THE EFFECT OF PASTURE MANAGEMENT ON GRASS AND ANIMAL PRODUCTION FOLLOWING FROSTING OF NITROGEN FERTILIZED SUB-TROPICAL GRASS PASTURES

R. J. JONES

CSIRO Division of Tropical Crops and Pastures, Cunningham Laboratory, 306 Carmody Road, St. Lucia, Qld. 4067.
Present Address: CSIRO Division of Tropical Crops and Pastures, Davies Laboratory, Private Mail Bag, Post Office, Aitkenvale, Qld. 4814.

ABSTRACT

In a factorial experiment on nitrogen fertilised pastures of Nandi setaria and Samford Rhodes grass, the effect of stocking rate (3.75 and 5.0 steers/ha) and 2 management systems (a control and a continuously stocked treatment, where excess summer grown feed was conserved and fed back on the same pasture) produced pastures which had varying amounts of herbage present at the onset of winter. Heavy frosting killed top growth in all pastures, but the regrowth in spring was far slower on pastures which carried a bulk of feed into winter. Pastures of Samford Rhodes grass were more severely affected than those of Nandi setaria, but both grasses subsequently recovered without destocking.

Liveweight change over the August-November period was related positively and linearly to yield of green dry matter/ha ($r = +0.8$ to $+0.9$) and negatively to total dry matter on offer ($r = -0.7$ to -0.9). Thus, steers on control paddocks stocked at 5 steers/ha gained more weight over spring and early summer than those at 3.75 steers/ha due to the greater amount of green feed in the former.

On low lying areas in the sub-tropics, frost damage to N fertilised grass pastures may be overcome by reducing the bulk of senescing pasture in autumn.

RESUMEN

En un experimento factorial sobre pasturas de setaria Nandi y pasto Samford Rhodes fertilizados con nitrógeno, el efecto de la carga animal (3.75 y 5.00 novillos/ha) y dos sistemas de manejo (un control y un tratamiento de carga continua, donde el exceso de crecimiento del verano fue conservado y devuelto a los animales en la misma pastura), produjo pastos que tenían cantidades diferentes de disponibilidad al comienzo del invierno. Una fuerte helada mató el crecimiento superficial en todos los pastos, pero el recrecimiento en la primavera fué mucho más lento en las pasturas que tenían más biomasa al entrar al invierno. Las pasturas Samford Rhodes fueron afectadas en forma más severa que las de setaria Nandi setaria, pero ambos pastos se recuperarán sin descargarse. El cambio en el peso vivo al entrar al experimento, durante el período Ago-Nov fue relacionado positiva y linealmente al rendimiento de materia seca verde/ha ($r = +0.8$ a $+0.9$) y negativamente al total de materia seca, que se ofrecía ($r = -0.7$ a -0.9). Asi los novillos en los potreros control cargados con 5 novillos/ha aumentaron más peso durante la primavera y principios de verano, que con los de 3.75 novillos/ha, debido a una mayor disponibilidad de forraje en los primeros.

En áreas bajas en los subtrópicos, el daño por heladas a pastos fertilizados de nitrógeno puede ser superado, reduciendo la cantidad de pasto muerto (viejo) en el otoño.

INTRODUCTION

A comparison of animal production from pastures of Nandi setaria (*Setaria sphacelata* cv. Nandi) and Samford Rhodes grass (*Chloris gayana* cv. Samford) fertilized annually with 336 kg N/ha, and with and without conservation of hay has been described earlier (Jones 1976). Significant ($P < 0.05$) responses to feeding hay in winter only occurred in 1 out of 4 years, when a 49% benefit was recorded. This large response was the result of losses in liveweight of steers on control paddocks not supplemented with hay during winter/spring, 1964 (incorrectly referred to as 1963 in the Discussion of Jones 1976) when heavy frosts were encountered which killed all above-ground herbage. In this paper the effect of the pasture management treatments on regrowth of the frosted pasture is described and related to animal production in the following spring and early summer.

MATERIALS AND METHODS

The experiment was conducted at the CSIRO Samford Pasture Research Station (lat. 27°22′S, long. 152°53′E, altitude 50 m, annual rainfall 1150 mm). A 2^3 factorial of 2 grasses (Nandi setaria and Samford Rhodes grass), 2 stocking rates (3.75 and 5.0 steers/ha) and 2 managements (control and a conservation treatment) was replicated twice giving 16 paddocks. The conservation treatment involved cutting excess feed in summer, conserving this as hay, and then feeding back the hay on the same paddocks from which it was made, in winter. All paddocks were set-stocked with yearling steers in December each year.

During the 1963/64 summer, hay was made from the conserved treatments on 2 occasions—December 16, 1963 and March 12, 1964. Hay was baled, stored under cover and fed back in winter between June 12 and October 3.

On October 5 and November 10, 1964 and January 12, 1965, yields were estimated in all paddocks using an electronic capacitance meter (Jones and Haydock 1970). Thirty readings were taken per paddock and the yield was estimated by cutting 3 quadrats, each with the mean paddock reading, to ground level. Samples were sorted into dead and green material, and dried to obtain DM yield estimates. Pasture height measurements (to the top of the leaf canopy) were also measured when meter readings were taken.

Steers were weighed every 14 days after an overnight fast. Mean liveweight gain for the various treatments for the periods July 7 to November 10, August 18 to November 10 and September 15 to November 10 were regressed on mean green pasture yield recorded in October.

RESULTS

Meteorological data

Frosts occurred in June, July and August 1964 interspersed with short rainy spells (Table 1). A very heavy frost (−5.5°C screen temperature) occurred on August 13. This resulted in a completely frosted pasture on all paddocks. Temperatures increased in September, although mean monthly minimum temperatures did not exceed 10°C until November.

TABLE 1

Mean monthly temperatures, rainfall and numbers of frosts (Terr.Min < 0°C) for the June-October period 1964 at Samford.

	June	July	August	September	October
Max (°C)	25.0	21.2	23.7	24.0	25.9
Min (°C)	6.1	3.5	2.8	9.5	9.3
Terr. Min (°C)	5.8	3.4	2.3	9.8	9.3
Frosts	2	5	6	0	0
Rainfall (mm)	26.9	46.7	21.3	85.3	62.4
Average (mm)	59.9	54.6	32.1	46.0	85.1

Pasture yields

In August there was no green pasture present, the severe frosting having killed all top growth. At the samplings in October and November 1964 and January 1965 total DM yields were consistently higher on the control paddocks than on the conserved paddocks ($P < 0.01$) as was expected (Table 2). Green DM yields, however, were highest on the conserved paddocks in October and November, though lower in January.

Conserved paddocks had shorter pastures than did the control paddocks (8.8 cm versus 12.0 cm, $P < 0.05$) and Rhodes paddocks were shorter than setaria paddocks (9.5 versus 11.3 cm, ($P < 0.1$).

In October, green DM yields were higher on the conserved paddocks, and also on paddocks with the higher stocking rate, especially for the conserved treatments (Table 2). This trend was also apparent at the November sampling, but by January 1965, yields of green DM reverted to the expected pattern of being higher on the low stocked treatments. Total and green DM yields were significantly higher for the control paddocks compared with the conserved paddocks at this January sampling even though conserved paddocks had not been cut for hay at this time (Table 2). This suggests that there was some compensatory growth of pastures on the control paddocks.

TABLE 2

Total and green dry matter paddock yields (kg/ha) for the treatments in October and November 1964 and January 1965.

Variable	OCT		NOV		JAN	
	Total	Green	Total	Green	Total	Green
			(kg/ha)			
Grass:						
Setaria	3520	1180	3420	1700	3540	2420
Rhodes	3610	790	3540	1460	3020	2510
Management:						
Conserved	2490	1360**	2920	1820*	2790	2020
Control	4640**	610	4040**	1330	3770**	2900*
Stocking rate (b/ha):						
3.75	3900	880	3700	1660	3550*	2740*
5.00	3230	1090	3260	1500	3010	2190

*,** yields significantly greater than the other paired treatment at $P < 0.05$ and $P < 0.01$ respectively.

Steer weight changes

Steers on the control paddocks lost weight from the end of June until the end of September. Mean weight loss over this period of 112 days was 42 kg, compared with a gain of 16 kg for steers on conserved paddocks, which had been fed hay. Losses were similar on low and high stocked paddocks, at 40 and 45 kg per steer respectively. Steers on setaria lost 45.5 kg compared with 39 kg for those on Rhodes grass, but differences were not significant.

Gains from August to November were similar for the high and low stocking rates on the conserved treatment but on control paddocks, gains were significantly ($P < 0.05$) greater at the high stocking rate than at the low stocking rate giving a management × stocking rate interaction.

TABLE 3

Management × SR interaction for steer gains over the period August to November 1964.

Stocking rate (b/ha)	Management	
	Conserved	Control
	(kg)	
3.75	50	1
5.00	49	24
LSD ($P = 0.05$)	17.6	

Steer performance in spring was positively and linearly related ($r = +0.87$ to $+0.94$) to green pasture DM yield measured on October 5 and November 10, irrespective of what period of gain between July and November was used. Conversely, steer gain was negatively related to total DM yield over these periods ($r = -0.77$ to -0.90).

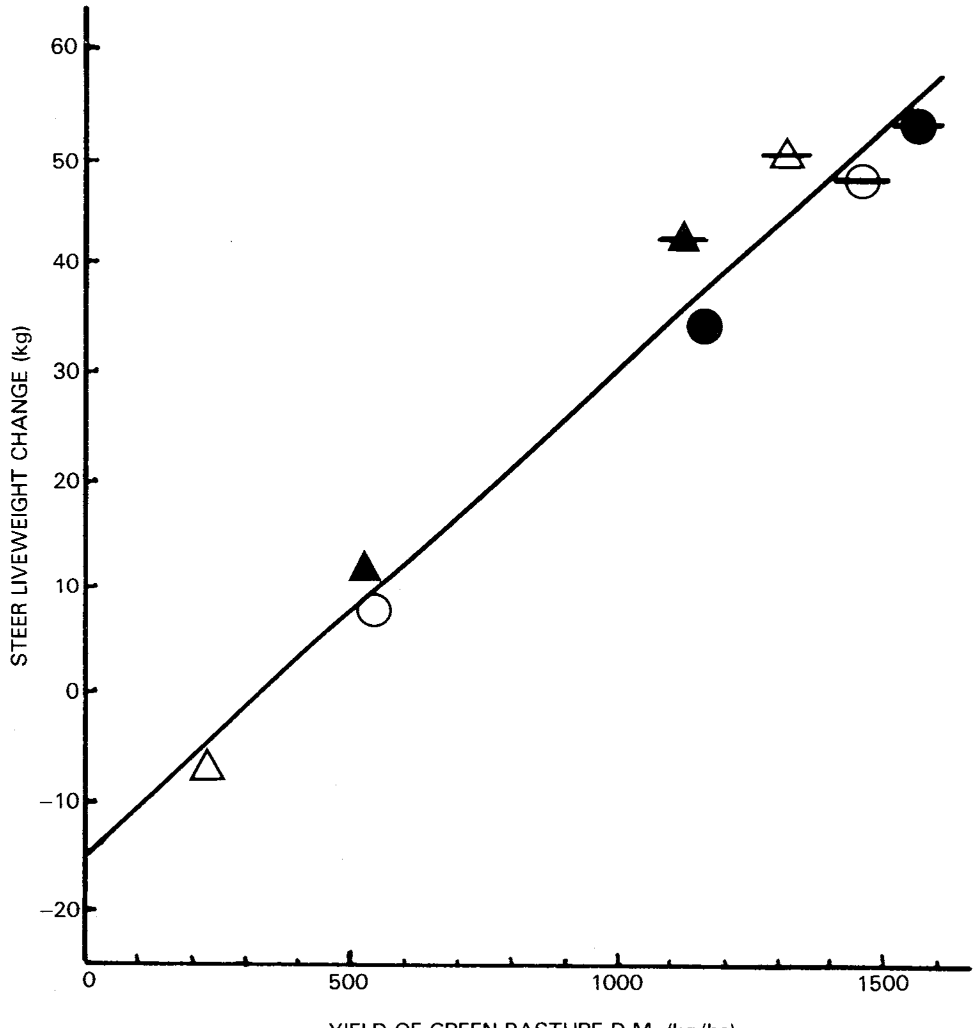

FIGURE 1

The relation between steer liveweight change (mean of 2 replicates) from August to November and the yield of green pasture dry matter in October in paddocks of Nandi setaria (○ ●) and Samford Rhodes grass (▲ ▲). Open symbols—paddocks stocked at 3.75 steers/ha, closed symbols those at 5.0 steers/ha. Barred symbols represent conserved paddocks, non-barred symbols control paddocks. Only the data from the control paddocks was used in the linear regression: $y = -15+0.0446x$ ($r = +0.990^{**}$).

DISCUSSION

The major finding in this study was that the adverse effect of frosting on spring regrowth was greatest on paddocks which carried a high yield of pasture into winter. This was contrary to what I expected because the cover of grass on these paddocks could have protected the crowns from severe frost damage. The paddocks which had been cut twice for hay were shorter and more exposed to frost than the control paddocks. However, all above ground material on both treatments was completely killed by frost. By September, conserved paddocks and paddocks stocked at the higher rate were regrowing more rapidly than the control and low stocked paddocks. These effects would be greater than the data for presentation green yield show since more green pasture would have been consumed on paddocks at the higher stocking rate. It could be argued that the better steer growth rates on the high stocked control paddocks in spring were due to compensatory growth. However, there was only a 13 kg difference (81 v 94 kg) in favour of the low stocked steers over the previous 7 months and from Fig. 1 it is clear that gains were related to green pasture DM yield with no signs of compensatory growth on some treatments. In previous years (when frosting was less severe) losses were lower or gains higher on the low stocked treatments in the winter/spring period. In 1964 the reverse was true.

Reasons for the adverse effect of high pasture yield on frost damage and subsequent regrowth may be associated with the different height of tiller buds induced by the previous management and/or differences in the temperatures at the crown of plants in the different swards, since the effect of mulch has been shown to increase the frosting on Siratro (Ludlow and Fisher 1976). It is unlikely that the canopy of dead grass would have reduced light penetration sufficiently to account for the depressed growth in spring; this reduction does not occur every year even though dead pasture yields may be as high or higher than those reported here. For example in October 1963, green yields were 860 and 710 kg/ha on the low and high stocked treatments, and 760 and 810 kg/ha on conserved and control treatments. These followed total winter presentation yields exceeding 3000 kg/ha (unpublished data).

The fact that setaria regrew better than Rhodes grass after frosting may be due to the better cold tolerance of setaria noted in other experiments at Samford, although Nandi setaria is not the most frost tolerant of the accessions tested (Hacker and Jones 1969). Despite these differences, both grasses recovered without re-sowing and without de-stocking.

The effect reported here is not unique to sub-tropical grasses since interactions of pre-winter management with winter kill or slow recovery in spring have been reported in temperate grasses in the United Kingdom (Green 1964; Hides 1978 a,b). Key factors contributing to this effect were high nitrogen rates of 336-448 kg/ha, high yielding swards going into winter, and lower than normal temperatures. Swards regularly mown through summer and entering winter in a short leafy stage were relatively unaffected (Green 1964; Thomson 1974; Charles *et al.* 1975).

In the sub-tropics, utilisation of intensively managed, nitrogen fertilized grass pastures during summer and autumn would not appear to predispose them to greater frost damage than more leniently managed pastures; rather the converse appears to hold. From the results reported here it would be prudent to reduce the bulk of herbage going into winter on pastures if frost damage is to be minimised.

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