which are key early stage processing performance parameters. Therefore, it is not surprising that staple strength is consistently second only to fibre diameter as a major determinant of the value of raw wool. In general, wool that measures 35 N/ktex is considered 'sound' and this figure is used as the benchmark for reporting staple strength premiums and discounts. Historically, the premiums and discounts applied to wools of varying staple strength are considerably greater for fine wools compared to medium wools. Objective measurement of staple strength was developed to provide an indication of potential fibre breakage during early stage processing, specifically for testing sale lots of wool.

What influences staple strength?

Wool staples consist of many hundreds of single wool fibres and the measured strength in Newtons/kilotex (N/ktex) of a staple is controlled by four different biological components:

- variation in fibre diameter along fibres;
- variation in fibre diameter between fibres;
- follicle shutdown;
- intrinsic fibre strength.

However, it is the variation in the fibre diameter along a wool fibre and variation in fibre diameter between fibres within the staple that have the biggest impact on staple strength.

Pregnancy and lactation can have a significant impact on staple strength with reductions of up to 45% reported for ewes raising twins compared to dry sheep. Reproduction data of the Sheep CRC Information Nucleus Flock (INF) ewe progeny, first joined at 19–21 months of age, indicate that dry ewes had the highest staple strength, followed by single-bearing ewes, while twin-bearing and lambed-and-lost ewes were not different to each other (Table 1).

Table 1. Deviations from the mean staple strength due to reproductive performance of adult Merino ewes from the Sheep CRC's INF (based on INF Merino ewe reproduction data from 2009 to 2012).

	Mean	Pregnancy Status			
	(N/ktex)	Dry	Single	Twin	Lambed-and-lost
All INF ewes	35.0	1.7	0.7	–0.3	–0.4
Ultrafine/Superfine	36.1	0.6	–0.1	–5.0	0.5
Fine/Fine-Medium	36.0	0.9	–0.1	1.0	–1.3
Medium Strong	34.2	2.2	1.2	–0.7	–1.0

How can environmental differences in staple strength be managed?

Previous research found that live weight could be used as a proxy for changes in the fibre diameter profile, therefore, minimising live weight variation over a full year should reduce variability in wool growth, fibre diameter variability and hence, staple strength. However, these strategies are not always effective, results varied between autumn- and spring-shorn wools and with the age of the animal, its sex and pregnancy status.

The genetics of staple strength

Given the large impact of the environment and the variable responses to on-farm strategies to manage staple strength, genetic improvement of the trait is an important approach to generate long-term improvements. The heritability of yearling staple strength (YSS; 11 months) is 0.23 while that of adult staple strength (ASS; 23 months) is 0.25; both would be classified as moderately heritable traits.

Staple strength, however, is only one of a suite of wool quality traits that impact on the price paid for wool, so selection decisions must be made on the full array of traits that impact on Merino enterprise profitability. It is, therefore, important to take into account the genetic relationships with other traits including live weight, wool production and both visual and measured wool quality, shown in Table 2.

It is important to note that breeding objectives that aim to improve the various visual wool quality traits, live weight, wool production, fibre curvature, mid-breaks and brightness will produce correlated increases in staple strength, although of a low magnitude. However, the high unfavourable genetic correlation between fibre diameter and staple strength means that breeding objectives that aim to reduce fibre diameter will lead to lower staple strength unless some selection pressure is placed on staple strength. For this reason, it is recommended that commercial producers aiming to reduce the fibre diameter of their wool clip should purchase rams with a higher Yearling Staple Strength (YSS) ASBV (preferably above zero).

Take home messages

- Staple strength is a measurement of a material property and unlike other wool production and quality traits has no single, simple biological basis. This contributes to the large differences in phenotypic expression of the trait, which makes on-farm management to improve staple strength problematic.
- Genetic improvement of staple strength is an important means to produce long-term improvements in staple strength. For commercial producers, selection of sires with a positive staple strength ASBV, while also choosing a lower FD ASBV can generate simultaneous decreases in fibre diameter and improvements in staple strength and overcome the unfavourable genetic correlation between these two traits.
- Coefficient of variation of fibre diameter can be reliably used as an alternative selection criterion for staple strength when selecting replacement animals to enter either the breeding flock or wool growing mob in a self-replacing Merino enterprise.

Further information

Sheep Genetics - www.sheepgenetics.com.au

NSW DP - www.dpi.nsw.gov.au

AWI - www.wool.com

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Table 2. Genetic correlations between staple strength, visual wool quality traits, off-shears live weight and wool production and measured wool quality traits (2008–2012 INF shearings).*

Visual Wool Quality Scores	**YSS**	**ASS**
Colour	Neg	Neg
Character	–0.32 ✔	–0.22 ✔
Dust	–0.37 ✔	–0.21 ✔
Weathering	–0.36 ✔	–0.33 ✔
Fleece rot	–0.22 ✔	Neg
Staple structure	Neg	Neg
Handle	–0.25 ✔	Neg
Live weight and wool production	**YSS**	**ASS**
Off-Shears Live Weight	Neg	Neg
Greasy Fleece Weight	Neg	Neg
Yield	0.45 ✔	0.36 ✔
Clean Fleece Weight	0.28 ✔	Neg
Measured wool quality	**YSS**	**ASS**
Fibre Diameter	0.36	0.54
Fibre Diameter Standard Deviation	–0.42 ✔	–0.29 ✔
Coefficient of Variation of Fibre Diameter	**–0.70 ✔**	**–0.61 ✔**
Curvature	Neg	Neg
Resistance to Compression	Neg	Neg
Staple Length	Neg	Neg
Mid-breaks	Neg	Neg
Brightness (Y)	0.37 ✔	Neg
Yellowness (Y–Z)	Neg	**0.68**

** Neg = Negligible correlations (<0.2), low correlations (0.2–0.4) are in normal text, medium correlations (0.4–0.6) are in bold text and high correlations (>0.6) are shaded. ✔ indicates a favourable genetic relationship.*