QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

DIVISION OF ANIMAL INDUSTRY BULLETIN No. 170

PERFORMANCE OF STEERS GRAZING A TROPICAL GRASS-LEGUME PASTURE ON THE ATHERTON TABLELAND

by L. WINKS, B.Agr.Sc.; P. C. VENAMORE, Q.D.A.H.; T. A. JAMES, Q.D.A.H.; P. O'GRADY, Q.D.A.H.; and P. K. O'ROURKE, B.Sc.(Hons.)

SUMMARY

The performance of beef steers grazing a green panic (*Panicum maximum var. trichoglume*)-glycine (*Neonotonia wightii* cv. Tinaroo) pasture at three stocking rates (2·5, 4·0 and 5·0 steers ha^{-1}) was measured over a period of 32 months. Weight gains in summer varied from 0·6 to 1·1 kg head^{-1} day^{-1} while weight losses occurred in late spring. Increases in stocking rate reduced the rate of gain and the period of weight gain. Highest production per unit area was achieved at the intermediate stocking rate. The legume component of the pasture declined during the course of the study and the long-term stability of the pasture at this grazing pressure is doubtful.

I. INTRODUCTION

Pasture mixtures of green panic (*Panicum maximum* var. *trichoglume*) and glycine (*Neonotonia wightii* cv. Tinaroo, formerly *Glycine wightii*) exhibited outstanding productivity under grazing on the Atherton Tableland, north Queensland (Tow 1967). Winks *et al.* (1970) recorded liveweight production as high as 578 kg ha^{-1} yr^{-1} in steers grazing these pastures at 2·5 steers ha^{-1}. These authors felt that the optimum stocking rate was not reached as pastures were undergrazed during the summer months and wastage of feed was high.

The aim of the this study was to determine how performance of steers grazing these pastures was affected when higher stocking rates were used.

II. MATERIALS AND METHODS

Experimental area

The study was carried out from 19 January 1971 to 9 December 1973 at Kairi Research Station, 8 km north-east of Atherton, north Queensland. Mean annual rainfall of 1250 mm falls in summer. Frosts occur during the winter.

The area used was that previously described by Winks *et al.* (1970). Soils were a mixture of a deep, red-brown clay-loam derived from basalt and a light-coloured soil derived from granite.

The green panic-glycine pasture was sown in the early 1960s and grazed uniformly until the study reported earlier. In January 1969, the granitic areas were fertilized with single superphosphate at the rate of 463 kg ha^{-1}.

Procedure

An area of 12 ha was surveyed for soil type and divided into six paddocks of 2 ha on the basis of soil type.

One area was predominantly basaltic and the other predominantly granitic soil. Grazing of the pastures began on 19 January 1971 (draft 1), at which stage all areas were carrying a heavy growth of material. Brahman cross steers (approximately 50% Brahman component), 12 to 15 months of age, and of mean liveweight 199·3 ± 20·4 kg, were allocated to groups of five, eight and eleven by randomization on the basis of liveweight. This produced stocking rates of 2·5, 4·0 and 5·5 steers ha^{-1}.

Animals remained on the area for approximately one year or until weight losses occurred and pasture dry matter was minimal. Marketable animals were slaughtered when removed. Draft 2, 18 to 24 months of age, and of mean liveweight 233·8 ± 18·7 kg, was introduced on 12 January 1972 and draft 3, 9 to 12 months of age, and of mean liveweight 161·7 ± 12·1 kg, was introduced on 15 February 1973. For these two drafts, the heaviest stocking rate was reduced to 5·0 beasts ha^{-1}.

Measurements

Presentation yields of herbage were measured on all areas on 12 March and 16 July 1973. Materials from 25 × 0·4 m^2 quadrats located at random along two transects parallel with the long sides of the paddocks was cut to ground level, sorted into glycine and other species, oven dried and weighed. Mean yields were calculated. Representative samples were analysed for protein and phosphorus by the methods of A.O.A.C. (1965).

Initial liveweights were taken on an unfasted basis and during the experimental period, unfasted liveweights were recorded at 28-day intervals. Carcass weights were obtained at slaughter.

Faecal samples were taken at each weighing from all animals, bulked within treatments, canned, and analysed for nitrogen and phosphorus by the procedures of Moir (1960 a, 1960 b).

Liveweight and carcass data were analysed by analysis of variance with treatment differences being tested by Student's t-test. The error term was estimated from the variation between steers within groups. Data were analysed with a factorial arrangement of treatments for stocking rate and soil type. Results indicated a different response to stocking rate on the two soil types so results are presented as a comparison of soil type-stocking rate combinations.

III. RESULTS

Seasonal conditions

Monthly rainfall registrations and the 40-year mean for Kairi Research Station (table 1) show that rainfall was average in 1971 and 1973 but above average in 1972. However, distribution in 1972 was poor with very heavy falls in January to March inclusive followed by a long period of below-average falls until February 1973.

TABLE 1

MONTHLY RAINFALL (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1971	102	225	353	210	18	26	14	10	4	71	96	185	1314
1972	282	320	837	56	79	51	7	13	58	6	25	29	1763
1973	43	214	406	144	45	18	11	11	15	28	180	265	1380
Mean (40 years)	253	255	252	102	54	39	26	23	18	31	62	136	1251

Pasture yield and quality

Pasture presentation yields in March and July 1973 (table 2) showed that pastures were heavily grass dominant. Legume content was low at both samplings but increased from less than 3% of total dry matter in March to 2·4 to 13·7% in July. Stocking rate had a marked effect on legume content at both samplings, with increase in stocking rate reducing the yield of legume. Differences between soil types were small.

Available pasture was virtually exhausted on heavily stocked areas by July–August in 1971 and 1972 and steers were withdrawn. Steers were withdrawn from the granitic area stocked at 4 beasts ha^{-1} in October 1971 and September 1972 because of shortage of available pasture.

Protein and phosphorus contents of the harvested material ranged from 9·5 to 11·4% and 0·18 to 0·35% for grass and 14·7 to 19·8% and 0·26 to 0·35% for legume. There was no consistent effect of soil type or stocking rate.

TABLE 2

MEAN PRESENTATION YIELDS (± SE) (kg D.M. ha^{-1}) OF CUT PASTURE IN MARCH AND JULY 1973

Soil type	Stocking rate beasts ha^{-1}	12–3–73		16–7–73	
		Grass	Legume	Grass	Legume
Granitic ..	2·5	4 906 ± 356·0	142 ± 24·9	3 839 ± 354·7	612 ± 92·3
	4·0	6 065 ± 371·7	35 ± 7·4	3 452 ± 248·1	211 ± 44·2
	5·0	6 685 ± 336·3	21 ± 6·7	2 869 ± 237·8	70 ± 23·0
Basaltic ..	2·5	5 370 ± 334·7	136 ± 21·4	4 613 ± 296·5	517 ± 61·8
	4·0	5 064 ± 357·7	23 ± 7·2	4 105 ± 345·3	103 ± 25·4
	5·0	5 497 ± 388·6	36 ± 11·2	3 582 ± 194·0	87 ± 25·5

Liveweight change

In all years, liveweight changes followed a similar pattern. Gains were recorded virtually throughout at the light stocking rate while progressive increases in stocking rate shortened the period of weight gain, so that weight losses were recorded during the winter–spring period at the highest stocking rate in all years (figure 1, table 3). During the period, January to April, stocking rate effects were minimal but the effect of stocking rate increased as the season advanced.

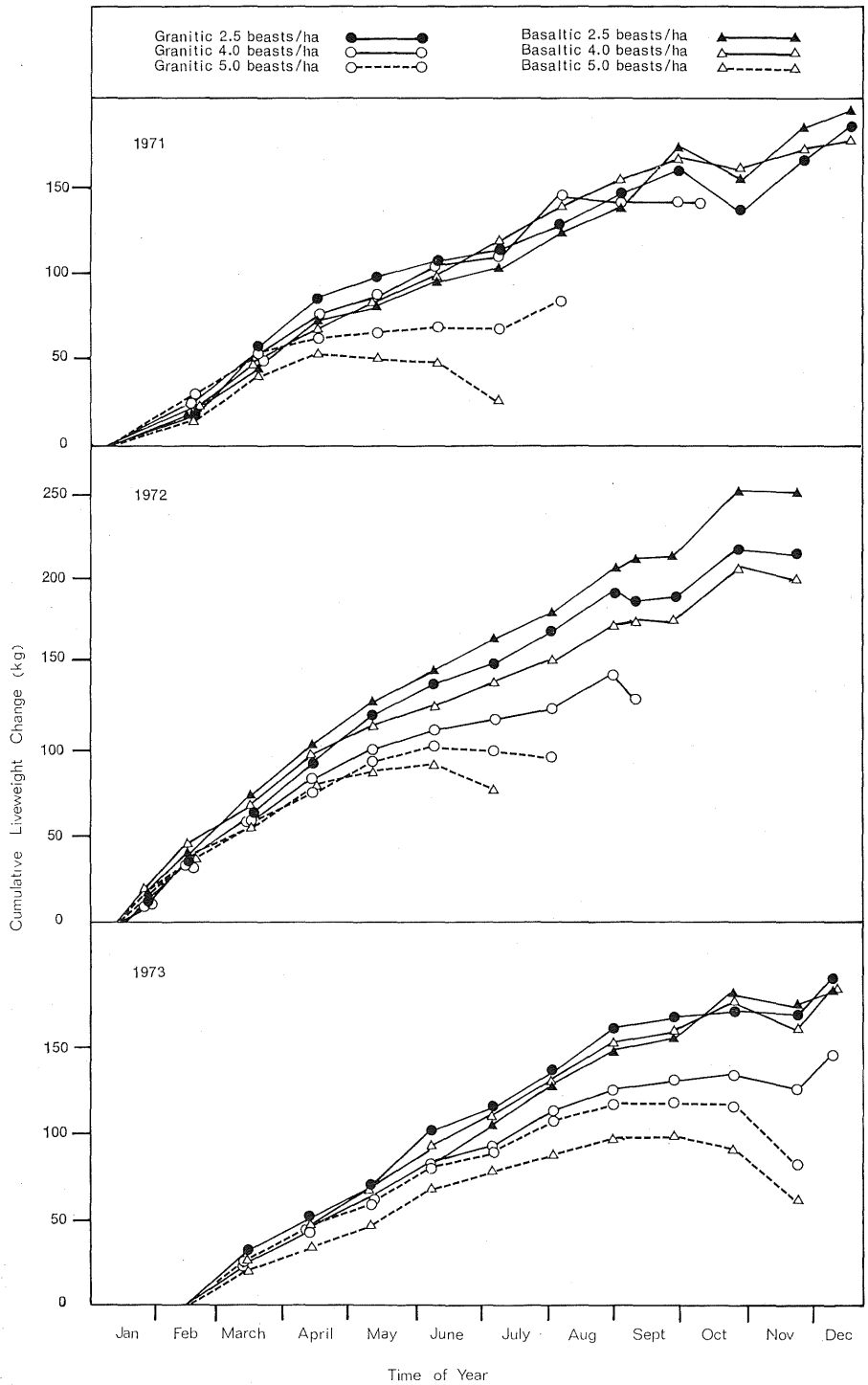

Figure 1. Effect of stocking rate and soil type on liveweight change.

TABLE 3

LIVEWEIGHT CHANGES OF STEERS OVER DIFFERENT SEASONS ON TWO SOIL TYPES AT THREE STOCKING RATES

Year	Soil Type	Stocking rate (steers ha^{-1})	Period of grazing	Rates of liveweight change (kg d^{-1})			
				Jan–Apr	Apr–Jul	Jul–Sep	Sep–Dec
1971	Granitic	2·5	19 Jan–17 Dec	0·87 ab	0·47 ad	0·55 a	0·35 a
		4·0	19 Jan– 8 Oct	0·98 b	0·33 a	0·35 b	..
		5·5	19 Jan– 5 Aug	0·75 a	0·04 b	..	..
	Basaltic	2·5	19 Jan–17 Dec	0·85 ab	0·38 ad	0·71 a	0·40 a
		4·0	19 Jan–17 Dec	0·82 a	0·54 d	0·68 a	0·12 b
		5·5	19 Jan– 8 Jul	0·62 c	−0·42 c	..	..
	Standard Deviation	..	..	0·122	0·151	0·127	0·185
1972	Granitic	2·5	12 Jan–14 Dec	1·02 ab	0·70 ad	0·45 ac	−0·01 a
		4·0	12 Jan–11 Nov	0·91 ac	0·42 b	0·20 b	..
		5·0	12 Jan– 3 Aug	0·90 ac	0·21 c	..	..
	Basaltic	2·5	12 Jan–14 Dec	1·13 b	0·74 a	0·58 c	0·41 b
		4·0	12 Jan–14 Dec	0·97 a	0·55 db	0·41 a	0·13 a
		5·0	12 Jan– 6 Jul	0·86 c	−0·01 c	..	..
	Standard Deviation	..	..	0·112	0·142	0·121	0·129
1973	Granitic	2·5	15 Feb– 9 Dec	0·90 a	0·76 a	0·63 a	0·30 ad
		4·0	15 Feb– 9 Dec	0·80 a	0·56 b	0·45 bd	0·21 a
		5·0	15 Feb–22 Nov	0·79 a	0·54 b	0·34 bc	−0·32 b
	Basaltic	2·5	15 Feb– 9 Dec	0·82 a	0·69 a	0·60 a	0·39 d
		4·0	15 Feb– 9 Dec	0·85 a	0·77 a	0·56 ad	0·32 ad
		5·0	15 Feb–22 Nov	0·61 b	0·49 b	0·25 c	−0·65 c
	Standard Deviation	..	..	0·138	0·106	0·115	0·122

N.B. Within drafts and periods, means marked with an alphabetical subscript in common are not significantly different ($P < 0·05$).

Carcass data

Only animals from the intermediate and light stocking rates were slaughtered as steers from the high stocking rate showed insufficient finish for local consumption. Hot carcass weights were higher on basaltic than on granitic soils at the intermediate but not the light stocking rate (table 4). The trend was for carcasses to be heavier from the light than the intermediate stocking rate. Carcasses were considered ideal for local trade requirements. Dressing percentages varied from 49·4 to 53·7% but showed no consistent effect of stocking rate or soil type.

TABLE 4

CARCASS DATA FOR STEERS ON INTERMEDIATE AND LIGHT STOCKING RATES ON TWO SOIL TYPES

Soil type	Stocking rate (steers ha^{-1})	Hot dressed weight (kg)			Dressing %		
		1971	1972	1973	1971	1972	1973
Granitic ..	2.5	195·5ab	215·3a	176·5a	50·4a	50·9ab	50·5ab
	4·0	172·7a	189·2b	150·9b	50·9a	51·8ab	49·4b
Basaltic ..	2·5	214·4b	249·7c	176·3a	53·7b	52·6a	51·3a
	4·0	202·9b	207·3a	173·0a	53·4b	50·1b	50·3ab
Standard	Deviation	19·34	15·68	13·62	1·23	1·75	1·45

Within years, means with an alphabetical subscript in common are not significantly different ($P < 0·05$).

Faecal composition

Faecal protein and phosphorus levels followed a seasonal pattern, being highest during the summer growth period and lowest towards the end of the dry season. There was a tendency for levels to be lowest at the highest stocking rate but the trend was inconsistent. Values exceeded 7·0% faecal protein and 0·20% faecal phosphorus at all samplings.

IV. DISCUSSION

The results of this study are noteworthy for the high output of liveweight gain recorded per hectare from a grass-legume pasture. The average production per draft on the basaltic soil at 4·0 steers ha^{-1} exceeded 700 kg ha^{-1}, a figure rarely exceeded under dryland conditions (Norman 1974). Carcasses produced were acceptable for the local domestic trade.

The pattern of liveweight change over the 3 years was consistent. While animals gained weight virtually throughout at the light stocking rate, the period of weight gain was progressively shortened with successive increases in stocking rate. The failure of animals on the heavily-stocked areas to gain weight after July in 1971 and 1972 was undoubtedly due to a lack of available dry matter.

Since unfasted liveweights were recorded, weight losses recorded in spring–early summer were confounded with changes in gut-fill. In general, performance tended to be better on basaltic than granitic soil. However, performance on the basaltic soil was lower than on the granitic soil at the heaviest stocking rate. There is no ready explanation for this deviation from the pattern.

During the summer period, growth rates ranged from 0·61 to 1·13 kg head^{-1} day^{-1} which compare favourably with those reported elsewhere for tropical pastures (Quinn *et al.* 1970; Smith 1970; Mellor and Round 1974). Mean gains for the duration of the grazing period exceeded 0·55 kg head^{-1} day^{-1} at the light stocking rate in all years, approaching the 0·60 kg day^{-1} regarded as a maximum for year-long production on tropical pastures by Stobbs (1974).

Stocking rate had a marked effect on legume content of the pastures on the area during the course of the study. In April 1969, legume content of the available dry matter was 18% and 11% on basaltic and granitic areas respectively (L. Winks unpublished). The values recorded in March 1976 of 0·3 to 2·8% and in July of 2·4 to 13·7% indicate a marked decline in legume content. The decline was greatest at the highest stocking rate. Failure of tropical, twining legumes to persist under close grazing or cutting regimes has been reported by numerous workers including Whiteman (1969), Bryan and Evans (1973) and Cowan, Byford and Stobbs (1975).

Initial liveweights of the three drafts varied, so effective stocking rates were highest in the second draft and lowest in the third draft. This effect confounded the year differences. Pastures were able to sustain animals for the full year in draft 3 partly because of the smaller steers used and hence lower grazing pressure.

Set stocking seems to be an ineffective way to utilize these pastures. Even at a stocking rate of four steers ha^{-1} the legume content of the pasture has declined and long-term stability is in doubt. Mott (1960) suggests using differential stocking rates for summer–autumn and winter–spring periods to utilize the summer flush of growth and reduce the spring feed shortage. At a stocking rate of five steers ha^{-1} during the summer–autumn period insufficient feed was available to support even a low stocking rate during the spring.

An alternative approach is to provide supplements. Provision of energy-rich supplements to animals grazing tropical pastures has allowed increases in carrying capacity and increased animal performance (Bisschoff *et al.* 1970; Mott *et al.* 1970; Cowan, Byford and Stobbs 1975). Molasses is readily available from adjacent sugar-cane growing areas and is relatively cheap. Research has shown that a supplement of molasses will significantly improve liveweight production from these pastures. This work will be reported in a subsequent paper.

V. ACKNOWLEDGEMENTS

The authors acknowledge the assistance of staff at Kairi Research Station in the conduct of the experiment and members of Biochemistry and Agricultural Chemistry Branches for chemical analyses.

REFERENCES

A.O.A.C. (1965).—'Official Methods of Analysis'. Tenth edition (Association of Official Agricultural Chemists: Washington, D.C.)

BISSCHOFF, W. V. A., QUINN, L. R., MOTT, G. O., and DA ROCHA, G. L. (1970).—Supplemental feeding of steers on pasture with protein-energy supplements. IRI Research Institute, Inc. Bull. No. 35.

BRYAN, W. A., and EVANS, T. R. (1973).—Effects of soils, fertilizers and stocking rates on pastures and beef production on the Wallum of south-eastern Queensland. 1. Botanical composition and chemical effects on plants and soils. *Australian Journal of Experimental Agriculture and Animal Husbandry* 13:516-29.

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* 15:740-6.

MELLOR, W., and ROUND, P. J. (1974).—Performance of beef steers in the wet tropics of Queensland. *Queensland Journal of Agricultural and Animal Sciences* 31:213-20.

MOIR, K. W. (1960a).—Nutrition of grazing cattle. 1. Estimation of protein in pasture selected by grazing cattle. *Queensland Journal of Agricultural Science* 17:361-72.

MOIR, K. W. (1960b).—Nutrition of grazing cattle. 2. Estimation of phosphorus and calcium in pasture selected by grazing cattle. *Queensland Journal of Agricultural Science* 17:373-83.

MOTT, G. O. (1960).—Grazing pressure and the measurement of pasture production. *Proceedings of the VIII International Grasslands Congress* 606-11.

MOTT, G. O., QUINN, L. R., BISSCHOFF, W. V. A., and DA ROCHA, G. L. (1970).—Molasses as an energy supplement for Zebu steers grazing nitrogen-fertilized and unfertilized colonial guinea grass pasture. IRI Research Institute, Inc. Bull. No. 36.

NORMAN, M. J. T. (1974).—Beef production from tropical pastures. Part 2. A.M.R.C. Review No. 17.

QUINN, L. R., MOTT, G. O., BISSCHOFF, W. V. A., and DE FREITAS, L. M. M. (1970).—Production of beef from winter vs summer nitrogen-fertilized colonial guinea grass (*Panicum maximum*) pastures in Brazil. *Proceedings of the XI International Grasslands Congress* 832-5.

SMITH, C. A. (1970).—The feeding value of tropical grass pastures evaluated by weight gains. *Proceedings of the XI International Grasslands Congress* 839-42.

STOBBS, T. H. (1974).—Beef production from sown and planted pastures in the tropics. *Proceedings of the Conference on Beef Production in Developing Countries.* Edinburgh, Sept. 1974.

TOW, P. G. (1967).—Sowing rate, survival and productivity of green panic-glycine mixtures. *Queensland Journal of Agricultural and Animal Sciences* 24:142-8.

WHITEMAN, P. C. (1969).—The effects of close grazing and cutting on the yield, persistence and nitrogen content of four tropical legumes with Rhodes grass at Samford, south-eastern Queensland. *Australian Journal of Experimental Agriculture and Animal Husbandry* 9:287-94.

WINKS, L., O'GRADY, P., EDGLEY, W., and STOKOE, JANET (1970).—Performance of steers in north Queensland grazing a tropical legume-grass pasture at two stocking rates on two soil types. *Proceedings of the Australian Society of Animal Production* 8:450-4.

(Received for publication 3 January 1979)

Mr Winks is Assistant Director, Beef Cattle Husbandry Branch, Queensland Department of Primary Industries, Brisbane, 4001. Messrs Venamore and James are District Advisers with Beef Cattle Husbandry Branch at P.O. Box 689, Rockhampton, 4700 and 'Swan's Lagoon', Millaroo, 4807, respectively. Mr O'Grady is an Experimentalist, Dairy Cattle Husbandry Branch, Artificial Breeding Centre, Redlands, Brisbane, 4165. Mr O'Rourke is a Senior Biometrician, Biometry Branch, P.O. Box 1085, Oonoonba, Townsville, 4810.