EFFECT OF PRESENTATION YIELD OF A TROPICAL GRASS-LEGUME PASTURE ON GRAZING TIME AND MILK YIELD OF FRIESIAN COWS

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ABSTRACT

The effects of presentation yield of green panic (Panicum maximum *var.* trichoglume)*—glycine* (Glycine wightii *cv. Tinaroo) pasture on grazing time and milk yield of Friesian cows was measured during autumn and winter on the Atherton Tableland, Queensland.*

Grazing time showed a curvilinear relationship with pasture presentation yield, maximum grazing times being recorded in the range 2,000 *to* 2,500 *kg DM* ha^{-1}*. Major differences between treatments in grazing time occurred from morning to afternoon milking. Above* 2,500 *kg DM* ha^{-1} *milk yield* cow^{-1} *was constant, but below* 2,000 *kg DM* ha^{-1} *both milk yield and grazing time were reduced.*

INTRODUCTION

Grass-legume pastures on the Atherton Tableland, Queensland, are in general lightly stocked. It has been suggested that the high yields of dry matter which accumulate under set stocking may reduce milk production (Edgley and Quinlan 1973).

There is very little information on the relationship between milk yield of set stocked dairy cows and presentation yield of tropical pasture. Stobbs (1974) has shown pasture presentation yield and morphology affect bite size and grazing time of cows during short-term experiments. Stobbs (1973) has also demonstrated that tropical pasture swards are very different in height, density and leaf and stem digestibility to temperate swards. These studies suggest that animal production will be increased by management practices which maintain a high pasture density and leaf to stem ratio.

Grazing time reflects the accessibility of tropical pasture to grazing cows and can be measured using vibracorders (Stobbs 1970). Milk yield is a sensitive indicator of energy intake (Stobbs and Brett 1974). We designed an experiment to measure these two parameters in cows grazing pastures of different presentation yields.

MATERIALS AND METHODS

The experiment was conducted on Kairi Research Station, north Queensland (145° 34'E, 17° 14'S, and 700 m altitude). Average annual rainfall is 1250 mm with 820 mm falling in the period January to March inclusive. Maximum and minimum temperatures range from 28.8/18.0°C in December to 20.8/10.6°C in July. Rainfall during 1974 was above average (2231 mm), but temperatures were close to average.

Pastures

The pastures, composed of green panic (*Panicum maximum* var. *trichoglume*) and glycine (*Glycine wightii* cv. Tinaroo) had been established six years previously, and for the past four years had been grazed at the same stocking rates as were used in these experiments. There were three pasture replicates and these formed part of the larger experiment described by Cowan and Stobbs (1976).

Animals and Treatments

Sixteen Friesian cows and four Friesian heifers, due to calve between October 1973 and January 1974, were blocked on calving date and milk yield of cows. They

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were allocated at random to four groups as part of the allocation of cows in a larger experiment (Cowan and Stobbs 1976). These four groups were a factorial arrangement of two stocking rates (1.3 and 2.5 cows ha^{-1}) and two levels of nitrogen fertilizer (nil and 100 kg N ha^{-1} year^{-1}). Nitrogen fertilizer was applied as ammonium nitrate in two dressings of 50 kg N ha^{-1} on April 16 and June 11, 1974. All paddocks were fertilized on the one day.

Management

Cows were placed on pasture in October 1973 and grazed the three pasture replicates on a five day rotation throughout the experiment. No supplement was fed. Milking was from 0530 h to 0630 h and 1430 h to 1530 h daily.

Measurements

Milk yield was recorded at each milking. Liveweight was measured after morning milking each two weeks. Four vibracorders were used to measure grazing times of cows arranged in five blocks as described by Cowan (1975). Four 24 h traces were obtained for each cow and days 2, 3 and 4 were averaged to give a measure of grazing time. Grazing times were measured from April 29 to May 19 and again from June 25 to July 16, 1974.

Pasture presentation yields were determined from three 0.43 m^2 samples cut to approximately 3 cm stubble height from each plot. Samples were hand sorted into green grass and legume, and dead material, then dried in a forced draught oven at 75°C for 48 h. After weighing, replicates were bulked and a subsample from each treatment ground for nitrogen analysis by the kjeldahl method. The sum of green grass and legume has been used as pasture yield in these analyses. Pasture presentation yield was measured on May 13 and July 10, 1974.

Statistical Analyses

Pasture yields were averaged for each plot and both pasture and animal data analysed by analysis of variance. Within group variation was used to estimate the error term when analysing animal data.

RESULTS

Experimental treatments were effective in establishing a wide range of pasture yields (Table 1). The legume content of pasture was lower at 2.5 cows ha^{-1} than at 1.3 cows ha^{-1} (Table 1). During each measurement period milk yields were reduced for cows grazing unfertilized paddocks at 2.5 cows ha^{-1} ($P < 0.05$).

Grazing time of cows was reduced on the two extreme treatments, namely fertilized pasture at 1.3 cows ha^{-1} and unfertilized pasture at 2.5 cows ha^{-1} (Table 2). The major changes in grazing time occurred from morning to afternoon milking. During the May observations grazing from 2200 h to 0200 h was less at 2.5 cows ha^{-1} than at 1.3 cows ha^{-1}.

The relationship between pasture dry matter yield and grazing time between morning and afternoon milkings is shown in Figure 1. The relationship accentuates the relation between 24 h grazing time and pasture yield. Grazing time was at a maximum in the range of total pasture yield 2,000 to 2,600 kg DM ha^{-1}. Yields of grass and legume associated with maximum grazing times were from 1,600 to 2,000 and 300 to 1,000 kg DM ha^{-1} respectively.

Associations between milk and pasture yield (Figure 2) indicate milk yield is not restricted by pasture yields above approximately 2,500 kg DM ha^{-1}. At pasture yields below 2,000 kg DM ha^{-1} milk yield of cows was restricted. Thus reductions in grazing time with pasture yields of 2,500 kg DM ha^{-1} or above were not associated with reduced milk yields. Restrictions in grazing time with pasture yields below 2,000 kg DM ha^{-1} were associated with reductions in milk output by cows.

TABLE 1

Effect of stocking rate and nitrogen fertilizer on milk yield, live weight, pasture yield and crude protein and legume content of pasture.

Nitrogen fertilizer (kg N/ha⁻¹)	Stocking Rate (cows ha⁻¹) 1·3		2·5		Standard error of mean
	0	100	0	100	
May 1974					
Milk yield (kg cow⁻¹ day⁻¹)	13·1* ab	15·6 a	10·6 b	13·8 a	1·00
Liveweight (kg)	453	445	441	429	11·9
Green pasture yield (kg DM ha⁻¹)	3618 a	4243 b	1413 c	2171 d	10·5
Legume (%) (DM)	27·5 a	27·4 a	20·5 ab	14·7 b	5·6
Crude protein (N × 6·25) (%)†	11·5	14·3	11·5	12·1	—
July 1974					
Milk yield (kg cow⁻¹ day⁻¹)	11·1 ac	13·1 a	5·8 b	10·1 c	1·20
Liveweight (kg)	454	461	423	438	15·6
Green pasture yield (kg DM ha⁻¹)	2356 a	3708 b	1157 c	1590 d	16·6
Legume (% DM)	48·1 a	33·8 ab	21·2 bc	11·3 c	8·0
Crude protein (N × 6·25) (%)†	11·3	13·3	9·5	10·9	—

*Treatment means followed by different letters differ at $P < 0·05$.

†Weighted mean for grass and legume.

TABLE 2

Effect of stocking rate and nitrogen fertilizer on grazing time of cows.

Nitrogen fertilizer (kg N/ha⁻¹)	Stocking Rate (cows ha⁻¹) 1·3		2·5		Standard error of mean
	0	100	0	100	
May 1974					
Grazing time (mins/24 hours)	627	610	604	634	19·5
Grazing time morning to afternoon milking (mins)	289 ab	245 a	274 a	325 b	14·9
Grazing time afternoon to morning milking (mins)	338 ab	365 a	330 ab	317 b	12·1
Grazing time 22·00 h to 2·00 h (mins)	148 ab	155 a	129 ab	121 b	9·4
July 1974					
Grazing time (mins/24 hours)	664 a	577 b	621 ab	646 a	19·5
Grazing time morning to afternoon milking (mins)	319 a	253 b	294 a	318 a	8·3
Grazing time afternoon to morning milking (mins)	345	323	327	328	16·0
Grazing time 22·00 h to 2·00 h (mins)	135	123	120	113	114

Treatment means followed by different letters differ at $P < 0·05$.

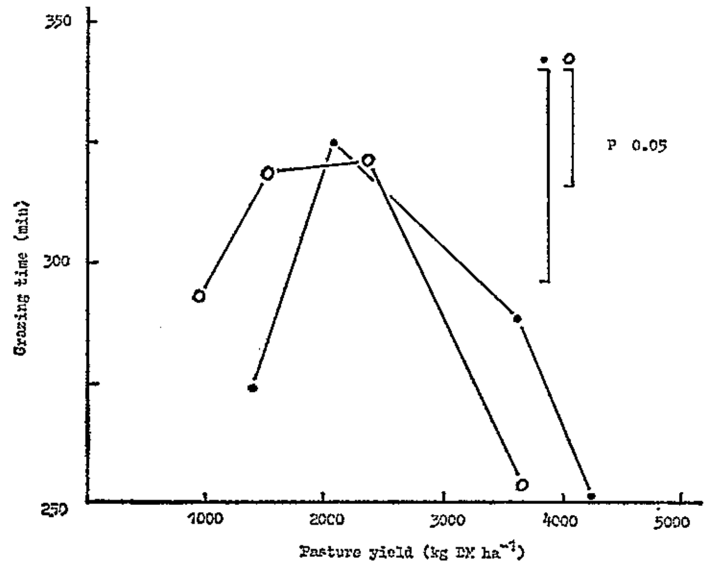

FIGURE 1

Relationship between grazing time from morning to afternoon milking and pasture yield on offer during May (•) and July (o).

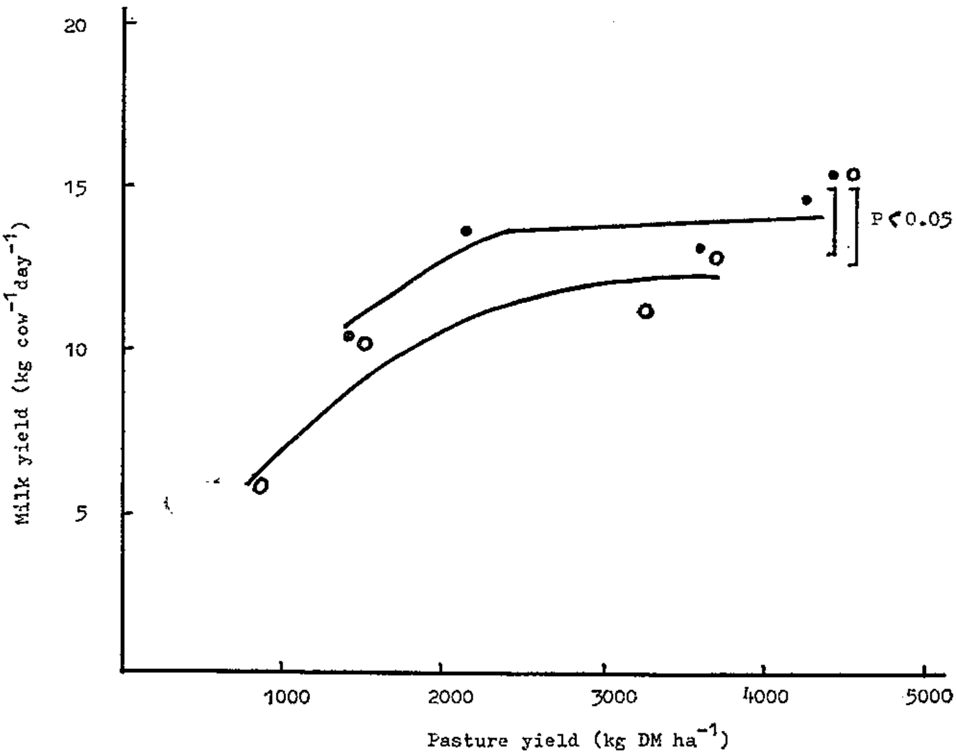

FIGURE 2

Relationship between milk yield of cows and pasture yield on offer during May (•) and July (o).

DISCUSSION

The grazing treatments used in this experiment caused pasture yield and per cent legume in the pasture to be partly confounded. Changes in grazing time associated with change in legume content of pasture were not consistent, and the maximum grazing times recorded in the two periods of observation were associated with approximately 15 and 48 per cent legume in pasture dry matter respectively. These maximum grazing times were associated with similar total green pasture yields in the two periods. Thus total green pasture yield, rather than legume content, appears to influence grazing time of cows.

Above 2,500 kg DM ha^{1-} milk yield was not influenced by pasture yields, apparently because cows adjusted their grazing habits to maintain a common level of pasture intake. Allden and Whittaker (1970) found sheep increased their grazing time in an attempt to maintain intake as pasture yields fell. Dairy cows grazing tropical pastures have been shown to increase rate of biting and grazing time as pastures become less accessible (Stobbs 1974).

When energy intake is restricted cows will attempt to maintain milk yields by drawing on energy reserves in the body. For this reason milk yield is often a less sensitive indicator of digestible energy intake in continuous experiments than other measures such as fatty acid composition of milk fat (Stobbs and Brett 1974). Since cows in our experiment reduced grazing time, and probably grazing effort, at high pasture yields it is unlikely they were restricted in pasture intake and drawing more heavily on body reserves to maintain milk production.

Cows grazed for a maximum of 660 min day^{-1} at approximately 2,500 kg DM ha^{-1}. Below this pasture yield grazing time of cows began to decrease, even though falling milk yields indicated energy intake of cows was falling. The reasons for these reductions in grazing time are not obvious but it is possible that factors other than the desire to maintain food intake increase in importance at these low pasture yields. For example cows may attempt to conserve energy by reducing grazing and avoiding grazing in the heat of the day. Though the crude protein figures in Table 1 cannot be applied directly to the cow's diet they do indicate that at high grazing pressures protein content of the pasture may become limiting for milking cows.

The maximum grazing times we recorded were not as high as maximum grazing times recorded by Stobbs (1974). There are a number of possible reasons for this. In the relatively mild environment on the Atherton Tableland pastures may not become as coarse and inaccessible to cattle as pastures in lowland tropical areas. Our previous recordings of grazing time have also indicated green panic-glycine pastures are not associated with grazing times above 670 min in 24 h (Cowan 1975). A second reason could be our pastures were grazed on a 5 day rotation (Cowan and Stobbs 1976). This frequent grazing would have a significant effect on pasture morphology. Thirdly, our observations are limited to two species in a mixed pasture, and it is not possible to extropalate to other species.

The absolute values for pasture yields at which grazing time is a maximum and milk yield begins to decline may be specific to a particular situation. Our experiment was done over three months of the year, using cows two-thirds through lactation. Cows in early lactation may need higher pasture yields before milking to the potential of the pasture. However the general associations between pasture presentation yield, milk yield and grazing time should be similar in these different situations. In year round experiments with green panic-glycine pastures we have not measured a decrease in milk yield associated with lighter stocking rates (Cowan, Byford and Stobbs 1975). In these experiments presentation yield of pasture was inversely related to stocking rate and in some months exceeded 6,000 kg DM ha^{-1} at 1.3 cows ha^{-1}. These results support the present observation that milk yield did not decline with increasing presentation yield of pasture.

Within the limits of this experiment we can predict no advantage to milk yield through manipulation of pasture yield on offer to cows while this yield is above 2,500 kg DM ha^{-1}. Below approximately 2,500 kg DM ha^{-1} a deficiency of pasture yield appears to limit milk yield per cow.

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REFERENCES

ALLDEN, W. G., and WHITTAKER, I. A. McD. (1970)—The determinants of herbage intake by grazing sheep: the interrelationship of factors influencing herbage intake and availability. *Australian Journal of Agricultural Research* **21**: 755-66.

COWAN, R. T. (1975)—Grazing time and pattern of grazing of Friesian cows on tropical grass-legume pastures. *Australian Journal of Experimental Agriculture and Animal Husbandry* **15**: 32-7.

COWAN, R. T., BYFORD, I. J. R., and STOBBS, T. H. (1975)—Effects of stocking rate and energy supplementation on milk production from tropical grass-legume pasture. *Australian Journal of Experimental Agriculture and Animal Husbandry* **15**: 740-46.

EDGLEY, W. H. R., and QUINLAN, T. J. (1973)—Managing tropical grass-legume pastures on the Atherton Tableland. Advisory Leaflet No. 244, Division of Dairying, Department of Primary Industries, Queensland.

STOBBS, T. H. (1970)—Automatic measurement of grazing time by dairy cows on tropical grass and legume pastures. *Tropical Grasslands* **4**: 237-44.

STOBBS, T. H. (1973)—The effect of plant structure on intake of tropical pastures 1. Variation in the bite size of grazing cattle. *Australian Journal of Agricultural Research* **24**: 809-19

STOBBS, T. H. (1974)—Rate of biting of Jersey cows as influenced by the yield and maturity of pasture swards. *Tropical Grasslands* **8**: 81-6.

STOBBS, T. H., and BRETT, D. J. (1974)—Milk yield and composition of milk and blood as indicators of energy intake by Jersey cows. *Australian Journal of Agricultural Research* **25**: 657-66.

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