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THE EFFECT OF DIFFERENT PASTURE MANAGEMENT STRATEGIES IN NORTH-WEST QUEENSLAND ON LIVEWEIGHT GAIN AND WOOL GROWTH RATE OF SEVERAL GROUPS OF YOUNG SHEEP

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Abstract

The effect of three different pasture management strategies on liveweight gain and wool growth rate of young (weaner) sheep was examined immediately after weaning on Mitchell grass-Flinders grass pastures during the dry season of north-west Queensland. The pasture management strategies were designed to mimic various industry situations, while the performance of four different progeny groups was compared and used to provide an overall assessment of pasture quality.

Pasture treatments (experiment 1) consisted of three paddocks, a harvested (c. 8% of pasture harvested and baled) and spelled, a spelled, and a continuously grazed paddock. Spelled paddocks were not grazed during and after the wet season for a period of six months while the continuously grazed paddock was continuously stocked before the experiment. Experiment 2 consisted of spelled and continuously grazed paddocks. Pastures were evaluated by measuring the changes in composition and quality (experiment 1) and the responses in liveweight gain (experiments 1 and 2) and wool growth of the weaners (experiment 1). Marked improvements (c. 100%) in weaner growth rates occurred in the spelled paddocks. Greasy wool production by three groups of ewes in experiment 1 was about 14% greater in the harvested paddock than in the others.

At the start of the trial there were no significant differences in dry matter yield but a significant difference in botanical composition occurred between paddocks. The changes in dry matter that occurred between the beginning and end of grazing were not significantly different between paddocks. Before grazing, forbs made up approximately 16%, 4% and 1% of pastures in harvested, spelled and continuously grazed paddocks respectively. The change in the percentage forbs that occurred between the beginning and end of the grazing period was significantly greater in the harvested paddock than in the other paddocks indicating preferential selection and intake by sheep. The differences in weaner live weight and wool growth between paddocks suggest that paddock management can improve weaner productivity. The study also indicates that paddock management could be successfully used to increase the percentage of forbs and quality of the pasture during the dry season. The superior wool growth of two progeny groups also suggests that improved productivity of breeding flocks in the tropics is possible if superior sheep can be identified. The results highlight the importance of preferential management of pasture for weaners so that productivity advantages can be exploited.

Introduction

A harsh semi-arid tropical environment has often been reported as the primary cause of poor animal productivity in north-west Queensland (e.g. Moule 1954, Rose 1972). Heat stress caused by high summer temperatures has an adverse effect on pregnant ewes, new-born lambs and wool production (Hopkins *et al.* 1978 and 1980). Also the short summer rainfall is followed by a long dry season when pasture quality progressively declines and becomes inadequate for maintaining live weight of sheep (Lorimer 1978). The seasonal rainfall pattern dictates an autumn lambing when lactating ewes have the benefit of optimum pasture quality. This regime results in lambs being weaned at the end of winter when pastures are mature. This paper describes the performance of different weaner groups, weaned in the dry season into paddocks that had been subjected to different management treatments during the wet season and the first half of the dry season. The groups were progeny of different sire blood lines. Pasture conditions were manipulated to mimic various situations which occur in industry during the dry season in north-west Queensland. Pastures in paddocks were evaluated by measuring the changes in composition and quality, and the responses in liveweight gain and wool growth of the weaners. The performance of the different progeny groups in the different paddocks was compared, and an assessment made of their suitability to conditions that can occur in north-west Queensland.

Materials and methods

Climate

The experiments were carried out at "Toorak" Research Station near Julia Creek in north-west Queensland (21°S, 141°E). The environment is characterised by high ambient heat loads (4,300 kJ/m^2/hour) and a mean monthly maximum > 35°C for six months each year (Hopkins *et al.* 1978). The rainfall is seasonal and variable, with effective rain (66% reliability) only falling during two summer months between December and March. This seasonality of climate, together with absence of trees imposes severe restrictions on animal productivity (Rose 1972). Perennial Mitchell grass (*Astrebla*) has adapted to the harsh environment by developing an efficient root system. The basal area of the dense stand may cover only 4-5% of the ground surface, with annual species of both grasses and forbs growing prolifically after wet season rains (Lorimer 1978). In the year of the experiments (1979) rainfall totalled 178, 193 and 56 mm in January, February and March respectively. No further rain fell until the end of October when 32 mm was recorded.

Treatments

At the end of July a group of 500 mixed ewe and ram weaner sheep (4-5 months old) consisting of progeny of four different groups of ewes and rams was stratified on sire origin and randomly allocated within strata to three paddocks (experiment 1).

The groups were:

1. "Local" — progeny of c. six generations of a tropical sheep breeding enterprise;
2. "Introduced" — progeny of rams purchased from a southern (New South Wales) stud joined to local ewes;
3. "Crossbred" — progeny of first cross Wiltshire x Merino rams joined to local ewes;
4. "South Australian" — progeny of South Australian ewes and rams brought from New South Wales and joined at "Toorak".

Only five rams were used for each sire group and therefore no valid comparisons of strains can be made. Phenotypically, the "local" sires were the smallest (approx. 56 kg liveweight) while the "South Australian" sires were the biggest (approx. 82 kg liveweight) at the time of joining.

Each paddock contained similar numbers of each of the groups. In the first experiment, weaners were allocated to either a harvested and spelled paddock, a spelled paddock or a continuously grazed paddock. The harvested paddock had had 20 hectares (c. 8%) of pasture hay baled and removed immediately after the wet season in March. This percentage of pasture would approximate the minimum amount required for hay production on a property. This paddock was not grazed during or after the wet season. The spelled paddock had also been unstocked since before the wet season. The continuously grazed paddock had been stocked both during and following the wet season at a set stocking rate of one sheep to two hectares. It was not possible to replicate the whole experiment so partial replication was carried out in a second experiment with a spelled and a continuously grazed paddock stocked with 360 "local" ewe and wether weaners consisting of progeny of another separate joining. These weaners were randomly divided into the two paddocks. The age of weaners in all groups varied by up to six weeks. All paddocks were 160 hectares in area and all of the spelled paddocks were deemed to be preferentially managed.

Animal measurements

Growth rates of the weaners were calculated for a 10-week period (August to October) in the dry spring and early summer before green pasture growth. After their different 10-week treatments as weaners, all groups were run together as one flock in another larger paddock after pasture conditions had improved with early summer rain. Wool growth of experiment 1 ewes at 13 months of age was recorded at the June shearing to measure the effect of weaning treatment on performance during the first year of life. Wool growth of rams over a 7 month period between November and the June shearing was recorded to measure subsequent productivity differences due to weaning treatment. To test the effect of management strategy, the paddocks need to be replicated to provide an estimate of error variance. A combined analysis of both experiments would provide too few error degrees of freedom for a meaningful comparison. Hence, the effect of actual paddocks in each experiment has been tested using the animal variation as an estimate of error variance in analysis of variance. In experiment 1, analysis of variance and Student's 't' tests were used to examine the effect of different progeny groups and their interaction with the paddocks using animal variation to estimate error.

Dry matter yield and botanical composition of paddocks

Dry matter yield and botanical composition were estimated for paddocks in experiment 1 in July before the introduction of weaners, and again at the end of the trial. Dry matter yields were estimated using the visual estimation technique of Haydock and Shaw (1975) at two or three observation points within each paddock. At each point, two observers threw 30 quadrats each, scoring each quadrat for dry matter yield and ranking the species in the quadrat. The botanical composition was estimated at each observation point using the weighted dry weight rank method with cumulative ranking (Jones and Hargreaves, 1979). These techniques have been validated for similar pastures at "Toorak", Julia Creek by comparing results derived from the method with those obtained by hand cutting and sorting. The dry matter yield in all paddocks was over-estimated by 5% (Pritchard & Pepper, unpublished).

Differences in pasture measurements between paddocks were tested by analysis of variance using the variation due to observation points within paddocks as error variance. The cut and uncut areas of the harvested paddock were assessed separately.

Pasture quality

Nitrogen determination of plucked samples was used to assess pasture growing on the cut and uncut areas of the farmed paddock before the introduction of weaners.

Results

Animal performance

Although the effect of management strategies cannot be tested to provide generalised conclusions, the paddock effect was similar in both experiments, giving some confidence in the generalisation of the results. Weaner growth rates improved in preferentially managed paddocks (Table 1). This result was most noticeable in the harvested paddock. The observed differences (approximately 100%) would be of practical importance to the industry. There was significant interaction between weaner groups and paddock, for growth rates (Table 2); however, the effect of paddock was dominant, with all groups performing significantly better in the harvested paddock. Although the group 4 weaners in the spelled and continuously grazed paddocks grew at a significantly slower rate, their live weights at the end of the experiment were heavier than those of the other three groups. Greasy wool production of groups 1, 2 and 4 was significantly greater in the harvested paddock than in other paddocks (Table 3). Wool production of the ewe weaners was significantly different between groups, with ewes from groups 2 and 4 superior

Table 1. Mean growth rates and live weights of weaners measured after ten weeks' grazing in differently managed paddocks (experiments 1 and 2).

Paddock	Experiment 1 Growth rate (g/d)	Experiment 1 Live weight (kg)	Experiment 2 Growth rate (g/d)	Experiment 2 Live weight (kg)
Harvested* and spelled	93a	29.6a	–	–
Spelled	46b	26.2b	21b	23.7b
Continuously grazed	29c	25.3c	−6b	20.6c
Average SE of mean	2.2	0.31	3.7	0.48

* Approximately 8% of pasture was harvested and baled immediately after the wet season.

Parameters within columns with differing superscripts differ significantly ($P < 0.05$).

Table 2. Growth rates (average SE of mean ±4.4) and live weights (±0.61) of weaners of different sire origin after ten weeks' grazing in differently managed paddocks (experiment 1)

Paddock	Weaner groups 1. Local	2. Introduced	3. Crossbred	4. South Aust
Harvested and spelled				
Growth rate (g/d)	85aA	98abA	100bA	88abA
Liveweight (kg)*	27.1	30.7	27.8	32.8
Spelled				
Growth rate (g/d)	56aB	48aB	52aB	27bB
Liveweight (kg)*	24.8	26.6	24.2	29.1
Continuously grazed				
Growth rate (g/d)	36aC	37aB	40aC	3bC
Liveweight (kg)*	23.3	26.6	23.7	27.7
Mean initial liveweight (kg) (average SE+09.34)	20.7a	23.6b	20.5a	27.1c
Mean final liveweight (kg)* (average SE+0.36)	25.1a	27.9b	25.2a	29.9c

Superscripts a, b, c denote significant differences ($P \leq 0.05$) between weaner groups within paddocks; superscripts A, B, C denote significant differences between paddocks within weaner groups. Means with the same superscripts are not significantly different.

* Liveweight of weaners after 10 weeks' paddock treatment; no significant difference testing on 2-way table of means as F-test not significant.

Table 3. Greasy fleece weights (kg) of ewes at 13 months of age (average SE of mean +0.12) and of rams with 7 months' wool (+0.076) after weaning treatments (experiment 1)

Paddock	Weaner groups Wool production (kg) 1. Local	2. Introuced	3. Crossbred	4. South Aust
Harvested and spelled				
Ewes	3.47bA	4.07cA	2.68a	4.39cA
Rams	2.20cA	2.41cA	1.87a	2.38c
Spelled				
Ewes	3.16bAB	3.47cB	2.76a	3.84dB
Rams	1.93aB	1.97aB	1.86a	2.43c
Continuously grazed				
Ewes	3.12bB	3.48cB	2.75a	3.51cB
Rams	1.94aB	2.03aB	1.82a	2.32c

Superscripts a, b, c, d denote significant differences ($P \leq 0.05$) between weaner groups within paddocks; superscripts A, B denote significant differences between paddocks within weaner groups. Means with the same superscripts are not significantly different.

in all paddocks. The paddock effect on wool production of the rams during the seven months after the weaning period remained in groups 1 and 2 (Table 3). There was no difference in wool yield between groups.

Dry matter yields and botanical composition of paddocks

There were significant differences in botanical composition between paddocks, and between the cut and uncut areas of the harvested paddock. These differences were apparent both before and after grazing over the weaning period (Table 4). There was significantly less dry matter in the cut area of the harvested paddock than in the other paddocks before grazing. After grazing, the amount of dry matter in the harvested and continuously grazed paddocks was significantly less than in the spelled paddock. However, the change in the quantity of dry matter between the beginning and end of grazing was not significantly different between paddocks.

Before grazing, there were more forbs in the cut area of the harvested paddock than in the uncut area, in the harvested than in the spelled paddocks and in the spelled than in the continuously grazed paddock. After grazing, there was still a significantly larger amount of forbs in the harvested paddock than in the spelled paddock with virtually no forbs being recorded in the continuously grazed paddock. However, the change in the percentage forbs that occurred between the beginning and end of the weaning period was significantly greater in the harvested paddock than in the other paddocks.

The forb genera present were *Glycine*, *Euphorbia*, *Pterigeron*, *Polymeria*, *Sida*, *Rhynchosia*, a small white-flowering *Chenopod*, and *Ipomoea*.

The percentage of other grasses (*Cyperus*, *Aristida* and *Dichanthium grass*) in the paddocks was small and did not differ significantly between paddocks.

The protein content of pasture samples plucked from the cut and uncut areas of the harvested paddock is given in Table 5.

Discussion

The difference in live weight and wool growth of weaners between paddocks suggest that paddock management can improve weaner productivity. The studies also indicate that paddock management could be success-

Table 4. Dry matter yield (kg/ha) and botanical composition of paddocks before and after the introduction of weaners (experiment 1).

Attribute	Time of sampling	Paddock: Harvested and spelled, cut area	Paddock: Harvested and spelled, uncut area	Paddock: Spelled	Paddock: Continuously grazed	Average SE
Yield (kg)	Before	2100^{a}	3559^{b}	4219^{b}	4098^{b}	±299
	After	1081^{a}	2118^{ab}	3440^{c}	2409^{db}	±284
Composition (%)						
Mitchell grass	Before	21.3^{a}	53.2^{b}	83.8^{c}	73.8^{bc}	±6.2
	After	34.7^{a}	74.4^{b}	89.5^{b}	81.8^{b}	±6.0
Flinders grass	Before	41.4	30.0	12.0	18.8	±7.3
	After	58.8^{a}	19.3^{b}	4.7^{b}	12.0^{b}	±8.2
Forbs	Before	36.8^{a}	15.7^{b}	4.2^{c}	0.8^{d}	±1.0
	After	6.5^{a}	6.3^{a}	1.6^{b}	0.0^{b}	±1.0

Parameters within rows with differing superscripts differ significantly ($P<0.05$).

fully used to increase the percentage of forbs and quality of the pasture during the dry season, when under normal stocking practices, mature Mitchell (*Astrebla*) and Flinders (*Iseilema*) grasses make up more than 90% of available dry matter (Lorimer 1978). Although the quantity of forbs was greater in the harvested paddock, this was further enhanced by the hay baling oepration (cut area) carried out earlier in the year. In addition, the measurement of protein content in both forbs and Mitchell grass indicated that plant regrowth was stimulated on the cut area, resulting in protein values greater than those previously reported for the dry season (Weston and Moir 1969, Lorimer 1978). Because a larger percentage of the available forbs disappeared from the harvested paddock where the best growth rates and wool cuts were recorded, it could be concluded that both preferential grazing of forbs and out-of-season pasture regrowth are beneficial. Lorimer (1978) also reports a positive correlation between selection of forbs and liveweight change in adult wethers. An increase in liveweight gain and wool growth of young sheep such as occurred in this trial would improve the poor productivity of weaners in the semi-arid tropics (Rose 1972).

In this study the results suggest that the weaning treatment had an effect not only during the weaning period (10 weeks) but also subsequently as demonstrated in the ram wool cuts (see Local and Introduced groups). In addition, the magnitude of the differences (0.4 to 0.9 kg) in wool cut between the ewes in the harvested and continuously grazed treatments would suggest that this extra wool could not all have been grown during the 10-week weaning period. The 0.9 kg gained by group 4 ewe weaners in the harvested paddock represents an increase of 25% for the period of 13 months. If the 10-week treatment period only is considered, then the extra wool represents a 130% increase. The 1985 value of this extra wool would be in the range of $1.40 to $3.10 per cent.

Strategies to improve the quality of the pasture sward by changing the botanical composition present during the dry season may be practical for weaner sheep because they are only a small component of the total flock. To accommodate the weaners, only small areas or paddocks need to be spelled. This conclusion differs from the continuous set-stocking management of sheep that has been the traditional method of pasture usage (Moule 1950) and is still the normal recommended practice.

Preliminary results of an evaluation of strains of Merinos at "Toorak" indicate superior performance of South Australian Merinos, which suggests that some sheep may be more adapted to the harsh tropical environment (Stephenson *et al.* 1976). In experiment 1 of this study, the group 3 (crossbred) weaners were progeny of Wiltshire first cross Merino rams. This genotype may explain the low fleece weights and the lack of paddock effect on wool production. Although the group 4 (South Australian) weaners performed poorly in the continuously grazed (normal) paddock, their initial live weight at weaning demonstrated superior productivity during favourable pre-weaning conditions. Overall good performance is confirmed by the wool growth of this group. The superior wool growth of these weaners and the group 2 (Introduced) weaners suggests that improved productivity of

Table 5. Protein content (%) of plucked samples obtained from the harvested paddock before weaning.

Cut area	Uncut area	
Grasses		
Astrebla	8.7*	3.1**
Iseilema	3.1	3.1
Dichanthium	6.1	6.2
Other species		
Pterigeron		
— pre-seeding	8.3	
— post-seeding	9.2	
— hayed off	7.6	
Sida	13.0	
Euphorbia	10.5	
Glycine	5.8	
Others	11.3	

* 100% green material
** 10% green material

tropical breeding flocks is possible if superior sheep can be identified. Other studies (Pritchard unpublished) suggest that such sheep demonstrate their superiority over poorer wool producers when nutritional conditions are favourable. Therefore, the ability of various groups of weaners to perform differently warrants further investigation so the potential benefits of pasture management strategies can be adequately determined. In conclusion, the present results highlight the importance of preferential management of pastures for weaners so that productivity advantages can be exploited.

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