ASSESSMENT OF FACTORS AFFECTING WOOL GROWTH IN WESTERN QUEENSLAND

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SUMMARY

Reasons for differences in the rate of wool growth between Merino sheep in grazing experiments at Charleville and at Julia Creek were assessed using a simulation model based upon the utilisation of energy and selected amino acids. Reasonable agreement between observations and predictions was obtained for the two sets of results except for one period at Julia Creek when the predicted growth was low. It is hypothesised that during this period, ingested nitrogen was absorbed or used more efficiently than was represented in the model.

Simulations suggested that the lower wool growth of sheep at Julia Creek could be explained by reduced per head intake of forage with at times a lower organic matter digestibility and nitrogen content.

INTRODUCTION

Wool production in southern Australia is superior to that in the northern tropics (Brown and Williams 1970). The north-south gradient is also evident in the Mitchell grass downs country of Queensland. This paper examines reasons for differences in wool production of sheep at Toorak, Julia Creek, and at Charleville at the northern and southern extremities respectively of the downs country.

The effect of climate on the environment of Julia Creek and Charleville is illustrated by Fitzpatrick and Nix (1970). Both areas have a predominance of summer rainfall but Charleville also has a significant winter component. In summer tropical grasses grow more profusely at Julia Creek than at Charleville; in the south temperate grasses and legumes grow throughout the year. Wool growth usually peaks during the summer at Julia Creek; at Charleville it is more evenly distributed throughout the year. Experimental data from both environments were used to test the efficacy of a computer model that simulates energy and amino acid balance in sheep. The model was then manipulated in an endeavour to explain the differences in wool growth between these environments.

MATERIALS AND METHODS

The computer model was based on the description by Weston and Hogan (1973) of the various processes which influence a wether's production systems. Maintenance energy requirements were assumed to be composed of fasting heat production (FM) plus energy costs due to grazing (EW). Energy consumed in excess of these requirements was assumed to be used for the production of fat (FAT), tissue proteins (TIS) and clean wool (WOOL).

\[
\text{MEI} = \frac{(\text{FM} + \text{EW})}{K_m} + (39 \times \text{FAT} + 24 \times \text{TIS}) z + 24 \times \frac{\text{WOOL}}{K_f} \quad (1)
\]

where MEI = metabolisable energy intake (kJ)  
\[K_m, K_f\] = efficiency of utilisation of metabolisable energy for maintenance and for production respectively (A.R.C. 1965)  
\[z = 0.8\] where fat and tissue protein were being catabolised to provide energy (Harston 1940)  
\[1/K_f\] where sheep were gaining weight

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\[ \text{FAT} = 66 \text{TIS/9 (Searle and Griffiths 1976)} \]

The method of calculating fasting heat production and the calorific values of fat, tissue proteins and wool were taken from Graham et al. (1976). Energy costs due to grazing (EW) were derived from the reports of Graham (1964) and Allden and Whittaker (1970).

The absorbed amino acids (AA), methionine plus cystine and lysine, were ascribed to maintenance and production of wool and tissue proteins. The method of calculating absorbed amino acids was taken from Hogan et al. (1979).

\[
\begin{align*}
\sum_i \beta_i & = \frac{\text{TIS} j + \text{VP} + \text{MFP}}{j} \times \text{WOOL} \quad \ldots \quad (2)
\end{align*}
\]

where \( \beta_i \) = proportion of amino acid \( i \), in digestive, tissue protein (and maintenance) and clean wool respectively (calculated from Weston and Hogan 1973)

\[
\begin{align*}
\text{VP} & = \text{protein required to sustain vital processes within the body} \\
& = 12.5 (\text{FM} + \text{PM})/4.144 (\text{g/day}) \quad \text{Weston and Hogan 1973, pm} \\
\text{MFP} & = \text{metabolic faecal protein (g/day)} \\
& = 6.25 \text{ (dry matter intake, kg)} \quad \text{Weston and Hogan 1973}
\end{align*}
\]

Results and Discussion

The wool growth data for the Toorak study are presented in Fig. 1. The simulated and actual wool growth rates agree reasonably well from December 1971 to December 1972. From August 1971 to December 1971 the simulation indicated a much lower rate of wool growth than was actually achieved by the grazing animals. During this period there was a high proportion of Pterigeron in the diet (Lorimer 1976) and it is hypothesised that the absorption or utilisation of protein from this plant was more efficient than was represented in the model.
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Predicted wool growth at Charleville was constant at about 9 g/head/day throughout the experimental period. This agreed reasonably well with the actual rates recorded (Fig. 2.) considering sampling periods to determine intake and wool growth were two months apart in contrast to the monthly samplings at Toorak.

In Fig. 3., are presented the simulations designed to explain the difference in wool growth in the two environments. A theoretical 40 kg liveweight sheep was given a diet, the quantity (g dry matter/day) and/or quality (crude protein content and in vitro organic matter digestibility) of which had been predetermined by the experimental results obtained at the two sites.

Fig. 1. Wool growth at Toorak (—— experimental; .... simulated)

Fig. 2. Wool growth at Charleville (—— experimental; .... simulated)

Fig. 3. Simulated wool growth of a 40 kg sheep on pasture. (.... Charleville quality and quantity; —— Charleville quality, Toorak quantity; —— Toorak quality, Charleville quantity; ——— Toorak quality and quantity)
When quality and intake of the diet per unit of metabolic live weight were as found in the Charleville experiment, simulated wool production was relatively constant throughout the year at 8 g/day. By expressing diet in this way, an attempt was made to isolate the influence of animal size on intake and hence wool growth. This needs to be explored further since the live weight of mature wethers in the north of the state is typically around 40 kg while that of those in the Charleville area would be closer to 50 kg.

In general, Toorak sheep did not consume, on a metabolic liveweight basis, as much as Charleville sheep. Consequently, when the Charleville quality diet was fed at a level fixed at that of Toorak sheep, the mean simulated wool production was about 5.5 g/head/day. It could be argued that the lower intake of Toorak sheep is a direct result of a lower quality diet in the Toorak environment. However, during the January to March period, the simulated wool growth was the same for sheep consuming a diet with either Toorak quality or Charleville quality provided the intake was fixed to that found at Charleville. Therefore, during these months at least, the quality of the Toorak diet is sufficient to maintain wool growth at 8 g/head/day if the sheep would eat at the Charleville level of intake. If quality of diet alone dictated intake, then during the January to March period, the simulated wool growth of the sheep consuming a diet with Toorak quality and intake should have equalled that of the sheep eating the diet with Toorak quality at a Charleville level of intake. This was not the case. Thus it must be concluded that part of the reason for the sheep in the Charleville environment growing more wool than those in the Toorak environment is that, irrespective of diet quality, the Toorak sheep do not eat as much per unit of metabolic live weight as their counterparts further south.

The results of this exercise suggest that to improve the wool growing ability of northern sheep the factor(s) restricting their intake need to be identified and overcome, and that the mature size of northern wethers needs to be improved. The latter aim may be achieved following a solution to the former.

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REFERENCES


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