FIBRE DIAMETER AND WOOL GROWTH EFFICIENCY ESTIMATED FROM WA WETHER TRIALS

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SUMMARY
The WA linked wether trial dataset contains records on 7500 animals born in the five years 1997 to 2001 and sampled from 303 flocks. These animals were monitored for fibre diameter, clean fleece weight and live weight over two years in 24 trials. The aim was to compare the genetic productivity of the flocks. Inclusion of a link team in each trial enabled comparison between trials. The estimate of efficiency of wool growth used was the fleece weight index (grams of clean wool production per unit of live weight near shearing). Values recorded varied between 34 and 115 g/kg, with a small positive relationship (r = 0.08) with fibre diameter. It is concluded that for half the flocks of WA sheep producers there is a significant opportunity to improve wool growth efficiency by use of animals from genetically superior flocks, with no need to change their current fibre diameter.

Keywords: Efficiency of wool growth, genetic variation, fibre diameter.

INTRODUCTION
Wool growth efficiency, or the amount of wool grown per unit of feed consumed, is an important factor influencing wool production and has been reviewed by Butler and Maxwell (1984). In summary, within an individual or flock, the relationship between wool growth and gross efficiency (which describes the phenotype) is dynamic. This follows the concept of diminishing returns, as changes in the nutritional environment stimulate changes in bodyweight. In contrast net efficiency (the efficiency measured at maintenance) appears to be a constant (static) for an individual or flock and represents the genetic or inherent potential for wool growth and efficiency.

An indirect estimate of efficiency is fleece weight corrected for differences in body weight or metabolic bodyweight (fleece weight index or FWI; Ferguson 1956) expressed as g wool per kg live weight. Herselman et al. (1998) use the term Wool Production Potential (WPP) and express it as kg wool per kg live weight percent. Within a flock, FWI has been shown to be a better indicator of wool growth efficiency than fleece weight alone (Schinckel 1960).

As the body weights of animals become more similar, efficiency accounts for a higher proportion of the differences in wool production. Differences in net efficiency between genotypes (Ferguson 1956) have been found to be more pronounced at high maintenance feed intake levels (high live weight). Thus high levels of intake may be desirable for a clear distinction between individuals differing in net efficiency. There is some evidence that larger animals with a greater voluntary feed intake may be inherently (genetically) more efficient (Schinckel 1960). Although such a concept may apply to between-flock as well as within-flock comparisons, Lee et al (2002) report little variation in efficiency between bloodlines.
This work is designed to identify the relationship between fibre diameter and our estimate of FWI between flocks in WA. It examines the variation in FWI between samples of WA Merino flocks, using data derived from WA linked wether trials.

**MATERIAL AND METHODS**

Linked wether trials (Butler 2003) have been conducted in Western Australia since 1997. In brief, the trials were conducted by running a random sample of a participant’s weaner flock (team) on a host farm in a single mob, together with teams from other flocks, as per Department of Agriculture, Western Australia (DAWA) guidelines (Butler 2003). Performance was monitored for at least 2 years. DAWA supplied a genetic link team and analysed the data from different trials at each trial’s conclusion. The inclusion of a genetic link team in each trial removes many of the non-genetic differences between the trials and enables valid comparison of the performance of teams across the different trials. Differences between flocks therefore reflect mainly genetic differences.

A total of 303 flocks (estimated 4.5% of WA flocks) participated in 24 trials in which live weight was recorded close to at least one shearing, in addition to wool parameters. A sample of between 10 and 50 weaner wethers from each flock was run as one mob in each trial, and the individual performance records averaged for each team. Individual flocks were benchmarked in up to 19 trials.

FWI was calculated from clean fleece weight and live weight records at shearing and expressed as clean wool production in grams per kg live weight per head. The FWI and fibre diameter records were analysed to investigate the relation of wool growth efficiency (estimated by FWI) with fibre diameter between teams. In trials in which only the hogget (18 month) live weight was recorded, the hogget FWI was used.

**Statistical analysis.** A REML model based on the wether trial example in Gilmour et al (2002) was fitted in GenStat (2004), and a univariate analysis of each of the variates CFW, FD and FWI was conducted. The REML model had fixed terms of site and age (shearing number) and site x age, with random effects of team and animal (tag number). The repeated measurement of two shearings within the animal is the residual term in the model.

**RESULTS AND DISCUSSION**

The mean clean fleece weight, live weight and fibre diameter were 3.18 kg (average standard error = 0.10), 48.1 kg (average SE = 1.10) and 19.9 microns (average SE = 0.25) respectively. These results compare with those of the National Bloodline Analysis (Coelli et al. 2000) of 4.4 kg (average SE = 0.11), 52.1 kg (average SE = 1.09) and 21.3 (average SE = 0.26) respectively. The average FWI for the dataset was 65 g/kg (average SE = 2.00) which equates to an average of 3.25 kg clean fleece weight over the first 2 shearings from a 50 kg animal. This compares with an estimate of the average FWI for WA flocks of about 60 g/kg, based on an estimated State average clean fleece weight of 3.25 kg and live weight of 55 kg (AWI 2004).

The FWI of the teams ranged between 34 and 115 g wool/kg live weight. Butler (1982) reported a similar three fold variation in feed conversion efficiency between individuals within a Corriedale flock, and efficiency values of between 0.3 and 2.18 g wool per 100 g feed intake have been reported.
in the literature (Butler and Maxwell 1984). Figures published previously in various formats for fleece weight index range from 18 to 91 g/kg (Ferguson 1956) and 61 to 105 g/kg (Schinckel 1960). Herselman et al. (1998) report WPP values of 8.2% and 11.2% (equivalent to 82 and 112 g/kg) for the Merino at 2 sites. We are not aware of any across flock comparisons for efficiency.

Since efficiency is markedly affected by plane of nutrition, these comparisons are made valid (put on a level playing field) by reference to the link teams, in the same way as other traits.

The regression of FWI deviation versus fibre diameter deviation (Figure 1) is \( Y = -3.07 + 1.46X \) with a correlation between efficiency and fibre diameter of 0.04. This suggests that efficiency has no dependency on fibre diameter.

![Figure 1. Deviations from the mean for fleece weight index (g clean fleece weight per kg live weight) versus fibre diameter (microns). Numbers plotted are individual flock codes from the 1997 to 2001 drop animals. The line is the fitted regression (correlation = 0.04).](image)

These data indicate that there is a huge variation in the estimated efficiency with which feed is converted to wool between flocks in Western Australia. This reflects the huge variation of around one kg in clean fleece weight for any given micron category between flocks (Butler 2003) and highlights the opportunity for sheep producers to increase their level of productivity by improving their genetics. For example, half the flocks could improve their efficiency by 15 g/kg or more (half the range of deviations from the mean) or more by introducing genetically superior animals from a different flock source.
However producers must remember that there are a number of traits that impact on the profitability and productivity of their enterprise. In particular, recent WA research (Greeff 2005) has demonstrated that selection for fleece weight without maintaining live weight may result in a reduced reproductive rate, which also support the results from Herselman et al. (1998). Therefore it is not recommended that breeders select breeding animals on FWI but rather use a multiple trait selection index where the component traits can be used as selection criteria and efficiency is included in the breeding objective.

CONCLUSION
It is concluded that half of WA sheep producers have the opportunity to improve wool growth efficiency (by 15 g/kg live weight or more), without needing to change current fibre diameter.

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REFERENCES
(http://www.genstat.com).