Management effects on seasonal fibre quality in Angora goats

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ABSTRACT

The effect of nutritional management of Angora goats on fibre production and fibre quality was investigated over two years. After shearing in August, does were fed either maintenance (MPA) or *ad libitum* (HPA) ryegrass/white clover pasture (approximately 1.0 kg and >4kg DM/head/day respectively). In October half the does were removed from each allowance group and introduced into the alternate allowance group. This was repeated in early February, allowance groups being balanced for their previous allowance history. Fleece weights were recorded at shearing in February and August. Fibre diameter, medullation and kemp levels were measured at shearing in February and August and also in October and May. Doe live weights were recorded monthly and when fleece measurements were made. After one year of measurements, does were completely randomised onto new pasture allowances and the experiment was repeated.

Nutritional treatments generated liveweight differences betwen HPA and MPA does throughout the year ($P<0.05$). February fleece weights were similar in both HPA and MPA groups in 1990 (1.73 vs. 1.67; s.e.d 0.067 kg for HPA vs. MPA respectively) and in 1991 (1.43 vs. 1.41; s.e.d 0.060 kg for HPA vs. MPA respectively) though approximately 25% lower than in 1990. August fleece weights were similar in 1990 and 1991 but were approximately 20% higher in HPA does than in MPA does (1.46 vs. 1.26; s.e.d 0.051 kg for HPA vs. MPA respectively in 1990 and 1.49 vs. 1.20; s.e.d 0.040 kg for HPA vs. MPA respectively in 1991). Increased August fleece weight was associated with increased fibre diameter (34.9 vs. 32.7; s.e.d 0.52 μm for HPA vs. MPA respectively in 1990 and 33.4 vs. 31.7; s.e.d 0.67 μm for HPA vs. MPA respectively in 1991).and increased medullation in August 1991 (2.91vs. 2.09; s.e.d 0.443 % for HPA vs. MPA respectively). Kemps were not affected by nutritional management in this experiment. A positive relationship between fleece weight and fibre diameter was demonstrated, fibre diameter increasing by 1μm for every 50g increase in fleece weight.

Keywords Angora, goat, mohair, fibre diameter, kemps, medullation, pasture allowance, live weight, nutrition.

INTRODUCTION

Kemp in mohair is undesirable and reduces fleece value (Sinclair, 1988). Bigham and Baker (1990) and Bown, et al., (1990) suggested that environmental factors, particularly nutritional level, can influence fibre growth and quality of the Angora fleece during spring. Stapleton (1978, 1985) and Winklemaier (1983) have shown that mohair production has a seasonal cycle which is dependent upon photoperiod. However, the effect of seasonal nutrition on this inherent cycle is less well defined. Improved goat nutrition generally results in increased fibre growth and is associated with increased mean fibre diameter (Muftuoglu, 1962; Malacheck and Leinweber, 1972; Shelton and Huston, 1966; Huston and Shelton, 1967a;b; Menzies, 1967; Huston, et al., 1971; Stewart, et al., 1971) though it's effect on medullation and kemp proportions in the fleece have not been reported. The present experiment investigated the relationship between fibre production and fibre quality during the year in goats at high and low feed allowances.

MATERIALS AND METHODS

Experimental design.

From the beginning of August (after shearing), approximately 100 Angoras does were allocated randomly to two treatment groups (n=50), and managed separately thereafter. Treatment groups were balanced for doe age, live weight, their most recently measured fibre characteristics and doe sire. One group was offered ryegrass/white clover pasture at high (HPA group) and the other at maintenance (MPA group) allowance. Maintenance pasture allowance (approx 1.0 kg DM/head/day) was expected to maintain a relatively constant doe live weight (adjusted for conceptus weight during pregnancy) whereas high pasture allowance (>4.0 kg DM/head/day) was in excess of requirements and was not expected to limit doe live weight gain. At key physiological times during the year (kidding in October and weaning in early February) half the does and their kids were removed from each allowance group and introduced into the alternate allowance group. At each alternation does were randomly allocated to their new allowance group so that groups were balanced for their previous allowance "history", i.e. during the second period of nutritional treatments (Oct to Feb) half the does in the HPA group had previously grazed in the MPA group (from Aug to Oct) and *vice versa.*, and during the third period of nutrtional treatments (Feb to Aug) half the does in the HPA group had previously grazed in the MPA group during period 2 and *vice versa* . After shearing in August of the second year all does were completely re-randomised and the experimental procedure repeated for a second year.

Measurements.

Animal live weights were recorded monthly and at the time of fleece measurements. Fleece weights were recorded at shearing in February and August. Mid-side fleece samples were taken from each doe at shearing in February and August and also in October and May. Fleece samples were submitted to the Whatawhata Fibre Testing Centre for standardised evaluation of fibre diameter, %medullation and %kemp. Animals were treated monthly with anthelminthic to minimise parasitism. Statistical analysis of all animal parameters was by analysis of variance.

Doe age and initial (August) live weight was used as a covariate in all analyses and initial (August shear) fibre characteristics were used as covariates in the subsequent analyses of fibre characteristics.

RESULTS

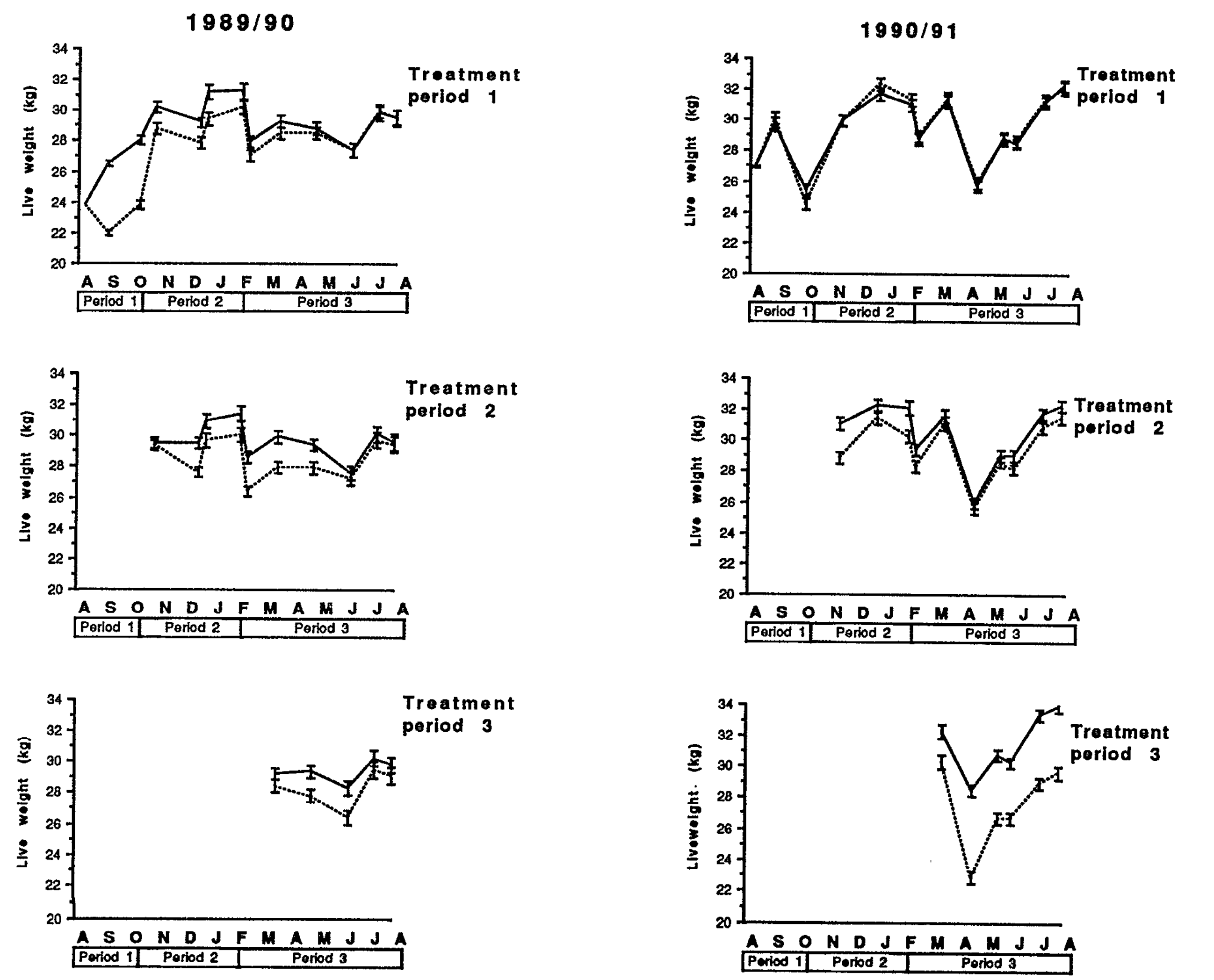
Due to abnormally high kid mortality a large proportion of the does (>85%) were effectively "dry" for most of the first year of the experiment. Pregnancy and kidding rates were normal in the subsequent year. Therefore it was necessary to analyse the results from each year separately. Data for year one (1989/90) refers to does which did not raise a kid. Data for year two (1990/91) refers to does which raised a kid normally.

Figure 1 shows the effect of pasture allowances on does liveweight during 1989/90 and 1990/91. Treatment period 1 shows the liveweights of does which grazed in HPA and MPA allowance groups from August to October. Treatment period 2 shows the liveweights of does which grazed in HPA and MPA allowance groups from October to February (half the number of does in period 1). Treatment period 3 shows the liveweights of does which grazed in HPA and MPA allowance groups from February to August (half the number of does period 2). Therefore the live weights shown for Treatment period 3 relate to does which had grazed in the HPA or MPA groups throughout the experiment. By the end of each treatment period (Aug to Oct, Oct to Feb, Feb to Aug) significant differences in doe live weights ($P<0.05$) were observed between MPA and HPA groups throughout both years of the experiment, though towards the end of the first year (July and August 1990) treatment effects were not significant (Figure 1.). In both years February fleece weights were similar in both HPA and MPA groups (Table 1.) though in February 1990, fleece weights were approximately 25% higher than in 1991 despite similar mean doe live weights at shearing (Figure 1.). However, August fleece weights were approximately 20% higher ($P<0.001$) in HPA than in MPA groups in

TABLE 1 Mean greasy fleece weights (kg) of Angora does fed pasture at maintenance allowance (MPA) or *ad libitum* (HPA) over two years. Figures in parenthesis are the standard errors of the differences between means (sed).

	1990			1991		
	HPA		MPA	HPA		MPA
February	1.73	(0.067)	1.67	1.43	(0.060)	1.41
August	1.46	(0.051)	1.26	1.49	(0.040)	1.20

FIGURE 1 Mean live weights (kg) of Angora does fed pasture at maintenance allowance (MPA:) or *ad libitum* (HPA:) in 1989/90 and 1990/91. Treatment period 1 shows the liveweights of does had which grazed in HPA and MPA allowance groups from August to October. Treatment period 2 shows the liveweights of does which had grazed in HPA and MPA allowance groups from October to February (half the number of does period 1). Treatment period 3 shows the liveweights of does which had grazed in HPA and MPA allowance groups from February to August (half the number of does period 2).



both 1990 and 1991. Increased August fleece weight in HPA does was associated with greater mean fibre diameter in both 1990 ($P<0.010$) and 1991 ($P<0.001$) and with increased medullation in 1990 ($P<0.050$; Figure 2.). Kemp levels were similar between MPA and HPA groups throughout the experiment (Figure 2.). To examine the relationship between fleece weight and fibre diameter, coefficients from the regression of fleece weight on fibre diameter in February and August are shown in Table 2. Coefficients were similar in February 1990 and 1991 though greater in August 1991 than in 1990 ($P<0.050$).

TABLE 2 Coefficients (B) of the regression of mean greasy fleece weights (kg) on mean fibre diameter (mm) of Angora does during the experiment.

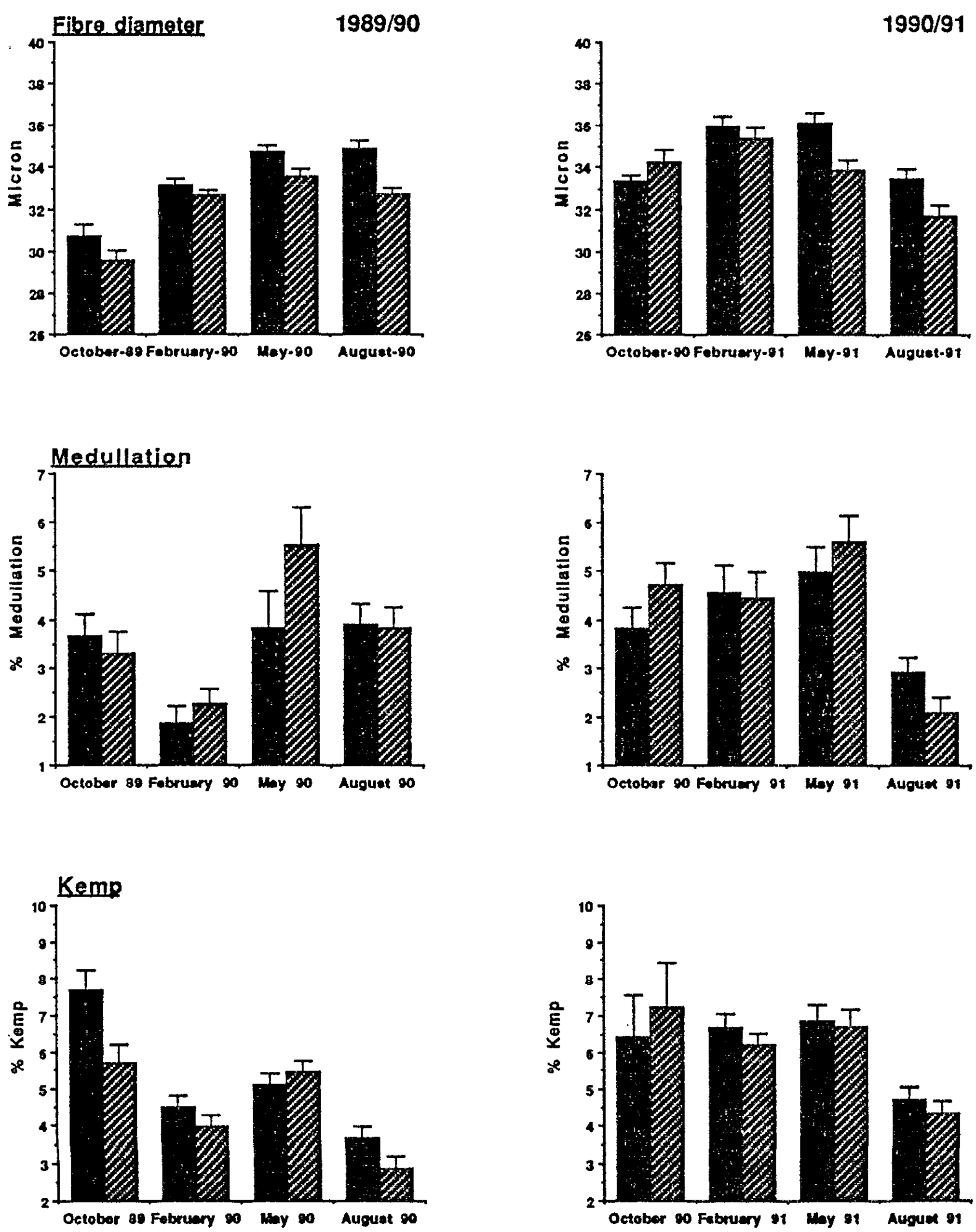
	1990	1991	sed
February	0.040	0.05	0.0135
August	0.046	0.068	0.0105

DISCUSSION

Mohair growth is seasonal and is dependent upon photoperiod. Stapleton (1978, 1985) and Winklemaier (1983) have demonstrated that the seasonal cycle of mohair growth is associated with concomitant changes in fibre diameter, length growth and the proportion of medullated fibres in the fleece. Fibre diameter, length growth and kemps are highest in spring and early summer though production declines in late summer and through autumn and winter with a concurrent reduction in fibre diameter, length and kemps. The results of this investigation are in general agreement with these principles though the characteristics of the cycle were different in the two years.

Lower fleece weights in February of the second year may reflect an effect of lactation during the spring on subsequent fibre growth. Pregnancy and lactation has been shown to depress fleece weight in sheep (Corbett, 1979, Sumner and McCall, 1989) indicating that reproduction has a higher relative priority

FIGURE 2 Fleece characteristics (fibre diameter, medullation and kemps) of does fed pasture at maintenance allowance (MPA: ▨) or *ad libitum* (HPA: ■) over two years.



for nutrient supply compared with wool growth. Similar effects have been shown in Angora goats (Stapleton, 1978). In the present experiment his effect would be absent in the first year since does included in this analysis did not lactate.

Increased mohair fleece weight has been shown to be mainly a result of increased fibre diameter (Shelton and Huston, 1966; Huston and Shelton, 1967a;b; Menzies,1967; Huston, et al., 1971; Stewart, et al., 1971). In the present study, elevated August fleece weights in *ad libitum* fed does (HPA group) were associated with increased fibre diameters compared to maintenance fed does. Examination of the relationship between fleece weight and fibre diameter in the present experiment demonstrated a positive relationship between these characteristics (Table 2.). Fibre diameter increased by one micron for approximately every 50g increase in fleece weight. This compares with a one micron increase in diameter for every 150g increase in fleece weight reported by Bigham and Baker (1990) in Angora bucks. The difference between the present results and those of Bigham and Baker (1990) probably reflect the superior genetic value of the bucks compared with the unselected does. Though the relationship between fleece weight and fibre diameter was similar between years in February, the relationship was significantly different in August 1991. The reason for this is unclear. The result is possibly an artefact due to greasy fleece weight (rather than scoured fleece weight) being used in the calculations.

Medullation and kemp levels in the fleece showed characteristic seasonal differences in both years. Medullation was higher in the August 1991 fleece samples of *ad libitum* (HPA) fed does compared to maintenance (MPA) fed does, though nutritional level did not affect the proportion of kemps in the fleece during the experiment. McGregor (1990) demonstrated that increased feeding levels for angora goats during the summer increased mohair growth rate and the proportion of medullated fibre in the fleece. Bown, et al., (1990) could not demonstrate this relationship during spring. Nixon, et al., (1991) examined hair follicle activity in both HPA and MPA does throughout the present experiment (during 1989/90) and noted that secondary follicles from goats on high pasture allowance contained significantly more medullated fibres than those at maintenance. Increased incidence of medullated fibres in secondary follicles, though due to the relative insensitivity of the analytical procedure could not be detected in the fleece tests (Figure 2.). Nixon, et al., (1991) found that the differences in effect of nutrition on fibre growth could not be explained by a change in the duration or timing of the fibre cycles.

Though Stapleton (1976) and Winklemaier (1983) have shown that kemp grows in a characteristic seasonal manner, the present investigation and those of Bown, et al., (1990) Nixon, et al., (1991) and Lupton, et al., (1991) have demonstrated that the absolute measurements of medullation and kemp in the fleece are highly variable between seasons. Bigham, et al., (1990) concluded that the manipulation of kemp levels in the fleece by altering nutritional levels is unlikely to be an option for mohair producers. However, it is evident from this investigation that improved doe nutrition can increase considerably the growth of mohair, particularly over autumn and winter resulting in increased August fleece weights.

It is evident that the effects of season and nutrtion on medullation (and kemps) are not clear and require further nutritional and physiological studies.

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