MANAGING STAPLE STRENGTH IN WINTER RAINFALL ENVIRONMENTS

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SUMMARY

Low staple strength is a problem in winter rainfall environments. It is most apparent in wool from young or breeding sheep and results in high price penalties particularly for finer wools. Minimising liveweight loss over summer/autumn and a higher liveweight at the start of the dry period will increase staple strength in young sheep. In pregnant ewes, feeding high quality protein supplements such as canola meal, around parturition has, in some cases, increased staple strength. Shearing in autumn or early winter and lambing in winter or spring are also management techniques that can increase staple strength. As the heritability of staple strength and the correlation between staple strength and coefficient of variation of fibre diameter (CVFD) are both high, inclusion of CVFD in a selection program can be used to improve staple strength.
Keywords: Staple strength, wool quality, sheep, nutrition, coefficient of variation of fibre diameter.

INTRODUCTION

While the price penalties for tender wool have been variable in recent years, it is inevitable that this characteristic and other raw wool measures will be used increasingly in the determination of wool prices. The discount figures for wool sold at auction in the first quarter of the 1996/97 selling season indicate that discounts for low staple strength were up to 190 c/kg, 66 c/kg and 22 c/kg for fine, medium and broad wools respectively (International Wool Secretariat 1996).

Low staple strength is particularly a problem in winter rainfall environments. This environment accounts for over 60% of Australian wool production (Australian Council of Wool Exporters 1996). In a survey from 1989 to 1992, Barton *et al.* (1994) reported that up to 70% of weaner/hogget wools and 43% of adult wools grown in Western Australia were tender or part-tender. This resulted in approximately 35% of the entire clip from this State being below 32 N/Ktex. Other States with winter rainfall regions have similar problems with between 20 and 30% of the wool from Victoria and South Australia having a staple strength of less than 30N/Ktex (K. Curtis pers. comm.).

NUTRITION AND STAPLE STRENGTH

Young sheep. Studies in Western Australia with spring-shorn weaner/hogget sheep have shown a good relationship between staple strength and loss in liveweight over the summer/autumn. In one experiment, carried out across a number of sites, reducing liveweight loss by 10 g/d increased staple strength by 3.5

N/Ktex in weaner/ hogget sheep (Figure 1). Using predictions from GrazFeed (Freer *et al.* 1997), reducing the rate of liveweight loss by 10 g/d would require a lupin supplement costing $0.013/d or $1.20 for 90 days. Currently 3.5 N/ktex is worth between $0.17 and $0.95, depending on the average fibre diameter. Therefore, while the results indicate that sound wool can be produced, the costs of feeding traditional supplements to manipulate liveweight change are currently higher than the price premium for sound wool.

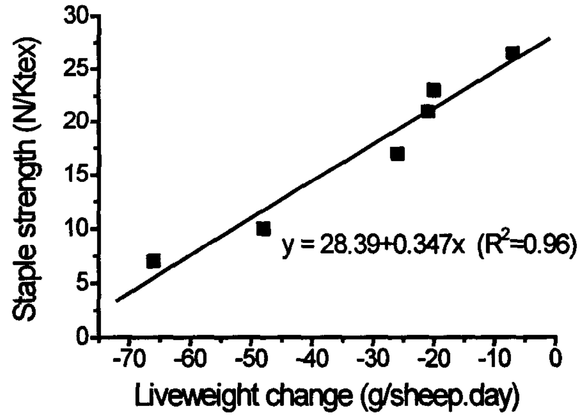

Figure 1. The relationship between liveweight change over summer/autumn and staple strength in young sheep. (Each point is an average of 20 sheep.)

Rate of wool growth is related to liveweight, as well as change in liveweight, (Allden 1979) and this may also influence staple strength. In an experiment designed to evaluate the effect of liveweight on staple strength, two groups of young sheep, born at the same time (June) were prepared in the field to have different liveweights in December. The sheep were then moved into an animal house and either put through a period of weight loss for one month followed by weight gain for one month, or maintained at a constant liveweight. Wool growth and staple strength in the lighter sheep were lower than in heavier sheep with the same rate of change of liveweight (Table 1). Therefore, preparation of young sheep to attain the highest possible liveweight prior to summer/autumn, together with management to minimise weight loss during the dry period will both increase staple strength.

Reproducing ewes. Breeding ewes tend to have a lower staple strength than dry sheep (Masters *et al.* 1993a), although this is not always the case (J.Z Foot pers. comm.; Robertson *et al.* 1996). The reduced staple strength in ewes is associated with the reduced rate of wool growth usually around the time of parturition (Masters *et al.* 1993b) but sometimes later, in lactation, if feed supply is poor. Wool growth in late pregnancy can be substantially increased by the provision of protein supplements protected from degradation in the rumen (Masters *et al.* 1996). Substitution of lupinseed protein with the partially protected, expeller canola meal has been shown to increase wool growth in late pregnancy and early lactation by 50% (Masters and Mata 1996). In the field, feeding canola to ewes late in pregnancy has improved in staple strength in some but not all experiments.

Table 1. Effect of liveweight and liveweight change on wool growth and staple strength of young sheep

Starting liveweight (kg)	Liveweight change in first month (g/d)	Wool growth in first month (g clean/d)	Staple strength (N/Ktex)
34.1	-116	6.52	32.4
33.7	8	6.81	41.6
25.2	-113	4.28	24.7
25.5	4	5.17	30.1
Significant effects ($P<0.05$)		Liveweight, liveweight change	Liveweight, liveweight change

MANAGEMENT AND STAPLE STRENGTH

Time of shearing. Shearing near the point of break results in longer fibres in the processed top due to a reduction in the number of mid staple breaks (Ralph 1984). The measured staple strength may also be higher if the weakest point is at the end of the staple and is therefore clamped during the testing process.

In winter rainfall areas, shearing needs to be in autumn or early winter to coincide with the point of break. Shearing at this time may cause problems later in the year with an increase in seed penetration and vegetable matter contamination in the wool (Ralph 1984). In addition, the possibility of flystrike is increased in spring and this may require additional use of chemical treatments. These problems can be overcome but improved management is necessary to take advantage of the benefits of shearing near the point of break.

Time of lambing. The majority of sheep producers in winter rainfall areas still lamb in the autumn, although there is a trend towards later lambing (Bell and Ralph 1993; Foot and Vizard 1993). Delaying lambing until there is an increase in the availability of green feed in winter or spring will increase staple strength. In a series of experiments over 4 years, Foot and Vizard (1993) reported that ewes lambing in August had between 3 and 15% fewer tender fleeces than ewes lambing in May. In addition later lambing in the medium to high rainfall areas is associated with increased sheep carrying capacity over the full year and decreased use of supplementary feeds (Bell and Ralph 1993).

SELECTION FOR STAPLE STRENGTH

Howe *et al.* (1991) and Lewer and Ritchie (1993) showed that the heritability of staple strength of Merino wool varies between 0.23 and 0.51 with an average of 0.40. This heritability is of the same order to that of clean fleece weight and fibre diameter (Mortimer 1987; Greeff *et al.* 1995), indicating that all three traits can be improved by selection. Staple strength is, however, an expensive trait to measure costing approximately $9 per sample. Howe *et al.* (1991) and Lewer and Ritchie (1993) showed that staple strength of Merino wool is genetically negatively correlated (rg≤-0.50 with an average of -0.72) to coefficient of variation of fibre diameter (CVFD). This allows CVFD to be used as an indirect selection criterion to improve staple strength.

In a multiple trait selection program where fleece weight, fibre diameter and staple strength are included in the breeding objective, the rate of gain will depend on their relationship with each other and also on their genetic relationship with the other traits. The genetic correlation between fibre diameter and staple strength ranges from -0.15 to 0.46 with an average positive correlation of about 0.30. Fibre diameter is genetically positively correlated to clean fleece weight (0.16 to 0.63) whereas the genetic correlation between staple strength and clean fleece weight varies between -0.19 to 0.42 (Greeff *et al.* 1995).

The practical implications are that if selection is only focused on clean fleece weight and fibre diameter, staple strength will deteriorate genetically as the amount of selection emphasis to decrease fibre diameter increases. This deterioration can be prevented by using CVFD as an indirect selection criterion in the index to improve staple strength. Including staple strength into the breeding objective will result in only a small penalty in genetic gains in fleece weight.

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